TELE-TECH

Formerly the TELE-communications TECH-nical Section of

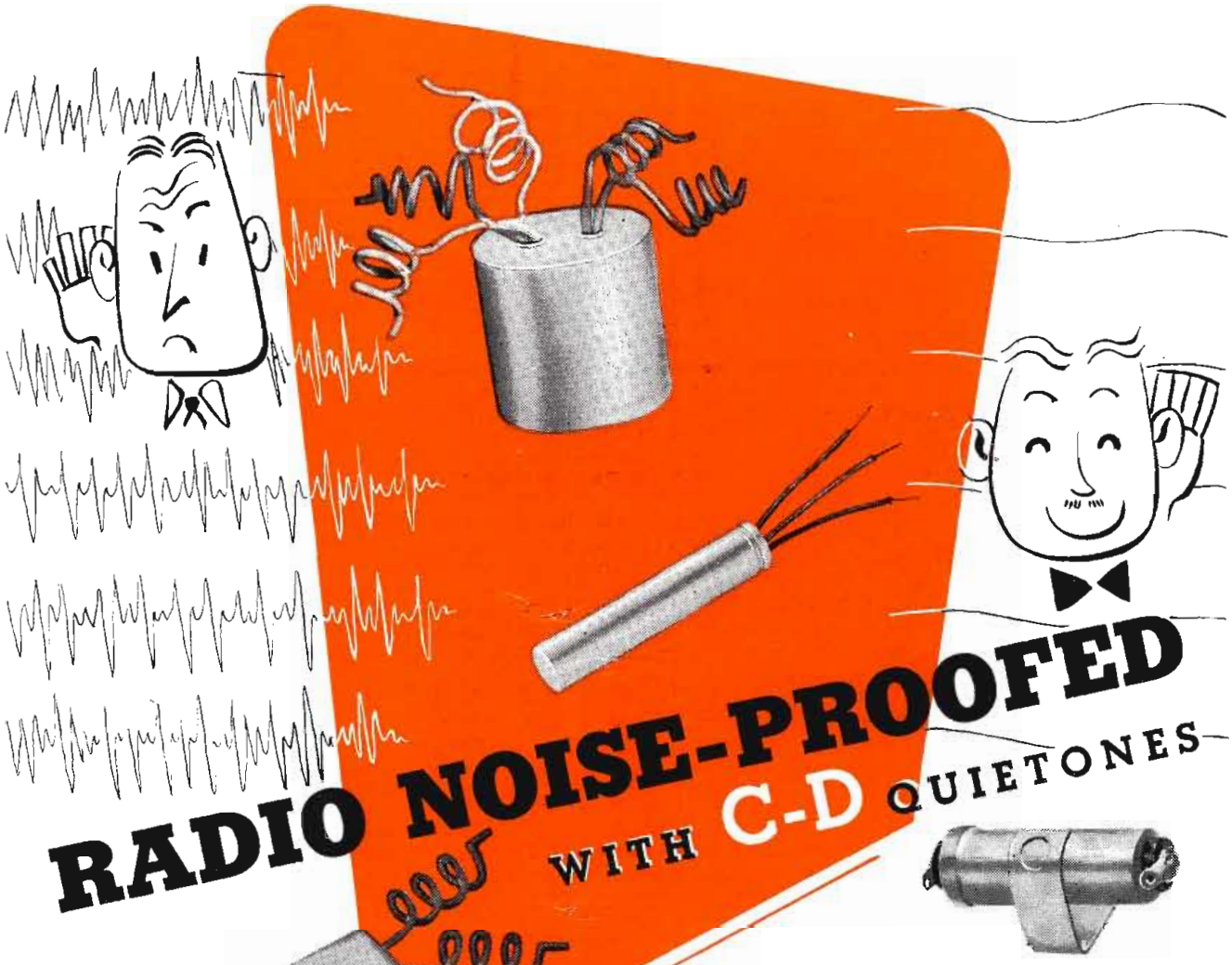
ELECTRONIC INDUSTRIES

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

September · 1947

IN THIS ISSUE

CALDWELL-CLEMENTS, INC.



RADIO NOISE-PROOFED WITH C-D QUIETONES

More and more, electrical appliance customers are asking — "Will it cause radio interference?" And in the answer to that question lies the secret for many more sales of your products.

Here at Cornell-Dubilier you'll find *your* answer — in a modern and complete laboratory, devoted to RADIO NOISE AND SPARK SUPPRESSION DEVICES — the industry's most experienced engineers — the thirty-seven-year C-D background, unequalled in the capacitor field. They're all at your disposal — NOW. Whether you want to Radio Noise-Proof equipment already in production — or if you're engineering a new product from the ground up — C-D Quietones will do the job efficiently and permanently. YOUR INQUIRIES ARE INVITED. Cornell-Dubilier Electric Corporation, Dept. J9, South Plainfield, New Jersey. Other large plants in New Bedford, Worcester and Brookline, Mass., and Providence, R. I.

Make Your Products More Saleable with C-D Quietone Radio Noise Filters and Spark Suppressors

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TELE-TECH

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

SEPTEMBER, 1947

Editorial Contents

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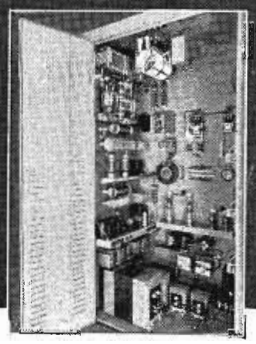
IF IT'S 1000 WATTS YOU WANT

. . . STUDY THIS NEW, ADVANCED RAYTHEON AM TRANSMITTER

"It's a beauty,"
says the visitor . . .

"It's a star performer,"
says the station engineer . . .

"It's an excellent investment,"
says the station-owner.



AGAIN RAYTHEON presents an item of broadcast equipment that scores a hit with all who see it. Following on the heels of Raytheon's highly successful 250 Watt design, this new 1000 Watt AM transmitter provides the same excellent performance, the same inherent superiorities for higher-powered stations . . . and at surprisingly low cost.

It's an outstanding design . . . perfected after months of careful engineering. Simpler circuits give the all-important *dependability* that Raytheon transmitters are becoming widely noted for. Exceptional signal quality is achieved through triode type tubes and audio transformers better than were ever before available. Its striking modern beauty catches the eye of visitors—makes it a show-piece.

This Raytheon transmitter commands attention of 1000 Watt station owners and engineers. Before *you* decide on a transmitter, write or wire for our fully illustrated specification bulletin. *Prompt deliveries can be made.*

HERE'S WHAT RAYTHEON OFFERS

Study these RAYTHEON features before you choose any transmitter, for replacement or new installation.

1 **Simplified, More Efficient Circuits**—A high level modulation system eliminates necessity of complicated and critical adjustment of linear amplifiers and minimizes harmonic distortion. Tube cost low, power consumption considerably lower.

2 **Greater Dependability**—Modern components, operated at well below their maximum ratings, and simplified circuit design reduce failures to minimum. Designed to withstand overloads—fully resistant to excessive temperatures, high humidity. Performance not impaired by ordinary line voltage fluctuation.

3 **High Fidelity Signal**—Modern triode type tubes used in all audio stages have an inherently lower distortion level. Specially designed audio transformers reduce distortion still further. The feedback circuit also improves signal quality but is not essential in this simplified circuit.

4 **Push-Pull Final Amplifier**—A Push-Pull R F final amplifier materially decreases harmonic distortion. Parasitic oscillation in this stage is eliminated and suppressors are not needed.

5 **Easy to Operate**—Only two stages, the R F Drive Amplifier and Power Amplifier, have to be tuned. A Video type amplifier eliminates complicated tuning of the Buffer stage.

6 **Fast, Accurate Tuning**—All operational controls are centralized on the front panel; every circuit is completely metered and instantly checked. Low speed motor tuning gives positive micrometer adjustment of the two tuned stages.

7 **Easy to Service**—Vertical chassis construction and symmetrical mechanical layout make servicing easy. Hinged side panels give access to all cabling and meters. Full height double rear doors give maximum access to wiring and components.

8 **Easily Meets All F.C.C. Requirements**—Flat frequency response from 30 to 10,000 cycles per second. Noise level —60 db below 100% modulation. Less than 2½% RMS for 95% modulation.

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Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

COMMERCIAL PRODUCTS DIVISION, WALTHAM 54, MASSACHUSETTS

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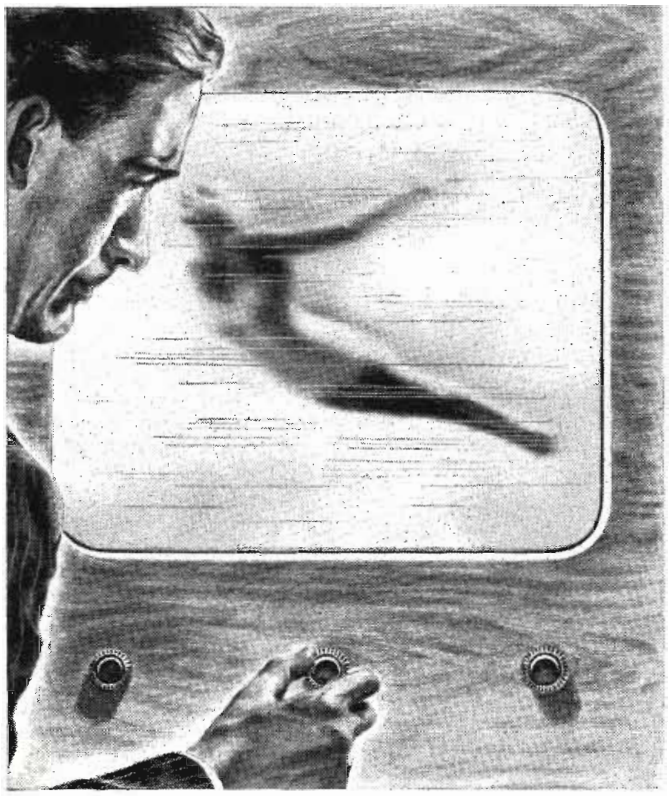
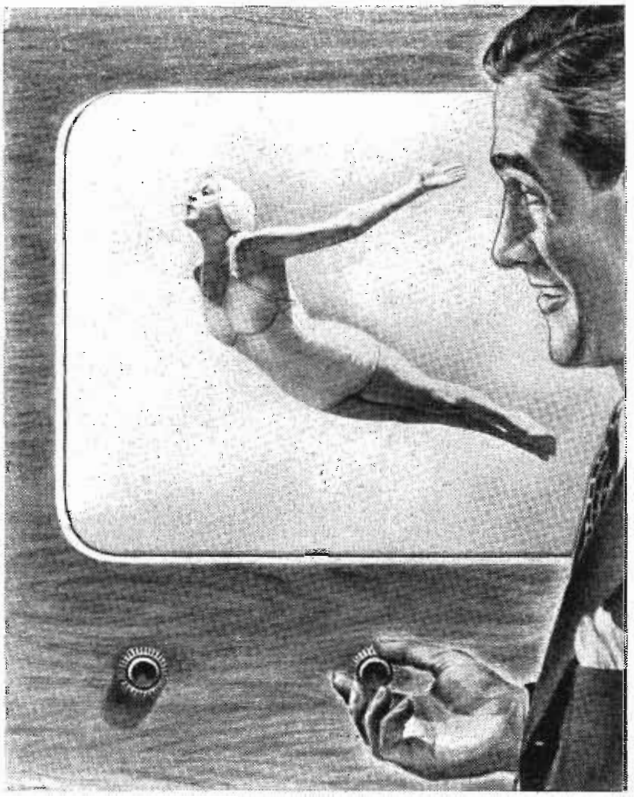
Nerves? OR Curves!



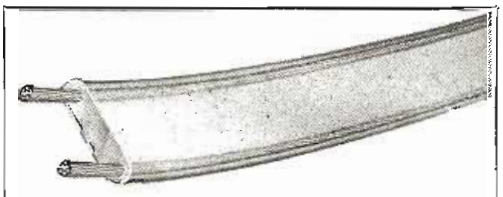


A Type ATV* Television Lead-In Line Can Make All the Difference

ANACONDA Type ATV lead-in lines are playing an important part in helping to give television buyers the kind of reception they want.

The well balanced design of conductors and dielectric in ATV lead-in lines minimizes the effects of attenuation and impedance mismatch. Satin-smooth polyethylene insulation sheds water readily — thus avoiding subsequent impedance discontinuities.

ATV line fulfills the most exacting requirements of wide-band reception — providing maximum freedom from distortion. Television buyers expect a lot. See that an ATV lead-in line helps your set to deliver! 47462



A Type ATV Lead-In Line for Every Need

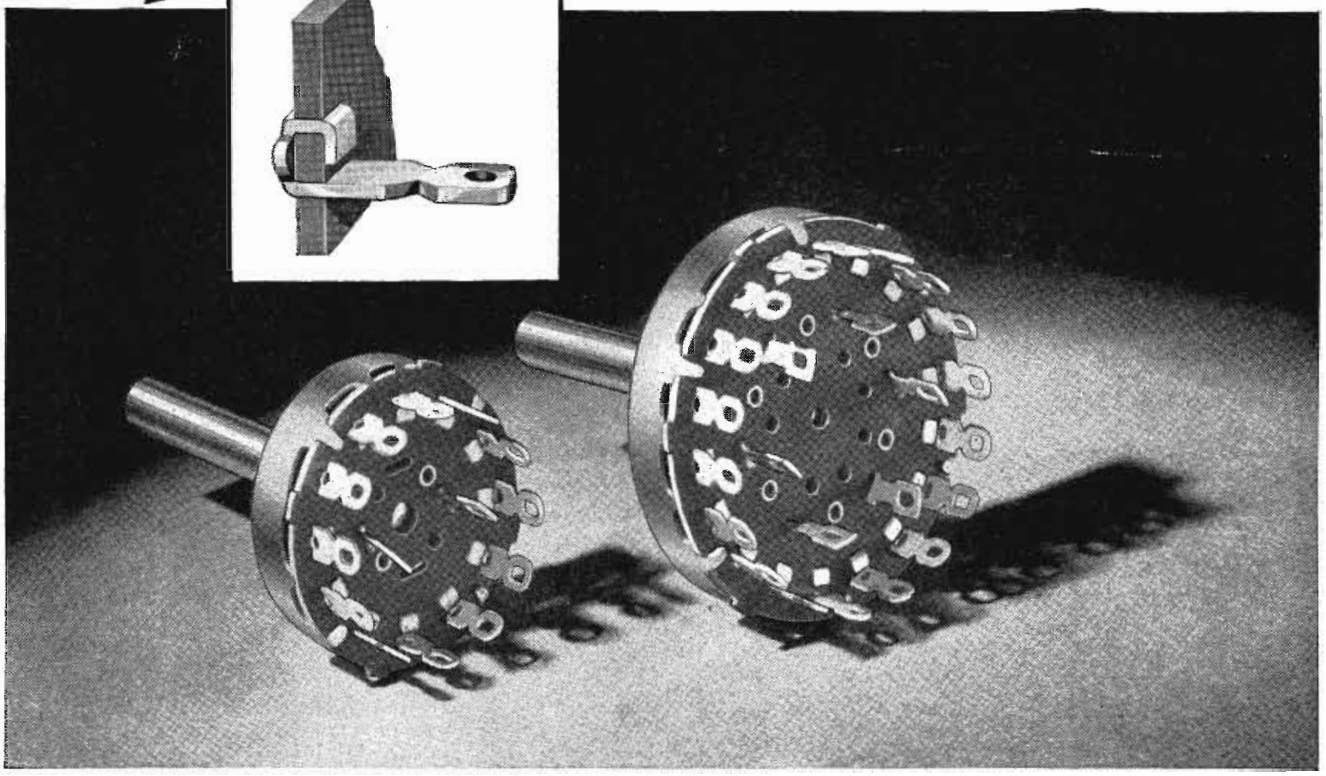
Anaconda offers a complete selection of Type ATV lead-in lines for 75, 125, 150 and 300 ohms impedance unshielded and 150 ohms shielded. For an electrical and physical characteristics bulletin, write to Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York. Also, write for the characteristics of the complete line of Anaconda coaxial cables.

ANACONDA from mine to consumer

ANACONDA WIRE AND CABLE COMPANY

*An Anaconda Trade-Mark

This Terminal Won't Pull Off or Work Loose . . .

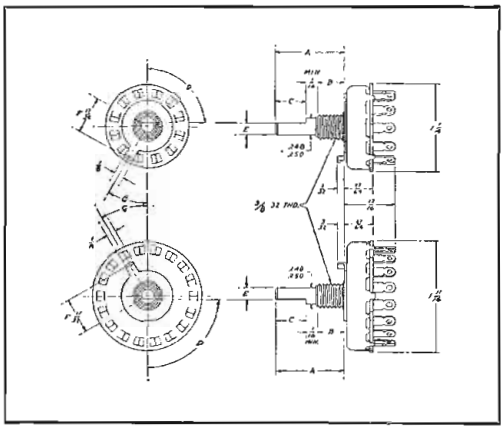


. . . IT'S ONLY ONE FEATURE OF THIS COMPACT LOW VOLTAGE MALLORY SWITCH

The inset at the top of this picture shows how the terminals of Mallory 3100 Switches are doubly fastened by a wrap-around method which holds them tight and secure against damage and at the same time provides them with a smoother contact surface.

What the picture cannot show is that the stator is made of low-loss XXX Phenolic especially selected for good insulation properties at high humidities . . . that a metal web spaced between the terminal contacts improves non-shorting construction . . . that terminals and stator together provide an excellent solder shield.

Small size, of course, is another distinguishing feature of these 3100 Switches, of which millions have been sold to manufacturers of radios, inter-communication systems and test equipment. The larger model, shown above, is 1 1/16" in diameter and has 18 position 20° indexing, embracing one to six circuits. The smaller model, with 12 position 30° indexing, embracing one to four circuits, is only 1¼" in diameter.



For more details, send for Mallory 3100 SWITCH Engineering Data Folder. A wide range of standard stock types is available through convenient Mallory Distributors.

ASK FOR

3100 SPECIFICATION SHEETS

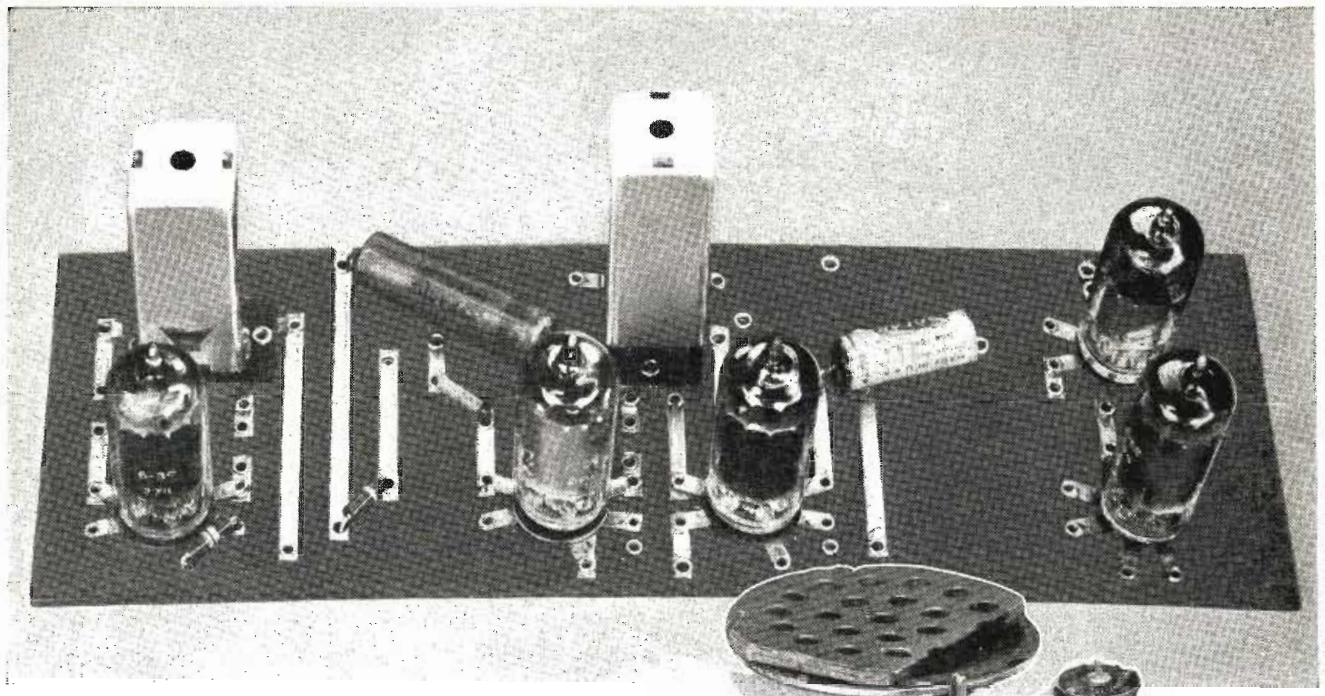
Printed on tracing paper to permit blueprinting, these sectional drawings indicate standard and optional dimensions—make it easy for you to order production samples built to your exact requirements.

P. R. MALLORY & CO. Inc.

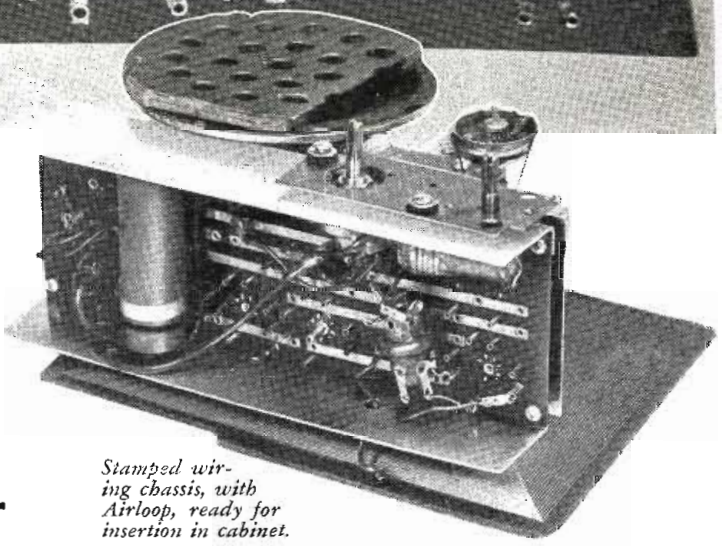
MALLORY SWITCHES

(ELECTRONIC, INDUSTRIAL and APPLIANCE)

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



Stamped wiring deck, with tubes, transformers, capacitors and resistors, ready for assembly in metal chassis. This is a development of the Franklin Airloop Corp., New York City.



Stamped wiring chassis, with Airloop, ready for insertion in cabinet.

Once again, REVERE says—

"Copper is the Metal of INVENTION"

STAMPED wiring offers new proof of the complete adaptability of copper to the development of new ideas. In this type of wiring, copper strips are stamped into both sides of an insulating sheet, the strips on one side running at right angles to those on the other. Connections between the two sides can be made by eyelets, pins, or other simple methods. It is estimated that with this system it should be possible to stamp about 90% of the wiring in the average radio or other electronic device. Thus many operations such as cutting, skinning, cabling and soldering wires should be almost completely eliminated. This new idea, though still in the development stages, will also make possible large economies in the telephone and communications fields, and for measuring instrument panelboards of airplanes, ships, and automobiles. The copper used is Revere OFHC.

Revere produces many metals, and is glad to collaborate with the electronic industry in such matters as selection and fabrication. These metals are available in mill products, as follows: *Copper and Copper Alloys:* Sheet and Plate, Roll and Strip, Rod and Bar, Tube and Pipe, Extruded Shapes, Forgings; *Aluminum Alloys:* Tube, Extruded Shapes, Forgings; *Magnesium Alloys:* Sheet and Plate, Rod and Bar, Tube, Extruded Shapes, Forgings; *Steel:* Electric Welded Steel Tube.

• • •

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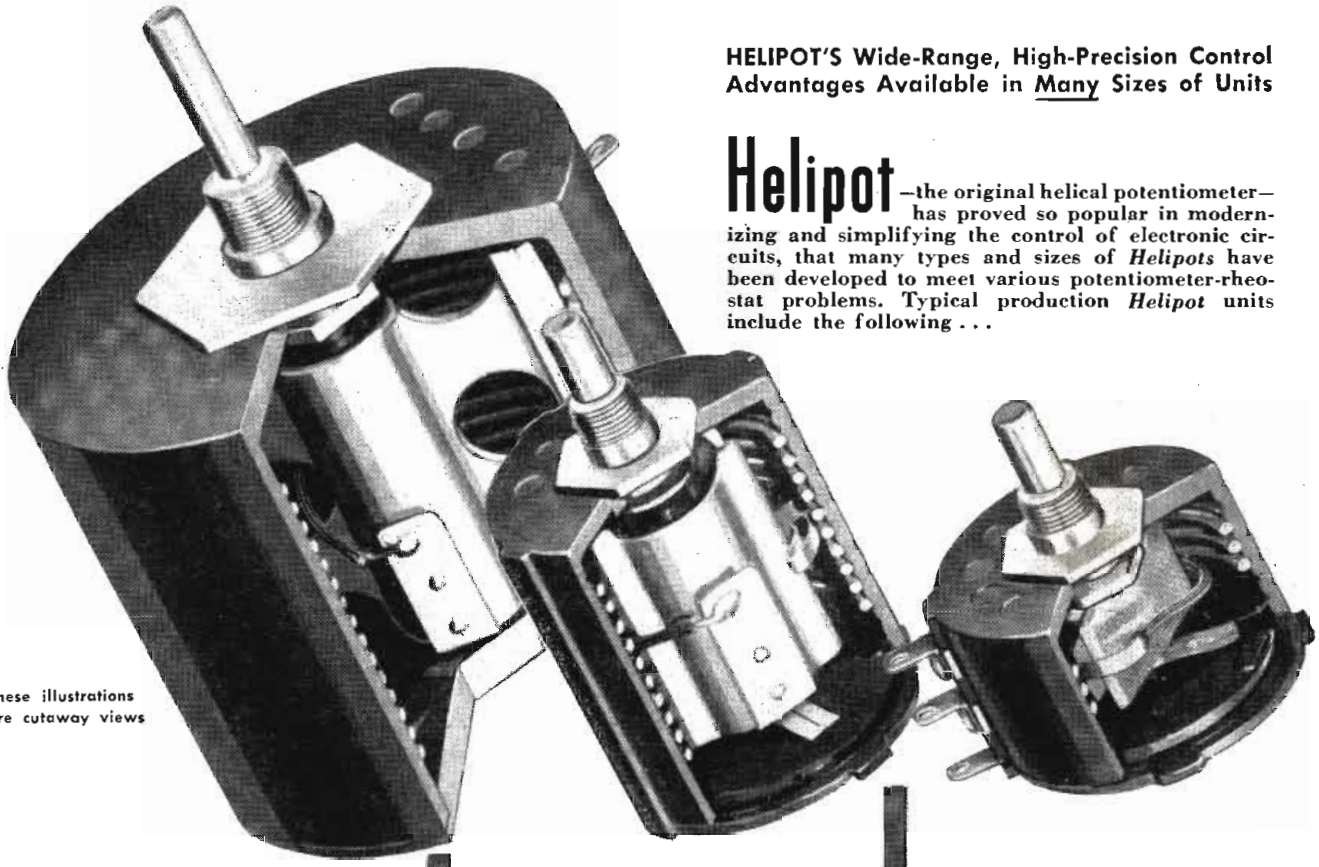
(Trade Mark of the **HELI**cal **POT**entiometer)

to simplify YOUR Potentiometer—Rheostat Problems!



