TELE-TECH

Formerly the TELE-communications TECH-nical Section of

ELECTRONIC INDUSTRIES

DESIGN AND OPERATION OF RADIO · FM · TELEVISION
RADAR AND ALL COMMUNICATIONS EQUIPMENT

June • 1947

IN THIS ISSUE:

CALDWELL-CLEMENTS INC

your Noise Problems, too can be Solved Better with C-D Quietones

Just because Mom wants to bake a cake is no reason why she shouldn't hear her pet soap opera. And sooner or later she's bound to find out that *some* mixers *don't* cause radio interference. Mixers equipped with C-D Capacitors, for example.

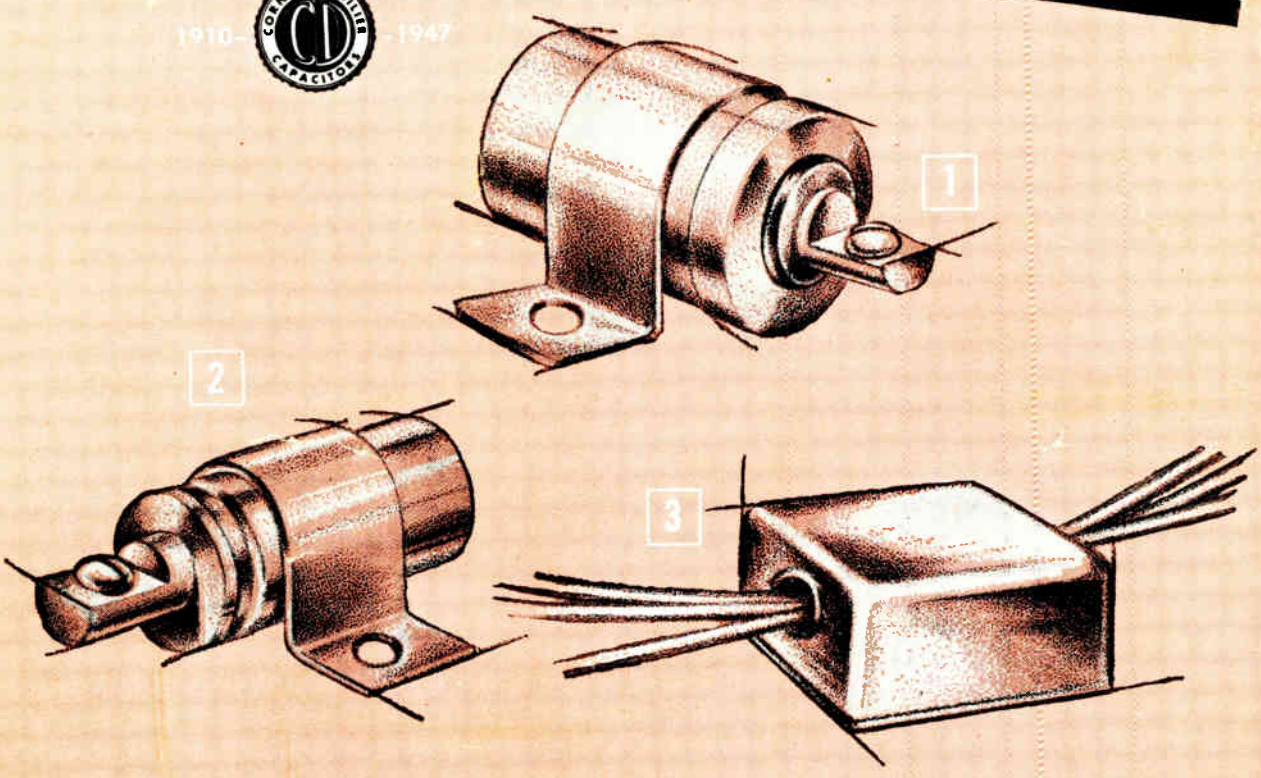
C-D's experience in designing and building noise suppressors is unequalled in the capacitor industry. We are now manufacturing hundreds of types of noise filters for electrical appliances and equipment. It's possible, of course, that the exact unit for solving *your* noise problem is not included. In that case, our engineers are ready and anxious to design and build the suppressor best suited to your specific requirements—*better, faster, more economically. Consult with them.*

Catalog of standard types will be mailed on request. Cornell-Dubilier Electric Corporation, Dept. J6, South Plainfield, New Jersey. Other large plants in New Bedford, Brookline and Worcester, Mass., and Providence, R. I.

CORNELL-DUBILIER
world's largest manufacturer of
CAPACITORS

MICA • DYKANOL • PAPER • ELECTROLYTIC

1910 — 1947



TYPICAL NOISE SUPPRESSORS

CAPACITORS #1 AND 2

Two of the Type MC Filter Capacitors designed for heavy duty service on buses, trucks, etc. for spark and noise suppression. Mechanically rugged, oil filled and impregnated and hermetically sealed.

CAPACITOR #3

A general purpose filter effectively controls radio noise energy created by fluorescent lamps. This capacitive — inductive type filter is compact and can be quickly installed in a variety of positions. Convenient leads simplify installation.

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ELECTRONIC INDUSTRIES

JUNE, 1947

Editorial Contents

CALDWELL-CLEMENTS, INC., Publication Office, Orange, Conn., Editorial and Executive Offices 480 Lexington Avenue, New York 17, N. Y., Tel. Plaza 3-1340

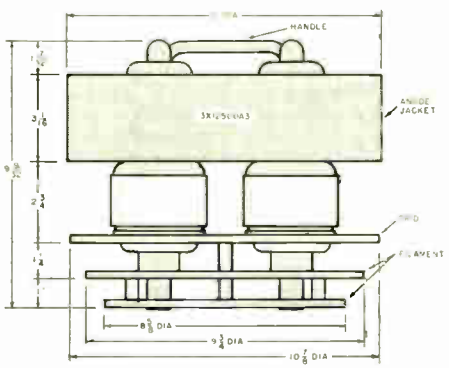
BRANCH OFFICES — Chicago 6, R. Y. Fitzpatrick, 201 N. Wells St., RAN 9225; Cleveland 14, D. J. O'Rourke, Citizens Bldg., 850 Euclid Ave., Main 8270; Los Angeles 5, The Robert W. Walker Co., 684 So. Lafayette Park Pl., Drexel 4388; San Francisco 4, 68 Post St., Sutter 5568.

CAPABILITIES.....25 kw zero to 110 Mc.

A REVOLUTIONARY NEW EIMAC TRIODE

YES . . . The 3X12500A3 is truly revolutionary . . . packaged power . . . that will fill not several, but all applications for a power-amplifier or oscillator from zero to 110 Mc. It will do a low frequency job better than "special low frequency" tubes. It's performance at vhf has long been the aim of vacuum tube researchers. The 3X12500A3 is smaller (over-all 11"x9") and lighter (net 32 lbs.) than any comparable tube. . . . Yes, it is truly a revolutionary tube.

Audio
Induction heating
Broadcasting
Dielectric heating
Communication
Television
Industrial
FM Broadcasting
Research



RADIO FREQUENCY POWER AMPLIFIER
Grounded-Filament Circuit

Class-C Telegraphy (Key-down conditions, per tube)

MAXIMUM RATINGS (Frequencies below 85 Mc.)

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C PLATE CURRENT	8 MAX. AMPS
PLATE DISSIPATION	12,500 MAX. WATTS
GRID DISSIPATION	600 MAX. WATTS

TYPICAL OPERATION (Frequencies below 50 Mc., per tube)

D-C Plate Voltage	3500	4000	5000	volts
D-C Grid Voltage	—420	—360	—400	volts
D-C Plate Current	7.2	6.4	8	amps
D-C Grid Current	2	1.7	1.9	amps
Peak R-F Grid Input Voltage	735	630	710	volts
Driving Power (Approx.)	1.3	0.95	1.35	kw
Grid Dissipation	480	350	590	watts
Plate Input	25.2	25.6	40	kw
Plate Dissipation	5.2	5.6	10	kw
Plate Power Output	20	20	30	kw

RADIO FREQUENCY POWER AMPLIFIER
Grounded-Grid Circuit

Class-C FM Telephony or Telegraphy

MAXIMUM RATINGS (Frequencies below 110 Mc.)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C PLATE CURRENT	8 MAX. AMPS.
PLATE DISSIPATION	12,500 MAX WATTS
GRID DISSIPATION	600 MAX. WATTS

TYPICAL OPERATION (110 Mc., per tube)

D-C Plate Voltage	3700	4000 volts
D-C Grid Voltage	—450	—550 volts
D-C Plate Current	7.2	7.4 amps.
D-C Grid Current	0.9	1.1 amps
Driving Power (approx.)	6.4	7.6 kw
Useful Power Output	27.4	30 kw
Apparent Overall Efficiency	102	101 per cent

EITEL-McCULLOUGH, Inc.
1652 San Mateo Avenue, San Bruno, California

Follow the Leaders to

Eimac TUBES
The Power for R-F

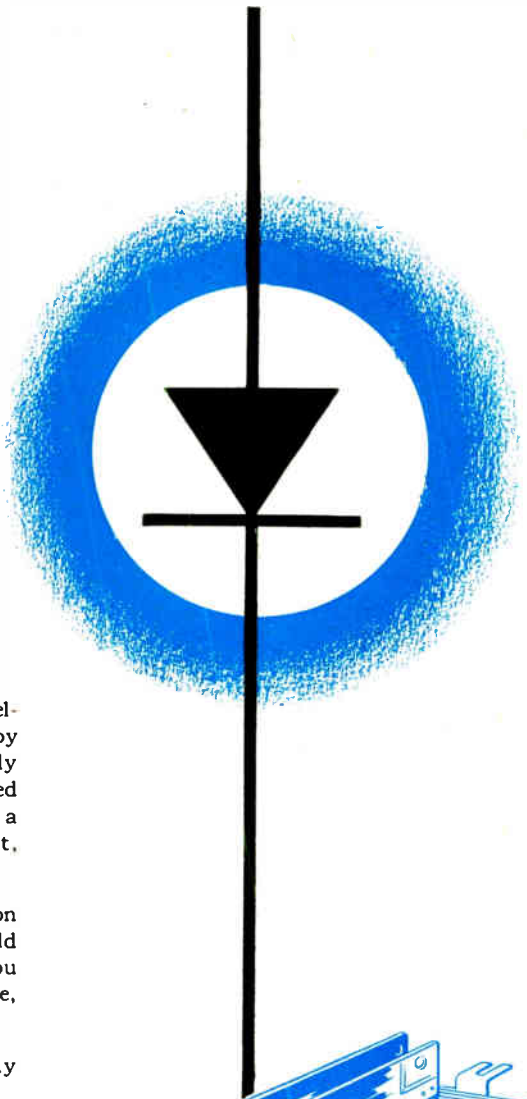
EXPORT AGENTS: FRAZAR & HANSEN, 301 CLAY ST., SAN FRANCISCO 11, CALIFORNIA

THREE THINGS EVERY ENGINEER SHOULD KNOW

about

Federal Selenium Rectifiers

FOR CONVERTING AC TO DC



THEIR DEVELOPMENT. The Selenium Rectifier was developed by IT&T — and was first manufactured in this country by Federal, in 1938. For the past 9 years Federal has continually improved and perfected the Selenium Rectifier — has developed *every major advance* in its design and construction. As a result, the Federal Selenium Rectifier is now the most efficient, compact, and economical means of converting AC to DC.

THEIR APPLICATION. Federal has pioneered the application of the Selenium Rectifier to *new jobs* in practically every field of the industry. From milliwatts to kilowatts — wherever you need DC from an AC source — you can now save space, time, and money with Federal Selenium Rectifiers.

THEIR DESIGN. These features make Federal your best buy in Selenium Rectifiers:

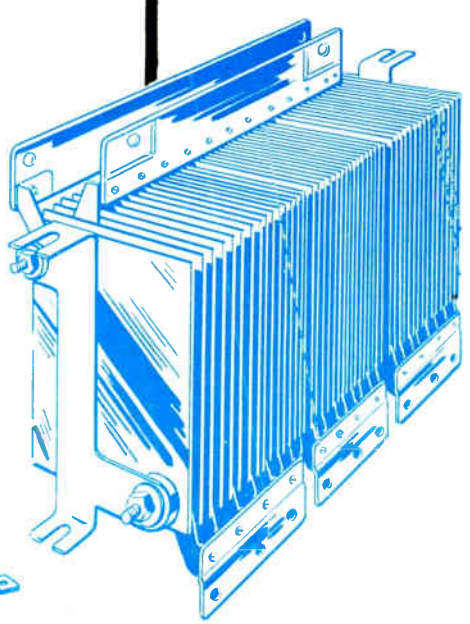
Center-Contact Construction — permits entire stack to be permanently protected against corrosion.

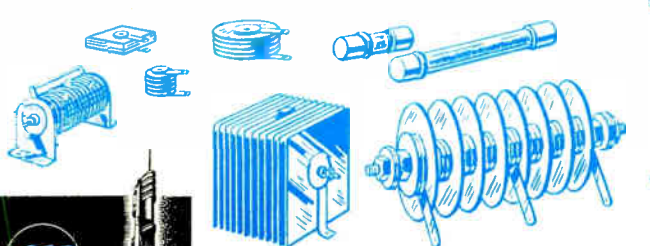
Higher Voltage Plates — give extra breakdown strength, extra dependability.

Aluminum Plate Designs — for use where extremely light weight is desired.

Long Life — constant use in all types of applications prove Federal's superiority and long life.

Available in Wide Range of Standard Ratings — for information, write to Federal today. Dept. F 166.





KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

Federal Telephone and Radio Corporation

100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

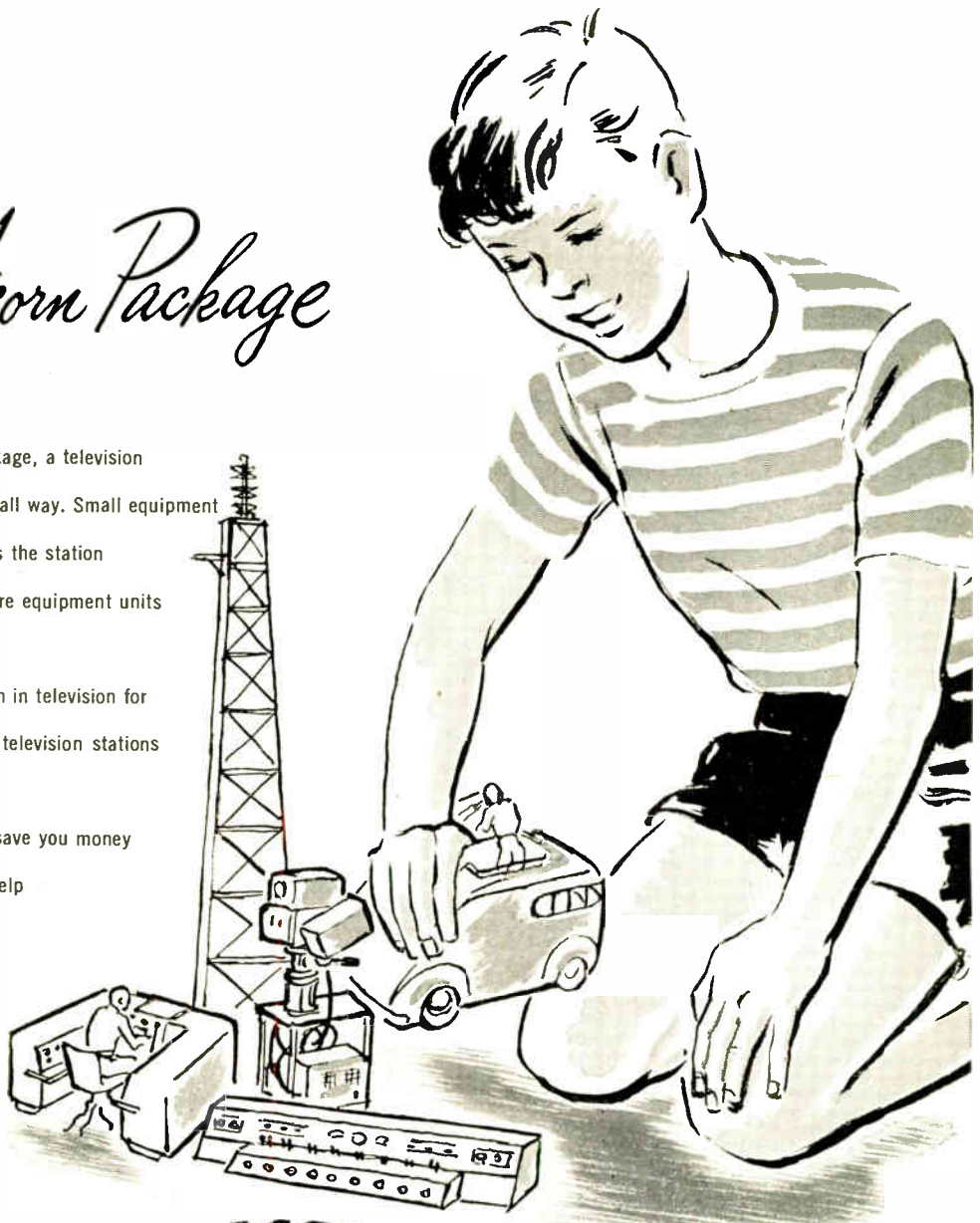
In Canada: — Federal Electric Manufacturing Company, Ltd., Montreal.
Export Distributors: — International Standard Electric Corp., 67 Broad St., N. Y. C.

TELE·TECH

Formerly the TELE communications TECH nical Section of ELECTRONIC INDUSTRIES

Tele-Tech*, June 1947, Vol. 6, No. 6. Regular price per copy 25 cents. Published Monthly by Caldwell-Clements, Inc., Publication Office Orange, Conn., Editorial and Executive Offices 480 Lexington Ave., New York 17, N. Y. Direct all subscription inquiries to Orange, Conn., or to 480 Lexington Avenue, New York 17, N. Y. M. Clements, President; Orestes H. Caldwell, Treasurer. Subscription rates: United States and possessions, $3.00 for two years. Canada (Canadian Funds Accepted) $4.00 for two years. Pan American Countries $5.00 for two years. All other countries $7.50 for two years. Entered as second class matter at the Post Office at Orange, Conn., under the act of March 3, 1879.

Start small with the *Du Mont Acorn Package*



With the Du Mont Acorn Package, a television broadcaster can start in a small way. Small equipment cost. Small operating cost. As the station grows, he simply adds on more equipment units like building blocks.

Remember, Du Mont has been in television for 15 years . . . has built more television stations than any other company.

Du Mont's "know-how" can save you money right from the start . . . can help you avoid costly mistakes.

Call, phone or write for full information about the Du Mont Acorn Package.

DUMONT

First with the finest in Television

ALLEN B. DU MONT LABORATORIES, INC. • GENERAL TELEVISION SALES OFFICES AND STATION WABD, 515 MADISON AVE., NEW YORK 22, N. Y.
DU MONT'S JOHN WANAMAKER TELEVISION STUDIOS, WANAMAKER PLACE, NEW YORK 3, N. Y. • HOME OFFICES AND PLANTS, PASSAIC, N. J.

ONLY SO BIG...

TYPE C—*Only 1 1/32" in diameter. Full two watts normal rating (entire element) for continuous operation.*

TYPE M — *Normal rating of 4 watts. Diameter 1⅝". Insulated for 1,000 volt DC breakdown to ground.*

TYPE E—*Dissipates 7 watts. Diameter 2 5/16". Supplied with grounded contact arm.*

. . . they have everything you want in a wire-wound control!

Size is always an important matter when you're designing products like radio and television receivers, testing equipment, light dimming devices and miniature motor controls. That's why Mallory makes its wire-wound variable resistors good *and small*—the type C control being the smallest two-watt control of its kind available today.

On the plus side, too, is the fact that all Mallory wire-wound controls are designed for maximum heat dissipation. In addition, the M and E types are metal-enclosed to provide electrostatic shielding . . . all types are tapered with extreme accuracy (linear taper tolerance is within 3%) . . . precision-wound to give extremely long, noise-free service. A special feature of the M and C type controls is a spring clamp which maintains positive pressure between silver-plated terminals and silver element terminations, insuring extremely low terminal resistance.

The M type Variable Resistor is also available in a complete line of Mallory T and L Pad Attenuators, designed to provide impedance matching in audio circuits or resistive networks to secure maximum power transfer and minimum distortion.

It's a story on a par with that of so many other precision electronic products—

YOU EXPECT MORE AND GET MORE FROM MALLORY

P. R. MALLORY & CO. Inc.

MALLORY RESISTORS

(FIXED AND VARIABLE)

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

REVERE COPPER IN THIS 6C22

This type 6C22 vacuum tube was developed and is manufactured by the Federal Telephone and Radio Corporation, Clifton, New Jersey, and is rated at 1000 watts, plate dissipation at 600 mc.

THIS 6C22 tube, the result of a closely-guarded development during World War II, is a modified version of the tube used extensively for pulsing signals in radio transmission and may have had a vital influence in jamming enemy radar communications. Peacetime pursuits indicate that it will play an important part in furthering the development of television, having already proved of great value in a transmitter employed for color television. An unusual feature in the construction of this tube is to be seen in the one-piece formation of the anode and water-cooled radiator. The anode and grid ring are produced from Certified Oxygen Free High Conductivity Copper Bar, Revere Alloy 103-C, being formed by cold working in a 600-ton coining press.

Machining consists of drilling the center hole and milling the radiator slots. Each piece receives a special rolling operation in the area where it is sealed to glass. The grid ring which extends through the glass structure performs a dual function in supporting the grid internally and providing an external connection. As in other types of vacuum tubes Certified Oxygen Free High Conductivity Copper is used for ease of outgassing and excellent glass bonding characteristics.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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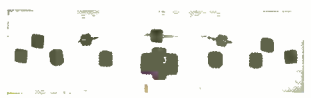
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities. Distributors Everywhere.

ELECTRONICS

Designers

4 improved magnet materials add design possibilities

Augmenting the many sintered and cast Alnico alloys, 4 additional General Electric magnet materials greatly extend magnet design possibilities.



1

1. VECTOLITE. This light-weight, high-resistance magnet material is a combination of iron oxide and cobalt oxide. High in coercive force, it is finding wide application as a rotor magnet for d-c selsyns and in many types of moving magnet instruments. A number of shapes are shown in illustration 1.

2. CUNICO. An alloy of copper, nickel and cobalt, Cunico is malleable, ductile, and machinable and is supplied in wire, strip, or rod stock. Illustration 2 shows a rod of Cunico, and screw-machine magnets machined from it.

2

3. CUNIFE. Cunife has all the physical advantages of Cunico. However, this alloy of copper, nickel and iron has directional properties, and to secure best magnetic results must be magnetized only along the direction in which the material has been worked. It is supplied in wire stock in round, square, and rectangular form. Ductility of Cunife is shown in illustration 3.

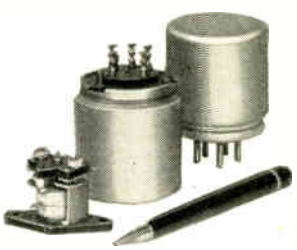
3

4. SILMANAL. High in coercive force, this alloy of silver, manganese, and aluminum is most useful in instruments where service in strong electrical fields is necessary. The Silmanal magnets in illustration 4 were rolled, punched, and machined from the ingot shown. For more information about these magnetic materials, write for Bulletin GES-3337.

4

RELAYS THAT ARE REALLY SENSITIVE

For electronic applications where switching functions must be performed by small amounts of power, General Electric has a complete line of current-sensitive, d-c relays. These relays are built to withstand shock and vibration and will operate in ambient temperatures from —70F to 200F. They cover the range from 10 mw to 180 mw; 0.47 ma to 1470 ma; 0.07 ohms to 67,000



ohms coil resistance; and weigh from 0.1 to 0.7 pound. Contact ratings from 12 volts to 110 volts a-c/d-c with a contact rating at 24 volts d-c of 2.0 amperes non-inductive and 0.5 ampere inductive. Installation is easy with either the plug-in base or the solder-lug terminals. Write for Bulletin GEA-3819.

ONE SWITCH CONTROLS MANY CIRCUITS

For transfer and control switching there is a G-E (Type SB-1) switch to do almost any job. Standard Type SB-1 switches are available from single-stage models to 12-position, 16-stage models. For more complex switching, special models are furnished up to 100 stages.

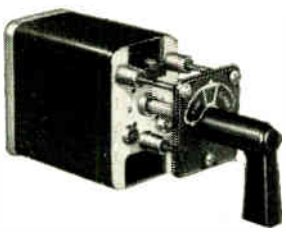
Precision construction makes operation easy, even in the larger models. Rated at 600 volts, 20 amp continuous, or 250 amp for 3 seconds, the long-lived, cam-operated silver contacts have stood more than 1,000,000 test operations without excessive wear.

Stages are isolated by dielectric bar-,

GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS



riers. There is ample space for easy connection. Two types of locks permit locking in any position, and standard switches are dead front. Write for Bulletin GEA-1631.

PUTS A LOT OF COIL IN A LITTLE SPACE

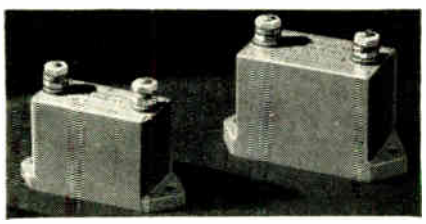
When product design puts a premium on space, G-E Formex* magnet wire lets you wind more compact coils.

Where coils wound in rectangular shapes crack enamel insulation, the tough film on Formex stands up. In fast winding operations, too, Formex takes the punishment. When coils must stand up year after year, depend on Formex, because age has little effect upon this polyvinyl-acetal insulation. Round Formex is available in standard sizes from 6 AWG to 44 AWG and in ultrafine sizes of 1¾, 1½, 1¼ and down to 1 circular mil in copper area. Rectangular Formex is also available. For full information on shapes, sizes and application methods, write for Bulletin GEA-3911.

LECTROFILM CAPACITORS AT NEW LOW PRICES

Circuit designers now have complete freedom to use either high or low capacities in r-f blocking and by-pass applications — without paying a premium for high capacity—because General Electric case-style 65 Lectrofilm* capacitors are now all at one new price, approxi-

*Reg. U.S. Pat. Off.



mately half of the previous level! Similarly, all listed ratings of case 70 designs are offered at one new, low price.

General Electric's development of Lectrofilm, a new capacitor dielectric, and the advanced methods used in manufacturing these capacitors have resulted directly in these new low prices. Lectrofilm capacitors are now the answer to new circuit economies, better circuit designs, lower over-all equipment costs. Bulletin GEA-4295.

TO SELL RADIO LISTENING BY THE HOUR

Dispensing 2 hours of use for each coin deposited, the General Electric Type TSC-9 coin-switch mechanism is suitable for installation in table-model radios such as hotels provide for guests. Powered by the widely used, reliable Telechron motor, and with silver contacts rated 2 amp, 110 volts a-c, the switch is constructed for long, maintenance-free service. The Type TSC-9 switch may be connected to allow intermittent use of the radio until the time paid for has been exhausted. As many as 6 coins, providing a maximum of 12 hours use, may be deposited at one time. A continuous coin counter registers deposits up to $25.

TRAINS BETTER WELDERS IN LESS TIME

Visual methods of employee education have proved their ability to increase output and decrease rejects. Now General Electric has produced a new, full-color, sound movie that uses animated drawings to teach the principles and applications of spot, projection, and seam resistance welding. The film takes you inside fifteen different industrial plants, and shows more than 100 applications of resistance welding where it is speeding production and cutting costs. Ac-

companying the film is an interesting "refresher" bulletin covering the salient points of the film.

Ask your local General Electric office to lend you "This Is Resistance Welding"; no charge or obligation to you.

GENERAL ELECTRIC COMPANY, Sec. E642-14
Apparatus Dept., Schenectady 5, N. Y.

Please send me:

- ....GES-3337 (Magnet materials)
- ....GEA-3819 (Current-sensitive relays)
- ....GEA-1631 (Type SB-1 switches)
- ....GEA-3911 (Formex magnet wire)
- ....GEA-4295 (Lectrofilm capacitors)

NOTE: More data available in Sweets' File for Product Designers

Name _____

Company _____

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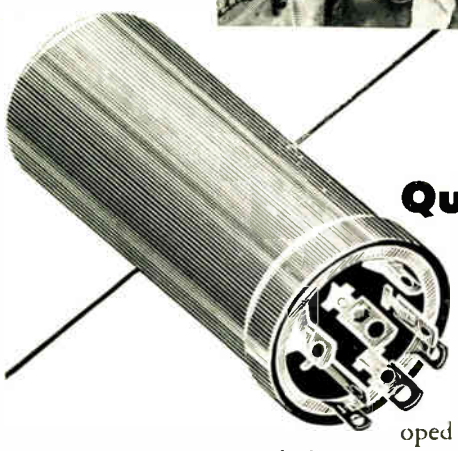
8010

Skilled Operators *winding voice coils, the heart of Magnavox dynamic speakers*



Electrolytic Capacitors—standardized into 8 container sizes to simplify design and assembly problems.

Quality, Economy, Dependability Assured — in Components by Magnavox

As the oldest and largest manufacturer of loud speakers, Magnavox has developed overall experience and skills, that are unsurpassed in the radio industry. Magnavox capacitors, speakers and other component parts are established as *the standard of quality.*

Today six acres of modern plant and equipment, a competent staff of trained engineers and designers, plus 32 years of research and development stand ready to be applied to any of your component problems. Specializing in the quantity production of quality components for the manufacturing trade, Magnavox can meet your specifications *exactly!*

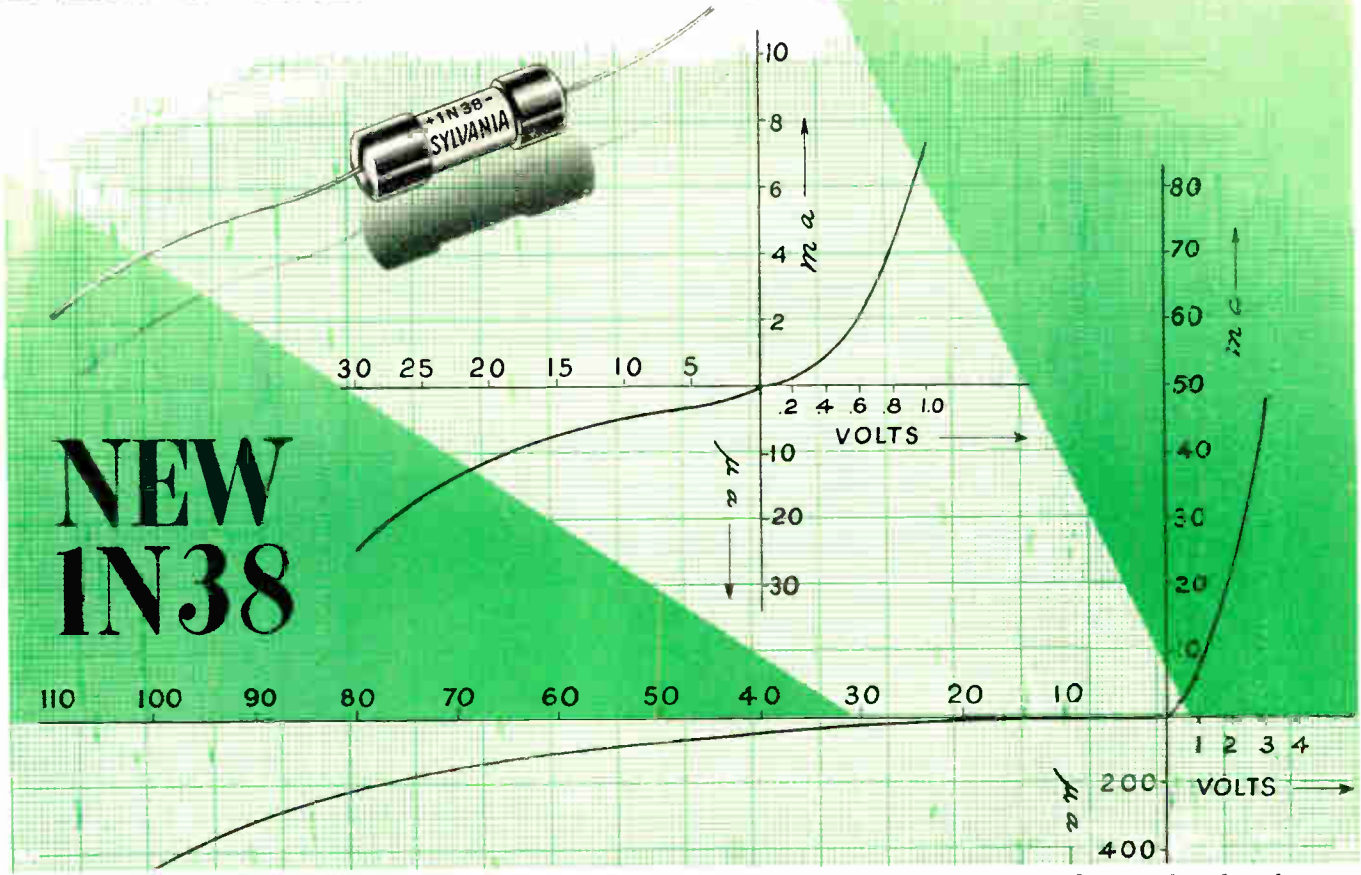
When you need component parts, specify the name Magnavox—symbol of quality in radio manufacturing since 1915. The Magnavox Company, Components Division, Fort Wayne 4, Indiana.

Magnavox

has served the radio industry for over 32 years

SPEAKERS · CAPACITORS · SOLENOIDS · ELECTRONIC EQUIPMENT

HIGH VOLTAGE FREQUENCY TEMPERATURE CRYSTAL



HIGH VOLTAGE. The new Sylvania 1N38 Crystal is designed for a back voltage of 100 volts maximum.

HIGH FREQUENCY. With its shunt capacitance of only 0.8 to 1.1 $\mu\mu$f, the 1N38 is ideal for high frequency use.

HIGH TEMPERATURE. Rectification efficiency decreases only .0007% per degree temperature rise from 27° to 75° C.

Newest addition to the Sylvania family of Germanium Crystals, the 1N38 is of compact, space-saving design. Pigtail leads permit easy soldering into position.

Back resistance is as high as 2½ megohms.

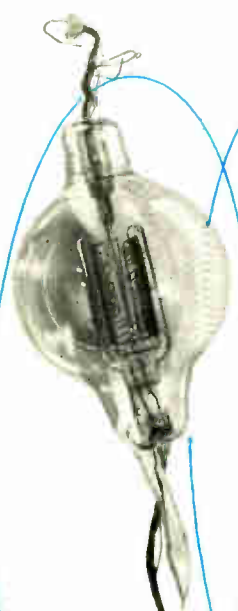
Minimum life is 5,000 hours at 22.5 ma DC.

Write for full details

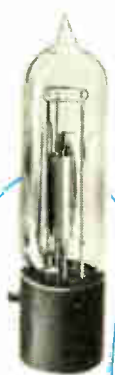
Electronics Division, 500 Fifth Avenue, New York 18, N. Y.

SYLVANIA ELECTRIC

Why this team brings you better ELECTRON TUBES



1912. The first effective high-vacuum tube, developed by the Laboratories for long distance telephony, was capable of operation at both audio and radio frequencies, and thus marked the beginning of modern electronics.

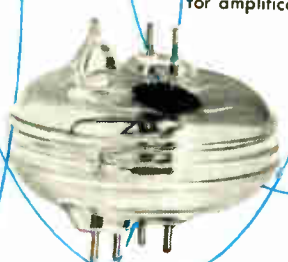


1918. This "peanut" tube, the Western Electric 215A, was developed for service in World War I. It was the first commercial tube whose filament was powered by a single dry cell . . . made possible compact, light weight radio equipment.

1919. The introduction of the copper-to-glass seal made water cooled tubes practical. The resulting high power tubes were used for broadcasting and for transoceanic radio-telephony.

1925. This was one of the earliest photoelectric cells. It was made by Western Electric for use in commercial picture transmission over telephone wires.

1940. The beating oscillator, used in the great majority of radar systems. This tube generated a wave in the receiver with which the received microwave was reduced in frequency for amplification.



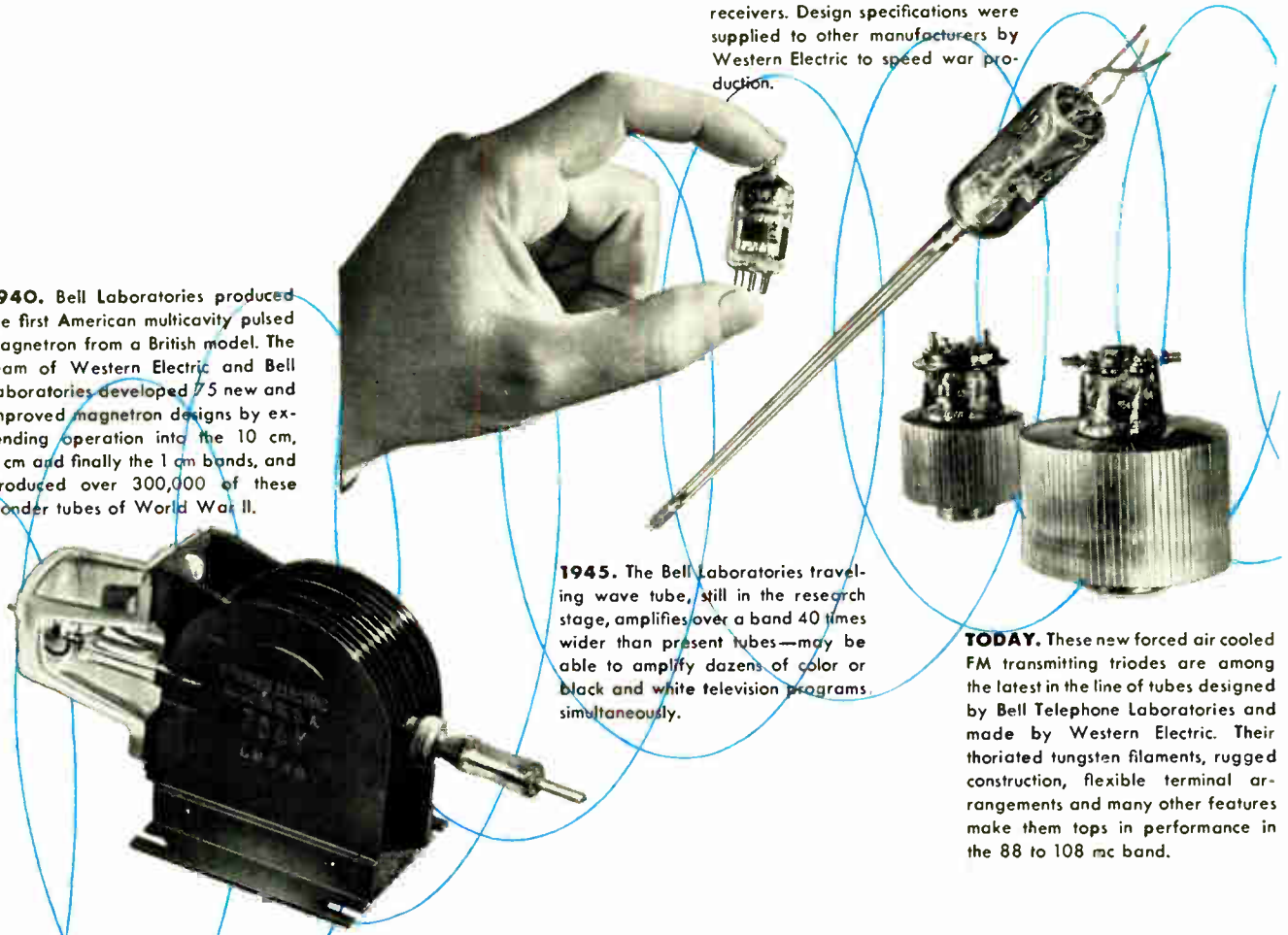
1937. This microwave generator, the 368A, was the first commercial tube to generate frequencies higher than 1500 mc. This type of tube was used by Western Electric in the first absolute altimeter.

Distributed by GraybaR
OFFICES IN 95 PRINCIPAL CITIES

—QUALITY COUNTS—

1942. This tiny 6AK5, operating in the vicinity of 400 mc, proved itself invaluable as an amplifier in radar receivers. Design specifications were supplied to other manufacturers by Western Electric to speed war production.

1940. Bell Laboratories produced the first American multicavity pulsed magnetron from a British model. The team of Western Electric and Bell Laboratories developed 75 new and improved magnetron designs by extending operation into the 10 cm, 3 cm and finally the 1 cm bands, and produced over 300,000 of these wonder tubes of World War II.



1945. The Bell Laboratories traveling wave tube, still in the research stage, amplifies over a band 40 times wider than present tubes—may be able to amplify dazens of color or black and white television programs simultaneously.

TODAY. These new forced air cooled FM transmitting triodes are among the latest in the line of tubes designed by Bell Telephone Laboratories and made by Western Electric. Their thoriated tungsten filaments, rugged construction, flexible terminal arrangements and many other features make them tops in performance in the 88 to 108 mc band.

OVER 34 years ago in the laboratories of Western Electric, De Forest's Audion was improved and developed into the high vacuum tube and put to work for the first time amplifying telephone and radio frequency currents. And *for over 34 years* Western Electric and its research associate Bell Telephone Laboratories have been foremost in designing new and better electron tubes.

Every tube shown here and many developments *basic* to the tube art are examples of that leadership. More than 10 years ago, for instance, Bell Laboratories first used microchemistry to determine what gases were destructive to tube elements, and with Western Electric developed a manufacturing technique to keep these damaging elements out—thus increasing tube life many-fold.

Every one of the more than 300 codes of electron tubes now being made by Western Electric from Bell Laboratories' designs has the same unequalled background of research and manufacturing skill.

BELL TELEPHONE LABORATORIES

World's largest organization devoted exclusively to research and development in all phases of electrical communications.

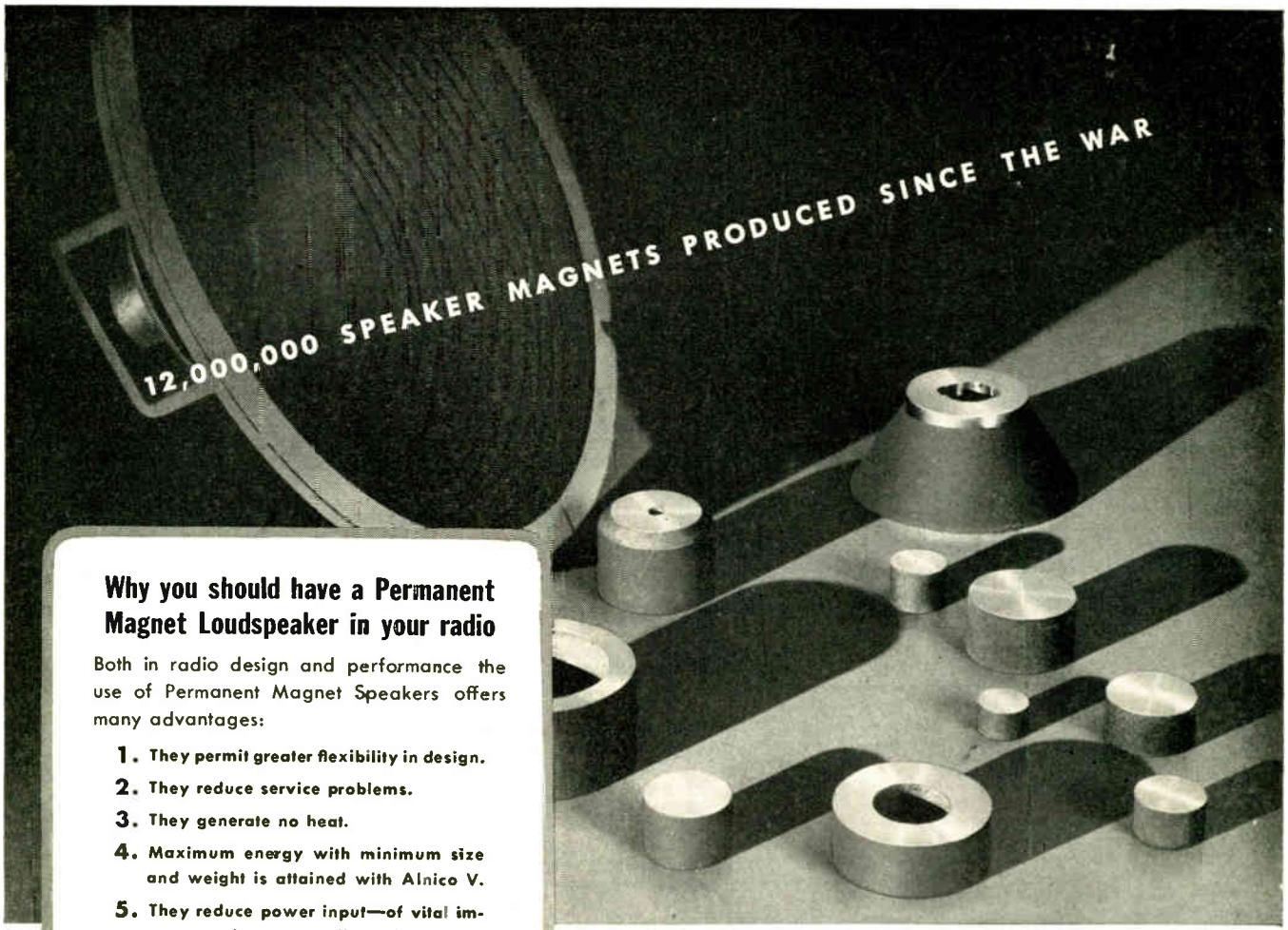
Western Electric

Manufacturing unit of the Bell System and the nation's largest producer of communications equipment.

PERMANENT MAGNETS MAY DO IT BETTER

Have you looked inside your loudspeaker lately?

Let's look into the busy end of your radio . . . into the part that does the talking. The loudspeaker owes much of its fine, full, clear tone quality to the magic aid of the permanent magnet. Particularly in the construction of FM radios, where the finest acoustical quality attainable is desired, permanent magnet speakers are proving their excellence. The widespread popularity of permanent magnet speakers is well demonstrated by production records. Over 12 million speaker magnets such as those shown below have been made by *The Indiana Steel Products Company* since World War II.



Why you should have a Permanent Magnet Loudspeaker in your radio

Both in radio design and performance the use of Permanent Magnet Speakers offers many advantages:

1. They permit greater flexibility in design.
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3. They generate no heat.
4. Maximum energy with minimum size and weight is attained with Alnico V.
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"THE FUTURE IS SOUND"

World War II brought many technological advances. New materials now make possible magnet designs which were formerly impractical. ALNICO V, undoubtedly the best known example, is now used almost universally in the manufacturing of speaker magnets.

Watch for INDALLOY.

Investigate the use of permanent magnets in your radio speaker. As the largest producer of permanent magnets for loudspeaker use, *The Indiana Steel Products Company* offers you an exceptional permanent magnet engineering design service . . . complete from plan to finished product. Versatile in finding the most practical solution to your magnet problem, whatever it may entail, our engineers welcome the opportunity to be of assistance.

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SPECIALISTS IN PERMANENT MAGNETS SINCE 1910

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TYPE BH5
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Midget holder with aluminum plated crystal mounted between spring contacts on wire supports. Hermetically sealed metal case protects assembly. Recommended for use only with low power oscillator tubes and circuits where space is at a premium.

TYPE MC9
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Compact holder for multichannel portable equipment where space is a factor. Gasket sealed against moisture and humidity. Suggested for all vehicular and air-borne equipment having low power oscillator tubes and circuits.

TYPE SR5
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This unit is prototype of crystal stabilizer used in majority of AAF equipment. Case is gasket sealed at all openings for maximum protection. Suggested for multichannel operation in air-borne equipment.

TYPE MC7
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Gasket sealed holder with pressure airgap crystal assembly. Ideal for multichannel applications. Accommodates quartz plate up to .7" x .9" for adequate activity in medium power circuits. Used widely in marine radio-telephone equipment.

TYPE KV3
100-500kc

Compact unit features low drift, silver plated crystal mounted between wire supports soldered to plated surfaces. Design assures exceptional frequency stability. Recommended for use in low power oscillators where regeneration is employed.

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Constant temperature oven and crystal assembly in compact case. Heater current 1 ampere at 6.3 volts. Stabilizes crystal temperature at 70° C for close tolerance requirements in VHF services.

Bliley CRYSTALS

TYPE TC92
TEMPERATURE STABILIZER

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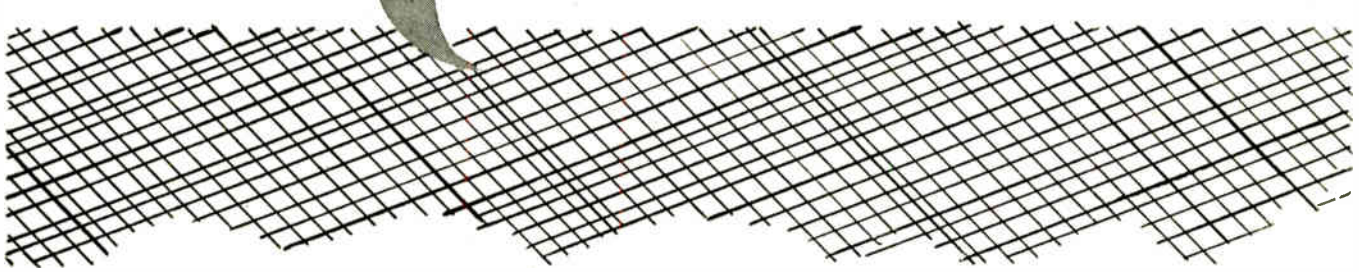
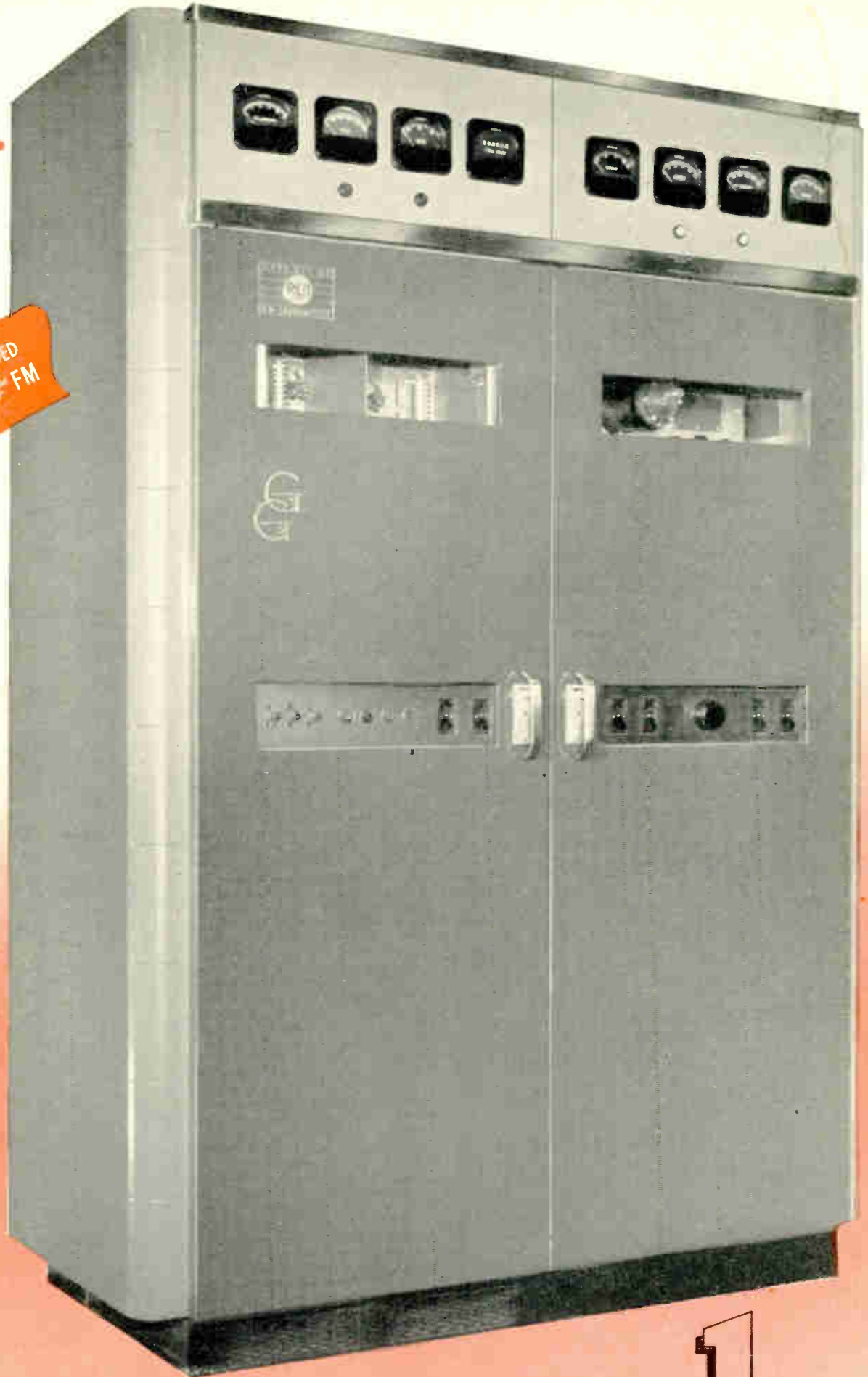




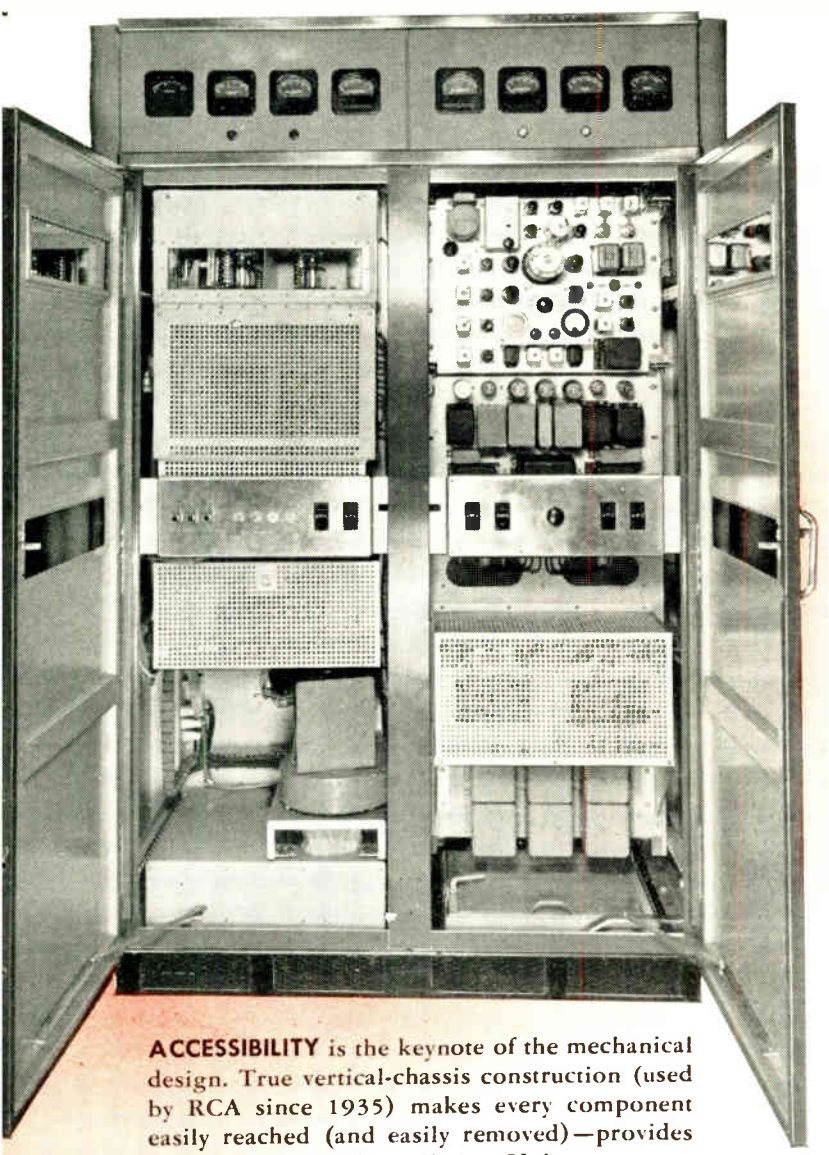
RCA 1 KW FM
Broadcast Transmitter
BTF-1C

RCA KILOWATT FM

This is a Transmitter Man's TRANSMITTER

You know what is meant by a ballplayer's ballplayer. He looks good to the public. Sure . . . but more than that, he looks good to other ballplayers. He makes every play in just the right way—and he makes them look easy, not hard.

The RCA 1KW FM Transmitter (Type BTF-1-C) has a similar standing among transmitter men. It looks good (RCA has always been the leader in styling)—and it sounds good, too (performance specifications are unexcelled). But more than that, it has the engineering features which your engineer appreciates and wants. Some of these features, such as the mechanical design and the control circuits, are common to all RCA transmitters and are already well-known to him. Other features, listed below, are particular to this new FM transmitter.



ACCESSIBILITY is the keynote of the mechanical design. True vertical-chassis construction (used by RCA since 1935) makes every component easily reached (and easily removed)—provides unimpeded up-draft ventilation. Unit-type assembly makes for easy installation, flexibility and simple modification for higher power.

DIRECT FM-type exciter. No fussy, complicated circuits. No trick tubes. (There are only four r-f tubes—an oscillator, two triplers and a buffer amplifier). Frequency control circuits provide crystal-equivalent stability, but are completely independent so that a failure in these circuits does not affect modulation or take the transmitter off the air. Because it uses fewer tubes, does not involve phase multiplication, this exciter is inherently capable of lower noise and distortion than any type yet developed.

ONLY 8 R-F TUBES in the whole transmitter (one oscillator, two triplers, one doubler, four amplifiers). There are two audio tubes, and seven tubes in the power supplies (not including voltage regulators). Thus there are only 17 tubes whose failure can take the transmitter off the air (thirteen additional tubes in regulator and control circuits do not contribute to outages). The total of 30 tubes is, we believe, the lowest number of any similar transmitter of this power.

GROUNDED GRID CIRCUIT used in final amplifier, requires no neutralization, provides greater stability than can be obtained with older, more conventional amplifier circuits. This is the easiest transmitter to adjust that you've ever worked on. Can be tuned in a few minutes' time by inexperienced personnel.

DISC-SEAL TUBE, the RCA 7C24, especially designed for grounded-grid operation, is used in the final amplifier (and also in the final amplifier stages of the RCA 3KW and 10KW FM transmitters). Quantity produced, field-tested, rugged, and inexpensive—it is the best-suited tube yet designed for this use.

SHIELDED TANK CIRCUIT used in the final amplifier (and also in RCA 3's and 10's) is a concentric-line design in which the outer tube is at ground potential. Tube and inner line are completely enclosed providing near-perfect shielding. Only in this way can the flow of r-f currents in the cabinet be prevented. R-f radiation from the transmitter housing (and r-f pick-up in nearby audio circuits is less than with other tank circuit design).

SINGLE-ENDED OUTPUT is an important feature. Single-ended circuits are more stable and easier to adjust (no balancing) than push-pull circuits—particularly at FM frequencies. Moreover, single-ended circuits are more easily matched to the grounded transmission lines universally used in FM service.

BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

COMPACT ENERGY FOR PHOTOFLASH CAPACITORS

Progress in practical flash photography has been greatly facilitated by new smaller, lighter capacitors incorporating the exclusive Sprague Vitamin Q impregnant. Write for engineering bulletin No. 201.

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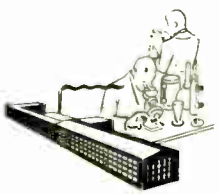
A major fluorescent lighting problem has been one of finding ballast capacitors to withstand the combination of severe temperature and voltage conditions—and again Sprague Vitamin Q impregnant has proven the answer. Sprague Fluorescent Ballast Capacitors rated at 330v. AC not only give maximum life under normal temperature and voltage conditions, but can be operated at 460v. AC at 85° C. for 1,000 hours—without deterioration or major change in power factor. Thus they assure adequate safety factor under blink start conditions.

It's all done with *VITAMIN Q!



The history of capacitor progress is inseparably linked with the development of new and better dielectrics. Throughout the years, the aim has been to increase the amount of energy that can be stored in a capacitor of given size and to improve performance characteristics all along the line.

The most remarkable advance in these respects has come with the development of the exclusive oil dielectric—Sprague Vitamin Q. Throughout industry, Sprague Capacitors impregnated with this material are setting new standards for smaller, lighter units for dependable operation at higher voltages and higher temperatures and for greatly improved insulation resistance.

The units illustrated are typical of the many new capacitor designs now available using Sprague Vitamin Q.

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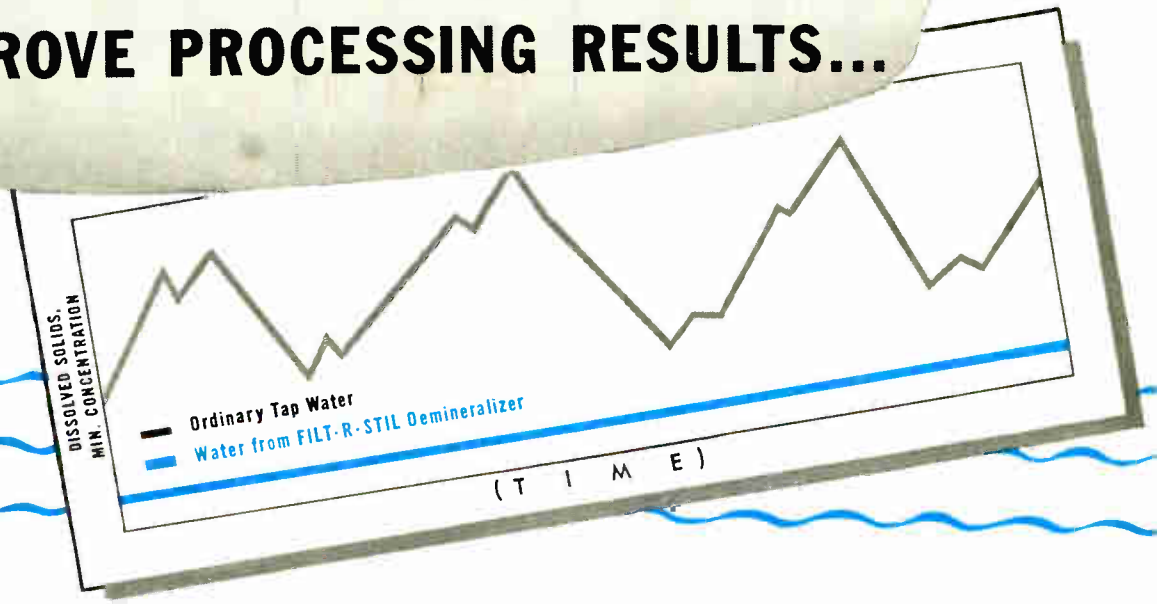
SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASS.

MINERAL-FREE WATER

CAN IMPROVE PROCESSING RESULTS...



New FILT-R-STIL* WATER DEMINERALIZING UNIT ELIMINATES

- HIGH COSTS
- PRODUCT CONTAMINATION
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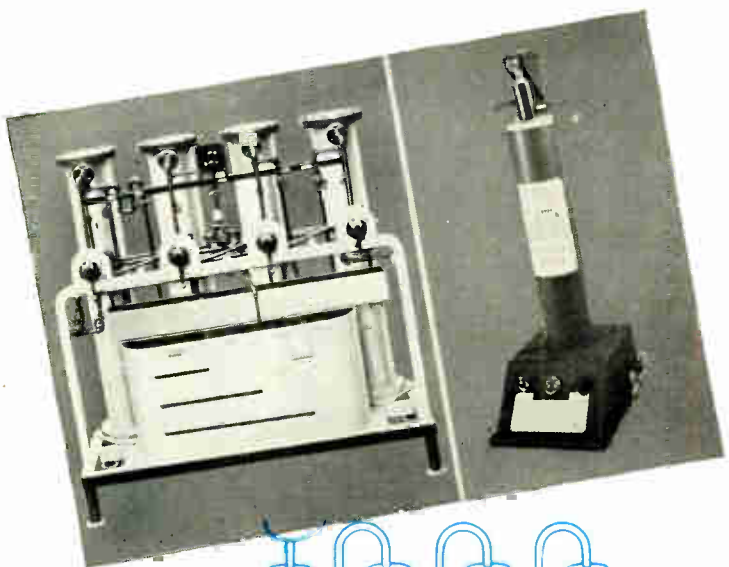

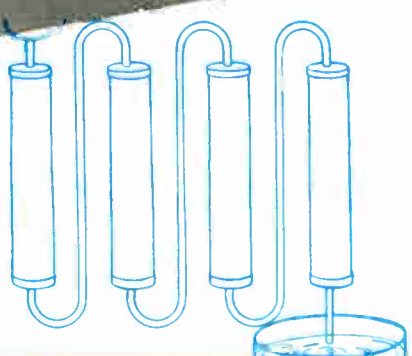

How a FILT-R-STIL Demineralizer works . . . Units consist of four "beds" of IONAC* Resins which, by principle of ion exchange, successively remove the dissolved minerals from water. Water is fed through a conductivity cell which indicates quality of water being produced. When resins are exhausted, a regenerative system restores units to full operating efficiency.

You can count on substantial economies in the production of mineral-free water when you install a Cyanamid FILT-R-STIL ion exchange demineralizing unit. This is because, among other things, these units are completely self-contained, simple to install, and easy to operate and maintain.

Available in types and sizes for *every* need, FILT-R-STIL Demineralizers use IONAC* Resins which remove ionized solids, completely or partially—*as specified*—without imparting color, odor, or taste to the solution treated.

The process can be compared to a simple, cold filtration since no heat or cooling water is required. In fact, so simple is the operation that the only requirements are connection to a raw water source, an electrical outlet, and a drain.

Mail coupon now for complete data on FILT-R-STIL Demineralizers.

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Send me your free booklet on FILT-R-STIL.
Briefly, my water problem is of the following nature:

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You can beat today's high silver costs and still get solid silver performance by using General Plate Laminated Metals in applications requiring silver.

Because General Plate Laminated Metals . . . sheet, wire and tube . . . are made by permanently bonding a thin layer of silver to a thicker layer of base metal, they give you solid silver performance where you need it. Thus you pay for a small quantity of silver plus the cost of inexpensive base metal . . . resulting in a large saving over solid silver. Remember, too, that the base metal adds strength, ease of fabrication and workability.

General Plate Laminated Metals have high corrosion resistance, better electrical conductivity, better spring properties, are easier to fabricate. Use them in such applications as chemical apparatus, electrical equipment, physical instruments, radio and electronic devices.

Write for complete information, today. Engineers are available for consultation; ask for their services.

GENERAL PLATE DIVISION

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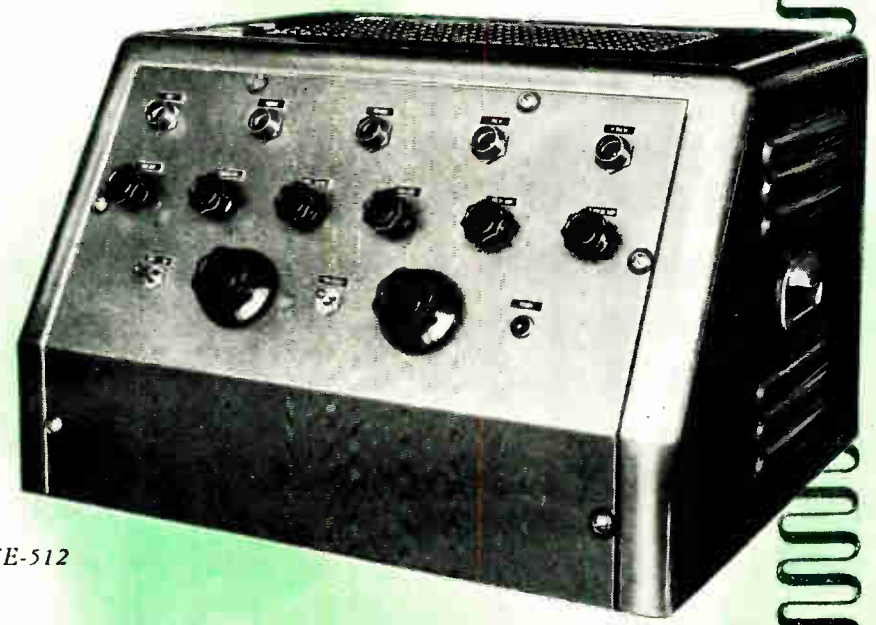

Model SE-512

SHERRON *Multi - wave shape Generator*

This latest Sherron development incorporates into a single instrument the source of several wave shapes. Because it supplies these fundamental wave shapes, it serves in testing amplifiers and related equipment at audio and video frequencies. This advancement is a further demonstration of the electronics know-how which has made the Sherron name a reliable guide to dependable laboratory control.

SHERRON ELECTRONICS COMPANY

Division of Sherron Metallic Corporation

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West Coast Sales Office: Mechanics Institute Building • 57 Post Street • San Francisco, Calif.

SPECIFICATIONS

OUTPUTS: *Sine waves, square waves, positive pulses, negative pulses and a trigger pulse. The impedance (output) is 250 ohms for all voltages.*

FREQUENCY RANGE: *50 cycles to 50,000 cycles for all voltages continuously variable with a direct reading dial.*

SQUARE WAVE: *Rise time is less than 3 of a micro-second at the highest frequency and about .7 of a micro-second at the lowest frequency.*

PULSES: *Pulse width of both positive and negative outputs is variable from about 1 to 75 micro-seconds.*

POWER REQUIREMENTS: *115 volts, 60 cycle, 300 watts.*

Sherron Electronics W2XOK

BROADCASTERS— *Simplify* YOUR PROGRAM SWITCHING

...TO THE MOVEMENT OF A SINGLE KEY!

EVEN your most complicated program switching operations are reduced to the simple operation of *one* key—when you use Western Electric's new Relay Type Program Dispatching System. It speeds up the switching involved in serving several destinations with rapidly interchanged studio, line and transcribed programs, auditions and announcements—yet reduces operating errors.

Check these features against your operating requirements:

1. Provides simple, fool-proof method of pre-setting the next scheduled program condition—*leisurely*—while the present program is "on the air."
2. Operation of a single key instantaneously switches from the program "on the air" to the pre-set condition.
3. This one-key switching operation can be controlled from either the Master Panel or any selected control booth.
4. During light load periods, control of selected lines may be extended to any studio control booth.
5. "On Air" and pre-set circuit conditions—including point of release control—are positively indicated by lamps at all control points.
6. Any or all programs may be interrupted instantly for "flash booth" announcements without upsetting the existing studio circuit conditions.
7. System may be engineered and furnished to meet your *individual* operating requirements—regardless of number of program sources or outgoing lines.

For further details, call your local Graybar Broadcast Representative or write Graybar Electric Co., 420 Lexington Avenue, New York 17, N. Y.

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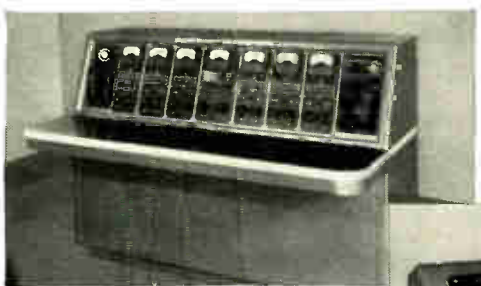


● *Six-line Master Control Panel for Western Electric Relay Type Program Dispatching System.*

● *Below—Flash Booth Indicator Panel (at left) and Control Signal Indicator Panel (at right).*

Western Electric

—QUALITY COUNTS—

TELE·TECH
Formerly the TELE-communications TECH-nical Section of
ELECTRONIC INDUSTRIES

O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17), N. Y.

Requirements for "Chief Engineer"

Discussed in broadcast circles recently is the issue of what constitutes a chief engineer for broadcast stations. Some advocate that FCC require a more rigorous examination qualifying for the job.

We believe the position of chief engineer carries with it not only the requirement to handle technical matters, but also demands administrative and executive ability as well. No examination has yet been devised that can sift out executive calibre, which is any better than the long-standing method of watching a man in action under fire. A chief engineer's certificate would be nothing more than a necessary evil; a negative approach; more footage of red tape.

Dr. C. B. Jolliffe of RCA Laboratories, was evidently thinking along these lines in his IRE Convention address when he urged the radio engineer to "break out of his professional shell and accept the challenge of leadership in business and public affairs." Such leadership is not acquired by passing a mere technical examination.

New 30-kc Proximity Rule

AM station owners find new worries in the 30-kc proximity proposal under which the FCC may assign to new AM applicants frequencies which are 30-kc from those of existing stations in a given area. A major point of contention arises here: With present standards in receiver design will the public be better served under the old 40-kc rule (usually 50-kc in actual practice), or under the new 30-kc proposal?

A broadcasting station is "just another business" in our economy and should be thrown into the stream of competition where it will sink or swim on its own merit. Frequencies under the law belong to the people and should be available to all competent applicants. The FCC should assign them to the technical limit.

Microwave TV Relays

The next needed step in television development for cities will be microwave links to outlying satellite transmitters, reproducing the TV program of the central station. For television programs are costly and the range of a single transmitter is inherently too limited to provide TV service that is both economic and satisfactory to all the neighboring people who will want to "look in."

Only through microwave aids can a TV station of the first class in any way approach the service area of a present-day first-class broadcast station (say 100 to 150 miles radius for a 50-kw transmitter 24 hours a day). As television stations get operating in cities, the sheer force of public demand will require that provision be made for supplementing the natural limitations of transmitters working on 50 to 200 mc. Both television engineers and FCC will have to recognize this situation.

TV in Overalls

Intramural television offers expanding opportunities for TV engineers and is unplagued by Federal regulation. Practical television equipment for watching a critical boiler-water line 65 feet above the firemen's station, has been in successful use for a year in New York City and now the Farnsworth Company is building twenty more of these "Utiliscopes," to sell at about $2500 per installation.

Experience gained during the war with TV equipment of this type (but other make) indicated that the "inherent complexity of television was the greatest stumbling block." Therefore what is needed is (a) the simplest system that will give the desired resolution at the receiver; (b) rugged, long-life tubes and components; (c) non-critical adjustments; (d) ease of servicing, preferably by semi-skilled electricians. And finally (e) easily-replaceable spare units.

LEAVE THE BEATEN PATH occasionally, and dive into the woods. You will be certain to find something you have not seen before.—Alexander Graham Bell, 1914

Television Antenna Installations

Closeup of one of the antennas. It is oriented so as to receive all three New York stations

WITH the increasing realization of commercial television broadcasting, consideration is being given to the installation of television in hotels. This article deals with some of the general considerations and problems involved in engineering and making a hotel installation, and their application to the specific installation at the Hotel Pennsylvania.

• For the large hotel installation, where over a thousand rooms would be served with television reception, the most satisfactory and economical method of accomplishing this probably will be to have master receivers in the main control room, and to distribute the video signal to the various rooms by means of coax. Any number of channels could be provided, with a channel selector switch at each room receiver. Such a system would have the advantage of simplicity, lowered cost, and ease of operation. The receivers in the rooms would not require RF or IF circuits, or elaborate sync. separators, so could be manufactured quite inexpensively.

Since such a system is not available at the present time, the hotel installations now made use individual television receivers in each room. All of the installations in the hotels mentioned are made with standard RCA Victor Model 630TS. 10-in. table model receivers. At the Hotel Pennsylvania, which is the most extensive installation, there are 18 receivers, arranged as follows: 12 in guest rooms; 4 in the cocktail lounge; 1 in a private dining room; 1 in the radio control room.

The receiver in the radio control room acts as a monitor to maintain a check on the general quality of reception, and also serves as a spare.

Any method of signal distribution for television receivers must meet several requirements: It must be capable of suppiying sufficient signal to the receivers to override any local noise or pickup, and it must have sufficient attenuation between outlets to prevent interference between receivers operating from the same line. There are two general types in present use—one having amplifiers feeding the distribution system, and the other merely matching the receivers to the line by means of resistance pads.

The former system must be used where the signal strength is not sufficient to operate more than several receivers, or where a large number of receivers must be operated from one antenna. It has further advantages where individual antennas must be installed for reception on each station. In this case, the amplifiers afford a means of mixing the signal from the various antennas.

The amplified system has the disadvantage of higher cost of both the amplifiers and the transformers and line used in its distribution. There is also the problem of maintenance of the amplifiers. A further disadvantage is that the signal voltage appearing at the individual outlets may not be sufficiently great to override any stray pickup of signal or interference arriving at the receiver directly.

In some localities, near the television transmitter, signals in excess of 5 millivolts have been received with the transmission line disconnected from the receiver. This is even increased when a length of transmission line is connected between the receiver and the outlet of the system. This condition, plus the fact that attenuation between receivers must be provided, imposes difficult conditions on the systems. Several such systems tested in midtown New York city locations have failed to perform for this reason.

Where adequate signal is available, a resistance pad system has several advantages over a system using an amplifier. The cost is considerably less, both from the standpoint of initial installation, and from that of maintenance. In many locations where the signal strength is great, such as midtown New York, such a system will give

*48 Remington Ave. Mt. Ephraim, N. J.; formerly with RCA Service Co., Camden, N. J., and in charge of installations described.

Giving Multiple Receiver Outlets

By R. J. EHRET*

System developed for use in hotels permits feeding three or six receivers without interference

Table-model television receiver installed in a guest room is part of the 18 receiver installation at the Hotel Pennsylvania

greater signal to each receiver than that obtained at the outlets of an amplifier system.

The chief disadvantage of the pad system is that it requires a fairly good signal to operate receivers. The actual value of signal required per receiver will vary with the amount of noise and interference present, and the quality of the receiver. In residential districts, away from most ignition noise and other interference, satisfactory reception may be obtained down to 2 millivolts of signal on an RCA receiver. In heavy interference areas, much greater signal is required.

In order to ascertain the number of receivers that may be operated from one antenna, a survey should be made using a receiver and substitution of a number of loss pads between the antenna and the receiver. Taking as the basis that the signal per set will be a fraction whose denominator is the number of sets on the line, pads may be made to give ½, 1/3, ¼, 1/5, and 1/6 of the signal voltage. Then by trial and error, the correct number of receivers can be found.

However, experience has shown that six receivers are a safe maximum that may be operated from one antenna, regardless of signal strength. An explanation of why trouble might be experienced if more sets, and hence more attenuation is used, can be based on the fact that in such high signal areas, the unwanted signal picked up on any transmission line between the receiver and the matching pad becomes of the same order of magnitude as that received through the attenuator.

Fig. 1 shows a schematic of a system to feed 6 receivers from one antenna, using 300-ohm transmission line. Each receiver receives 1/6 of the voltage appearing across the transmission line from the antenna. The transmission lines may be run any distance from the junction box to the receivers, since each line terminates in its characteristic impedance at the receivers. It will be noted that the impedance of the transmission line is properly matched by the parallel combination of the 6 receivers and their series resistors. Any signal coming from the antenna will be properly

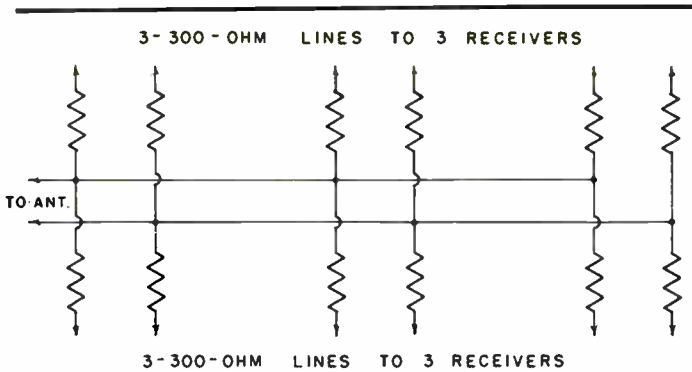
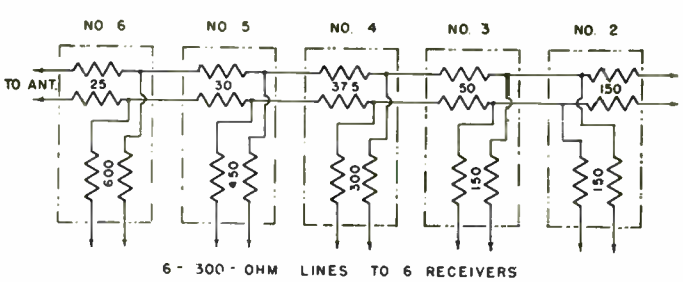


Fig. 1. (left) Six-set distribution box (all resistors are 750 ohms)

Fig. 2. (below) Series type distribution system



terminated, and no energy will be reflected back.

Since the transmission line is only terminated in one direction, it is important that the termination be fairly exact. Otherwise, the energy received on the transmission line will be reflected at the receiver end, and again at the antenna by any mismatch at the upper end, causing standing waves on the transmission line and reflection in the picture. The number and distance of these reflections will be dependent upon the number of round trips the signal makes, and the length of the transmission line. These standing waves will cause reflections to appear in the picture similar to those caused by nearby structures. Movement of the antenna itself will help to reduce the latter, whereas the transmission line must be properly terminated to reduce the former.

High Attenuation

The attenuation system also has the advantage of offering high attenuation between receivers. Just as each receiver gets only 1/6 of the transmission line voltage, any oscillator radiation from the receiver also is reduced by the matching resistor in the same ratio. This signal will be further attenuated by a factor of 1/6 before reaching another receiver. Thus the attenuation to the antenna is 1/6, or 15.5 db., and 36:1, or 31 db. between receivers. This is adequate to eliminate interference between well-designed receivers.

Where fewer sets are to be installed, the matching resistors are calculated so as to give the correct terminating impedance to the transmission line. The values of the resistors to give the proper termination can be calculated from the formula

$$R = Z\,(n-1)/2 \text{ (for balanced lines)}$$

where:

Z = characteristic impedance of the line
n = number of receivers
R = value of the resistor to be placed in each leg of the line to the receivers.

The system shown in Fig. 1 is used where it is desired to have

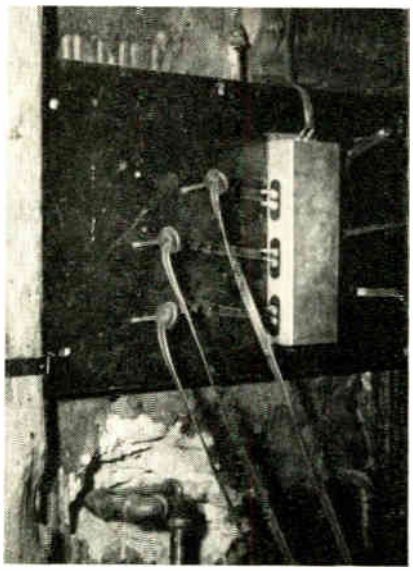


Fig. 3.—Distribution box located in the plumbing shaft at the 15th floor level. Six lines go to rooms above and below this level

one distribution box and distribute all of the sets from this common point. However, where receivers are to be located in a line, such as vertically above each other and some distance apart, another system has been devised which results in a better physical layout, with a resultant saving in transmission line. It also has the advantage of shorter runs of transmission line after the signal has been attenuated. A diagram of such a system is shown in Fig. 2.

Resistance Values

The resistance values are so chosen that each receiver has the same amount of signal, which in this case is 1/6th of the transmission line voltage. Where fewer receivers are to be installed, the "No. 6" pad may be omitted, and then each receiver will receive 1/5th the transmission line voltage. For 4 receivers, the "No. 5" pad is omitted, and so forth. The only disadvantage to this arrangement is that the attenuation between receivers is less at the end of the line than with the other system.

Care should be taken that all of the resistors used are carbon resistors. Some manufacturers do not make carbon resistors in low values. The only way to be sure is to break open a sample resistor and inspect it.

At the Hotel Pennsylvania, both systems are used. The receivers in the guest rooms, which are on the 17th, 16th, 15th, 14th, 13th and 12th floors directly above each other, are fed by means of a 6-set junction box shown in Fig. 3. The boxes are in the plumbing shaft on the 15th floor, and lines are run up and down to the rooms. Fig. 3 shows a photo of one of the boxes in the plumbing shaft.

For the radio room on the 19th floor, a "No. 6" pad is used to couple on the one receiver. From this point, the line runs down to a 5-set distribution box that feeds the 4 receivers in the cocktail lounge on the lobby floor, and the one set in the private dining room.

Antenna Placement

The choice of the antenna will depend upon a number of factors. For reception on more than one channel, the antenna must have a response covering the desired channels. A standard RCA No. 225 single dipole and reflector has a reasonably uniform response over the television spectrum when feeding a 300-ohm transmission line. Where slightly more gain is required at the expense of bandwidth, a folded dipole and reflector can be used. It should be cut for use on the desired channel, and the response on other channels will not be as good.

More elaborate arrays are not too practicable for hotel locations, for the reason that they are bulky, and present more of a mounting problem. Their frequency and direction selectivity preclude their use where more than one station must be received. A reflector usually is required in most metropolitan areas to reduce back pickup and reflections.

Attempts to use non directional antennas have not met with success where there are reflections; the nulls in the direction of the ends of the dipole are helpful in reducing reflection pickup from the sides.

The placement and orientation of antennas is one of the important factors in obtaining a good installation. For best results a test receiver should be used, and various locations tried for the antenna, trying different orientations in each location. Where the stations

all lie in the same general direction, usually a best location and orientation can be found that will give good reception on all of the stations. At both the Hotel Pennsylvania and the Hotel New Yorker this was accomplished. The antennas were oriented toward the Chrysler building where WCBS-TV transmitter is located, and this afforded reception on WNBT as well as WABD, which stations are located on either side of the Chrysler Building.

Transmission Lines

Where stations are located so that lines of sight to them make appreciable angles to each other, the problem becomes more difficult. Usually, however, some location can be found that will give satisfactory signal from all of the stations. Here a test receiver and a great deal of patience are required to try all possible locations. In some midtown locations, one system which has been used successfully is to receive WCBS-TV and WNBT from the front side of a dipole and reflector, and WABD from the rear. Where reflections are not too severe, a dipole without reflector sometimes can be used for reception from stations 180 degrees apart.

Occasionally, locations will be found where it is necessary to put up two or more separate antennas and transmission lines, and select the proper antenna by means of a selector switch at the receiver. In "custom" installations, this selector switch has even been ganged with the receiver bandswitch.

In order to avoid matching transformers and networks at the input of each receiver, it usually is best to use a transmission line designed to match the input of the receivers. 300-ohm parallel transmission line has the advantage of having the lowest loss of any of the television lines now in use, being at least twice as good as RG-11/U coax. The parallel type lines also lend themselves better to concealment along baseboards and moldings. It also has the advantage of being the least expensive, and this feature becomes important in hotels where some runs are over 400 feet long.

For extremely noisy locations, "Twinax"-100 ohm balanced, shielded line may be used. This type gives the best interference reduction, since the signal current does not flow in the shield braid as with single coax. With coax used to feed a receiver having balanced input, trouble has been experienced with noise pickup, sometimes even greater than that received on parallel line.

The 300-ohm line can be mounted on screw-eye type standoff insulators. It may also be tacked to wood moldings by means of insulated fibre head wiring nails. Where the transmission line goes through walls, loom or rubber tubing may be used to provide mechanical protection. The line also may be run under carpets, and no interference has been experienced by people walking on it. If the carpet has a pad under it, the line will not even cause a noticeable hump.

Where the transmission line is to be run outside, it should not be unsupported for lengths over about 4 ft. Otherwise, the flat surfaces of the line act somewhat like an airplane wing, and cause severe whipping action in the wind. This may cause flashing effects in the picture, and eventually will break the line.

Where it is necessary to cross open spaces, two messenger wires may be strung about 8 in. apart, and the line mounted midway between them on spacers. Otherwise, it can be run along railings or walls. At the Hotel Pennsylvania, a special covered wooden trough was constructed, and the line mounted on screw-eye standoffs which were screwed to the inside of the trough. Runs down the pole, and along the edge of the roof were mounted with standoffs on the pipe straps.

For installation of vertical runs, most hotels and buildings have plumbing shafts convenient to rooms. The horizontal runs can be made in false ceilings. Such routes were made use of at the Hotel Pennsylvania.

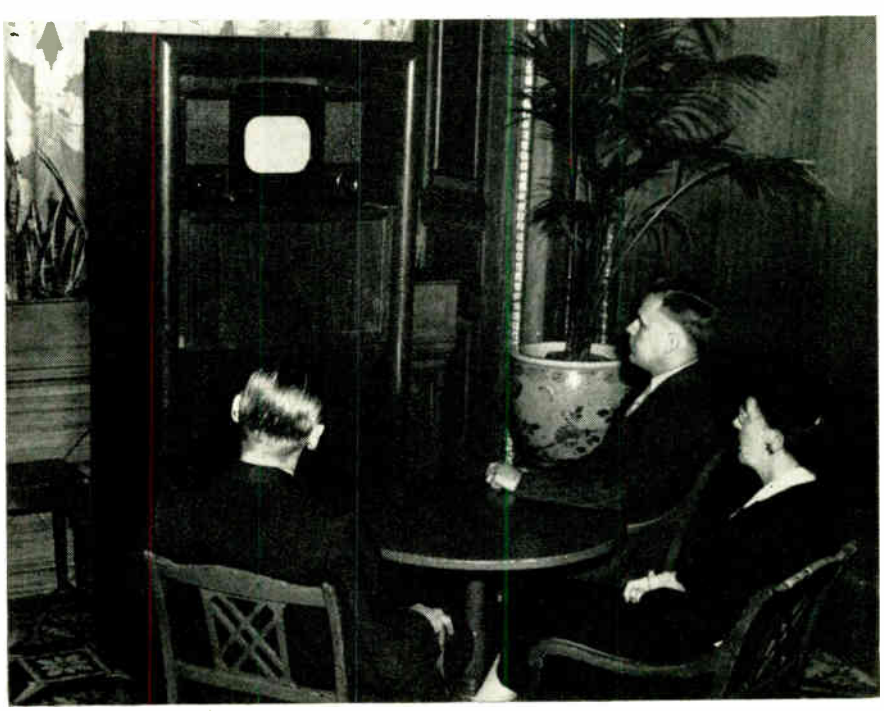
Interference Problems

The principal sources of television interference are diathermy, FM stations and receiver oscillators, auto ignition noise, radio amateurs, and electrical noise. Interference elimination methods may be classified in two general groups, depending on the frequency of the interference.

The first, is that which has its frequency in the same band as the desired television signal. In this class we include diathermy, 2nd harmonics of amateur stations,

(*Continued on page 99*)

Receiver located in the cocktail lounge is an RCA table model 630TS, housed in the cabinet which may be closed when the receiver is not in use



Raydist — a Radio Navigation and Tracking System

By CHARLES E. HASTINGS, Chief Engineer, Hastings Instrument Co., Hampton, Va.

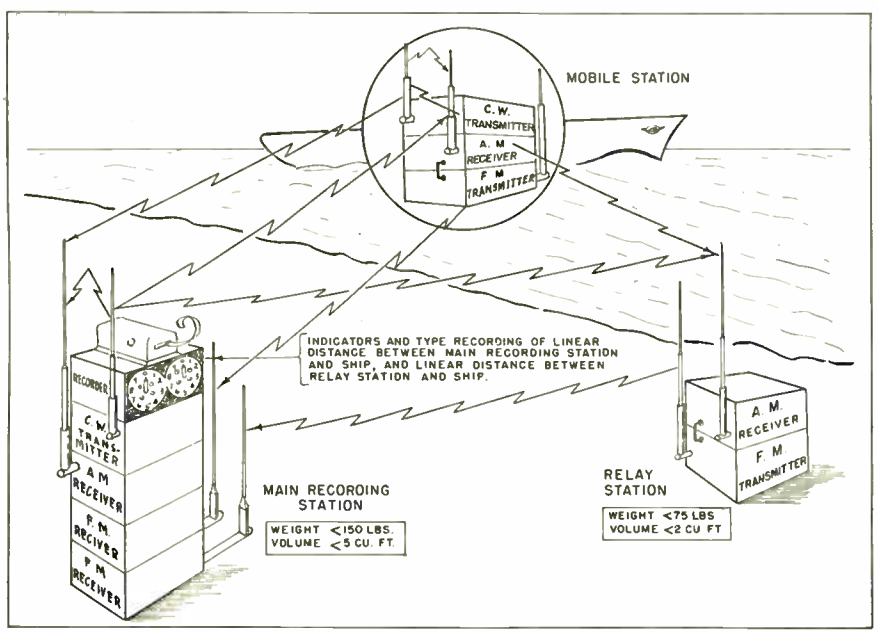
A highly accurate electronic distance-measuring system applicable to aeronautical problems requiring precise determination of position

• Although the Doppler effect on radio signals reflected from moving objects was one of the earliest discoveries in the development of Radar, the use of continuous-wave technics of navigation and distance measurements has almost been eclipsed by pulse methods. The desire to increase the accuracy and precision of Radar systems for many applications, however, is causing the trend to swing back. The simplicity, reliability, and lower cost of the continuous-wave apparatus also are factors in the increased interest in continuous-wave methods of navigation. A continuous-wave system has been used in Great Britain as a navigation method and a Doppler system was used by the Germans in determining the velocity and distance traveled by the V-2 rocket[1].

Raydist* is the newest system to receive public attention and relatively little has been written about it to date. Some of its basic principles were first used successfully in 1940 as a precise means for measuring the true ground speed of aircraft[2]. It then remained in confidential status during the war but has since undergone intensive development as a means for surveying over water or rough terrain and as a precise navigation and tracking system. In these applications the Raydist system results in high accuracy with the use of light and simple apparatus.

Raydist is a continuous-wave system and depends on the relative phase relationship between continuous-wave radio transmitters. One of the particular innovations of this system is the application of the heterodyne principle which increases the accuracy by causing a number of errors to cancel which might otherwise be relatively large. The Raydist system measures relatively short distances accurately, but it is also capable of precise measurements of long distances and is not limited to line-of-sight measurements. It may be set up as a hyperbolic line-of-position system or as a pure range system to measure the straight line distance between a portable unit and a single fixed ground station. In either case errors in the system result only from variations in the frequency of a single transmitter and from radio propagation phenomena. By the use of a high-quality crystal-controlled transmitter, the accuracy is limited only by the consistency of radio propagation phenomena.

A two-dimensional system set up to show true position of a ship at all times within an accuracy of an inch



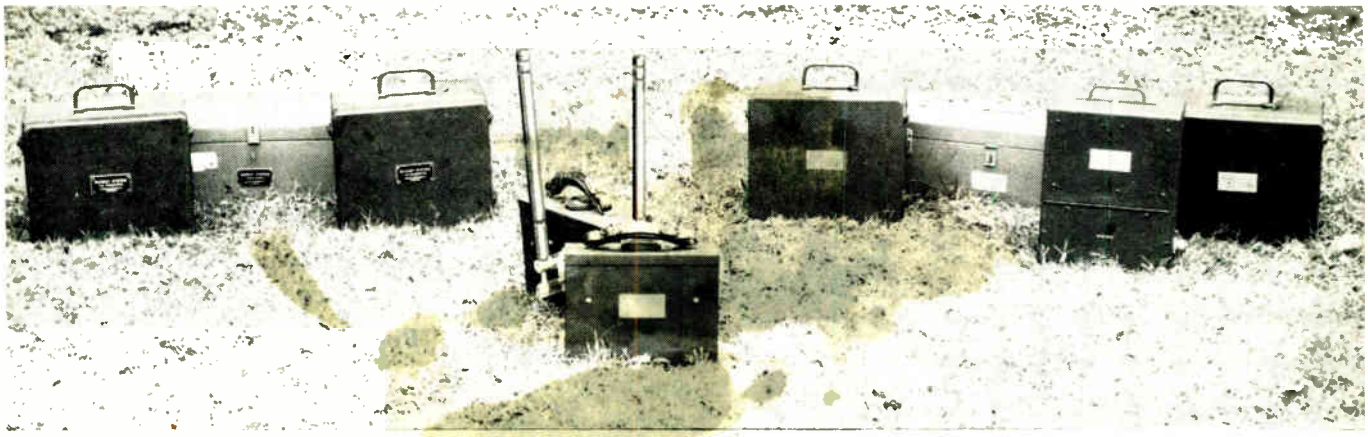
Surveying System

In setting up for the measurement of a linear distance between any two points, equipment is placed at two stations located conveniently adjacent to the distance to be measured. A transmitter is then moved over any convenient path from a point at one end of the distance to be measured to a point

1—McAllister, J. F.: "Measuring Velocity of V-2 Rockets by Doppler Effect," Tele-Tech, February 1947.

2—Hastings, Charles E.: NACA, Radio Ground-Speed System for Aircraft. NACA AR. Feb. 1943.

*Patents pending



Portable Raydist equipment for use in surveying. This equipment may be used over water or rough terrain

at the other end. Light weight portable equipment for a surveying system of this type was recently supplied to the Photographic Mapping and Charting Branch of the Army Air Forces, Air Materiel

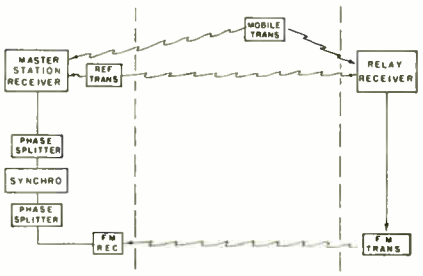


Fig. 1. Typical hyperbolic Raydist system

Command. A block diagram of this apparatus is shown in Fig. 1.

A phase relationship exists between the signals from the mobile and reference transmitters as these signals are received at the Master and Relay stations. As long as the mobile transmitter remains stationary, the phase difference between the signals received at these stations is fixed. As the mobile transmitter moves, however, the signals received at the Master and Relay stations from the mobile and reference transmitters go in and out of phase at a rate proportional to the velocity with which the mobile transmitter is moving with respect to the Master and Relay stations.

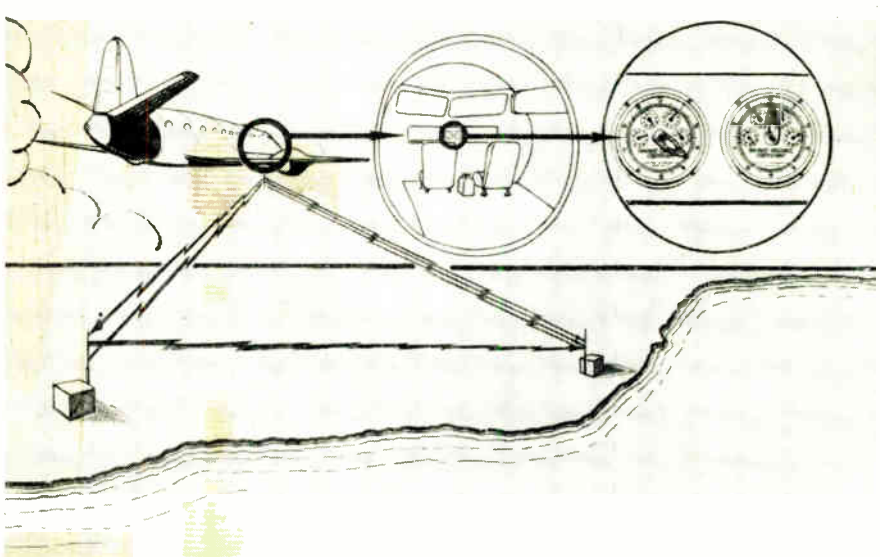
If the mobile transmitter is approaching the Relay station and receding from the Master station and moves ½ wavelength, the signal as received at the Relay station is increased 180° in phase and at the Master station it is decreased 180° in phase. Therefore, the difference in phase between the two stations is increased by 360° for each half wavelength distance moved by the mobile transmitter on a straight-line path between the stations. A synchro-operated phase comparator counts the number of complete 360° changes in phase and also indicates the final phase relationship of the signals received at the two stations at any instant. Each complete revolution equals a distance traveled by the moving transmitter equal to the half wavelength of its transmitted frequency. The dial reading gives the fractional change in phase and therefore the fractional part of the half wavelength distance.

The application of the heterodyne principle to a Doppler system results in considerable simplification of apparatus and an increase in accuracy over systems that do not use this principle. Consideration of the typical hyperbolic Raydist system shown in Fig. 1 will demonstrate this result.

Typical frequencies for the mobile and reference transmitters would be of the order of 2 to 15 mc, sufficiently low to avoid phase errors due to multiple transmission paths but high enough to allow readable phase indications to represent precise measurements of distance. The nominal difference in frequency between the mobile and reference transmitters would be approximately 400 cycles.

Due to the Doppler effect the two receivers would receive the signal from the mobile transmitter at a frequency either higher or lower than its nominal value, depending on whether the transmitter was moving toward or away from the receiver. The receivers beat the signals from the two transmitters, thereby obtaining an audio signal slightly higher or

Two dimensional system for indicating position of an airplane, applicable for precise navigation, for over-water oil prospecting, or for similar problems



Master station installed in carryall for field operations

lower than 400 cycles. The audio signal at the relay station is transmitted by telephone line or by FM radio link.

These beat signals are then fed into phase measuring circuits with integrated counters. The FM link normally would be used in preference to an AM link because of its higher signal-to-noise ratio. If the mobile transmitter reverses its direction the counter will be rotated in the opposite direction. Regardless of the direction and path traveled by the mobile transmitter, the reading will be the same every time the transmitter reaches a given point in space.

The accuracy of the system depends on the frequency of the mobile transmitter but not on the difference in frequency between it and the reference, because any drift in this beat frequency will be cancelled at the two receivers. There is thus no need to synchronize the two transmitters either in frequency or in phase. Any phase errors that might be introduced in the receivers will be almost completely cancelled due to the fact that both signals would be shifted equally.

At the receivers the phase measurement problem is simplified and made more accurate by the reduction of the signals from radio frequencies to audio frequencies. The phase measuring system becomes in effect a narrow-band pass filter. Only signals which are split in phase supply torque to the synchro. Static or stray signals within this band have the effect of first driving the synchro in one direction and then in the other but inertia in the synchro causes these effects to damp out. This system is thus made extremely free from difficulties from static of all kinds.

Pure Range System

Other arrangements of the heterodyne principle can be made to suit a particular problem. For some applications a pure range system is desirable; that is, two sets of equipment are required and the indicator gives a continuous indication of the distance between the two sets. With this type of system the indicator can be either in the moving object or at a fixed ground station, or the equipment can be used with two moving stations and the indicator will indicate the distance between them. The pure range Raydist system can be used to indicate the distance between two airplanes or two railroad trains or automatically to control one craft in order to maintain a definite spacing with respect to the other, or fixed so that some minimum distance will not be decreased.

Fig. 2 is a block diagram of a pure range system for determining the distance between two stations. In the pure range system each station contains a CW transmitter and a receiver. Each receiver receives a beat note between the CW transmitter at the same station and the CW transmitter in the other station. The transmitters at the two stations differ in frequency by an

Fig. 2. Pure range system for determining distance between two stations

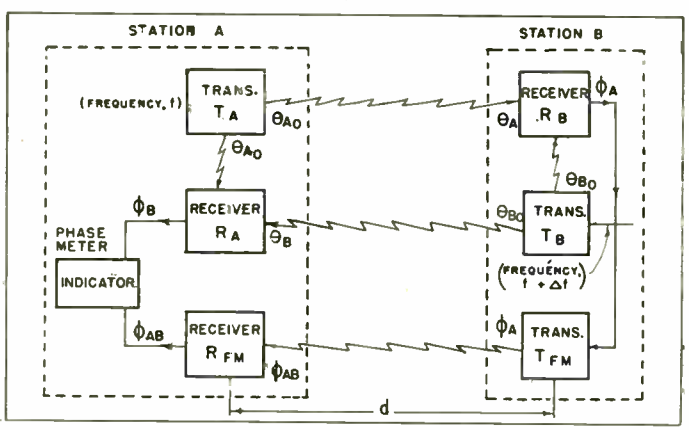
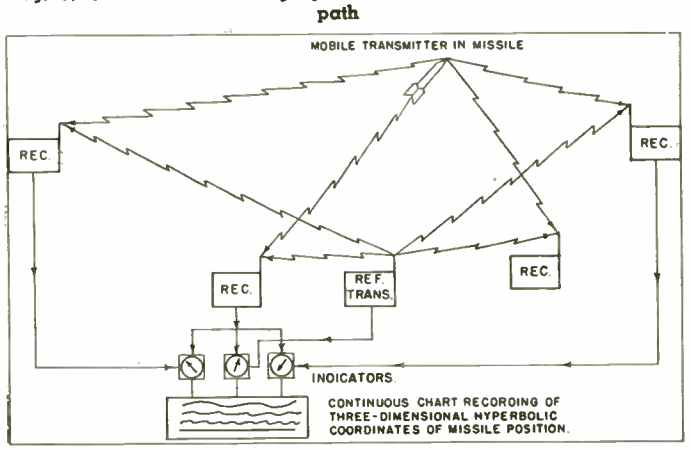
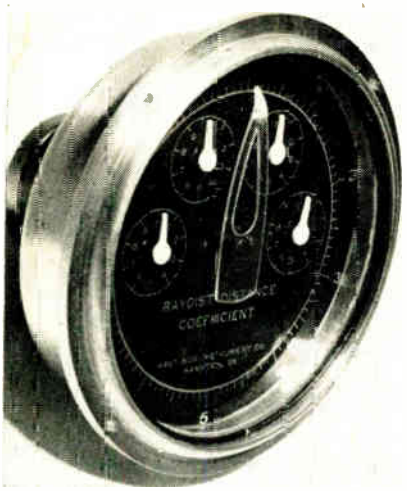


Fig. 3. Guided missile range provides accurate charting of flight path





Distance meter; distance can be figured mathematically from meter or, for a particular frequency on which the system is to be operated, the indicator can be geared to read directly in distance

audio note. A means of returning the heterodyne signal received at one station to the other station is also required. An FM radio link normally is used for this purpose. The two signals then are fed into the phase measuring and counting circuits by which the distances are measured.

The reading of the Raydist indicator is dependent only on the frequency of one transmitter, the velocity of propagation and the distance between the two stations. A simple mathematical proof of this statement may be given as follows:

Referring to Fig. 2 the phase, θ_A of the signal of the transmitter T_A at station A operating on a frequency f and with a phase angle of θ_{A_o} when received by receiver R_B at station B is:

$$\theta_A = \theta_{A_o} + \frac{2\pi(f)d}{c}$$

where c is the velocity of radio propagation and d is the distance between station A and station B.

Likewise the phase, θ_B, of the signal of the transmitter T_B at station B operating on $(f+\Delta f)$ and with a phase angle of θ_{B_o}, when received by receiver R_A at station A is:

$$\theta_B = \theta_{B_o} + \frac{2\pi(f+\Delta f)d}{c}$$

The signal as transmitted from each station is available at that station without any change in phase such as results when it is received at a distance. Therefore the beat at station A between the signal transmitted from T_A at that station and signal transmitted from T_B at station B is:

$$\phi_B = \theta_B - \theta_{A_o}$$

$$\phi_B = \theta_{B_o} + \frac{2\pi(f+\Delta f)d}{c} - \theta_{A_o}$$

and likewise the beat at station B is:

$$\phi_A = \theta_{B_o} - \theta_A = \theta_{B_o} - \theta_{A_o} - \frac{2\pi(f)d}{c}$$

the shift in phase in ϕ_A after being retransmitted to station A is:

$$\phi_{AB} = \phi_A + \frac{2\pi(\Delta f)d}{c}$$

this second term is in terms of the beat frequency Δf since the audio beat frequency is retransmitted:

$$\phi_{AB} = \theta_{B_o} - \theta_{A_o} - \frac{2\pi(f)d}{c} + \frac{2\pi(\Delta f)d}{c}$$

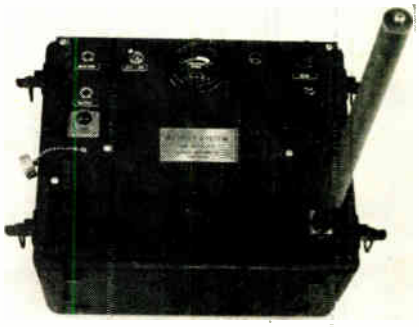
$$\phi_{AB} = \theta_{B_o} - \theta_{A_o} - \frac{2\pi(f-\Delta f)d}{c}$$

Comparing ϕ_B and ϕ_{AB} in a phase meter:

$$\phi = \phi_B - \phi_{AB} = [\theta_{B_o} + \frac{2\pi(f+\Delta f)d}{c} - \theta_{A_o}] - [\theta_{B_o} - \theta_{A_o} - \frac{2\pi(f-\Delta f)d}{c}]$$

$$\phi = \frac{4\pi(f)d}{c}$$

The change in phase meter reading thus depends only on the distance d, the frequency f, which is the frequency of the Master sta-

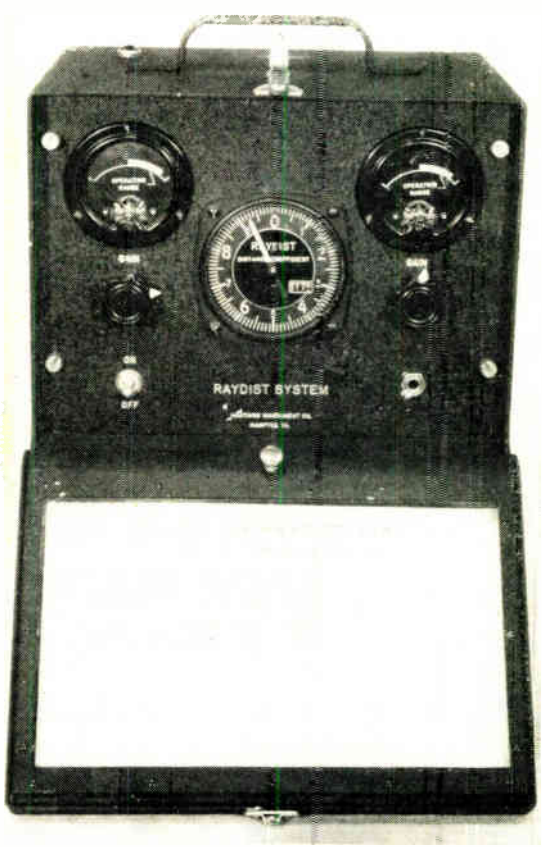


Portable receiver (waterproof cover removed)

tion transmitter, and the velocity of propagation c. It is also well to note that the variation of frequency of only one transmitter is involved and it enters the equation directly instead of varying with the beat frequency. If the lower frequency transmitter varies in frequency by 0.01% the error introduced is a proportional error of 0.01% of the true distance. Crystal controlled transmitters easily attain this accuracy and with care higher accuracies are practical.

The Raydist systems thus far described yield either single dimensional pure range data with regard to location on lines of posi-

(*Continued on page 100*)



Portable distance indicator for use with surveying equipment contains two phase splitting amplifiers and a synchro unit (AAF photo)

Standing-Wave Ratio Meter for VHF

By G. GLINSKI, Consulting Engineer, Electronics Div., Northern Electric Co., Montreal

Simple instrument suitable for field or production tests on FM and TV transmission lines also serves to measure power

• The well known slotted line technic of standing-wave ratio measurements at VHF frequencies is time consuming and, therefore, not well adapted to field or production tests. It is based on the determination of voltage (or current) maximum V_{max} and minimum V_{min} along the slotted line. Standing-wave ratio q is then

$$q = \frac{V_{max}}{V_{min}} \qquad (1)$$

Neglecting the line attenuation the rf power P delivered to the load is

$$P = \frac{V_{max}\, V_{min}}{Z_o^2} \qquad (2)$$

where Z_o is transmission line characteristic impedance.

During the war, a more direct technic for standing wave ratio measurements has been developed at SHF frequencies. This method is based on the use of the so-called "directional coupler". The directional coupler is essentially a device responding to the energy flow in only one direction. A properly designed directional coupler measures, therefore, the magnitudes of either the incident V_i or reflected V_r voltages on the line. The standing wave ratio is found then from the relation

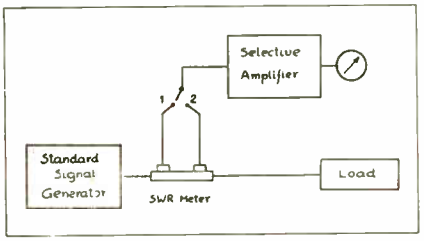


Fig. 3—Method of using the standing wave ratio meter at low power levels

$$q = \frac{1 + \frac{V_r}{V_i}}{1 - \frac{V_r}{V_i}} \qquad (3)$$

Actually, the calculation may be entirely avoided, if the magnitude of incident voltage is always kept at some constant value, since then the instrument reading the reflected voltage may be calibrated directly in standing-wave ratios.