These illustrations are cutaway views

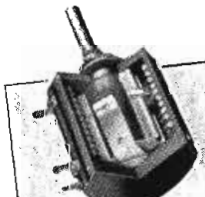
HELIPOT'S Wide-Range, High-Precision Control Advantages Available in Many Sizes of Units

Helipot—the original helical potentiometer—has proved so popular in modernizing and simplifying the control of electronic circuits, that many types and sizes of *Helipots* have been developed to meet various potentiometer-rheostat problems. Typical production *Helipot* units include the following . . .

MODEL B—Case diameter—3.3"; Number of turns—15; Slide wire length—140½"; Rotation—5400°; Power rating—10 watts; Resistance ratings—50 to 200,000 ohms.

MODEL A—Case diameter—1.8"; Number of turns—10; Slide wire length—46½"; Rotation—3600°; Power rating—5 watts; Resistance ratings—10 to 50,000 ohms.

MODEL C—Case diameter—1.8"; Number of turns—3; Slide wire length—13.5"; Rotation—1080°; Power rating—3 watts; Resistance ratings—5 to 15,000 ohms.



WIDE CHOICE OF DESIGN FEATURES

Not only are *Helipots* available in a wide range of sizes and ratings, but also can be supplied with various design features to meet individual requirements . . .

- Available with special length shafts, flatted shafts, screwdriver slots, etc.
- Can be supplied with shaft extensions at each end to permit coupling to indicating instruments or other devices.
- May be provided in ganged assemblies of two or three units, all operating from a common shaft.
- Available with linearity tolerances of 0.1%—and even less.
- Models A & B can be modified to include additional taps at virtually any point on windings.

. . . and many other special features.

Investigate the many important advantages to be gained by using the *Helipot* in your electronic control applications. Write outlining your problem!

SPECIAL MODELS

In addition to the above standard *Helipot* units, special models in production include . . .

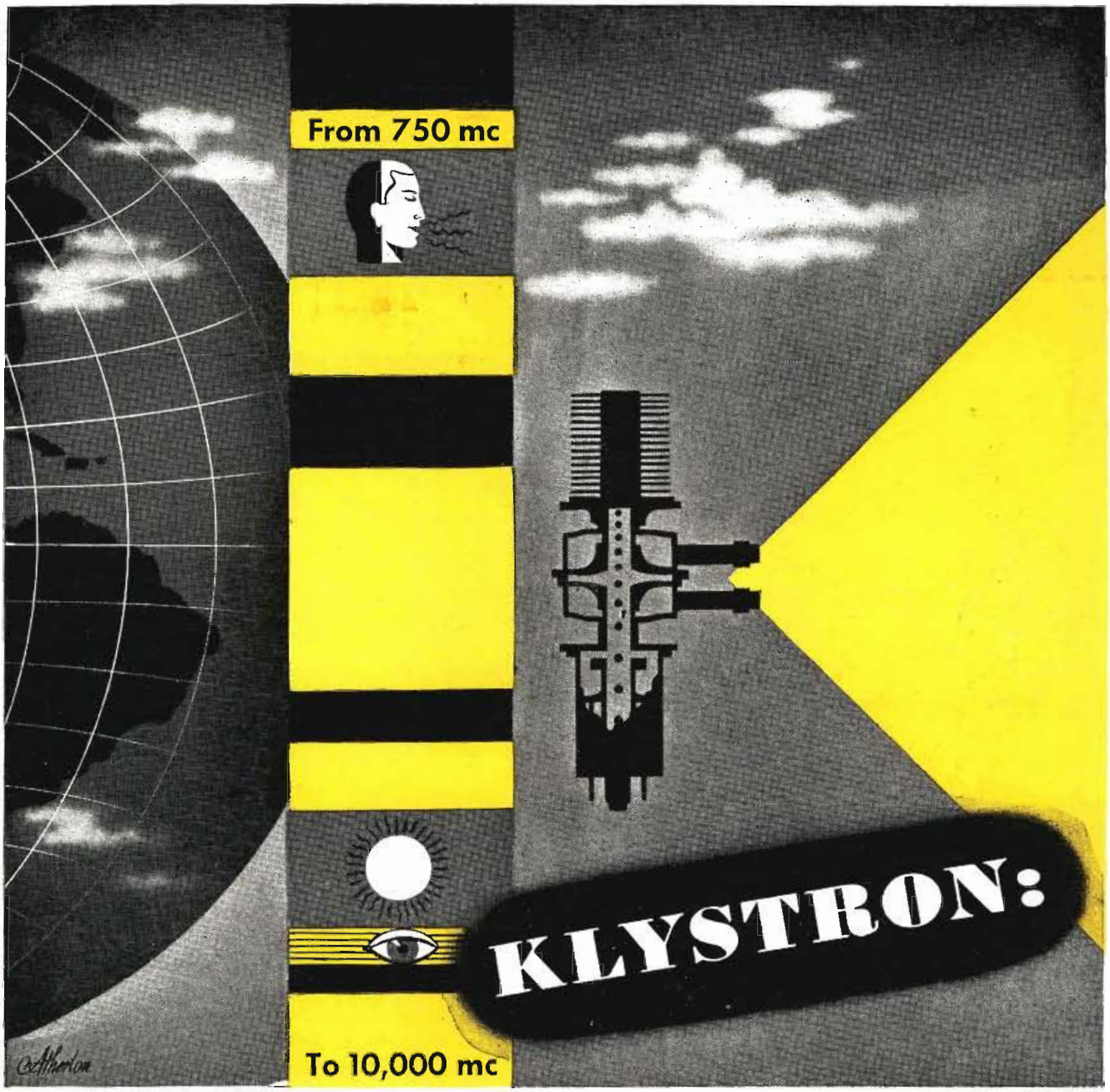
MODEL D—Similar to Model B, above, but longer and with greater length of slide wire. Case diameter—3.3"; Number of turns—25; Slide wire length—234"; Rotation—9000°; Power rating—15 watts; Resistance ratings—100 to 300,000 ohms.

MODEL E—Similar to Model B, but longer and with greater length of slide wire than Model D. Case diameter—3.3"; Number of turns—40; Slide wire length—373"; Rotation—14,400°; Power rating—20 watts; Resistance ratings—150 to 500,000 ohms.

Send for HELIPOT Literature!

THE Helipot CORPORATION

1011 MISSION STREET, SOUTH PASADENA 3, CALIF.



HORIZONS UNLIMITED

Today there's no mystery about the Klystron tube. It's being used in a lot of things you see and read about every day . . . radar, television, communications and even medicine.

Radar with Klystrons guides merchant ships and sky giants through fog, smoke, clouds. You'll find it in television relays . . . in medical diathermy . . . in dielectric heating . . . in telephone, telegraph, aircraft radio and broadcast radio relays.

We're anxious to put the Klystron to work even harder. We know there must be many undeveloped applications that will make your products better or help you make new products. The Klystron is adaptable in both local oscillator and high power applications.

Sperry engineers will gladly cooperate with manufacturers in adapting Klystron to new fields.

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NOW - A SIXTY-FIVE WATT

- *Hard Glass*
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- *Low Drive*
- *Low Voltage*
- *Low Feed-Thru Capacitance*
- *Low Cost*

$14.50

TYPE 4-65A

ELECTRICAL CHARACTERISTICS

Filament: Thoriated tungsten		
Voltage	6.0	v
Current	3.5	amp
Grid-Screen Amp. Factor (Av.)	5	
Direct Inter-Electrode Capacitances (average)		
Grid-Plate	0.08	μuf
Input	8.0	μuf
Output	2.1	μuf

TYPICAL OPERATION

Class C Telegraphy or FM Telephony
(Key Down Conditions, 1 Tube)

D-C Plate voltage	400	1000	2000 v
D-C Screen voltage	250	250	250 v
D-C Grid voltage	−40	−50	−70 v
D-C Plate current	100	125	125 ma
D-C Screen current	40	37	35 ma
D-C Grid current	13	16	16 ma
Peak R-F grid input voltage	135	155	180 v
Driving power (approx)	1.8	2.5	2.9 w
Screen dissipation	10.0	9.2	8.8 w
Plate power input	40	125	250 w
Plate dissipation	12	30	50 w
Plate power output	28	95	200 w

THE ANSWER TO THE TRANSMITTER-MAN'S PRAYER

Available now, type 4-65A is a small radiation cooled, instant heating tetrode. Devoid of internal insulating hardware, the 4-65A was designed as a transmitting tube . . . not a blown-up receiving tube. This rugged new Eimac tetrode really performs at low voltage, and its instant heating thoriated tungsten filament makes it ideally suited for mobile installations. The 4-65A operates well into the VHF, beyond the 160-Mc. band, and is capable of delivering relatively high-power with a plate voltage range from 400 to 3000 volts. As do other Eimac tetrodes, type 4-65A embodies the inherent characteristics of low grid drive, low feed-thru capacitance, and general stability of operation.

Type 4-65A's versatility of operation is demonstrated in the adjacent data showing typical operation at 400, 1000, and 2000 volts. Additional data on the 4-65A are now available, write direct.

EITEL-McCULLOUGH, Inc.
177 San Mateo Ave., San Bruno, California

■ *Follow the Leaders to* Eimac TUBES *The Power of R-F* ■

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MODEL VH-91 Hypex* SPEECHMASTER

Delivering good quality, intelligible speech with maximum "punch" to override high noise levels, the Model VH-91 Speechmaster is recommended for paging and intercommunication applications. Hypex horn formula gives useful output over a 100° angle.

Especially efficient for voice, the VH-91 has a frequency range of 400-5,000 cycles. Power handling capacity: 15 watts maximum speech signal input. Designed for both inside and out-of-door use, VH-91 will withstand extreme weather conditions, including exposure to salt spray. Nominal voice coil impedance 8 ohms. Transformer number Z-3345, with ⅝" x ⅝" core available for 45-ohm use. Bell diameter, 8⅞ inches; height, 9-1/16 inches; weight, 4¼ pounds.

Universal mounting bracket adjusts projector to any direction, locks securely in position by a single wing nut, has facilities for mounting transformer.

Jensen VH-91 Speechmaster Projector (ST-171).....$32.50

*Trade mark registered

JENSEN MANUFACTURING COMPANY
6605 S. LARAMIE AVE., CHICAGO 38, U. S. A.
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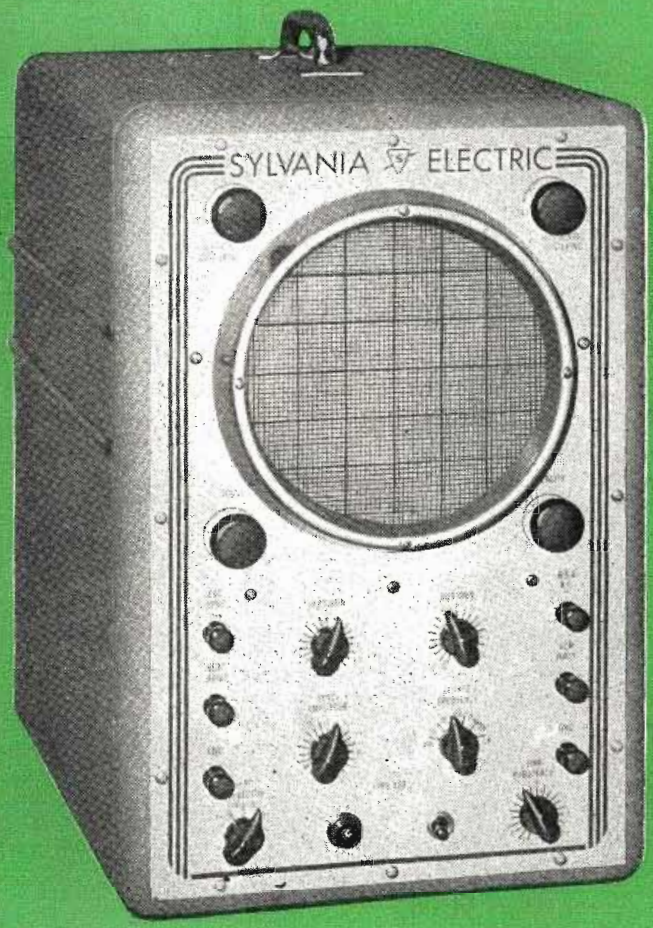
Jensen
FINE ACOUSTIC EQUIPMENT

Designers and Manufacturers of Fine Acoustic Equipment

Now... A 7-INCH OSCILLOSCOPE

AT THE SENSATIONALLY LOW PRICE OF ONLY $124.50



The new Sylvania 7-inch Oscilloscope Type 132 incorporates many features that give it an exceptional range of utility in radio service shops, laboratories, plants and colleges.

JUMBO PATTERNS

Use of the large 7-inch Sylvania Cathode Ray Tube Type 7GP1 provides "jumbo" patterns which enhance the value of the instrument for instruction purposes as well as in shop and laboratory.

A new push-pull deflection circuit provides clearer patterns, less distortion and more gain.

INTENSITY MODULATION

Observation of a wider variety of phenomena is made possible by the addition of a Z axis input for intensity modulation. This feature is useful in studying pulses and portions of cycles, and leads to many applications in industry.

Type 132 is designed and built to provide the finest instrument in its class. The panel is "efficiency designed" with control size and placement offering time-saving ease of operation.

And . . . it's priced within the range of the average budget!

Cabinet size is 17" high by 11⅜" wide by 17¾" deep. Weight is 37 pounds, and convenient carrying handle is supplied.

Instrument consumes 35 watts from 105-125 volt, 50-60 cycle line. Extra-long heavy-duty line cord is furnished.

Product of Sylvania's Electronics Division, Oscilloscope Type 132 is distributed through the Radio Tube Division. Instrument may be purchased from Sylvania Distributors.

For more complete information on the Type 132 Oscilloscope, together with application notes, hints and suggestions on the use of Oscilloscopes, mail the coupon below.

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Dept. E1509, Electronics Division
500 Fifth Avenue, New York 18, N.Y.

Gentlemen:

Please send full details on Oscilloscope Type 132.

Name.....

Business Connection.....

Street Address.....

City..... Zone #.....

State.....

When and where *Split-Second Action* spells successful telecasts . . .

DU MONT Type 5098A IMAGE ORTHICON PICKUP HEAD

Vital functions at very fingertips...electronic viewfinder showing precisely what is being telecast . . . every component and circuit instantly accessible—yes indeed, the cameraman with the new Du Mont Image Orthicon Pickup Head is ready for *anything* and *everything* that comes along. And that means still better television programs.

Operated as part of the Du Mont Type TA-124-B Image Orthicon Chain, this latest television camera is truly ideal for reporting news, sports and other field operations. It is also suitable for small-scale studio operations because of its inherent sensitivity and flexibility.

Now in regular production, the Du Mont Image Orthicon Pickup Chain, equipped with this new Type 5098A Head or improved camera, is available for prompt delivery.

START AS SMALL AS YOU WISH, WITH THE DU MONT *Acorn Package*

FEATURING...

Essential controls concentrated at rear of camera.

Hinged chassis and removable "Snap-on" panels permit immediate adjustments and replacements.

Super-sensitive Image Orthicon tube.

Lens turret takes up to four lenses of various focal lengths.

Rotatable handle at rear positions, locks and indicates any lens. Iris control setting adjustable from rear. Focusing by rotatable pan handle.

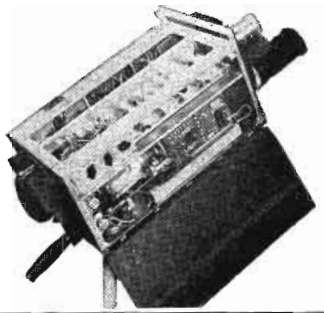
Electronic viewfinder removable. Mounts and plugs in on camera frame.

Video pre-amplifier essentially non-microphonic.

Pilot light indicates "On the Air." Second pilot light in shadow box cues cameraman while televiewing.

Plug-in headset and microphone harness for intercommunications.

Du Mont "one-operation" connecting plugs make all connections with orthicon chain units, saving minutes of precious time.



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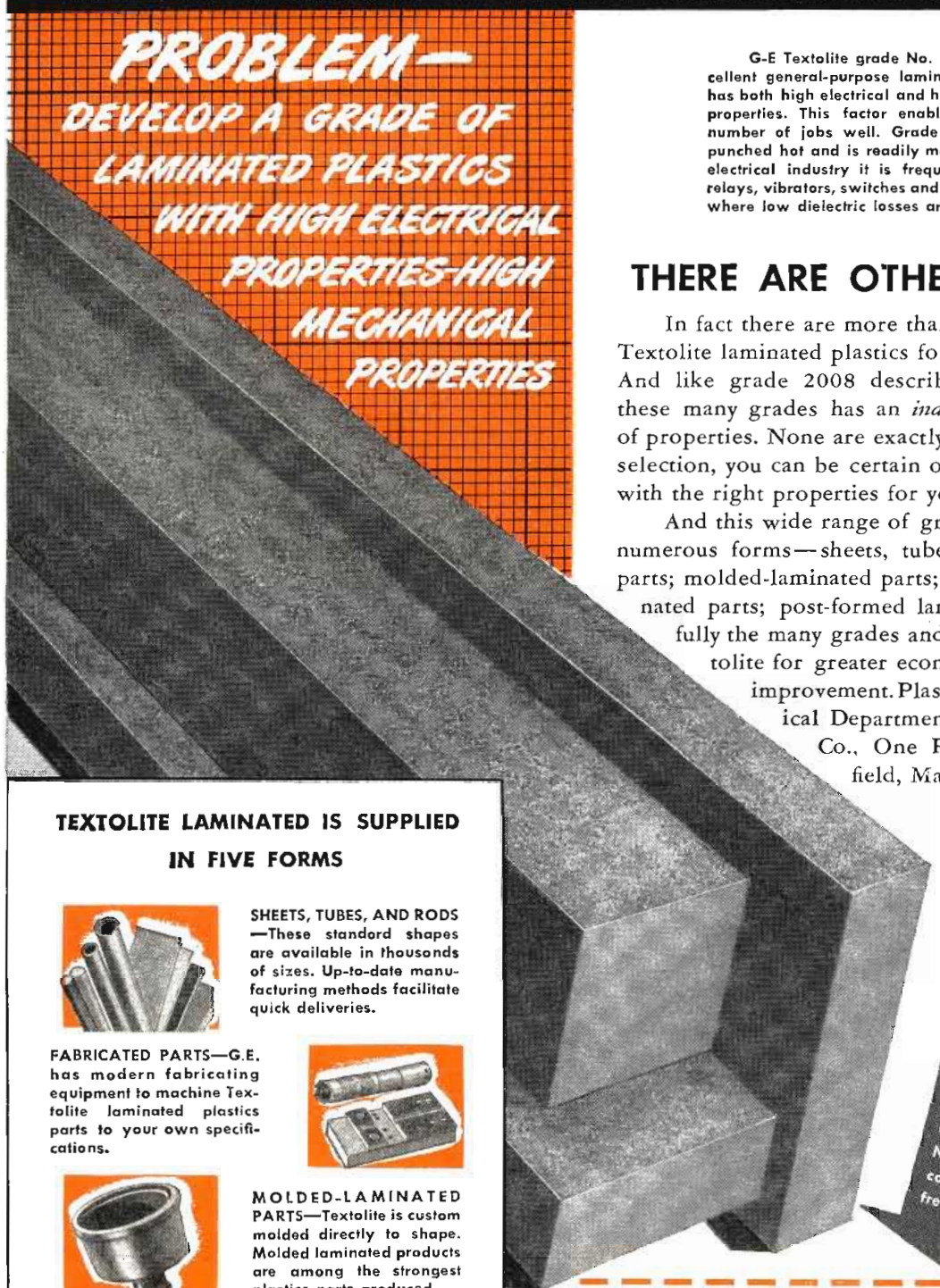

G-E Textolite grade No. 2008 is an excellent general-purpose laminate because it has both high electrical and high mechanical properties. This factor enables it to fill a number of jobs well. Grade 2008 can be punched hot and is readily machined. In the electrical industry it is frequently used for relays, vibrators, switches and in applications where low dielectric losses are important.

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FABRICATED PARTS—G.E. has modern fabricating equipment to machine Textolite laminated plastics parts to your own specifications.

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GENERAL ELECTRIC

CD47-E4

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Having a microphone with the proper pick-up pattern is one thing, but putting that mike in the *right place,* at the *right time,* is a problem that plagues you daily. Especially do you encounter it in table pick-ups, in dramatic and orchestral presentations, in any group broadcast where the mike must be shunted from one person to another.

It is here that you need the *flexibility* and *long reach* of a Dazor *Floating* Arm. For the mike, when attached to this fixture, may be raised, lowered, pushed, pulled, tilted or rotated in a circle with a touch of your fingers. It is held firmly and automatically in the position chosen, and at the exact angle placed, by a patented self-balancing mechanism. No locking necessary.

In radio broadcasting and studio recording the Dazor-floated microphone reduces set-up time, permits a wider working radius and easier, more complete control of background disturbances. It also makes possible livelier and more spontaneous programs . . . a *must* in night clubs, theaters and dance halls. Recommended for airport and railroad control towers, police radio networks—wherever microphone *flexibility, convenience* and *added working comfort* are sought.

Phone Your Dazor Distributor for full details. For his name, if unknown to you, write Dazor Manufacturing Corp., 4481-87 Duncan Ave., St. Louis 10, Mo. *In Canada* address inquiries to Amalgamated Electric Corporation Limited, Toronto 6, Ontario.

MOVES FREELY INTO ANY POSITION AND STAYS PUT—*WITHOUT LOCKING*

CHOICE OF 2 BASES

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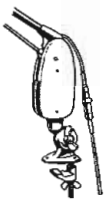
With this combination base the Dazor may be clamped or screwed to any surface —horizontal, sloping or vertical.



PEDESTAL

This base, a portable floor-type fixture, is equipped with rubber pads to absorb shock.

DAZOR FLOATING ARM FOR MICROPHONES

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LONGER-LASTING PERFORMANCE

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H-F Transmission Lines

1. **Their unusually low attenuation losses assure the most efficient transfer of energy between antenna and receiver or transmitter.**
2. **Their uniformity and permanence of characteristics permit peak receiver performance, without annoying distortion from locally-induced interference.**
3. **Their flexibility and outstanding resistance to weathering, moisture and abrasion contribute to years of trouble-free service.**

IN THE FIVE ITEMS listed here, there's a high-frequency cable for practically every antenna application. The K-1128 75-ohm line, for transmitter use—the K-1079 and K-1046 lines for general FM and Television service. The smooth oval cross-section of these 75, 100, and 300-ohm lines prevents the accumulation of foreign matter, thereby maintaining stable capacity characteristics. The K-32 and KT-51 coaxial cables offer peak performance for applications where locally-induced interference is severe.

For complete information and prices on these cables, see your local distributor. For other high-frequency cables —write to Federal, Dept. D166.

DATA FOR FEDERAL H-F CABLES

Type Number	Characteristic Impedance Ohms	Velocity of Propagation (in percent)	Capacitance Per Ft. mmf	Attenuation, Db per 100 Ft. Frequency in Megacycles				
				1.0	1.7	30	100	300
K-1079	100	71	15.5	.6	.75	2.8	5 2	8.8
K-1128	75	71	19.5	.3	.4	2.0	4.0	7.3
K-1046	300	300	4.0	.38	.57	.85	2.0	—
K-32	73	66	22	—	—	2.0	3.8	7.0
KT-51	95	66	16	—	—	1.8	3.8	7.5

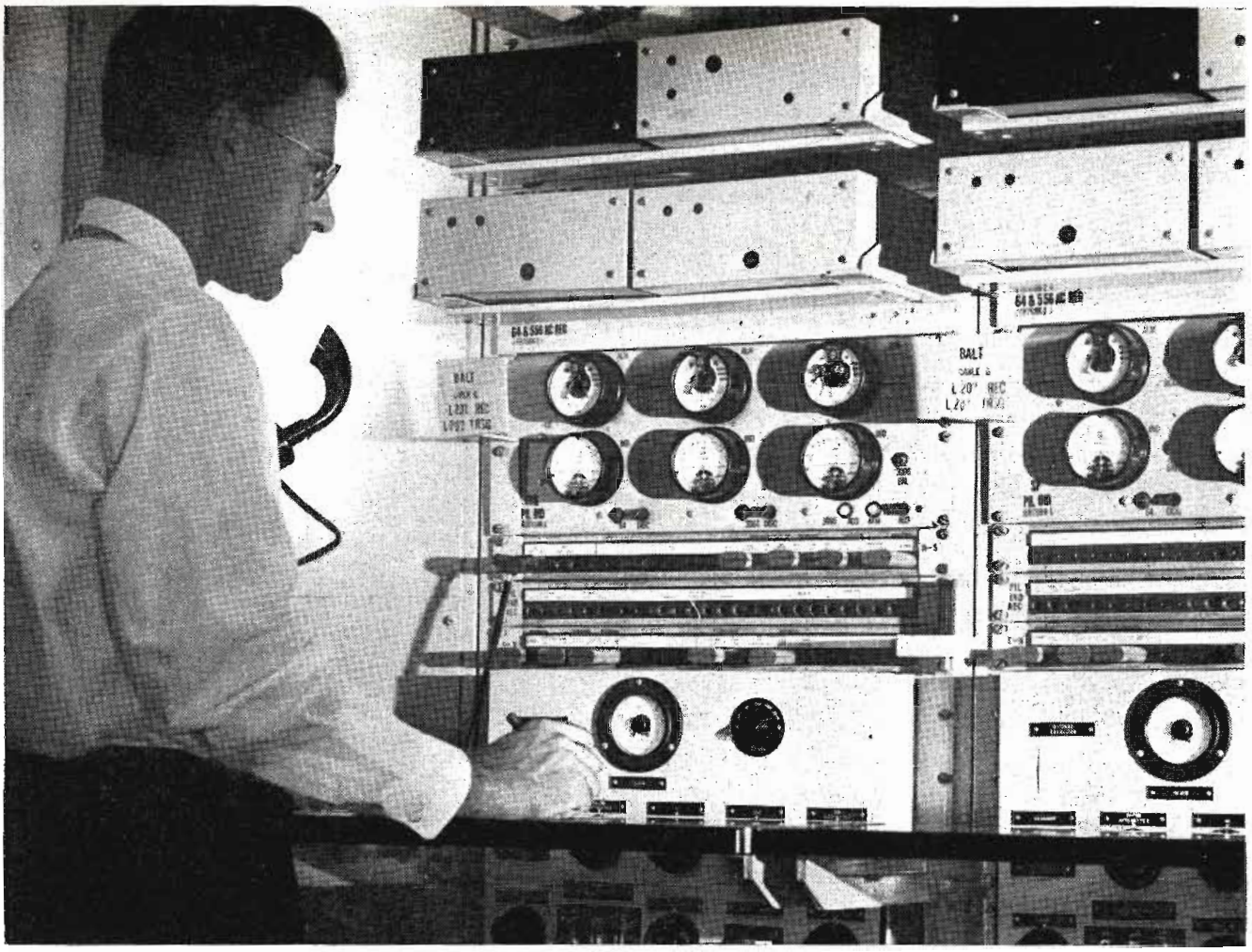
*Reg. U. S. Pat. Off

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

SELENIUM and INTELIN DIVISION, 1000 Passaic Ave., East Newark, New Jersey

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



At Philadelphia, a testboard man answers as an electronic watchman calls attention to conditions on one of the coaxial systems to Baltimore and Washington.