Obviously, the device also may be calibrated in terms of power. The power P delivered to the load is found then by subtracting the reflected power P_r from the incident power P_i.

$$P = P_i - P_r \qquad (4)$$

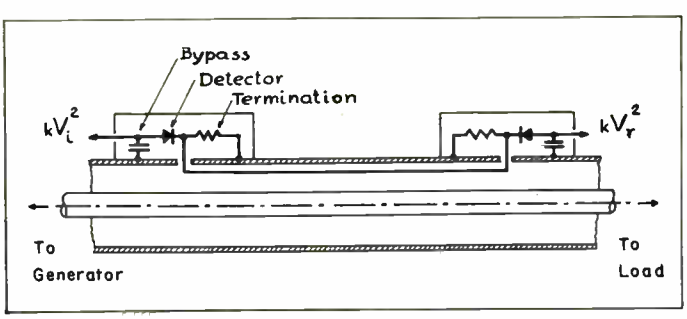
A very simple and convenient variety of directional coupler called "standing-wave ratio meter" has been developed. It consists essentially of a section of auxiliary transmission line with matched terminations at each end, coupled to the main transmission line, as shown in Fig. 1.

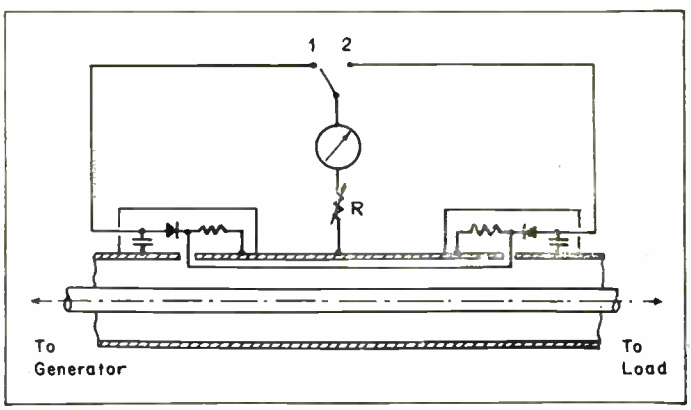
The simple theory of operation of such directional coupler has been presented by Howe[1] and will not be repeated here. The essential conclusions are that, if the main and auxiliary lines are matched, the voltage on the right hand termination of the auxiliary line is zero and on the left hand termination, proportional to the incident voltage on the main line. In other words, the left hand termination of the device responds to the incident voltage, whereas the right hand termination responds to the reflected voltage.

Fig. 2 is a photograph of an experimental model of the standing-wave ratio meter for 151-163 mc band. The band-width of the de-

[1] "An Instrument for Direct Measurement of the Travelling Wave Coefficient in Feeders," Wireless Engineer, Vol. XX, No. 239, pp. 365-367, Aug., 1943.

Fig. 1—(Below) Schematic of standing wave ratio meter showing method of coupling to transmission line. Fig. 5—When used at high power levels recified current is indicated on meter





vice is limited only by unavoidable discontinuity effects at the terminations.

For a given amount of coupling, the sensitivity of the device is maximum when the auxiliary line is a quarter wave (or an odd multiple of quarter wave) long.

For the model shown in Fig. 2, the coupling (defined as 20 log (V_i^A/V_i^B), where V_i^A = incident voltage on the main line, V_i^B = voltage on the left hand termination of auxiliary line) is of the order of 20 db. The directivity (defined as 20 log (V_i^B/V_r^B), where V_i^B = voltage on the left hand termination, V_r^B = voltage on the right hand termination of auxiliary line when the main line is matched) is of the order of 40 db.

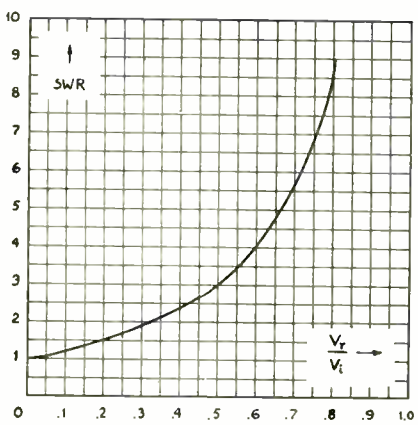


Fig. 4—Chart for determining standing wave ratio when meter is uncalibrated

When used as a standing-wave ratio meter on low power levels, the matched crystal detectors are used to convert 400 cps AM modulated carrier from a standard signal generator into 400 cps ac voltage which is then amplified by the 400 cps selective amplifier and measured on the output meter (Fig. 3.) The procedure follows.

The standing-wave ratio meter is inserted between the transmission line and the signal generator. The switch is thrown into the position 1 and the volume control of the amplifier is adjusted to full scale deflection on the output meter. Then the switch is thrown to position 2 and the output meter reading taken again. Standing-wave ratio is then found from Fig. 4 (or read directly on the meter if previously calibrated in standing-wave ratios).

The use of the device as a power meter will require previous determination of the proportionality constant between the actual power in the main line and the output meter reading for a given sensitivity range of the amplifier.

This calibration is accomplished by inserting a slotted line between the standing-wave ratio meter and main line. The rf power P_{ref} is then determined from the formula (2) If the corresponding output meter reading is P_{ref} then, under the assumption of square law detector characteristic and linear amplifier characteristic, the actual power P corresponding to output meter reading p is

$$P = \frac{P_{ref}}{P_{ref}} p \qquad (5)$$

When used as a standing-wave ratio meter on high power levels, the rectified currents of matched crystal detectors may be read directly on the dc micro or milliammeter (Fig. 5). The procedure is as follows.

The standing-wave ratio meter is inserted between the transmission line and the transmitter. The switch is thrown to position 1 and the potentiometer R is adjusted to full scale deflection on the meter. Then the switch is thrown to position 2 and the meter reading taken again. Standing-wave ratio is then found from Fig. 4 (or read directly on the meter, if previously calibrated).

The device may be also used as a power meter. The calibration is again carried out as previously described.

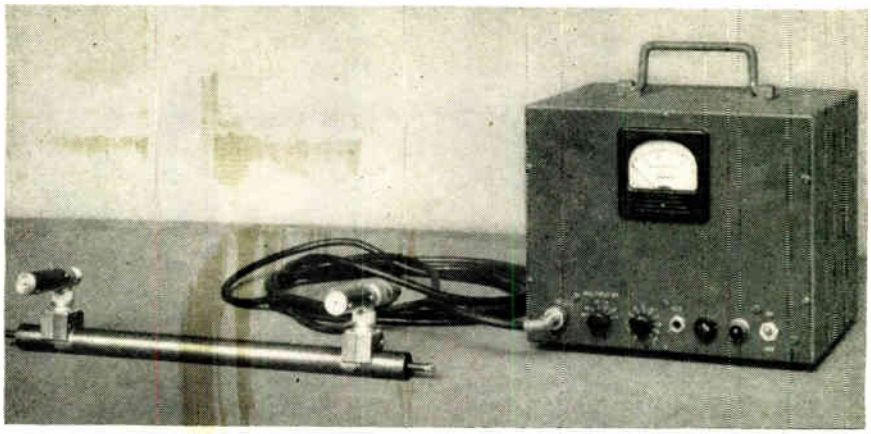
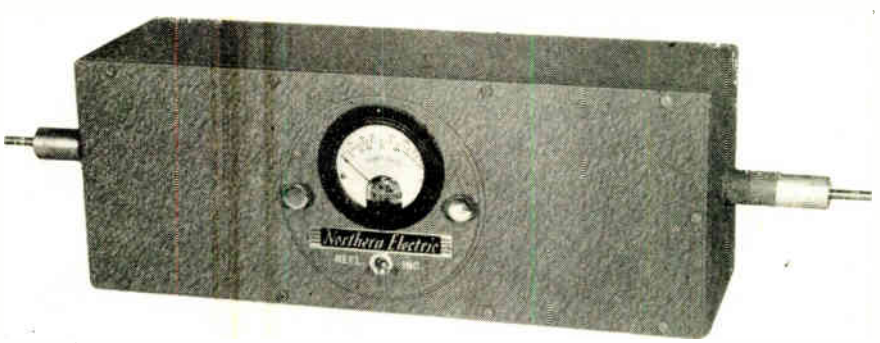


Fig. 2—Photograph of an experimental model of the standing wave ratio meter for the 151-163mc band, showing general appearance of the instrument

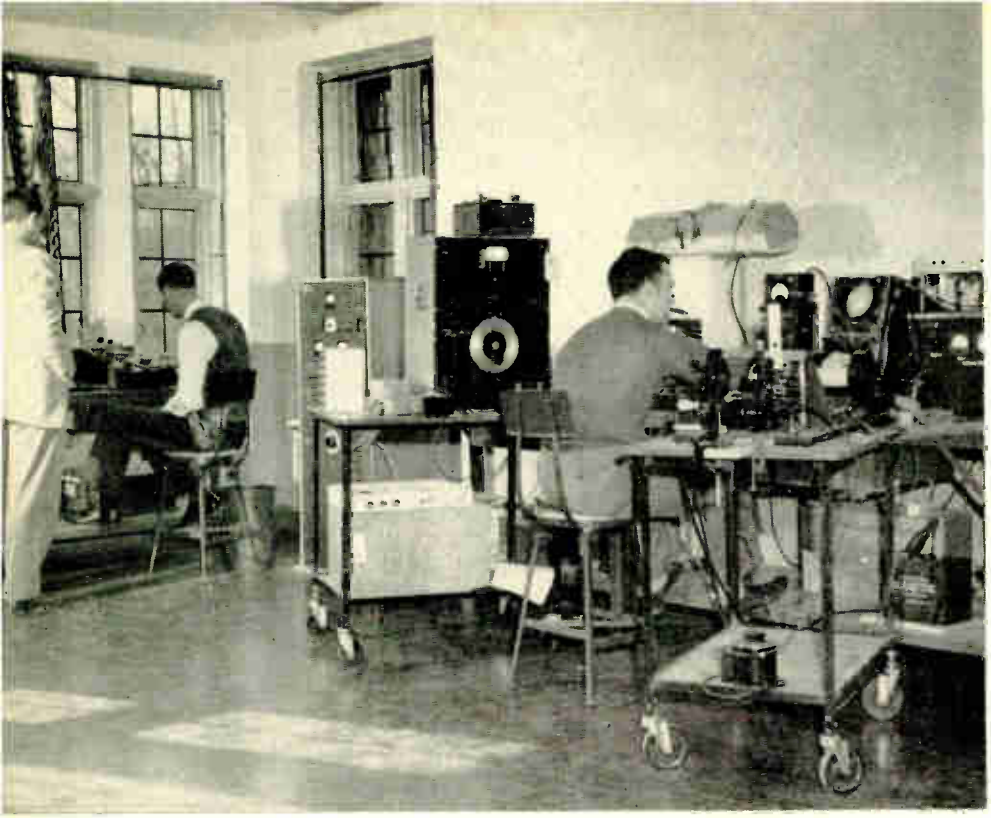
Fig. 6. Model of direct reading power meter for powers up to 275 watts and frequencies of 151-163 mc/s



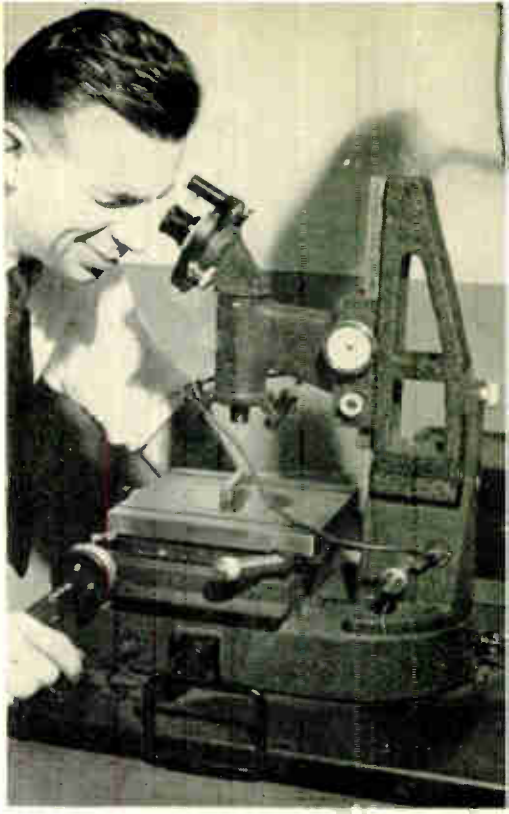
Crystal-Controlled FM Home Receiver

A pilot model of one of the first crystal-controlled FM home receivers, just off the drafting board, is now in operation at the American Quartz Laboratories in Yonkers, N. Y., ready for production. The set will have eighteen low-drift quartz crystals allowing selection of eighteen FM channels.

The chief feature of the new AQL home receiver is the local crystal oscillator. Circuit arrangement of the oscillator is such that a relatively high harmonic output is obtained from the crystal. This harmonic is mixed with the incoming signal to produce an IF of 10.7 mc. The AQL receiver is designed to operate with an input of ten microvolts per meter.



Corner of Systems laboratory, one of several equipped for development of motion picture sound equipment. This laboratory was converted from a former master bedroom and bath. Similar units are available for optical research and study of intricate units



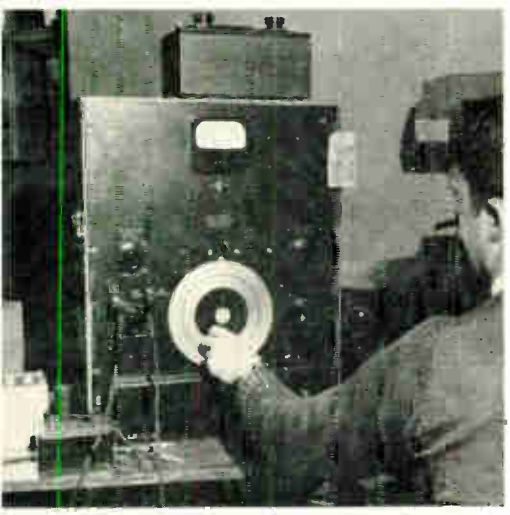
To maintain accuracy with this toolmaker's microscope, the temperature in this room is controlled within extremely close limits

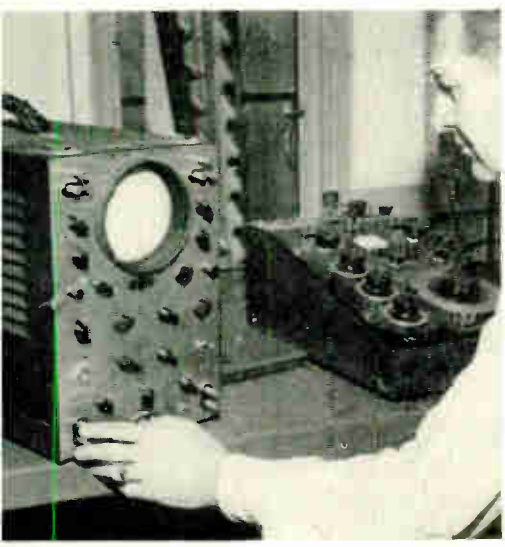
Electronic Research Lab Designed to Promote Creative Work

• The establishment of the General Precision Laboratory Inc., at Pleasantville, N. Y., comprising 69 acres of a former palatial estate, (Mandeville) follows a trend pioneered by the leading industrial organizations of this country to establish their research laboratories in a college-like atmosphere where creative thinking and fundamental developments can

Each research group has its own model-making facilities for limited work, in order to be able to handle any design problem that comes up. A fully equipped machine shop was established in a building formerly used as a carriage house. Machinery is mounted on concrete

View of the front of the former Mandeville mansion, now converted into a laboratory





Research pertaining to sound equipment includes all general and many specialized equipments for designing and checking theatre developments. Two views here show routine test set-ups in this field

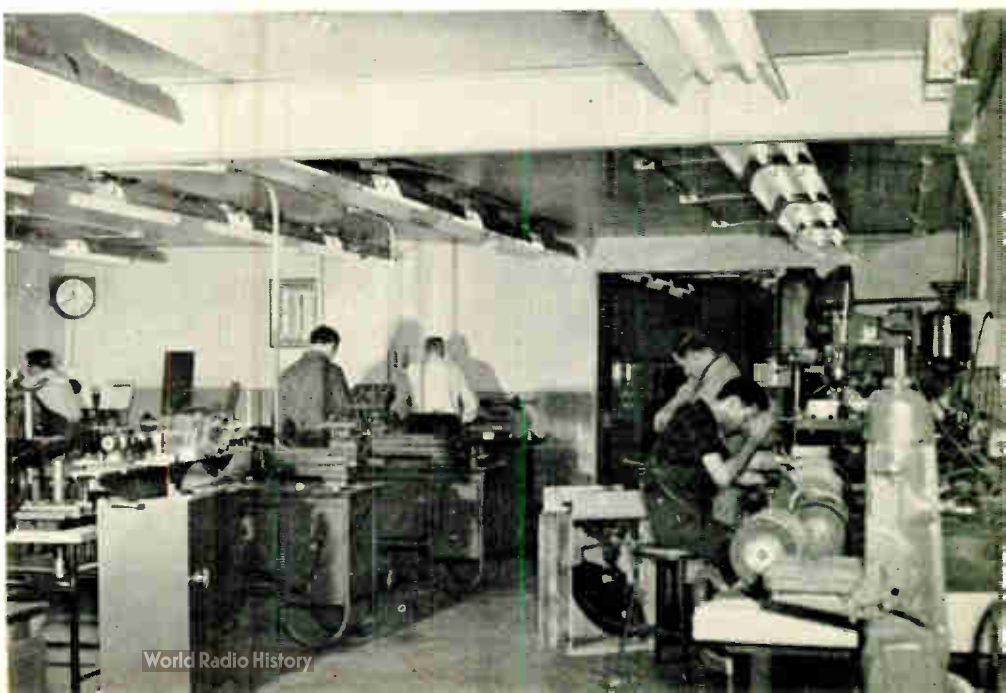
Part of a fully equipped chemical laboratory converted from a large area formerly used for cutting, arrangement and storage of fresh flowers. Reagent shelves at back

thrive to best advantage. The main laboratory building is a stone structure of approximately 50 rooms.

General Precision Laboratory Inc., was organized as a central research laboratory for General Precision Equipment Corp., and its subsidiaries, including Ampro Corp., Askania Regulator Co., CineSimplex Corp., the Hertner Electric Co., International Projector Corp., Librascope, Inc., J. E. McAuley Mfg. Co., Motion Picture Engineering Corp., National-Simplex-Bludworth, Inc., and the Strong Electric Corp.

Developments in the fields of precision mechanics, optics, electronics, sonics, supersonics and hydraulics as they apply to motion picture, television, industrial process control and airmarine navigation equipment as well as fire control and other specialized equipment can be handled.

Another room in the group comprising the model shop, for light machinery and bench work. The staff of toolmakers, instrument makers and machinists is skilled in precision work



Predicting World Area Coverage by Reflected Waves

By NEWELL A. ATWOOD*

Technical details of a method and a new tool by means of which it is possible to determine maximum usable frequency and optimum working frequency

THIS paper describes technics now in use for the prediction of radio wave propagation conditions from point to point, and a new method for graphically ascertaining, several months in advance the areas of the world to which one may expect high frequency radio waves to be propagated each hour of the day from any location in the world by reflection from the F_2-layer of the ionosphere.

• Within the tele-communications field, it frequently is necessary or advantageous to understand wave propagation theory and to make use of all available propagation data. This is particularly true in connection with sky wave propagation whereby the higher frequencies may be reflected by various layers of the ionosphere to widely scattered areas of the world.

The continuous trend to higher and higher frequencies of the radio spectrum further emphasizes the importance of taking into consideration the effects of sky wave reflection. The present peak period of the solar cycle permits the reflection of radio waves of frequencies probably higher than have heretofore ever been observed, high frequency technics having been materially advanced in the interval since the last peak period of this current eleven-year cycle.

Today, the short wave broadcast industry is vitally interested in determining the world areas where high frequency broadcast programs may be received, and it is necessary that this information be available sufficiently far in advance to permit proper choice of hours of operation and frequencies as well as to aid in choice of programs (which may vary in language and nature for different world areas).

Communicators, both commercial and governmental likewise are interested in the choice of optimum frequencies from assigned channels, and in the choice of hours of operation for maximum world coverage, both for transmission and reception. Knowledge of the possible occurence of reflected radio waves also is important to scientists and engineers engaged in the study of wave propagation whether their interest lies in such fields as, for example, tropospheric propagation or in the proper allocation of frequencies which will cause least interference to others in the same or other services.

Problems of the latter category are exemplified by the recent controversy over high or low frequency bands for frequency modulation broadcast service and by the allocation of channels for urban radio telephone service. Radio amateurs, foremost pioneers in long distance and high frequency communication, are today frequently diligent students of wave propagation theory and data, in order that longer distances may be covered at higher frequencies. Thus, it can be truly said that tools and technics developed for use in connection with ionospheric data are or should be matters of interest in some degree to almost everyone with a technical interest in communications.

During the recent war, valuable ionospheric information was made available to the military services by the Interservice Radio Propagation Laboratory of the Joint Communications Board under a cooperative program between the Inter-Services Ionosphere Bureau and National Physical Laboratory of England, the Australian Radio Propagation Committee, the Canadian Naval Service, the Carnegie Institution of Washington and the National Bureau of Standards. Similar information is now being made available to the public through the publications and services of the Central Radio Propagation Laboratory of the National Bureau of Standards.

One of the most useful sources of ionospheric information made available by the Central Radio Propagation Laboratory (CRPL) is the monthly publication "Basic Radio Propagation Predictions".* This publication contains charts and nomographs which may be utilized to predict propagation conditions three months in advance, with instructions as to the manner of using the data. By means of this publication, it is pos-

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*Available by subscription for $1.50 per year domestic, $2.00 per year foreign, from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

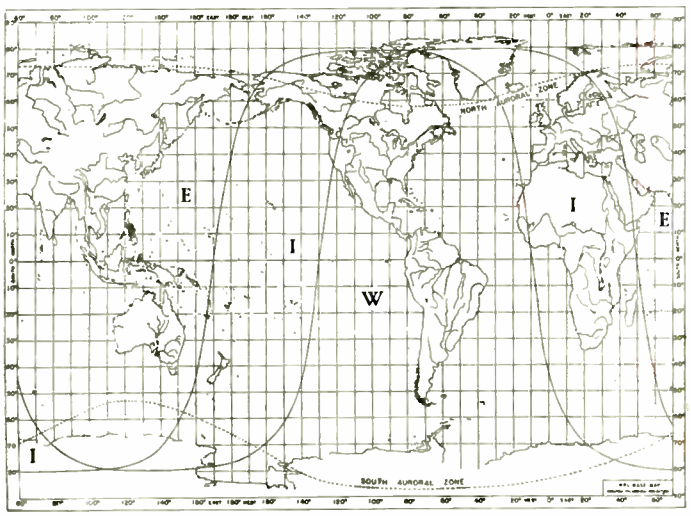


Fig. 1—CRPL world map, furnished with each monthly issue of "Basic Radio Propagation Predictions", for use as the base map in determining propagation paths and zones in which control points lie

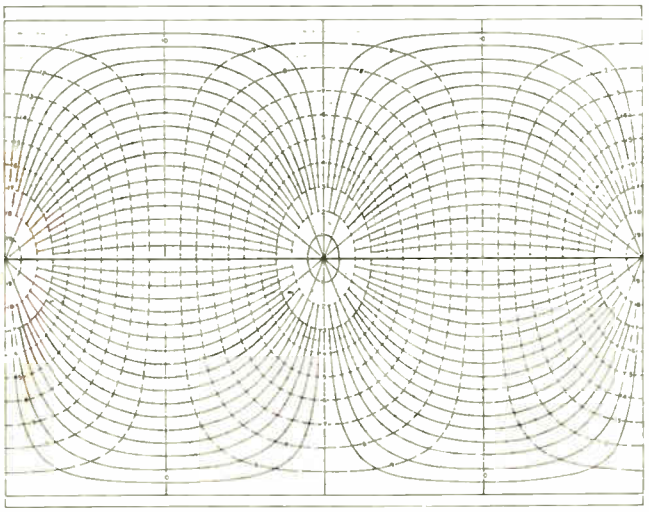


Fig. 2—CRPL great circle chart contained in "Basic Radio Propagation Predictions" from which great circle paths between selected points of the world map may be traced, control points determined

sible to predict the maximum usable frequency (MUF) and the optimum working frequency (OWF) between any two locations on the earth's surface for any hour of the day, month by month, three months ahead. It is also possible, with this publication, to determine great circle distances and bearings between points on the earth's surface, the determination of this information constituting a necessary step in the prediction of MUF and OWF.

Propagation Theory

The procedures recommended by the CRPL are based upon the following theory of radio wave propagation: Radio waves, reflected from the several layers of the ionosphere, travel between locations on the earth's surface along great circle paths, and are controlled in such travel primarily by the condition of the ionosphere at the point where reflection takes place. For distances up to about 2500 miles, the point of reflection for the F-layer (from which the preponderance of radio waves are reflected) is a control point in the ionosphere midway along the path between the two locations on the earth's surface. For distances in excess of 2500 miles, there are two control points, each one being 1250 miles along the great circle path toward the other location.

By determining the condition of the ionosphere at any desired control point or points in terms of the maximum frequency that will be reflected from such point or points, the highest frequency that can normally be used for communication between these locations is obtained, and other factors relative to communication conditions can be derived from the maximum usable frequency data thus obtained.

Each copy of the CRPL publication referred to contains a map of the world, illustrated by Fig. 1, and a great circle chart, illustrated by Fig. 2, by means of which it is possible to determine the great circle path between two locations on the earth's surface, and to determine the 1250-mile control point or points along this great circle path. This is preferably done by the use of a sheet of transparent paper, upon which the great circle paths, the locations of the two stations and the position of the control point or points with reference to the equator are marked.

Fig. 3 illustrates a transparent sheet with the great circle path

Fig. 3—Transparent chart showing great circle path between Washington, D. C. and Trieste, Italy, and showing 1250 mile control point "A", lying within the W zone, and control point "B" in I zone

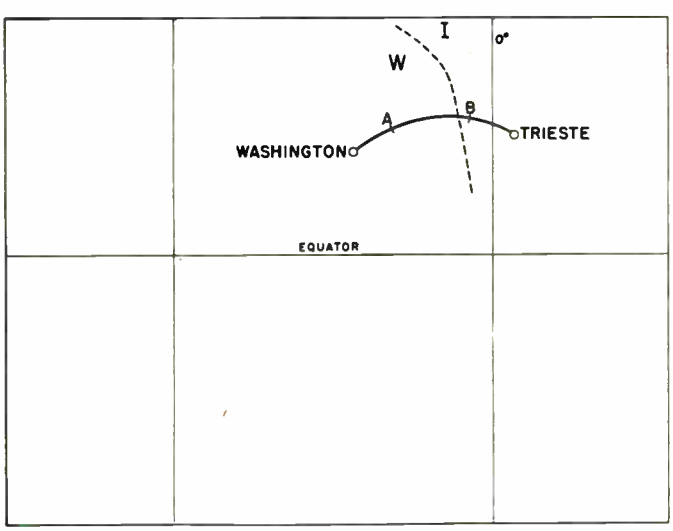
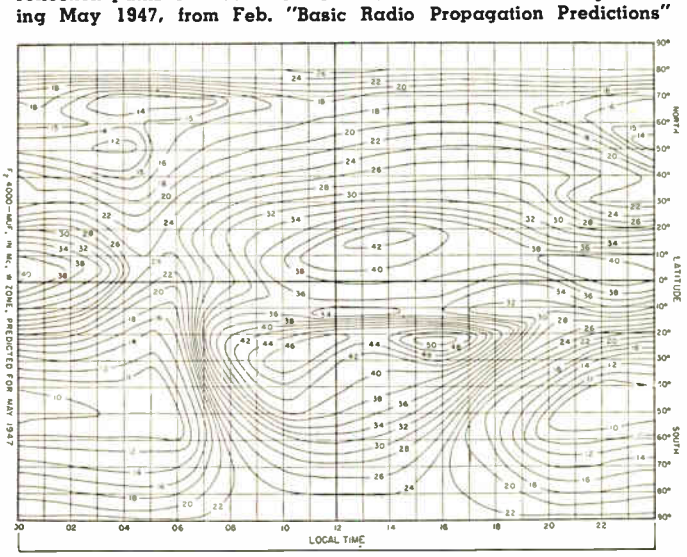


Fig. 4—CRPL contour chart of maximum usable frequencies for reflection paths of 2500 miles or more for the W zone F_2-layer during May 1947, from Feb. "Basic Radio Propagation Predictions"



CRPL-FORM AH — Solution of long-path transmission problem — DATE 2 January 1947

MUF-OWF WORK SHEET FOR PATHS OVER 4000 KM.

From Washington, D. C. To Trieste Distance, 7100 km Predicted for May 1947

Note: All frequencies are in megacycles

	A-end						B-end											
	Pt A in W Zone			Pt A' in W Zone			Pt B in I Zone			Pt B' in I Zone								
GCT	f_{E_s}	E_s 2000-muf	F_2 4000-muf	E-layer 2000-muf	E_s 2000-owf	F_2 4000-owf	f_{E_s}	E_s 2000-muf	F_2 4000-muf	E-layer 2000-muf	E_s 2000-owf	F_2 4000-owf	MUF A-end	MUF B-end	OWF A-end	OWF B-end	MUF for PATH	OWF for PATH
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
Procedure	Scale pt A	5 × a	Scale pt A	Scale pt A'	5 × e	85% c	Scale pt B	5 × g	Scale pt B	Scale pt B	4 × k	85% i	Highest of b,d,h	Highest of c,i,j	Highest of e,g,l	Highest of f,h,k	Lower of m,n	Lower of o,p
00	2.6	13.0	23.0	7.3	9.0	19.6			23.0			19.6	23.0	23.0	19.6	19.6	23.0	19.6
01																		
02			19.3			16.4			22.1			18.8	19.3	22.1	16.4	18.8	19.3	16.4
03																		
04			14.0			11.9	2.0	10.0	18.8	6.9	6.0	16.0	14.0	18.8	11.9	16.0	14.0	11.9
05																		
06			12.9			11.0	3.0	15.0	19.0	12.9	11.0	16.2	12.9	19.0	11.0	16.2	12.9	11.0
07																		
08			12.2			10.4	3.3	16.5	22.0	16.3	12.5	18.7	12.2	22.0	10.4	18.7	12.2	10.4
09																		
10	2.4	12.0	17.2	11.0	8.0	14.6	3.8	19.0	24.2	17.7	15.0	20.6	17.2	24.2	14.6	20.6	17.2	14.6
11																		
12	3.9	19.5	19.8	15.6	15.5	16.8	3.8	19.0	25.4	18.3	15.0	21.6	19.8	25.4	16.8	21.6	19.8	16.8
13																		
14	4.1	20.5	21.2	17.7	16.5	18.0	3.7	18.5	26.4	17.5	14.5	22.4	21.2	26.4	18.0	22.4	21.2	18.0
15																		
16	4.2	21.0	22.8	18.7	17.0	19.4	3.4	17.0	28.1	15.8	13.0	23.9	22.8	28.1	19.4	23.9	22.8	19.4
17																		
18	4.1	20.5	24.0	18.3	16.5	20.4	3.1	15.5	30.1	12.0	11.5	25.6	24.0	30.1	20.4	25.6	24.0	20.4
19																		
20	3.9	19.5	24.9	16.8	15.5	21.2	3.0	15.0	29.4	5.5	11.0	25.0	24.9	29.4	21.2	25.0	24.9	21.2
21																		
22	3.8	19.0	24.6	13.5	15.0	20.9	2.0	10.0	25.1		6.0	21.3	24.6	25.1	20.9	21.3	24.6	20.9
23																		
Done by																		
Checked																		

Fig. 5—Table showing hourly data obtained from CRPL charts such as Fig. 4 for the transmission path shown in Fig. 3 for the month of May 1947, and indicating the manner in which the maximum usable frequency and the optimum working frequency for each hour of the day are determined

between Washington, D. C. and Trieste, Italy, drawn thereon, with the control points labeled as "A" and "B". By placing the transparent sheet over charts in this publication showing frequency "contour" lines for a given month, and sliding this sheet along these charts, it is possible to determine the maximum usable frequency for each control point for each hour of the day.

Basic Predictions

Fig. 4 illustrates a chart taken from a current issue of "Basic Radio Propagation Predictions" showing frequency "contour" lines for reflection paths of 2500 miles or more for the W zone F_2-layer during May of 1947, this chart having been constructed by CRPL on the basis of numerous observations made over an extended period.

The data thus read from the charts for various hours of the day is entered in a table, illustrated by Fig. 5, and from this table the maximum usable frequency and other information pertaining to the transmission path between the two selected locations on the earth's surface, may be obtained. Such information may be presented graphically as is illustrated by Fig. 6, which shows maximum usable frequencies, optimum working frequencies, and recommended frequencies for use over the transmission path between Washington, D. C. and Trieste, Italy, for the month of May 1947.

Since reflection may sometimes occur from layers other than the F_2-layer, charts and instructions are furnished in the CRPL publication to compute hourly maximum usable frequencies by reflection from such other layers. Propagation is affected by reflection from such other layers. Propagation is affected by reflection from the layer for which the highest maximum usable frequency is obtained. The table of Figure 5 shows MUF and OWF data not only for the F_2-layer but also for the E-layer and for the sporadic E layer (E_s); however, it will be observed that maximum usable frequencies during May of 1947 for the transmission path shown in Fig. 3 are all based upon reflection from the F_2-layer.

For distances less than 2500 miles, the CRPL method is somewhat similar to that for distances in excess of 2500 miles, except that only one control point is used. Two maximum usable frequencies for this point, obtained from separate charts, are determined for various hours of the day, and a distance factor is applied to the relationship between these maximum usable frequencies to obtain the usable frequency.

While the procedures recommended by the Central Radio Propagation Laboratory have been found extremely useful in connection with point-to-point communication, it will be apparent that each series of computations gives data pertaining only to the transmission path between the two selected points, and that an infinite number of such computations would be necessary to obtain a picture of propagation conditions throughout the world. It will also be apparent that such computations result in data expressed in terms of hourly maximum usable frequencies. It is frequently desirable to know to what areas of the world, radio waves of a given frequency may be transmitted as has been previously pointed out in this article.

There has recently been developed a method and a device which permits a rapid determination of much valuable information relative to world wide radio wave propagation conditions, without extended computation and unlimited by the necessity to select two locations on the earth's surface for which the data is desired. While this new technic is based upon the same theory as that earlier described in this article in connection with F_2-layer reflection, and uses charts and data obtained from the CRPL publication described, the information obtained thereby is all presented graphically, in terms of a selected frequency.

This is accomplished by means of a slide rule type of a device, photographs of which are shown in Fig. 7 and 8, this device consisting of a transparent world map, a transparent time-frequency chart, and a series of great circle charts, assembled in a holder permitting the charts and map to be moved with respect to one another.

Figs. 7 and 8 illustrate the assembly of the map and charts of this new device, which includes respectively a transparent world map, a transparent time-frequency chart, and a great circle chart. The world map is of the same scale as that contained in the CRPL publication and is similar to that of Fig. 1 except that it is made transparent, land areas are shown in

different colors for each of the three zones, and the map covers a world and a half to show Asiatic and Oceanic countries twice, for convenience in following great circle paths around the world.

The world map also has indicated along the equator central time-zone meridians for use in reading local time from the time-frequency chart. The time-frequency chart is of the same scale as the world map, and is generally similar to Fig. 4, except that this chart contains only a time-scale along the equator with border lines. This chart is transparent with a roughened or mat finish in

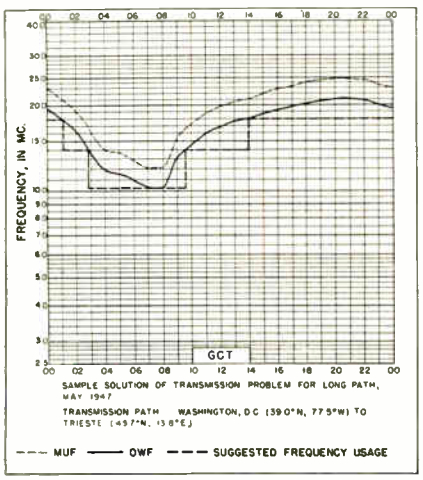


Fig. 6—Graphic representation of maximum usable frequency, optimum working frequency and recommended frequency as derived from the table (Fig. 5) for the transmission path shown in Fig. 3

order that there may be drawn thereupon in colored pencil, F_2-layer contour lines as shown for a given frequency for each of the three zones of the world represented on the world map.

These contour lines are traced or drawn from charts, such as Fig. 4, contained in the CRPL publication for a given month. Several such charts may be constructed, each for a different frequency or a different month, and these charts may be reused by erasing the pencil lines.

The great circle charts are illustrated in the photograph, which shows a representative great circle chart with paths converging at a latitude of 40°, the scale of such charts also being identical with that of the world map. A series of such charts is provided. for latitudes of 0° to 60° at ten degree intervals, and each chart is constructed so that it may be rotated one hundred and eighty degrees, thus to give either one convergence point north of the equator and two south of the equator, or the reverse, for convenience in centering a convergence point at some location on the earth's surface.

Great Circle Paths

The curves shown on each chart represent great circle paths extending from the convergence point every 30 degrees in azimuth from the lines perpendicular to the equator line, these lines representing the North and South great circle paths from the convergence points. With great circle curves at 30° intervals, other great circle paths may be interpolated, when using the proper chart with the world map.

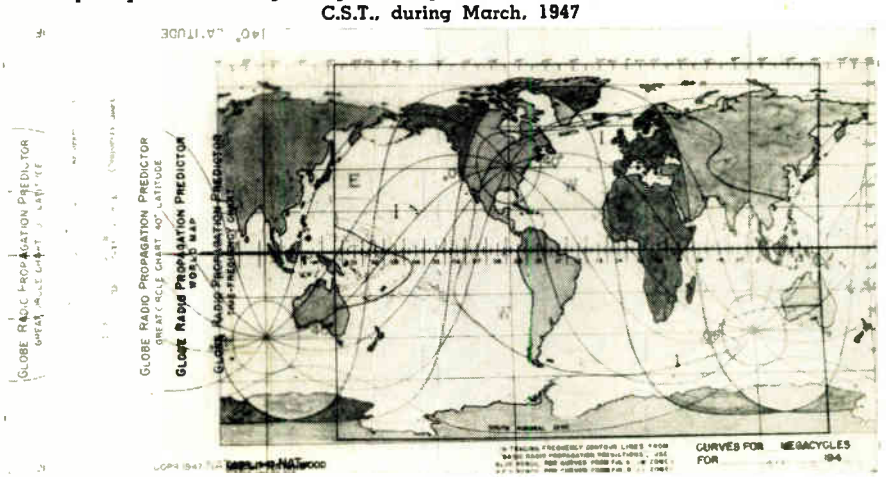
Surrounding each convergence point on each great circle chart is a circular line connecting points 1250 miles distant from the convergence point on all great circle paths, and thus enclosing an area 1250 miles in radius. Because of the projection of the world map used, this area appears egg-shaped, or as a spinning top, with the point toward the equator. It will be recalled that 1250 miles from any location on the earth's surface in any direction is the distance to a control point of the ionosphere, and therefore the circular line surrounding each convergence point represents control points on each great circle path.

In use, the great circle chart for the latitude nearest to that of the location on the earth's surface for which propagation information is desired, is placed under the transparent world map, and moved, with equator lines adjacent, until a convergence point is centered upon the longitude and within 5° in latitude of the selected location. The great circle paths from this location and the azimuthal bearing to all areas of the world may then be determined by inspection, and the control points 1250 miles from this location will be readily apparent upon the world map.

Next, the transparent time-frequency chart, upon which has been traced, from the CRPL publication, F_2-layer contour curves for the desired frequency and for the desired month (with a separate curve in different color for each zone of the world) is placed on top of the world map, retaining the great circle chart in its proper position. As the time-frequency chart is moved to the right and left with its equator line corresponding to that of the world map, changes in time can be read from the time-scale of the time-frequency chart by reference to the central time zone meridian marks on the world map, the mark nearest to the longitude of the selected location on the earth's surface representing local time as read from the time scale.

As the time-frequency chart is moved to the left over the world map with the equator lines of each being kept adjacent to each other, areas enclosed by the frequency contour lines on this chart pass over the world, resembling the

Fig. 7—Photograph of the new prediction device described in the accompanying article, showing the various components and the manner in which the device is used. As here pictured, the device indicates world area coverage by F_2-layer reflected radio waves at a frequency of 30 mc originating from a point near Chicago, at approximately 8:30 am C.S.T., during March, 1947



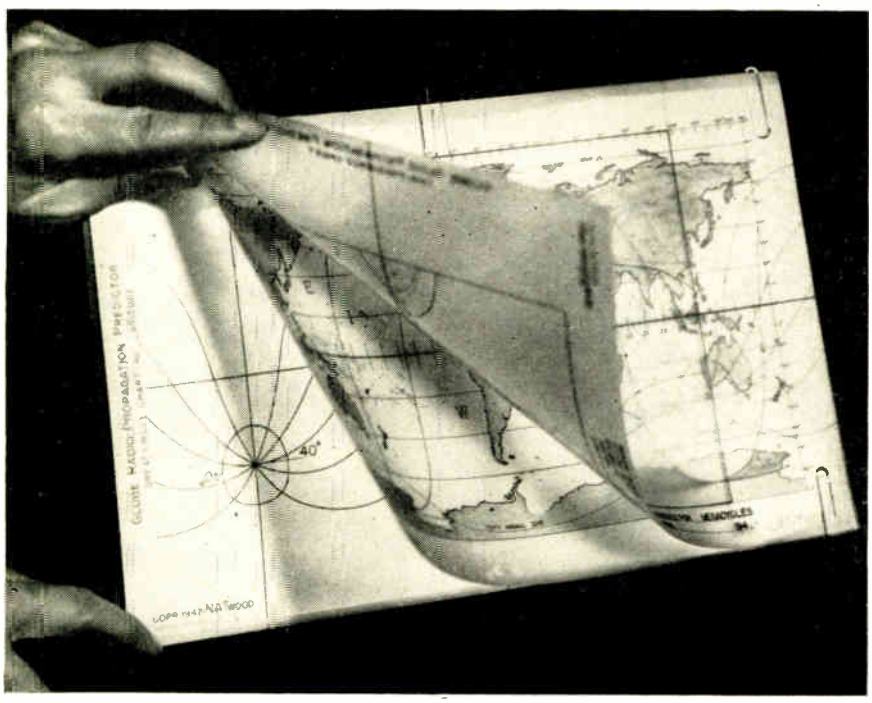


Fig. 8—Photograph showing the manner in which the principal components of the prediction device described in the accompanying article are assembled and used

shadow of a cloud moving from east to west progressively during the hours of a day. Since the cloud represents that portion of the F_2-layer of the ionosphere which will reflect radio waves of the selected frequency, it will be apparent that sky wave reflection will not normally occur until the cloud casts its shadow upon a control point, as indicated by the circular line surrounding the location upon which the convergence point is centered.

Control Points

It will also be apparent that radio waves will travel along only those great circle paths, the control points of which fall under the cloud—and that such waves will travel along those paths only as far as the cloud extends over these paths. Control points beyond the portion of the time-frequency chart enclosed by the frequency contour lines will not reflect radio waves back to any areas on the earth's surface.

In this connection, it should be observed that the areas to which radio waves will be reflected extend 1250 miles *beyond* the frequency contour lines *along great circle paths* and due allowance must be made for the additional world areas thus covered. The additional 1250 miles may be estimated by reference to the 1250-mile area surrounding the convergence point on each great circle chart. By the method and with the device just described, there may be determined at a glance, for any hour of the day, whether there will be sky wave propagation, along what paths such propagation will take place, and in what areas of the world radio waves of the selected frequency thus propagated might be received.

Fig. 7 illustrates the information that can be obtained by a method using a prediction device such as that just described. In this photograph, the great circle chart for a latitude of forty degrees is positioned with one of its convergence points at a longitude of 88° North, thus corresponding (within two degrees of latitude) with the location of Chicago. The time-frequency chart of Fig. 7 shows curves for 30 megacycles for the month of March 1947. The time scale of the time-frequency chart, read in reference to the central time-zone meridian nearest to the longitude of Chicago, i.e., Central Standard Time, indicates time of day as approximately 8:30 a.m.

The contour lines of the time-frequency chart can be seen to encompass all of South America, the eastern half of the South Pacific Ocean, all of the Atlantic Ocean, all of Africa, and most of the European countries, including the Near East countries, but not including Finland. Australia, New Zealand and the Asiatic countries are not encompassed, and therefore contact between Chicago and these countries could not normally have been expected at 8:30 a.m., Chicago time, during March of 1947.

Practical Application

Representative use to which the method and device described above might be placed is found in connection with the problem arising from the assignment of 40mc channels for urban radio telephone service. It is understood that there has already been observed interference between East and West Coast installations, and such interference may again occur, particularly as such installations become more numerous throughout the world.

The method here described will permit a determination of the extent to which such interference might be expected, and could thereby well serve as a guide in the selection and allocation of channels, as well as in the selection of equipment, the design of antennas, the determination of the extent of power to be used, and the establishment of regulations relative to such installations. Other representative uses of this method and device have been mentioned in an earlier part of this paper.

It will be observed that several zones are shown on the world map, and that separate frequency contour lines for each of these zones are drawn upon the time-frequency chart. The extensive observing program of the CRPL has shown that ionospheric data for a given latitude, while generally similar for all longitudes at a given hour of the day for each latitude, does differ sufficiently to necessitate separate curves for this longitude effect, due, it is believed, to the location of the geomagnetic poles of the earth.

As has been pointed out above, the contour lines which are applied to the time-frequency chart by tracing from the CRPL publication

(*Continued on page* 103)

VHF Railroad Trackside Portable

Crystal controlled transmitter and receiver with storage battery operated dynamotor power supply designed for use at 158-161 mc frequency

• The use of radio for railroad communications purposes, expanding at a rapid rate as the utilitarian value of such equipment demonstrates itself, frequently involves the need for means by which "walking" railroad personnel can communicate with train crews. To fill that need Bendix Radio Division, Baltimore, has developed a pack set that contains a number of unusual features and that is rugged enough, though relatively light, to take quite a beating.

Type MRT-2B VHF pack set has a self-contained rechargable power supply in a compact unit to be carried by a shoulder strap so that the metal case hangs on either hip. The retractable vertical rod antenna when fully extended measures 36 in. The equipment is turned "On" when the antenna is completely extended. When not in use, the antenna retracts into the case and the radio set is automatically turned "Off." The antenna when fully extended is a half-wave type at the railroad radio frequencies, namely 158.25 mc to 161.97 mc.

The over all size of the case is 11 9/16 in. high by 9 1/8 in. wide by 4 3/16 in. deep. The weight including power supply and handset is 15 lb. 2 oz. Both the transmitter and receiver are crystal controlled and are especially designed for use with the standard Bendix type MRT-1B VHF two-way train radio units. Both tiny radio sets are built on a single small chassis using 9 miniature type tubes; 3½ tubes are used in the transmitter and the remaining tubes are used in the receiver.

Bendix MRT-2B VHF FM railroad radio pack set provides trackside extension of standard VHF communications for railroad use

The receiver utilizes an especially adapted superheterodyne circuit for maximum sensitivity and gain. The power supply which fits into a compartment in the carrying case as an integral part of the unit and may be easily and quickly removed for recharging, is a completely enclosed bank of miniature non-spillable storage batteries which activate a dynamotor, designed for a 6 volt input and 100 volt output. Filaments operate from a 1½ volt source. The rechargeable, non-spillable, storage battery unit is completely enclosed in a metal box which is ventilated with an external escape vent so that no fumes accumulate within the enclosed case.

The folding hand-set may be tucked away in a compartment without danger of injury when the pack-set is carried in normal railroad use. The transmitter is activated by a push-to-talk button on the earphone and the circuit is so designed that filaments of the receiver are not in use when the transmitter is in operation and vice-versa thus saving at all times on current consumption providing a more economical use of the portable power supply.

Each pack set may be provided with *two* power supply units so that when the pack set is returned to the caboose, for instance, after having been in prolonged trackside operation, the miniature power

(*Continued on page* 112)

Color Television for Theatres

By H. G. SHEA, Contributing Editor, Tele-Tech

High illumination (8–10 foot-lamberts) and good color balance and resolution obtained electronically on a screen 7½ by 10 ft in size

Operating at 70 kv accelerating potential, three cathode ray tubes in a large metal housing as shown in the artist's drawing reproduced here are caused to project their images in registration on a screen distant about 35 ft. giving all-electronic color pictures which compare favorably with early color film movies. This development of the Radio Corporation of America shown recently at the Franklin Institute in Philadelphia depends on the same technic which had been revealed earlier during hearings on color television before the Federal Communications Commission. However in the latter case the screen size (15x20 in.) of course, was only suited for use in a large room.

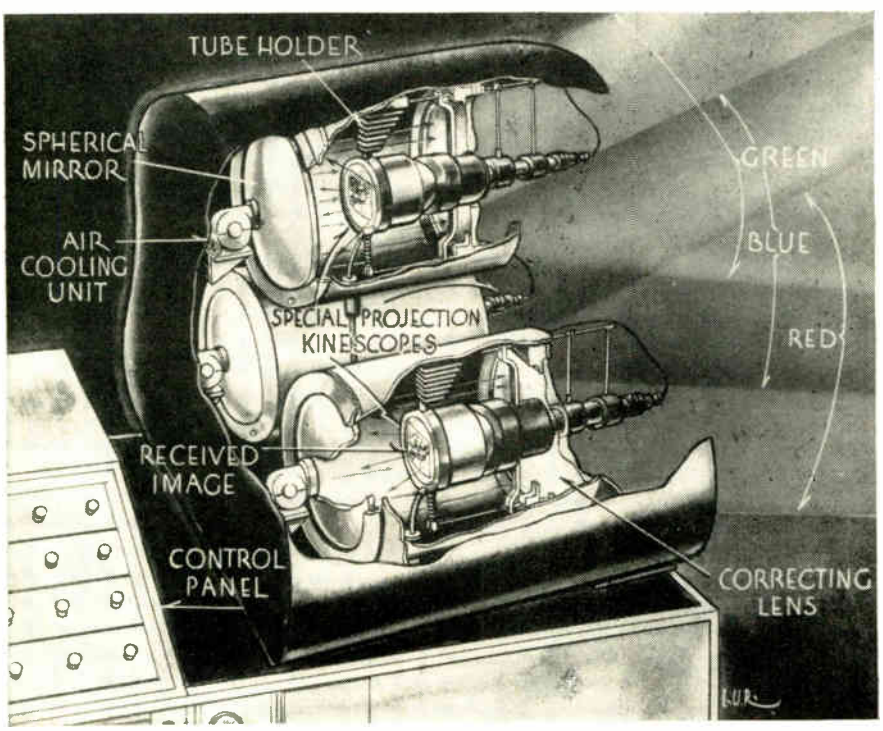
The larger increase in light necessary to illuminate the theatre size screen has been obtained by increasing the cathode ray tube operating potential and of course by using the latest aluminum backing for the phosphorescent materials in the tube faces. In addition the colors, red, blue and green projected, respectively, from the three tubes, are not derived by the use of light reducing filters, but instead from special color emitting phosphors in the cathode ray tubes themselves.

In this connection it has been stated by Dr. Zworykin that the efficiency of the red emitting phosphor as at present developed is lower than that of the green and blue emitting phosphors. As a consequence a good deal of forcing is necessary in the entire channel transmitting the red image to get the illumination up to the level of that of the other two channels. This is evidenced in the final result by the presence of considerable "noise" visible in the pure red portion of a projected image. This "noise" gives a speckled effect which is not particularly obtrusive, however, unless the image is studied closely.

It will be remembered* that the system used to transmit color electronically is to pass the light from a scanned raster on a cathode ray tube face through a film or slide to be viewed and then via a lens system through a pair of dichrois reflectors set at an angle of 45°. One of these passes the green and blue colors and reflects the red to a photocell. The second passes the green color to a second photocell and reflects the blue color to a third photocell. Each photocell modulates a separate television channel. The three channels terminate finally in the three-color projection cathode ray tubes.

The flying spot method of scanning the film or slide is not adapted to outdoor pickups. Dr. Engstrom stated, however, that the RCA had in mind developments which would permit such pick-up. It was emphasized throughout the demonstration that the equipment was not yet in final

Cut-away drawing showing principal components and functions of new type receiver-projector with which theatre screen TV color pictures are projected



*RCA reveals first electronic color TV-Electronic Industries, Dec. 1946, pp 58-59.

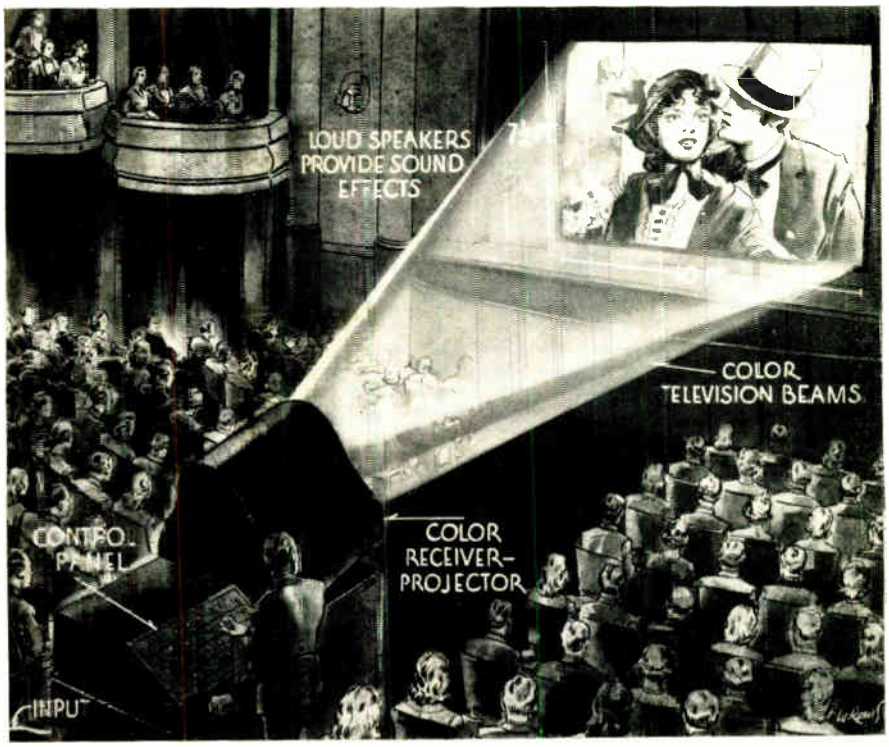
form and that more development work would have to be done before it could be merchandized.

One of the important questions much in the minds of the audience was the nature of the commercial application which could be made of this new art of theatre television, be it black and white or color. David Sarnoff, President of the RCA pointed out that this could not be foretold with exactitude at present. He stated that it was a new form of art which might have to develop its own technics. He visualized possible injection of events of national importance by theatre television into straight entertainment programs in movie houses.

This, he said, might induce customers to go to the movies when otherwise they might wish to stay at home to hear an important address. Sarnoff further stated that it was not the movie industry but the electrical laboratories that had developed sound on film, now considered indispensable by the theatres. In the same way theatre television might become indispensable, he said.

Dr. Zworykin pointed out that in using the flying spot scanning system it was necessary to use a tube with a very small spot, great spot brilliance and very short persistence of the luminescence excited by the beam on the fluorescent screen. While in a kinescope persistence of the light for up to 1/30 second only serves to minimize vestiges of flicker, in the flying spot tube a continuation of the light emission for as much as a microsecond gives rise to reduced resolution in the transmitted picture.

The method of forming the aluminum backing for the face of the projection tubes is to deposit a thin cellulose blanket over the phosphor. Aluminum is then evaporated over it to the thickness of about a hundred-thousandth of an inch. When the tube is baked, the cellulose is disintegrated, leaving the aluminum file which, retaining its flat surface is transparent to high velocity electrons but opaque to light. Accordingly, light emitted backward by the phosphor is reflected forward. The gain obtained by this film depends on the operating voltage. An important property of the metal backed screen is that it remains at anode potential and image shifts due to the charging up of the screen are avoided. This feature is of tremendous importance in the proper registration of the images on the screen.

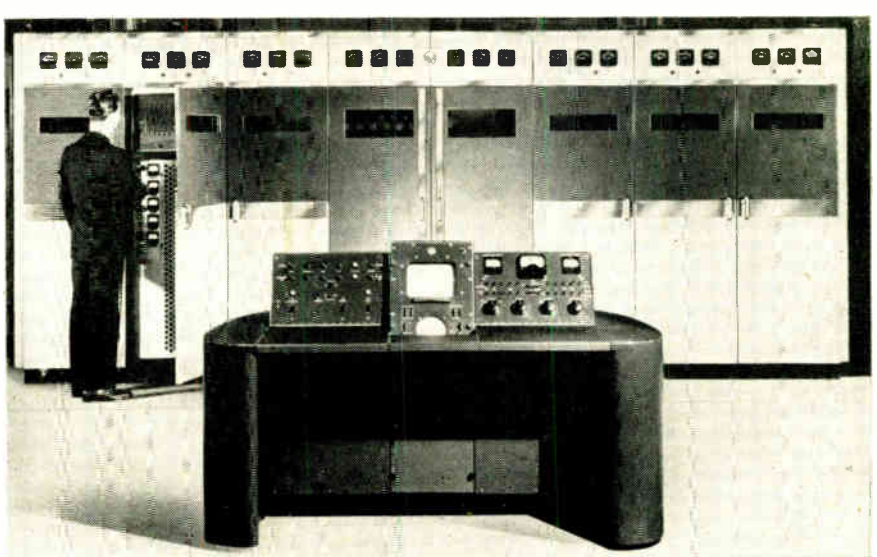


Artist's conception of experimental color television receiver-projector for theater use, latest advance in RCA's all-electronic color TV system

The production of this theatre size television system resulted from the combined efforts of many men, and acknowledgments are due to R. D. Kell and his associates, G. C. Sziklai. A. C. Schroeder and K. R. Wendt for the principles used and the development of the flying spot pick-up; to D. W. Epstein for the projection receiver; to F. H. Nicoll for the special projection kinescopes; to Joseph Ford and R. H. Marple for drafting and model shop work respectively.

First Postwar Television Transmitter

TV station WNBW, Washington, D. C. has this new RCA 5 kw television transmitter. Type TT5A operates on all 12 channels, will function on channel 4 for WNBW. Transmitter measures 17x3x7 ft. not including control console and monitor in front



Acoustical Design of Studios for

By CLARENCE R. JACOBS, Studio Consultant, Scarsdale, N. Y.

Design and construction of a modern studio to meet acoustical demands for both AM and FM transmission. New York WNEW studio meets problems

• What is a good studio? The answers to this oft-repeated question may be as varied as those who reply, whether they be musicians, engineers or average listeners. An exact and concise definition is difficult to write due to complex subjective opinions and a scarcity of adequately descriptive words.

Despite these obstacles the writer has the temerity to venture a description—rather than a definition, as follows: A good studio must sound "clean"; it must impart to the radio listener the sensation of being present at the broadcast; it should permit the producer to transmit to the listener that character which he contributes to the production; microphone placement should not be critical; the studio should be easy to work in—natural, not artificial.

Studios should be designed to be as acoustically perfect as is possible whether for AM or FM. This is the reply, inadequate perhaps given to those who ask, "How are you designing studios for FM? The acoustical engineer cannot do justice to his assignment if he designs only to that portion of the frequency range for which published data are available. FM calls for a broadcast range of from 50 to 15,000 cycles. Although the FCC has no specific requirements relative to the acoustical treatment of studios, some sincere effort must be made to extend the range of calculation beyond the former limits of 128 to 4096 cycles.

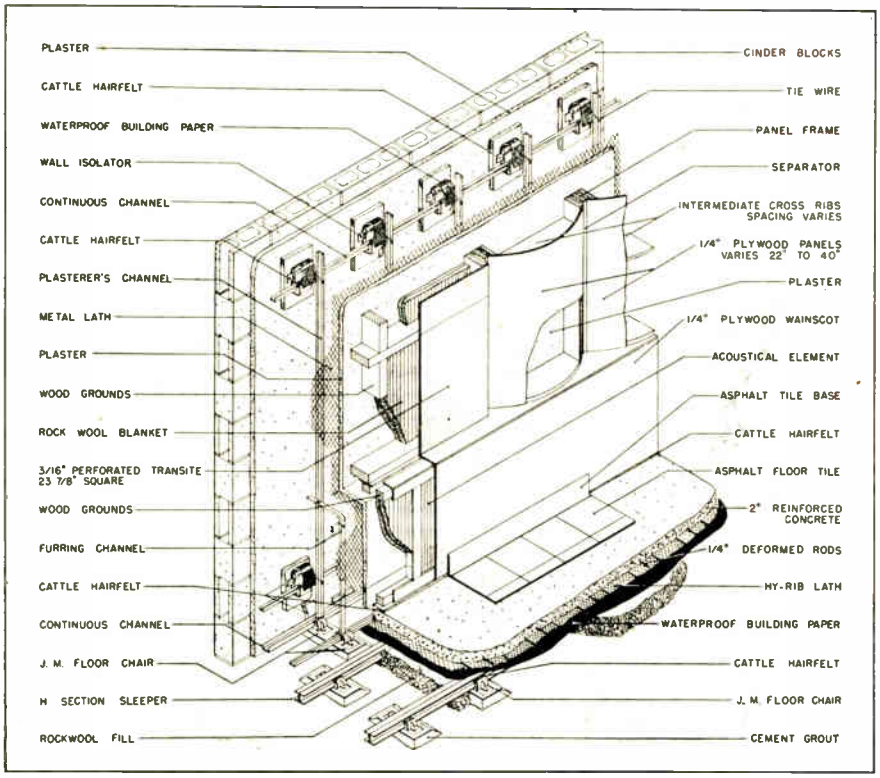
In planning the plant for the average radio station, it usually is found that four or more studios will be required: A main studio for the larger programs, usually including a participating audience; two studios of similar size for dramatic productions, and a smaller studio which is used for speech. The latter generally is used for spot announcements, station identification and news.

The development of the plan requires first, establishing the studio sizes. The proportions should be determined by following the rule of cube-root-of-two, as it is the trade concensus that these proportions are somewhat superior to the proportions of 2:3:5 formerly used.

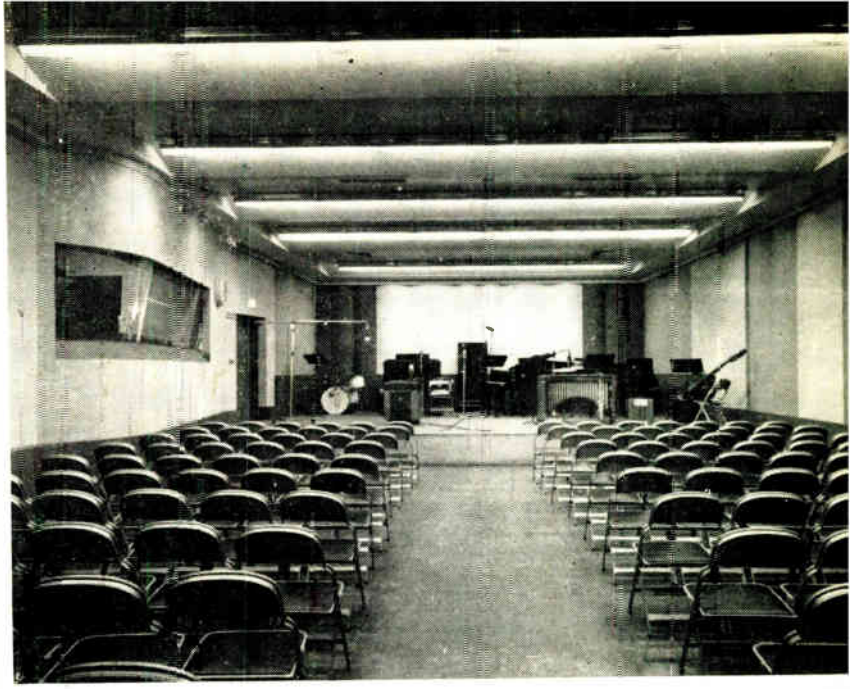
The control room for the studios preferably should be the same length, width and height. The acoustical conditions should approach the characteristics of the average living-room where programs eventually are heard.

WNEW studios, as is often the case with many new stations, were constructed in an existing building. This always presents many problems and certain deviations from the theoretical ideal may be necessary because of space limitations. Even with the many limitations imposed by an existing structure, a good plan still can evolve when owner, architect and acoustical engineer work as a team. These

Construction details of section through studio wall (courtesy Fellheimer and Wagner, architects)



AM and FM



Orchestral performers report new WNEW studios are easy to "work" in; sound "lively"

studios have worked out well from both an acoustical and functional point of view.

Involved in the studio design are lighting, air-conditioning, isolation, acoustical treatment and decoration. The lighting should be installed for uniform 98% visibility, as the most critical seeing task is reading script. The air-conditioning system was designed so as not to contribute to background noise level. This called for acoustically lined ducts, canvas connections between ducts and grills and a remote location for the equipment.

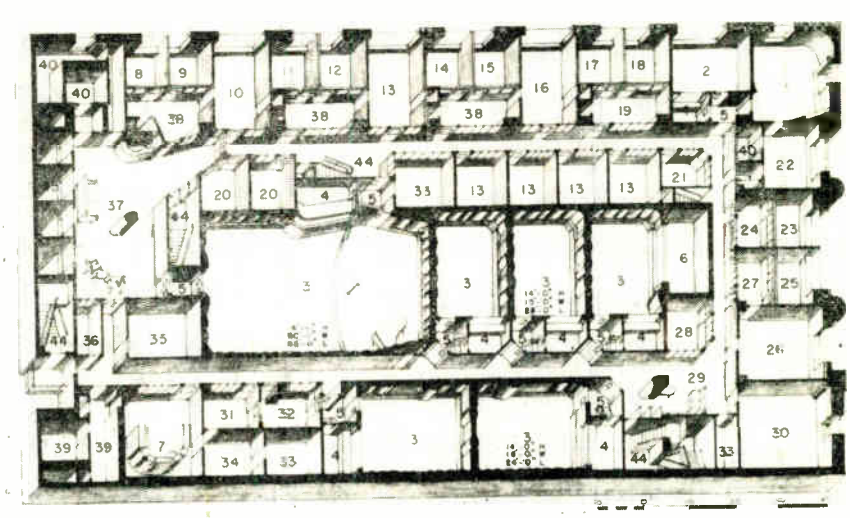
The method of isolation used is illustrated. The floor construction consists of a 2 in. thick reinforced concrete slab on "H" sections which were spaced 23 in. on centers. The "H" sections are supported by felt-lined steel clips manufactured by Johns-Manville. An additional thickness of hairfelt was inserted in these clips further to increase the sound isolation value at the lower frequencies. It is rather simple to control the transmission of sound at the higher frequencies; so attention is directed to attain the highest attenuation at the lower frequencies.

The wall construction consists of a metal lath and plaster diaphragm supported by a series of furring channels; these are supported in a channel resting in felt-lined clips spaced on such centers as to result in the highest degree of isolation at the lower frequencies. This diaphragm is supported from the wall by additional felt-lined isolators which are fastened by means of toggle bolts through pads of cattle hairfelt for low-frequency attenuation. The ceilings are also supported in felt-lined clips spaced on such centers as to be properly loaded for highest efficiency. The isolators in this case were spaced 24 x 48 in. on centers.

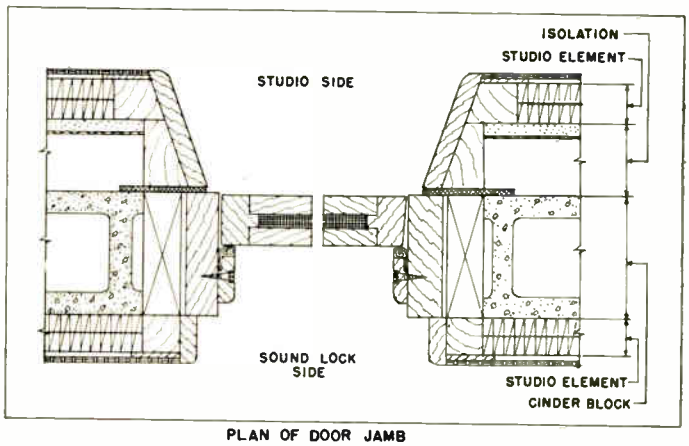
The windows between control rooms and studios are double-glazed with ¼ in. and ½ in. thickness of polished plate glass. This glass is spaced approximately 4 in. and portions of the jam, head and sill of the windows between the double glass were covered with wool felt to absorb sound transmitted to the air space between the two plates of glass. The plates themselves were set in wool felt rather than putty to hold resonance effects to a minimum.

The method of isolation used at the doors is illustrated. It should be remembered that the degree of isolation obtainable is dependent to a large degree upon the care exercised during the installation. Carelessness during the construc-

Isometric drawing of WNEW studio layout. (1) General Manager; (2) auditions, speakers; (3) studio; (4) control room; (5) sound lock; (6) organ chamber; (7) master control (note rack and panel arrangement); (8) purchasing; (9) publicity; (10) publicity chief; (11) chief engineer; (12) announcer; (13) sales; (14) program and traffic; (15) commercial traffic; (16) sales direction; (17) research chief; (18) promotion chief; (19) research and sales promotion; (20) program; (21) copywriters; (22) secretary to manager; (23) copy chief; (24) copy; (25) production chief and traffic; (26) program director; (27) program secretary; (28) production; (29) talent lounge; (30) record library; (31) announcers; (32) teletype; (33) storage; (34) shop; (35) mail and supplies; (36) switchboard; (37) lobby; (38) secretary; (39 and 40) restrooms. (Courtesy Fellheimer and Wagner, architects)



Speech studio design keynotes comfortable living-room motif for psychological effect



Construction details of door jamb between studio and sound lock

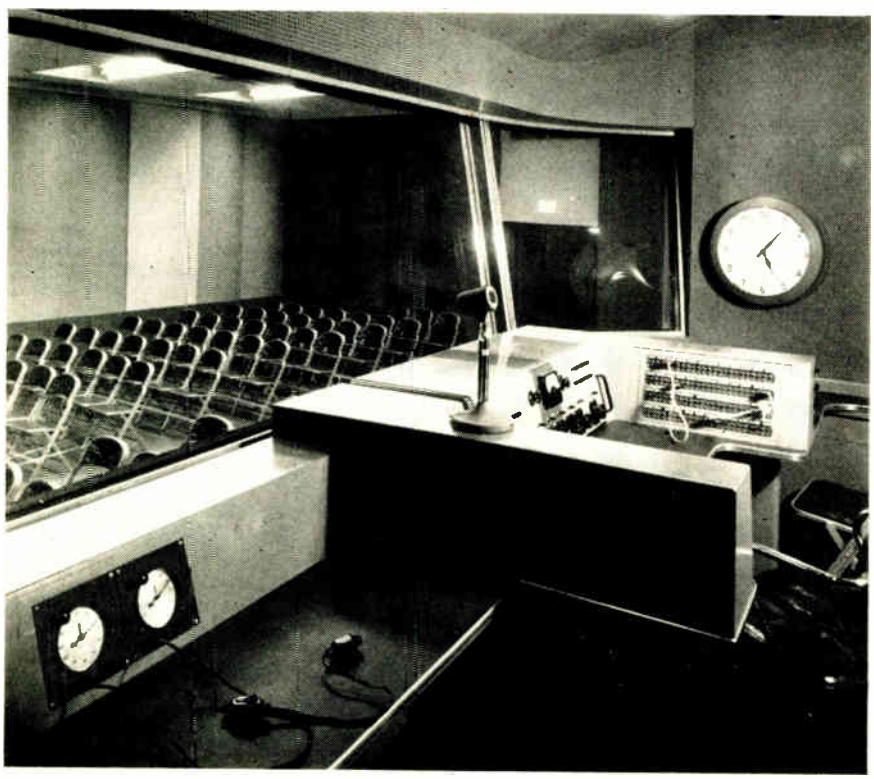
PLAN OF DOOR JAMB

tion resulting in contacts between the floating membranes will, of course, result in inefficient isolation. Both supply and return ventilating ducts were lined their full length with a 1-in. water-repellent rigid rockwool material. It is inadequate to line only the return air ducts, for sound travels at a rate so much faster than air that there is no apparent difference between transmission through an unlined duct whether it be supply or return. Canvas connections installed between the metal ducts and the grills which were fastened to the floating wall and ceiling treatments.

In selecting acoustical materials and constructions, consideration was given to the characteristics of the materials over a frequency range of 60 cycles to 6000 cycles. No longer can material acoustics be considered at only 512 cycles as in the early broadcasting period when measurements were made by blowing a calibrated pitch-pipe and clocking the length of time (by means of a stop-watch) for the sound to decay to inaudibility.

The cost of the material and the possibility of decoration and redecoration without physically changing its absorbing characteristic, were examined. Available stock sizes were determined. The material had to withstand the abuse of continual use and had to meet the requirements of the Department of Buildings and Housing of the City of New York.

When the reverberation times for each studio were determined, the required amount of absorption and the quantities of each acoustical material were arrived at by the usual process*.



Typical studio control booth. Note novel stop-watch with inverse numbering to save production engineers a mental operation in figuring "seconds to go"

Materials Selected

The materials or constructions selected were: (A) a treatment consisting of 2 in. of rigid rockwool covered with a protecting membrane of 3/16 in. perforated asbestos board; (B), the (A) construction without the element; (C), a low-frequency diaphragmatic type of element covered with a protecting membrane of perforated asbestos board; (D), the (C) construction without the element; (E) a treatment consisting of a triple-tuned element covered with perforated asbestos board; (F) cylindrical panels of ¼ in. plywood; and (G) ¼ in. plywood backed by 2 in. thick rockwool blankets. Splayed and curved plaster surfaces were used to tie the overall design together. The materials and construction members have a variety of absorbing characteristics as shown in the Table of Calculations.

In calculating the reverberation times at the higher frequencies, due consideration was given to atmospheric absorption. Flat plywood surfaces with the rockwool

*Tele-Tech, March and April 1947.

backing have a high degree of low-frequency absorption and were used for the wainscot areas to absorb noise from the shuffle of feet. Curved surfaces were distributed over the wall and ceiling areas with due regard for acoustical design and decorating requirements. The high absorbing materials were distributed in a so-called "checker-board" fashion, that is, various treatments in small patches, rather than a large patch of one treatment on one wall, and different treatments on other surfaces.

Distribution of Treatments

The distribution of the treatments is all-important, for even though the calculations may show an "ideal" reverberation time over the entire frequency range, the location or placement of the materials will determine the smoothness of the decay curves. When used near the microphone pickup area, a curved surface in a horizontal plane can result in a condition which makes the pickup critical. Because of this, curved surfaces were mounted on the wall areas with a vertical axis.

TABLE OF CALCULATIONS

Constants: Volume = 5800 cu. ft., Surface Area = 2000 sq. ft., .049 v = 284.2

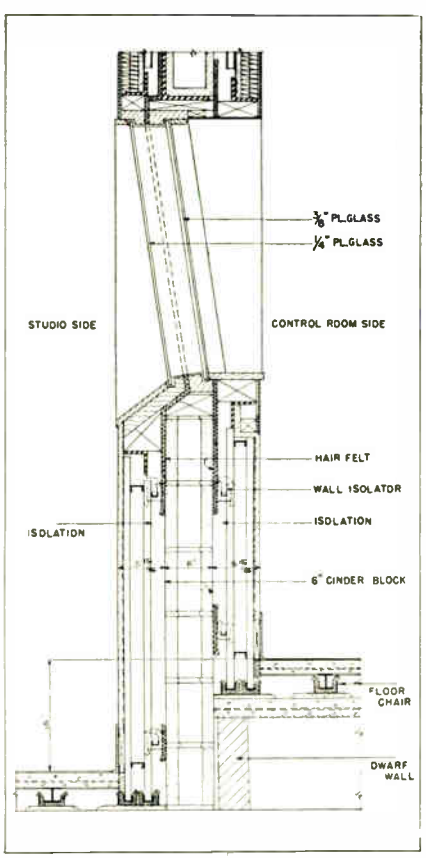
Calculations based on unoccupied studio

Frequency in c.p.s.	60	128	256	512	1024	2048	4096	6000
Absorption coefficient of A:	.30	.40	.55	.66	.78	.72	.53	.35
Absorption coefficient of B:	.03	.05	.11	.14	.33	.17	.15	.10
Absorption coefficient of C:	.40	.66	.60	.50	.50	.35	.20	.20
Absorption coefficient of D:	.03	.04	.10	.28	.23	.19	.20	.13
Absorption coefficient of E:	.50	.66	.61	.80	.74	.79	.75	.60
Absorption coefficient of F:	.25	.20	.25	.15	.10	.05	.05	.05
Absorption coefficient of G:	.65	.65	.40	.25	.10	.05	.05	.05
Absorption of 236 sq.ft. of A	71	94	130	156	184	170	125	83
Absorption of 12 sq.ft of B	1	1	1	2	4	2	2	1
Absorption of 188 sq.ft of C	75	124	113	94	94	66	38	38
Absorption of 24 sq.ft. of D	1	1	2	7	5	3	5	3
Absorption of 130 sq.ft. of E	65	86	79	104	96	102	98	78
Absorption of 250 sq.ft. of F (random ribbed convex panels)	63	48	58	43	23	15	15	15
Absorption of 147 sq.ft. of G (¼" rockwool backed plywood)	90	94	57	34	18	14	14	14
Absorption of 432 sq.ft. floor	26	22	17	13	13	13	13	13
Absorption of 558 sq.ft. plaster, glass and misc.	50	41	28	22	16	16	16	16
Total absorption of studio	442	511	485	475	453	401	328	261
Average absorption/sq. ft.	.221	.255	.242	.237	.226	.200	.164	.130
Corrected averages/sq. ft.	.251	.293	.277	.271	.256	.225	.182	.142
Total absorption	502	586	554	542	502	450	364	284
Add for air absorption	..	..	..	..	..	9	41	71
Total corrected absorption of empty studio	502	586	554	542	502	459	405	355
Calculated time in seconds	.56	.48	.52	.52	.56	.61	.69	.79
or	.6	.5	.5	.5	.6	.6	.7	.8

Various charts have been published indicating optimum reverberation times for studios of volumes from 1000 to 1,000,000 cu. ft. These charts invariably cover the frequency range of 50 to 10,000 cycles. The author has made his calculations from 60 cycles to and including 6000 cycles for at least ten years.

The difference between calculation and measurement at 60 cycles and 6000 cycles is, as expected, greater than that at the customarily used six frequencies. However, experience indicates these calculations over a wider range are most valuable. They permit plotting calculated reverberation times over a greater part of the frequency range, thus present more complete data for study and analysis.

The reverberation time of a studio, of course, is the length of time required for a sound to decrease along any simple or complicated decay curve to one millionth of its initial intensity or 60 db. This dimension is important, but not to the extent that the character of the decay curves should be neglected. Experience indicates that the character of the decay curve determines the utility of the en-



Constructional details of section through control room window

Polycylindrical surfaces of plywood diffuse impinging sound rays; reduce "roomy" effects

closure. One hears the expression that a studio is difficult to "work in, that it is "muddy", or that microphone placement is critical. The decay curves in these instances invariably are irregular and follow a complicated pattern.

The decay curve is determined primarily by the location of the various acoustical and constructional materials used in the design The photos indicate the author's use of absorbing elements of varying degrees of acoustic absorptivity. No large area of any one type of material is used, but rather a series, in this case five, of materials located in conjunction with serrated and curved plywood and plaster areas. Experience dictates the design and the location of the materials. This design must be flexible to allow the designer to apply variegated color patterns.

Much work remains to be done in connection with the behavior of the various acoustical materials especially at the lower frequencies. Undoubtedly, the absorption coefficients are not available because the technic of measuring these behaviors has not been sufficiently developed. It is hoped that laboratories will now have time to engage in research and make such data available.

WNEW Program Dispatching System

By JOEL PETERSON, Associate Editor, Tele-Tech

Master control console designed for handling ten channels will accommodate seven studios and three remote channels simultaneously

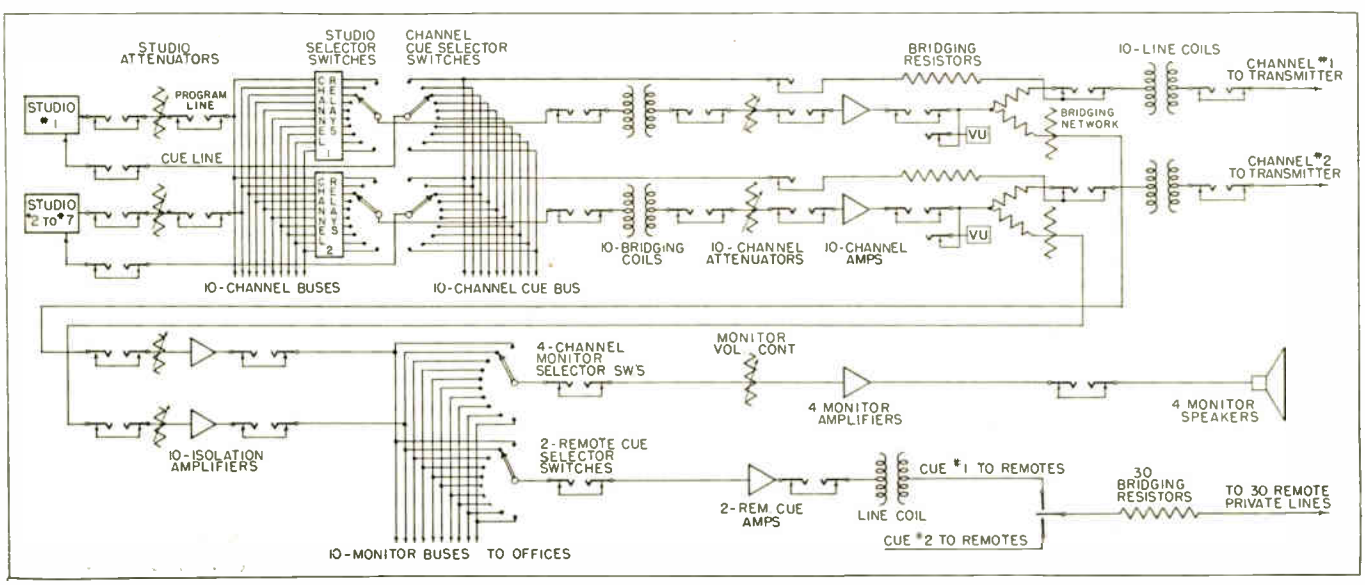
• Opening of the new WNEW studios in New York revealed some recent innovations in broadcast station programming equipment. The main feature is the manner in which the master control console has been designed for flexibility in handling multiple programs and routine audition services. This console has ten channels and accommodates seven studios leaving three lines for remotes.

With this new program dispatching system, WNEW can now handle almost any program arrangement that may arise as well as providing service to the program director, sales department and others for auditioning and recording purposes.

Ten RCA type BA-3A program amplifiers are used. Chief engineer M. J. Weiner directed a series of tests on these amplifiers and reported the average results as follows: gain, 64 db; noise —80 db; distortion, largest amount at 40 cycles equal to 0.46% with an output level of +18 db; frequency characteristic, greatest deviation was —0.9 db at 17,000 cps, but averaged ±0.2 db over most of the audio range with 1.000 cycies as a reference point.

One-hundred safety contact Clare relays are used for program.

Simplified schematic of WNEW's main channel, feedback and monitor circuits



interlock and holding circuits. Relay coils are energized from a 12-volt selenium rectifier using saturable core reactors for regulation. Two interlock circuits are wired through each relay. The first precludes any two studios being on the air simultaneously; the second insures that no feedback goes to the originating studio.

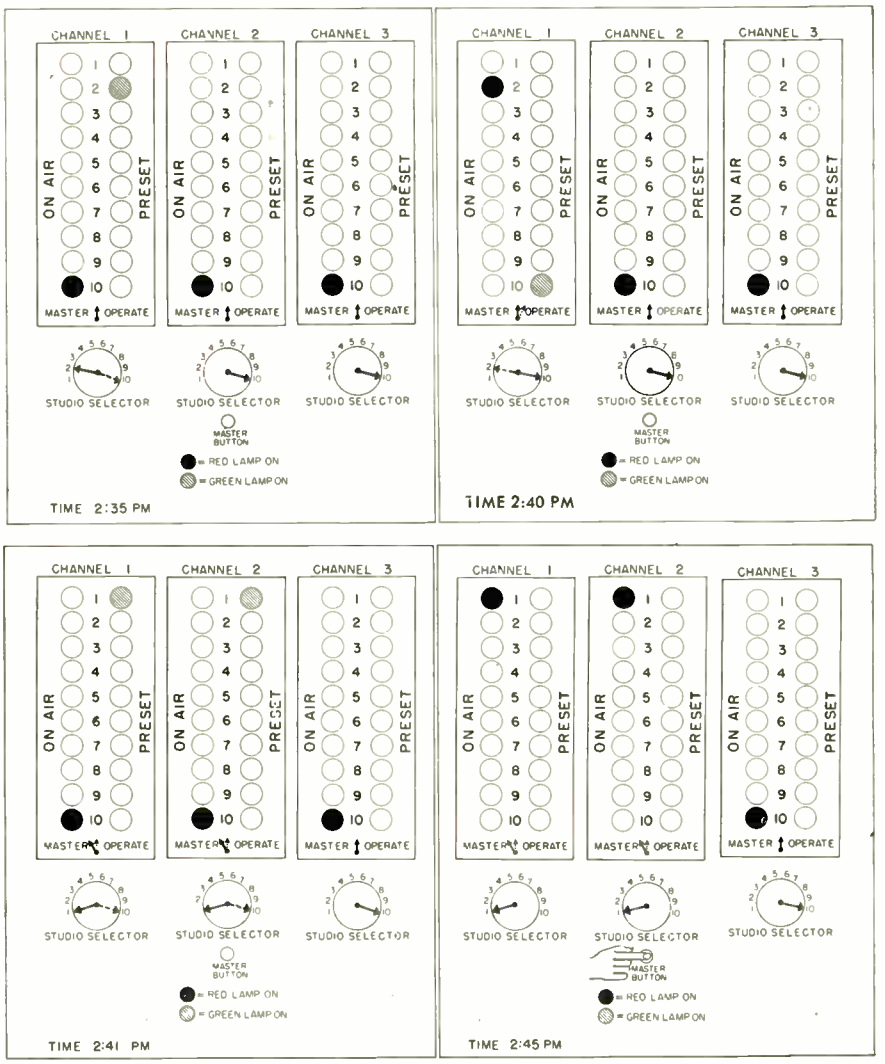
The three-deck studio and channel selector switches were specially designed for WNEW by Daven. The program circuits are on one deck, effectively isolated from the other two decks which contain the lamp, interlock and holding circuits. Ten balanced-H type channel attenuators feed into individual bridging coils transforming the impedance from 20,000 to 600 ohms.

George Scriven, studio engineer, described the flexibility of the new console using as an illustration the following program problem. A remote program covering important tennis matches is fed to the transmitter, the network, and the recording room over channels 1, 2 and 3 respectively. The time of day is 2:35 p.m., and the following conditions must be met: at 2:40 p.m., an important one-minute news flash must be broadcast over WNEW from local studio No. 2, following which the tennis matches are resumed from the remote point. The tennis match description to the network and the recording room is to continue uninterrupted in the meantime. The various panel setups are shown.

Alerted for the local news flash at 2:40 p.m., the control operator presets the channel No. 1 selector switch to the No. 2 position signifying that the announcement will be made from studio No. 2. At 2:40 the operator throws the channel No. 1 MASTER OPERATE key to the OPERATE position (OPERATE position is a momentary contact; MASTER position, a snap contact). Studio No. 2 is now on the air and the announcer is making the local news flash over the WNEW transmitter. The network and the recording room still receive a play-by-play description of the tennis matches.

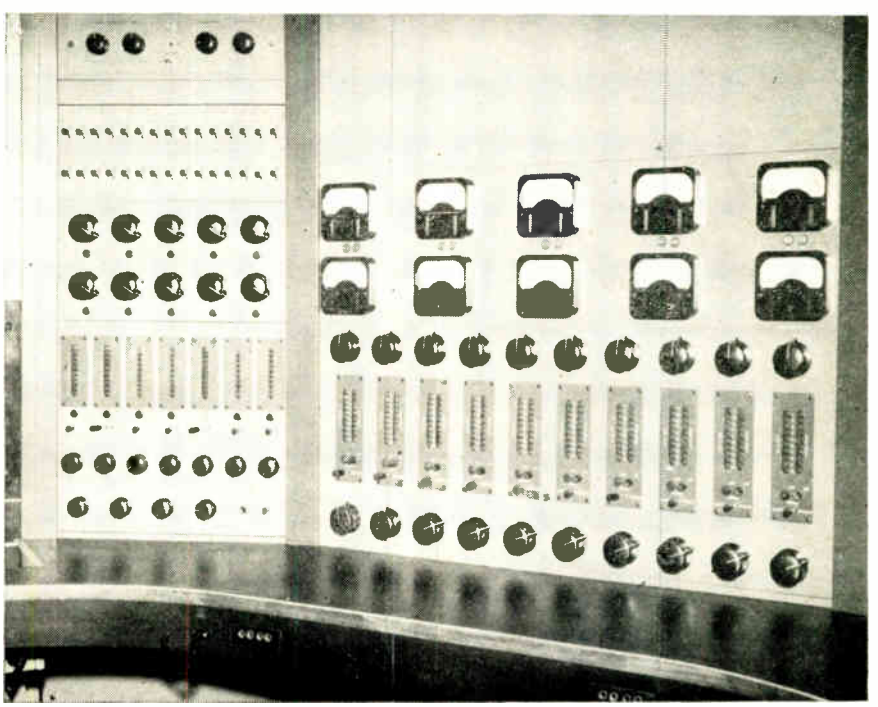
During the interval when the one-minute news bulletins is being

(*Continued on page* 109)



Various panel set-ups illustrates how control operator solves special program problem

WNEW master control board illustrating switch and signal panels for ten independent amplifier channels



Trends in Development of Parts and Components

By CHESTER I. SOUCY,
Consulting Engineer, Toronto, Canada

Experience in military equipment shows up deficiencies and indicates nature of improvements that are imperative—Part I

• Those who were concerned during the recent war with the design and operational performance of military electronic equipment may well be conscious that its generally fine performance often fell short of the desired goals. Engineers who, in addition to such equipment familiarity, were acquainted with the great cooperative effort made by the services and industry to perfect component designs, and to ensure uniform quality in the product through previously unknown detailed requirements in manufacturing and test specifications, may realize that the optimum in performance characteristics has not even yet been achieved. It is proposed to examine some of the shortcomings of the present "improved" components and also to indicate in some cases probable trends of component development to meet anticipated equipment development trends in both the commercial and military fields.

THE urgency and stringency of the requirements for electronic equipment set by the Armed Services during the recent global warfare necessitated rapid progress in the improvement of electronic components. It also led to the development of a number of radically new types of components and electron tubes. In addition to the continuing future military requirements for such components there will be an increasing demand for them in commercial equipment as designers become more widely acquainted with the improved products now available.

Basic Trends

It is obvious that past trends toward miniaturization will be continued to a greater extent. This is due to the general shift to the use of higher frequencies and to the wide application of electronic equipment in compact designs for airborne and other mobile uses. Increased stability of electrical characteristics over a wide range of temperature, humidity, vibration, and shock will be sought for. Independence of altitude and humidity will lead to further application of sealing and pressurization technics of equipment and components. The upward shift of frequencies will lead to still more ways of minimizing undesired capacitance or inductance; and applications of pulse technics will require further advance in the design of components intended for such special service.

Some of the deficiencies of the present components as judged by present equipment requirements are presented here. In addition, new equipment designs of the future that have become possible through the use of the many radical component and tube developments now available will create additional requirements for their components and thus necessitate further developments beyond those discussed here.

Due to the wide range of components considered, it will be possible to refer to only a few of the major improvements now urgently needed. It is hoped that recognition of the present shortcomings in components and their basic materials will stimulate and hasten further development. Many such projects are already under way in commercial and Service laboratories. Cooperative effort of industry and government or Armed Services organizations may be necessary to furnish other essential developments. In this regard, attention is drawn to the wider extent to which research and development of industry-wide interest is encouraged in England through the cooperative effort of manufacturers' trade technical associations.

Conditions of Use

The use of components in equipment housed in heated buildings does not impose severe requirements as to temperature range and humidity. However, commercial requirements for airborne electronic equipment will equal in some respects those recently set up for military equipment. Furthermore, future developments in high-altitude supersonic-speed aircraft and guided missiles are likely to impose still stiffer requirements with respect to temperature and altitude variations, vibration and shock. The increased export of equipment to tropical countries is occasioning an increased commercial interest in designs suitable for resisting heat, humidity, and marine exposure.

The world record of shade temperature is 135°F (57.2°C) found at Aswan, Egypt, but very few places in the world experience temperatures in excess of 120°F, and then only for short periods. Equipment exposed directly to the sun may reach temperatures of 65° to 85°C (149° to 185°F). Also equipment enclosures may cause increases of 20° to 30°C (68°to 86°F) above the ambient shade temperatures, and heat-dissipating elements within sets may cause average temperature rises of a similar amount (or even much more) in the electronic equipment itself.

Operating Temperatures

The present upper limit of operating temperature for the highest grade of components, namely 100°C is adequate for most, but not all, possible conditions of use. (It may be noted that very few prewar components were suitable for operation at temperatures as high as even 55°C (131°F).) For components located in the engine compartments of aircraft still higher ambient temperatures of 125°C (257°F) must be considered; while temperatures as high as 300°C from flue gases will be encountered by electrical cables that must be exposed to such heat on smoke stacks or masts of ships.

For the temperate zone, ground temperatures of –40°F (–40°C) generally are not exceeded. In Arctic regions –85°F (–65°C) may be attained, as in Siberia. A fact that is not well known is that at the poles the lowest temperature at altitudes reached by aircraft is –43°C (–45°F in winter), whereas over the tropics the average temperature falls to a minimum of about –73°C (–99°F) at the tropopause level which is about 55,000 ft. at the equator.

Humidity values up to saturation and condensation conditions in combination with medium high temperatures, dust, fungus, and salt-spray are among the most difficult conditions to meet in the operation and storage of electronic equipment. Space does not permit an adequate consideration of vibration and shock requirements except to point out that values approaching to the 20,000-g acceleration volues imposed upon proximity fuse tubes and components may be required for high-speed aircraft and guided missiles of the future.

Future Materials

Despite important advances that have been made recently in electrical insulating materials, the greatest need of the electronics industry is for a versatile new material of low cost having the required combination of electrical and mechanical properties. Many

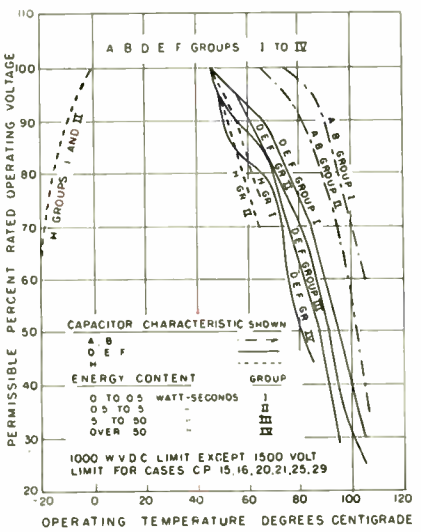


Fig. 1—Voltage deratings versus temperature for various paper dielectric capacitors (per specification JAN-C-25) indicate the need for new designs for high-temperature use.

excellent insulating and dielectric materials have been produced recently of both plastic and ceramic types, but none is free from limitations which restrict its range of usefulness or which render it difficult or expensive to use.

Insulation Shortcomings

Both rigid and flexible forms of the perfected insulation desired will be required. It seems inevitable, with such a large and definite need indicated, that some patient investigator will produce a more versatile general material. The perfect solid insulation should have the low power factor and low loss factor over a wide frequency band (10 cycles to say 30,000 mc) of polystyrene and polyethylene, a low value of permittivity (dielectric constant); and these properties should be little affected by temperature variations in the range of –60°C to +100°C

Low temperature coefficients of permitivity (a factor too little recognized at present) and of linear thermal expansion are necessary, and the material must be stable dimensionally, free from cold flow and thermal distortion and from non-cyclic variations with temperature.

The perfect insulation must be suitable for use at higher temperatures than many present materials in wide use, say at least to 125°C, without suffering any impairment of its main properties, and should permit the use of a soldering iron on terminals. While furnishing the permanence of ceramics, it should have the machinability of plastics such as bakelite, and the capability of being molded or extruded would be desirable. High insulation resistance and low moisture absorption and moisture vapor transmission equal to polystryene are needed, as well as a non-hygroscopic, non-wetting surface. In addition to high voltage-breakdown strength and non-arcing qualities, there should be no conducting ash on electrical breakdown.

Some interesting approaches toward this ideal are now being investigated in silicone resins and elastomers[1], in complex polystyrene-base compounds[2], and new plastics such as polytetrafluorethylene (G.E.Co's "Teflon")[3]. Further advances in coating materials to replace enamel on copper wires can be expected. Silicones and ceramic materials (such as Sprague's "Ceroc") allow the use of much higher coil operating temperatures. The results of wartime research lead to the expectation that ceramic dielectric materials of high dielectric constant will find extensive commercial applications and lead to more compact designs in capacitors for given voltage ratings as well as reduced HF losses.

The present notable advances in magnetic materials including permanent magnet steels, magnetic paper tape, and permalloy tape, and the utilization of these and further developments yet to come will be evidenced in high-quality, high - efficiency loud - speakers (such as the FM receiver market will require), in compact sound re-

corder-reproducers, and in wide-band pulse, audio, video, transformers and non-linear coils.[4,5]

In the design of better components we have progressed not only in the products themselves but also in the thoroughness of our knowledge of their characteristics as affected by conditions of usage. Accordingly, our testing technics and adequacy of specifying and standardizing requirements has advanced. The fact that the optimum of performance characteristics has not yet been attained will be illustrated by a few examples. In many cases the necessary developments to attain the desired improvements that are indicated in this analysis already are under way.

Capacitor Limitations

Standard commercial types of paper-dielectric and mica-dielectric capacitors are seriously limited in voltage and current ratings applicable at the maximum temperatures encountered in enclosed heat-dissipating equipment or in hot climates. According to the Joint Army-Navy specification JAN-C-5, nominal voltage ratings on mica capacitors apply up to 70°C or 85°C, according to the case style, with RF current values derated to 70%. The large deratings applicable to the voltage ratings of several classes of paper capacitors are indicated in Fig. 1.

Utilization of new solid and liquid dielectrics and capacitor impregnants can be expected to continue. Polystyrene[6], glass, and other plastic films have been used, and combinations of new impregnants or solid dielectrics have made possible capacitors with temperature ratings up to 105°C (Sprague "vitamin Q" paper type) and 123°C (Condenser Products "Plasticon" types with silicone fluid impregnation).

The perfect liquid dielectric or impregnant for paper dielectric capacitors has yet to be developed. The chlorinated diphenyl series of Arachlors (known by various trade names as Inerteen, Pyranol, and Dykanol) give compact designs due to their high dielectric constant, but suffer from more capacitance variation at low temperatures, and are less suitable for high temperatures than mineral oil.

Lack of stability in capacitance values of paper and mica capacitors can be very troublesome in some circuit applications, and is caused by erratic shifts with time and non-cyclic variations with temperature changes. For the mica types this lack of stability and erratic changes of temperature coefficient are illustrated in Fig. 2, which is based upon tests conducted by the writer early in the war years. Incidentally, these illustrate the poor fashion in which many silvered-mica types justify their reputation for stability. Also, it can be seen (in curve 3) how a high-priced type of capacitor that is rated as having a negligible temperature coefficient demonstrates this only in the region of room temperature and performs erratically when exposed to higher temperatures. Even at approximately uniform room temperature, mica capacitors exhibit capacitance shifts as great as 1.6% over a period of a week. When exposed to rapid temperature cycling between −40°C and +50°C, the average shifts in the writer's tests were less than 0.5% which, however, is by no means negligible.

For small 1000-mmf capacitors (type CM-20 per Specification JAN-C-5), the average shift after temperature cycling as above was 1.1% and the greatest value was 2.65. Little if any stabilization was obtained by this cycling process, contrary to current claims, since a further five cycles produced an average shift of 0.82%.

Other capacitors having a slight ridge reinforcing the case exhibited changes of approximately one half the values for the smooth-cased ones. Samples of 2000 mmf capacitors in a larger case (type CM-30 per JAN-C-5) showed an average shift of only 0.24% for 10 cycles and a maximum shift value of 1.22. The poorer stability of the small size units indicates that crowding of the mica stack in the molded case has left too thin a wall of bakelite. Measurements of insulation resistance and Q-factor after humidity cycling tests confirm the fact that overcrowded assemblies give poorer results. The maximum capacitance rating in

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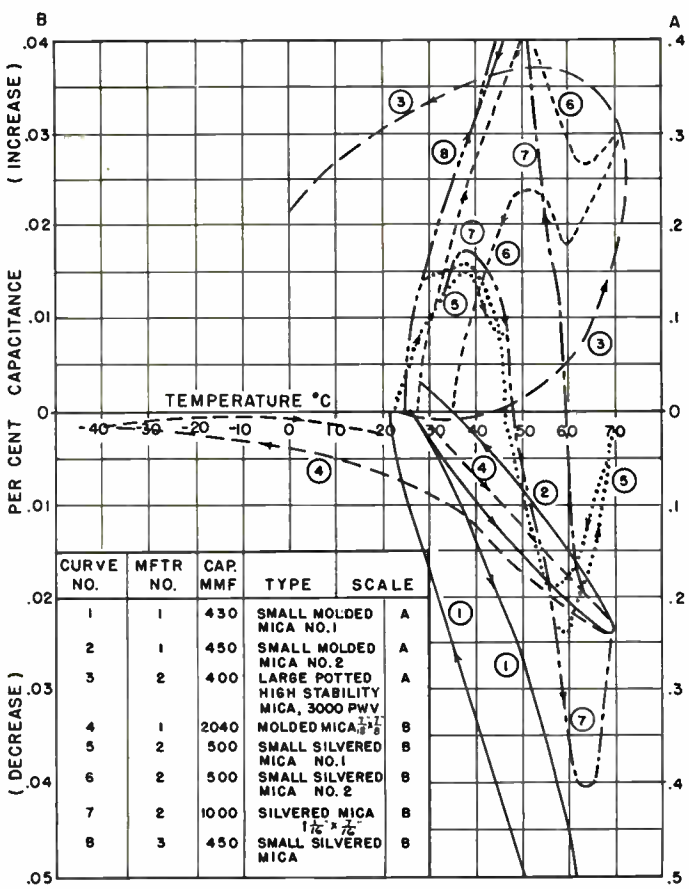


Fig. 2 — Temperature cycling effects upon various mica-dielectric capacitors.

Embossing Type Sound Recorder

Utilizing 3¾-in discs pre-grooved at 350 lines per inch, new machine has single permanent stylus, records 15 minutes on each side of discs

• Tackling instantaneous recording-reproducing in a new manner, Wagner Recorder Mfg. Corp., 67 West 44th St., New York, has developed an instrument that has a number of unusual features. Recording is done by the embossing process with a permanent stylus which is also used for reproducing but which has been entirely divorced from all groove forming functions; nor are there any lead screws or other mechanical devices of the kind. In short, the grooves are pre-formed, but on the back of the blank, not the "work" side. Furthermore recording is done at an altogether unusual 350 lines per inch.

The embossing of sound on a plastic disc is not new. of course. The method, though, has been felt to suffer from various limitations which the Wagner Nichols instrument is designed to eliminate. Thus, with the embossing-reproducing head freed from any connection with groove formation, better frequency response and fidelity have become possible. As produced at present, frequency response has been ascertained to be flat to 11,000 cycles per second though this is not expected to be the limit.

Several factors are involved in the performance of the equipment. Chief among them is the use of a Vinylite disc 0.010 in. in thickness and having a diameter of only 3¾ in. Two types of discs are supplied. In one of them a guide groove without sound modulations and having 350 lines to the inch, is pressed from a master. The other disc is plain on both sides. The pre-grooved disc may be used for making recordings on its plain side, or it may be used to guide the stylus in making recordings on both sides of the plain discs. Inasmuch as the pre-grooved disc has only a smooth track with no modulation, it may be used practically indefinitely.

In operation, a pre-grooved disc is placed on the machine with the grooves down and the plain surface up. On this pre-grooved disc another disc of the plain type is placed. The machine does not have the conventional turntable but receives the disc on a revolving shaft so that, while turning, it is in frictional contact with a stationary felt covered table. Upon this table and along the radius line of the disc is a narrow slit through which a specially constructed tracing stylus slightly protrudes and makes contact with the grooved surface of the disc.

The recording head, which is directly above the tracking stylus, and with which it is an integral part, is then lowered so that its own stylus makes contact with the polished surface and directly embosses its signal thereon. Both styli being an integral part of a free floating carriage mechanism, they are now carried laterally across the record surface. The disc therefore serves as its own lead screw and consequently eliminates the need for gears or other driving mechanisms of the kind in the machine itself.

The recording stylus thus has been divested of the tracking function. Its sole purpose is to impress an embossed sound groove on the smooth surface, and this it proceeds to do efficiently by virtue of its smaller radius (approximately .0005 in.) and its lighter pressure.

This sound groove is smaller in linear dimensions than has heretofore been possible with conventional embossing methods, so that aside from its increased fidelity, it permits longer playing time. Both styli are of hardened and permanent construction and are designed to last the lifetime of the machine. Speed of the disc is 33-1/3 rpm.

After the record is completed. it may be reproduced instantly. The same stylus traces its path as a reproducer. The Wagner-Nichols Recorder is designed to permit a full fifteen-minute program on one side of a 3¾ in. disc. The discs are about ten cents.

Pre-grooving on the back of the disc, not the "work" side frees the stylus of all groove forming functions, permits extremely small track and improves fidelity of recording and reproduction

The Design of Resonant Filters

By S. Y. WHITE*

Mechanical analogy provides the reasoning for a new method of attack giving immunity to shock excitation, sharp cut-off

THE addition of electronic gateing produces a tuned filter with fast rise time, a broad top, immunity to shock excitation, and in the case shown, complete attenuation at 7% off frequency, regardless of signal amplitude.

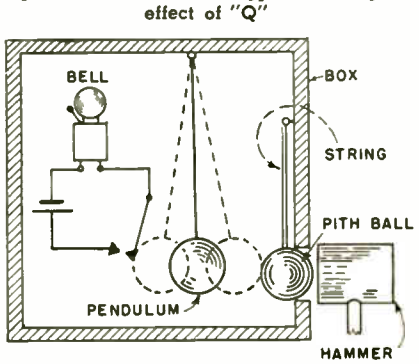
• In communication work it often is necessary to discriminate between high intensity transients such as static, ignition noise, or power leaks and useful frequencies in voice communication which may have a top cut-off of 3 to 5 kc. In other applications it may be necessary to transmit a signal over such a voice circuit to actuate control apparatus, such as a teletype, by sending a tone just above the voice range (where some response is still left in the transmission circuit) and then separate this control signal through a filter.

When a fast rise time (such as a few milliseconds) is needed as in teletype work, a cascaded series of tuned circuits (perhaps with some gain between stages) could be set up. However, there is a limit to the combined Q or selectivity of the system, as it takes too long to start this succession of tuned circuits swinging and then the system long continues to swing after the signal has stopped. The filter also is subject to shock excitation by the high intensity transients, which start it oscillating by brute force, allowing a high output voltage to be built up. lasting until the frequently enormous energy of the transient has been dissipated.

Since in practical experience, someone always wants to control something else on an adjacent channel, a filter for this service must attenuate signals on each side, so Q must be increased, with the result that the rise time also increases along with the shock excitation effect. Study indicates that these requirements cannot be met except by some new method of attack. For this reason it was necessary to reexamine the basic concept of resonant circuits and "Q".

A given coil has a Q of 100 because it is a hundred times better as a coil (inductance) than it is a resistance. An axe hanging on a nail has all the elements of a tuned circuit, with one fundamental frequency. However if it is rubbing on the wall, it will have a Q of only about two, and is quite ineffective as a precision frequency standard. Excited by brute force methods (as with a hammer) it can be driven at almost any oscillating rate because of this high "signal level". At the other extreme, the most aristocratic member of the pendulum family in the standard clocks of the Bureau of Standards is housed in a special room in bedrock, mounted in an evacuated steel housing with the most exquisite of precision bearings. With a Q up in the thousands, it swings continually with infrequent "fly power" jabs of energy.

Fig. 1—Mechanical analogy illustrating the effect of "Q"



But if this astonomical time pendulum were to be driven with a sledgehammer at any rate desired, it, too, then would be useless as a frequency standard. The thing well known, but not often actually realized is that high Q and small driving power must go together. To a very rough approximation. Q equals the number of cycles taken for the wave to rise to practically full amplitude. For fast rise time, the Q must be low, and by limiting the effects of shock excitation one step of the problem is accomplished.

A simple mechanical analogy provides the reasoning for a new method of attack. In Fig. 1, in a box of infinite mass, a pith ball of small mass is hung on a thread so that it protrudes slightly through the wall. It also contains a pendulum of any Q we want, energized by repeated blows of the pith ball. No matter how heavy the hammer blows, only a tiny "quanta" of energy is carried to the pendulum, the rest being wasted against the wall of the box. This is the mechanical representation of a limiter tube. However only when the hammer blows are accurately timed, will the pendulum swing through the arc shown in dotted lines.

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This amplitude of oscillation reaches a point where the loss in the pendulum per cycle exactly equals the quanta of energy delivered by the pith ball. Because of the limiter and the choice of Q of the pendulum, the final amplitude of the latter can be determined accurately, so a pair of contacts can be mounted to indicate when the amplitude of swing has nearly reached its maximum so as to ring the bell. This is obviously a discontinuous function; until the full swing is reached, no output results. The device responds to the chosen frequency of the pendulum only and we have eliminated shock excitation.

A circuit (Fig. 2) was devised and studied with a median frequency of 7 kc. Here V_1 and V_2 are parts of a twin triode (6SN7), the first being the limiter with a high value plate resistor (R_1 = one-half megohm or more) and a bias of between 1 and 2 volts. The resonant portion of the circuit is represented by the two coupled circuits L_1 and L_2, each tuned with iron cores. By keying the 1 volt 7 kc input and measuring the rise time on a scope by counting the cycles required to build up to 90% of full amplitude, it was found that the 3 millisecond requirement of 21 cycles was met by two circuits having a Q of 26 each, set at optimum coupling to obtain a relatively broad top, so that the input signal could drift a little and the tuning of L_1 and L_2 would not need to be precise.

V_2 is an ordinary amplifier stage with gain of about ten. Its use avoids running the diode V_3 at such low amplitudes that operation occurs on the square law part of the curve. The circuit equivalent of the backed-off contacts of Fig. 1 is the highly-biased diode. With its cathode at about ten volts. it is inoperative until the signal peak exceeds ten volts. The output filter R_3 and C_1 is not critical. For fast recovery R_3 should approximate 0.1 megohm and C_3 = 0.005 mmd, which is sufficient for many purposes. The output performance is shown in Fig. 3. Limiter action starts at 1 volt input and the peak is rather broad.

Although the circuits were so broad that the response at 6.5 and

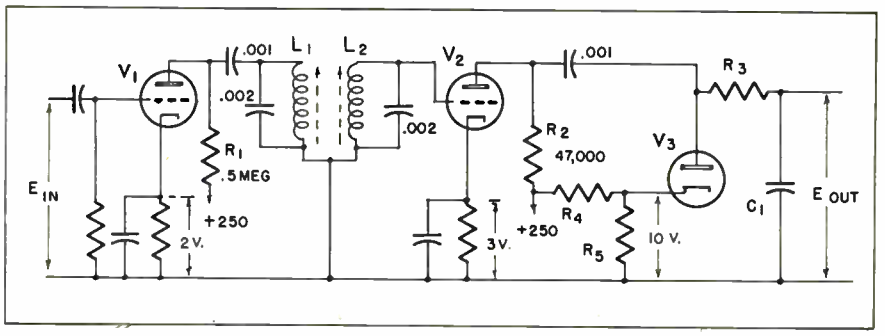


Fig. 2—Experimental circuit giving rapid rise, immunity to shock excitation and low response slightly off frequency

7.5 kc was only a little more than 3 times down, these values were below the diode bias so complete cutoff is obtained. By increasing the input to 100 volts of signal, we obtained curve B. The response at 6.5 kc was only 9 volts, so again the output is zero. About 14 volts dc signal control voltage was obtained however. By taking dc of

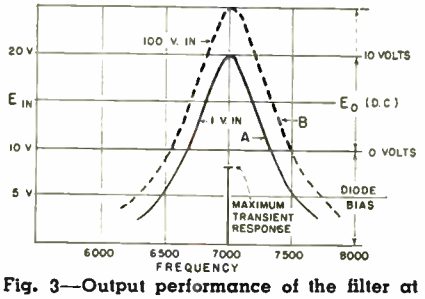


Fig. 3—Output performance of the filter at two input levels

both polarities and all possible amplitudes and keying it directly on the first grid, and looking at the envelope with an oscilloscope, the greatest transient we could develop across the tanks was about 7.5 volts, which is below the passing level.

The coils were about an inch long, and an inch in diameter, with 3/8 in. hydrogen iron cores an inch long, mounted with their tuning capacitors in a 2 by 2 in. aluminum can 4 in. high. A two-to-one tuning range usually can be obtained by permeability tuning. The curves were made with coils (set at about 400 mh) which were layer wound with paper between layers.