"Send Help to Manhole 83"

Strung out along every Bell System coaxial cable, electronic watchmen constantly mount guard over your voice. Some are in manholes under city streets; some are in little huts on the desert. Most situations they can deal with; if things threaten to get out of hand, they signal the nearest testboard.

Principal care of the electronic watchman is the transmission level. Sun-warmed cables use up more energy than cold ones, so a transcontinental call may take a millionfold more energy to carry it by day than by night. Each watchman — an electronic regulator — checks the transmission level and adjusts the amplification which sends your voice along to the next point. Many hundreds of regulators may be at work on a single long distance call.

Without automatic regulation, the precise control of energy in the Bell System's long distance circuits would be a superhuman task. So Bell Laboratories, which in 1913 developed the first high vacuum electronic amplifier, went on to devise the means to make them self-regulating in telephone systems. This is one reason why your lang distance call goes through clearly, summer or winter.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service.

Just roll it open!

SIMPSON Model 260 Volt-Ohm Milliammeter

...with Roll Top Safety Case*

• The world's finest high sensitivity set tester certainly deserves the best in carrying cases. So we decided to give it just that by *building* the tester into the case to make an integral unit of case and instrument. Here's how we do it: we take the standard Model 260, place it inside a housing of heavily molded bakelite, and permanently fasten it there. Instrument and case become one unit. Beneath the instrument is a compartment for test leads. Over the face of the instrument a roll top (of molded bakelite, too) slides up to open, down to close, the case. With a flick of the finger you roll it up and out of sight and the instrument is ready to carry, and fully protected. With the Roll Top Safety Case you cannot leave your carrying case behind. It is never in the way. And you have *constant, important protection to your 260 from damage, whether in use or not.*

Just remember this fact, always: You cannot touch the precision, the useful range, or the sensitivity of Simpson Model 260 in any other instrument of equal price or in some selling for substantially more.

**The regular Model 260, without Roll Top Safety Case, is always available, of course.*

Simpson 260, High Sensitivity Set Tester for Television and Radio Servicing

At 20,000 Ohms per volt, this instrument is far more sensitive than any other instrument even approaching its price and quality. The practically negligible current consumption assures remarkably accurate full scale voltage readings. D.C. current readings as low as 1 microampere and up to 10 amperes are available.

Resistance readings are equally dependable. Tests up to 20 megohms and as low as ½ ohm can be made. With this super sensitive instrument you can measure a wide range of unusual conditions which cannot be checked by ordinary servicing instruments.

Model 260—Size 5¼" x 7" x 3⅛" $38.95
Model 260, in Roll Top Safety Case—Size 5⅜" x 9" x 4¾" . . . $43.75
Both complete with test leads

Volts D.C. (At 20,000 ohms per volt)	Volts A.C. (At 1,000 ohms per volt)	Output	Milliamperes D.C.	Microamperes D.C.	Ohms
2.5	2.5	2.5 V.	10	100	0-2000 (12 ohms center)
10	10	10 V.	100		0-200,000 (1200 ohms center)
50	50	50 V.	500		0-20 megohms (120,000 center)
250	250	250 V.	Amperes		
1000	1000	1000 V.	D.C.	(5 Decibel ranges: —10 to +52DB)	
5000	5000	5000 V.	10		

SIMPSON ELECTRIC COMPANY
5200-5218 West Kinzie Street, Chicago 44, Illinois
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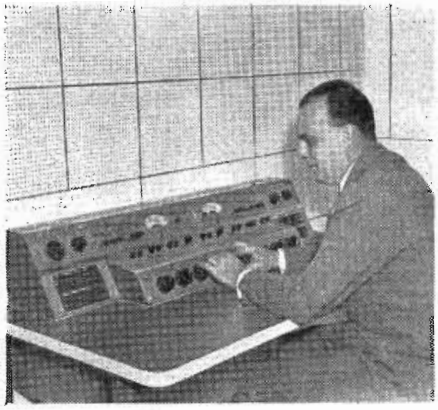
Simpson
INSTRUMENTS THAT STAY ACCURATE

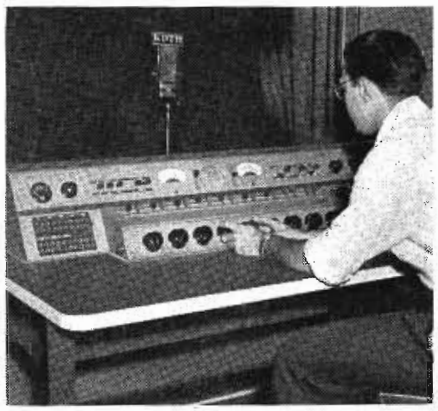
ASK YOUR JOBBER

Western

25B SPEECH INPUT



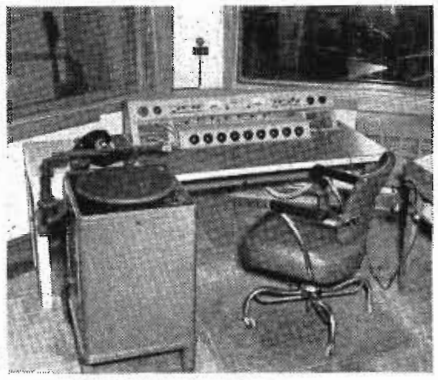
KANS
Wichita, Kansas



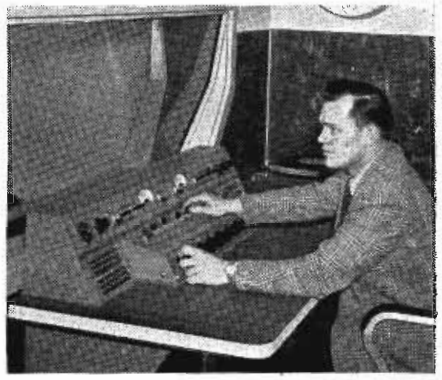
KDTH
Dubuque, Iowa

KUSC
Los Angeles, California

WMBD
Peoria, Illinois



WMBR
Jacksonville, Florida



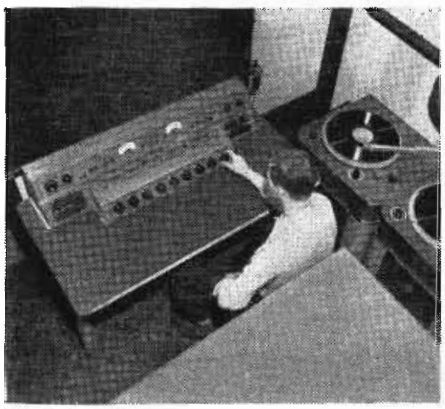
WNBF
Binghamton, New York

Here you see a few of the *more than 200* new 25B Speech Input Consoles which have been shipped to stations all over the country. 25B's are now coming off the production line in a steady stream to fill orders being received from other broadcasters eager to install this high quality, economically priced equipment.

Broadcast studios choose the 25B because: its two main channels handle FM and AM programs simultaneously—its noise and distortion are well within all requirements for high quality FM

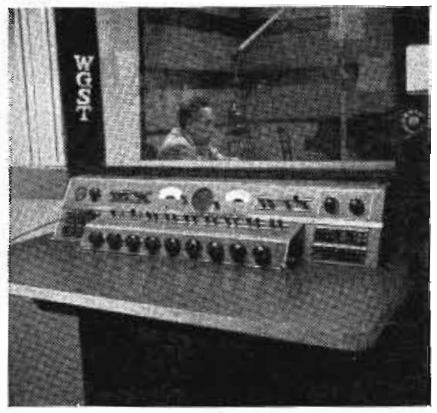
Electric

CONSOLES ON THE JOB

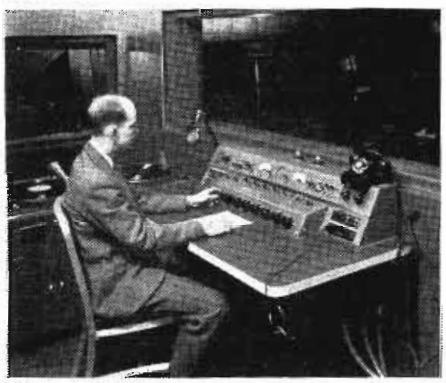


WBCM
Bay City, Michigan

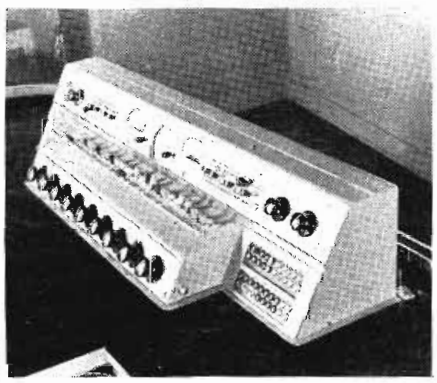
WDAE
Tampa, Florida



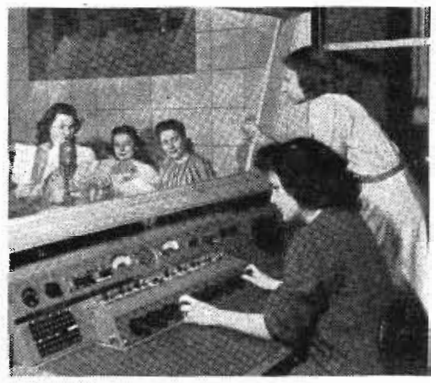
WGST
Atlanta, Georgia



WROV
Roanoke, Virginia



WSAV
Savannah, Georgia



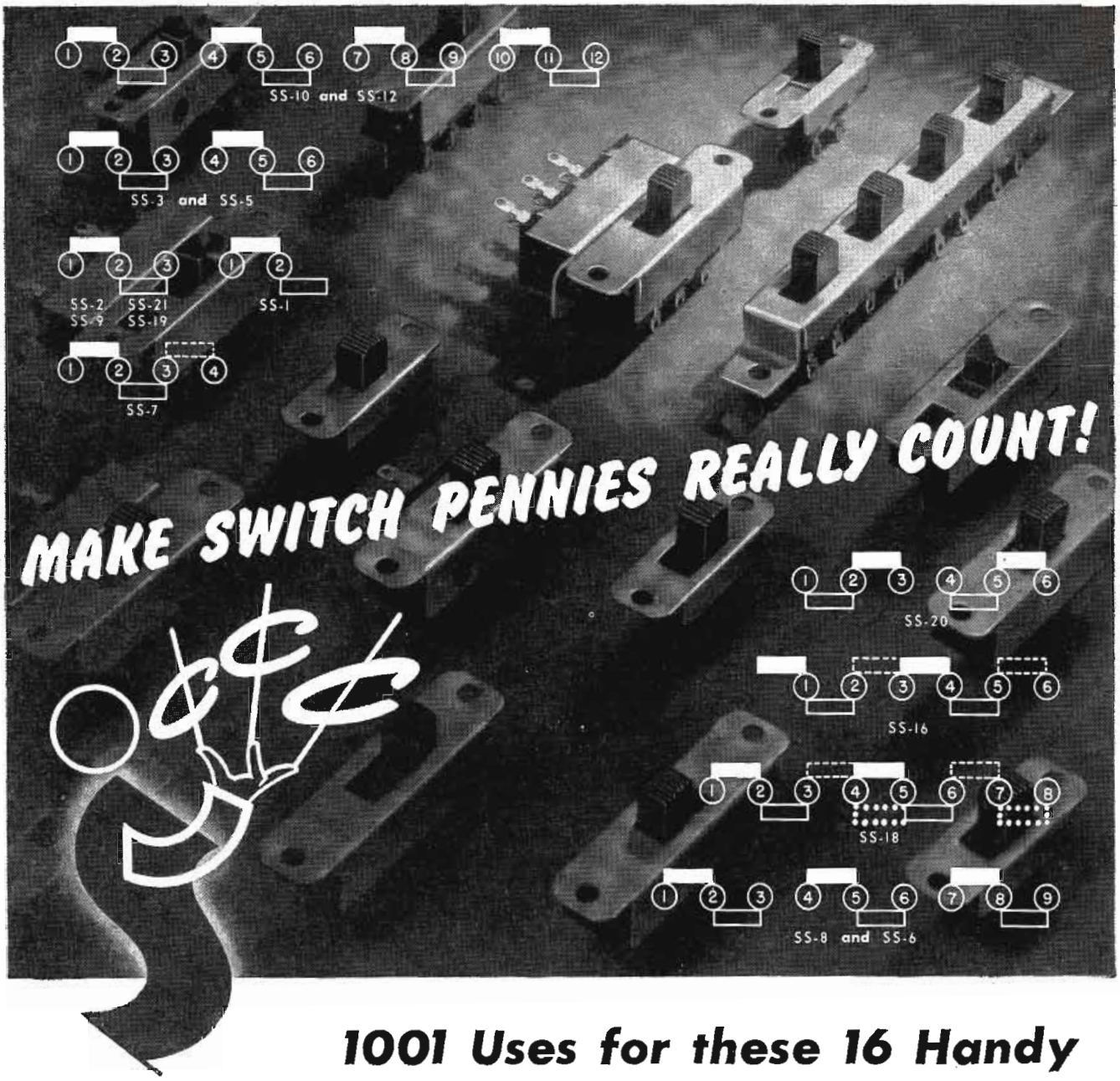
WWC
Columbia, Missouri

operation over a 15,000 cycle range—all controls are arranged for maximum operating flexibility and convenience—it's completely wired for plug-in cable connection—all parts are accessible for inspection and maintenance—and its modern styling makes it really eye-appealing.

For early delivery of your 25B Console, get your order in *now* to your local Graybar Broadcast Representative or write Graybar Electric Co., 420 Lexington Ave., New York 17, N. Y.

Distributed by GraybaR
OFFICES IN 95 PRINCIPAL CITIES

— QUALITY COUNTS —



1001 Uses for these 16 Handy SLIDE SWITCHES

Name the switch contact arrangement you need! From 1 to 6 poles, up to 4 positions, with or without detent, spring return, covers, or other optional features.

Chances are Stackpole can supply exactly the right switch—promptly and inexpensively. 16 standard slide types, each designed for good appearance and real dependability, provide a low cost way of modernizing almost any electrical equipment and adding greatly to its sales appeal. Many economical adaptations can be supplied on special order to large quantity users.

Write for Catalog RC-6

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MICROPHONE CARBONS
SINTERED ALNICO II
PERMANENT MAGNETS
. . . and dozens more

CONTACT CODE

POSITION 1
POSITION 2
POSITION 3
POSITION 4

STACKPOLE

STACKPOLE CARBON CO. • ST. MARYS, PA.

ELECTRONIC COMPONENTS DIVISION

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.

'47 TV-SET OUTPUT SOON 100,000—To Sept. 1, some 89,000 television receivers were produced, according to industry estimates. Based on earlier breakdowns, eight-month production included 63,000 table models, 18,000 consoles, 6500 radio-phono combinations and 1500 converters. Nobody knows how many TV receivers were home-built using any one of the eight or ten "kits" currently available. That total probably might prove surprising.

PERCENTAGE FOR RESEARCH out of every sales dollar, is 1947 policy of several leading radio-set manufacturers. Resulting expenditures run into big money, which is being assigned in part to new communications and industrial developments to stabilize future manufacturing program.

TV NEWSREELS will shortly be shown in Broadway theatre by Paramount-DuMont interests. Pictures will be received by television, photographed on film, processed in 30 seconds to one minute, and be ready for showing with the regular theatre projector. Such distribution of newsreel pictures by TV will eventually greatly speed up present week-long delays for printing and shipping thousands of reels, and is expected to revolutionize whole newsreel situation.

TAMING THE MISSISSIPPI—Mark Twain is probably twirling in his grave. For the skill that made pilots on "ole man River" world-known is becoming less and less necessary as radar takes over. Already radio-echo technic has made one of the river's powerful Diesel towboats independent in heavy rain, fog and snow. More are to be equipped.

BY AIR OR WIRE—You never know. Half the time you pick up your telephone to call someone in a distant city and if you think about it at all you probably imagine your voice is going over wires. Maybe it is. Chances are, though, that it is going microwave over the air—along with ten or a dozen or a hundred similar and simultaneous communications. Vast expansion of the frequency spectrum has made it possible to reach anyone anywhere at any time. That was a goal set up quite a few years back.

FARE ENOUGH—Taxicab operators are increasing their take by as much as 30% with the aid of two-way mobile radiophones. Time was when such systems were in the nature of a novelty. Now they are money-makers. As yet, FCC insists they are "experimental". has issued no permanent licenses. But the evidence of their practical value, and necessity, is plain.

CONTINUOUS CHECK-UP—Incidentally, FCC is currently operating 22 monitoring stations, 10 primary (bigger) and 12 secondary. Main job of the engineers who operate them, aside from checking to see that all stations are on their assigned frequencies, is to trace sources of interference which can cause trouble to some two score types of radio services. That's an important job in our already crowded spectrum.

HERE COMES THE TV JUKEBOX—Sooner or later someone had to think of it. So now the fertile brain of an inventor has evolved the nickle-in-a-slot television receiver, and what's more, has coupled with it photographic equipment. Idea is, you view a TV broadcast and when a particularly intriguing scene appears, press a button, and presto! out pops a photographic print of the scene. Developers of the equipment see a market for it in amusement parks and in newspaper offices.

NEWSPIX ON THE FLY—The New York Mirror has started test transmissions to determine the feasibility of using facsimile equipment in reporters' cars. Ten cars are to be equipped to operate in conjunction with a land station for direct transmission to the newsroom of typed, written or printed material, and perhaps, pictures. Even expense accounts can be transmitted!

THE BIRD CALLED "ENGINEERING"

What is the absolute end-result of any engineering effort? Some of you will say that it is to create services for mankind. Perhaps others will talk about creative effort and other high-sounding and philosophical ideas. But stripped of all its feathers, the bird we call "Engineering" has just one—and only one—end-objective. It is very simple to state, but not too easy to realize. This objective is—to MAKE A PROFIT for someone!—Dr. W. R. G. Baker, Vice-president, General Electric Co.

General view of part of the control room at United Nations headquarters at Lake Success on Long Island, N. Y., where simultaneous broadcasting and recording are under the watchful eye of engineers. (Official UN Photo)

UN Telecommunications Facilities

By Joel Peterson, Associate Editor Tele-Tech

Proposed plan, to cost $6,000,000, will have strategically located transmitters and rebroadcast stations to provide world-wide coverage

● It appears likely that the plan for worldwide broadcast and teletype facilities as proposed by the Advisory Committee on United Nations Telecommunications* will be adopted at a cost of $6,000,000 when presented to the General Assembly sometime in September.

The basic plan of operation is geared to provide the greatest worldwide coverage with a minimum amount of UN communication equipment necessary to tie together local national facilities in the various countries of the world. The most modern and dependable communications equipment will be used to siphon United Nations programs to strategic informational reservoirs from which indigenous broadcast networks and commercial facilities will lay down a strong signal for native populations. The United Nations telecommunications facilities will not compete with national private or governmental communications networks in any nation.

"The success or failure of the United Nations international broadcasting mission will hinge on the power of programming technics to produce effect. For this gravely important task, UN program personnel are already mapping plans. Once the key to proper programming is found, the UN need have no fears for the technical facilities. Equipment of the very latest and most efficient types will be used to aid the magic medium that is radio serve the greatest task in its history."—General F. E. Stoner.

It is estimated that approximately 500 million people the world over listen habitually to radio receiving sets. Of these, most sets listen to their own national radio facilities, the remaining depend upon international shortwave. Hence, the basic goal is to supply local national facilities with higher quality UN programs for rebroadcast, rather than to beam high-powered radio waves directly to the listeners. Some radio sets to which local broadcasts are not available, however, will tune in directly on the shortwave band.

To carry out the basic plan for wide distribution of United Nations program material in 25 languages, three main methods will be used:

(1)—Direct short-wave broad-

*General Frank E. Stoner, Chairman (United States); S. Kagan, (France); and G. F. Van Dissel, (Netherlands).

These members of the UN Radio Division are: Chief Communications Engineer General Frank A. Stoner (USA, Retired); V. Duckworth-Barker, United Kingdom of Great Britain, Director of UN Europeon office; Peter Aylen, Canada, Radio Division Director; Carlos Garcia Palacios, Chile, Chief Radio Officer. (Official UN Photo)

casts. These, of course, need the use of high-frequencies, but in closely settled regions for broadcasts to adjacent countries, low and medium frequencies will be used.

(2)—Programs produced in one country may be supplied by wire or radio point-to-point transmission for rebroadcasting over local facilities.

(3)—Export of United Nations program material in the form of recordings, transcriptions, and script material for use by stations in other countries.

This proposal calls for an expenditure of $6,000,000 which is comparatively small when compared with a cost of $1,000,000,000 for wartime research, development, installation, and operation of military inter-zonal communications facilities. Twelve frequencies in the broadcasting spectrum constitue the minimum requirements for the immediate plan; some of these will be taken from former League of Nations frequency assignments.

The technical plan for operation of the UN telecommunications facilities involves the use of equipment for: (1) broadcasting and (2) written record transmission. United Nations broadcast service will provide the most extensive world coverage within reasonable economical and technical limits. The objective is to take care of the distribution of heavy inter-office communication between United Nations general headquarters in New York and its outlying branches in various parts of the world.

United Nations official messages will pass to and from member countries and the traffic will increase as the various departments of the Secretariat and other UN agencies expand. It is anticipated that as many as a million words daily will pass over the written record facilities in the dissemination of administrative circulars, orders, bulletins, documents, news, etc.

Radio Centers

The UN headquarters station in New York will, of course, be the focal point of all telecommunications activities. However, a large and powerful originating and relay station will be located somewhere in Central Europe, possibly Geneva, Switzerland. Another station in a stragetic position in the Pacific will act as a relay point for serving the Orient. For future use, it may be necessary to establish an originating and relay station in Latin America.

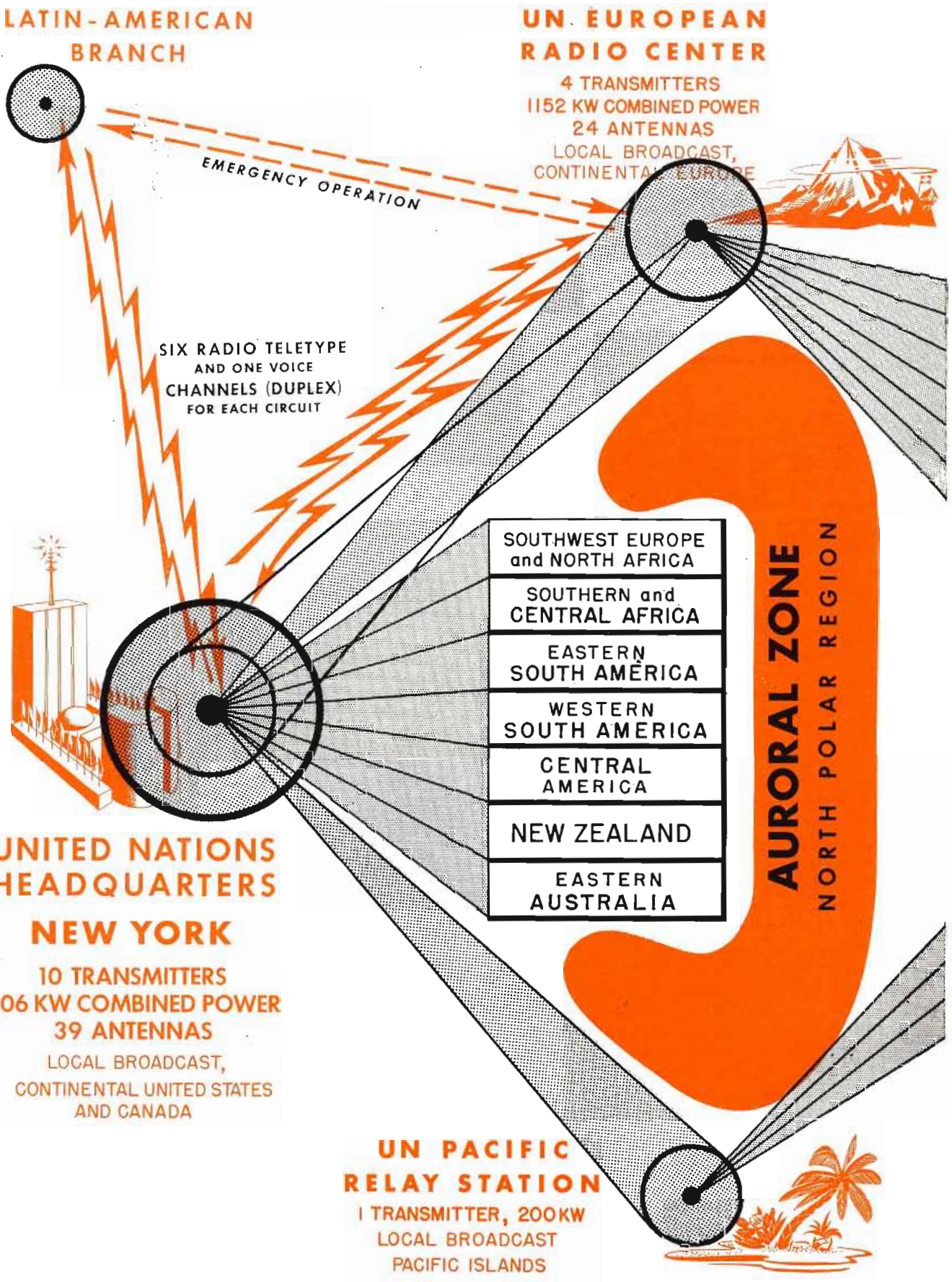
Each of these United Nations radio centers will be connected either by wire lines, low-powered radio, or microwave channels to local radio stations and networks. By this means the objective of a maximum listening audience will be reached by the fullest utilization of existing national, governmental or private communication facilities.

Bulk of the equipment will be situated at the United Nations general headquarters in the New York area and will cost approximately $3,000,000 for the major transmitting equipments and other associated gear. Ten transmitters of various powers will feed nearly forty antennas of the rhombic and dual-frequency curtain types which will be beamed to diverse parts of the world. Special arrangements will allow the same transmitters to broadcast to areas in the eastern as well as the western hemispheres. As listeners in Europe and the Middle East turn off their sets preparatory to retiring, the transmitters will be switched to antennas beamed to South and Central America; then later to the New Zealand-Australian area, and eventually to Eastern Asia. In this way the "off-the-air" time for the various transmitters will be kept as low as possible, at the same time obtaining maximum world-wide coverage.

The European relay station will complement the programs of the United Nations at general headquarters by originating informational and cultural programs for independent broadcasting. In pursuance of the objective to provide the most extensive broadcast coverage, the European radio center will operate a 1,000 kw transmitter on a low or medium frequency (about 250kc) in the politically vital European area. The daytime coverage of such a station is expected to be practically all of Europe, and the nighttime coverage will extend well beyond, into North Africa and the Middle East. This powerful station will broadcast United Nations programs to the large European audience on a wavelength to which most Continental radio sets can be tuned. Four transmitters and twenty-four antennas will be used at the European radio branch.

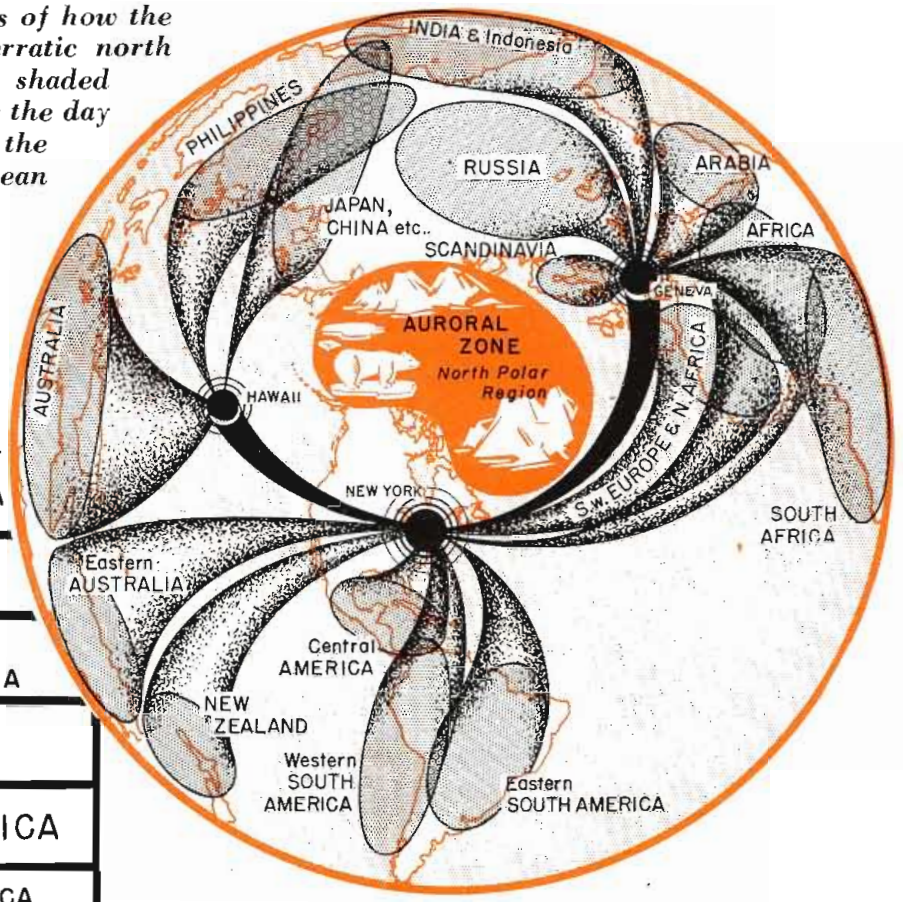
The Pacific radio station will be used only for relay purposes. Under the immediate proposal, no United Nations programs will originate at this point. One transmitter will be used.

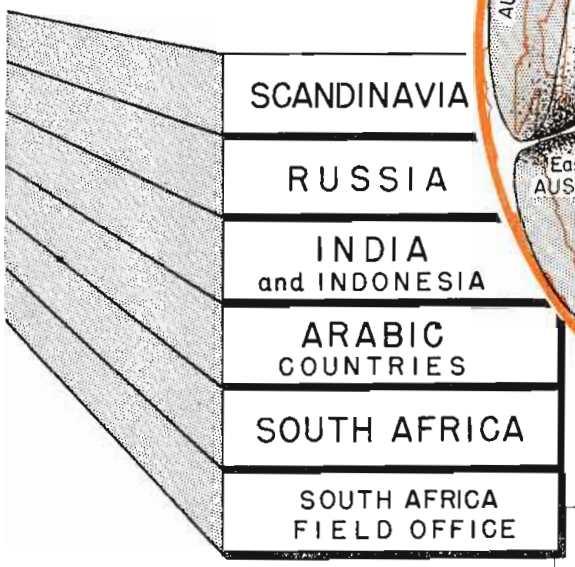
UNITED NATIONS WORLDWIDE

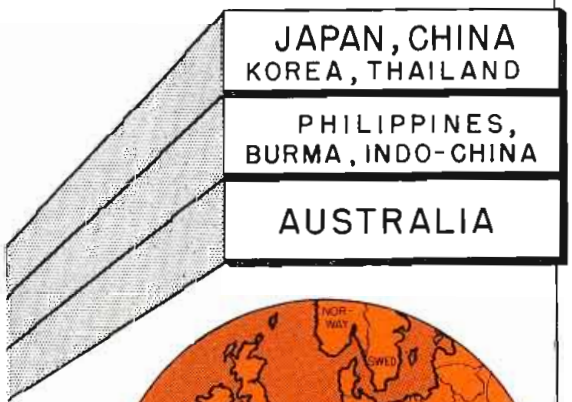


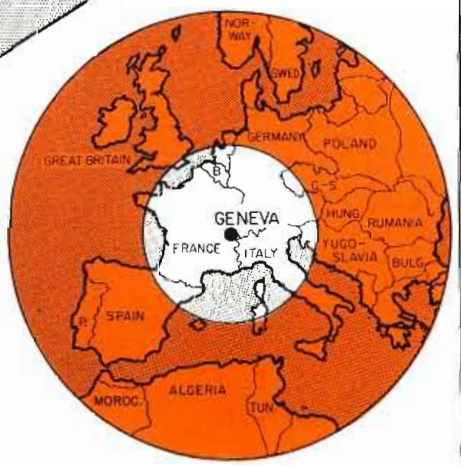
TELECOMMUNICATIONS PROPOSAL

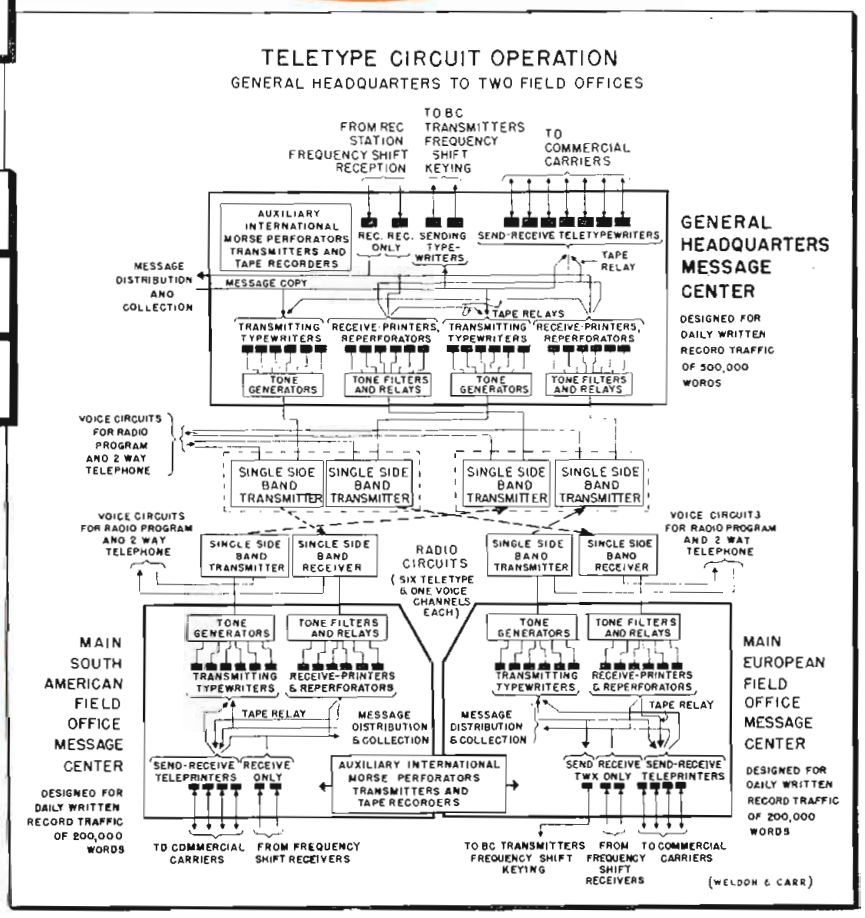
Shown here are two perspectives of how the UN plan will circumvent the erratic north polar region to reach places in shaded areas. The lower circle compares the day and night (color) coverage of the 1000 KW station at the European radio center. Lower right is a schematic of the triangular written-record network connecting UN Message Center with field offices in Europe and South America











The choice of these broadcasting centers is predicated on the results of investigations of such problems as propagation paths, listener response, auroral effects, multi-language areas, frequencies, seasonal variations, sun spots, etc. For international shortwaving, the North American continent is one of the less desirable originating areas. It would be impracticable for the New York station to transmit to Japan and China, for example, because the great circle path passes directly through the north polar region and the erratic auroral zone. The UN headquarters station, it is seen, will broadcast to practically all areas of the world except those shaded by the auroral zone.

The general headquarters station in New York will transmit to East and Northwest Europe, Southwest Europe and North Africa, South and Central Africa, Eastern and Western South America, Central America, New Zealand, Eastern Australia and to the Pacific relay station. The European radio center will broadcast to Scandinavia, the Soviet Republics, India and the Netherlands East Indies, Turkey and the Arabic states, South Africa, North America, and to the South American teletype field office. The Pacific relay station will transmit to Australia, the Philippines, Burma, and the Japan, China, Thailand area.

A number of new developments and ingenious methods of the recent war are embodied in the UN telecommunications plan. For example, a new type of radio set called an exalted carrier receiver reduces the effect of selective fading in international radio broadcasting. Exalted carrier reception[1] is particularly useful in ionospheric transmissions where multi-path effects become objectionable. Selective fading or carrier phasing type of distortion is produced when the upper sideband reacts with the lower sideband resulting in the generation of second harmonics. For example, a carrier modulated with 400 cycles produces one upper and one lower sideband displaced from each other by 800 cycles. During detection under adverse conditions, an 800 cycle instead of a 400 cycle note is heard. For speech and music, of course, this condition would produce heavy distortion.

To circumvent this distortion, the exalted carrier principle is used in the receiver. A sharp filter circuit, such as a crystal type, tunes out the carrier frequency and rejects the sidebands. This isolated carrier is then recombined with the original signal in such a way as to produce the effect of an exalted carrier. One method of doing this is to amplify the isolated carrier and to recombine it in a diode type detector with the original sidebands. The sidebands heterodyne with the stronger carrier, rather than with each other, to produce the desired modulation products.

Communications Methods

Extensive use will be made of single sideband transmission technics. Single sideband facilities are used by commercial carriers for overseas as well as local circuits. Principle advantage of this method of transmission is the conservation of the frequency spectrum. Another feature of the single sideband system is the reduction of fading so common in conventional double sideband systems.

At the transmitter, the carrier is suppressed on the order of 20 db below normal. This saving in power can be diverted into one of the sidebands which contains the useful intelligence. At the receiver, the single frequency carrier is amplified and recombined with the sideband component in a conventional detector.

Two or more separate radiotelephone channels on the same transmitter permit a still greater economy of wavelength. One proposed transmitter, for illustration, will be capable of transmitting a radiotelephone program of voice or music on one sideband and as many as six or more teletype circuits each operating at 60 words per minute on the other sideband. This is equivalent to a message traffic of 360 words per minute and one voice channel using only one wavelength.

In the high-frequency range where violent fading is usually encountered, greatly improved reception will be obtained by the use of diversity reception. This system, using two or more properly spaced antennas and separate channels, was used with excellent results

(*Continued on page 98*)

Part of the recording equipment which includes facilities for recording speeches in five languages for later rebroadcast. (Official UN Photo)

[1] Crosby, M. G. "Exalted Carrier Amplitude and Phase Modulation Reception," Proceedings, Institute of Radio Engineers, September 1945.

Finch Facsimile-in-Color Process

Colorfax system, using pencil leads of four hues synchronized through rotating filter, reproduces original without need for special paper

• A new color facsimile process which does not require the use of specially treated paper in the home receiver has been developed by Finch Telecommunications, Inc., New York. The system, styled Colorfax, makes use of colored pencil leads which operate woodpecker fashion and scribe a colored line picture comprised of a blend of colors similar to the original.

Colorfax, the joint invention of Capt. W. G. H. Finch and Dr. LaVerne Philpott, respectively president and director of research of Finch Telecommunications, uses red, blue, yellow, and black pencil mechanisms which successively print these individual color values on a single line. As illustrated, this four-pencilled mechanism revolves in synchronism with a color wheel at the transmitting end. For each revolution of the printer a staccato of colored pencil impressions is superimposed on each other to produce a full-color line.

The original colored copy is mounted on a rapidly rotating scanning drum which moves slowly along its axis past the optical path of a photocell system. A revolving disc with four light filters is interposed in the optical path. The scanning drum rotates four times as fast as the color filter, thus a sample line is scanned with four differently colored light points before the cycle is repeated on the adjacent line.

Each of the four filter segments on the color wheel is selected to yield the greatest reflection coefficient for its particular color. For example, when red is being transmitted, the scanning light is of such quality that reflections from red-colored areas into the photocell are of greater intensity than are reflections from other colors. Simultaneously the red scriber at the receiver is printing in accordance with these varying intensities.

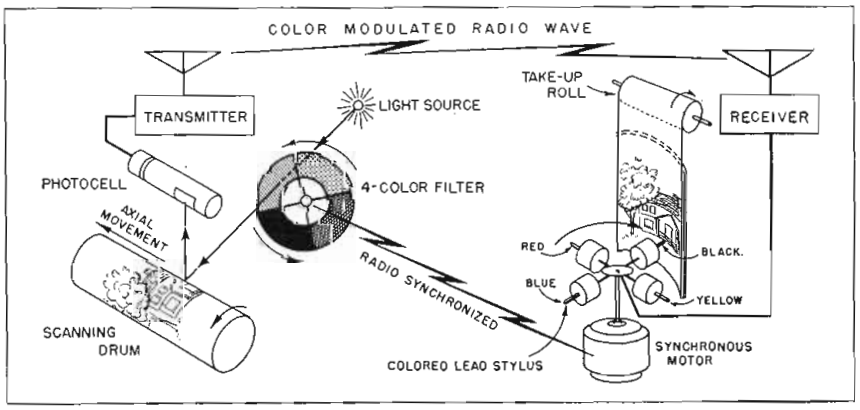
Capt. W. G. H. Finch with one of the new Colorfax instruments for the reception of facsimile pictures in color

The signal resulting from the scan is not unlike that of any facsimile system, except that the progress of the drum is slower to prevent color break-up. The demonstrated speed was 4 sq. in. per minute or ½ in. linear per minute for 8 in. width recording paper. The definition is 100 lines per inch.

The receiver is equipped with four marking styli of the solenoid type. These electromagnetic drive units are mounted on a turret type head which revolves in synchronism with the color wheel. As it sweeps the page, each stylus with its colored lead vibrates against the paper. The solenoid drives exert adequate pressure on the leads to deliver a succession of blows in accordance with the modulation on the received carrier.

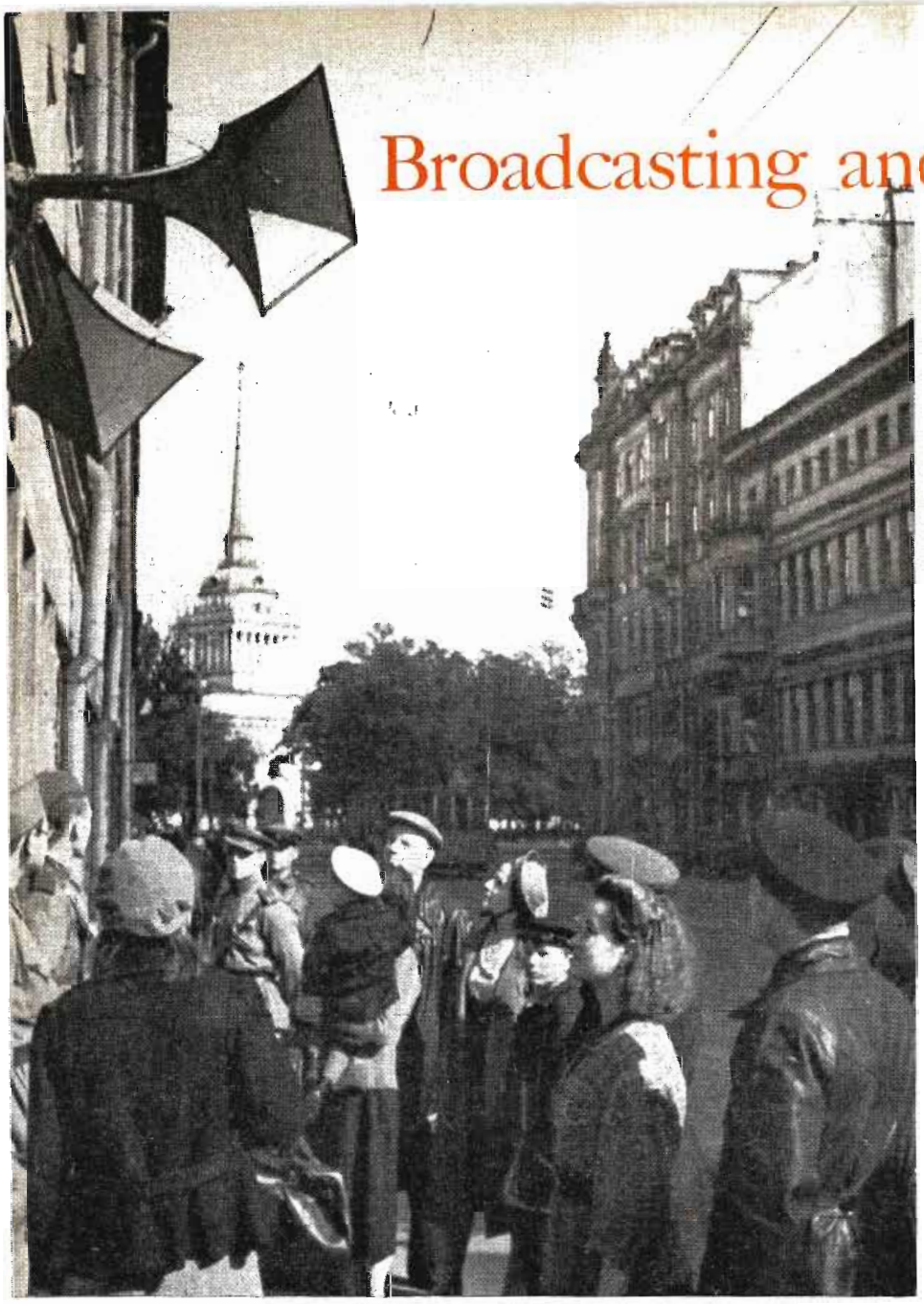
Colorfax is expected to find use in many fields and especially for industrial and business applications. Buyers in distant markets, for example, can send Colorfax samples of merchandise, such as textiles, back to the home office for an immediate decision. Eventually, full color advertising may be sent via radio to facsimile units in American homes, opening up new frontiers in advertising promotion.

Functional diagram showing the method of operation of the Finch Colorfax system which relies upon the use of colored leads at the receiving end to reproduce the colors of the transmitted drawing



Broadcasting and Television

By DR. ARNO HUTH,
International Radio Expert



The Russian audience, like this typical gathering on a Leningrad street, relies mostly on hundreds of thousands of loudspeakers wired to central receiving sets

THE Russian Radio which differs so widely from all other radio systems is but little known outside the "iron curtain". Most articles published on this subject have been incomplete or offer propaganda rather than information; frequently, they also have been misleading because of inaccurate technical terms. It might therefore be interesting to collect all reliable facts and figures, and to attempt an objective and non-political analysis of the development and the present situation of broadcasting and television in the Soviet Union. (See "Status of Broadcasting Overseas" by Dr. Arno Huth, TELE-TECH, Jan. '47, Page 56).*

• Communications, and especially radio broadcasting, meet in the U.S.S.R. with some particular problems and difficulties, due to the extent of the country, which is almost three times as large as the United States, and to the poverty of a great many of her 195,000,000 inhabitants who can not buy radio sets. It should be remembered too that nearly 200 ethnic groups, speaking different languages and dialects, are living together. These factors have determined, and still determine today, the development and the organization of the Soviet Radio as well as the methods used for the distribution of programs.

In order to cover the immense territory and to reach the masses, the central broadcasting service is supplemented by numerous regional and local services concerned both with the transmission and the reception of programs. National (and international) programs originate in Moscow, regional programs in 170 republics and districts, and local programs in more than 3000 towns and villages. They are distributed not only by radio, from the transmitter to the receiver, but also by wire, by means of "central receiving points" connected with the loudspeakers used by listeners and listening groups.

The majority of the Russian listeners receive programs, or rather one (pre-selected) program, by wire. Political objectives greatly influence the centralized administration of radio, the program work and the technical planning; preference is given to high-powered long wave stations which can be heard throughout the country — and beyond the frontiers.

Radio Five-Year Plans

As early as 1918 Lenin realized the exceptional importance of radio for his country where other means of communication must necessarily fail, and discovered the potentialities of broadcasting as a medium for the propagation of ideas and statements, and particularly as a powerful instrument for political propaganda. Thus the

*The term "radio stations", for example, has been used for radio telegraph and telephone as well as for broadcasting stations, frequently even for receiving centers. To avoid any confusion, we should note that the term "wire broadcasting" is applied in this article to the distribution of radio programs by wire.

Methods in the Soviet Republics

Relying principally on high-power longwave transmitters, 195,000,000 people speaking over 200 dialects must be reached — Collective listening predominates

Russian Radio became, from its very beginning, the voice of the Communist Party and the Soviet Government.

Experimental broadcasts started in 1919. Three years later, the Moscow station went on the air introducing regular transmissions. A State Broadcasting Service was established in October 1924, and far ahead of all other countries the Soviet Union arranged for political broadcasts in foreign languages, the first of which, broadcast from Leningrad, was heard in England on October 17, 1926.

Radio industry and radio broadcasting in the Soviet Union were built up according to the various *Five-Year Plans*. Every one of these plans included important provisions for the development of radio communications, especially for the establishment of more and better broadcasting stations. Simultaneously, a ramified network of receiving stations was set up, with relay points in all towns and district centers.

The first Five-Year Plan started with the establishment of a 100 kw station in Moscow in 1929; this was followed in 1933 by the opening of the 500 kw longwave station, then the most powerful station of the world, and in 1938 by the construction of two 120 kw shortwave transmitters (RW-96) which likewise were the most powerful international stations. In 1940 Stalin ordered the building of a "still more powerful" station which seems to be the strongest voice on the air. It was completed in the autumn of 1942, at the time of the siege of Stalingrad, but its exact location and power are still undisclosed.

A Television Center, partly built with American equipment, was inaugurated in Moscow in 1938: a Television Theatre, whose projection screen provided pictures of 3 2/3 x 4½ ft., was opened in the "Central Park for Culture and Rest".

130 Broadcast Stations

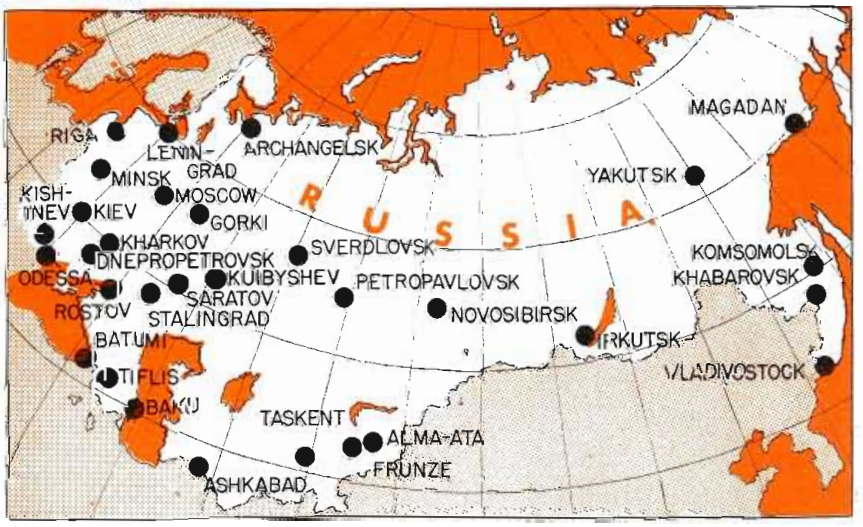
The growth of the Soviet radio is reflected by the increasing number of stations; there were 57 in 1932, 93 in 1937, and 110 in 1942. At present, the Soviet Union has about 130 broadcasting stations whose total power most probably exceeds 3000 kilowatts. The principal stations are listed in the appended table.

The war caused tremendous damage to the Soviet radio. In the German-occupied areas all broadcasting and relay stations were destroyed, and so were most of the receiving installations. The Soviet Government thus faced the enormous task of repairing or rebuilding the radio facilities in the Western part of the country.

The Five-Year Plan which covers the period 1946-1950 calls for the establishment of numerous transmitters and studios, and the manufacture of millions of receivers and loudspeakers. An important part of this program has already been carried out. The work of reconstruction seems to be completed; transmitters in Kiev (150 kw), Minsk, Kharkov, Rostov, Stalino, and in several other cities have been restored.

In addition, the Plan foresees the construction of 28 powerful broadcasting stations; some of them are already on the air, such as the new stations in Moscow (with 50 and 100 kw), Riga (70 kw), and Vilna (50 kw), in Leningrad, Ashkabad, Dnepropetrovsk, Stalingrad and Simferopol. Other important stations are under construction in Lvov, Krasnoyarsk (Central Siberia), and Kuibyshev.