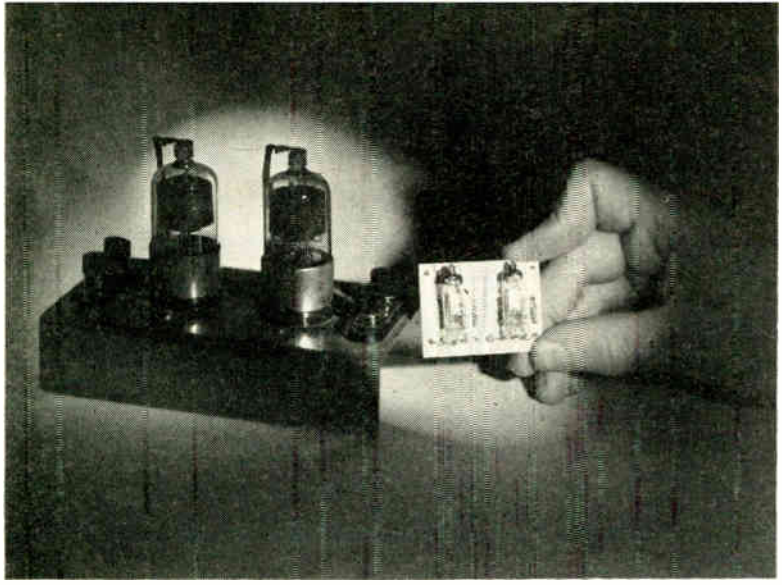
There is, of necessity, considerable harmonic generation in this type of limiter, so it will respond to the half and one-third frequencies. While in the case of the noisy voice channel, no transient or overmodulation would give an output, a sustained tone of about one-half the resonant frequency about 20 db down would show up somewhat.

This system is simple enough to find application because of its rapid rise, immunity to shock, and low response slightly off frequency, or its inherent limiting action. A thyratron relay can be tripped with it. By operating in the channel just above voice frequency cut-off one often can find enough response left to carry a weak signal to operate this filter. If a slower response than 4 milliseconds is permissible, the Q of the tuned circuits can be increased, which greatly increases the selectivity.

Zoomar Lens Facilitates Television Productions

The new Zoomar lens, a tube-like structure that looks like an Army Bazooka gun, was demonstrated for the first time publicly in connection with television in Studio 3H of the RCA building by Jerry Fairbanks, distributor, and its inventor, Dr. Frank Back. The lens is designed to enable the television camera to smoothly transform a long shot to a close-up without switching lenses or moving the camera on a dolly. A simple lever adjustment provides for a smooth shift from extremely short to extremely long focal length in a continuous presentation with good definition and constant light transmission.

The lens housing contains 24 lenses, 8 of which are mounted on a shaft and movable by an adjusting control. The Zoomar automatically compensates for aperture stop, aberration and displacement by optical means.



Evolution of

Fig. 1. Size comparison between a conventional two-stage amplifier and a miniature amplifier

• The proximity fuze, that tiny radio transmitter and receiver packed so tightly into the nose of our shells, withstanding the tremendous shock of firing, was the secret reason why anti-aircraft fire by our gunners brought down plane after plane with shots that previously would have been "near misses". The projectile passing within 70 feet of the target was exploded, by radio means, with a devastating effect upon the enemy. The development of sub-miniature vacuum tubes to withstand the terrific forces encountered upon firing, often over 10,000 times that of gravity, is a story in itself. The radio circuits which proved sufficiently rugged and compact were of the "printed circuit" type.

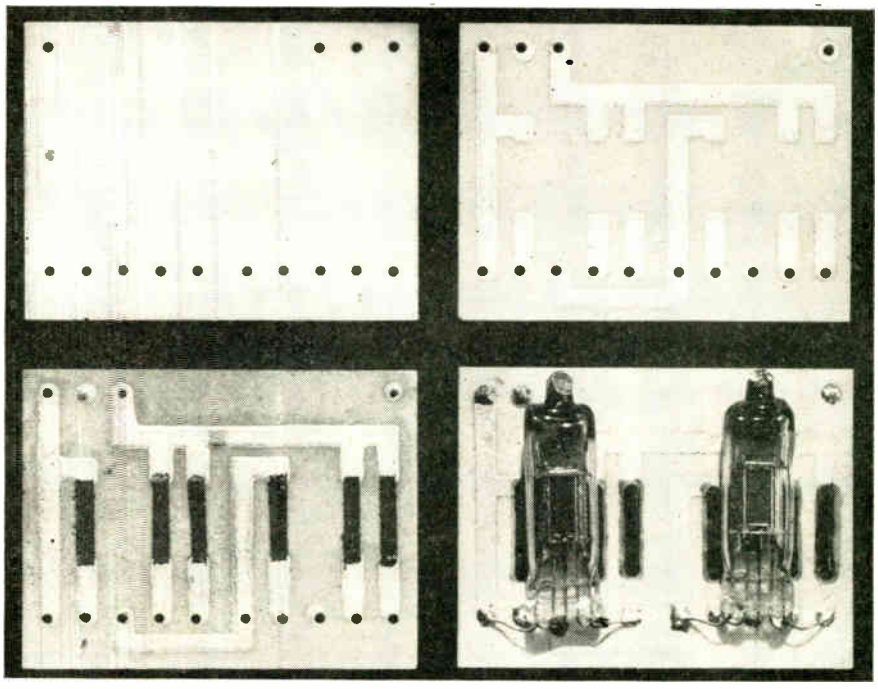
Many electronic workers are becoming familiar with the technics of printed circuits. Some commercially manufactured units recently have been offered for radio set use. The work of scientists at Ordnance Laboratory, National Bureau of Standards, was described to TELE-TECH by one of them, Dr. Cledo Brunetti, Chief of the Engineering Section, who has developed a satisfactory printed circuit technic in connection with the outstanding research that led to the successful production of one type of proximity fuze.

In considering printed circuits we first ask: what they will do that other conventionally-wired apparatus will not do? The advantages are: compactness, ruggedness, low-cost of materials and assembly. The reduction in size can be noted from Fig. 1, in which the usual 2-stage amplifier is compared with one using printed circuits.

What are printed circuits anyway? They are complete electronic circuits, generally built around sub-miniature tubes, in which the components such as resistors, wiring and inductors are printed or stenciled on a flat piece of nonconductor, such as glass, porcelain, paper or Steatite. To get an idea of the appearance of a 2-stage amplifier, shown as it grows from the plate of Steatite, to the silver-printed wiring, with the resistors painted on, finally to the complete unit with the tubes in place, examine the four steps shown in Fig. 2.

What are some of the applications of this new technic? This idea can be used where small size is imperative; for example, in pocket radio receivers, really small hearing aids, radio sonde, measuring instruments and among other things personal radiotelephones. In fact it was the dramatic demonstration of the latter by Dr. Brunetti at the recent I. R. E. convention in New York that focussed attention on printed circuits. In the laboratory, just before the convention, the writer was shown by Dr. Brunetti the "Lip Stick" transmitter and the companion receiver in operation. These two examples of printed circuits are illustrated in Fig. 3.

Fig. 2. Four steps in making a printed electronic circuit: a steatite plate after firing and shrinkage (upper left), plate with circuit wiring (upper right), resistors added (lower left), and finally the assembled unit with miniature tubes (lower right)



Printed Circuits for Miniature Tubes

By DR. A. F. MURRAY, Consulting Editor, Tele-Tech, Washington

Engineering and constructional technics involved in the miniaturization of practical transmitters and receivers

Think of a transmitter, including battery and microphone, which measures only one inch in length by one-quarter inch in diameter! It has a range of about 2 miles. Built around a sub-miniature tube, such as the Sylvania 6K4 the grid and plate inductors are "printed" on the glass portion of the tube. A tiny battery furnishes 120 volts for the plate and 1.2 volts for the filament. These miniature transmitters and receivers are operated in the band 139 to 143 mc. Grid modulation is used. Where possible an antenna, a rod about 3 ft. long is used; but in the demonstration that the writer took part in the microphone cord, about 28 in. long, which was purposely connected without a radio by-pass. was used as the transmitting antenna.

Receiver 2 x 5 Inches

The 4-tube receiver, measuring 2 in. by 5 in. has a square-law detector followed by an amplifier having a gain of 1500 and a power tube capable of operating a large loudspeaker, if desired. Clear speech was transmitted to this receiver by the writer while walking around the large laboratory, carrying the miniature transmitter in the hand.

The practical-minded may ask, "How long will the miniature battery last?" Well, the chances are that for economical operation, hour after hour, the size of the battery dwarfs the size of the radio equipment it powers. This means that the battery manufacturers, who for so many years have heard (and later met) the demands of the radio industry for smaller and smaller batteries once again will have to develop the type of battery needed for this equipment and crowd it into a size no larger than a match box.

Miniature Transmitters

The smallest transmitter units consist of sub-miniature triodes with the circuit painted directly on the tube envelope (Figs. 4 and 5). The coils and small grid leak are painted on the glass envelope of the tube with silver and graphite paints respectively. The addition of a tiny high-dielectric ceramic capacitor completes the circuit.

If good adhesion of the circuit to the glass is desired, the tube envelope must be absolutely clean prior to painting. Although the coils may be painted free-hand, more uniform results can be obtained by applying the silver paint with a ruling pen mounted on a lathe while the tube held in the chuck is rotated by hand. Precise coils can be applied in this manner. Another variation involves the application of the coils to the tube envelope before the tube elements are inserted and sealed.

Fig. 3. In his left hand, Dr. Cledo Brunetti, chief of the Ordnance Engineering Section of the National Bureau of Standards, is holding a sub-miniature radio transmitter; and in his right hand a sub-miniature radio receiver

The center unit of Figure 5 was made by first wrapping a stencil of the coil pattern around the tube using masking tape. The glass envelope was then etched in fumes of hydrofluoric acid (sand blasting could have been used) which roughens the surface and allows excellent adhesion of the paint to the envelope. After etching, the hydrofluoric acid was neutralized with strong caustic soda solution, and the envelope washed thoroughly with soap and water and rinsed in distilled water. The conducting paint was applied to the etched surface and allowed to dry in air.

To improve the Q of the coil, it was silver plated in a silver-cyanide bath by applying a current of 0.2 ampere for 15 minutes, depositing a layer approximately 0.003 in. thick. The grid-leak resistor was painted on using a resistance paint (described in detail later) and dried at a temperature of 50°C under an infrared lamp.

The procedure used to print the transmitter and receiver circuits on steatite plates is the stencilled screen method, now accepted as a standard way of printing electronic circuits (Fig 7). Although steatite was used for the base plate, the process is applicable to such materials as glass, porcelain, bakelite, lucite, and other insulating surfaces. Steatite, a hard dense ceramic material, is well adapted for use as a base material. It is unaffected by water, solvents or even acids—important factors in its electrical use.

The printed silver wiring is applied through a silk or metal screen stencil containing the appropriate pattern. The stencil is laid over the clean ceramic plate and silver ink brushed over it.

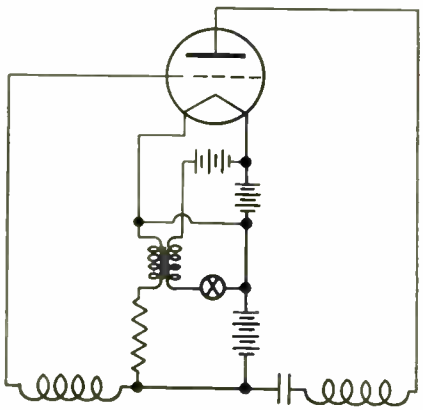


Fig. 4. Circuit diagram for sub-miniature printed transmitter

For flat plates, a squeegee may be used to apply the paint. When the stencil is removed a pattern of silver lines representing the wiring of the circuit appears. Examples of this may be seen in Fig. 6.

Figure 5 (bottom) shows the development of the flat-plate transmitter (both sides). The upper side carries the three spiral coils and a 50 micromicrofarad coupling capacitor. The lower side bears the remainder of the circuit wiring including three resistors (the dark rectangles) and four capacitors. One of the resistors, though not shown in the circuit diagram is connected to the grid coil. It serves as a blocking resistor for measuring the oscillator grid voltage.

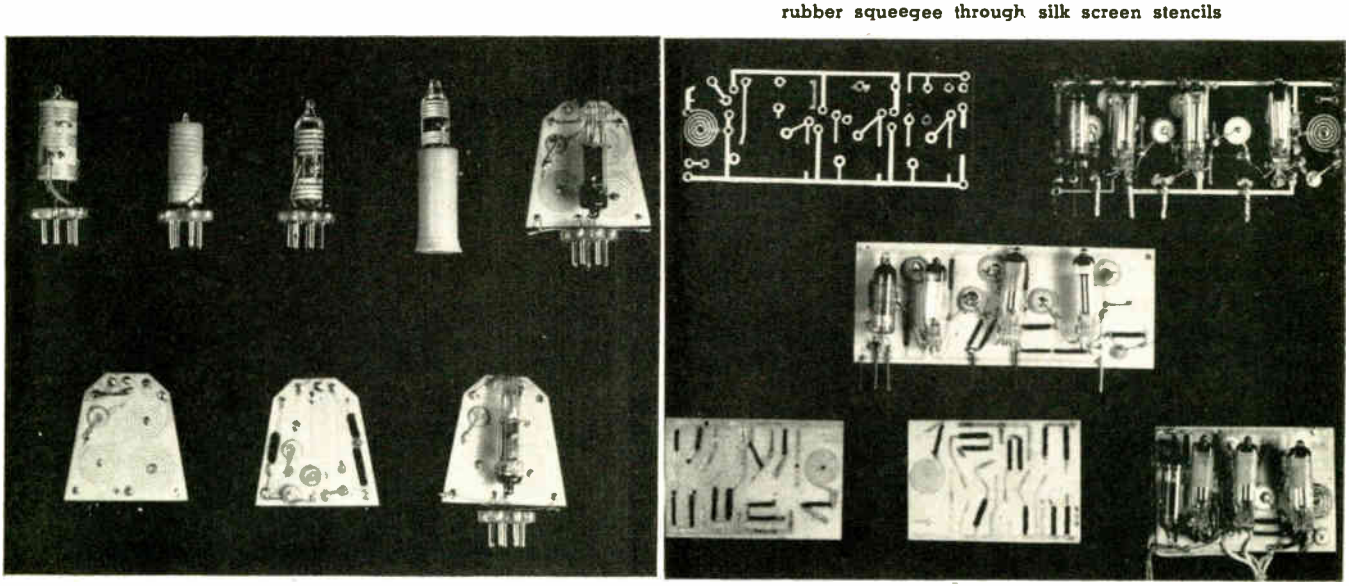
The silver paint may consist of very finely divided silver or silver oxide mixed with a binder to make a paste and thinned with a solvent such as acetone. On highly refractory surfaces, such as Steatite, a flux of low temperature glass may be added to improve adhesion to the surface.

After impression of the pattern, the plate is heated to a temperature of 800°C to bond the silver permanently to the plate. Paints which do not require firing at high temperatures have been developed for use wherever elevated temperature equipment is not available or desirable. The principal advantage which is gained by firing at high temperature is an exceedingly strong adhesion to the plate.

The screen is prepared by stretching the mesh material over a supporting frame and coating it with a photosensitive solution which is made by mixing gelatin or polyvinyl alcohol with a sensitizer such as potassium dichromate. A photographic positive of the wiring pattern is held tightly against the sensitized silk screen and exposed to strong light. Exposure makes the coating insoluble except for those portions beneath the wiring diagram. When the screen is washed in water, the parts not exposed to light dissolve

Fig. 5. (Top row) Five types of sub-miniature radio transmitters; all are grid modulated and require only connection to a microphone and battery to operate. (Bottom row) Developmental stages of a steatite plate transmitter

Fig. 6. (Top and center rows) Two 4-tube radio receivers printed on thin plates 2 in. x 5 in. (Bottom row) Two developmental stages of a 4-tube radio. Wiring on the plate at the left was applied free-hand except for spiral coils, on the center plate, with a Buna N rubber squeegee through silk screen stencils



and wash out, leaving openings in the screen corresponding to the desired wiring diagram.

The resistors are applied in proper places through another stencil. The resistor paint consists of a conducting material such as powdered graphite mixed with inert or nonconducting compounds such as mineralite or lampblack and a resin binder to form a paste or heavy ink. The resistance may be adjusted by varying the amount of inert filler or by varying length, width, or thickness of the resistors.

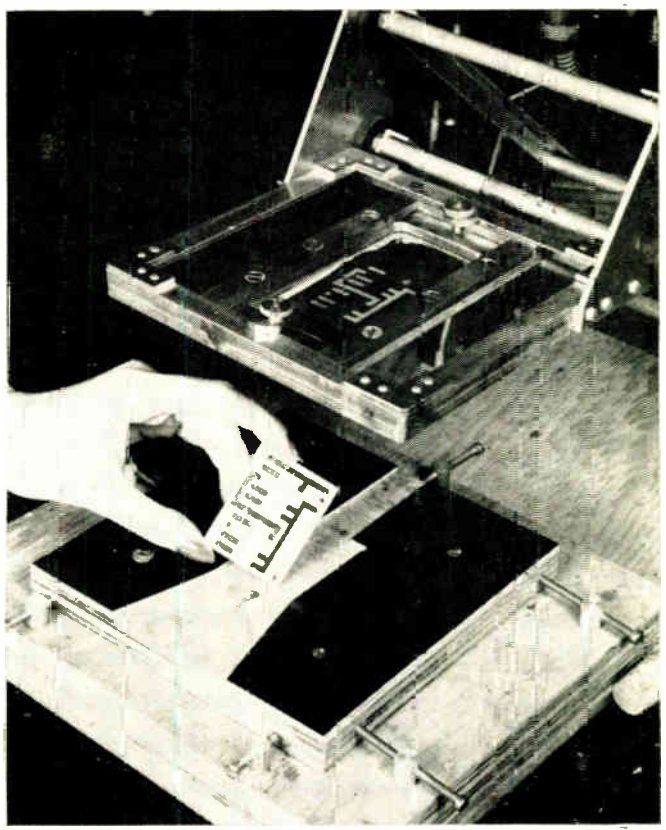


Fig. 7. The printed conductors consisting of silver oxide paint are shown just after the stencil screen is raised from the ceramic plate

Resistors Cured in Oven

After the resistors have been applied, they are cured in an oven at 150°C for approximately one hour, the heat converting the resin binder to an infusible state. Minor adjustments in the value of a resistor are possible after drying. The resistance may be increased by grinding away part of the resistor with a small grinder of the type used by dentists, or decreased by simply adding another layer of paint. A special resin coating may be applied to the plate as protection against humidity and other atmospheric effects.

The ceramic disc capacitors which are prepared from high-dielectric mixtures of titanates are soldered into position. They range from 1/8 to 7/16 in. in diameter and 0.02 to 0.04 in. in thickness. The capacitance is controlled by the mix, the thickness of the disc and the area of the silvering on the faces. Such capacitors, available in values from 6.5 to 10,000 micro-microfarads, are soldered to the plate with a low-temperature solder which allows soldering through the condensors without adversely affecting the performance. A bismuth solder (110°C melting temperature) consisting of 40% bismuth, 40% lead and 20% tin is used.

Wiring of the units is completed by soldering the sub-miniature tubes and leads for the antenna, batteries, and loud speaker directly to the silver wiring on the plate. To prevent absorption of silver by the solder it is desirable to use a solder containing about 2% silver. A solder composed of approximately 1/3 lead and 2/3 tin with 2% silver is suitable. The development of a method of dipping the plate into a solder bath eliminates individual soldering of the leads.

If a plastic base is desirable instead of a more highly refractory material, a simpler procedure may be followed. In this case the wiring is applied through the stencil (as with the Steatite plates), but paints are used which dry at room or slightly higher temperature. A suitable silver paint consists of powdered silver in lacquer solution, the consistency being adjusted with an acetate solvent. For best results a high percentage (65%) of silver powder is used. Paints mixed and ready for use, which will dry on brief exposure at 50°C or overnight at room temperature, are commercially available.

The conductivity of the wiring applied in such a manner is somewhat lower than that of wiring applied by the firing process, but it is usually completely satisfactory for most electronic circuits. An example of a lucite plate wired in this manner is shown in Figure 6. To increase the conductivity of the spiral coil it has been silver plated. As silver plating is relatively easy, it was found convenient to plate all wiring on the plate in the same operation at a rate of 0.2 ampere for 15 minutes in a silver-cyanide bath.

Humidity Protection

Prior to stenciling the wiring, the lucite plate was cleaned with a dilute solution of tri-sodium phosphate, rinsed in water and dried at 50°C to remove any oil stains. After addition of the resistors—applied through a stencil—and the condensers—soldered to eyelets in the lucite plate— the complete surface was coated with a thin layer of lucite cement for protection against humicity and other effects.

It is generally more convenient to purchase paints than to mix them in the laboratory. This is especially true for the silver paints which are readily available commercially. A satisfactory preparation for painting transmitter coils on the tubes is a sodium-silicate conducting paint known as Sauereisen Conductulute. This paint dries in air at room temperature and may be plated readily.

A satisfactory formula for silver

(*Continued on page* 111)

Analyzing TV Propagation at UHF

By ROBERT P. WAKEMAN, Research Division,
Allen B. DuMont Labs., Inc., Passaic, N. J.

Based on FCC investigation of diffraction effects, UHF appears useul only for line-of-sight at present carrier power levels

• Before making its recent decision relative to color standardization, the FCC heard reports on the problems of utilization of the higher frequency bands in providing good signal coverage over wide areas. The new frequency range (480-920 mc) has been largely unexplored for broadcasting services.

The experience of FM going "upstairs" has not been forgotten and many tests have been planned to survey the "promised land" before having to move in. The tests on the following pages, described before the FCC, are not a condemnation, as certain newspaper reports implied, of the CBS color system but do point out the problems inherent in the 500-900 mc range that must be solved by research before any system of television can be said to be commercially useful in this range, whether it be color or black-and-white.

When receiving dipoles are measured in inches instead of feet excellent directivity is possible with conveniently-sized arrays or reflectors, but on the other hand, such directive methods are absolutely necessary to get the same absolute signal pickup possible with simple dipoles on the longer waves.

It is also a basic rule that bandwidth and gain follow inverse laws in any presently used amplifier, so that either more signal pickup or greater amplification are necessary with any system of color with its tripled bandwidth requirements, but this may be only a minor consideration since the possibility of much higher gains is easily imagined.

Unfortunately for the art, the public's knowledge of television has been diverted from its many advantages by numerous technical controversies that have been limelighted in the press. Some of these matters have been confusing even to engineers who have not kept track of the intimate details of tests.

The natural propagation characteristics of waves in the higher bands is a more important consideration, the result of greater attenuation by normal impediments along the transmitting path and the greater reflection effects and lower diffraction around natural obstacles. The tests reported here do point out that even if a perfect system of color reproduction were now available, there would still be much work to do to overcome these propagation difficulties.

Preliminary to the hearing in Washington, February 10, the FCC set forth a general plan that a limited number of tests within the short time allowable should be carried out by a special committee including: Goldmark, Lodge, Murphy and Brauner, (all CBS); Detmar and Kell of RCA; Bingley of Philco; Goldsmith and Wakeman of Du Mont; Allen representing the FCC and Norton (Bureau of Standards).

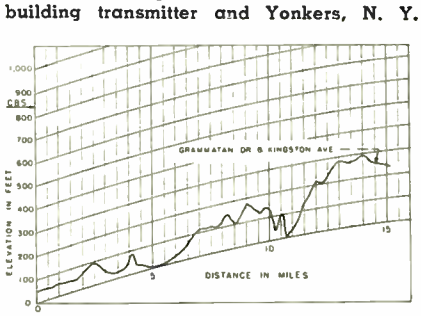
They agreed that it would be desirable to make installations of color television receiving equipment, first in a form of field test apparatus of a portable nature for both black-and-white and color, and later regular home installations. The following locations were selected at random by blind spotting on a map: Newburgh and Nyack, N. Y.; Bronxville, N. Y.; Yonkes, N. Y.; Cedar Grove, N. J.; Passaic, N. J., Morristown, N. J.; Millburn, N. J.

While it seemed desirable to make at least five measurements in reasonably fixed locations at these points, obviously 40 individual locations, proved to be too much of a task for the time allotted, and a modified schedule was later used. For these tests the CBS color transmitter and CBS black-and-white transmitter operated from 9 a.m. to 5 p.m. every day until completion.

The weather was bad for such tests, a really cold week. As a result, the points indicated in Table 1, consist of eight major points at which measurements actually were taken.

The equipment in use on these tests consisted of the following apparatus. The CBS group used a

Contour readings between CBS' Chrysler building transmitter and Yonkers, N. Y.



panel truck with its portable gasoline-driven generator for supplying power to a station wagon in which field test equipment was mounted. For this system an antenna support consisting of a pole which could be erected at various heights up to 30 ft. was available.

For the color reception on 490 mc, the double horn receiving antenna was used giving a power gain of 16 over a simple dipole (voltage gain, approximately 4). Inside this truck there was a television receiver for the W2XCS-UHF color transmitter, together with its sound channel. In these reception tests a Measurement Corp. type 84, signal generator for substitution measurements was used.

First signals were received and deflections on auxiliary equipment indicating a certain signal level were noted. Calibration was made by then substituting signals from the standard signal generator, adjusted to give the same deflection as originally observed from the transmitting station. Thus, the microvolts from the signal generator were recorded as indicative of the microvolt signal applied to the color television receiver terminals.

The Du Mont equipment consisted of a large six-wheel-drive truck equipped with benches and equipment for observation and measurement of television field strengths on both the high frequency bands and the low-frequency bands. In general, the data were taken with the CBS equipment in the case of the high-frequency transmitter and the D Mont equipment in the case of th two low-frequency transmitte Observations with the Du Mon field truck were made in genera on Station WCBS-TV, with additional measurements on WNBT A trailer provided about 6 kilowatts of 110-volt 60-cycle ac power for operation of the lights the heaters and the television measuring equipment in the truck.

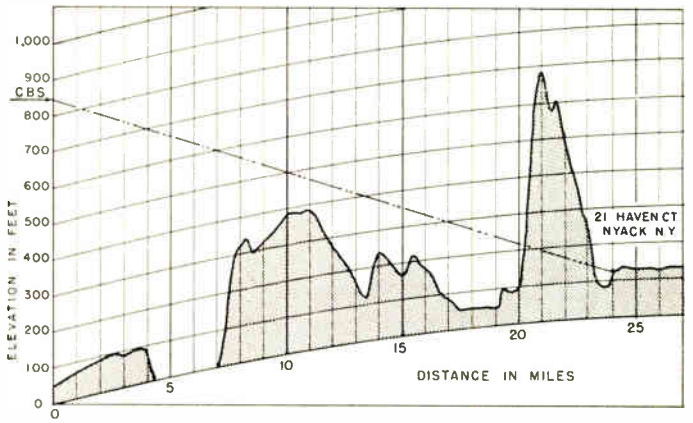
The equipment included two Easterline-Angus recorders, one for the high-frequency and one for the low frequency. These were available in both the Du Mont and CBS equipment. However, signal strength measurements were made at each fixed location rather than continuous, mobile measurements.

In the Du Mont truck was a Du Mont "Clifton" model 12-in. television receiver, an RCA 10-in. table model receiver, and an old-style DuMont type 180 receiver which had been adapted with switching, so that it could receive either the low band black-and-white signals, or with suitable converters could portray on its cathode-ray tube the reception from the high frequency transmitter. For the latter, a Measurements Corp. type 84, signal generator was used in measurements made in this truck.

The high-frequency signals were received on a five-element directive Yagi array. This antenna had a height above ground of only 12-ft. and as a result the measurements on the high-frequency transmitter recorded were mostly those made with the CBS equipment with its higher gain receiving array and with its greater antenna height.

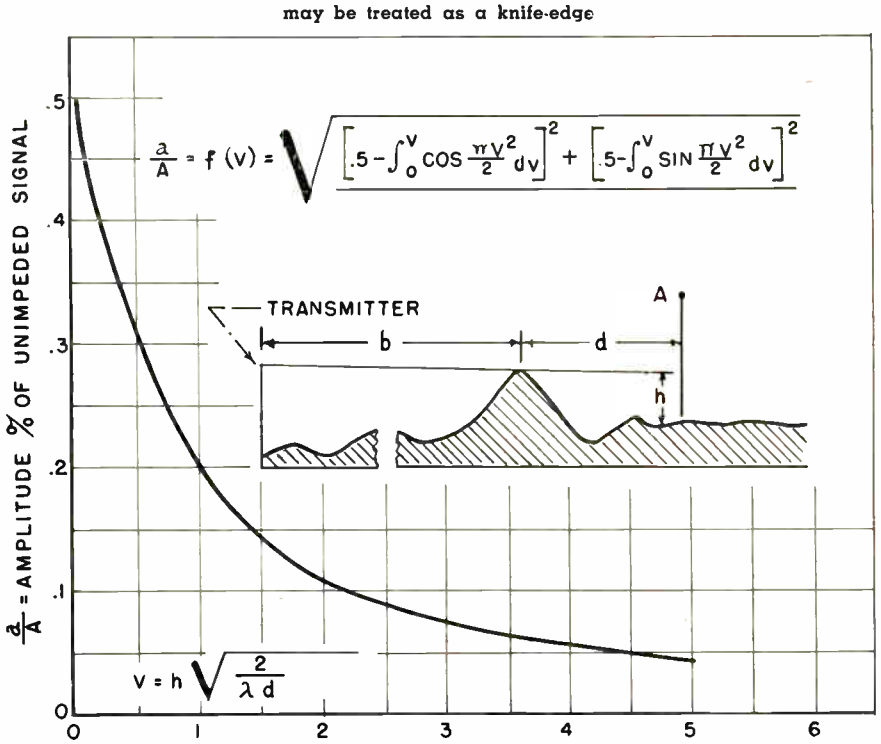
For black-and-white measurements in the Du Mont truck, a signal strength recording set was utilized consisting of a type S-36 Hallicrafter receiver operating a tape recorder and a meter. A Ferris type 18-B signal generator was used for calibration of the S-36.

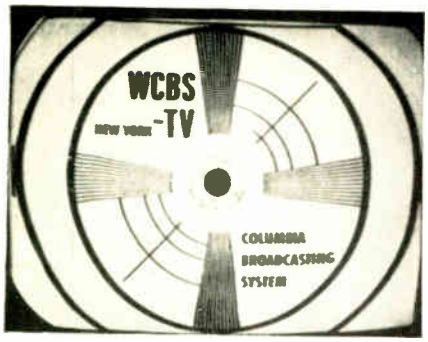
In addition, numerous auxiliary test systems were available in other vehicles so that a number of checks could be carried out rapidly



Contour readings between CBS' Chrysler building transmitter and the location in Nyack, New York where tests were made, showing nature and location of intervening elevations

Curve based on optical diffraction theory, predicting signal amplitude at "a" in terms of "A" as f (h, d, λ). Assumption is made that b is much larger than d and that the hill may be treated as a knife-edge





Photograph of the receiver screen showing reception at Yonkers test location

under diverse reception conditions. The following review of the tests conducted during the period is concerned mainly with reporting characteristics of the higher bands as they will affect future engineering plans.

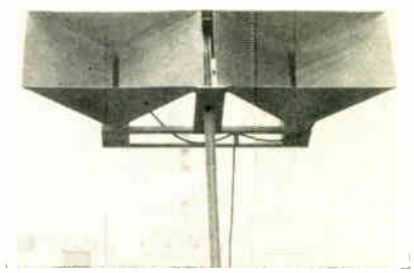
The main difficulty of these frequencies usually has been the marked shadows that are encountered behind buildings, hills. etc. Only when thousands of such checks are made will the complete story on coverage be available, but a description of reception conditions at two points will typify what may be expected where direct line-of-sight pickup is not encountered.

As a starting point in such an analysis it is desirable to provide a means for determining the average, expected field intensity at a point in the shadow of a hill (or other obstruction) as a percentage of the field intensity which would be available in the absence of the hill, since the latter value is easily computed.

Since the field intensity at any point is, inevitably, the result of refraction, diffraction and reflections, it becomes practically impossible to predict accurately the field strength at any one point. However, if the point is deep in the shadow and the obstruction can be considered to be a knife edge, the refraction effects will be negligible. Also the reflections will be such that movements of the receiving antenna over a distance of a few wavelengths about the chosen point probably will result in considerable variation in field intensity. Consequently, only the effects due to diffraction, based on Frensel optical diffraction theory. will be considered here.

In view of the many variables which determine the field intensity at a point, it cannot be too strongly stressed that this curve provides only a very approximate means for predicting the average expected signal intensity.

In considering a hill as a diffracting knifeedge it should be noted that the ratio of the length of a 5-meter electromagnetic wave to that of 5000 A light wave is 10^7.



Double horn type of receiving antenna used for color reception at 490mc and giving a power gain of 16 over a simple dipole

This means that a hill about 800 ft. wide would appear the same to the 5-meter wave as a knifeedge one thousandth of an inch thick does to the light wave.

The curve is a plot of the equation:

$$\frac{a}{A} = \sqrt{\frac{\left[.5 - \int_0^v \cos\frac{\pi v^2}{2}\,dv\right]^2 + \left[.5 - \int_0^v \sin\frac{\pi v^2}{2}\,dv\right]^2}{2}}$$

Where $\frac{a}{A}$ = the fraction of the unimpeded signal amplitude $v = h\sqrt{\frac{2}{\lambda d}}$

h = vertical distance below "line of sight"

d = horizontal distance from crest of hill

λ = wavelength

h, d, and λ are measured in the same units.

The definite integrals in the preceeding equations are Frensel inte-

Location	Path Conditions With Respect to Line of Sight	Miles to WABD	Miles to W2XCS	Ground Elevation	Signal u V (av) W2XCS	Signal u V (av) WNBT	Signal u V (av) WCBS-TV	Quality of Received Picture 590 mc Full Color	Quality of Received Picture 500 mc B & W	Quality of Received Picture Low Band B & W
12 Sunny Brae Pl Bronxville, N. Y...	above	14.6	15.1	180	Truck: 750 House: 1000	2000	2000	Fair	Fair	Excellent
Gramatan & Kingston, Yonkers, N.Y.	0.6° below	14.0	14.5	280	50	1400	1400	None	None	Good
Gramatan & Kingston, Yonkers, N.Y.	0.6° below	14.0	14.5	280	250	2350	2100	None	Poor	Excellent
Jefferson & 5th Nyack, N. Y.	2.5° below	23.2	23.7	80	8-12	400	190	None	None	Good
21 Haven Ct., Nyack, N.Y.	2.1° below	23.2	23.7	140	25	500	450	None	None	Good
Meadow Brook, Cedar Grove, N.J.	just below	15.6	15.7	360	130	1000*	1100*	None	Unsatisfactory	Excellent
Lakeside Ave., Verona, N. J.	1.5° below	15.0	15.1	360	0-110	2200*	1400*	None	Unsatisfactory	Excellent
Du mont Lab., Cedar Grove, N.J.	above	13.9	14.0	640	1300-	1200*	6700*	Not tried	Fair	Excellent

*8 foot antenna

grals and tabulations of the values in terms of the argument v are available.*

As an illustration of the use of this curve we will first consider the conditions at test point No. 3. This was the corner of Gramatan and Kingston Streets in Yonkers. N. Y. Inspection of the profile of the radial, Fig. 1, shows that the test point was 2600 ft. from the diffracting hill and 30 ft. below line of sight.

Converting these figures to meters and inserting the two values of λ used (5.5 meters and 0.6 meters) we solve for the two values of v

$v_{5.5} = 0.19$

$v_{0.6} = 0.59$

Consulting the curve, on page 63, we find that

$$\frac{a}{A_{5.5}} = 0.42$$

$$\frac{a}{A_{0.6}} = 0.28$$

These values are the percentages of the unobstructed signal amplitude which we would expect to find at this point. The ratio of these values is 1.5. Thus, assuming equal field strengths in the absence of the hill, we would expect to find the signal amplitude at the low frequency to be 1.5 times as great as that at the high frequency

Actual measurements resulted in a voltage of 250μv at the high-frequency set terminals and 2100μv at the low frequency set terminals. Multiplying the high-frequency signal by 9 (the frequency ratio) and dividing this result by 4 (the antenna gain) we find that the signal amplitudes were actually in the ratio of 3.8.

Obviously this is considerably worse than was indicated by the above simple theory. Some probable reasons for this discrepancy are as follows. Although the effective radiated powers were approximately equal at the transmitters, we have no reason to believe that the fields in the absence of the hill would have been equal. In fact, it is very probable that the high-frequency signal suffered considerably greater attenuation throughout the propagation path than did the low-frequency signal.

*Fundamentals of physical optics—Jenkins & White—Pg. 189

Field equipment ready for UHF television tests showing parabolic receiving antenna on field car and on twelve foot pole

This theory is corroborated by an examination of the data taken at the Du Mont Field Laboratory (point No. 8). The propagation path from the Chrysler Building to this point is entirely clear of all obstacles and doesn't come within 200 ft. of the earth except over the final quarter mile. Nevertheless, when the measured high-frequency signal is converted so that it can be compared with the low-frequency signal we find the ratio of low-frequency signal to high-frequency signal to be 2.3 instead of 1. Another possible source of error in the theoretical result is that this point was not in a sufficiently deep shadow to eliminate refraction and reflection effects.

For a second example, let us consider the point at 21 Haven Court, Nyack, N. Y.

An examination of the radial profile shows that we were in a deeper shadow here and that two diffractions were required for a signal to reach this point. In order to determine the fraction of the unimpeded signal which will be available here, it will, therefore, be necessary to take the product of the two fractions resulting from the two diffractions.

Considering first the 5.5 meter wave:

The first diffraction has the following conditions:

$h = 80$ ft. $= 24.4$ meters

$d = 3170$ ft. $= 966$ meters

(Continued on page 113)

Engineers Discuss TV Problems

Two-day gathering at Cincinnati devoted largely to engineering aspects of television transmitters and receivers — Inspect WLW

• Another of a group of regional technical conferences, the first to be sponsored by the Cincinnati section of the IRE, was held May 3 at the Engineering Society of Cincinnati Hall, at which some 300 engineers were introduced to the newest trends in the television art. This conference was a well engineered event, with a program of a few papers chosen for timeliness and importance. A feature of conferences of a decade ago was resurrected—the issuance of preprints which enabled those registered to have authentic notes of details and circuits shown by the speakers.

At this meeting many midwesterners saw their first television program—with special programs sent out from W8XCT an experimental transmitter of Crosley Broadcasting Corp.—picked up by late receiver models at the conference. The technical papers covered most phases of receiver design from antennas down to the details of synchronizing circuit methods.

P. P. Holst (Crosley) described a circuit arrangement and the mechanical details of a new television receiver input system handling eight selected channels as may be needed for a particular receiving area. A balanced input bridge antenna transformer with its intershielded windings provides an effective barrier to reradiation, while a hermetically shielded oscillator system removes most of the trouble caused by oscillator frequency drift. The principal advantages claimed were the elimination of unneeded parts in a receiver since no more than 7 stations are to be provided in a given area. The design shown permits the ready-replacement of plug-in units, if the particular requirements in an area are changed at a later date. Frequency stabilized oscillators obviate the need for the usual vernier frequency adjustment.

The usual circuit arrangements for IF amplifiers in the video channel were analyzed and compared by S. W. Seeley (RCA Service Labs). The characteristics particularly stressed were the band shape and selectivity requirements with emphasis on the rejection points, the network or circuits used, and the time delay of the overall networks. It was pointed out that the latter effect was a primary cause of loss of detail in received pictures. Circuit means whereby these phase delay effects could be minimized were shown, and a simple oscillographic check of the phase shift was described.

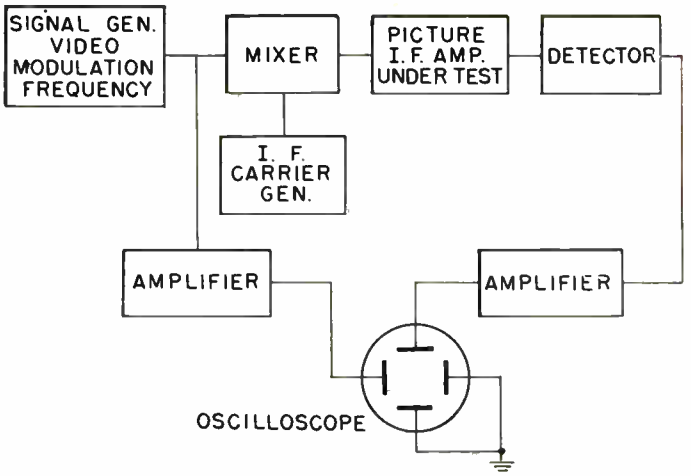
Synchronizing Methods

A comparison of the usual methods of effecting synchronization in the scanning system of a television receiver was presented by R. W. Saunders (Farnsworth) along with the details of a circuit that was found to synchronize exceptionally well, even in the presence of enough input noise to otherwise completely spoil a picture by its action on the kinescope grid modulating system. The circuit is economical in the use of tubes and permitted the elimination of the usual hold control on the front of the receiver.

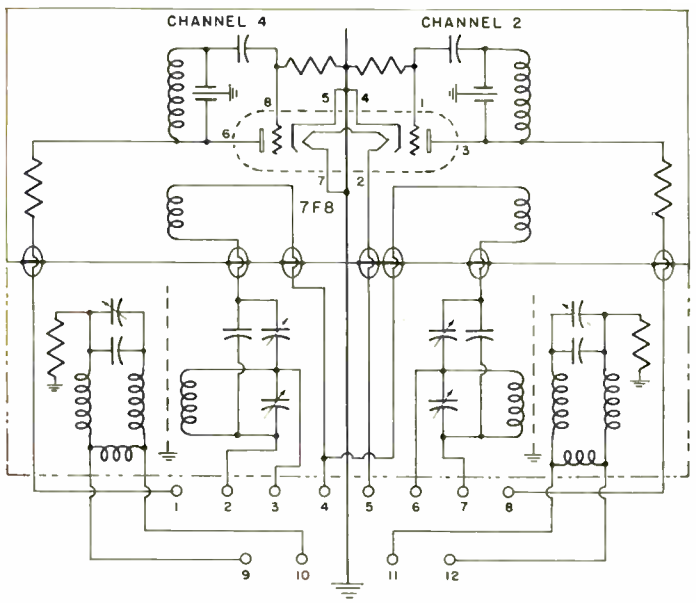
A review of the difficulties of designing television reception antennas was given by A. Alford (Consultant). Practical design requirements were outlined and some suggestions were made as to the selection of component sizes that would minimize impedance variations over the necessary wide range. The problem of attaining high gain, wide range and minimum reflections difficulties has as yet not been solved, however.

W. E. Bloeker (A T & T) reviewed the progress made in the construction of a nationwide coaxial cable network since the close of the war. As of January 1, 1947 about 4,000 route miles of coaxial cable had been placed in the ground and construction is continuing. Extensions planned for the next three or four years, will bring this to a total of about 12,000 miles, completed by 1950. Television service can be made available on most of these routes. The trend to wider frequency bands, needed to handle the ever increasing demand for both telephone communications and for greater definition and later color television, will continue. Wider band circuits are already under development, and a 7-mc coaxial system was described.

The advantages of cathode ray tube screens mounted on metal plates were described by C. S. Szegho (Raulard). Several ingenious projection tube designs were shown, some including inherently mounted Schmidt optical systems. Extremely low conductivity and secondary emission ratio below unity limit the velocity of



(Above) A convenient method (Seeley) for analyzing phase characteristics in an IF video system. The rotation of the elliptical pattern through one or more pattern series as the modulation signal swings through the modulation band indicates phase differences throughout the operating range



Circuit diagram of channel selector unit (Holtz) containing the hermetically sealed oscillator section (above) and the balanced bridge arrangement for oscillator radiation suppression (below). Four of these units provide service for 8 channels

the impinging electrons; the potential of the screen in respect to the cathode ray cannot be raised above the "sticking potential". In addition light emitted from the bombarded side, is lost if the screen has the optimum thickness for conversion of the electron energy into light. It was mentioned that these drawbacks can be minimized by having a fluorescent screen in contact with an opaque and reflective metallic layer.

In a first surface tube the screen must be observed through a comparatively small window and such a tube is, consequently, best suited for projection. Pipe-shaped tubes have been developed to be used with refractive optical systems having fluorescent screens on aluminum discs from 3 in. to 7½ in. diameter. Large screen television becomes possible by use of such tubes. A highlight brightness of approximately 5 ft.-lamberts on a 15 ft. wide screen was obtained with an f/1.5 lens.

A comparison of the advantages and disadvantages of the reflective and refractive optical systems for projection television receivers was made by G.K.Schnable (Rauland).

RMA Engineers Talk Transmitters at Syracuse

The program of the RMA spring meeting, held April 28 to April 30 at Syracuse, N. Y., was devoted to technical papers and committee deliberations relating to radio transmitter engineering.

Eight scheduled papers were presented starting with a general survey of the problems and methods of standardization, by C. F. Crawford (GECo). Here were analyzed the differences between absolute standards, those based on physical laws, and industrial standards which are in a constant state of flux, based on progress in the art and upon experience gained from field tests, etc.

A new low-power transmitting tetrode, the 3D24 was described by H. C. Longacre (Sylvania). This small-sized air-cooled tetrode, designed for use in small compact transmitters, delivers 100 to 140 watts output at a frequency of 125 megacycles with 4 watts driving power. The operating efficiency of the tube is due, in part, to the Zirconium coated graphite plate structure.

A description of the design of a television transmitter system in the UHF range, presented by J. T. Wilner (CBS), referred to the design of the currently-used CBS color transmitter operating in the 480-500 mc range. This was followed by a description of a new television mobile unit by W. J. Poch (RCA). Here the facilities for a two-camera chain with a remote pickup-to-transmitter radio link are carried in a 1½ ton truck which can be driven to a field event and rapidly set up. Extension cable reels permit the cameras to be placed up to 1000 ft. from the truck if necessary. The design pays particular attention to the frequency stability and reliability of the scanning pulses, since these become the basic control signals for the whole television system during the remote pickup interval. A mg set on a two wheel trailer can be attached if local power is not available at the pick-up.

The design considerations of an automatic gain control and limiting amplifier for general program use were outlined by William Jurek (Langevin) with a description of a practical instrument (called the PROGAR) which automatically limits the over-normal peaks but still maintains the dynamic power range required for fidelity.

Basic plans for studio- transmitter links operating in the 920-960 mc band were described by E. Ostlund (FTL). Facilities have been developed and are in operation using velocity-modulated reflex Klystrons in both transmitters and receivers. In the former, a power of 3 watts gives common ranges of 25 miles, or more, if line-of-sight transmission is possible. Here a 500 kc shift provides 100% modulation. In the receiver, a similar Klystron with 6 stages of IF (30 mc stagger tuned) with a

(*Continued on page* 115)

Survey of World-Wide Reading

Electronic news in the world's press. Review of engineering, scientific and industrial journals, here and abroad

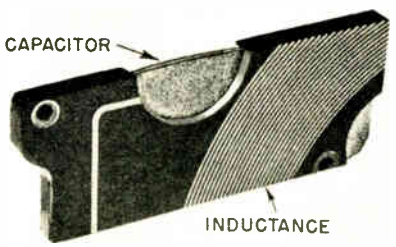
Automatic Production of "Printed-Circuit" Receivers*

The E.C.M.E. (Electronic Circuit Making Equipment) developed by John Sargrove, Sargrove Electronics, Walton-on-Thames, England, provides for the automatic manufacture of broadcast receivers. Circuit elements are integral components of molded plastic panels. Inductances, see figure. consist of spiral grooves filled with molten metal from a spray gun, while resistors are formed by dispersed graphite sprayed onto the plastic, burnished and aged. Thin webs of molded material integral with the panel and sprayed with metal on both sides serve as capacitors. Web thickness is accurately controlled to 0.01 inch. Capacitances are reproducible to ±10 per cent, inductances to ±0.05 per cent, Q-values of the inductances to ±25 per cent; resistors can be made to dissipate 1 watt per square inch.

A machine was designed for the automatic manufacture of panels for a two-tube, ac-dc, line-operated receiver set. Plastic plates provided with required indentations and fed into the machine are first sandblasted to remove surface skin, sprayed with metal on both sides, milled to remove surplus metal, tested, and sprayed with graphite through stencils; then tube sockets are inserted and finishing treatment is given. After that the panels are transferred to conventional conveyor machines where tubes, loudspeakers, etc. are put in their proper places.

It is assumed that this method will very-considerably reduce production cost of simple local-station receivers and, possibly, also that of sub-assemblies of more complicated receivers. The present maximum rate of output is three panels per minute. Circuit wiring is determined by the depressions and grooves of the plastic molds and, if the dies for these molds are correctly shaped, wiring errors are impossible. Each stage in the equipment is separately controlled by electronic circuits and operates only upon the arrival of a panel for treatment. This procedure permits operation to stop up to a point in the machine where two successive panels have been rejected for the same fault, while panels past this point will be finished.—JZ

Wireless World (London, England), April, 1947, pp. 122-123.



Automatic equipment produces receiver incorporating molded plastic panel with metal-filled groove as inductance, and thin metal-coated web as capacitor

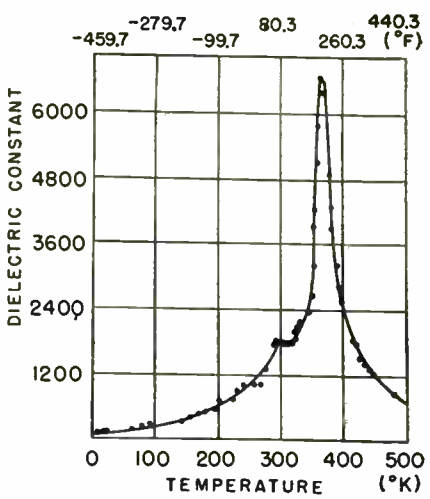
Barium Titanate Has Dielectric Constant Over 1000

B. Wul and V. Ginsburg (Journal of Physics, Moscow, Russia, Vol. X, No. 2, 1946, pp. 95-105 and pp. 107-115).

The first article by B. Wul deals with a theoretical investigation of the relation between chemical composition, crystal structure and dielectric properties of titanates of berillium, calcium, strontium, barium, magnesium, zinc, and cadmium, all metals of the second group of the periodic system. It is established that the perovskite crystal lattice causes a higher dielectric constant than the ilmenite lattice, and further that the effect of the type of crystal lattice outweighs the effect of the polarizability of the metal ions involved. Another systematic dependence is the increase of the dielectric constant with an increase in the radius or the atomic number of the metal due to the larger distances between the ions in the lattice.

As indicated by these rules, barium titanate has the highest dielectric constant; measurements gave a value exceeding 1000. The very strong temperature dependence of the dielectric constant at 1 mc is illustratd in Fig. 1. No variation with frequency was observed at room temperature and for a range of 50 cycles to 150 mc. Some variations in dielectric constant with changes in pressure and voltage are reported. Dielectric hysteresis is recorded. These particular properties are manifest in the temperature region below the Curie point, 80°C (176°F). The unusual properties of barium titanate are interpreted in analogy to ferromagnetism and it is suggested that barium titanate repre-

Fig. 1. Dielectric constant of barium titanate at 1 mc



sents a new type of insulator which may assume the same significance among dielectrics that ferroelectrics have among conductors.

In an effort to find a material with a desired temperature coefficient of the dielectric constant, a mixture of magnesium titanate and a compound of titanium dioxide and dolomite appears to be most

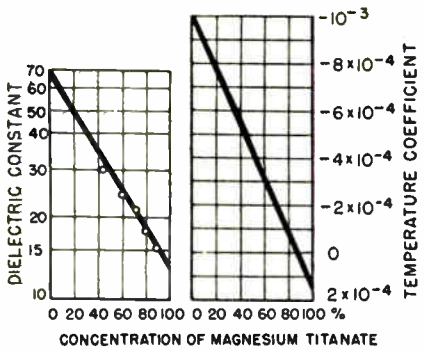


Fig. 2. Dielectric constant and temperature coefficient of dielectric constant as function of percentage of magnesium titanate in mixture with titanium dioxide

suitable. By varying the percentage content of magnesium titanate, a material having a dielectric constant between 14 and 70 (see left-hand curve on Fig. 2) and a temperature coefficient of the dielectric constant between -10^{-3} and $+1.5 \times 10^{-4}$ (see right-hand curve on Fig. 2) is obtained.

In a separate article V. Ginsburg presents a thermodynamic study on the gradual phase transition of barium titanate from a pyroelectric to a non-pyroelectric state at its Curie temperature, 80°C (176°F). The exceptional behaviour of barium titanate is compared with similar phenomana observed in Rochelle salt, quartz, KH_2PO_4 and KD_2PO_4; piezoelectric properties of barium titanate are established below 176°F.—JZ

Noise Reduction in Pulse Amplifiers

H. Koehler (Elektrische Nachrichten-Technik, Berlin, Germany, Vol. 20, No. 3, pp. 61-65.)

Square-wave response of an RC-coupled amplifier is investigated relating noise-level, time-delay characteristics and pass-band width. Output noise is proportional to amplification and to the root of the pass-band width. Further the pass-band width, and consequently the noise, increases with the time constant of the parallel elements: internal tube resistance, plate-cathode capacitance, output resistance, input resistance of the following tube and grid-cathode capacitance of the following tube.

When operating a relay, it may be desirable to have a large signal-to-noise ratio. However, increased signal-to-noise ratio for a desired amplification can only be obtained by a reduction in pass-band width and associated increase in delay time. The decay time constant is given by the reciprocal of half the band width.—JZ

Spiral Chronograph

R. J. Emrich (The Review of Scientific Instruments, March 1947, pp. 150-157).

The spiral chronograph involves a cathode-ray tube with a spiral deflection path traced at a rate of 10,000 revolutions per second and interrupted every 5 microseconds for 0.5 microsecond. Tracing starts at the beginning of the time interval to be measured and stops at the end of the time interval so that the length of the time interval can be readily found by counting the number of revolutions of the spiral on the screen. A long persistence screen facilitates immediate counting while the taking of photographs supplies permanent records. Time intervals up to 2000 microseconds can be measured with an error not exceeding one microsecond, equivalent to 0.01 turn of the spiral. Measurements may be repeated every 30 seconds.

Inspection of the schematic diagram will reveal the principle of operation of the spiral chronograph. Details of the individual sections generating the beam control voltage and the deflecting voltages are illustrated separately and their functioning is explained. The spiral is produced by means of two sinusoidal voltages, 90 deg. out-of-phase, the amplitude of which decreases linearly with time. The modulating signal generator provides a negative sawtooth wave which continuously reduces the amplitude of the 10 kc sinusoidal voltage.—JZ

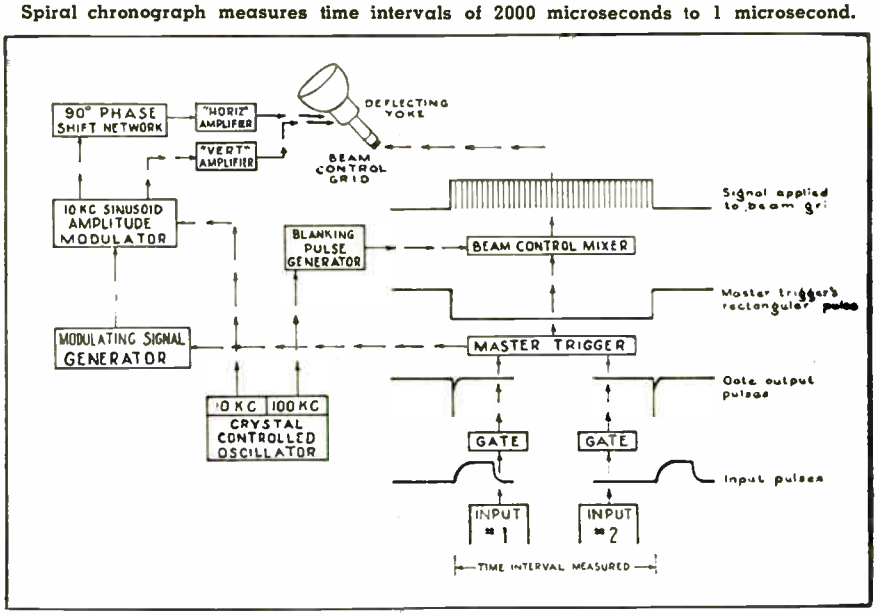
Single-Layer Solenoids

R. G. Medhurst (Wireless Engineer, London, England, February, 1947, pp. 35-43 and March, 1947, pp. 80-92).

Previously known expressions for the resistance, self-capacitance and inductance of single-layer coils are compared with experimental results on about 40 different coils. Corrected formulae and tables in agreement with the measured values are obtained. The ratio of coil length to coil diameter and the ratio of wire diameter to turns spacing are made the basis for all computations. A range of zero to infinity is covered for the coil length to coil diameter ratio and a range of 1.0 to 0.1 for the turns spacing ratio.

A table of values is compiled for the ratio of high frequency resistance of a coil to the resistance of a straight wire of equal length at the same frequency. A simple expression for the Q-value of a coil is found which involves only the

Spiral chronograph measures time intervals of 2000 microseconds to 1 microsecond.



mean radius of the coil, the operating frequency, and a variable which is tabulated as a function of the coil dimension ratios. Another table facilitates the numerical evaluation of the self-capacitance of single-layer coils. Multiplication of the tabulated figure with the mean coil diameter gives the self-capacitance.—JZ

Reduction of Microphonics

A. H. Waynick (Journal of Applied Physics, February, 1947, pp. 239-245)

Mechanical oscillations of the grid structure in a tube may cause variations in the plate current. Theoretical and experimental studies of this effect for planar triodes indicate its dependence on various parameters. It depends strongly on the frequency, presumably because of mechanical resonances of the grid rods. It varies considerably with grid bias, and its disturbing effect may consequently be reduced by a suitable choice of bias voltage. Plate voltage also influences microphonic output. Tubes may be designed with a view to minimize microphonic disturbances for desired operating conditions. Alternatively, mechanical vibrations of the grid can be transformed into plate current variations for use in a vibrations indicator.—JZ

Distributing Television Signals

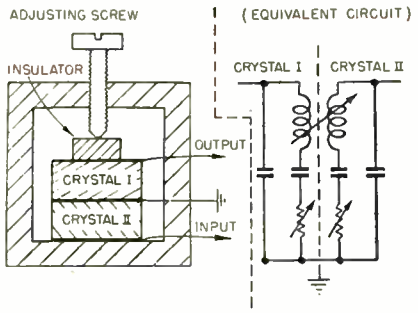
Y. Angel (La Télévision Française, Paris, France, March, 1947, pp. 7-11).

Different methods of servicing large areas with a wide-band television signal are considered. Coaxial cables and repeater stations, radio waves and relay stations, or relaying by aircraft are compared as to their economical aspects, performance, technical difficulties, etc.—JZ

Quartz Transformer

Y. Angel (La Télévision Française, Paris, France, March-April, 1947, pp. 107-111).

In an article on piezoelectric filters for receivers, the quartz transformer is mentioned. It incorporates two quartz crystals of identical resonance frequency, the two adjacent silver electrodes of which are grounded, see figure. A screw mounted in the isolating support permits adjustment of the over-all pressure. As indicated on the equivalent circuit on the right-hand side of the figure, the mutual inductance,—dependent on the distance between the two crystals, —as well as the resistances,— which are a function of pressure, —will vary when the screw is rotated.



Quartz transformer and equivalent circuit

The combination is electrically equivalent to a transformer with a high Q-value of 4,000, the pass-band of which can be readily adjusted between 10 cycles and 1,000 cycles. Undesired frequencies may be eliminated by so dimensioning the two crystals that, though they have identical resonant frequencies, their response to other frequencies is different.

Another development is a quartz shaped as an annular cylinder or like a doughnut; its axis is identical with the electric axis of the quartz. The resonant frequency of this annular quartz is equal to 110 times its thickness, as compared with 104 times their thickness for quartz plates.—JZ

Television Receivers

A. Wright (RCA Review, March, 1947, pp. 5-28.)

Several receiver models are described as to their appearance and performance. Complete receiver circuits are illustrated and special features are discussed in more detail. The rf tuner includes three 6J6 double triodes operating as rf amplifier, local oscillator and converter, respectively; inductance tuning is used. Staggered tuning in the four-stage, IF, video amplifier assures the required wide-band and provides absorption traps for the associated sound channel, and the adjacent sound and picture channels to reduce interference. Two video amplifier stages follow the IF amplifier.

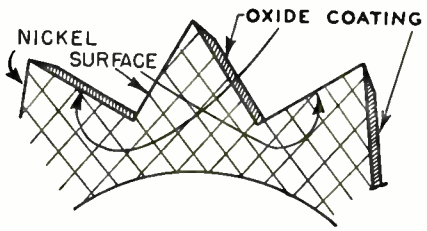
An automatic hold control is incorporated in the horizontal deflecting circuit. The hold control compares the phase of the synchronizing pulse with that of a locally generated oscillation and applies the output of the discriminator comparison circuit to a reactance tube which controls the local oscillator to be exactly in phase with the synchronizing signal. An ion trap magnet deflects the ions of the 10BP4 kinescope tube to prevent discoloration of the picture screen.—JZ

Excess Noise in Cavity Magnetrons

R. L. Sproull (Journal of Applied Physics, March, 1947, pp. 314-320).

It was observed that magnetron oscillations were frequently modulated with excess noise many times larger than the expected shot noise. Excess noise is not noticed if the magnetron operates in the transmitter circuit, however, it is of importance in any development of receiving tubes and in special applications.

Measurements indicated that the excess noise is small for low anode voltages. At some voltage, V_o, the noise current started to increase very rapidly with an increase in anode voltage, assuming values 100 and 1000 times the low voltage



Oxide coated cathode for magnetron, designed to reduce excess noise

noise value. This region of excess noise contained the ordinary operating point of the magnetron oscillator. Similar phenomena were observed in magnetrons of different design.

The hypothesis developed attributes excess noise to ionized atoms removed from the cathode coating by electron bombardment. Based on this hypothesis a special cathode, see figure, was constructed with a view to reduce excess noise and to raise the starting voltage V_o. To prevent the removal of cathode material by back-bombarding electrons, the cathode was shaped as a 13-pointed star; only

one side of each star point was coated with oxides. Under these conditions and for the correct orientation of the magnetic field, the returning electrons will strike the nickel surface instead of striking the oxide coating. Measurements showed that the excess noise starting voltage, V_o, is 200-300 volts larger when the magnetic field is applied in the correct sense. Cathodes with sheltered oxide coating may permit substantially longer life than has previously been experienced with magnetrons.—JZ

Theory of Magnetron Operation

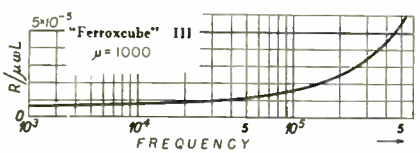
F. Ludi (Helvetica Physica Acts, Basel, Switzerland, Vol. XIX, No. 1, 1946, pp. 3-20).

The electron paths in magnetrons are studied and the formation of electron bunches is investigated. It is found that the cathode radius and the number of anodes are closely related to the efficiency. A formula for the optimum magnetic field intensity and the associated anode voltage is derived. Experimental results in agreement with the theory are reported.—JZ

Ferrites as Core Material

J. L. Snoek (Philips Technical Review, Eindhoven, Holland, December, 1946, pp. 353-360).

Ferrites are compounds of the type MFe_2O_4, where M denotes a bivalent metal. Most of these nonmetallic substances are ferromagnetic, in other words their permeability is high though their electrical conductivity is low. It



Losses in "Ferroxcube III" as function of frequency

is essential for the ferromagnetism of the substance that both types of ions, the iron and the other bivalent metal ion, occupy similar places in the crystal structure and are therefore readily interchangeable. For the present purpose ferrites with a cubic crystal structure and with a bivalent metal ion having approximately the size of the iron ion have particularly interesting properties. These ferrites are obtained by substitution of the bivalent iron ion in the cubic Fe_3O_4 by another bivalent metal. Magnesium, manganese, cobalt, nickel, copper, zinc, and cadmium appear to have promising qualifications. The cubic ferrites can form mixed crystals in all proportions and it has been found that under favorable conditions mixed crystals of magnetic with nonmagnetic ferrites, particularly with zinc ferrite, have very high values of initial permeability, see table.

The different grades of ferrites manufactured by Philips are marketed under the trade names "Ferroxcube" I, II, and III. The important expression

$$\frac{R}{\mu f L} = \frac{2\pi}{\mu} \cdot \frac{R}{\omega L} = \frac{2\pi}{\mu} \cdot \frac{1}{Q}$$

which is a measure of the sum of hysteresis losses, eddy current losses and residual losses is plottted in the diagram as a function of frequency for "Ferroxcube" III; its permeability is about 1000. It is possible to reduce the residual losses, which contribute most to the overall loss figure, at the cost of permeability only. The highest frequency limit so far reached, about 40 mc, was obtained with a nickel-zinc ferrite having an initial permeability of about 50.

Discs, rings, cubes, etc. are made by compressing the powdered ferrite in steel molds. Long cylindrical shapes are obtained by mixing the powdered material with a binder to form a plastic mass which is then forced through an aperture of the required shape. Annealing at temperatures between 1000°C and 1400°C causes evaporation of the binding agent.

"Ferroxcubes" are particularly recommended as core material and for shielding in band-pass filters for carrier wave telephony. An assembled coil having a quality factor of 600 at 60 kc occupies a volume of 44 cm^3. The size of intermediate frequency band pass filters can be considerably reduced by the use of "Ferroxcube". "Ferroxcube" may be used for permeability tuning and for induction heating purposes.—JZ

Table listing initial permeability of ferrites and mixed crystals

Ferrites and Mixed crystals	Initial permeability
$Fe\,Fe_2O_4$ (normal)	appr. 10
$Fe\,Fe_2O_4$ (stress-free)	appr. 70
$Cu\,Fe_2O_4$ (quenched)	appr. 70
$Mg\,Fe_2O_4$	max. appr. 10
$Ni\,Fe_2O_4$	max. appr. 10
$Co\,Fe_2O_4$	scarcely > 1
$Mn\,Fe_2O_4$	max. appr. 250 but inconsistent
$Cu\,Fe_2O_4 + Zn\,Fe_2O_4$	appr. 1500
$Mg\,Fe_2O_4 + Zn\,Fe_2O_4$	appr. 700
$Mn\,Fe_2O_4 + Zn\,Fe_2O_4$	appr. 3000
$Ni\,Fe_2O_4 + Zn\,Fe_2O_4$	appr. 4000

Sound Transmitted on Video Carrier

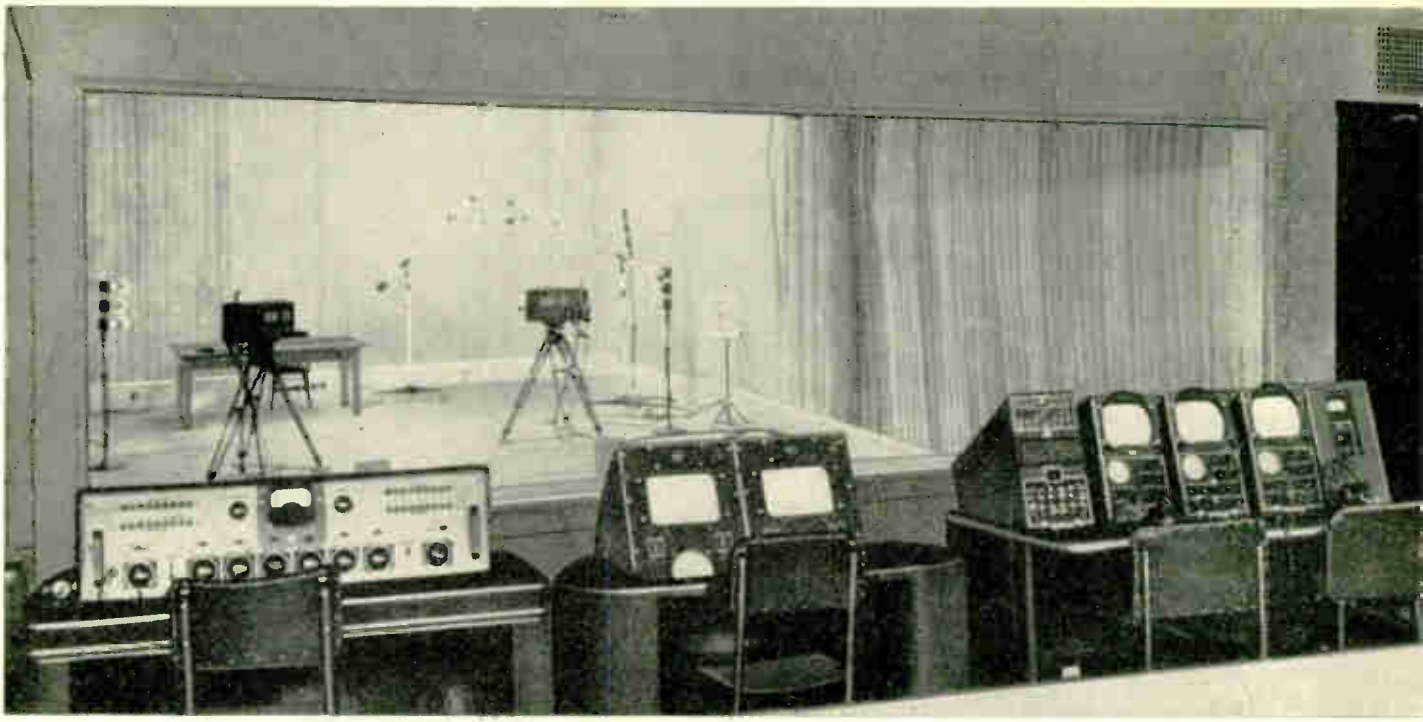
D. I. Lawson, A. V. Lord and S. R. Kharbanda (Journal of the Institution of Electrical Engineers, Part III, London, England, No. 24, 1946, pp. 251-275).

Test equipment has been built where the sound is transmitted during the line synchronizing period by a pulse-width modulation method. The modulation frequency must not exceed one-half of the pulse recurrence frequency. Demodulation may be accomplished by passing the pulses through a low-pass filter having a cut-off frequency below one-half of the pulse recurrence frequency. Using the British pre-war television standards, an upper limit of the transmitted audio-frequency range would be 5 kc.

Pulse-amplitude, pulse width, pulse position or pulse recurrence frequency may be alternatively modulated by the audio signal. These four methods are compared as to their merits and pulse width modulation is given preference because of the comparative simplicity of the associated receiver and the low signal-to-noise ratio. The total period allowed for each sound modulated pulse is 5μsec, so that the 2μsec modulation entails an acceptable minimum pulse width of 1μsec. Under these conditions, the resulting audio signal will have an amplitude of 0.4 percent of the peak white-signal.

In the receiver, the width modulated pulses are separated from the video waveform by cutting the pulses above the peak-white level of the picture. A circuit designed for this purpose includes a double-triode, the second section of which passes only the audio pulses. A low-pass filter couples to the following stage where the sound wave-form is recovered from the pulses. For this purpose a parallel resonant circuit tuned to the pulse

(*Continued on page* 116)

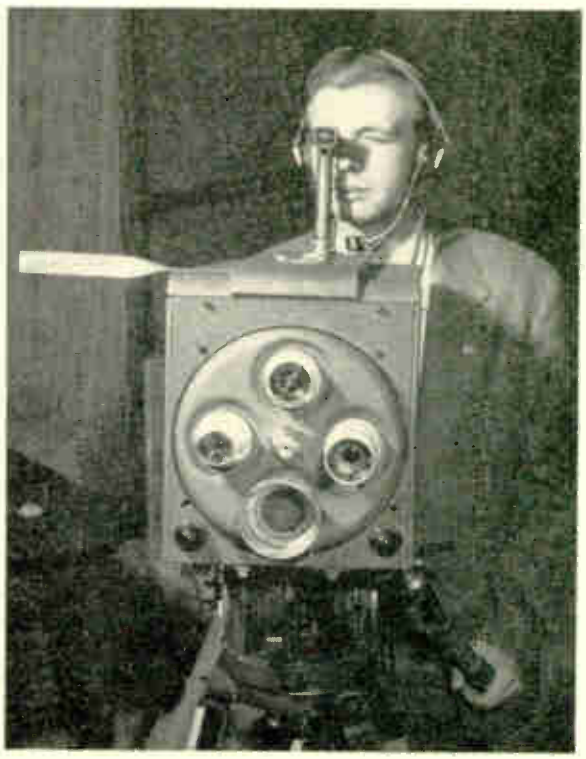


General view of the main studio, control room and monitoring equipment of the new TV station of the St. Louis (Mo.) Post-Dispatch. KSD-TV is the first postwar television station to be completely RCA equipped, from cameras to antenna

Modern TV Station Installation

This view of the studio shows the bare equipment before the scenery was installed and gives a good idea of the flexibility of the lighting arrangements

One of KSD's new Image-orthicon cameras showing turret which accomodates lenses of four focal lengths. Lowest holder is for telephoto lenses, used only on remotes



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By ALFRED JORYSZ, Development Engineer
Presto Recording Corp., New York

A compilation of technical and engineering articles which have appeared in print from 1921 to date with brief digests of each

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WITH the increasing use of disk recording for broadcasting purposes there has long existed an urgent need for a bibliography which would serve as a valuable source of reference material for the use of engineers involved with the technical development of improved equipment. This listing covers all important articles which have appeared in technical magazines during the past 25 years.

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L. B. Hallman, Jr., "Practical volume compression," Electronics, vol. 9, pp. 15-17, 42; June, 1936: New automatic volume compressor without cut-off on peaks and low distortion.

E. P. Irany, "New synthetic resins in manufacture of gramophone records," Canad. Chem. and Met., vol. 20, pp. 193-195; June, 1936: Requirements for gramophone records and some of the new resins used.

E. A. Ollard, "Gramophone record matrices," Metal Industry, vol. 49, pp. 165-169; August, 1936; pp. 239-242, 265-266; September, 1936: Electroplating process used in manufacturing matrices.

"Sound on discs," Electronics, vol. 9, pp. 6-10, 48, 50; October, 1936: New recording materials, new equipment and new technics which give results almost equal to the original studio pickup.

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R. P. Glover, "A record-soving pickup," Electronics, vol. 10, pp. 31-32; Feburary, 1937: A reduction of the change in tracking angle, as needle moves from center to edge, is claimed to minimize record wear considerably.

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J. R. Bird and C. M. Chorpening, "The off-set head crystal pickup," Radio Eng., vol. 17, pp. 16-18; March, 1937: Principles underlying a method of avoiding tracking distortion in a new type of pickup arm.

G. J. Saliba, "Instantaneous recording head," Communications, vol. 17, pp. 8-9, 16, 25; March, 1937: Features of a new cutting head include special armature construction, low operating level and high sensitivity expressed by the modulation of a 112 lines per in. cut.

A. C. Keller, "Direct recording and reproducing materials for disc recordings," Jour. Soc. Mot. Pict. Eng., vol. 28, pp. 411-426; April, 1937: Materials available for direct disc recording classified chemically in five groups and measurements of frequency characteristics, surface noise, life and distortion. Data for both lateral and vertical recording.

E. W. Kellogg, "A review of the quest for constant speed," Jour. Soc. Mot. Pict. Eng., vol. 28, pp. 337-376; April, 1937: Importance of constant record speed. Brief descriptions and discussions of a number of ingenious arrangements for improving speed constancy, some applicoble to turntables, some to film drives.

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T. L. Dowey, "Disc recording," part 2, Communications, vol. 17, pp. 17-19, 58, October, 1937: High quality recording and reproducing equipment and advantages of vertical recording.

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H. Bartels and E. Severin, "On the development of new cutters and pickups," Telefunkenzeitung, Nr. 75, pp. 27-37; 1937: Theoretical and practical considerations that enter into the design of new high quality recording and reproducing heads, and a description of their performance.

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D. G. Knapp, "Offset head crystol pickup," Communications, vol. 18, pp. 28-29; February, 1938: An exact formula is derived for optimum value of the ratio of overhang to pickup arm length (for nearly constant tracking error).

W. F. Wichart, "A turntable wobble indicator," Electronics, vol. 11, p. 13; February, 1938: It is claimed that the instrument is fairly accurate and sensitive. Further advantages are its simplicity, portability and low cost.

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A. W. Niemann, "Measuring the recording system with limited equipment," Communications, vol. 18, pp. 14-15, 36-37; May, 1938: Procedures for checking recording equipment with relatively simple measuring apparatus. Discussed are: impedance measurements, frequency characteristics, peak load capacity, non-linear distortion and maximum permissible recorded amplitude.

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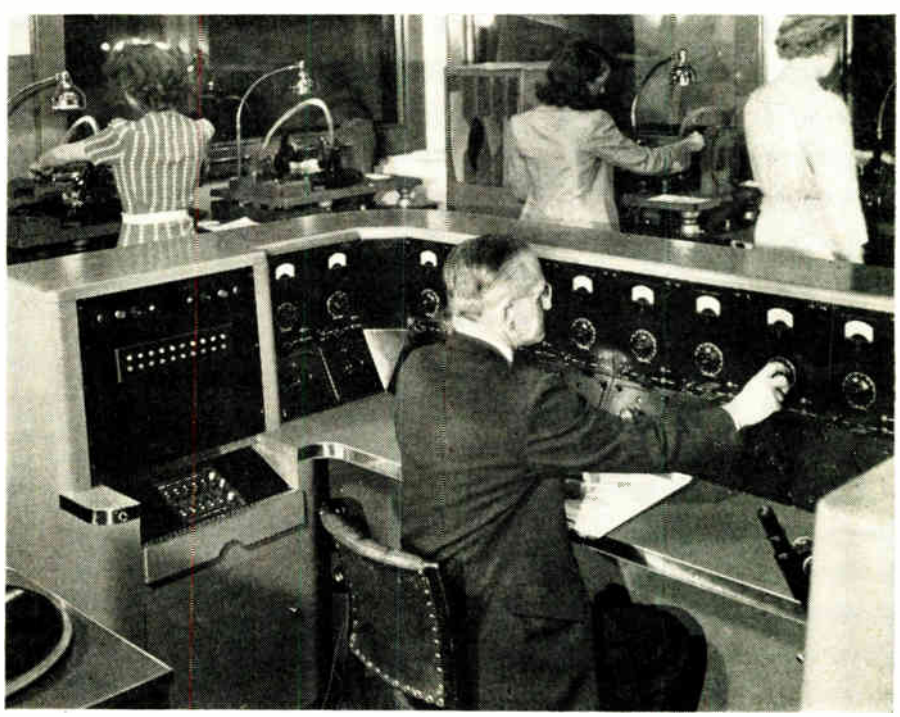
Control console and a few of many recording turntables installed originally at New York headquarters of the former Office of War Information now the Office of Information and Cultural Affairs, Broadcast Division (OICBD)



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H. Rahmel, "Variable equalizer amplifier," Electronics, vol. 14, pp. 26-29, 61; July, 1941: Amplifier with variable frequency characteristics permitting maximum fidelity reproduction of records made under a variety of recording conditions.

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H. Fletcher, "Hearing, the determining factor for high-fidelity transmission," Proc. I.R.E., vol. 30, pp. 266-277; June, 1942: Requirements for ideal speech and music transmission systems based on extensive tests and measurements made under a variety of conditions. Comparison between a wide band single channel system and a narrow band two-channel stereophonic system.

C. B. de Soto, "How recordings are made," Q.S.T., vol. 26, Part 1: "Principles of disc recording, pp. 30-34, 94, 96; July, 1942. Part 2: "The recorder," pp. 56-59, 104, 110; August, 1942. Part 3: "The amplifier," pp. 65-72, 118, 120; September, 1942. Part 4: "Playback" pp. 54-59, 114, 116, 118; October, 1942. Part 5: "Tests and trouble shooting," pp. 51-55, 88, 90, 92, 106; December, 1942. A detailed discussion of the practical aspects of disc recording.

H. Keller, "Piezoelectric pickup," Hochfrequenztechnik and Elektroakustik, vol. 60, pp. 5-10; July, 1942.

L. C. Smeby, "Recording and reproducing standards," Proc. I.R.E., vol. 30, pp. 355-356; August, 1942: Report on a series of standards adopted by the National Association of Broadcasters covering recording characteristics, dimensions of turntables, records and grooves; speeds and label information.

M. Rettinger, "A modern music recording studio," Jour. Soc. Mot. Pict. Eng., vol. 39, pp. 186-194; September, 1942: Description of a new recording studio and discussion of constructural details, in particular the influence of convex wood splays on the reverberation characteristic.

P. L. Jensen, "The Jensen concert needle," Radio, vol. 26, pp. 24, 41; October, 1942: A long life playback needle with a precious metal tip has high compliance, low needle talk and its use is claimed to result in a reduction of scratch and record wear.

H. D. Brailsford, "Recording machinery noise," Electronics, vol. 15, pp. 46-51, 164-166; November, 1942: Cutting and playback apparatus used for accurately recording sounds made by industrial and other equipment. Frequency spectrum analysis is then performed with oscilloscope, camera and sound analyzer.

1943

A. D. Burt, "The reduction of "record noise" by pickup design," Electronics, vol. 16, pp. 90-93, 198, 199; January, 1943: Crystal pickup in which the usually highly objectionable needle talk is removed at its source through special construction features of the reproducer. Test setup measured results.

H. E. Roys, "The measurement of transcription-turntable speed variation," Proc. I.R.E., vol. 31, pp. 52-55; February, 1943: Review of some existing speed measurement equipment; need for simplified instrument to evaluate wow content as a single figure. Ballistic constants of indicating meter represent greatest design problem.

C. R. Keith, "Sound recording depends upon electronics," Electronics, vol. 16, pp. 114-115; March, 1943: General review of the recording field and its development since the 1920's.

G. L. Beers and C. M. Sinnet, "Some recent developments in record reproducing systems," Proc. I.R.E., vol. 31, pp. 138-146, April, 1943: An experimental record reproducing system using the principle of frequency modulation; data on the measured and computed performance characteristics of the pickup.

A. J. Ebel, "High fidelity systems," Communications, vol. 23, pp. 39-40, 42, 44; April, 1943; pp. 24, 26, 28, 62-63, 66-68, 70-71; May, 1943: An ideal electro-acoustic transmission system requires: uniform frequency response from 20 to 15,000 cycles, linear amplitude range of 75 db with 1% distortion and a noise level 75 db below peak level.

T. R. Kennedy, Jr., "Hi Fi transcribing," Electronic Ind., vol. 2, pp. 90-91, 161; May, 1943: High quality recordings are made off the air with special receiver and recording equipment perfected by the author.

"Static charges on records," Wireless World, vol. 49, p. 165; June, 1943: Glass base blanks are made with fiber insert to counteract the accumulation of an electrostatic charge.

A. M. Wiggins, "Mechanical impedance bridge," Jour. Acous. Soc. of Amer., vol. 15, pp. 50-53; July, 1943: Instrument to measure mechanical impedances of phonograph pickups over a frequency range from 30 to 10,000 cycles.

1944

C. R. Miner, "Wow meter," Gen. Elec. Rev., vol. 47, pp. 31-34; April, 1944: Simplified electronic instrument for measuring instantaneous variations of phonographs turntable speed. Based on the use of a 1000 cycle frequency record, a frequency discriminator circuit and an indicating meter.

R. Dally, "Tone arm design," Radio, vol. 28, pp. 34-36, 72; July, 1944: Fundamental principles of tone arm design and practical considerations to be observed in their application.

R. Dally, "Crystal phonograph pickups," Radio, vol. 28, pp. 38-40, 46: September, 1944: Operation, construction and characteristics of crystal pickups and their application in reproducing systems.

W. C. Miller and H. R. Kimball, "A re-recording console, associated circuits and const. B. equalizer," Jour. Soc. Mot. Pict. Eng., vol. 43, pp. 187-205: September, 1944: Two-position re-recording console with sliding volume controls and pre-set equalization, also a variable type attenuation equalizer circuit.

B. F. Miessner, "Frequency-modulation phonograph pickup," Electronics, vol. 17, pp. 132-133; November, 1944: Stylus movement causes a capacitance change in an oscillator circuit, thus producing frequency modulation. Pickup is claimed to have flat frequency characteristic, self-contained volume expansion and operates with less than one ounce of needle pressure.

1945

"Two-speed turntable for transcription," Electronics, vol. 18, pp. 230, 234; January, 1945: Unit designed to prevent playing of 78 rpm discs erroneously at 33 1/3 rpm.

B. B. Bauer, "Tracking angle in phonograph pickups," Electronics, vol. 18, pp. 110-115; March, 1945: Offset arm design and an overhanging needle help minimizing tracking error of a phonograph pickup. Design equations for optimum conditions and a design chart for use with 12-inch records.

B. B. Bauer, "Notes on distortion in phonograph reproduction caused by needle wear," Jour. Acous. Soc. Amer., vol. 16, pp. 246-253; April, 1945: High frequency losses and distortion caused by needle wear. The effects of "flat" spots appearing on the spherical tip for hill-and-dale and lateral modulations. Needle wear expressed as a function of playing time.

Th. Lindenberg, Jr., "Moving-coil pickup design," Electronics, vol. 18, pp. 108-110; June, 1945; correspondence, Electronics, vol. 18, pp. 416, 424; September, 1945: Reproducer with its mechanical resonance practically at the limit of audibility, thus ensuring light needle pressure and negligible record wear.

H. E. Roys, "Experience with an FM calibrator for disc recording heads," Jour. Soc. Mot. Pict. Eng., vol. 44, pp. 461-471; June, 1945: Performance of cutting heads under different load conditions, i.e. in air, cutting at 78 rpm and 33 1/3 rpm. Variations in recorded level with groove width and cutting stylus.

W. S. Bachman, "Phonograph dynamics," Electronic Ind., vol. 4, pp. 86-89, 124, 128, 190; July, 1945: Fundamental problems of disc recording. Limits of record amplitude velocity and acceleration and results compared with the NAB standards requirements. Groove wear and reproducer design.

"Strain-gage phono pickup" Electronic Ind., vol. 4, p. 89; August, 1945: Claims of wide frequency response, light needle pressure and lack of output due to vertical stylus motion for a pickup based on strain-gage design

W. M. Brooker, "Some aspects of sound recording," Proc. I.R.E. Australia, vol. 6, pp. 3-7; September, 1945.

Small independent WLAN, Lancaster, Pa., broadcast station, relies heavily on high-fidelity transcriptions for musical portions of its local program schedule

G. C. Misener, "Optical cueing device for disc playback," Jour. Soc. Mot. Pict. Eng., vol. 45, pp. 297-301; October, 1945: Simple optical arrangement which permits accurate placement of pickup stylus on the disc for cueing purposes.

N. C. Pickering, "Improving recordings," Electronic Ind., vol. 4, pp. B2-B4, 206, 210, 214, October, 1945: How to get the most out of phonograph records through proper adjustment of frequency range, reduction of distortion and the use of a new type of volume expander which increases "presence".

H. A. Chinn, "Glossary of disc recording terms," Proc. I.R.E., vol. 33, pp. 760-763; November, 1945: Prepared by the Recording and Reproducing Standards Committee of the National Association of Broadcasters.

W. L. Thayer, "A multisection re-recording equalizer," Jour. Soc. Mot. Pict. Eng., vol. 45, pp. 333-33B; November, 1945: Five equalizers are arranged so that they can be controlled by one hand. The equalizers are capable of emphasis or de-emphasis in five different frequency bands without changes in reproduced level.

B. B. Bauer, "Crystal pickup compensation circuits," Electronics, vol. 18, pp. 128-132; November, 1945: Consideration of record properties, pickup frequency response and listener acceptance lead to the determination of a compensating network for crystal pickups with the desired overall response.

R. G. Leitner, "New vibrating reed magnetic pickup," Radio, vol 29, pp. 25, 63; December, 1945: Design, construction and operating characteristics of a new type of magnetic pickup. Frequency response curves with and without damping.

R. W. Ehrlich, "Volume exponder design," Electronics, vol. 18, pp. 124-127; December, 1945: Electronic volume expander provides full expansion in about ten milliseconds and returns to normal gain in one second. Details of construction and oscillegrams showing performance.

1946

W. S. Bachman, "Phonograph reproducer design." Presented at A.I.E.E. winter convention New York, January, 1946: Problems in the design of strained wire resistance pickups and variable reluctance reproducers discussed with the aid of electrical equivalent circuits of mechanical systems.

A. Badmaieff, "Push-pull frequency modulated circuit and its application to vibratory systems," Jour. Soc. Mot. Pict. Eng., vol. 46, pp. 37-51; January, 1946: Push-pull action is accomplished by varying the resonant frequencies of both the oscillator and the discriminator in opposite phase relation to each other. Two capacitors with common plate achieve push-pull modulation. Applicable in the calibration of recording heads and the determination of their frequency response and distortion.

H. Davies, "B.B.C. disc recording — some technical details of the new equipment," Wireless World, vol. 52, pp. 14-18; January, 1946: Recording units developed by the B.B.C. for their own use.

L. D. Grignon, "A three-band variable equalizer," Jour. Soc. Mot. Pict. Eng., vol. 46, pp. 64-74; January, 1946: Equalizer providing emphasis and de-emphasis in three frequency bands with the important feature of zero insertion loss.

H. P. Kalmus, "Pickup with low mechanicol impedance," Electronics, vol. 19, pp. 140-145; January, 1946: Amplitude modulation is produced in a radio-frequency oscillator due to variation in its losses, which is caused by the movement of a metallic vane attached to the stylus. Pickup has low mechcnical impedance.

H. E. Roys, "Recently developed tools for the study of disc recording performance," Presented at A.I.E.E. winter convention, New York, January, 1946; see also Communications, vol. 26, pp. 33, 35; April, 1946: Investigation and measurements of cutting force, cutting head bounce, lacquer hardness variation, turntable speed accuracy and intermodulation distortion.

F. M. Haines, "High fidelity bass compensation for moving-coil pickups," Electronic Eng., vol. 18, pp. 45-46; February, 1946.

H. E. Haynes, "An integrating meter for measurement of fluctuating voltages," Jour. Soc. Mot. Pic. Eng., vol. 46, pp. 128-133; February, 1946: Instrument for measuring voltages of fluctuating amplitude by integrating them over a short interval. Possible application as a turntable speed meter.

J. K. Hilliard, "Intermodulation tests for comparison of beam and tetrode tubes used to drive loud speakers," Communications, vol. 26, pp. 15-17, 54; February, 1946: Examination of the outputs of 10-, 15-, 40- and 50-watt amplifiers with beam power and triode tubes using an intermodulation analyzer. Comparison of results with actual listening tests.

H. H. Scott, "The meosurement of audio distortion," Communications, vol. 26, pp. 23-25, 52-56, April, 1946: Study of methods used to measure non-linear or harmonic distortion which may include components not necessarily harmonically related to the signal. Procedures and instruments for distortion measurements in audio systems.

B. F. Fredendall, "Lateral disc recording," Part 1. Broadcast Eng. Jour., Vol. 13, pp. 4-5, 12; May, 1946: Fundamental principles of present day recording. Constant amplitude and constant velocity recording characteristics.

P. C. Erhorn, "Nuernberg trial recording system," Electronic Ind., vol. 5, pp. 70-73, 111-112, 114, 114B; June, 1946: Technical details of the complete recording, interpreting and broadcasting systems used during the trials of German war criminals.

B. F. Fredendall, "Lateral disc recording," Part 2, Broadcast Eng. Jour., vol. 13, pp. 4-6, 9; June, 1946: Discussion of sound energy distribution and equalization in disc recording. The use of the optical pattern in determining the frequency characteristic of a cutting head.

N. C. Pickering, "Measuring audio intermodulation," Electronic Ind., vol. 5, pp. 56-58, 124-125; June, 1946: Methods and equipment for analyzing audio distortion by the application of two signals to the tested device. Relationship between harmonic and intermodulation distortion.

S. T. Rich, "Torsional magnetostriction pickup," Electronics, vol. 19, pp. 107-109; June, 1946: Design and characteristics of a phonograph pickup operating on leakage flux in a torsional magnetostriction system. Wide frequency response and ruggedness are obtained with a small moving mass and low distortion.

J. D. Goodell and B. M. H. Michel, "Auditory perception," Electronics, vol. 19, pp. 142-148; July, 1946: Factors affecting design and use of inverse volume-expansion circuits, tone controls and other methods of obtaining response having a subjective effect that approaches true high-fidelity reproduction.

J. K. Hilliard, "Intermodulation testing," Electronics, vol. 19, pp. 123-127; July, 1946: Fidelity of audio amplifiers is determined by intermodulation tests. Results thus obtained show closer correlation with actual listener tests than harmonic distortion measurements.

H. Kalmus, "Improved modulated-oscillator pick-up," Electronics, vol. 19, pp. 182, 184, 186; July, 1946: New version of the circuit used in the Cobra pickup, resulting in 15 to 20 db output increase and 6 db microphonics reduction.

A. A. Kees, "Recording and broadcasting of preparation for Bikini Atom-bomb test," Communications, vol. 26, pp. 11-13; July, 1946: Methods used to prepare "on spot" recordings in planes, at sea and on land. Amplifiers and recording equipment are selected to operate under conditions of extreme temperature and vibrations.

"A new moving-coil pickup," Electronic Eng., vol. 18, pp. 224-226; July, 1946: Description of a wide range pickup with low needle pressure which uses playback needles of special shape.

"Mechanical modulation of electron flow," Electronics, vol. 19, pp. 178, 180, 182; July, 1946: Metal electron tube weighing 1/15 of an ounce converts mechanical motion directly into variable electron flow. Usable as pickup head.

A. N. Butz, Jr., "Surgeless volume expander "Electronics, vol. 19, pp. 140, 142; September, 1946: Single-ended expander requiring no push-pull transformer for cancelling out the d-c surge in the expander tube. Dynamic change in signal tube plate current is balanced out by opposite change of screen current in dummy tube.

A. J. Campbell, "Laterol disc recording at the Naval Research Laboratory," Communications, vol. 26, pp. 11-15, 50; September, 1946: NRL recording system facilities and performance. Modifications made on commercial equipment used in the laboratory.

A. B. Kaufman and E. N. Kaufman, "Carbon phonograph pickup," Electronics, vol. 19, pp. 162, 164, 166, 168; September, 1946: Reproducer with phonograph needle mechanically connected to carbon microphone button. Response essentially flat from 100 to 6000 cycles, output between 6 and 45 volts using commercial records.

B. B. Bauer, "Measurement of recording characteristics by means of light patterns," Jour. Acous. Soc. Amer., vol. 18, pp. 387-395; October, 1946: Analytical treatment of the geometry of optical patterns formed by light reflection from record groove walls. Influence of angles of light incidence and reflection, included groove angle and distances between record, light source and observer.

J. D. Goodell, "The reproduction of disc recordings," Part 1, Radio-Electronic Engineering, vol. 7, pp. 5-7, 27-29; October, 1946: Development of high quality reproducers and associated problems of pickup arm design, tracing distortion, surface noise and pre-equalization.

W. F. Leidel, Jr. and N. E. Payne, "Tuned-ribbon pickup," Electronic Ind., vol. 5, pp. 67-69, 100-101; October, 1946: New reproducer extends playback range to 15 kilocycles, providing at the same time "magnetic cushion" for record noise suppression. Discussion of the various forces acting on a pickup during playback.

I. L. Capps, "Recording Styli," Electronic Ind., vol. 5, pp. 65, 67, 100, 102, 104, 106, 108, 110; November, 1946: Importance of stylus contour, cutting edge and burnishing facet is stressed. Correlation between the stylus radius cutting pitch and cutting depth is pointed out.

H. A. Chinn, "Disc recording," Electronic Ind., vol. 5, pp. 64, 66; November, 1946: Variety of recording and reproducing styli used in the industry demonstrates pressing need for standards, definitions and methods of measurements.

U. R. Furst, "Periodic variations of pitch in sound reproduction by phonographs," Proc. I.R.E., vol. 34, pp. 887-895; November, 1946: Causes of recurrent variations of pitch encountered in the reproduction of phonograph records, commonly called "wow". Design of an instrument to measure these variations at 78 rpm.

K. J. Germeshausen and R. S. John, "Phonograph pickup using strain gage," Electronic Ind., vol. 5, pp. 78-79, 118, 120; November, 1946: Wide-range reproducer using the resistance vs. strain characteristic of carbon. Pre-amplifier circuit with low frequency compensation.

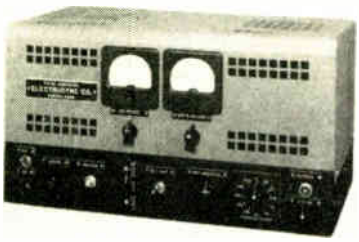
J. K. Hilliard, "40-watt beam-power amplifier for disc recording," Communications, vol. 26, pp. 22-24; November, 1946: Amplifier to maintain its rated output over a wide frequency range with low intermodulation distortion.

A. B. Ellis and J. P. Gilmore, "A problem in outdoor sound," Electronics, vol. 19, pp. 126-129; December, 1946: Audio facilities provided for Vancouver's 60th anniversary, including microphone placement to cover 520 by 125-foot stage and loudspeaker arrangement to cover 525 by 200-foot audience area.

J. B. Ledbetter, "Placement and operation of microphones in broadcast studios," Communications, vol. 26, pp. 12, 13, 15; December, 1946: Analysis of microphone arrangements and discussion of phasing of microphones.

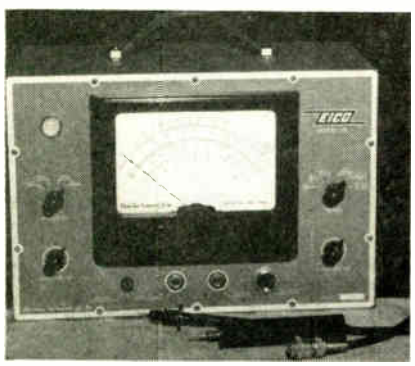
(*Continued on page* 104)

New Lab and Test Equipment



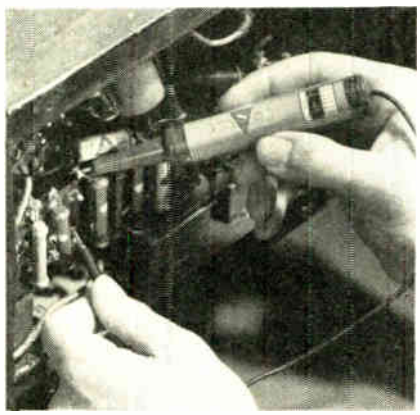
PULSE GENERATOR

Providing 3 output ranges of rectangular shaped voltage pulses of 1. 5, and 50 volts max., continuously variable from 0 to maximum of each range with an accuracy of ±5%, the Electrodyne Pulse generator utilizes a pulse triggered by the sweep of a type 208 oscilloscope at any sweep rate from 0-500 cycles per second or by any source of positive pulses of 20 volts minimum. A duration selector permits 12 different pulse durations of 10, 20, 35, 50, 75, 100, 150, 200, 300, 400, 700, and 1000 microseconds length. The pulse voltage is independent of repetition rate, and line voltage variations from 100-130 volts. The output voltage is calibrated for a load of approx. 10,000 ohms, the output impedance being determined by the position of the range switch. The instrument operates on ac.—*Electrodyne Co., 899 Boyston St., Boston 15, Mass.*



VISUAL SIGNAL TRACER

Model 210 vacuum tube voltmeter and visual signal tracer is suitable for general circuit testing. A 8½-in. D'Arsonval meter is used as indicator. Multiplier resistors are matched to 1% error. A UHF diode permits signal tracing from 20 cps to 100 mc. DC input resistance is 26 megohms, capacitance being 7 mmfd. Twenty-nine separate ranges are provided, covering 0-5,000 V. dc (± 2%) in 6 ranges, 0-1,000 V. ac in 5 ranges, 0.1 ohms to 1,000 megohms in 6 ranges, and db ranges. DC readings are made with a single high voltage test probe. —*Electronic Instrument Co., 926 Clarkson Ave., Brooklyn, N. Y.*

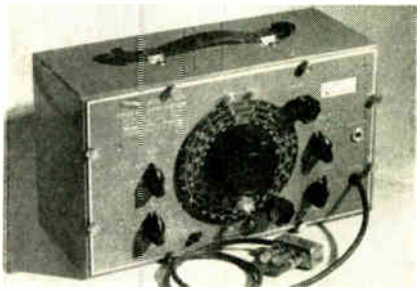


MINIATURE OHMMETER

Spot check of component values in radio receivers and electrical appliances is made conveniently with this miniature ohmmeter having a 0-10,000 ohm range on a 1.5 ma full scale Weston meter in series with a carbon resistor and penlight dry cell. The pocket-size ohmmeter is enclosed in a tubular plastic case ⅞ in. in diameter and 5¾ in. overall.—*Radio Tube Div., Sylvania Electric Products, 500 Fifth Ave., New York 18.*

FREQUENCY METER

For determining the resonant frequency of any resonant circuit within a range of 2.2 to 400 mcs by use of 7 plug-in coils or for measuring capacitance, inductance, mutual inductance, "Q", etc. the model 59 Megacycle meter comprises a variable frequency oscillator, an absorption wavemeter, an oscillating detector and a tuned absorption circuit detector. Essentially the familiar "grid-dip" meter, it is especially suited for receiver and transmitter adjustments. CW or 120 cycles fixed modulation is provided at approx. 30% at 15 mc. The instrument uses 3 tubes and operates on ac.—*Measurements Corp., Boonton, N. J.*



AM-FM SIGNAL GENERATOR

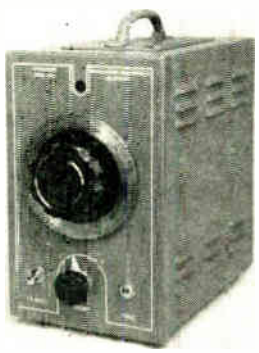
Utilizing an eight-range rotary turret-type oscillator to cover the range of 90 kc through 170 mc on fundamental frequencies, model 906 AM/FM signal generator provides advanced features such as multiple shielding, output microvoltmeter, dual variable and ladder 4-step attenuator etc., usually only found in costly instruments. All 8 ranges are directly calibrated to ±1% accuracy upon the 10:1 vernier-driven dial. Audio modulation at 400 cps. is variable from 0 to nearly 100%. FM output is available at any frequency between 90 kc and 210 mc with a total frequency swing adjustable zero to 500 kc, and at a sweep rate of 60 cycles. Output is controllable from less than 1 microvolt to 1 volt. —*McMurdo Silver Co., Inc., 12149 Main St., Hartford, Conn.*

INSULATION TESTER

For testing control circuits, generators, cables and other equipment in lighting and power installations and for production testing of all types of electrical equipment and components this "Megger" insulation tester can be plugged into the ac line instead of being hand-cranked. The rectifier-operated instrument is especially useful where a large number of tests are to be made at one time or where one test is to be continued for a longer period, such as dielectric absorption tests. The hand generator of the conventional "Meg" type tester is replaced by a power pack consisting of a constant voltage, step-up transformer and a selenium rectifier. The instrument covers a wide range. Ratings are available up to 2000 megohms and 1000 volts. —*James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa.*

ULTRASONIC GENERATORS

Suitable for a variety of research and industrial applications the Televiso Ultrasons generate stable sound vibrations in the ultrasonic range with controllable power and accurate resetting of vibration intensity. Model U-300 is a high power source for research and production applications, generating a max. of 250 watts in an oil bath with a variable frequency range. Model U-500 has been primarily designed as a research instrument for observation of ultrasonic effects by microscope and produces a max. of 6 watts power at the crystal with a variable frequency range. Standard vibration crystal frequency for both models is 450 kc. Different frequencies and crystal holders can be provided. The instruments operate on 115 volts, 50-60 cycle.—*Televiso Products Co., 7466 West Irving Park Rd., Chicago 34, Ill.*



INDUSTRIAL STROBOSCOPE

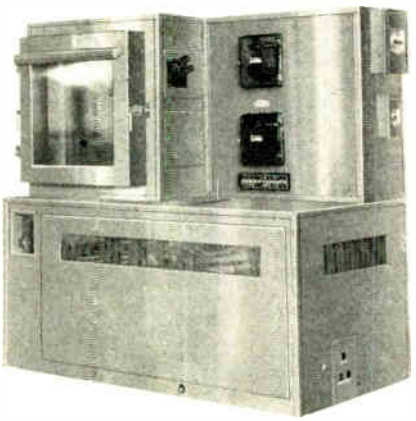
Chief uses of model 1210 Stroboscope are to check the speed of moving machinery and study undesirable motions and vibrations. The instrument operates over a range of 450 to 60,000 rpm using 1.1 flashing rates. This coverage is broken down into 4 ranges which are selected by means of a range switch on the panel. Accuracy is within 3% under all operating conditions. The unit uses four tubes including rectifier and operates off the 105-125 volts, 50-60 cycle supply. — *Communication Measurements Laboratory, Inc., 120 Greenwich St., New York 6.*

TUBE MANUFACTURE UNIT

Capable of performing all operations required for making incandescent lamps, electronic tubes, vacuum switches, photo-electric cells etc. this new-type electronic laboratory unit consists of a steel fabricated table, upon which the necessary machines and tools are located. Intended for experimental and research labs, colleges etc. the unit permits such glass working operations as glass cutting, flare and stem making, sealing-in, exhausting, basing, soldering, welding and vacuum testing.—*Eisler Engineering Co.. Newark 3, N.J.*

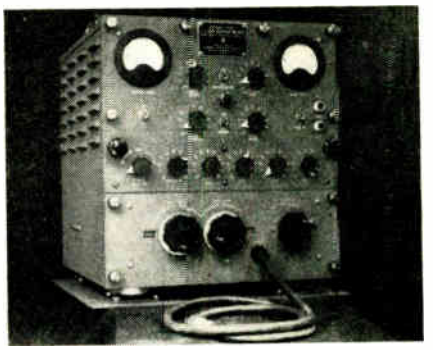
SIGNAL GENERATOR

Combining four basic units into one instrument to supply rf and af signal voltages for aligning AM and FM receivers the type YGS-3 signal generator has eight types of outputs of af, modulated and unmodulated crystal and rf. Fundamental frequency range of the rf oscillator is 100 kc to 150 mc while the FM oscillator operates with center frequencies of 1, 20 and 50 mcs and frequency deviations of ±20, ±300, and ±750 kc, respectively. The instrument also comprises a one-megacycle crystal calibrator and a variable frequency audio oscillator. The RC-type audio oscillator provides flat output from 100 to 12,000 cps.—*Specialty Div., General Electric Company, Wolf St. Plant. Syracuse, N. Y.*



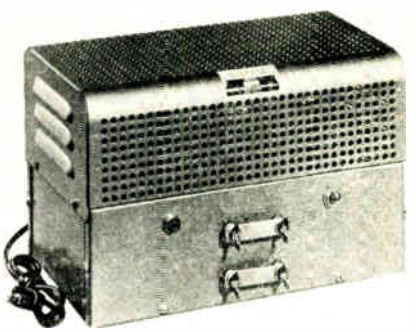
INSTRUMENT FOR COLD TESTING

Having a wide range of temperature control from +180° to −100°F, the Bowser laboratory units permit efficient cold testing and processing of materials for controlled conditions of temperature, altitude and relative humidity. Relative humidity may be simulated from 20% to 95% from 34° to 178°F. An oilsealed vacuum pump provides for altitude simulation to a vacuum of 1 in Hg, abs. at an average climb rate of 30,000 ft. per min. to 50,000 ft. The illustrated model L18-100 VH has a capacity of 18 cu. ft., but other units are available in capacities from 1 to 27 cu. ft. —*Bowser Inc., Refrigeration Div., Terryville, Conn.*



UHF SIGNAL GENERATOR

Designed to furnish an rf signal for the calibration and alignment of uhf receivers and for laboratory work in the range of 1200 to 4000 megacycles model P142 signal generator permits selection of an unmodulated, pulse modulated or 60-cycle frequency modulated signal. Oscillator of the unit is a velocity-variation reflex type using an adjustable cavity. Output voltage at the end of the 6 ft. 50 ohm cable will be greater than 40,000 microvolts for all frequencies within range. A bolometer with indicating meter permits continuous checking of rf output level.—*General Communication Co., Boston, Mass.*



POWER SUPPLY

Useful for servicing automobile, marine, and aircraft reecivers or for any purpose where a 6 or 12 volt power source is required model A power supply unit is equipped with oversize transformers, chokes, and rectifiers for negligible hum and high instantaneous power output. The unit consists of two 6 v., 7.5 amp. filtered dc power sources which can be connected in parallel for 15 amps. continuous service or in series for 12 v., 7.5 amp. continuous service. Dimensions of model A are 7¾ x 7¾ x 11¾ in. length, the weight being 31 lb. Operation is from 105-125 volts, 60 cycle, ac.—*Electro Products Laboratories Inc., 549 West Randolph St., Chicago 6, Ill.*

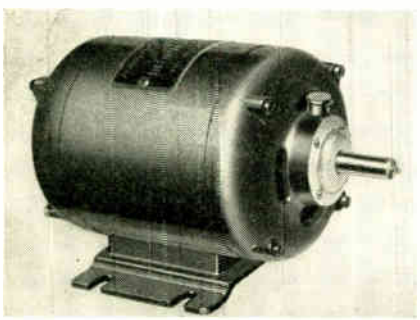
BATTERY CHARGER

Built in a heavy-gage steel cabinet and equipped with oversize transformer the Accurate selenium battery charger model 6-10-1 operates on any ac line. A fuse is provided for protection against shorted battery cells and against incorrect polarity connection. Charging rate starts at 10 amps. and tapers off to approx. 5.8 amps. for a completely charged battery.—*Accurate Engineering Co., 2005 Blue Island Ave., Chicago 8, Ill.*

Parts for Design Engineers

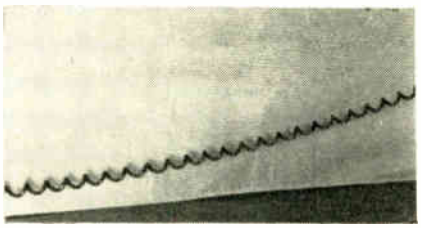
TRANSMITTING TUBE

Designed primarily for amateur, marine, and mobile radio transmitters, this beam power tetrode, measuring less than 4½ in. overall, provides high plate dissipation, low driving power and compact structure with high conductivity leads essential for efficient performance at frequencies up to 125 mcs. The type 3D24 achieves high plate dissipation through the use of a porous, zirconium coated graphite anode having approx. twice the heat dissipation area of similar metal anodes. A carburized thoriated tungsten filament is rated at 6.3 volts, 3 amps. With a plate voltage of 2000 volts, plate current of 90 ma and driving power of 4 watts, the plate power output is 140 watts.—*Sylvania Electric Products Inc., 500 Fifth Ave., New York 18.*



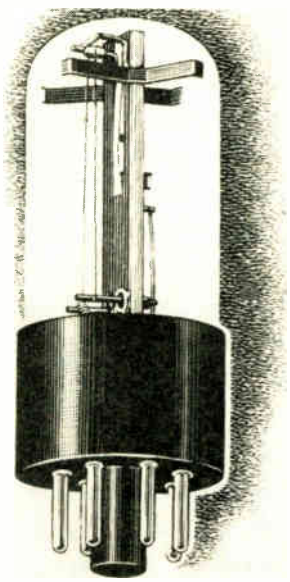
SYNCHRONOUS MOTORS

Designed for recording, tape pulling and facsimile use, the Cyclohm 29 size synchronous capacitor type motors can be supplied in ratings of 1/100, 1/75 and 1/50 hp, 1800 rpm, 115 volts, 60 cycles. The motors are available with either sealed and shielded, permanently lubricated ball bearings, or large self-lubricating bronze sleeve bearings which withstand heavy or vibrating loads. Stator and rotor laminations are punched from silicon steel of high quality and heavy formex insulated wire is used throughout.—*Cyclohm Motor Corp., 5-17 46th Rd., Long Island City 1, N.Y.*



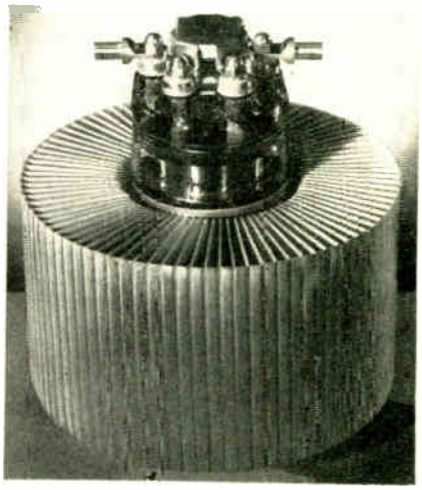
RETRACTABLE CORD

An addition to their line of retractable cords, this single conductor shielded 23 gage Koiled Kord is intended for use on various types of microphones and recording machines. The cord is manufactured of brown crude rubber with an O.D. of .160 in. and is extensible to 5-6 times its retracted length. MMF rating is 35-45 per foot.—*Koiled Kord Div. Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago, Ill.*



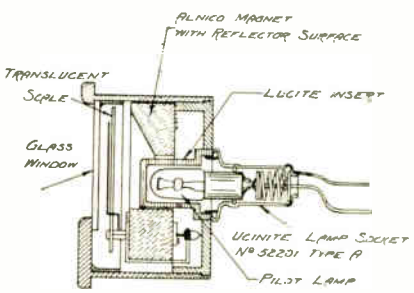
CURRENT-INTERMITTORS

To provide the need for a fast-starting interruptor with stable operating characteristics for flashing lamps, time delay and sensitive relays etc., Tung-Sol current intermittors utilize the elongation and contraction of a resistance wire, when alternately heated and cooled through make and break of the current, to provide the motive power to actuate various forms of snap action contacts. The constrained vane intermittors and relays, designed for currents not exceeding 2 amps., have inherently high resistance to vibration and are efficient for economical operation of dry-cell powered devices. They will operate on ac or dc and are available for voltages up to 120. Ambient temperatures have practically no effect within the limits of −50 and +150°F.—*Tung-Sol Lamp Works, Inc., Newark 4, N. J.*



TRANSMITTING TRIODES

Capable of operating at full ratings up to 110 megacycles the type 5541—10KW high frequency triode (illustrated) is useful in grounded-grid and grounded-cathode circuits as well as in grounded-plate operation. The air-cooled unit uses a self-supporting thoriated tungsten filament to eliminate sliding supports, insulators and tension springs. Also available is the type 5530, a tube of similar construction, which may also be used at full ratings up to 110 mc. Its applications are the same as for the type 5541.—*Western Electric Co., 195 Broadway, New York 7.*



PANEL-TYPE METERS

Evenly-distributed and bright instrument dial illumination has been achieved with new-design panel meters, applicable to all 2½ and 3½ in. Marion round and square instruments, the 4½ in. rectangular instrument and model 52S tuning meter. Overcoming the drawbacks of an aperture in the back of the meter and frequent use of oversized replacement bulbs, the instruments utilize a transparent lucite cavity which seals the opening against dust, and controls the size of the bulbs. A special Alnico magnet, whose front face is shaped like a flashlight reflector, concentrates the rays on the dial. —*Marion Electrical Instrument Co., Manchester, N.H.*

FORMICA TOOL OF THE ATOMIC AGE

Long before Oak Ridge, production engineers were controlling the streaming particles of the invisible world of atoms, electrons, protons and waves of heat, light, sound and energy. Specialized insulating materials were, and increasingly will be, the engineer's indispensable tools for preventing some of these forces from interfering with others.