Map showing the dispersion of the principle Russian broadcasting stations



Principal Russian Medium Wave Broadcast Stations

	kc	meters	Watts
North East St.	155	1961	100,000(?)
South East St.	200	1500	100,000(?)
Abakan	695	431.7	2,500
Alexandrovsk	356	843	2,000
Alma-Ata	182	1648	10,000
Archangelsk	356	843	10,000
Ashkabad	385	779.2	10,000
Astrakhan	598	501.7	10,000
Baku	217.5	1379	35,000
Birobidschan	718	420.8	-----
Cheboksary	318	943	5,000
Chelyabinsk	577	519.9	10,000
Chernigov	1013	296.2	4,000
Chita	194	1546	20,000
Chkalov	356	843	1,000
Dnepropetrovsk	913	328.6	10,000
Dschandschikan	770	386.6	-----
Elista	704	426.1	2,500
Engels	937	320.2	1,000
Erivan	361	824	10,000
Frunze	608	493.4	2,500
Gomel	959	312.8	1,000
Gorki	506	530	10,000
Grozny	676	443.8	1,000
Igarka	340	882.4	2,000
Ijevsk	731	410.4	4,000
Ioschkar-Ola	888	337.8	1,000
Irkutsk	270	1111.1	20,000
Ivanovo	668	449.1	10,000
Kalinin	1411	212.6	2,500
Karagrande	791	426.1	1,000
Kazan	283	1060	10,000
Khabarovsk (RW54)	340	882.4	10,000
Kharbarovsk	638	470.9	10,000
Kharkov	385	779.2	40,000
Kiev	248	1209.6	150,000
Kishinev	565	531	-----
Krasnodar	583	514.6	1,000
Krasnoyarsk	356	843	1,000
Kuibyshev	767	391.1	10,000
Kursk	804	373.1	2,500
Leningrad (RW-53)	208	1442	100,000
Leningrad (RW-70)	1040	288.6	10,000
Madona (Latvia)	582	515.5	50,000
Makach-Kala	313	958.5	4,000
Minsk	269	1115	35,000
Moscow	950	315.8	750,000*
Moscow (RW-1)	174	1724	500,000
Moscow (RW-43)	232	1203	100,000
Moscow	620	483.9	-----
Moscow	708	423.9	-----
Moscow (RW-39)	832	360.6	100,000
Moscow	1435	208.9	-----
Murmansk	648	463	10,000
Nalchik	350	857	1,000
Novosibirsk	217.5	1379	100,000
Nukus	364	824	-----
Odessa	968	309.9	10,000
Odessa	1071	280.1	10,000
Odessa	671	447.1	-----
Oirot-Toura	310	968	1,000
Omsk	395	759.6	-----
Ordzhonikidze	749	400.5	10,000
Oufa	405	741	10,000
Oukhta	968	309.9	2 000
Penza	640	468.8	1,200
Petropavlovsk	385	779.2	-----
Petrozavodsk	400	750	10,000
Piatigorsk	610	491.8	10,000
Riga (Latvia)	583	514.6	70,000
Rostov	556	539.6	20,000
Saransk	695	431.7	1,000
Saratov	340	882.4	20,000
Simferopol	850	349.2	-----
Smolensk	610	491.8	10,000
Stalinabad	350	857	2,000
Stalingrad	648	463	10,000
Stalino	776	386.6	10,000
Stavropol	722	415.5	-----
Sverdlovsk	370	810.8	40,000
Sykty.kar	590	508.5	1,000
Tallinn (Estonia)	731	410.4	5,000 (15,000?)
Tashkent	210	1250	25,000
Tiflis	283 (263	1060 1141)	35,000
Turtkul	333.3	900	2,000
Ulan-Ude	350	857	10,000
Uzhgorod	400	750	-----
Vilna	536	559.7	50,000
Vinnitsa	1095	274	10,000
Vladivostock	239	1255	10,000
Voronezh	356	843	10,000
Yakutsk	227	1321.6	10,000
Zaporozhe	876	342.5	10,000

*according to the Foreign Broadcast Intelligence Service, Washington, D. C.

Shortwave transmitters are located in Alma-Ata, Ashkabad, Baku, Batum, Erivan, Frunze, Grozni, Irkutsk (20 kw), Khabarovsk (20 kw), Kiev (40 kw), Komsomolsk (50 kw), Leningrad, Magadan, Moscow (20, 50 and 100 kw, using more than 50 frequencies), Novosibirsk (20 kw), Samarkand, Saratov, Stalinabad, Stalingrad, Sverdlovsk (15 kw), Tashkent (15 kw), Tiflis, and Yakutsk.

the famous wartime radio center.

Relay networks have been built in Estonia, Latvia and Lithuania, and also in remote Asiatic regions. The Soviet authorities intend to increase the radio relay system by 75% in comparison with the prewar service, and to set up new wire connections for several millions of loudspeakers.

Communications Plans

The current Five-Year Plan also includes important projects for other communication branches. Reliable telegraph and telephone communications will be established between Moscow and all capitals of the Soviet Republics, as well as between these cities and the regional centers. The Plan therefore requires the establishment of 55 powerful radio telegraph and telephone transmitters; twenty of them will be placed in the central districts to tighten the link with the Far East, Kazakhstan, Central Asia, and the Transcaucasus.

The new plan covers also FM and Television which at present are seriously studied in the Soviet Union.

The Soviet Radio—which employs a permanent staff of 17,000 exclusive of station and network engineers—produces a considerable amount of program material. In 1946, the Soviet stations operated for 1,750 hours daily including the 152 hours of the Moscow stations. The home programs are broadcast in 70 languages of the peoples of the U.S.S.R., and the international programs in more than thirty foreign languages.

Because of the great distances, Radio is widely used to supply news to the press, and already in 1939 the Telegraphic Agency of the Soviet Union (TASS) daily transmitted by radio information to 3252 newspapers. Thus the central network alone has broadcast last year over 500,000 words daily.

Programs are planned and produced by a central committee, 133 regional and local committees, and more than 3000 district and factory radio councils. Consequently, the technical organization is composed of central, regional and local facilities: the programs broadcast by central stations located in large cities, with varying power from 100 to 500 kw, are relayed by regional stations with 10 to 50 kw and small-powered relay transmitters. They are received either directly, by a limited number of radio sets, or indirectly, by intermediary of more than ten thousand "radio centers", i.e. receiving installations connected by wire to millions of loudspeakers used by individual listeners and collective groups. Contrary to the practice in Great Britain, in Holland or Switzerland, the receiving center or "point" is not always a station or relay exchange, but frequently a radio set at least as good or of better quality than the usual broadcast receiver.

PRINCIPAL EUROPEAN STATIONS

in the frequency band 300 — 500 kc (exclusive of Soviet transmitters)

	Kc	M	Watts
Joensuu, Finland	310	968	10,000
Finnmark Norway	347	864.6	10,000
Bergen II, Norway	355	845.1	1,000
Banska Bystrica, Czechoslovakia	392	765.3	20,000
Lulea, Sweden	392	765.3	10,00
Geneva, Switzerland (off the air)	401	748	1,300
Ostersund, Sweden	415	722	10,000
Oulu (Uleaborg), Finland	433	692.8	10,000
Pilsen, Czechoslovakia	514	584	15,000
"Radio Vorarlberg" (Dornbirn), Austria	519	578	6,000
Innsbruck, Austria	519	578	2,000
Hamar, Norway	519	578	1,000
Kuopio, Finland	527	569.3	20,000
Ljubljana, Yugoslavia	527	569.3	10,000
Bolzano, Italy	537	559.7	10,000
"Radio Sardegna" (Cagliari), Italy	536	559.7	5,000
Budapest I, Hungary	546	549.5	120,000

Collective Listening

According to a broadcast from Moscow (April 3, 1946) the Scientific Research Institute of Communications has developed a new type of "Radio Rediffusion Centers" for collective farms. This inexpensive and simple installation consists of a set switched to receive one of the fixed stations, an amplifier and the batteries; the "Center" which is similar in size to an ordinary radio receiver, can serve from 50 to 100 loudspeakers.

The Soviet authorities encourage by every means the habit of collective listening. There are loudspeakers in tens of thousands of collective farms (Kolkhozh) and factories, in town halls,

schools, libraries, clubs and other meeting places.

Every town and district center, every big enterprise and workers' settlement has its own radio relay system; quite often it not only transmits "All-Union Programs", but also produces programs of local character. This is particularly true for the *"Factory Radio Systems"*. These local services operate a public address system within a particular plant and distribute — through loudspeakers installed all over the plant—many programs which originate in the factory itself and deal with factory life; they also inform on hospitals, schools, stores, clubs, theatres and restaurants in the neighborhood.

Political Programing

In addition the factory system broadcasts political and professional talks by chairmen of trade union committees, by the chiefs of the different sections as well as experienced workers; it offers valuable advice given by experts in modern production methods, by doctors, agricultural and housing specialists. Some of the large factories have sound trucks which tour hostels, hospitals, and other factories in the area.

The dual system of program distribution — the coordination of wireless and wire broadcasting — has enabled the Soviet authorities to cover large areas and to make important political broadcasts heard all over the country. It has enabled them, also, to mobilize all forces of the nation for the fulfillment of the Five-Year-Plans, and especially for the war effort. Thanks to relay and receiving stations, the whole country has been linked to the central government and kept informed of political, economical and international developments.

When the Soviet Government ordered on June 28, 1941 that all private radio sets be turned in for the duration of the war, wire broadcasting remained practically the only means of contact between the government and the people. Even during the most critical period of the war contact could be maintained with districts isolated by the enemy, for example with the city of Leningrad. In German-occupied areas the communications from Moscow were copied by hand, then printed on separate sheets and widely distributed.

Radio plays a vital role in the Arctic regions of the Soviet Union just as it does in the remote areas of Alaska and Northern Canada. The key stations in the Dixon Island, for example, are in direct communications with Moscow and with 50 stations in the Far North. Whereas their chief function is to collect weather information, they also broadcast news and programs.

Short Wave Links

Shortwave stations are used both for domestic and international purposes, for the transmission of home broadcasts to distant places, and of international programs to foreign audiences. In addition, thousands of shortwave radio telegraph and telephone transmitting and receiving stations operate in rural districts in order to link farms and farmers to the production centers.

All sets as well as the loudspeakers connected by wire to relay centers must be registered, and license fees have to be paid for their use. But except for a few Soviet Republics no official figures of the present number of licenses have been made available.* The estimates of individual sets vary from ten thousand to several millions. Charles Thayer, Chief of the Russian Section of the International Broadcasting Division, U. S. Department of State, believes that half a million sets are in use; he bases his figures on the fact that about 500,000 to 1,000,000 receivers have been confiscated in Germany by the Russian occupation authorities. Ernest Bevin, the British Foreign Minister, assumes that there are 2,000,000 sets, and the American-Russian Institute in New York agrees with this figure. (In 1940 two million receivers were reported, and the U.S.S.R. Minister of Communications recently declared that the prewar level was

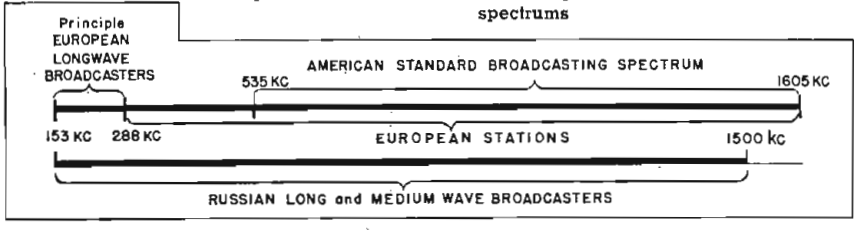
(*Continued on page* 109)

*In autumn 1946, the number of registered sets and loud-speakers reached 678,000 in the Ukraine, 86,000 in Byelorussia, 50,000 in Latvia, 35,000 in Estonia, 21,000 in Lithuania, and 15,000 in Finnish Carelia.

Principal European Long Wave Stations

kc/s Frequency	Meter		Power (Watts)
153	1961	Berlin, Germany (under Russian control)	100,000
"	"	Prague I (Liblice) Czechoslovakia	10.000 (reduced power)
160	1875	Brasov "Radio Rumania"	150,00
"	"	Lahti, Finland	150,000
		The same frequency was also used by Hilversum I. now operating on 995c kc—301.5 m.	
167	1796	Ottringham, England (BBC European Service)	150.000—200.000
182	1648	Ankara, Turkey	120,000
		The destroyed station "Radio Paris" used the same frequency.	
191	1571	This frequency was used by the principal German station called "Deutschlandesender" (at Herzberg), and until December 31, 1946 by Prague I.	
200	1500	Droitwich, England (BBC Light Program)	150,000
216	1388.9	Motala, Sweden	150,000
224	1339	Poland—the Warsaw station, now operating on 1303 kc—230.2 m, will use this frequency again, as soon as the high-powered transmitter is reconstructed.	
232	1293	Junglinster, "Radio Luxemburg"	200,000
240	1250	Kalundborg, Denmark	60,000
260	1154	Bergen 1, Norway	20,000
"	"	Oslo, Norway	60,000
271	1107	Reykiavik, Iceland (original frequency 208 kc)	100,000
282	1064	Tromsoe, Norway	10,000
"	"	V gra, Norway	100,000
288	1042	Katowice, Poland	1,000 (reduced power)

Comparison between American, European and Russian broadcast spectrums



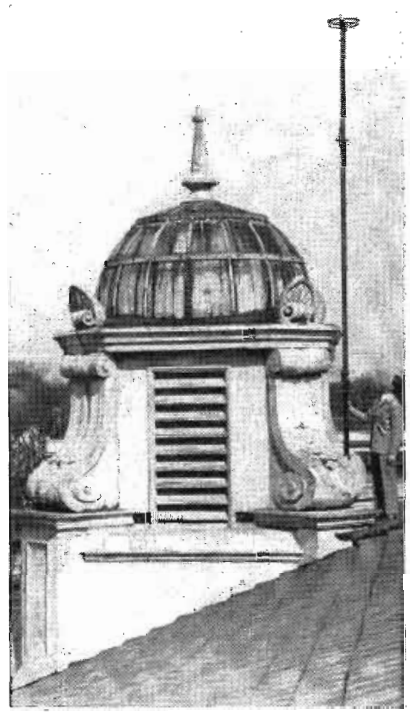
2½-Watt FM Transmitter Permits City-Wide Coverage

With effective radiated power of but one watt, Syracuse University installation gives 50 micro-volt/meter at distance up to 7 miles

• The development of a radio broadcasting service for an exclusive audience, such as a single community, has not been given the attention it deserves. In the early days of AM broadcasting many 5- or 10-watt stations were in operation, rendering good service over small areas, but the competition from stations "getting wider coverage" and the requirements of the FCC for a certain minimum level of financial responsibility has either eliminated these flashlight power stations or caused them to jump to "respectable" (!) levels.

At present FM frequencies, the area covered is circumscribed by line-of-sight distances anyway. The subject of power requirements for a station under these conditions is being reopened by educational groups and others, to find out if good coverage of a single community can be obtained with only a modest financial outlay.

So far, the actual utilization of the FM channels allocated to educational service has been limited. At the present time, the number of FM stations (for education use) in operation, under construction, or applied for, in total are less than a hundred. It was thought that a plan that would permit starting a local service in a small way would find many adherents, especially since it is being shown by a remarkably simple installation at Syracuse University that good coverage of a community (even in territory as hilly as around that vicinity) can be obtained with a small outlay.



Syracuse University antenna is a GE one-bay circular unit, gain 0.79

In this setup, the studios and the microphone control equipment are laid out to attain highest quality so that there need be no sacrifice of quality. These studios and their equipment also serve other groups such as in dramatics, diction, and radio script writing classes. The transmitter itself was engineered by General Electric Co., and delivers a carrier power output of 2.5 watts (not kilowatts). Actually, since the transmitter is the modulator section of their standard 250 watt installation, several advantages are found: greater power can be provided at any future date by simply setting the power amplifier section of the GE 250 watt FM transmitter alongside. The quality modulation capability, center frequency stability and other features are the best, and no remodeling or change of operating technics are needed should the power be increased.

The modulator unit, shown at the left as a campus transmitter at Syracuse will provide 2.5 watts at 88.1 megacycles. Other characteristics and operating details are shown in the Table.

Before going into some of the technical details of the apparatus, it is of interest to examine the actual and theoretical service areas, since the station has now been on the air for some months. Because of the unusual power

GE engineer Elwin Macrea, left, and Lisle Conway, technical supervisor of Syracuse University's radio workshop, check operation of General Electric's 2½ watt FM transmitter

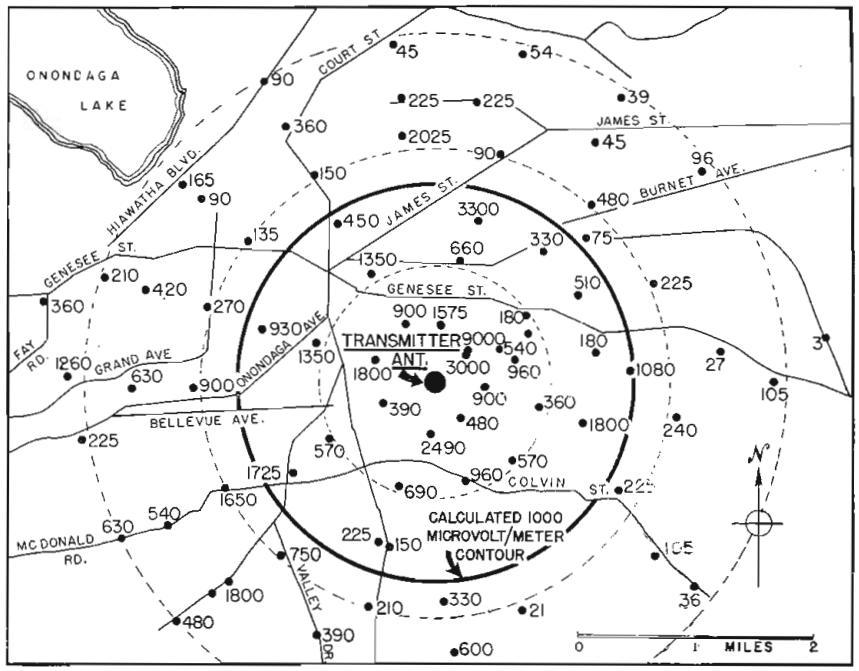
levels radiated (actually approximately 1 watt gets to the antenna), many unusual listening tests have been applied. Syracuse University is about one mile from the business section, in a city of about 275,000 people. In view of the interference of large buildings and hills, a "smooth" contour curve cannot be expected and so the actual measurements shown on the map are of interest. The tests showed ample signal at all points where coverage was desired.

The following calculated distances to 5000, 1000, and 50 microvolts/meter contours assume the use of a single bay, circular antenna with a power gain of 0.79, 100 ft. high, connected by 200 ft. of RG-8/U cable having an attenuation 0.027 db/foot. The calculations show 5000 microvolts/meter at 0.82 miles, 1000 microvolts/meter at 1.9 miles, and 50 microvolts/meter at 8.8 miles. These circles are drawn in on the map, together with the actual values at typical points.

The basis of this 2.5 watt transmitter is the Phasitron tube, Type GL-2H21. It provides crystal frequency control of the FM carrier. The modulator uses 10 rf tubes nine tuned circuits, and one crystal in a line up shown opposite. While it may seem that a large number of tubes are used, they are all small. With the exception of the final stage using a GL-815, all tubes are of the receiving type.

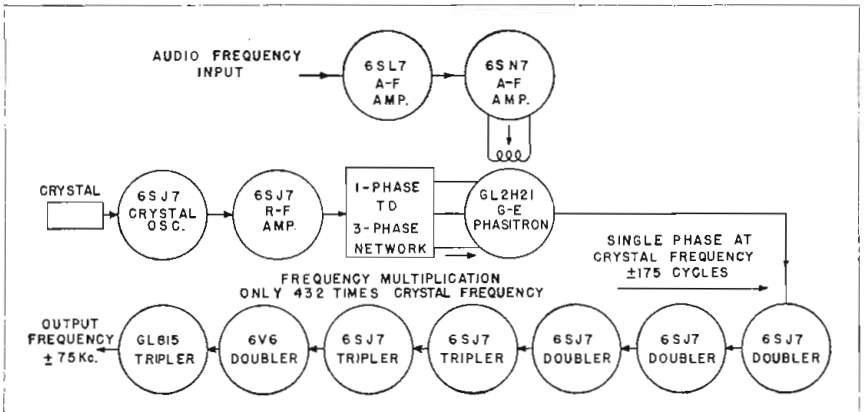
It would seem that the utilization of low power broadcasting facilities by schools and colleges to reach their community audiences may be an answer to the challenge of Ex-Commissioner J. L. Fly reported in a U. S. Office of Education bulletin, in 1944, "If education doesn't want and doesn't need those channels, and if it doesn't prove its desires and needs by actually making intensive use of them, history is going to repeat itself, and education will again find that it is left with memories of a lost opportunity."

The extreme ruggedness of the terrain surrounding S.U. should be considered when comparison is made between calculated and measured field strengths since abrupt and large variations occur in rough, city terrain. This results from shadows and interfering reflections.



A portion of the Syracuse University field strength showing readings in microvolts per meter (30 ft. above ground) over the most densely populated and most hilly regions in Syracuse. The transmitting antenna was 100 ft. above ground (and not above the average terrain.)

The calculated 1000 microvolt/meter and 50 microvolt/meter contours occur at a radius approximately of: 1000 microvolt/meter —1.7 miles; 50 microvolt/meter —7.0 miles, under the following conditions of calculation: (1) Smooth, spherical earth; (2) Frequency—88.1 mc/sec; (3) E.R.P. —1 watt (2.5 watts transmitter output, less 2.8 db of attenuation due to 140 feet RG/8U cable; antenna power gain of 0.79.



CHARACTERISTICS OF SYRACUSE UNIVERSITY 2½-WATT TRANSMITTER

Carrier power output .....2½ watts
Frequency range 88-108mc
Frequency stability ....Within ±1000 cycles

FM carrier-noise level ....65db below ±75kc swing unweighted

Am carrier-noise level ....50db below 100% amplitude modulation, unweighted

RF load characteristics ....To couple to coaxial transmission line of 51.5 ohms surge impedance, standing wave ratio not over 1.75 to 1

Modulation capability ....±100 kc carrier swing, 50 to 15,000 cycles with less than 3% RMS distortion

AF input level ....10 dbm ±2db required for 100% modulation at 400 cycles; input impedance 600/150 ohms, balanced or unbalanced

AF response ....Within ±1 db of FCC pre-emphasis standard from 50 to 15000 cycles

AF harmonic distortion ....Less than 1.5% RMS for any single modulating frequency from 50 to 15000 cycles and less than 1% RMS from 100 to 7500 cycles at carrier swing up to 75 kc

Power supply ....115/230 volt, 50/60 cycle, single phase

Power input .....Approximately 180 watts at 90% power factor, plus 7 watts for crystal heater

Optical Design of Philco Television Projection Receiver

By WILLIAM F. BRADLEY
and ERNEST TRAUB*

Details of lens and mirrors in folded Schmidt arrangement giving excellent detail, brilliance and contrast with new type specular screen

• During the Federal Communications Commission's recent hearings on color television, a new type of projection receiver for black-and-white was demonstrated at Princeton and the level of performance received wide acclaim. This article supplements the preliminary details previously reported in the March issue of Tele-Tech, concerning the design and construction of this receiver and stresses its optical system because of its many novel features.

The receiver produces a 15 in. by 20 in. picture, with outstanding overall brightness resulting from the use of a high-intensity cathode ray projection tube, a modified wide-aperture Schmidt optical system, and an entirely new type of directional, light-diffusing viewing screen.† The 4 in. Philco projection tube, operating at about 20 kv includes a screen coated with an especially developed phosphor which provides a truly black-and-white picture. The color is substantially independent of beam current under practical operating conditions. Aluminum backing may be used. The beam current (about 80 microamps average) reaches about 600 microamps in the highlights and requires a swing of some 80 volts on the grid.

The modified Schmidt system used, consists of a spherical mirror with a reflective coating on the front face, and a weak aspherical correcting lens located at the center of the curvature of the mirror, Fig. 1. (A spherical mirror with an aperture located at the center of curvature of the mirror suffers only from two aberrations; spherical aberration which is uniform all over the field; and curvature of the field).

The correcting lens takes care of spherical aberration of the mirror without introducing any serious aberrations in itself. By locating it in the plane of the aperture at the center of curvature, the symmetry property of the mirror is least disturbed, and the lens can be made very weak.

The spherical aberration of the mirror may be analyzed in zones, each zone having a different focal length. Each zone of the correcting lens thus has a different focal length that just compensates for the various focal lengths of the mirror. In other words, as in Fig. 2, the shape of the correcting plate must be such that all rays (such as 1, 2, 3) emanating from an object point (Q) and reflected by the mirror, shall meet at the image point (I) located at a distance (S) from the correcting plate. In the absence of the correcting lens, these rays would intersect the axis at distances Q1, Q2 and Q3 from

Both direct view and projection television systems have always had a common difficulty which detracts from both the brightness and contrast. The highlighted parts of the picture appear by virtue of the fluorescent screen being bombarded by the electron beam. The black areas of the picture result from the same screen without the bombardment. In both cases the screen appears white if any ambient light falls upon it.

In direct view systems, light from windows and lamps is reflected back to the eye as bright highlights, and because of the curved face of the tube one cannot avoid getting these reflections by changing one's viewing position. In addition the general illumination in the room shows up the screen in its true whiteness the same as any other white area. In spite of this, one attempts to get the deep blacks of the picture by providing even brighter fluorescent spots—by greatly increased anode potentials. On projection screens the direct reflections from windows and room lights are less annoying but the general illumination of the exposed screen is still troublesome.

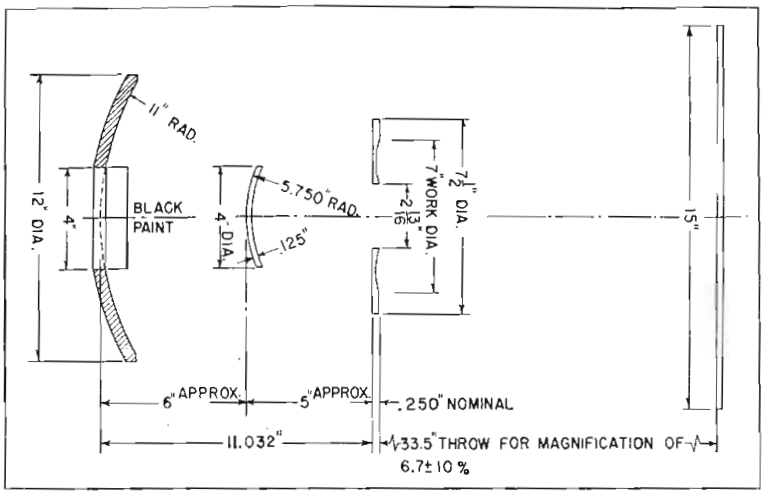
The earliest and still-effective cure-all for this condition is to view television in complete darkness. Another method which may be used would be to box in the viewing screen to block off most of the general illumination. This restricts the viewing angle in proportion to its effectiveness in darkening the screen from the ambient light. And the method incidentally makes the cabinet a monstrosity.