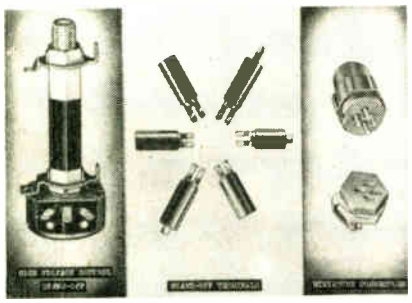
Formica has the physical properties, mechanical strength, durability, and machinability to serve today's and tomorrow's needs in more ways than you may be familiar with. The fires of war have tested and proved the superior fitness of old specifications for their more familiar uses, beyond all possible doubt. The wartime research has given you new grades for new uses.

Why not state the insulating job you have in mind and let us suggest a material that your experience might easily prove to be the most perfect tool you have yet found for your purpose.

FORMICA

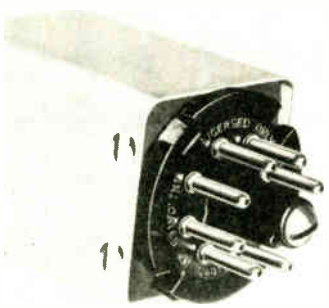
REG. U.S. PAT. OFF.

THE FORMICA INSULATION COMPANY, 4657 SPRING GROVE AVENUE, CINCINNATI 32, OHIO



TERMINALS AND CONNECTORS

Three new parts consisting of stand-off terminals, mounting controls, and miniature connectors, have been added to the company's line. For use in radio transmitters, H.V. power supplies, etc. a simple, compact control mounting is being offered. The High Voltage Control Stand-Off No. 401 fits all standard variable resistors and provides 1-3/16 in. spacing between high voltage and grounded parts. A complete line of small stand-off terminals eliminates the necessity for a cumbersome mounting board. The silver-plated terminals are machined of brass. Where space is extremely limited the Winchester 4-contact miniature connectors will provide good mechanical and dielectric strength and take maximum wire size of No. 20 A.W.G. Silverplated phosphor bronze sockets assure good contact action. — *The Winchester Co., 6 East 46 St., New York 17.*

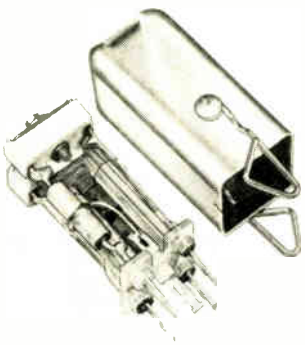


PLUG-IN SENSITIVE RELAYS

Permitting the lining up of contiguous relays as close together as the smallest octal sockets will permit, these plug-in sensitive relays are available for dc in type 41RO and for ac in type 41ROZ. DC sensitivity is .02 watts min. input, ac sensitivity being 0.1 volt-ampere min. input. Units are available in ratings up to 15 amperes on low voltage. Outline dimensions are 1¼ x 1¼ x 2 in. above octal socket.—*Sigma Industries, Inc., 60 Ceylon St., Boston 21, Mass.*

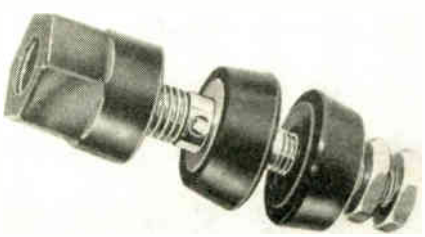
CATHODE RAY TUBES

Developed as part of a line of special electronic tubes, types ET-3000 and ET-5000 are 3 and 5-in., respectively, cathode-ray tubes of the polar coordinate type for applications requiring high radial sensitivity. The 3-in. tube is comparable to the RMA type 3DP1, but has a deflection sensitivity, which is 9 times higher. No terminal or supporting structure appears on the tube screen of either type, this construction permitting high radial sensitivity for 5-in. screen or larger diameters. The tubes operate by the application of a signal voltage across two concentric cones mounted above and adjacent to the horizontal and vertical deflection assembly. Screens can be supplied of any of the standard phosphors. Data sheets are available from *Electronic Tube Corp., 1200 East Mermaid Ave., Chestnut Hill, Philadelphia 18, Pa.*



IF TRANSFORMERS

Three basic types of μ-net 455 kc IF transformers have been developed to cover the average need of AM set designers. Each type is available with a built-in diode filter, either grounded to the shield or connected to the fifth lug. Where max. gain is required, as in the case of battery tubes, the 2.4 mh coils are recommended. (#14733, #14734, #14746). The 1.2 mh coil will provide sufficient gain for conventional circuits using IF tubes of the common type such as the 6SK7. (#14698, #14699, #14700). For applications using high gain pentodes such as the 6SG7 and 6BA6, the 800 microhenry coils give adequate gain and good circuit stability. (#14701, #14702, #14703). They are well adapted for AM-FM combination receiving sets. — *F. W. Sickles Co., Chicopee, Mass.*

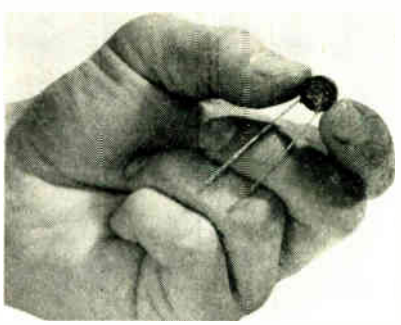


BINDING POST

Meeting the need for a multi-purpose electrical connector the new Superior binding post type DF30 offers five ways of connecting leads. Wire up to size 12 may be permanently clamped through the center hole or may be looped around center shaft. Also provided are standard ¾ in. banana plug, clip lead connection and spade lug connection. The post is insulated from the mounting panel, which may be to ¼ in. thick. Current carrying capacity is 30 amperes.—*Superior Co., Bristol, Conn.*

UHF POWER TETRODE

Particularly well suited for high-power mobile applications because of its ability to operate at plate voltages of 400 to 500 volts, the Eimac 4X150A operating in a coaxial amplifier circuit will deliver up to 75 watts useful output at 500 mc. Transconductance of the tube is 15,000 micromhos, max. plate voltage 1000 volts, and max. plate dissipation 150 watts. Heater current is 2.8 amps. at 6 v. The tube is forced-air cooled and requires 5.6 cu. ft. per minute. — *Eitel-McCullough Inc., 1453 San Mateo Ave., San Bruno, Cal.*



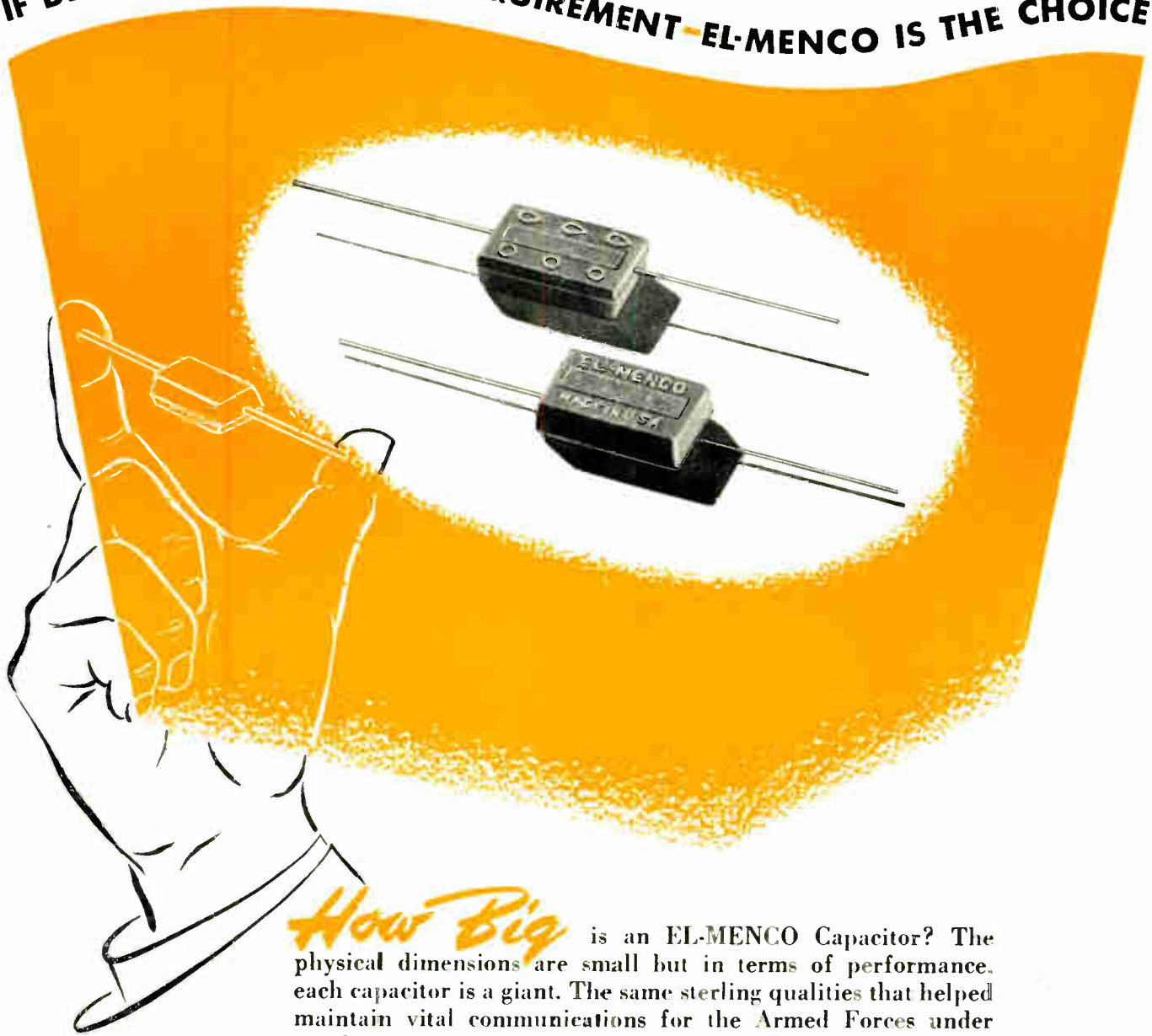
MINIATURE CAPACITOR

Made with Centralab's Ceramic-X the new "Hi-Kap" ceramic disc miniature capacitors have a max. diameter of ⅝ in., thickness of 5/32 in. and weigh approx. .035 oz. Designed for 450 volts dc working voltage, the units will withstand a 900 volt dc flash test and have a guaranteed min. capacity of .005 mfd. They have pure silver electrodes and are covered with specially impregnated phenolic coating.—*Centralab, Div. of Globe-Union Inc., Milwaukee, Wis.*

SELENIUM RECTIFIERS

High amperage capacity is provided by efficient circulating liquid cooling, of these cylindrical selenium rectifiers, which are manufactured by a new method of electrolytically depositing selenium. Ion selenium rectifiers are constructed in standard unit elements, each rated at 250 amperes continuous, or 500 amps. intermittent service. Assemblies for large scale industrial applications, such as refining, welding, plating, etc., are made by series and parallel combinations of standard elements. Weight of each unit is 4 lbs. — *Ion dustries, Inc., 600 W. 138 St., Riverdale (Chicago 27), Ill.*

IF DEPENDABILITY IS THE REQUIREMENT—EL-MENCO IS THE CHOICE



How Big is an EL-MENCO Capacitor? The physical dimensions are small but in terms of performance, each capacitor is a giant. The same sterling qualities that helped maintain vital communications for the Armed Forces under grueling wartime conditions are in every EL-MENCO Capacitor that goes into your circuit.

We who design and make EL-MENCO Capacitors are proud of the reputation of dependability that our products have earned. We pledge our every effort to its continuance.

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

ARMY ★★ NAVY

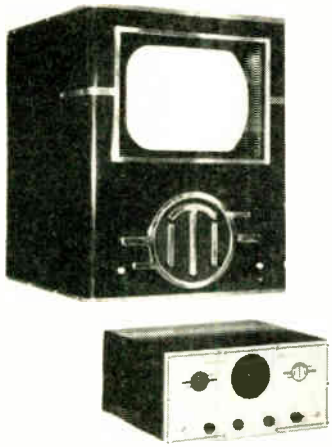
Foreign Radio and Electronic Manufacturers communicate direct with our Export Department at Willimantic, Conn. for information.

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

CAPACITORS

MARINE RADIOTELEPHONE

Instant selection of any of thirty crystal-controlled frequencies between 2 and 20 mc is provided for the Type 248A, 250 watt Marine radiotelephone, which is designed for two-way long or short distance telephone communication for ocean-going or coastal vessels. The equipment is housed in a single cabinet with a remote control unit (illustrated). Three radio receivers facilitate the handling of traffic and monitoring of three stations simultaneously.—*Western Electric Co., 195 Broadway, New York 7.*

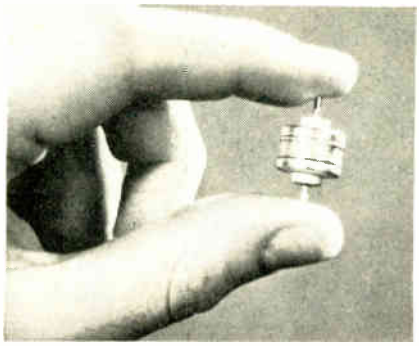


TELEVISION RECEIVER

Designed for taverns, recreation rooms and other locations where it is desired to have remote control of the television receiver to prevent the public from tampering with the controls, the type IT-1R television receiver uses a two-unit construction consisting of a control unit and a picture unit. Picture units are available using the 15AP4 15-in. CR tube and the 20BP4 20-in. cathode ray tube. The control unit contains the picture and sound receiver and all controls necessary for the operation of the picture unit, including station selector, sound tuning, brilliance, sound volume, mike input, and off-on switch. The receiver operates on ac and consumes approx. 500 watts.—*Industrial Television Inc., 36 Franklin Ave., Nutley 10, N. J.*

FM ANTENNAS

Available in both folded and straight dipole types, either of which may be equipped with a reflector to provide max. directional gain, this series of low-cost FM antennas is designed to operate in the 88 to 106 mc band and provides matched impedance to a 60 ft polyethylene insulated 300 ohm colinear transmission line. A universal base mounts at any angle on roof or wall. The vertical element revolves or tilts in the base for maximum gain orientation. Dipole elements are constructed of corrosion-proof aluminum, all other parts are weatherproofed. — *Ward Products Corp., 1523 East 45th St., Cleveland 3, Ohio.*

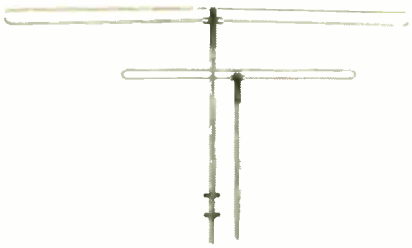


CRYSTALS

One of a complete new line of quartz crystals covering frequencies from 1.2 kc to 50 mc, the Western Electric 23AA crystal unit (CR-9U) provides direct crystal control at frequencies from 15 to 50 mc. It utilizes a crystal plate vibrating at a mode of thickness shear higher than the fundamental mode. The type 23AB is a similar unit, except that it is intended to operate as temperature controlled unit at 70° ± 10° and to have a frequency accuracy of ±.005%. Direct crystal control at these high frequencies makes it possible to simplify and increase the efficiency of VHF equipment.—*Western Electric Co., 195 Broadway, New York 7.*

AIRCRAFT RECEIVER

Airadio's Super"41" is a battery-operated aircraft receiver for personal planes. Weighing only 2 lbs., 13 oz. this compact receiver covers the frequency range from 195 to 420 kc. It has a built-in range filter, manual or automatic volume control, tuned rf stage, and slide rule dial. The dry battery pack will provide approx. 150 hours useful life, based on 4-hour daily use. — *Air Associates, Inc., Teterboro, N.J.*



FOLDED-DIPOLE ANTENNA

Designed to match 300-ohm transmission lines, these two new folded-dipole FM and television antennas have dipole elements, constructed of re-enforced aluminum tubing, which are directional both front and rear broadside to the antenna. Both masts are five ft. high and the television dipole's over-all width is 96 in., while the FM dipole's width measures 48 in. All metal parts of models UKA-002 and UKA-001 are either painted, electroplated or made of aluminum to insure maximum weather protection.—*Specialty Div., General Electric Co., Electronics Dept., Wolf St., Syracuse, N. Y.*

FM RECEIVER ANTENNA

The Stratovision FM antenna is a low-cost dipole, featuring rugged construction, a swivel base for multi-position mounting and non-corrosive fixed elements requiring no adjustments. Aluminum masts and elements provide all-weather service. The antenna can be used with all FM receivers using the 88 to 106 mc band. —*Westinghouse Electric Corp., Pittsburgh 30, Pa.*

TELEVISION CAMERA

One of a complete line of "packaged" television studio rehearsal equipment, this TV Camera contains an RCA 1848 Iconoscope with deflection yoke and Iconoscope divider, intensity and focus controls, preamplifier, optical lens and view finder—all mounted in a removable head housing. The self-contained preamplifier uses four 6AK5 tubes. An F:2 projection lens can be supplied in 6 and 9 in. focal length. Swivel mounting permits vertical and horizontal panning. The base housing, mounted on rubber tired rollers, comprises the camera sweep and blanking chassis, regulated power supply, high voltage power supply and preamplifier filament supply.—*Television Products, Inc., 24 Walnut St., Newark*

Now, For The First Time....

The Measured Quality of Each Lot of Springs Can Be Seen at a Glance

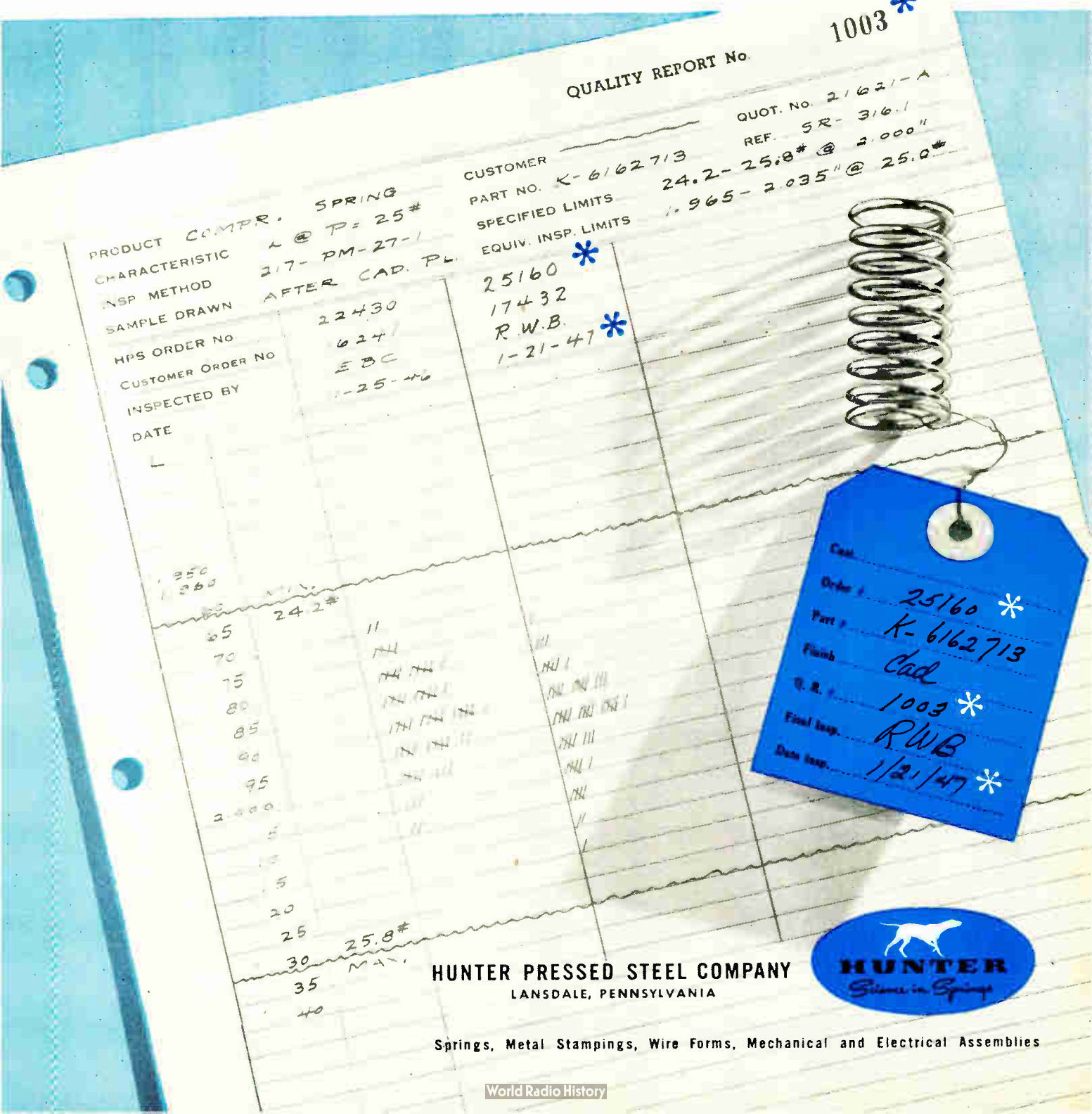
Quality Engineers have long predicted that some day suppliers would submit a record of quality to their customers and that this record would become part of a new era in vendor-customer relationships.

That day is here for Hunter customers.

Hunter now makes available to customers a report of the measured test loads for *every* lot of springs in the form of a frequency distribution. These Q.R.'s (Quality Reports) will be mailed to chief engineer, inspector or other person designated. The Q.R. of the sample drawn from *each* lot of *every* item will be sent as the lot clears Hunter's final inspection.

These reports enable one to compare quality lot-for-lot, consider tolerance revisions, reduce customers' sampling without sacrificing quality insurance . . . will lead eventually to a comparison of quality vendor-for-vendor.

Hunter believes it is the first in industry to make this valuable service available to all customers.



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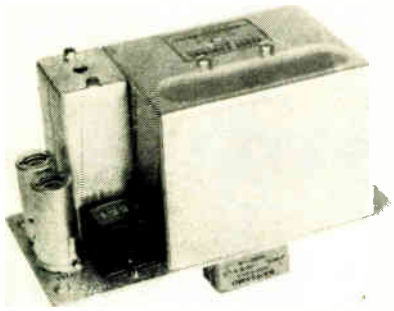
Communications Components

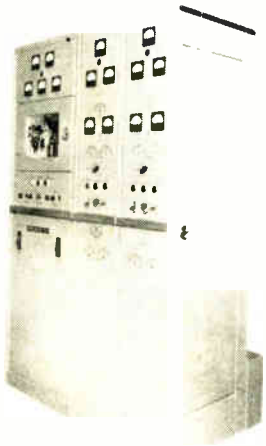


RADIO DIAL TELEPHONE

An improved model of the Fleet Control selective calling system for two-way radio telephone service incorporates all features of previous models and provides in addition a bell-ringing and light-flashing circuit for calling a mobile vehicle from the central station. "Fleet Control" is an attachment to a central transmitter and mobile receivers which permits selective "private" calling of any one of 84 mobile units per signalling frequency when four-digit code calling numbers are used. With five-digit code numbers 126 units can be controlled.—*The Hammarlund Mfg. Co., 460 W. 34 St., New York 1.*

AIRMARINE RADIO

Developed especially for personal planes and private boats this 3-band, 9-lb. portable receiver provides weather reports, air and marine communications reception, regular broadcast service, and may also be used as a navigation aid. The three bands covered are 195-410 kc, 540-1620 kc, and 2000-5,800 kc. A range filter is built in for the radio range band to assure clear reception of weather reports. Two loop antennas are included inside the case for reception and direction finding on radio range station. beacons, and broadcast stations. The unit has a self-contained 150 hour A-B battery pack, may also be used on 110 volts, ac or dc.—*Bendix Radio, Baltimore 4, Md.*

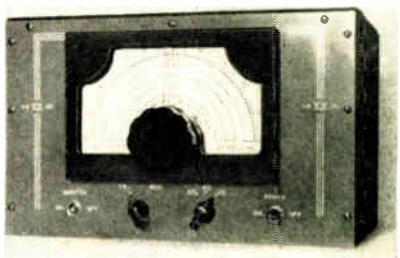


RADIO TRANSMITTER

Efficient long distance telegraph or telephone is provided by this new HF, point-to-point, 3 kw transmitter designed for use in public service, shore-to-ship, press and government service communication. The transmitter consists of an rf unit, modulator and rectifier, assembled to suit individual station requirements. The equipment is moisture-proofed. The rf unit, designed for an output load resistance of 60-80/600-800 ohms, operates at frequencies from 2 to 20 mc. The modulator has a frequency response range from 200 to 4500 cps. Rectifier operates from a power supply of 210/230/250 volts, 3 phase, 50/60 cycles.—*Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa.*

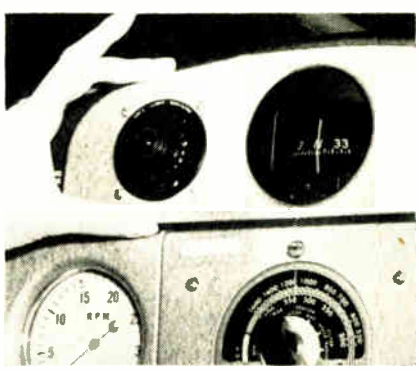
MARINE RADAR

Intended primarily for use on ocean freight and passenger vessels, the DeMornay-Budd marine radar equipment has a range from 100 yds. to 32 miles, exceeding specifications of the U. S. Coast Guard for Class A equipment. The unit operates in the marine navigation band at approx. 8,300 mc and has a peak pulse power output of 18 kw. The equipment with its 12-in. screen is capable of displaying U. S. Geodetic charts on a companion screen. — *De Mornay-Budd, Inc., 475 Gr. Concourse, New York 51.*



VARIABLE FREQUENCY EXCITER

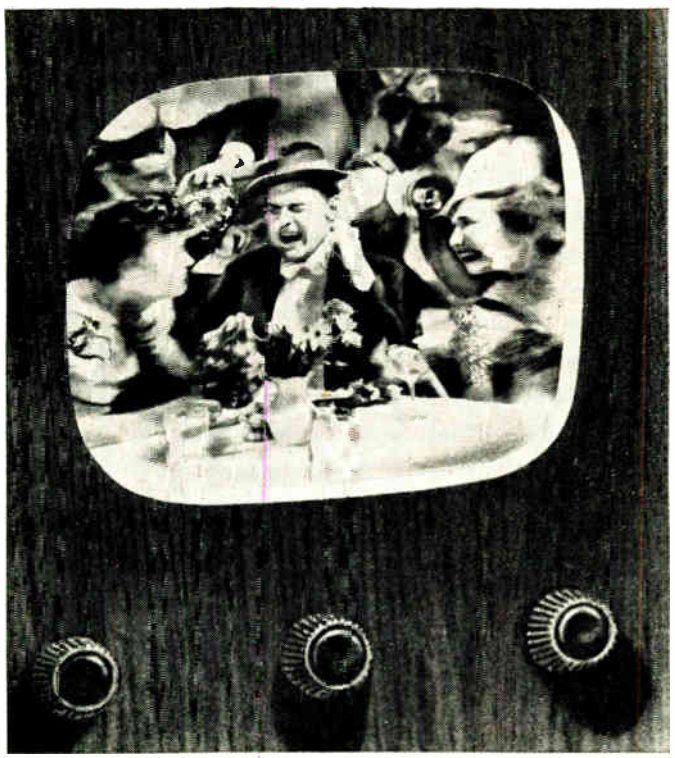
Having 12-16 watts output on the 80, 40, and 20 meter amateur bands, the VX-101 Jr. exciter unit uses a 6SJ7 electron-coupled oscillator, a 6SK7 doubler, and an 807 class "C" amplifier in the final stage, and has provisions for use of an external modulator with 12-14 watts output for phone operation. The unit is equipped with a National planetary drive dial. A switching arrangement divides the 80 meter band into two scales calibrated from 3500 to 3700 kc and from 3750 to 4,000 kc. The 40 meter band is calibrated from 7,000 to 7,500 kc, the 20 meter band from 14,000 to 15,000 kc. Amplifier or oscillator keying is available, and an effective key-click filter is incorporated.—*Electro-Mechanical Mfg. Co., Richmond Hill 18, N. Y.*



STALL WARNING INDICATOR

The Safe Flight Indicator, an aircraft instrument which precludes the possibility of a pilot stalling his plane inadvertently and makes possible lower insurance rates, operates on a new principle which gives ample warning of an impending stall, regardless of the altitude of the plane or the type of maneuver being performed. Shining a red light and blowing a horn when a stall is imminent the device, which is mounted on the instrument panel, is actuated by a "vane" protruding through the leading edge of the wing. The vane is located in such a way that in normal flight the airflow keeps the electric circuit of the device open. As the wing approaches a stall, the air division point moves below the vane, causing it to tip up and operate the warning signals.—*Safe Flight Instrument Corp., White Plains, N. Y.*

CONFUSING? OR AMUSING?

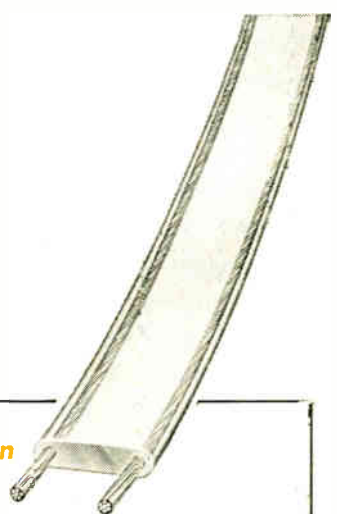


Lead-In Lines Play an Important Part in Television Reception

The effects of attenuation and impedance mismatch on FM and Television reception are minimized by Anaconda Type ATV* lead-in lines.

The satin-smooth polyethylene insulation of Type ATV line sheds water readily, thus avoiding subsequent impedance discontinuities. This material also has exceptionally high resistance to corrosion. Count on Anaconda to solve your high-frequency transmission problems—with anything from a new-type lead-in line to the latest development in coaxial cables. 47139

**An Anaconda Trade-Mark*



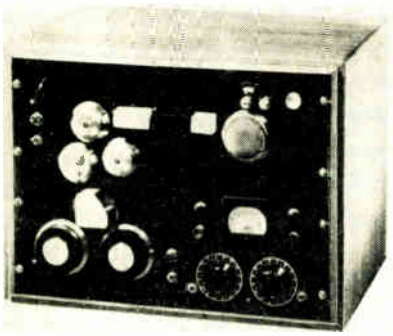
A Type ATV lead-in for Every Need

Anaconda offers a complete selection of Type ATV lead-in lines for 75, 125, 150 and 300 ohms impedance unshielded and 150 ohms shielded. For an electrical and physical characteristics bulletin, write to Anaconda Wire and Cable Company, 25 Broadway, New York 4, N. Y.

ANACONDA from mine to consumer

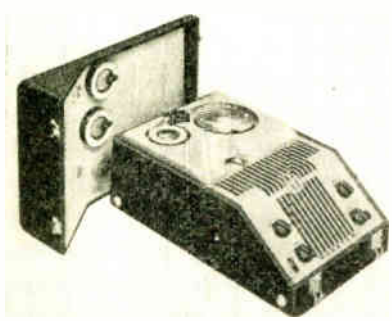
ANACONDA WIRE AND CABLE COMPANY

Sound and Recording Equipment



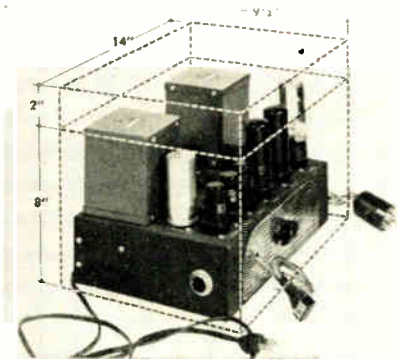
WIRE RECORDER

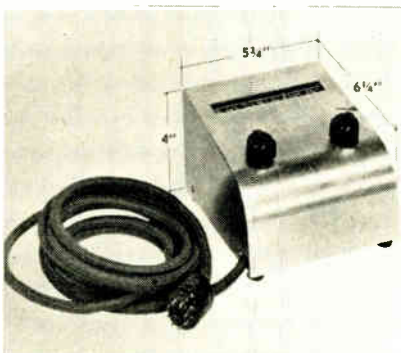
Designed for professional users, Magnecorder model SD-1 has a frequency response flat within 2 db from 50 to 12,000 cps with a signal-to-noise ratio of more than 45 db and harmonic distortion of less than 1½% overall. Capable of recording and playing back continuously for a half hour, the unit uses stainless steel wire .004 in. in diameter. A capstan drive system drives the wire across the heads at four ft. per second with wow and flutter kept to less than 0.2 of 1%. A separate playback head enables the operator to play back the recorded portion during the recording operation. A timer, which is calibrated in minutes and seconds, is directly coupled to the capstan. —*Magnecord, Inc., 304 West 63 St., Chicago 21, Ill.*



WIRE RECORDER

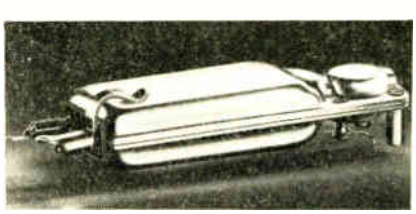
Designed for business, professional, and home use the popularly priced Webster model 80 wire recorder is furnished complete with efficient wire transporting mechanism, recording and playback amplifier, 5¼ in. speaker, microphone and three spools of wire. Recordings may be played back through the self-contained amplifier and speaker or through a separate amplification system. The wire is automatically wiped clean, when a new recording is made. Any part of the wire can be "erased" and re-edited. Simplified controls permit operation by non-technical persons. Additional wire spools are available for 15-minute, half-hour, or full-hour recordings.—*Webster-Chicago Corp., 5610 Bloomingadle Ave., Chicago 39, Ill.*





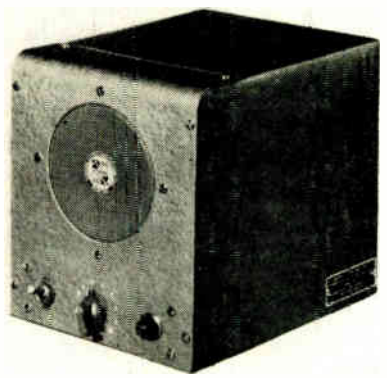
RADIO AND SOUND SYSTEM

Consisting of four major parts, a portable tuner, an amplifier, a record player and one or more speakers plus and antenna and necessary wiring, the Reeves Soundcraft radio system is intended to serve as functional part of a home with all units, except the tuner, being concealed in walls or other suitable space. Two speakers are available, the "Supersound" covering the frequency spectrum from 30 to 15,000 cps, or the Deluxe with a range from 80 to 12,000 cps. The Altec amplifier has an undistorted output of 15 watts for driving from one to three speakers. —*Reeves Sound Studios, 10 East 52 St., New York.*



PICKUP CARTRIDGE

Greatly reducing needle talk and record hiss the model P30 "Muted Stylus" crystal pickup cartridge weighs only .42 oz. and tracks at less than 1 oz. Very high needle compliance is assured by a special crystal drive. Output of the unit is 1.9 volts at 1000 cps. The needle is tipped with osmium or sapphire and is easily replaceable.—*Shure Brothers, Inc., 225 W. Huron St., Chicago 10, Ill.*



AMPLIFIER SYSTEM

Efficient for hotel, restaurant, and office installation the Dormitzer utility amplifier and loudspeaker has provisions for connecting up to four microphones at remote locations. A signal light at each microphone indicates when the amplifier is in use. The amplifier has a gain of 60 db and a power output of 4-5 watts. Speaker and amplifier are combined in one cabinet 6 in. long x 8 in. high x 7 in. wide. *Dormitzer Electric & Mfg. Corp., 782 Commonwealth Ave., Boston 15, Mass.*

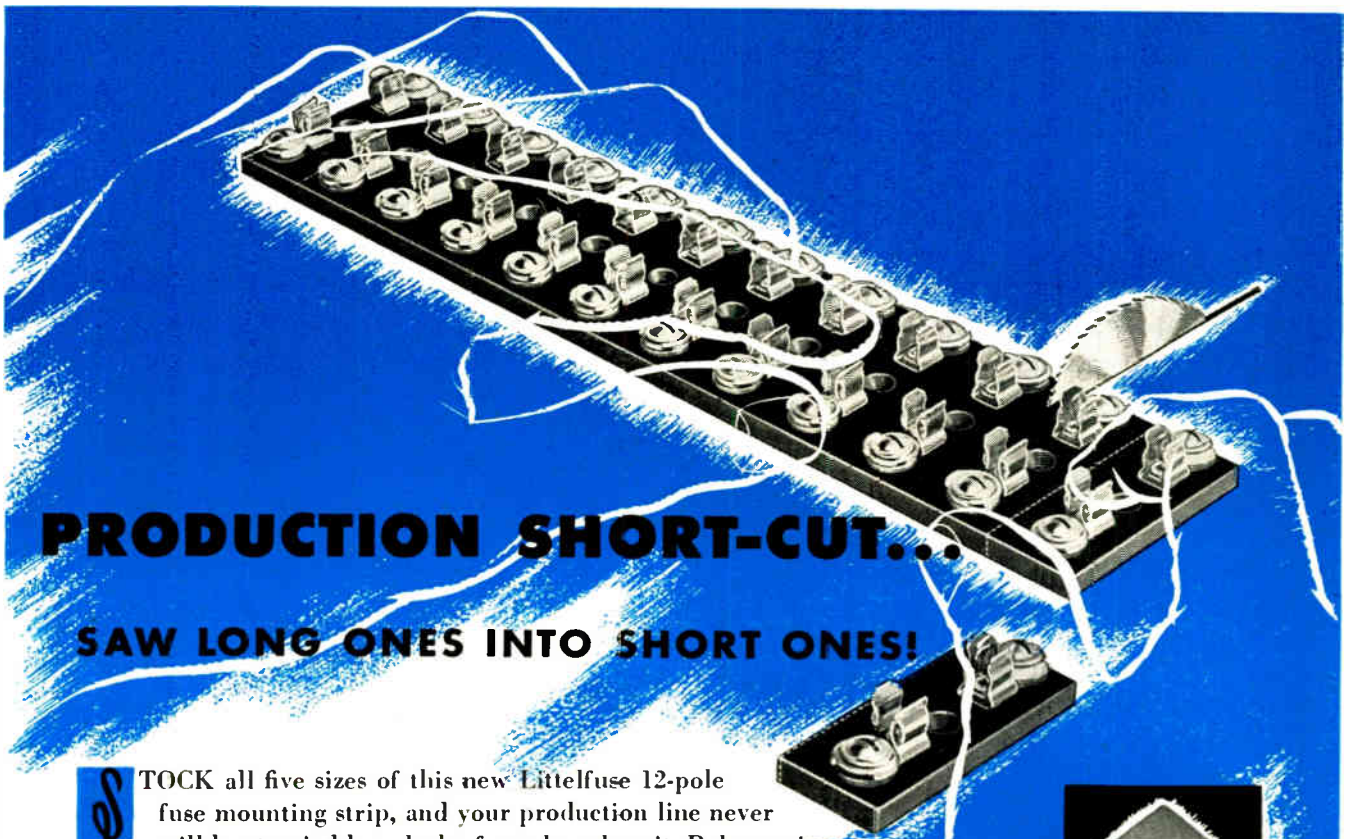
TONE ARMS

The V series of tone arms is one of three new types which have been added to the company's line of sound equipment. Unusual rigidity is provided by a high lateral ridge which is an integral feature of the design. The arm is available with the N7 high fidelity cartridge, tracking at less than 1 oz. It is supplied with sapphire needle.—*Webster Electric, Racine, Wis.*

REPRODUCERS

Intended for AM-FM broadcast stations, recording studios, theatres etc., this new line of Para-flux reproducers is available in three types for vertical, lateral, or universal use; the three types are interchangeable with model A-16 arm and model EL-1 equalizer. The response of all models is linear from 40 to well beyond 11,000 cps. A "hairline" indicator on the head and precise stylus construction makes accurate cuing possible and permits "backtracking."—*Radio-Music Corp., East Port Chester, Conn.*

(More New Products on Page 98)



PRODUCTION SHORT-CUT...

SAW LONG ONES INTO SHORT ONES!

STOCK all five sizes of this new Littelfuse 12-pole fuse mounting strip, and your production line never will be stymied by a lack of any length unit. Pole spacings allow 1/8" saw cut so they may be cut as needed in your own plant . . . or you may order them pre-cut in 1, 2, 3, 4 or more pole lengths. Bases are of grade X black Bakelite, with 1/32" sheet cemented to under side.

Solder terminal types (Type S) are made in styles for 3AG and 8AG size fuses. Both have Bright Dip Phosphor Bronze fuse clips. Solder terminals are made as an integral part of fuse clips. Non-turning anchors firmly hold clip to base. Either size can be furnished with Beryllium copper clips or special mountings. Quotations furnished on special orders.

Screw terminal types (Type "T") are available in 3AG and 5AG types with cupped wire retaining washers under terminals, and in 4AG size with lock washers. Nickel-plated brass screw terminals are spaced to protect equipment circuits and are seated in base. The 3AG types have fuse clips of Nickel-plated Phosphor Bronze. The other two have clips of Silver-plated Beryllium copper.

The new Littelfuse catalog number 9 offers you complete information on these time-saving strip fuse mountings, and on the complete line of Littelfuse devices for circuit protection. Send for your copy today!

LONG-LIFE combination fuse-holders and pullers of "Buna-S" synthetic rubber. One end, which is colored red, faces panel when both "working" and "spare" fuses are good, is exposed when holder is turned to indicate spare. Available for 3AG, 4AG and 5AG size fuses.

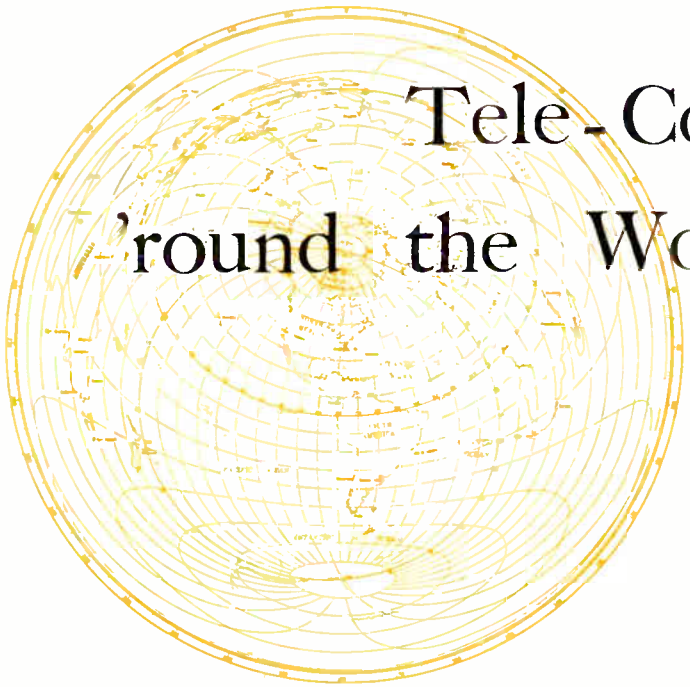
STEEL COVERED 3AG size fuse mountings available in single and double pole types, and in single pole and spare fuse holder combinations, with hinged cover; also in double pole types with removable non-hinged cover.

SLO-BLO 3AG Littlefuses (in 1/100 to 20 amp. ratings) have high time-lag. Anti-fatigue construction. 4AG size available in 1/4 to 5 ampere ratings. Spring and link element structure.

LITTELFUSE FIRST IN CIRCUIT PROTECTION *Incorporated*

4779 E. RAVENSWOOD AVE. CHICAGO 40, U. S. A.

FUSES, MOUNTINGS AND ACCESSORIES • CIRCUIT BREAKERS • SWITCHES • NITE-T-LITE • SWITCH-LITE • IGNITION-FRITZ • NEON INDICATORS



Tele-Communications 'round the World

By ROLAND B. DAVIES,
Tele-Tech Washington Bureau

News of engineering matters of importance and of markets in various foreign fields

RUSSIA EQUIPPING 1,000 FARM TRACTORS WITH RADIO-PHONE—Soviet Russia has just disclosed that 1,000 two-way mobile radiotelephone sets are being installed on farm tractors which will communicate with land stations in central agricultural headquarters. The first radio-equipped tractors will be sent to the main grain-growing areas in Siberia and the North Caucasus.

INTERNATIONAL FINANCING OF LORAN STATION IN ICELAND—International air transport across the North Atlantic will be further safeguarded as a result of an agreement signed April 30 at the International Civil Aviation Organization headquarters in Montreal providing for international financing of the loran station at Vik, Iceland. Representaitves of four nations — Canada, France, the Netherlands and the United Kingdom — signed the agreement in the presence of Dr. Edward Warner, President of the Interim Council of PICAO, ICAO's predecessor. The United States is already a signatory to the document. Cost of the station, about $6000 a month, will be borne by the signatory nations in agreed proportions.

BRITISH SPECIFICATIONS FOR MARINE RADIO AND RADAR—The British Post Office has prepared performance specifications for the climatic and durability testing of marine radio and radar equipment, entitled "Radio and Radar for Merchant Ships". Copies are available through H. M. Stationery Office.

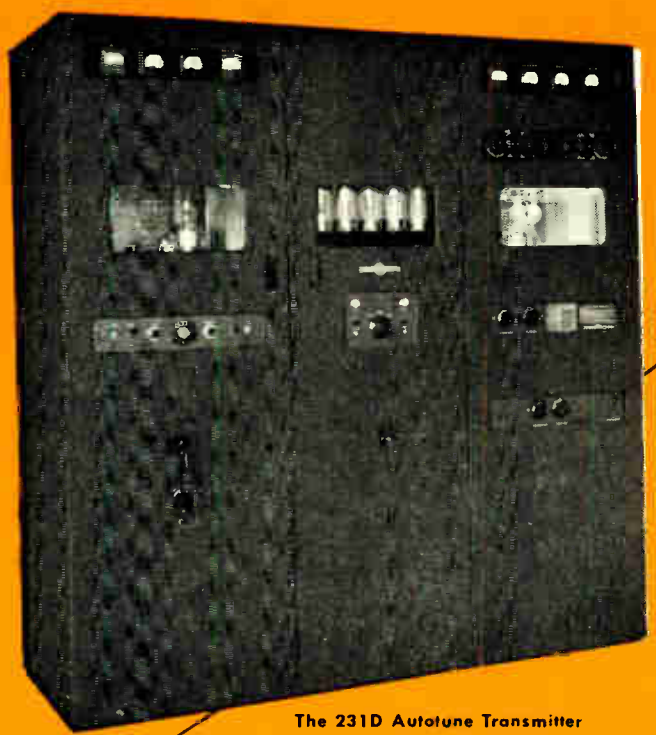
GREECE MAY BE MARKET FOR HOME RECEIVERS — While there is little necessity or prospect for the sale of American wire and radio communications equipment because the internal telephone system is in generally good condition, authoritative State Department sources told TELE-TECH's Washington Bureau that with the U. S. loan to Greece and after currency and economic conditions are stabilized, radio home sets may be in good demand. Stabilization of Greece will have to come first, but broadcasting has been well indoctrinated into its population.

AUSSIE SCHEME FOR RADIO "TOTE BOARD" — A new use for radio, to add to its seemingly unlimited possibilities, was reported from Australia this week where it was said a radio-controlled totalizator, to make it possible to lay bets on horse races as far as 500 miles from the track, will shortly be offered to the New South Wales Government by Automatic Totalizators Ltd. If the scheme is adopted, replicas of such race course boards as the one at Sydney will be built in other towns. Betting fluctuations transmitted by radio will appear on the country boards simultaneously with those on the indicators at the course and, similarly, off-course bets would be registered on the track boards. Racing men say the scheme would kill undesirable off-the-course betting and at the same time the Government would collect its share of taxation from betting in country towns and metropolitan areas.

FM BROADCAST SERVICE TO BE INAUGURATED BY BBC — Steps for inauguration of FM broadcast service are now being taken by British Broadcasting Corp., with a 25 kw transmitter to be supplied by Marconi Wireless Telegraph Co. This will be the first FM transmitter to be put into regular service by the corporation and it will embody improvements resulting from wartime experimentation. The Radio Industry Council has been advised of the program so that receiving sets will be available to the public in time to receive the new broadcasts, which are not expected to begin for nearly two years.

SET TAX QUADRUPLED IN DOMINICAN REPUBLIC — Effective this month, the licensing tax on radio receiving sets in the Dominican Republic has been raised from peso .50 to peso 2.00. The tax is collected from purchasers of receiving sets at the time of the sale and reported monthly to the government by dealers.

*UNEXCELLED



The 231D Autotune Transmitter
3 kw Phone, 5 kw CW

. . . for reliable communication

IMMEDIATE DELIVERY

The 16F Autotune Transmitter
300 w Phone, 500 w CW

You need a dependable, well engineered transmitter for point-to-point, ship-to-shore, or ground-to-plane commercial radio communication. The Collins 231D or the Collins 16F is the answer. These transmitters have proved themselves thoroughly reliable and efficient in all climates, and under difficult operating conditions.

Any one of eleven frequencies between 2.0 mc and 18.1 mc is available at the flip of a dial, with all circuits tuned and ready to operate. The widely acclaimed Collins Autotune system is utilized to shift the frequency quickly and accurately.

Compressor circuits are incorporated to raise the average modulation level during voice or MCW transmission. CW transmission is also available, with keying speeds of 60 wpm on MCW and 200 wpm on CW. Both transmitters can be adapted for frequency shift keying.

For dependable, trouble-free radio communication use either the 231D or the 16F. They are built for that purpose. Write today for free illustrated bulletins giving detailed information.

IN RADIO COMMUNICATIONS, IT'S . . .

COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 West 42nd Street, New York 18, N. Y. 458 South Spring Street, Los Angeles 13, California

News of the Industry

FCC Calls Conference On "Chain" TV Methods

The Federal Communications Commission has called an engineering conference for June 9 designed to pave the way for commercial "chain" television broadcasting.

Television broadcasters, communications common carriers, and manufacturers of television and microwave equipment have been invited. The purpose is the "formulation of a schedule which will set forth the expected installation dates of common carrier facilities for the relaying of television programs between cities."

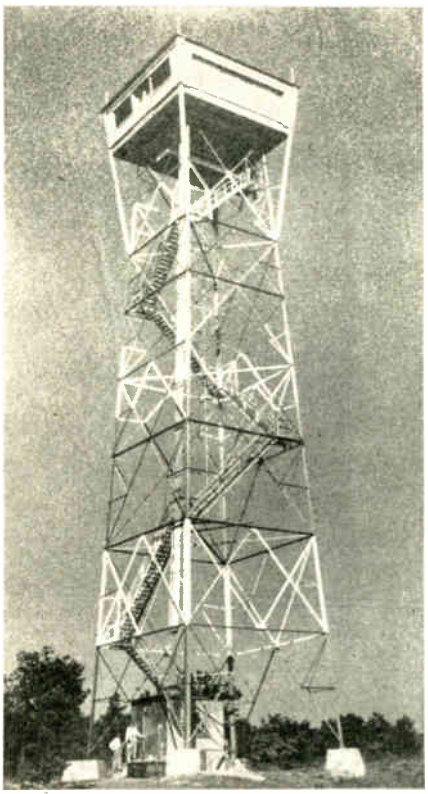
The June 9 conference is designed to acquaint television interests with what the owners of coaxial cable or microwave facilities have to offer for television relays, and to inform these common carriers what the broadcasters are thinking about in relation to intercity television.

Galvin Now Motorola

Henceforth it is to be Motorola, Inc., instead of Galvin Mfg. Co., Chicago. The change in the corporate style of the company has been made because the name Motorola has been so long and so closely associated with the company. The change was made effective May 15. There have been no other changes.

RMA Studies TV Antennas

Information relating to possible solutions for one of the most pressing problems confronting television reception in metropolitan areas—that of apartment house antenna installations—is being collected by a special task-group of the television sub-committee of the RMA. One aim of this survey will be to suggest specification items which, if followed, will insure good service to users. The requirements of the system will be based on the characteristics of television receivers set forth in presently established RMA standards.



General Electric's Helderberg mountain tower, housing microwave equipment for the Schenectady-New York relay network

It is the aim of this survey to provide information enabling real estate boards, managers, and superintendents of buildings to prepare for installing the new antennas and lines with the understanding that the equipment and standards will not be outmoded in a few years.

RMA US-Canadian Conference Meeting

RMA held its fourth Canadian-American industry conference late in April, the gathering being held in Absecon, N. J. Among other matters of business. directors voted to underwrite a proposed experimental clinic for servicemen, the project to be launched in Philadelphia and in a mid-western city. New officers are to be elected at the June 10-12 convention. Meantime six more manufacturers have been admitted to membership bringing the roster to 345.

Acoustical Experts Plan Music Institute

Keynote of the opening session of the 33rd meeting of the Acoustical Society of America, held at the Hotel Pennsylvania in New York during the second week of May, was recognition of the tremendous role that radio broadcasting plays in the general advancement of music appreciation throughout the world.

Harold Burris-Meyer, of the Stevens Institute of Technology, outlined three proposals to bridge the gap between acoustical science and musicology: 1) development of a common terminology for all people connected with music; 2) fixing of criteria for measurement of music and its effect on people; 3) establishment of information facilities for the exchange of ideas.

Harvey Fletcher. acoustical phy-

(*Continued on page 96*)

CONVENTIONS AND MEETINGS AHEAD

June 7—Institute of Radio Engineers—Annual Conn. Valley Section meeting, New London. Half-day session on FM receivers.

June 9-13—American Institute of Electrical Engineers — Summer general meeting, Mount Royal Hotel, Montreal, Quebec.

June 9-10 — Electron-Tube Conference—sponsored by Electron Tube committee of IRE, Syracuse University, Syracuse, N. Y.

June 16-20—American Society for Testing Materials—Annual (15th) Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

August 7-8 — Institute of Aeronautical Sciences, annual summer meeting. Los Angeles.

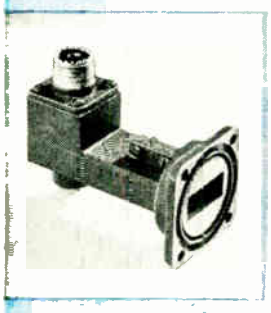
August 26-29 — Pacific General Meeting, American Institute of Electrical Engineers, San Diego Hotel, San Diego, Cal.

September 8-12—Second National Instrument Conference and Exhibit—Hotel Stevens, Chicago.

October 20-24 — Semi-Annual convention of the Society of Motion Picture Engineers, Hotel Pennsylvania, New York.