In the Philco design another solution is shown that provides a folded Schmidt projection system with convenient cabinet dimensions. It has a screen so positioned that it reflects into the eye only such light as is found in the interior of the darkened cabinet. This arrangement, together with the directivity factor of a viewing screen designed to cover a carefully chosen viewing angle provides a remarkable gain in brilliance and contrast in normally lighted rooms.

(Editors)

*Director of research and project engineer respectively, Research Division, Philco Corp., Philadelphia.

†The analysis of wide aperture optics in this section is similar to the excellent presentation of the subject by D. W. Epstein and I. G. Maloff in "Projection Television" in the Journal of the Society of Motion Pictures Engineers, June, 1945.



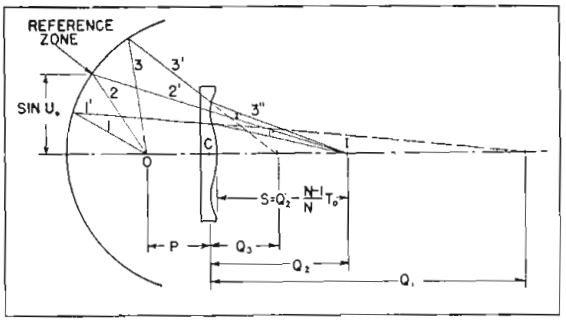


Fig. 1—Fundamental design of "folded" Schmidt optical system as developed for Philco receivers

Fig. 2—Correction of spherical aberration in a lens to cause all rays reflected by mirror to meet at image point

the center of curvature. The slopes on the correcting lens have to be such that all three rays intersect at I, i.e., the correcting lens has a flat at the point where ray 2 passes, negative slope where ray 1 passes, and positive slope where ray 3 passes.

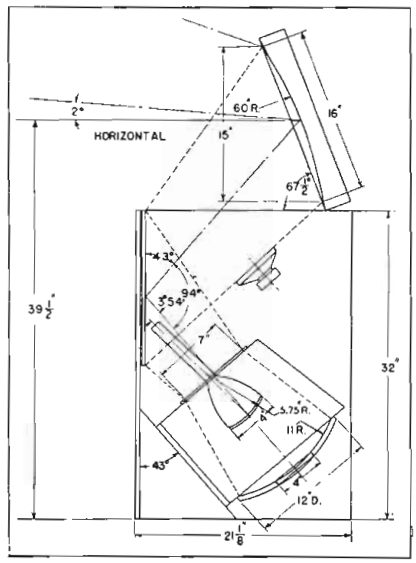
A mirror with an aperture at the center of curvature has no extra axial or chromatic aberrations. The aberrations which remain are caused by the correcting lens itself. This lens can be developed in several ways. If the paraxial (central) focal length of the mirror is chosen as that of the system, then the central focal length of the correcting lens is infinite and the shape of the curve is concave. Alternately, if a zonal focal length of the mirror is chosen as that of the system, there will be a zonal focal length of the correcting lens which is infinite and the shape of the curve is convex at the center and concave outside this zone. If the peripheral zone focal length is chosen, the required correcting lens is convex.

The shape and size of the correcting lens depend upon the throw or magnification for which the system is to be used. For a given focal length and relative aperture, the correcting lens aperture decreases as the magnification decreases.

In order to obtain the image field required to focus on a non-spherical viewing screen, it is necessary that the object field or tube face be curved. Calculations show that, in general, the shape of the tube face depends on the throw—a sphere for infinite throw and an ellipsoid for finite throw. The eccentricity of the latter is sufficiently small, however, so that even for finite throw the tube face may be made spherical with a radius of curvature equal to about 0.53 times the radius of the spherical mirror. The critical dimensions of the optical system in the new Philco receiver, designed for a 33.5 in. throw from correction plate to screen, are shown in Fig. 3. By adjusting the object distance, this distance may be varied about ±10% with resulting variation in magnification. However, variations of throw beyond this tolerance would lead to serious deterioration in image quality.

The projection efficiency is the *fraction* of total light flux emitted in a forward direction by an axial element of a non-directional source (such as the luminescent screen of a cathode ray tube) that the optical system accepts and focuses on the corresponding image element. It is assumed that the mirror reflects 100% and the lenses transmit 100%. This efficiency e is given by $e = \sin^2 u$, where u is the semi-apex angle, as shown in Fig. 4. Hence, it is merely necessary to know the angle that the lens (or entrance pupil) subtends at the source. As can be seen from the curves in Fig. 4, the farther a given lens is from a source, i.e., the less the magnification, the lower its efficiency. This fact is important in the case of home projection where magnifications as low as 5 may be used.

Fig. 3—Side sectional view of Philco system showing arrangement and essential dimensions



It is customary to rate a lens by its f/number for infinite magnification, i.e., with the object located at the focal point of the lens. This is defined as f/number = ½ sin μ = $1/e^{\infty}$ where e^{∞} is the efficiency for infinite magnification. Since the reflective optical systems under consideration are designed for a specific magnification, and since the central part of the reflective system is masked to maintain contrast (this part being blocked by the cathode ray tube), it seems preferable to rate such systems by efficiencies, rather than by an f/number which involves the focal length. The comparative efficiency e^{∞} of a lens as a function of f/number, can be determined from Fig. 4.

In these systems, the efficiency with no masking is about 40%, and the "efficiency" of the central part of the system that is masked is approximately 10%, so the efficiency of the system with masking will be about 30%. Hence, neglecting losses in the system,

about 30% of the light emitted by an axial point will be focused into an image point. This corresponds to the efficiency of an f/0.8 lens with a magnification of 6.7.

The general requirement for a viewing screen is that it give pictures of substantially uniform brightness visible over a large part of a room. Furthermore, it should be smooth in texture, in order to produce good resolution, and should render good contrast and pleasing color.

The simplest screen, a sheet of paper or linen such as are sometimes used with movie projections is unsatisfactory for television since it does not deliver nearly enough light to the audience. It is called a "perfect diffuser" as it gives uniform re-diffusion visible all over the viewing room (or throughout a hemisphere whose center may be considered as coinciding with the center of the screen). The brightness characteristic of the screen is shown in the Rousseau diagram, Fig. 5. A screen of this type is assumed to have a "gain" of unity, producing an apparent brightness of one foot-lambert for an incident illumination of one foot-candle.

A major problem in the development of a television projection system is how to increase the apparent brightness (in foot-lamberts) without increasing the incident illumination (in foot-candles). A screen having a gain greater than unity can be achieved by directing the incident illumination falling upon it into a concentrated sector of the hemisphere. Then comparing this reduced area to the original hemisphere determines the "gain" in brightness of the screen. The "gain" varies inversely with the reduction in area, as shown by comparing Fig. 5 with Fig. 6. It is apparent from these diagrams that an ideally directional screen should have perfectly sharp cut-offs. In other words, the picture should be quite invisible outside the predetermined viewing sector, roughly a sector with a 20° vertical angle and 60° horizontal angle. This is shown in Fig. 7.

Choice of this sector for viewing television receivers of the projection type in the home was guided by information available on an

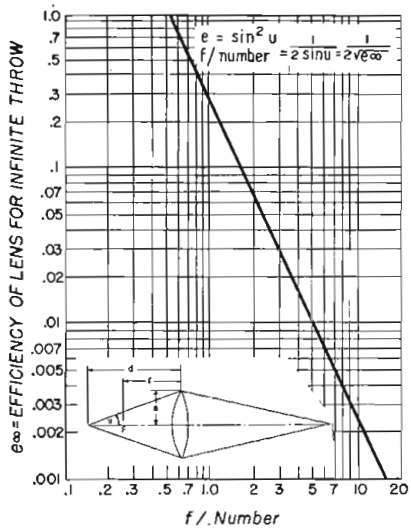


Fig. 4—Curve showing the efficiency of a lens of various apertures for infinite throw

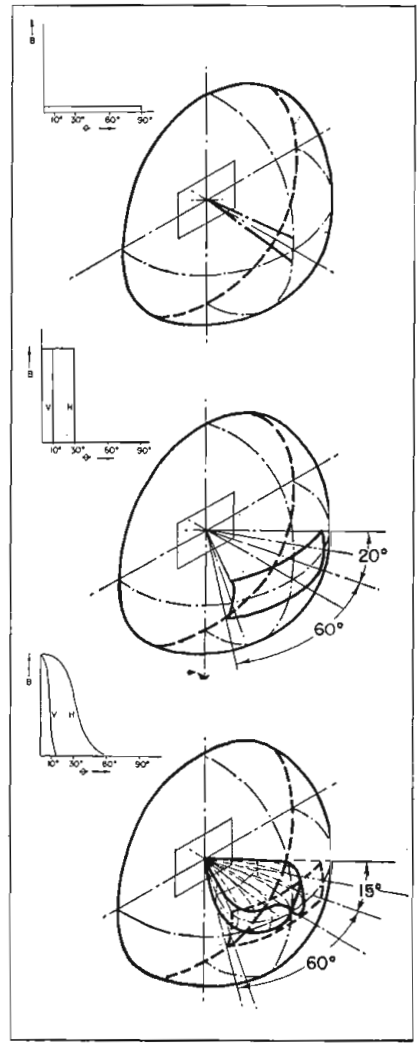


Fig. 5—Reflection from perfect diffuser screen

Fig. 6—Reflection from ideal directional screen

Fig. 7—Reflection from Philco directional screen; V, indicates vertical, H, horizontal reflection

allied subject* supplemented by Philco laboratory tests concerning optimum height of the viewing screen above the floor. A screen designed for a 20° by 60° sector will have a brightness gain of more than 9; a screen designed for a 15° by 48° sector will have a gain of 15.

A second advantage to be gained from the use of a rotationally asymmetrical screen, is a great reduction in susceptibility to any stray light from sources lying outside the viewing sector. This enormously improves the contrast of the image when there is random illumination present in the viewing room. This further improves the apparent "gain" of the screen when it is used under average livingroom conditions with stray light.

In view of the complexity of ideal directional screens of the type referred to, a special type of screen was developed which, although inexpensive and extremely simple, gives a close approximation to the results obtainable with an ideal screen, both as regards gain and freedom from susceptibility to stray light. Its characteristics are shown in Fig. 7. The screen itself is a reflecting sheet containing a large number of vertical grooves, random shaped and spaced with cross-sections which are in effect minor arcs of circles. These vertical grooves introduce broad but controlled horizontal light distribution over a sector subtending an angle about 60°.

The screen surface is cylindrically concave with respect to the viewer, the axis of the cylinder being horizontal and at right angles to the grooves. The radius of curvature is determined as twice the product of the projection throw and the viewing distance, divided by the sum of these distances. A screen of this kind is particularly adapted for use with large aperture optical systems.

In any Schmidt system, there are regions in the viewing space at which the screen appears to be under-illuminated, as will be evident from Fig. 10. Here the spherical mirror M reflects the light from the picture on the curved face F

*Based on the research of Professor Hooten of Harvard carried out in conjunction with Army Air Forces, Wright Field.

of the cathode ray tube T, through the correcting plate C, past the magnetic deflecting and focus coils D, to plane mirror P. Mirror P reflects the light onto screen S. The center of cylindrical screen S is perpendicular to line L. The axis of the projected light is designated as X. This projected light is reflected from screen S, making equal angles on both sides of the perpendicular line L. The ultimate direction of the axis X is slightly above the horizontal, as shown by its relation to the floor H.

The surface C_1C_2, at a distance from the screen S, is the region into which all the light traversing the correcting plate C is projected by the shiny surface of screen S, while region D_1 is the region in which the presence of the tube and deflecting coils D reduce the light from the tube face F. The visible rays from the picture on the screen S are directed into the upper and lower regions C_1 and C_2, rather than into the central region D_1. The result is that the same picture is seen at all points in the viewing area, but is brighter when viewed from regions C_1 and C_2 (above and below the screen's viewing axis) than it is when viewed from the central region D_1.

Each elemental area of the picture is lacking in rays directed toward a particular central zone (D_1) of the viewing area, because of the masked-out portion of the correction plate since a reduced

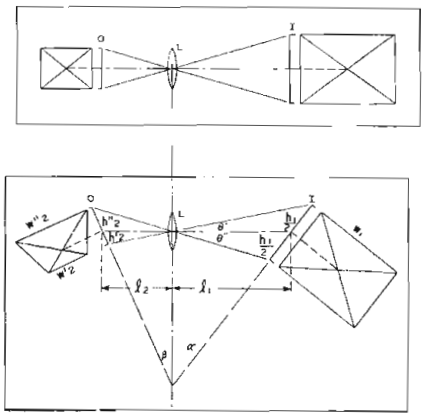


Fig. 8—Principle of rectangular image projection. Fig. 9—Geometry of Keystone projection

amount of light reaches this zone and constitutes an area from which the picture cannot be seen satisfactorily. However, in other than this central "dim" zone the picture will be seen normally. Obviously, this under-illuminated zone would constitute a defect.

Heretofore, the usable cooperative relation of this system—between the screen and the centrally vignetted light source—was not recognized. As a result, those who have worked in the field have felt that it was necessary to dissipate so large a portion of the available light in areas not useful for viewing purposes that the image could only be viewed in a darkened room.

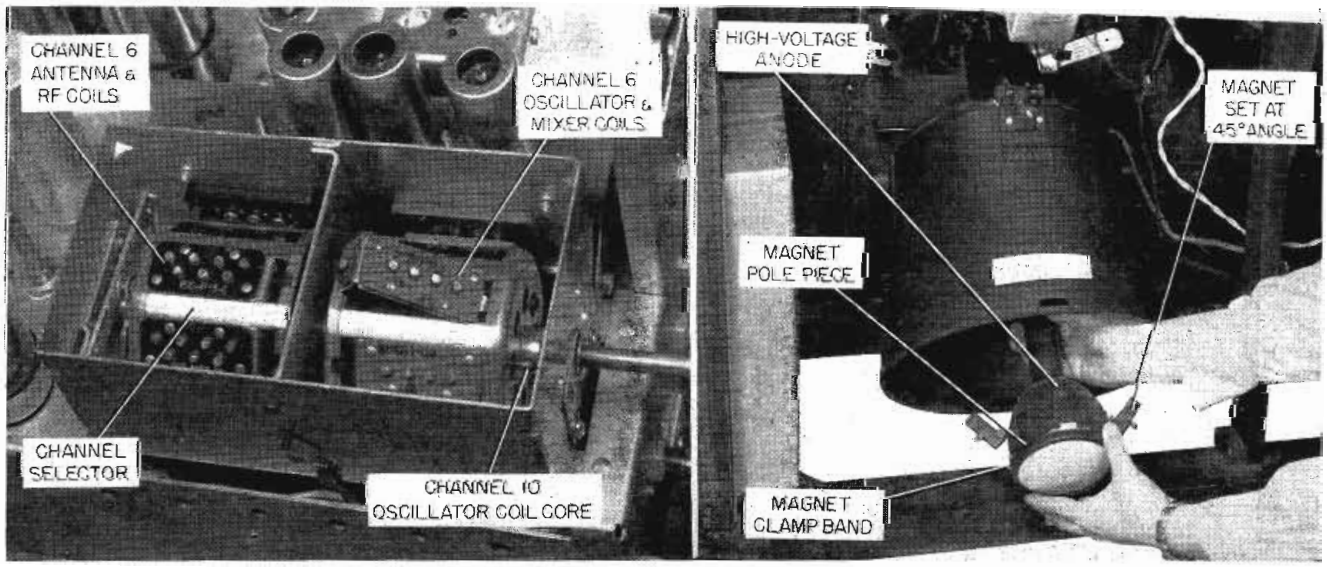
It should be understood that, if the viewing screen had directional characteristics of equal optical power in both coordinate directions, the dark zone appearing in the viewing area would be circular. With a spherical non-diffusing viewing screen this region would be absolutely dark. In the Philco system with its optical power in the vertical direction only (the minute vertical grooves provide horizontal distribution) the under-illuminated zone is not completely dark but is elongated horizontally throughout the width of the viewing area.

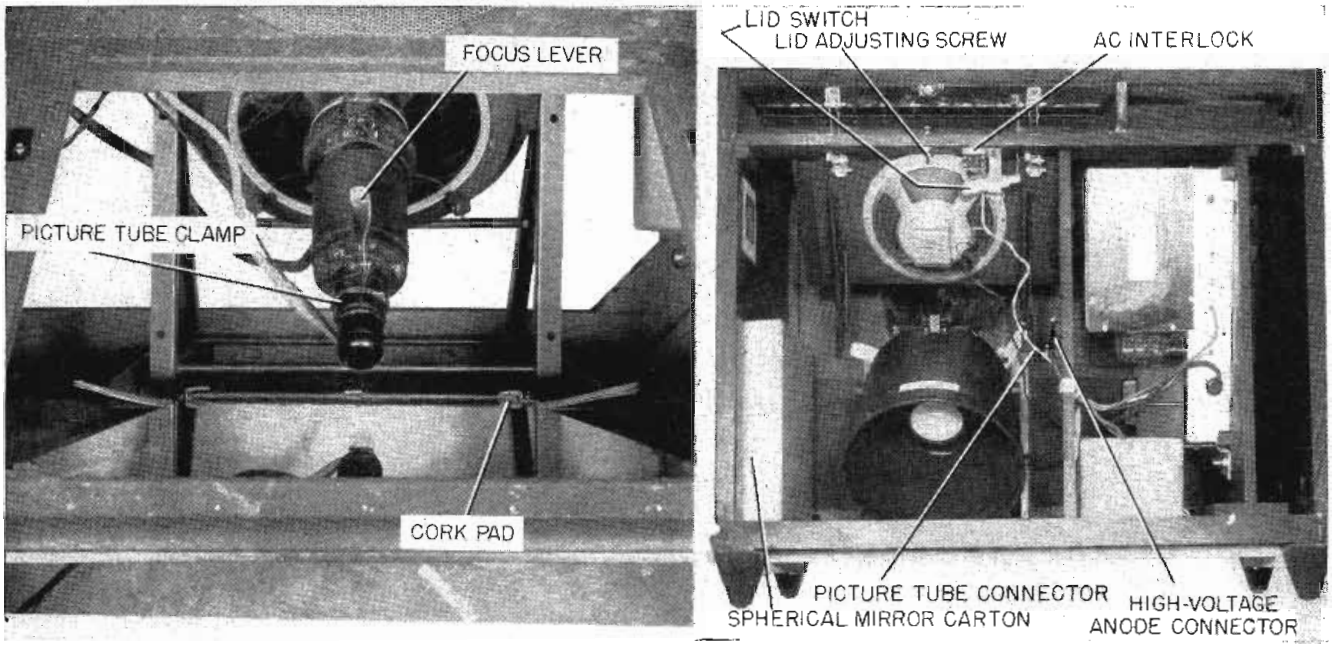
The new screen, in addition to its directional characteristics (concavity and vertical grooving), is provided with a great many minute or lenticular elements, each of which redistributes or diffuses the light focused on it throughout a narrow predetermined angle. This angle is just sufficient to cause some of the light from each elemental portion of the screen image to "spread out" and hence reach that central region of the viewing area which would otherwise be under-illuminated due to central vignetting.

The controlled diffusion thus applied is so much smaller in degree than that provided by the vertical grooves used for horizontal light distribution that the effect of the lenticular elements is unappreciable in the horizontal direction. The lenticular diffusion elements are conveniently provided by spraying the screen with a selected refractive lacquer.

The overall brightness of an experimental receiver using this

Close-up of Philco precision channel selector which provides for any eight channels of the 13 assigned by FCC. Right—Manner of inserting the 20kv (4-in.) picture tube in the receiver





Two views of the optical system in the Philco projection television receiver, the view at the right showing the inside of the cabinet after back cover has been removed

screen design was measured with 20 kv applied to the picture tube and found to be about 50 foot-lamberts. Similar measurements indicated that the brightness of the primary image on the cathode ray tube is about 20 times as great as the image on the screen, that is, in the order of 1000 foot-lamberts. When aluminum backed projection tubes are used, having a primary brightness of 2000 foot lamberts and over, the screen brightness is 100 foot-lamberts or more.

The cabinet is adapted to house the electrical apparatus and the optical system. The total overall length from the concave mirror to the screen dictates a folded optical system. A front projection screen furthermore required that the light hit this screen from below the horizon. The screen itself must be tilted slightly forward in order to direct the light reflected from the screen across the room approximately horizontally.

The layout and cabinet of the receiver are shown in Fig. 3. The screen is attached to the inside of the lid, which is hinged along the rear of the cabinet. When the receiver is not in use, the lid is normally closed.

The slight perspective distortion in the form of vertical compression resulting from the forward tilted screen (about 22°) is compensated for by a small increase in the physical height of the raster. As shown in Fig. 3 the physical height of the screen is actually 16 in. whereas, it appears to be only 15 in. high when tilted.

The correct choice of tilt angle of the screen and the position of the Schmidt unit within the cabinet and the folding of the optical system in general use were matters of considerable complexity for designers, because there are so many considerations that have to be fulfilled simultaneously and so many interactions between these considerations. For example, the optical system should, if possible, not project outside the rear line of the cabinet. This line may be defined as a perpendicular dropped from the back edge of the lid. Also, the neck of the tube must be a reasonable distance away from the plane

(*Continued on page* 102)

Close-up of picture tube mount

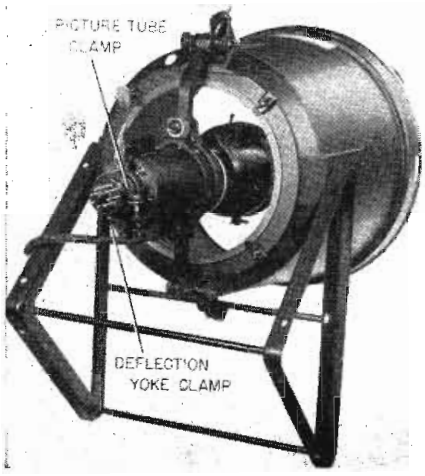
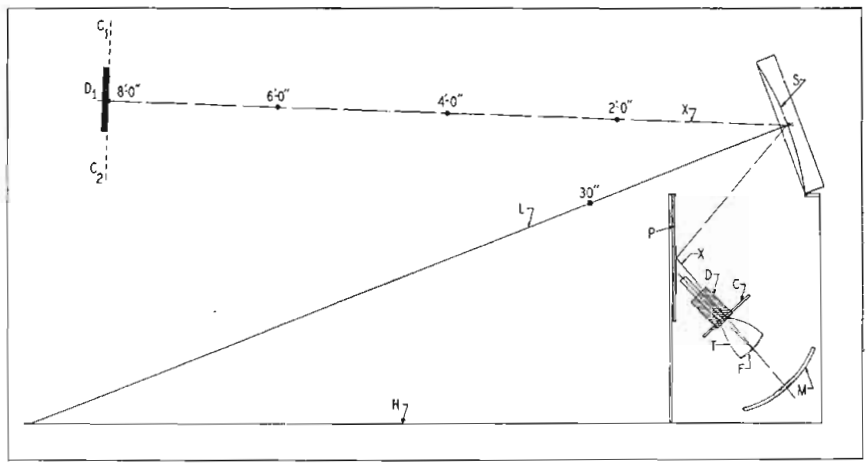
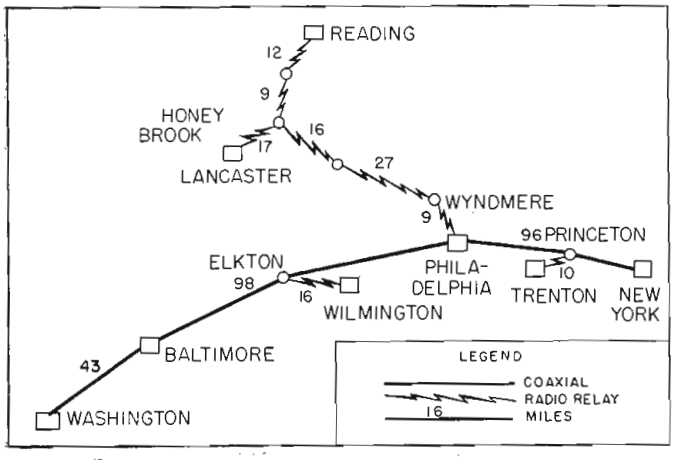
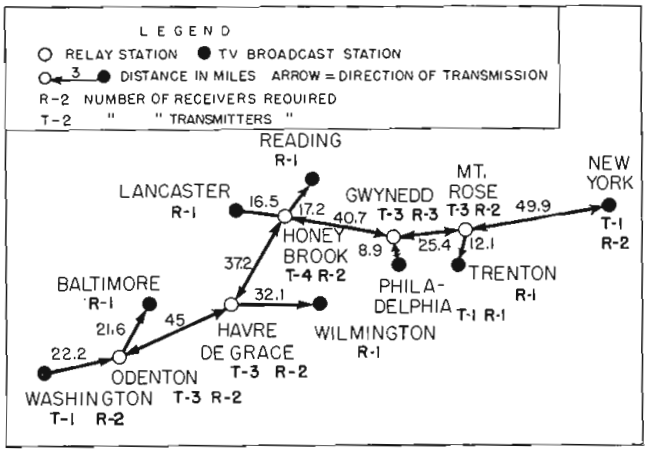


Fig. 10—Diagrammatic illustration of principles around which the Philco TV projection receiver is built







Routes proposed for television network relay service by AT&T (left) and DuMont (right) cover essentially the same cities

Comparative TV Network Costs

A T & T APPROXIMATE CHARGES

1. Assume transmission in both directions at New York, Philadelphia, Baltimore and Washington; receiving only at Trenton, Wilmington, Reading and Lancaster—8 consecutive hours daily.

4 Transmitting station connections @$750.			$3,000.
8 Receiving station connections @$750.			6,000.
N.Y.-Phila.-Balt.-Wash.	237 miles @$ 40.	$9,480.	
Wash.-Balt.-Phila.-N.Y.	237 miles @$ 40.	9,480.	
Princeton-Trenton	10 miles @$ 40.	400.	
Elkton-Wilmington	16 miles @$ 40.	640.	
Phila.-Honey Brook (junction point)	25 miles @$ 40.	2,080.	
Honey Brook-Lancaster	17 miles @$ 40.	680.	
Honey Brook-Reading	21 miles @$ 40.	840.	
Total Mileage			23,600.
Total Monthly Charge			$32,600.
Average Cost per station per hour—4 hrs. per day			34.
—8 hrs. per day			17.

2. Assume transmission in both directions for all stations—8 consecutive hours daily.

8 Transmitting station connections @$750.		$6,000.
8 Receiving station connections @$750.		6,000.
706 miles (353 in each direction) @$ 40.		28,240.
Total Monthly Charge		$40,240.
Average cost per station per hour—4 hrs. per day		$41.80
—8 hrs. per day		20.90

3. Assume transmission one direction only—8 consecutive hours daily.

8 station connections @$750.		$6,000.
353 miles @$ 40.		14,120.
Total Monthly Charge		$20,120.
Average cost per station per hour—4 hrs. per day		$20.90
—8 hrs. per day		10.45

DU MONT COST DATA

A. Capital Investment:

Item	Qty.	Unit Price	Total	Monthly
Main Transmitters	19	$ 4,000	$76,000	
Spare Transmitters	8	4,000	32,000	
Main Receiver	19	1,000	19,000	
Spare Receivers	7	1,000	7,000	
Relay Point Towers	5	10,000	50,000	
Relay Point Plot	5	5,000	25,000	
Power & Emergency Generators	5	2,500	12,500	
Miscellaneous			5,000	
Total			$226,500	
Monthly average on 10-year amortization				$ 1,887

B. Operating Cost:

Item	Cost per Month	
Property Maintenance		
Labor	$ 300	
Material	100	
Equipment Operation & Maintenance		
Labor	1,000	
Material	200	
Power	1,500	
Total	3,100	$ 3,100
Monthly cost to all 8 stations		$ 4,987
Average cost per hour (28 hrs./wk.) (121 hrs./mo.)		$41.20
Cost per station per hour (Du Mont Network)		$ 5.15
Pool facilities for 5 networks covering same general area		
Cost per station per hour		$ 2.00

That television network operation eventually will be evolved there can be no question; but there is as yet a big unanswered question regarding the method of evolution.

Major TV broadcasters have indicated a preference for common carrier service but have been quite frank in their criticism of suggested rates which are viewed as being much too high for a growing infant to assimilate.

AT&T tolls posted recently, to become effective August 1 for the New York-Washington coaxial cable (and for comparable radio relay service) have been withdrawn though the cable is still in use by broadcasters temporarily.

Meantime Dr. T. T. Goldsmith of the Allen B. DuMont Laboratories has transmitted to FCC for inclusion in records of the TV relay hearing held in June, plans for a proposed radio relay together with cost data thereon. At Dr. Goldsmith's suggestion AT&T has also compiled approximate charges for a similar service and these also have been placed before FCC. The figures and routes are appended.

Engineering Problems Involved in TV Interference

By ALBERT FRANCIS

FCC and industry engineers study diathermy, amateur and receiver emanations, tropospheric propagation and allocations — Increased spectrum space suggested

• The conference on frequency allocations in the 42-88 mc band held in Washington in June by FCC engineers and industry representatives was helpful to both groups. Television interference problems were examined and it was evident that services using these frequencies need more channels. There was a feeling of hopefulness that these needs might be met. True, this hopefulness was based on the possible shifting of frequency assignments now made to U. S. government agencies. In the past these have been considered sacred. Government frequencies are allocated, not by the FCC, but by the Interdepartmental Radio Advisory Committee (IRAC), composed of representatives of about 17 government agencies, reporting to the president of the U. S., but more about this later.

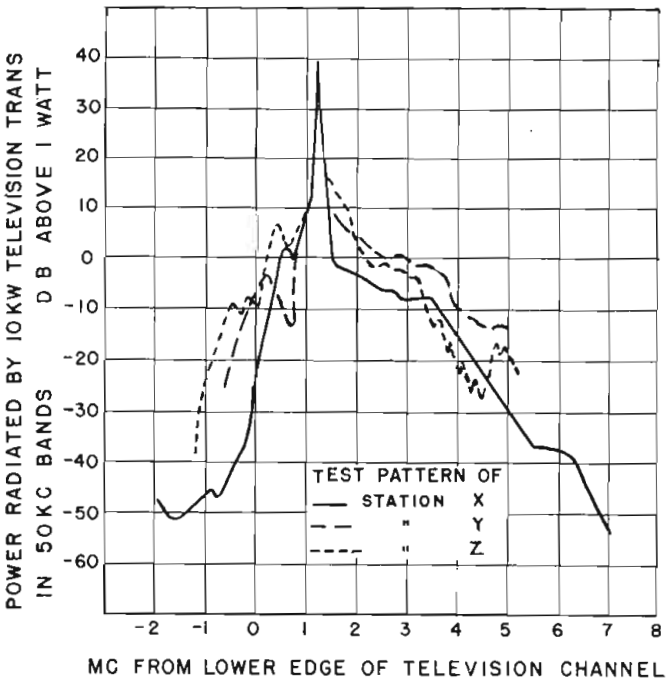
The more important problems discussed were: TV channel sharing; interference to TV from amateurs, diathermy and other sources; tropospheric propagation; radiating television receivers and problems of allocation.

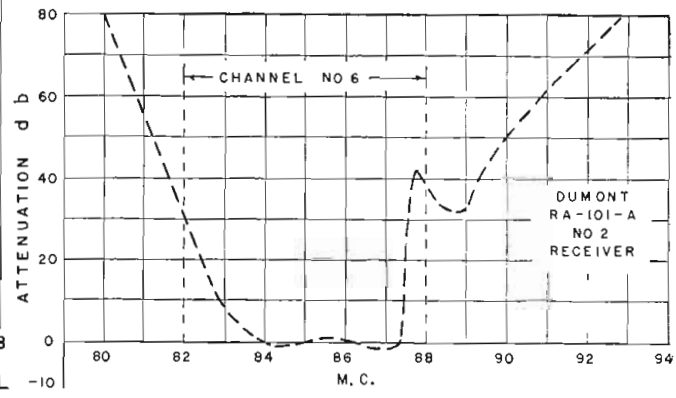
George E. Sterling, chief engineer of FCC, was an efficient chairman who, in this informal discussion, encouraged frank statements, "gripes" and worthwhile suggestions but discouraged "claim-staking" attempts in the higher frequency bands. Some of the FCC engineers who took part in the meeting were Plummer, Cowperthwait, Renton, Chapin, Jenson, Wofford, West, Nielsen and Price.

Television Channel Sharing

Events leading up to the Radio Technical Planning Board (RTPB) recommendation that fixed and mobile services share channels with television are related in an article on shared channels in TELE-TECH for February 1947 (p. 77). As indicated there, the FCC engineering department has been investigating, theoretically and by field measurements, the interference resulting from the sharing of adjacent TV channels by low-power services such as police, forestry, taxi dispatching, busses and railroads. The FCC and industry representatives brought to the conference evidence that leads to the decision that channel sharing is not practical because of interference. There was no dissenting opinion.

In view of this situation the evidence offered will be touched on only briefly to indicate its engineering trend. At the start of the





Left — Bell Telephone Lab. plot of approximate power-frequency distribution of three transmitters. Right — Acceptance-frequency curve showing selectivity of 1946 DuMont television receiver

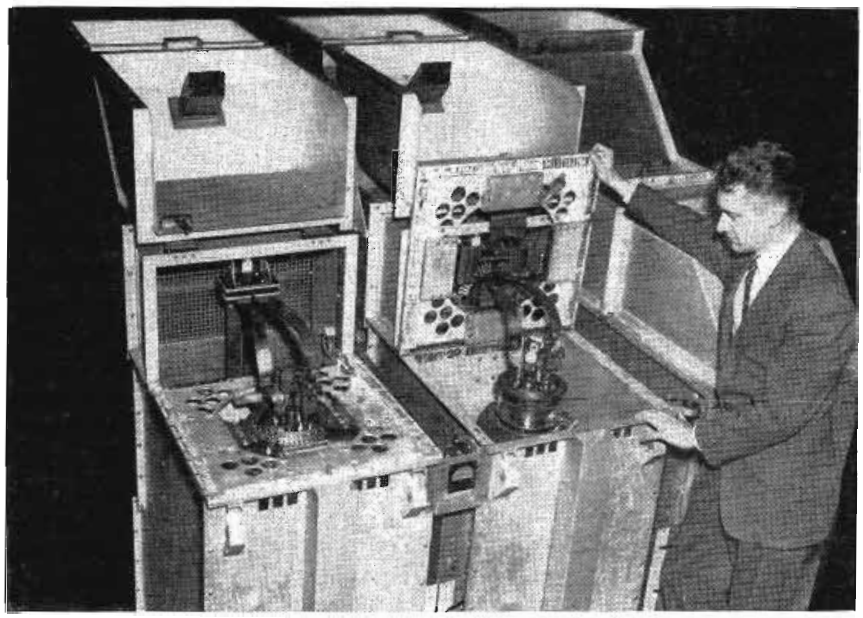
conference FCC engineers reported that, using a post-war TV receiver at Laurel, Md. tuned to a transmitter on channel 5 (76-82 mc) about 22 miles away they received fair pictures, (antenna height 58 ft. 100 microvolt signal). An automobile equipped with a 20-w. transmitter, unmodulated, radiating vertically-polarized waves on 75.5 mc was driven along a road extending away from the receiver to a distance of several miles. A 16-mm motion picture camera recorded the resulting interference which was superimposed on the received picture of the resolution chart. The presentation clearly showed the degree of disruption suffered by the picture which alternately turned from positive to negative, lost synchronism and was generally "hashed", even when the car was 0.4 miles away.

In a test in New York city a 50-watt FM transmitter was driven up and down 7th and 8th avenues. In homes where relatively weak TV signals were being received interference was observed when the mobile signal was 6 times stronger than the desired signal. Ordinarily if the car was more than 500 feet away there was no trouble.

Mobile Interference

What effect did TV transmission have on mobile FM reception? Before distortion of the received speech resulting from such interference was noticed the television signal had to be twice as strong as the FM signal; at the edge of the channel 100 times as strong and at the position in the channel where the TV sound is located, 10 times as strong.

Polarization effects obtained by receiving vertically-polarized radiation from mobile antennas on horizontally-placed TV antennas were tested because several suggestions of interference suppression based on this idea had been offered. The conclusion drawn from actual measurements was that an antenna for horizontally-polarized waves would receive from 0.2 to 0.5 of the signal from a vertically-polarized transmitter that would be obtained from a vertically-placed antenna. This reduction of the unwanted signal was not deemed sufficient to be of interest.



Unique construction is used in RCA's new 50 kw transmitter which has grounded grid tank circuits built around a newly developed type 5592 air-cooled high-power, high frequency tube, same type being used in both driver and amplifier circuits. Tubes are operated in metal-enclosed concentric tank assemblies which form an integral part of transmitter. Frequency range is 88-108 mc

Others offering testimony on channel-sharing were engineers from: the Bell System, who concluded from calculations that sharing was not possible, except probably under extremely favorable conditions when mobile services might share 1.5 mc of a TV channel; DuMont Labs., who referred to an article "Television Interference —Engineering Problem" by Dr. Goldsmith in the July and August 1946 issues of ELECTRONIC INDUSTRIES, and recommend no channel sharing; Motorola, who reported TV reception tests on Ch. 4, at 16 miles from the Chicago transmitter, during which mobile FM transmission on a frequency 340 kc. below the TV frequency produced bad interference at a distance of 4 blocks, and said sharing was not feasible; Panel 13, Com. 4 of RTPB, Public Utilities, recommended that sharing should not take place in areas where TV broadcasting is carried on; Philco, TBA and others recommended no channel sharing.

FCC measurements indicate operation in the amateur band 50-54 mc can produce interference in the adjacent television channels: in fact a powerful amateur station on 27.32 mc caused interference on all television channels in a nearby receiver. A sound recording made by FCC (at Laurel, it is believed) was reproduced at the conference to show in a striking manner a sample of amateur interference on Ch.1. First we heard the usual receiver background noise, distant static, etc. then two amateur phone stations, one of them, located in Miami, came in very loud. A typical case reported by the FCC Field Engineering group showing the effect of second harmonic radiation from amateur transmitters in the 28 mc band indicates that trouble can be expected on Ch. 2 up to 1 mile from a 750-watt transmitter with a harmonic suppression of 42 db.

Amateurs' Harmonics

On behalf of the A.R.R.L., R. M. Morris, a well-known radio engineer and an amateur operator, made a comprehensive and helpful report. His harmonic measurements agreed with those above. For the third harmonic he found no interference detectable at 0.25 miles. Working with members of the Central Jersey Radio Club to stop amateur interference with TV reception, he first gathered reports, some of which erronously accused

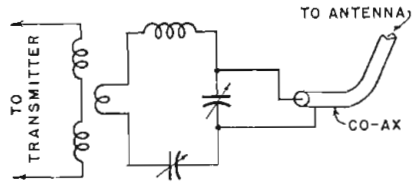
the "hams"; next, with field measuring equipment, studies of actual cases were made.

Second harmonics of 28 mc transmitters naturally caused trouble mostly with Ch.2. After experiments on several transmitters Morris recommends the following steps to reduce interference to TV reception: install power line filters or by-passes to block rf voltages; use a capacity-type harmonic suppressor, as shown at right, between the transmitter and coax feeding the antenna; add stubs to the antenna which effectively short-circuit second harmonic energy; shield the transmitter so that it will not radiate. The gratifying result will be harmonic suppression of 45 to 55 db.

In one case TV reception could be carried on with the antenna only 3 feet from the transmitting antenna. In another case Ch. 4 and 5 were free of interference on a receiver located 150 ft. from the transmitter; however it is impractical to try to eliminate on Ch.2 the second harmonic interference from a 28 mc. transmitter if the receiver is nearby. At the TV receiver, a trap, consisting of inductor shunted by a variable capacitor, tuned to the interference can be placed across the input terminals but this usually causes annoying transients in the picture. The use of directional receiving antennas, rotated for minimum interference, is helpful.

Diathermy Interference

Those having wide experience with TV customer complaints agree that diathermy is "Enemy No. 1". Actually there are more kilowatts of energy used for diathermy than for television broadcasting. The FCC has taken praiseworthy steps to limit industrial heating and diathermy interference with radio reception; for instance, frequency bands for operation have been assigned, the FCC Lab. is giving type-approval on equipment submitted by manufacturers; interference fields not exceeding 25 microvolts per meter at 1000 feet, (10 microvolts per meter at 1 mile for industrial heating), have been specified. Incidentally, to show the manufacturers what can be done the FCC Lab. has built a diathermy machine in which the second harmonic radiation, so troublesome to TV, has been reduced to 5 microvolts per meter. As the rapidly-growing numbers of television set owners increases in the vicinity of a doctor's office and owners become familiar with and are able to identify characteristic interference patterns on their picture screens produced by diathermy it is probable that the doctor, conscious of public opinion, will not give diathermy treatments during television hours.



Suggested type of harmonic suppressor to eliminate amateur's interference from TV

General Interference

F. J. Bingley of Philco, who also spoke for Panel 6 RTPB, listed the following interference to TV from other services:

Channel 1—Diathermy, reflections from the E and F_2 layers, adjacent channel interference.

Channel 2—Harmonics of 27 mc transmitters, amateur off-channel operation, FM, interference from Ch. 5 due to insufficient image rejection in some types of TV receivers.

Channel 3—Off-channel diathermy. (Otherwise generally good reception).

Channel 4—Sound from Ch.3, radiation from oscillators in receivers tuned to Ch.2, FM on 92.1 mc.

Channel 5—Osc. radiation from receivers tuned to other channels, diathermy; in Washington interference from Navy transmitters.

Channels 6 to 12—No experience).

Channels 12 and 13—FM harmonics from diathermy and industrial heating.

Non-specific—International BC received directly on IF amplifiers of older receivers.

Dr. G. L. Beers of RCA rated interference complaints noted by TV fieldmen on the basis of the number of times reported, as follows: (The score of 100 units is given to the most frequent complaint).

	UNITS
Diathermy	100
FM Stations (image response)	70
Amateurs (Ch. 2 mostly)	50
Receiver radiation	50
Harmonics of S.W. Stations (6-15 mc)	20
Auto ignition	5
Miscellaneous	5
Marker Beacons, 75 mc, (near airports)	1

Suggested remedies for harmonic interference were: traps, filters, oriented directional receiving antennas. The fact was stressed, and it was hoped that the FCC will take notice, increased transmitter power is needed for better television service.

Another excellent source of general information on disturbances to TV is the supplement to ELECTRONIC INDUSTRIES, July 1946, prepared by Dr. T. T. Goldsmith of DuMont Labs. and used by him as testimony in this conference. This not only shows the various sources but their frequencies and the reasons why they interferc.

Receiver Radiation

Early TV receivers had no rf amplification ahead of the mixer tube so that energy from the heterodyne oscillator could find its way to the antenna where it was radiated. FCC engineers reported that a radiated power of 560 microwatts was measured from a prewar receiver on Ch.1. In a postwar set this was reduced to 0.7 microwatts on Ch.5, but even this may cause trouble to nearby receivers. RCA estimated that their latest receivers were 100 times better than their early models in this respect.

It was stated at the conference that in general there probably was an improvement of 200 times in this feature, and now two receivers could operate from the same antenna without any trouble. Dr. Beers pointed out that the measurements were not taken under operating conditions and therefore data on actual radiated fields should be awaited before forming conclusions on the above rating.

Propagation has an impact on the sharing of channels and for

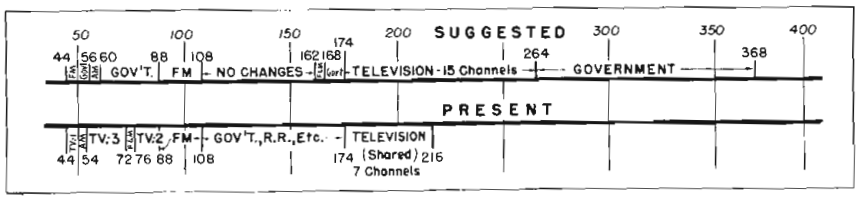
this reason it was discussed by: Allen, FCC Technical Information Service; Romnes, Bell Labs. who reported that 225 cases of long-range interference had been noted in the vicinity of 42 mc; Major Armstrong who reported on long-distance transmission in the FM band and said the phenomenon would reach its peak in September; Brown of Zenith who also reported long-range FM reception, a point confirmed by Ray Guy of NBC; Dr. DuMont, who took an active part in the conference, said there was little difficulty from tropospheric propagation in the TV bands.

Receiver Selectivity

Postwar TV receivers appear no more selective than those used prewar. In fact the RCA sets now have 6 tuned circuits as against 12 in their prewar models. This change was made because of economy it was said. It is well-known that if receivers are too selective the pictures are marred by a leading white transient, (visible as a white outline along the side of the figures in the picture) resulting from excessive phase-shift in the receiver.

DuMont Labs. placed in the record the most complete data on receiver performance of any conferee. The acceptance curve of their RA-101-A model taken in 1946 is reproduced on page 42. A summary of performance of the more recent model RA-103 receiver is in table at the right.

To show how television power is spread within a channel, (and just how much spills over into the adjacent channels), we are showing on page 42 the interesting Power-Frequency Distribution Curve for three transmitters (located in New York City). This was part of the Bell Lab. exhibit. The vestigial sideband method of operation influences the general shape of the curves. The high peak of power observed at 1.25 mc from the lower edge of the channel is due to the synchronizing impulses. All three stations are transmitting the same type of resolution chart so the power in the high frequencies around 4 mc should be about the same if the overall fidelity of the transmitters were similar.



Suggested rearrangement of the FM and Television spectrum, involving some shifts in government and fixed-mobile services, in order to increase the number of TV channels from 13, as at present, to 15

Before considering frequencies we have to know the needs of the services concerned. The television interests, lead by TBA, asked for more channels. The police need channels. Dr. Noble of Motorola and Panel 13, RTPB, was a most energetic spokesman for the mobile groups. Western Union desires frequencies for mobile telegraph pick-up and delivery service. Taxicab dispatching needs more space. Air navigation and communication requires high frequencies too. If the railroads and the utilities can not share channels with TV then they will need other channels. Bus operators, amateurs, diathermy, industrial heating, forestry and others require ether space.

All this sounds like the discussions of 1945 in the RTPB meetings; the difference being that now we have had some real experience in operating under the allocation plan that stemmed from the decisions of two years ago. Although listening tests today show that only a small percent of the channels above 42 mc to be in actual use, plans based on the delivery of ordered equipment indicate definite over-crowding in the future.

Summary of Performance of DuMont RA-103 Receiver

Sensitivity (measured from antenna)

Freq.	Rec. #18	Rec. #21	Rec. #22
52 mc.	61 μv.	48 μv.	100 μv.
84	94	..	72
150	..	60	..
192	86	..	86

Overall Video Attenuation (set tuned to 52 mc.)

Rec.	Associated Sound	Adjacent Video	Adjacent Image	IF
18	38 db.	30 db.	42 db.	56 db.
21	34	34	28	60
22	32	31	36	63

IF Bandpass*

Rec.	Δf mc. (—1 db.)	Δf mc. (—3 db.)	Δf mc. (—6 db.)
18	3.2	3.4	3.9
21	3.3	3.6	4.0
22	3.2	3.6	3.9

Sound Sensitivity at 90 mc.
(Antenna input to give standard audio output with 2 kc. deviation)

Rec.	μv.
18	20μv.
21	12
22	40

Sound IF Rejection (at ±400 kc.)

18	..
21	60
22	50

* The RF will narrow this response on Channel 1.

Allocation Recommendations

Suggestions of where to get the additional frequency space that is needed came from many in the industry. Some of these were: from Zenith—in order to give FM and TV more room move all services to higher frequencies; from TBA—higher power for TV and more frequencies above 108 mc, no change in present assignments; this latter was concurred in by Philco who realistically pointed out that it was now too late to change any of the TV frequencies, but not too late to add more frequencies; from DuMont—move services sharing with TV to space above 216 mc, gradually, during next two years, make more room for TV by securing 10 more channels in the space 108 to 174 mc, except that assigned to amateurs. At this point the taxicab operators said they were investing $16 million in equipment for the 152-162 mc band and the conference learned that CAA was planning to put 440 stations in the region 108-132 mc.

Suggested Re-allocation

FCC's Plummer placed before the conference a suggested reallocation plan for the purpose of stimulating thought and discussion. Underhill, of the Utilities Group, then proposed a scheme that was new to most of the TV men. In this plan he arranged the usual 6 mc TV chanels in order, as they are now, but he overlapped adjacent channels by 4 mc, thus getting more channels into a given space. The difficulty is that there would be a 1 mc beat note in TV pictures due to intercity interference.

Ray Guy, of NBC and TBA, one of the outstanding engineers of the conference, with Dr. Noble and others, asked: Why not use, or at

(*Continued on page* 108)

Superheterodyne Tracking Charts

By Y. P. YU, Associate Professor, Dept. of Electrical Engineering, State College Station, Fargo, N. D.

Values for all unknown circuit parameters that track properly in superheterodynes. Simplified design equations

NEARLY all receivers (both A-M and F-M) are built on the superheterodyne principle. But the superheterodyne tracking solutions given by various authors are still too complicated for engineering design. In order to simplify this design problem, the writer has devised charts for determining the unknown values of inductances and capacitances in permeability-tuned as well as in condenser-tuned systems.

• A conventional permeability-tuned system, shown in Figs. 1A and 1B, is used for discussion in this section. Fig. 1A is the radio frequency circuit, and Fig. 1B is the oscillator circuit. Both tuning coils in these two circuits are identical and are ganged.