November 3-5—National Electronics Conference, Edgewater Beach Hotel, Chicago.

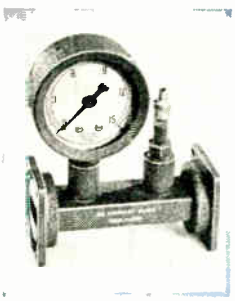
EVERY DE MORNAY-BUDD WAVE GUIDE
is Electrically Tested, Calibrated and Tagged



Crystal Mount DB-453

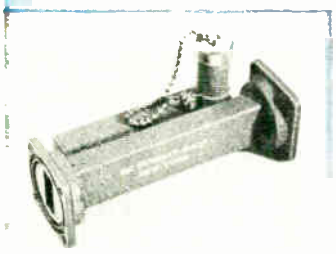
Rotating Joint DB-446

90° Elbow (H Plane) DB-433

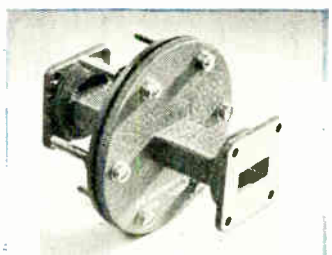


Pressurizing Unit DB-452

Mitered Elbow (H Plane) DB-439



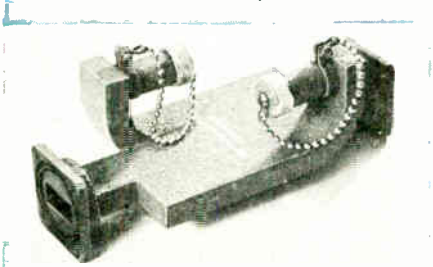
Uni-directional Broad Band Coupler DB-442



Bulkhead Flange DB-451

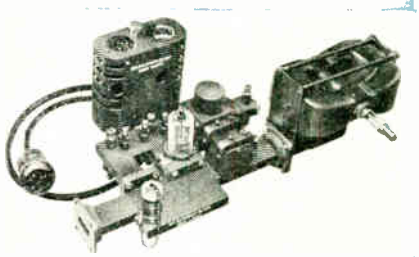
Uni-directional Narrow Band Coupler DB-440

90° Twist DB-435



Bi-directional Narrow Band Coupler DB-441

Typical plumbing arrangement illustrating use of De Mornay-Budd components available from standard stocks.



RF Radar Assembly DB-412

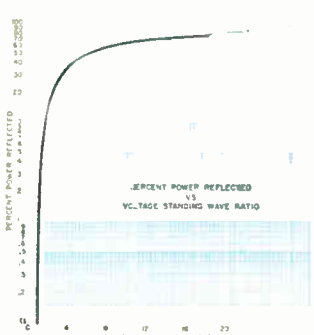
When you use any De Mornay-Budd wave guide assembly, you know exactly how each component will function electricolly. You avoid possible losses in operating efficiency through impedance mismatches, or breakdown and arcing caused by a high standing wave ratio. (See chart below.)

De Mornay-Budd wave guides are manufactured from special precision tubing, and to the most stringent mechanical specifications. Rigid inspection and quality control insure optimum performance.

NOTE: Write for complete catalog of De Mornay-Budd Standard Components and Standard Bench Test Equipment. Be sure to have a copy in your reference files. Write for it today.

The curve shows the manner in which the reflected power increases with an increase in the voltage standing wave ratio. The curve is calculated from the following equation:

$$\% \text{ Power Reflected} = \left(\frac{\left(\frac{V_{max}}{V_{min}}\right) - 1}{\left(\frac{V_{max}}{V_{min}}\right) + 1} \right)^2$$



DE MORNAY BUDD
EQUIPMENT FOR 97% OF ALL RADAR SETS

De Mornay-Budd, Inc., 475 Grand Concourse, New York 51, N. Y.

WASHINGTON

★ ★ ★ **Latest Electronic News Developments Summarized by Tele-Tech's Washington Bureau** ★ ★ ★

SPEED BROADCASTING APPLICATIONS — With an unprecedented burst of speed with day and night work by the staff and several continuous meetings of the Commission, including one up to midnight, the FCC has set its broadcasting station case-load house very well in order. The radio industry now can visualize what lies ahead for the remainder of this year in terms of the total number of Standard, FM, Television and Non-Commercial FM stations on the air. The crush of radio station actions recalled early days of the Federal Radio Commission, when TELE-TECH's editor, Dr. Caldwell, was a Commissioner. The FCC issued on the deadline of its temporary expediting procedure (Feb 7-May 1) actions on some 250 applications in a single week. Now the FCC is back to normal licensing processing and is able to keep up with its current load of applications.

2000 STANDARD AM BROADCASTERS — Within the next few months, based on FCC figures, approximately 2000 Standard broadcast stations will be on the air or under construction, almost double the number as of May 1, and over 900 FM broadcasting stations will be in operation or nearly ready, contrasted with the present about 200 FM stations on the air and 773 with authorization for operation.

VIDEO STATIONS REACH 61—In television there have been licensed or authorized 61 video stations and the Commission has before it 17 other applications. The other segments of the broadcasting field comprise 34 educational FM license stations and 15 applications, together with 30 international broadcasting stations which are leased for the State Department's "Voice of America" programs. All of this fevered activity in broadcasting is felt to add up to substantial sales of transmitting equipment to the stations' owners and will undoubtedly stimulate the sale of home receivers.

100,000 "HAMS" TO WORK FOR PEACE—With the aim of exchanging information about the activities of the United Nations to spread the gospel of world peace, the International Amateur Radio Union and the American Radio Relay League have launched a move in conjunction with the United Nations for the approximately 100,000 amateur radio operators in 37 countries all over the world to relay to each other a daily schedule of UN news. The plan, proposed by Brig. Gen. Frank E. Stoner, the new Chief Communications Engineer of the United Nations and former Assistant Chief Signal Officer of the U. S. Army, was formally approved and set in operation by George W. Bailey, President of the International Amateur Radio Union (who is also Executive Secretary of the Institute of Radio Engineers) and by UN Assistant Secretary-General Benjamin Cohen. Bailey, the "No. 1" amateur of the United States, transmitted the first broadcast and notice of the plan to key amateurs in virtually every nation of the globe. The "hams" also are to act as unofficial monitors of the UN shortwave broadcasting operations both from the technical and propagation standpoint and in analyzing listening habits and numbers of listeners in the various countries.

MOBILE RADIOTELEPHONE SERVICES — With the object of changing over the present experimental services to regular and permanent operations in the mobile radio field, FCC has despatched questionnaires to all licensees of mobile radio facilities inquiring into the results of their operations to date. The study will also have the object of splitting the present service classification into specific services for each type of operation. Commission in inquiring about the data from the licensees, who will be relieved of the necessity of filing experimental reports which are due at the end of the first year operations, will also build up a fund of information for prospective hearings in this field. The mobile service has really become "big business" with the equipment value already totaling over $27 million even though all operations are now on an experimental basis. Most interesting aspects of questionnaire is series of questions on use of radio for replacing wire line communications.

TELEVISION FACTOR IN POLITICS — Republican party in selecting Philadelphia for 1948 was greatly influenced by the video outlets in that city—Philco and Philadelphia Inquirer stations—and tie-in with the eastern span of the coaxial cable.

FACSIMILE AND THEATER VIDEO—Growing list of newspapers, testing value of facsimile, augurs that this field will be major one for facsimile for the present, according to FCC planning. Commission soon has to restudy frequency needs for theater television as main elements pushing large-screen video are seeking a decision on request for 75 additional channels.

ROLAND C. DAVIES
Washington Editor

HIGH VOLTAGE; NO DANGER

Portable - Rugged - Safe!

Salient Oscillographic Features . . .

- ✓ 10,000 volt intensifier potential available for use with cathode-ray oscillographs.
- ✓ Visual observation of single transients hitherto invisible.
- ✓ Photography of extremely high writing rates (for example, 2000 km./sec. on 5RP11 at 10 kilovolts).
- ✓ Observation of entire waveshapes of short duration on long persistence screens.
- ✓ Convenient use with Type 5RP-A Multi-band High-voltage Cathode-ray Tube.

Working Details . . .

- ✓ Continuously variable d-c output from 5,000 to 10,000 volts with loads up to 200 microamperes.
- ✓ Regulation within 20% from no load to 200 microampere load.
- ✓ Ripple voltage on output less than 0.5%.
- ✓ Power supply: 115 volts, 50-60 cps.
- ✓ Power consumption: 100 watts.
- ✓ Dimensions: 10⅞" h. x 8⅛" w. x 14¾" d.
- ✓ Weight: 24 pounds.

DU MONT Type 263-A HIGH-VOLTAGE POWER SUPPLY

High voltage is the keynote of modern oscillography. Especially for brilliant traces at ultra-high speeds.

Type 263-A High-Voltage Power Supply was designed with present and future needs in mind. It provides a dependable yet inexpensive power supply for modernizing and extending the usefulness of certain types of cathode-ray oscillographs when examination of extremely high writing rates is required.

So here's a complete high-voltage power supply. Suitable for any application where high voltage at low current is called for. Consists of radio-frequency oscillator with its own power supply, an r.f. step-up transformer, a half-wave rectifier, and a high-voltage filtering and metering system.

Compact. Light. So designed that inexperienced personnel may handle it with safety. And it is made still safer in case of accidental contact with high voltage, because very little power is stored in its filtering circuit. Furthermore, no equipment damage will result if output is short-circuited. Rugged mechanical construction permits field or laboratory use.

Surely Type 263-A is a "must" instrument whether for high-voltage oscillography or general use!

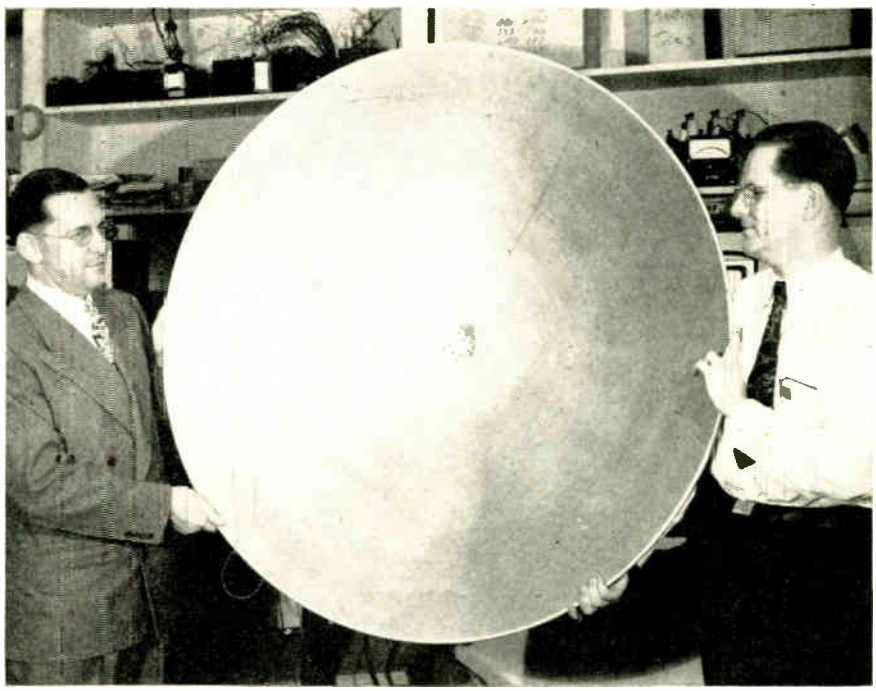
Details on request!

DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: ALBEEDU, PASSAIC, N. J., U. S. A.

Motorola Microwave Commercial Model

A project to develop a commercial model of the microwave relay now being tested jointly by Motorola and the Greyhound Corp., is planned by Motorola enginers. The relay operates in the 3000 mc band. An experimental model of the microwave relay is now in use at Lombard, Ill., nineteen miles west of downtown Chicago. The unit monitors a Motorola radio-telephone transmitter situated on top of Chicago's Board of Trade Building. The Motorola VHF transmitter, owned by the Greyhound Corp., operates on 43.220 mc. In Lombard, signals are picked up at this frequency. Another receiver in the microwave unit receives signals at 43.340 mc from Greyhound buses equipped with Motorola mobile radiotelephone. These signals are re-transmitted by the microwave relay and picked up minus interference by a super high frequency receiver located at the Board of Trade Building.



Antenna and parabolic reflector for 3000mc microwave relay being tested between Lombard, Ill. and Chicago by Motorola and Greyhound bus engineers

60 Railroad Channels

Making conclusive its decisions reached this past March on frequencies to be delegated the various branches of the railroad radio service, FCC on May 9 issued an order which enumerates frequencies available for train end-to-end stations, yard and terminal units. The Commission made no change in the number of channels assigned to the railroad service but set forth specifically the 60 frequencies which will be used. The 60 channels allotted for train radio stations all fall between 158.37 and 161.91 mc with the following frequencies specifically designated for yard and terminal facilities: 158.43, 159.09, 159.81, 160.53 and 161.01.

Pioneer to Gothard

Gothard Mfg. Co., Springfield, Ill., has purchased tools, equipment and inventory for dynamotor, inverter and motor generator production from Pioneer Gen-E-Motor, Chicago, which will discontinue the manufacture of these items. Harold Argue leaves the Pioneer engineering department to become chief engineer of Gothard. The company will commence operations at Springfield shortly. Organization of a line of standard dynamotors and inverters, for general trade distribution is planned for the future.

Hutmacher Enters Trade

Salescrafters, Inc., headed by Ray R. Hutmacher, formerly with Maguire Industries, Inc., has opened offices at 510 North Dearborn St., Chicago. The company will operate as manufacturers' representatives in the electronics and radio industries on both a national and a territorial basis. Prior to joining the Maguire organization in Chicago two and a half years ago, Hutmacher was for 10 years associated in an executive capacity with Utah Radio Products Co., Chicago. Under an arrangement recently completed with Gordon Carbonneau of Carbonneau Industries, manufacturer of radio speakers, the Salescrafters, Inc., will represent Carbonneau Industries in the national market with a complete line of speakers for the manufacturing and jobber replacement trade.

American Takes Allied

American Relay & Controls, Inc., Chicago, has acquired all equipment and personal property of the Chicago division of Allied Control Co., Inc. Production of electrical relays, switches and controls will be continued on an increased scale. The entire present personnel of the company, including about 350 employees, is being retained. Offices are in the First National Bank Building.

Switchcraft in New York

Switchcraft, Inc., 1735 West Diversey Parkway, Chicago, has a new New York representative. The S. S. Egert Co., 11 Park Place, will handle metropolitan matters for the company.

RKO TV Moves

RKO Television Corp. has occupied new headquarters in New York. The new address is 625 Madison avenue.

Acoustical Experts

Continued from page 92

sicist of the Bell Telephone Laboratories, outlined a plan for the establishment of an institute of musical science. This institute would operate on a scientific basic to study certain technics whereby music would contribute more fully to the esthetic life of a larger number of people. The fundamental goal of the institute would be to teach the students the artistic side of music along with the acoustic side.

SANGAMO

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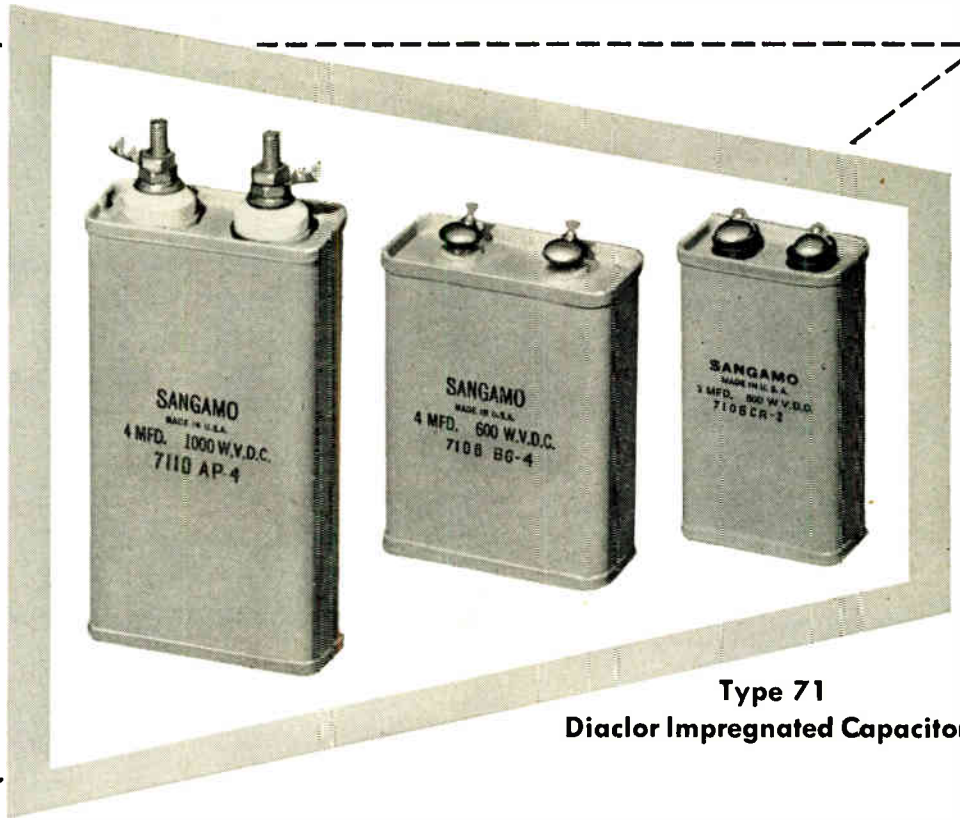

Type 71
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• Diaclor Impregnated to Assure Greater Uniformity of Production • Stable Capacity Over a Wide Range of Temperatures • Excellent By-Pass and Coupling Qualities • Available Within a Range of 600 to 6000 Volts Working, or Higher . . . these are the credentials that qualify Sangamo Type 71 Diaclor Impregnated Capacitors as Blue-Ribbon entries for broadcast and aircraft transmitters, industrial applications, and in high-voltage circuits of all kinds.

Diaclor, the chlorinated dielectric used by Sangamo, permits greater uniformity of production because of its controllable characteristics. *Smaller sized capacitors, for use where space is at a premium, are made possible because of its high dielectric constant.* Fire hazard due to accidental leakage is eliminated because Diaclor is non-inflammable and non-explosive.

Type 71 capacitors have high insulation resistance and low direct current leakage. They can be supplied with either composition rivet, screw type, hermetically-sealed pyrex glass or stand-off porcelain terminals, and with your choice of four types of mounting brackets. They are available in a wide range of capacities.

Sangamo manufactures a complete line of paper, mica, and silver capacitors for every radio and electronic application. A quarter of a century of experience in building better capacitors, with new and more exacting requirements and greater accuracy demanded each year, give Sangamo capacitors—of all kinds—Credentials that Qualify!

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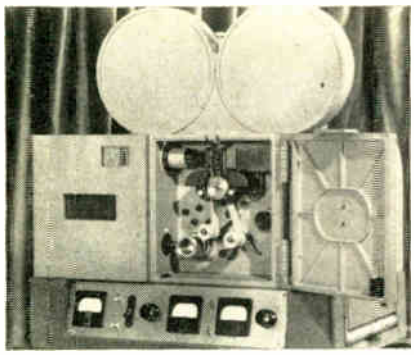


FILM RECORDERS

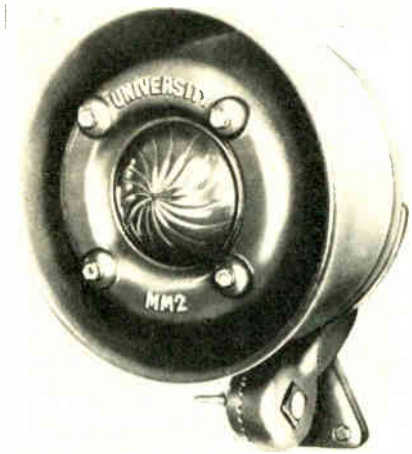
Use of magnesium alloy has made it possible to reduce the weight of RCA's new 16 mm and 35 mm recorders to as little as one-fifth of the weight of pre-war models. The new film recording equipment consists of two 35 mm recorders, a 16 mm recorder, a unit-construction recording rack, and light microphones. The unit construction rack constitutes complete "packaged" recording equipment, including power supply and amplifiers for portable and stationary use. The deluxe 35 mm film recorder (illustrated) combines simplified design—including an easy film threading path—with high-fidelity performance and light weight.—*Radio Corp. of America, RCA Victor Div., Camden, N. J.*

HAND MICROPHONE

Efficient in factories, machine shops, railroad yards etc. the Turner Model 15D-NC hand microphone cancels out background noise by means of a special diaphragm which balances out random sound arriving from a distance, but permits close talking speech directed at the front to be transmitted. Housed in a tough, lightweight alloy case finished in gunmetal enamel, the unit is available in 50, 200, and 500 ohms or high impedance. On request a "push-to-talk" thumb switch is built into the handle for on-off operation or relay work.—*The Turner Co., Cedar Rapids, Iowa.*

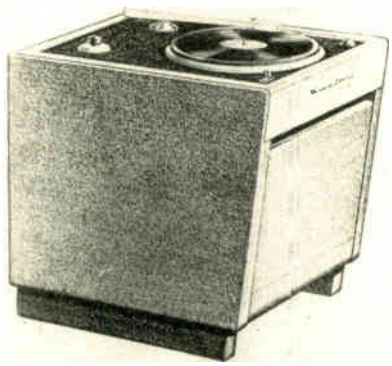
RECORDING DISC

Available in sizes from 6½ in 12 in. the improved Red Label Duodisc uses an aluminum base and nitrate composition material to assure uniform recording. Hard spots have been eliminated through a new process, thus extending the life of the cutting needles. To guarantee freshness an age retarding plasticizer formula has been developed. A static-free feature causes the thread, which is soft and silky, to be drawn towards the center of the disc during recording.—*The Duotone Co., Inc., 799 Broadway, New York.*



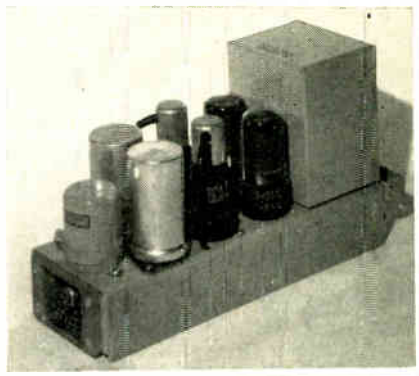
MARINE SPEAKERS

To meet the severe requirements of marine and railway installations this series of speakers is provided with reflex aircolumns and built-in hermetically sealed driver units, immune to dust, dirt or live steam. The speakers are available in four types. Model MIS and MIL have an output of 5 watts, impedance of 8 ohms and a frequency range from 400 to 9000 cps. Models MM-2 and MM-2F provide 15 watts output with response range from 300-6000 cps, and have 15 ohms impedance. Dispersion angle is 120° for all models. The MIL and MM-2 mount on adjustable bracket. The models MIS and MM-2F are designed for flush mounting on bulkheads, panels etc., where space is at a premium.—*University Loudspeakers, Inc., 225 Varick St., New York, N. Y.*



REPRODUCER TURNTABLE

Providing all equipment needed for feeding amplifier systems in the reproduction of transcriptions or disc recordings, vertically or laterally cut, at 33-1/3 or 78 rpm., the 1304 reproducer set is designed for professional use in broadcasting and sound system installations. A new turntable drive system eliminates flutter and "wow" (less than 0.1%) and maintains speed constant within ±0.5% at 33-1/3 and 78 rpm. The unit consists of a floor mounted cabinet and the 304A reproducer panel which includes the 109AA reproducer group.—*Western Electric Co., 195 Broadway, New York 7.*



PLUG-IN AMPLIFIERS

Complete broadcast audio facilities can be provided using only the Langevin type 116-A as pre-amplifier and booster, and the type 117-A (illustr.) as program amplifier, booster, and monitor. The units, provided with gold-plated Cannon plugs, utilize only type 6V6GT and type 1620 tubes throughout and have a frequency response range within 1 db from 30 to 15,000 cps. Output load impedance is 150 or 600 ohms, input source impedance being 30/150/250/600 ohms. Output power of type 116A is +18 dbm, gain is adjustable from 34 to 40 db. Type 117-A has an output of +30 dbm and a gain of 50 db. External filament and plate power is required.—*The Langevin Co., 37 W. 65 St., New York.*

INTERCOM SYSTEM

Available with facilities for the use of up to 24 master stations, permitting as many as 12 conversations to be carried on simultaneously the Amplicall intercommunication system meets the specialized needs of business offices, industrial plants, etc. Housed in a walnut plastic case, the master station unit can be supplied with or without handset for private conversation. Distinctive features include "visual" busy signal, locking type push buttons for station selection, illuminated "on-off" volume control, plug-in cable connections, and balanced line wiring to prevent cross-talk.—*Rauland Corp., 4245 N. Knox Ave., Chicago 41, Ill.*

CARBON MICROPHONE

No larger and considerably lighter than an ordinary pocketwatch, the A174 cartridge type carbon microphone utilizes a single button construction and is fully insulated. Useful for midget transmitters, detectaphones and low cost paging and call systems the unit has an impedance of 200 ohms and an output level of 12 db below 6 milliwatts for a 100 bar signal. Stationary setup is provided for by an adjustable metal ring hook at the back.—*Universal Microphone Co., Inglewood 2, Cal.*

HOTEL ANTENNAS

(*Continued from page 29*)

harmonics of low frequency FM stations, and ignition and electrical interference. Obviously, a trap cannot be effective against this type of interference, since it comes in at the same frequency as the desired signal. The most effective way of reducing it is either to use a more directional antenna, or relocate the antenna for a minimum of interference.

Often a roof penthouse or part of the building may be used as an effective shield between the source of the interference and the antenna. It has been found that the exact location of the antenna is often very important—sometimes a movement of the antenna several feet has resulted in a marked improvement. Sometimes it is possible to reorient the antenna slightly, pointing the ends of the dipole rods at the interference, thus taking advantage of the null at their ends.

To prevent transmission line pickup of man-made noise, all line runs should not be closer than 6 in. to any of the hotel wiring or piping. The lines to the individual receivers should be separated by this same distance from each other.

The second general classification of interference is that which comes in at frequencies other than that of the wanted television signal. Image and IF interference will come under this classification. It is against this type that traps are effective.

One simple trap can be made by connecting an open ¼-wave section of line, cut to the interfering frequency, across the receiver input terminals. This will be a short circuit to the interfering signal. A shorted quarter-wave stub in series with each side of the line, tuned to the interference is helpful.

Band elimination filters to eliminate the FM band may be made up using lumped constants, or transmission line, although the former usually are more compact and less affected by capacity effects. Any such filter should offer attenuation to both the balanced and unbalanced signal on the line.

At the Hotel Pennsylvania, difficulty was experienced with interference from WBAM operating on 106.5 mc. which was an image fre-

quency of WCBS-TV. This was eliminated by means of a low pass filter made up of shielded transmission line elements.

Since the average guest has not seen television before, or operated a receiver, it was found necessary to provide simplified instruction cards at each receiver, giving a step-by-step adjustment procedure. Knobs were painted distinctive colors to aid in the identification of the various controls. Experience has shown that it is desirable to enclose any accessible screwdriver adjustments such as height and linearity to prevent curious guests from misadjusting them.

The installation has provided good, dependable operation with no noticeable interaction between receivers. Much enthusiasm has been shown by guests toward having television in their hotel rooms.

The author wishes to thank the management of the Hotel Pennsylvania, and officials of the Statler Hotel Co. for the excellent cooperation received during the installation, and for help in obtaining illustrations for this article.

RAYDIST MEASURING SYSTEM

(*Continued from page* 33)

tion that constitute a family of hyperboles. These basic systems may be modified or combined in various forms for special applications.

A two dimensional system may be obtained by combining two components of pure range data for such applications as the navigation of ships in narrow channels and harbors. With equipment set up as shown on page 30 indicators and tape recorders at the main shore station would show the true position of the ship at all times within an accuracy of an inch or two if necessary. The system as shown represents the minimum outlay for equipment installed on the ship and with this system it would be necessary to telemeter the position to the ship. However, the main recording station may be interchanged with the mobile station if desired and the data will then be obtained on the ship. The system could be set up to supply the data simultaneously in both locations.

Actually the above system accomplishes the equivalent of two pure range measurements by combining a component of pure range data with a hyperbolic component through the medium of a mechanical differential connected between the two synchros. The pure range component between the ship and the master station is recorded directly. The master station, the relay station, and the CW transmitter on the ship constitute a hyperbolic system. Hyperbolic data actually represents the difference between the change in distance of the ship with respect to the master station and with respect to the relay station. The differential unit obtains the difference between the hyperbolic and pure range readings and this difference is equal to the pure range from the relay station to the ship.

This explanation may be simplified somewhat by consideration of the following. If the distance between the main recording station and the mobile transmitter is R_1 and the distance between the relay station and the mobile transmitter is R_2, the rotation of synchro S_1 is proportional to the distance moved by the mobile transmitter with relation to the main recording station, or in other words, the reading is continuously equal to R_1. The rotation of synchro S_2 is proportional to the change in distance between the mobile transmitter and the main recording station, R_1, and the mobile transmitter and the relay station R_2. Therefore, the rotation of one shaft of the differential is proportional to R_1 and the shaft of the other input of the differential is proportional to R_2 minus R_1. The output of the differential is then equal to R_2.

The high order of precision that may be obtained with Raydist suggests the application of this method for three-dimensional measurement of flight paths of guided missiles. When velocities and accelerations are to be calculated, it is an important consideration that the method used will allow measurements to the order of an inch instead of 50 or 100 ft. which is a common limitation in Radar systems.

The following examples illustrate the effect of the accuracy of

the space records on work-up of velocity data. In order to determine the velocity from a space record to an accuracy of only 2%, a recorded distance of at least 50 times the probable error in distance must be used. With a missile, for example, if 100 ft. is the error in measurement by Radar means, 5000 ft. would be required for an accuracy of 2% in the velocity determination. Variations within this range could not be accurately checked.

In a rising or falling body, large changes in density and temperature would be encountered in that distance and would make the data of questionable value. With a 1-in. accuracy-of-position measurement, as obtainable with Raydist, a velocity measurement could be made to the same order of accuracy over a travel of less than 5 ft. Higher accuracies could be determined over longer distances. A velocity measurement to 0.5% could be made over a 16-ft. travel, etc.

A missile range set up as shown in the diagram, Fig. 3, would set up three independent families of hyperbolic surfaces of revolution. The intersections of the three families of surfaces then represent three dimensional coordinates of position in space. The position of a missile flying through this range would be known at all times with respect to these coordinates.

This system would also allow the flight paths of a number of aircraft or missiles to be recorded simultaneously without additional ground receivers or transmitters. Audio filters and additional recording channels would be required, and each missile would be assigned a slightly different frequency. Widely different audio frequencies would result from the heterodyning of the ground transmitter, and filters would separate each channel.

Three-dimensional data would also be useful in aircraft blind landing systems requiring greater precision than is obtainable with existing methods. Modifications or combinations of the Raydist systems can be made for this purpose that may be used either to replace or to supplement existing systems.

Raydist is believed to have many

applications to problems requiring precise measurement of position. In addition to the surveying, missile tracking, navigation, true ground speed, and the blind landing applications referred to above, it is suggested that it will prove useful in applications to automatic control of aircraft and missiles, to aerial photography, to geodesy, and to prospecting. It may also prove useful in studies of earthquakes by obtaining continuous records of relative earth movements in the vicinity of earth faults and for fundamental research in measuring velocities of propagation of electromagnetic waves.

WORLD COVERAGE

(*Continued from page 42*)

represent maximum usable frequency curves. It is frequently desirable to ascertain world area coverage in terms of optimum working frequency, and in such cases, the curves traced from the CRPL publication may be selected as those twenty percent higher in frequency than the operating frequency, since it has been found that optimum working frequency is approximately fifteen percent lower than maximum usable frequency.

The data available in the CRPL publication represents estimates made several months in advance and may therefore be somewhat in error. For this reason, the Central Radio Propagation Laboratory will furnish up-to-date corrections to this data by mail about fifteen days in advance of the periods covered by the publication. With such corrections, revised curves may be drawn, if more accurate information is desired from the described prediction device.

There are several factors which will affect the accuracy of the predictions made either by the method heretofore in use, or that newly described in this article. Ionospheric storms lasting several days may vitiate all predictions; warnings of these, however, are given by WWV at half-hour intervals. Reflection from other layers of the ionosphere may result in propagation conditions differing from those predicted by the foregoing methods.

Additionally, since attenuation of radio waves becomes greater as the difference between maximum usable frequency and operating frequency becomes greater, increased power may be necessary at times to effect propagation in accordance with the predictions. There are other limitations upon the methods described in this article, with respect to which the reader is referred to various publications of the Central Radio Propagation Laboratory. However, in general, it has been found that predictions and observations are in agreement a predominant portion of the time. There is thus available to the tele-communications engineer and research worker, a method and device which should facilitate his wave propagation studies, regardless of the nature of the problems.

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1947

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TRENDS IN DEVELOPMENT

(*Continued from page 54*)

the standard CM-20 type is now 510 mmf.

Samples of silvered-mica capacitors made by two different manufacturers showed shifts as large as 6.8 and 36% after temperature cycling, while a better product by a third manufacturer (250-mmf value), which had been improved (after earlier tests in this series had shown its weakness) by the use of a superior clamping around the stack, provided average shifts of only 0.1%. Dissection of the two poor types disclosed separation of the silver coating from the mica which was traced to the effects of the cold-temperature exposure.

Paper-dielectric capacitors are less stable than mica types generally. The variations in capacitance with temperature to be expected in various types can be noted from the Joint Army-Navy Specification JAN-C-25 as −15, −30, and −10% at the prescribed low test temperatures of −55°C, −55°C, and −20°C for capacitors of characteristics A and E (mineral oil), B, D, and F (vegetable and synthetic oils), and H (wax-impregnated) respectively. The extent of the variation with temperature also varies a great deal with frequency in the audio range[7].

The highest permissible temperature ratings of dry electrolytic capacitors are 65°C and 85°C. At higher temperatures rapid deterioration occurs and sometimes explosions of considerable violence. For this reason their use in military electronic equipment was avoided wherever possible. However, the great need for large capacitance values in small containers will justify greater effort being made to obtain units suitable for use at higher operating temperatures.

Difficulties have been encountered in making the fullest possible use of the electrical stability and range of temperature coefficients possible in capacitors having ceramic dielectric of the high permittivity type, because production techniques do not allow control of the temperature coefficient with sufficient exactitude. For example, the zero-temperature-coefficient type (NPO) is usually supplied

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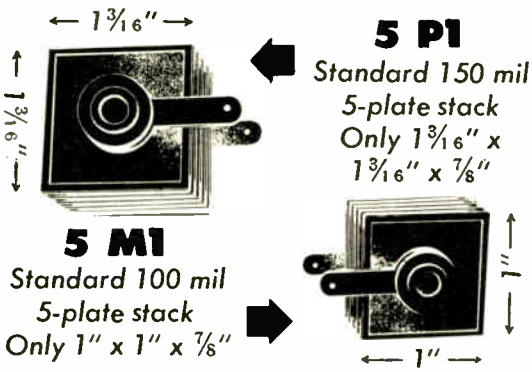

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with a coefficient tolerance of plus or minus 30 parts per million per degree Centigrade. Use of such capacitors in circuits designed to be compensated for very low thermal drift is not satisfactory from a design point of view.

Hermetically-sealed air-dielectric capacitors both of the ganged receiver tuning type, and, even more important, of the trimmer type are a requirement that has not yet been met, although a novel variable capacitor with a liquid dielectric (a silicone fluid) has been put on the market and may be of some help in this respect.

Rotating joints in sealed components are the main difficulty involved. Ingenious methods may be possible for overcoming this joint difficulty or for substituting entirely different actuating mechanisms. In this regard, it is noted that sealed actuating mechanisms have been devised satisfactorily for the vacuum type switches made by General Electric and in variable vacuum capacitors which have become available commercially.

The improvements added to a few commercial makes of paper capacitors[5] and mica types in reducing inductance and raising the resonant frequencies of units and in reducing R-F losses will probably be applied more generally in future.

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(To be concluded)

New FMA Headquarters

Effective May 1, FMA occupied new quarters located at 921 Twelfth Street, Washington, D. C.

PROGRAM DISPATCHING SYSTEM

(*Continued from page 51*)

flashed, the operator prepares to put the WNEW transmitter back on the tennis matches by turning the channel No. 1 selector switch to the No. 10 position. This is verified by the green light opposite No. 10 on the first channel. At 2:41 the first channel MASTER-OPERATE key is pressed to OPERATE and all three services are again receiving the tennis matches.

The next program problem is slightly more complicated than the first, but its execution is just as simple. Now it is necessary to switch both the WNEW transmitter and the network to studio No. 1 at 2:45 p.m. for a fifteen-minute show. The recording room, however, must continue to cover the tennis matches for rebroadcast at a later time. Prior to 2:45 p.m., the operator presets the panel for the 2:45 show. The selector switches on channels 1 and 2 are preset to the No. 1 position. The No. 1 green lamps on channels 1 and 2 signal that these two channels will have their inputs switched to studio No. 1 when the operator releases at 2:45. Channel No. 3, for recording, remains unchanged.

The MASTER-OPERATE key on both channels 1 and 2 are snapped to the MASTER position. At 2:45 the operator presses the MASTER BUTTON and studio No. 1 goes on the air over channels 1 and 2. The WNEW transmitter and the network are fed the broadcast show from studio No. 1, while the recording room continues to record the results of the tennis matches over channel No. 3.

The cue feedback system is another interesting feature of the WNEW program dispatcher. Another panel called the cue selector has a set of ten pilot lamps for each studio. Cue programs can be assigned to the studio next-on-the-air by setting the cue selector switch for that particular studio, to the channel number from which a cue is desired. The cue selector panel is seen at the left of the master panel in the photograph. As an example, we revert to the problem illustrated above.

Just prior to 2:40 p.m., studio No. 2 from which the news flash is

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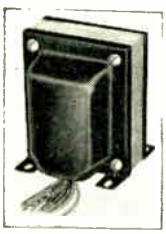

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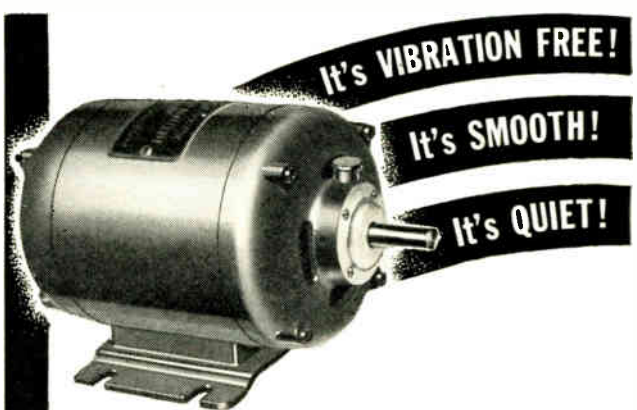

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to be broadcast, is assigned a cue from channel No. 1 by changing studio No. 2 selector switch to the No. 1 position. The green lamp opposite the No. 1 position signals that studio 2 will be assigned cue from channel 1 upon release. When the MASTER-OPERATE key is thrown to the OPERATE position on the master control console, studio No. 2 is on the air and the relay circuit automatically removes cue from that studio to prevent feedback. A single red lamp above the studio cue selector switch signals which studios have cue.

This illustrates the complex problems that can be solved when the engineer is concerned only with the programming. However, it is not uncommon in a broadcast station for the program director or the sales manager to request portions of the program dispatching equipment for auditioning or rehearsal purposes. The remaining channels not in use on the master control console serve these purposes without interfering with the main programming.

For remote programs another interesting cue circuit is used by the WNEW engineers. Just before the remote program goes on the air, the nemo engineer can ring back to the master operator over the cue program level to attract his attention. In answering the call, the master operator removes the cue during conversation and replaces it afterwards.

PRINTED CIRCUITS

(*Continued from page* 61)

paint used on a ceramic base consists of 62% silver powder, 15% cellulose lacquer 11.5% lead borate and 11.5% ethyl acetate. This paint requires firing at 800°C and gives excellent results—good adhesion to the surface (3000 lbs. per sq. in.) and good conductivity. For use on glass, a silver paint made of 76% silver oxide, 4% raw linseed oil, 12% lead silicate and 8% mineral spirits may be used. This paint requires firing at 450°C.

A resistor formula which cures at 150°C and is suitable for painting on Steatite, glass, and phenol-aldehydes (bakelite, etc.) consists of 15% powdered graphite, 29% phenol-aldehyde lacquer, 9% lamp black, and 47% alcohol-acetate

mixture. For methyl-methacrylates (lucite, plexiglass, etc.), a resistor paint which dries at room temperature may be made of 27.5% graphite powder, 34.5% methyl-methacrylate lacquer, 29% toluene, and 9% lamp black.

Although the silver wiring is applied in layers usually less than a mil in thickness, the current-carrying capacity exceeds that required in normal electronic circuits including filament supply leads. In tests at the Bureau a silver line 0.0005 in. thick and 1/8 in. in width carried over an ampere of current continuously and satisfactorily. It required 18 amperes to puncture the line. The resistors are rated conservatively at from 1/10 to 1/3 watt depending on the physical size. Larger ratings are possible.

Recent studies by the National Bureau of Standards have disclosed at least six principal methods of printing electronic circuits. They are, in addition to the painting method described above, spraying, chemical deposition, vacuum methods, die stamping, and electro-photography.

From the production standpoint we see many advantages. Some of these are: uniformity of production, reduction of assembly and inspection time. From 30% to 60% of the soldering can be eliminated. Plug-in sub-assemblies with printed circuits give advantages not available heretofore. In localities where repairmen are not at hand these tiny sub-assemblies can be removed, sent to the factory for repair and replacements inserted by the user.

RAILROAD TRACKSIDE PORTABLE

(*Continued from page* 43)

supply may be removed from the carrying case and recharged, while the second set of batteries provide a reserve operation. Normally, the power supply assures from 2 to 3 hours constant use with several hours intermittent usage. Provisions are made so that recharging facilities may be provided from either AC or DC sources.

Approximately one mile solid communication is normally provided in pack-set to mobile or fixed station operation.

TV PROPAGATION AT UHF

(*Continued from page 65*)

$\lambda = 5.5$ meters

$$v_{5.5} = 24.4 \sqrt{\frac{2}{5.5 \times 966}} = .47$$

From the curve $\frac{a}{A_{5.5}} = .315$

The second diffraction has the following conditions:

$h = 200$ ft. $= 61$ meters

$d = 12{,}700$ ft. $= 3860$ meters

$\lambda = 5.5$ meters

$$v_{5.5} = 61 \sqrt{\frac{2}{5.5 \times 3860}} = .58$$

From the curve $\frac{a}{A_{5.5}} = .285$

Therefore at this point we would expect to receive $.315 \times .285 = .09$ or 9% of the unimpeded signal strength

A similar treatment using $\lambda = 0.61$ for the high-frequency case results in an expectation of only 1.7% of the unimpeded signal strength. Therefore we would expect a ratio of signal amplitudes of $\frac{.09}{.017} = 5.3$ This corresponds to a field intensity ratio of 5.3^2 or 28.

The summary sheet shows that we measured 450 μv. on the low-frequency and 25 μv. on the high-frequency. The high-frequency antenna had a voltage gain of 4 over a standard dipole and the frequency ratio was 9. Therefore, the measured signal strength ratio was $\frac{450 \times 4}{25 \times 9} = 8$ and the field intensity ratio was 64.

Again this figure is considerably worse than the ratio of 28 obtained by using the simple diffraction theory. As previously observed, however, local reflections might cause the measured values to vary over wide limits if the equipment were moved only a few wavelengths and it is quite possible that the high-frequency signal had been attenuated more than the low-frequency signal before the diffraction.

Taking the conservative figure obtained by the theory, let us now consider its significance with respect to reception of the two signals. If simple dipoles were used in both cases and the transmitter effective radiated powers were

equal, the voltages delivered to the receivers would be in the ratio of 5.3 x 9 (frequency ratio) or 47.7.

In order to deliver equal voltages to the receiver terminals the high-frequency transmitter power would have to be increased by a factor of $47.7^2 = 2270$. Part of this could be made up by using a high-gain receiving antenna, but even the complex double horn used by CBS had a power gain of only 16.

It must be concluded, therefore, that at the present time, no 500 mc. equipment is available either at the transmitting or receiving end, which will deliver voltages at the receiver terminals comparable to those produced by low-frequency equipment when the receiver is in a deeply shadowed area.

Furthermore, in this particular case, equal voltage at the receiver terminals is not enough. As is well known, all types of noise increase with bandwidth, so that a broadband receiver requires a greater input signal than does a narrow band one in order to produce the same signal-to-noise ratio.

It should be noted that this is fundamental and although the signal-to-noise ratio may improve as the art advances, a broadband receiver must always have a greater input signal than an equivalent narrow band one. As a practical example of this principal, the CBS portable receiver used in these tests required about 1000 μv. to produce an acceptable picture whereas the photograph shows a satisfactory black-and-white picture taken at Nyack with 450 μv. at the set terminals. In rural districts good black-and-white pictures are being received with only 100 μv. or less.

Measurements were made at eight major locations. Of these eight locations six proved inadequate for 500 mc. reception and one of the remaining two was the Du Mont Field Laboratory at Cedar Grove, N. J. which must be considered an ideal location for any frequency. All eight points proved adequate for black-and-white reception on the lower bands.

The degree of black-and-white reception differed. There were places where it was much better than at others, but the black-and-white installations made all over

the country indicate that there are much worse places than any of these eight where standard band installations have been made and good commercial reception of black-and-white is found.

What, then, is the solution to the problem of UHF television? These frequencies are entirely adequate for point to point transmissions as for remote pickups, inter-city relay links, etc., and it is very likely that such usage will be greatly increased in the future. However, in the opinion of the writer, it is not practical to attempt to establish a broadcast service on UHF at the present time.

The results of the tests discussed in this paper, plus many measurements made over the past few years, indicate that the ultimate solution of the problem of UHF broadcast television lies in obtaining a "line of sight" propagation path from transmitting antenna to receiving antenna. To realize such a condition over an appreciable coverage area it will be necessary either to increase the transmitter height greatly over anything now existing or to provide a suitable reflector at such a height as to fulfill the above requirements.

RMA ENGINEERS

(*Continued from page* 67)

bandwidth of 3 megacycles provides ample sensitivity. A feature of this system is the precisely-regulated power supplies—a ripple level down 100 db and a drift stability of 60 db being maintained.

A description of a new commercial radar installation developed by Westinghouse and being tested in several types of marine service was presented by Coleman London. These units are particularly adapted to close-in surveys but are capable of plotting over a 30 mile radius when needed. This equipment has received favorable attention from originally skeptical navigators where test installations have been made.

A. C. Omberg (Bendix Radio) described the Bendix NA3 omnidirectional navigational system which gives a pilot his location and flying direction to reach any objective (not necessarily the point where the ODR is located). From

the information made available by the instruments (distance and direction data primarily) the pilot can set up the dials of an easily-operated automatic computer so that the required instructions for getting to a selected location are read directly. This method, sometimes known as the R θ system (since it is based on R = range and θ = angle of plane from the true north at ODR station), is more versatile than simple homing instruments. The computer uses the phase trigonometrically related outputs of autosyn (2 phase) generators.

As a part of this system an ingenious receiver has been developed which provides for the selection of any of the 280 channels in the airfield zone control band with crystal-controlled accuracy, but with only a few basic crystals involved. In this receiver the heterodyne oscillator frequency is controlled by a reactance tube operated from the output of two discriminators. The latter receives a signal which is established by combinations of frequencies from precision crystals.

A trip through the newly established Electronics Park division of GE was arranged for the delegates.

WIDE READING

(*Continued from page 71*)

repetition frequency is inserted in the cathode lead. Negative feedback voltage developed across this resonant circuit will filter out the pulse repetition frequency. To prevent interference of the sound pulses on the television picture, a negative pulse may be applied during the fly-back period.

Alternatively the sound-pulse amplitude may be made less than the peak video signal. A blanking pulse must then be added to the sound-pulse to raise it above the video signal so that separation on an amplitude basis is possible.

The pulse-shaping, modulating and amplifying circuits at the transmitter are described. Tests with equipment indicate satisfactory performance. Advantages are: simple and cheap sound receiver, no separate television-sound transmitter, reduction in band-width requirements, no sound and video carrier interference, sound-pulses used for avc at receiver.—JZ

PERSONNEL

Philip G. Caldwell has been appointed manager of sales of the General Electric transmitter division, Syracuse. He was formerly manager of television equipment of the division.

David C. Peterson has been made director of engineering and research at the main Chicago plant of Stewart-Warner Corp. He is an industrial consultant, has been associated with several large manufacturers of Diesel engines.

Ray E. Warner has been appointed tube sales engineer for the Westinghouse Electric Corp., will make his headquarters at 20 North Wacker Drive, Chicago. During the war he was a radar and air-borne electronics specialist for the US Naval Air Corps.

Fred E. Russell has been appointed controller for the Central Engineering Department of Sylvania Electric Products, Inc., Emporium, Pa. He will have charge of general business in connection with the company's advanced development and metallurgical research laboratories in the Long Island area.

Fred E. Russell Harold L. Mann

Harold L. Mann has been appointed chief industrial engineer of the Farnsworth Television and Radio Corp., Fort Wayne, Ind. He has been affiliated with RCA and Crosley, before joining Farnsworth was industrial engineer for the Fruehauf Trailer Co., Detroit.

G. Taylor Stanton has been appointed manager of engineering of Holtzer-Cabot division of First Industrial Corp., Boston, Mass. He was formerly chief engineer of TelAutograph Corp., New York.

Irving Rose has joined National Moldite Co., manufacturer of magnetic iron cores, Hillside, N. J., and

will represent the company in mid-western states. He was formerly production engineer for Hallicrafters Co., Chicago, will headquarter at 7752 South Kingston avenue, Chicago.

James D. McLean has been appointed commercial manager of Philco television station WPTZ. Latterly he has been manager of sales of the transmitter division of General Electric, Syracuse.

Robert Twells, plant manager of the spark plug division of Electric Auto-Lite Co., Toledo, has been elected president of the Institute of Ceramic Engineers. He is also president of Ohio Ceramic Industries Assn.

Jules J. Bressler has been appointed field sales engineer, covering the New York metropolitan area for Atlas Sound Corp., Brooklyn, N. Y. He was formerly chief engineer of Beltone Sound Systems Co.

Jack O'Brien has been appointed manager of RCA's theater equipment section. He was formerly sales manager of the section, succeeds J. R. Little as its manager. Little is sales manager of RCA distributed products.

Charles P. Cushway has been elected executive vice-president and a director of Webster-Chicago Corp., Chicago. Other organization changes involve the appointment of **W. S. Hartford** as general sales manager; the election of **E. R. Johnson** as treasurer. **Norman Conrad** remains as chief engineer.

C. P. Cushway

Maj. Gen. Ingles

Major General Harry C. Ingles, who served as chief signal officer of the United States Army from July 1943 to March 1947, has been elected president and a director of RCA Institutes, Inc., New York. The Institutes currently have an enrollment of 1350 students, 70% of whom are veterans of World War II.

Grenville R. Holden has been elected a vice-president of Sylvania Electric Products, Inc., Emporium, Pa. He has been assistant to the president.

Roy E. DeLay, manager of Federal Electric Mfg. Co., Ltd., Montreal, Canadian affiliate of IT&T, has been elected vice-president and a director of the Canadian company.

George F. Metcalf, manager of General Electric's Electronics Laboratory at Syracuse, N. Y., was decorated in Washington by Lord Inverchapel, British Ambassador, for his wartime contributions to airborne radar. Metcalf was appointed an Honorary Officer of the Military Division of the Most Excellent Order of the British Empire—conferred by King George VI. Metcalf headed the Aircraft Radar Laboratories at Wright Field, Ohio, while he was in the service.

George A. Scherry has been appointed chief electrical engineer for Grayhill, Chicago, at the company's La Grange, Ill. plant. He was formerly associated with Ohio Carbon Co., and Pioneer Gen-E-Motor, latterly has been in charge of engineering and production for Garner Electronics Corp., Chicago.

TELE-TECH

Advertisers, June 1947

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Clare Denver Office

A new Denver engineering office has been opened by C. P. Clare & Co., Chicago relay manufacturer. Clyde P. Elliott, mountain states representative, will have charge at 681 Grant street.

Johnson Takes Gothard

The E. F. Johnson Co., Waseca Minn., has purchased from the Gothard Mfg. Co., Springfield, Ill., its indicator lights business. All dies, tools, inventories and rights have been transferred to the new owner and the complete Gothard line is now being manufactured at the Johnson plant. The business will be administered as the Gothard Division of the E. F. Johnson Co.

Distillation in Chicago

The Vacuum Equipment Division of Distillation Products, Inc., Rochester, N. Y., has established a sales and service office to cover the Chicago and midwestern area.

Directing the sales activities of the company's high - vacuum pumps, gauges, stills and vacuum-coating equipment in the Chicago area will be Tom C. Comer. Offices will be located at 135 South La Salle Street.

New Selenium Home

Selenium Corp. of America has occupied its new home in El Segundo, California. The address is 2160 East Imperial Highway.

Astatic Corp., Conneaut, Ohio, has a new New York representative. The work is being taken over by Perry Saftler who will represent the company in the metropolitan area. Headquarters are at 53 Park Place.

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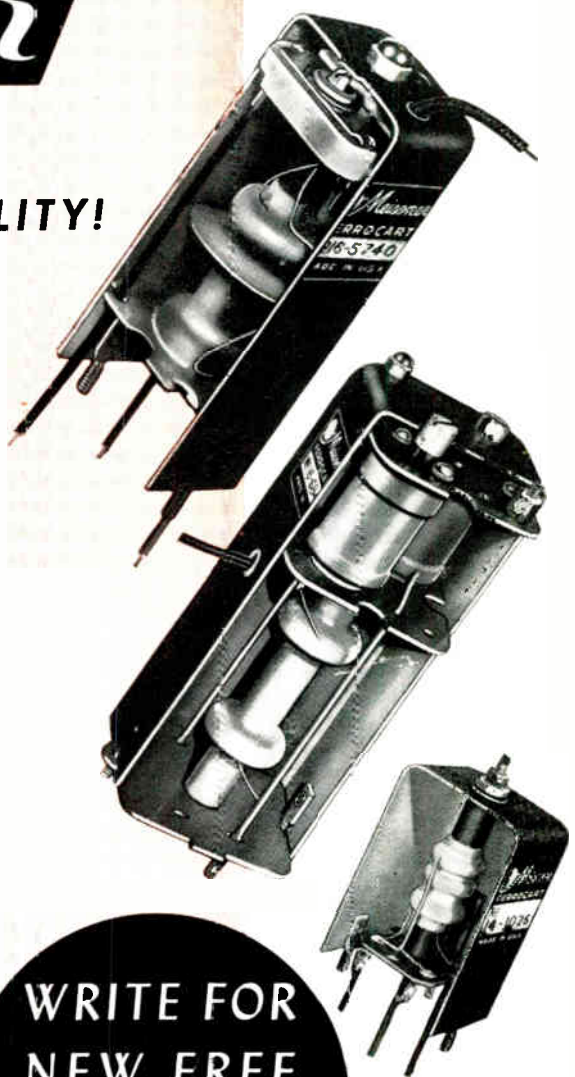

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RCA CIRCUIT INVESTIGATIONS—

RCA carries on independent research in circuit design for the exclusive benefit of its customers. Engineering reports are provided as a free service.

RCA TUBE DEVELOPMENT—

RCA works years ahead in tube design—anticipates future requirements. That's why you get the types of tubes you want *when* you want them.

RCA ENGINEERING LITERATURE—

As the fountainhead of modern tube development, you can look to RCA for the most authoritative and comprehensive technical literature on tubes.

RCA MANUFACTURING FACILITIES—

RCA tubes are manufactured in ultramodern plants equipped with RCA-designed, high-speed precision machinery—your assurance of uniform, dependable quality tubes of whatever type, in any quantity.

RCA QUALITY CONTROL—

Quality controls begin with the raw material and are followed through in every successive step of manufacture and assembly to the final tube. That's why RCA tubes are consistently good.

RCA SALES SERVICE—

A staff of seasoned sales representatives are within convenient reach. They're available *when* you want them.

RCA DISTRICT OFFICES—

RCA's Tube Department maintains four convenient district offices in Harrison, Cleveland, Chicago and Los Angeles to serve equipment manufacturers. You can get prompt service from the office nearest you.

RCA DISTRIBUTION—

RCA's Tube Department maintains bulk tube stocks in three warehouses strategically located in Jersey City, Chicago and Los Angeles for quick service.

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