The design equations are: for the unknown oscillator series inductance

$$\frac{L_s}{L_v} = \frac{nx - n}{1 - nx} - \frac{L_1}{L_v} \quad \text{.....(1)}$$

for the shunt inductance

$$\frac{L_p}{L_v} = \frac{ny - n}{1 - ny} - \frac{L_s + L_1}{L_v} \quad \text{.....(2)}$$

where $x = 1 + \frac{1}{A}$, $y = 1 + A$

The writer calculated for both L_s/L_v and L_p/L_v by using these two equations with the value of A varied from 1.1 to 4.5 and the value of B varied from 0.01 to 0.5. With the results of these calculations, a chart for L_s/L_v is plotted in Fig. 2 and a chart for L_p/L_v is plotted in Fig. 3. The method for determining L_s and L_p directly by means of these two charts may be made clearer by a numerical example as follows: The upper radio frequency, F_1, is 11.55 mc; the lower radio frequency, F_2, is 4.55 mc; the intermediate frequency, f_1, is 450 kc; the main tuning coil has its minimum inductance, L_1, equal to 4.14 μh and its maximum inductance equal to 26.68 μh. Let it be required to find L_s, L_p, and C_0.

$$A = \frac{f_1}{f_2} = \frac{F_1 + f_1}{F_2 + f_1} = \frac{11.55 + .45}{4.55 + .45} = 2.4$$

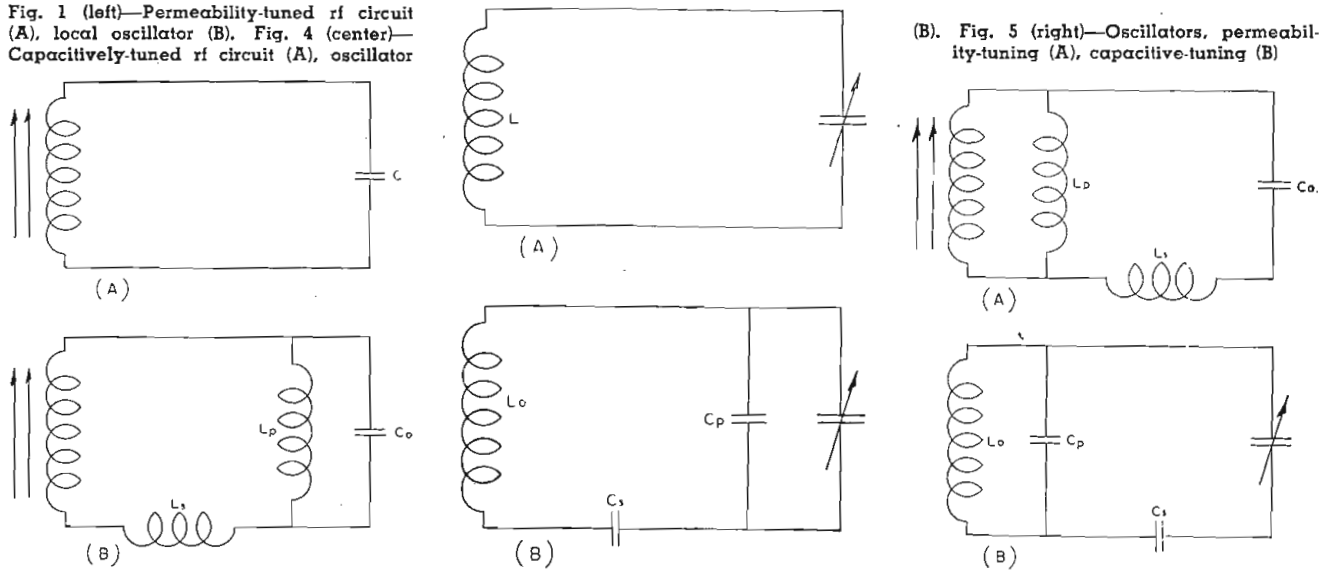
$$B = \frac{f_1}{f_2} = \frac{f_1}{F_2 + f_1} = \frac{.45}{4.55 + .45} = .09$$

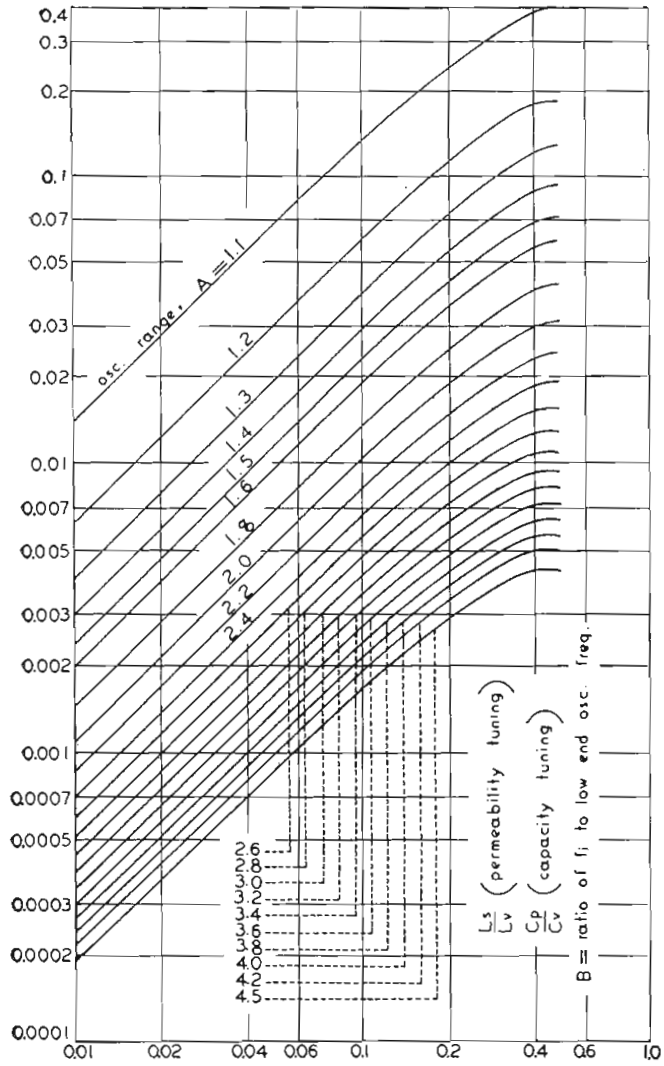
Using Fig. 2, we locate the point for B = 0.09 on the x-axis, then follow the vertical line upward until we reach the line for A = 2.4. And projecting to the left, we find $L_s/L_v = 0.0058$ on the y-axis. Since $L_v = 26.68 - 4.14 = 22.54$ μh, then $L_s = 22.54 \times 0.0058 = 0.13073$ μh. We enter the values of A and B in Fig. 3, by using the above procedure, and obtain $L_p/L_v = 11$, or $L_p = 248$ μh. For C_0, we have

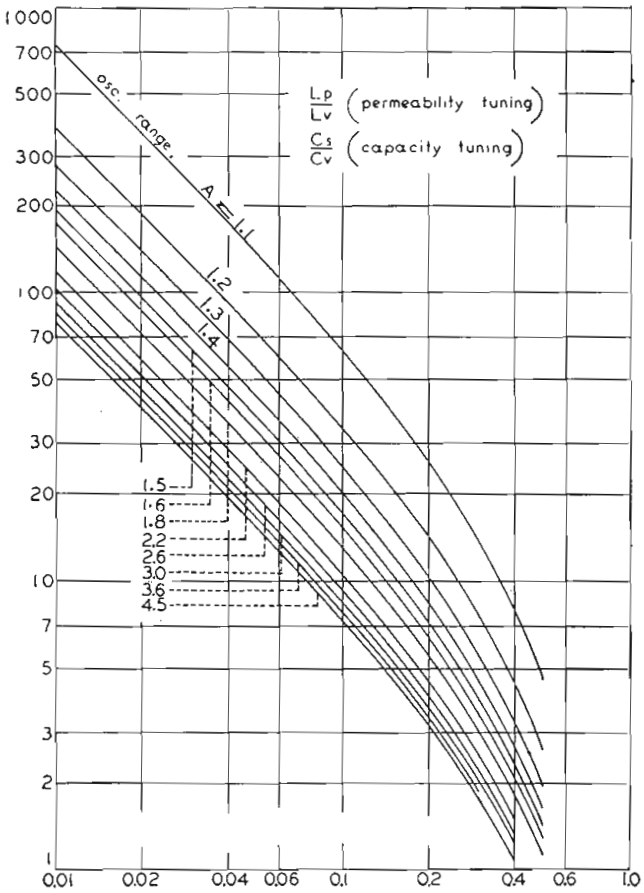
$$C_0 = \frac{1}{4\pi^2 f_1^2}\left(\frac{1}{L_1 + L_s} + \frac{1}{L_p}\right) = 41.88 \text{ uuf.}$$

When it is desired to eliminate both the series coil (L_s) and the shunt coil (L_p) for the purpose of simplicity in manufacturing, the main tuning coil in the oscillator circuit should have its minimum

Fig. 1 (left)—Permeability-tuned rf circuit (A), local oscillator (B). Fig. 4 (center)—Capacitively-tuned rf circuit (A), oscillator (B). Fig. 5 (right)—Oscillators, permeability-tuning (A), capacitive-tuning (B)







Figs. 2 and 3—Determining tuning ratios for series-inductance or parallel-capacitance tuning (left) and for parallel-inductance or series-capacitance tuning (right). B=ratio of fi to low end osc. frequency

inductance changed to

$$\frac{L_p(L_1+L_s)}{L_1+L_s+L_p} = 4.2 \text{ uh}$$

and its maximum inductance changed to

$$\frac{L_p(L_2+L_s)}{L_2+L_s+L_p} = 24.2 \text{ uh}$$

A conventional capacitor-tuned system, shown in Figs. 4A and 4B, is used for discussion in this section. Fig. 4A is the radio frequency circuit, and Fig. 4B is the oscillator circuit. Both tuning capacitors in these two circuits are identical and ganged.

The resultant design equations are: for the shunt trimmer

$$\frac{C_p}{C_v} = \frac{nx-n}{1-nx} - \frac{C_1}{C_v} \quad \text{.....(3)}$$

for the series trimmer

$$\frac{C_s}{C_v} = \frac{ny-n}{1-ny} - \frac{C_s+C_1}{\frac{C_v}{1}} \quad \text{.....(4)}$$

where $x = 1 + \frac{1}{A}$, $y = 1 + A$

Since Eq. 3 is similar to Eq. 1 and Eq. 4 is similar to Eq. 2, we are able to determine the unknown values of C_p/C_v and C_s/C_v by means

(*Continued on page* 107)

TABLE 1—NOMENCLATURE

F_1 = highest frequency to which the rf circuit is to be tuned

F_2 = lowest frequency to which the rf circuit is to be tuned

f_i = intermediate frequency

$f_1 = F_1 + f_i$ = highest oscillator frequency

$f_2 = F_2 + f_i$ = lowest oscillator frequency

$f_3 = \sqrt{f_1 f_2}$ = oscillator mid-track frequency

$A = \frac{f_1}{f_2}$ = oscillator tuning range

$B = \frac{f_i}{f_2}$ = ratio of intermediate frequency to lowest oscillator frequency

For Permeability-tuned System

L_1 = minimum inductance of the main tuning coil

L_v = maximum variation in inductance of the main tuning coil, and $= L_1[(F_1/F_2)^2 - 1]$

L_s = series inductance in the oscillator circuit

L_p = shunt inductance in the oscillator circuit

C_o = fixed capacitance in the oscillator circuit

For Condenser-tuned System

C_1 = minimum capacitance of the main tuning condenser

C_v = maximum variation in capacitance of the main tuning condenser, and $= C_1[(F_1/F_2)^2 - 1]$

C_s = series trimmer in the oscillator circuit

C_p = shunt trimmer in the oscillator circuit

L_o = fixed inductance in the oscillator circuit

n = multiplier of L_v (for permeability-tuned-system), or C_v (for condenser-tuned system), necessary to give the midtrack point

$$= \frac{F_2^2}{F_3^2} + \frac{L_1}{L_v}\left(\frac{F_2^2}{F_3^2} - 1\right), \quad F_3 = f_3 + f_i$$

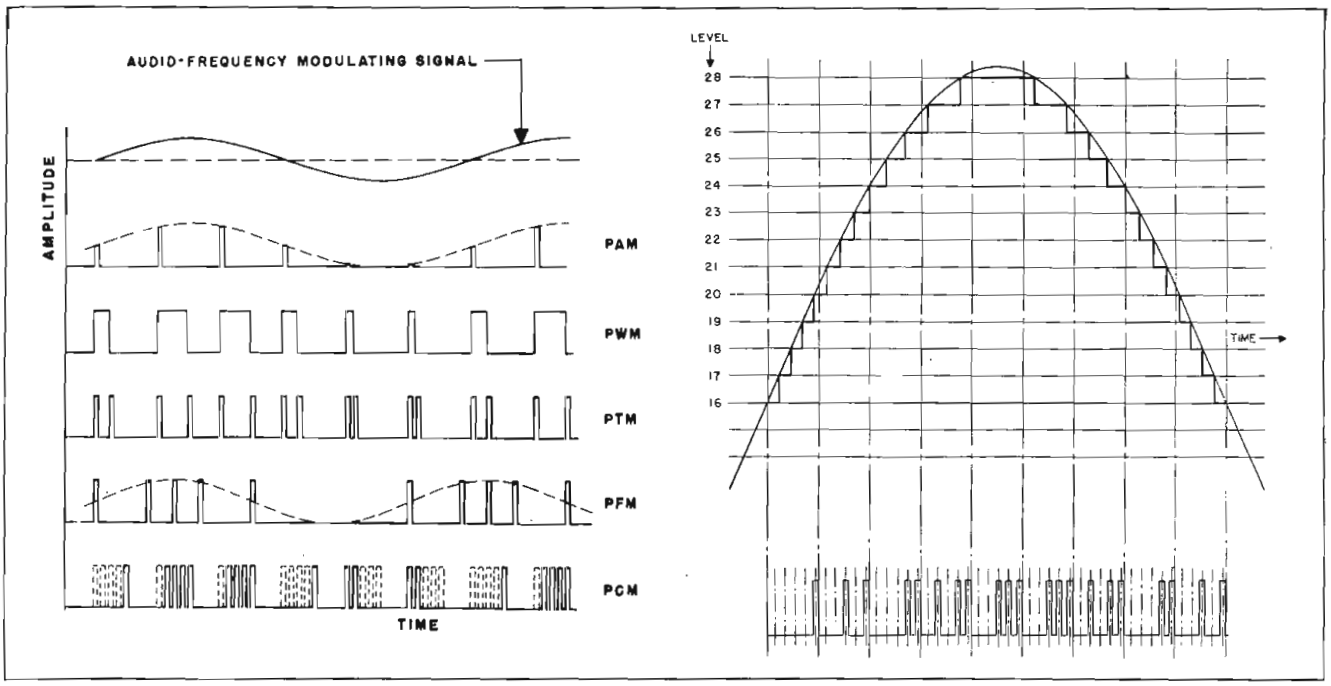


Fig. 1—General characteristics of several possible pulse modulation methods, showing only the so-called "video" pulses
Fig. 2—Binary count combinations for a 31-level system utilizing a total of 5 pulses to reproduce all levels

Pulse Count Modulation System

By D. D. GRIEG, Federal Telephone & Radio Co.

A simplified technical description covering the design and operation of equipment having particular advantages for use on wire lines and radio

• Within recent years a wide variety of modulation methods utilizing short bursts, or pulses of energy, have been developed. These methods have found application to a large number of problems including telephone systems, radio relay systems, telemetering and broadcasting.[1] The particular properties which have made pulse modulation applicable to transmission systems have followed both as a result of the multiplexing characteristics as well as the characteristics of the modulation method itself.

For example, by interleaving the modulating signals in time sequence, (time division multiplex) cross-talk introduced by non-linearities in the transmission system such as would be obtained with frequency division multiplex, is eliminated. This important property allows the use of repeaters with non-linear characteristics and makes possible long relays with many repeaters.

A further factor obtained with constant amplitude pulse systems is the constant transmission characteristics which permit the system to be independent of fading and other transmission vagaries. An additional property is the flexibility of the modulation method which allows the various transmission parameters to be exchanged, for example, bandwidth for noise reduction properties, distortion and cross-talk for bandwidth, thus permitting a system design suited to specific applications.

Basically, pulse transmission involves the sampling of the modulating signal at discrete intervals of time sufficiently short so as to allow little or no change in the modulating signal during the period of sampling. Since these samples, or pulses, are characterized by the parameters of timing, duration, frequency, build-up time, decay time and pulse shape, a large number of modulation methods involving these quantities either singly or in combination may be envisaged.

Thus, the amplitude of the pulses may be varied resulting in

pulse amplitude modulation or PAM. Alternatively, the width or duration of the pulses can be made to vary with the modulating signal resulting in pulse width modulation or PWM. In place of varying the individual pulse characteristics the time between pulses, or with reference to the marker pulse can be varied, resulting in pulse time modulation or PTM. Or, alternatively the repetition frequency of the pulse can be varied similar to conventional frequency modulation yielding pulse frequency modulation or PFM.

Other characteristics of the pulse, such as the pulse build-up time, or decay time, can be varied, and also combinations of the several modulations produced, giving rise to various hybrid modulations. Fig. 1 illustrates the general characteristics of a few of the possible modulation methods. It should be noted that the figure illustrates only the so-called "video" pulses which can be used directly for transmission over wires or cables, or alternatively utilized to key the rf carrier in either amplitude, frequency, or phase, for radio transmission.

Sampling Process

With the previously mentioned methods of pulse modulation, all levels of the modulating signal between zero and the maximum can be transmitted in the sampling process. However, a second class of modulation method can be devised in which, in addition to the time sampling, only selected levels of the amplitude range are transmitted; i.e., a system of double discreteness involving quantization of the amplitude as well as sampling of the amplitude at discrete intervals of time.

With such a system the amplitude range of the modulating signal is divided into a number of discrete levels and if the instantaneous amplitude of the signal falls between two levels either only the lower or the upper level are transmitted depending on the level which is closest. These methods were first described by A. H. Reeves in both United States and French patents.[2]

Since only a finite number of levels is involved it is possible to transmit the modulating information by a coded pulse system similar to the standard printing telegraph system. For example, if the modulating signal is divided into a total of 31 levels a five-unit binary numbering system may be used for identifying each of the discrete amplitudes. Thus, all levels from zero to thirty-one would be transmitted in terms of zero and unity, or absence and presence of pulse or any other two-value variation such as difference in frequency, respectively may be utilized. Zero (0) is transmitted as 00000, one (1) is transmitted as 10000, two (2) is transmitted as 01000, three (3) is transmitted as 11000, thirty-one (31) is transmitted as 11111, etc. Figure 1 illustrates this method of transmission in comparison with other methods discussed.

Fig. 2 shows the detailed characteristics. In this latter figure the solid line represents the audio modulating voltage. This signal is broken up into the discrete levels resulting in the step-type function also shown. At the time of scanning, the instantaneous level of the step function is reproduced in terms of the five-unit pulse code also shown. The type of transmission combining both the time sampling as well as the discrete amplitude or quantization has been termed Pulse Count (also Pulse Code) Modulation.

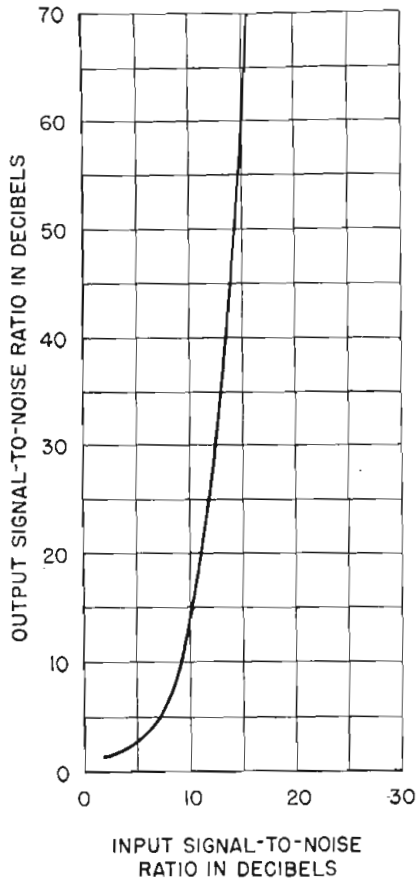


Fig. 3—Threshold values of rms/signal vs. rms/noise

Practical Advantages

It is apparent that with this type of system the many advantages that are obtained with the printing telegraph system can likewise be extended to voice transmission. For example:

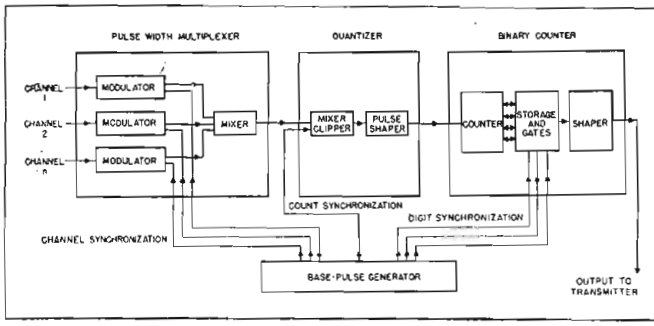
(1) Noise added to the system can be made non-cumulative for a long relay using repeaters since each pulse can be completely regenerated at each repeater with a complete suppression of noise previously added in the transmission path, provided the minimum signal received is above the noise threshold. This advantage allows a considerably larger amount of attenuation to be experienced resulting in a greater distance between repeaters, smaller power requirements and greater freedom from fading variation.

(2) Where multiplexing of the PCM signal by means of time division multiplex is utilized, crosstalk is correspondingly made non-cumulative. This factor is of considerable importance since the effect of reflections due to multipath transmission in a radio system, or alternatively due to mismatches or discontinuities in cable transmission, can be minimized.

(3) The system permits a low noise threshold value of approximately 15 db for thermal agitation noise or 3 db above the peak noise, in addition to an extremely large signal-to-noise improvement ratio which is substantially independent of the signal-to-noise input ratio above the noise threshold.

(4) The transmission method also allows relatively simple repeaters to be used since only the on-off characteristics need be recognized and transmitted.

In order to indicate the various



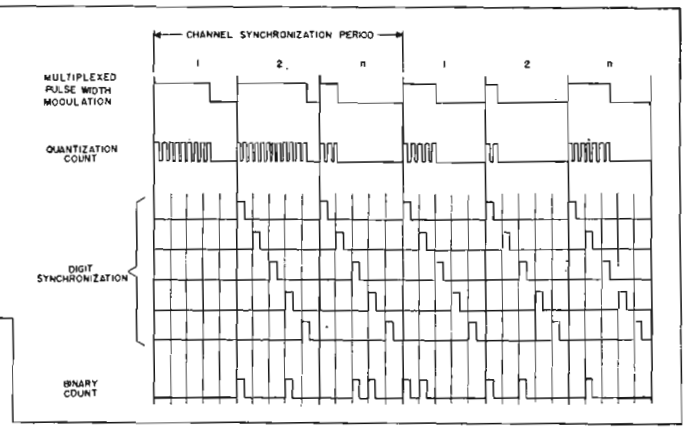


Fig. 4 (left)—Block diagram of terminal transmitter which multiplexes the individual audio channels as well as translates the channel information into a series of PCM pulses. Fig. 5—Modulating voltage applied to the channel modulators operates on the timing pulses supplied by the base pulse generator to yield a width-modulated pulse in proper time sequence

technical characteristics of the PCM transmission method a brief description of the system design considerations follows:

1—**Quantization Distortion**[3]—Since the method of transmission involves the quantization of amplitude as well as sampling in time, a consideration of first importance is the distortion introduced by this process. It is obvious that as the number of levels is increased the granulation of the signal becomes smaller and hence the distortion due to this factor is decreased. On the other hand this requires an increase in the number of code pulses to be transmitted and hence an increase in bandwidth, for any given number of channels.

The reference cited shows that the use of a relatively small number of levels is satisfactory for generally acceptable speech quality. For example, dividing the speech wave form into a total of thirty-one levels yields a distortion of the order of 3%. Tests have been conducted which indicate that intelligible speech can be obtained with as low a number as seven levels.

The per cent distortion D is a function of the total number of levels, 2m. Note, m is the number of levels either side of the zero axis, and is given by

$$D = \frac{1}{\sqrt{6}\,m} \times 100 \qquad (1)$$

This expression holds reasonably close for a number of levels less than approximately 100. Table 1 gives the distortion for the division of the signal into various numbers of levels.

2—**Time Sampling Distortion**—This type of distortion arises due to the scanning of the signal at discrete intervals of time. Time sampling distortion for PCM is the same as that for pulse amplitude modulation; i.e., distortion introduced occurs in the form of spurious components and is due mainly to the sideband harmonics of the pulse carrier falling into the audio transmission band. There is, in addition to this distortion, a small distortion component arising as a result of the finite width of the sampling pulse with constant pulse, but this latter component is sufficiently small for normal pulse widths and can be neglected.

The minimum ratio of sampling frequency f_p to the audio bandwidth $(f_h - f_l)$ where f_h and f_l are the high and low frequency end of the audio respectively, is given by

$$\frac{f_p}{(f_h - f_l)} = 2 \qquad (2)$$

TABLE 1

DISTORTION VS. NUMBER OF LEVELS

No. of Levels	Distortion (Per cent)
3	27
7	13
15	7
31	3.5
63	1.7
127	0.8
255	0.4
511	0.2
1023	0.1

TABLE 2

BINARY COUNT SYSTEM
NUMBER OF LEVELS VS. NUMBER OF PULSES

No. of Pulses	No. of Levels
1	2
2	3
3	7
4	15
5	31
6	63
7	127
8	255
9	511
10	1023

For practical purposes, in order to separate the sampling components from the voice components with a reasonable audio filter design, a larger ratio must be utilized. Since it is desirable that a simple filter be used, a cut-off at a frequency 1.5 f_l can be assumed. Also, if the low frequency cut-off f_l is small compared to the upper frequency f_h, the expression (2) becomes:

$$\frac{f_p}{f_h} \cong 2.5 \qquad (3)$$

3—**Number of Pulses**—The quantized signal is preferably transmitted by a series of pulses as previously mentioned. If p is the total number of pulses to be transmitted for any given level the number of levels 2m is given by $2m = NP$ where N corresponds to the counting system used. If a binary count system corresponding to the on-off function mentioned is utilized:

$$N = 2 \text{ and } 2m = 2p, \text{ or } p = \frac{1.55}{\log_e 2m} \qquad (4)$$

Note that the number of pulses must be the nearest whole number to the value given by the formula (4). Table 2 illustrates the number of pulses required for the various numbers of levels utilizing a binary counting system.

4—**Bandwidth Considerations**—Since the information transmitted by the PCM system is in the form of pulses, a larger bandwidth than that normally used for voice transmission must be utilized. On the other hand it is necessary to determine only the presence or absence of a pulse and hence a comparatively smaller bandwidth than that required for other types of pulse systems is satisfactory. Several factors determine the allow-

able pulse distortion and hence the bandwidth.

For example, the amount of carry-over from one pulse to the adjacent pulse determines the cross-talk in the system. This same factor influences the signal-to-noise ratio and noise threshold. Alternatively the bandwidth must be properly defined since the pulse distortion is a function of the low frequency cut-off, high frequency cut-off, and the type and rate of change of these cut-off points as well as the bandwidth value.

The minimum bandwidth required for zero cross-talk effect has been determined both theoretically and empirically for various types of cut-off characteristics including the frequency characteristics of equalized and unequalized coaxial cable. The results can be expressed approximately as follows:

$$F \cong \frac{f_p}{2} \text{ for upper frequency limit} \quad (5)$$

where F is defined as the pulse bandwidth limit at the 3 db point and f_p is the total number of pulses per second.

5—**Signal-to-Noise and Threshold** —A PCM system in common with the printing telegraph system yields a signal-to-noise improvement which is far greater than any other modulation system using equal bandwidths. With conventional AM and FM, or PTM, systems the audio output signal-noise ratio is always directly proportional to the input carrier-noise ratio provided the carrier is above the threshold value. With the PCM system however, the output signal-to-noise ratio is essentially independent of the input ratio once the threshold is reached.

Noise enters into a PCM system only insofar as a noise pulse substitutes for, or suppresses, a pulse of the PCM series. If it is assumed that the noise never exceeds an amplitude which is greater than approximately ½ the peak pulse amplitude then it is always possible to "slice" out a portion of the signal pulse which is completely undisturbed by the noise. The time of occurrence of this pulse may be advanced or retarded, but unlike other pulse systems this effect is unimportant since it is

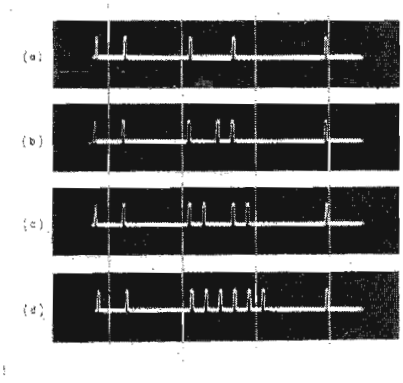


Fig. 6—Oscillogram illustrating pulses derived from a system such as is described

necessary to determine only the presence or absence of a pulse. Thus, it would be assumed that for ratios above the threshold the output signal-to-noise ratio is essentially infinite.

Since noise has a random distribution of peak amplitudes the threshold passes through a range of values before the maximum output signal-to-noise ratio is achieved. Various calculations and tests have been made for the threshold values and the results indicate that a threshold value of rms-signal-to-rms-noise is of the order of 15 db. This is illustrated by the graph of Fig. 3. This threshold value of 15 db has also been observed experimentally in teletypewriter tests to correspond to the "breaking point" between perfect and imperfect reception.

6—**General Design Relations** — Since the expression for the number of pulses in relation to the number of levels is given by equation (4) and the distortion as a function of the number of levels by the expression (1) these can be combined and given the relation between number of pulses and distortion or:

$$p = 1.44 \log_e \frac{80}{D} \quad (6)$$

The ratio of pulse frequency to the audio frequency is given for the practical case by expression (3) and the number of pulses per second per channel is given by:

$$f_p = 3.6\ f_h \log_e \frac{80}{D} \quad (7)$$

For N channels this expression is, of course, multiplied by the factor N. Since the frequency band is given by the total number of pulses divided by 2 [expression (5)] the ratio of the transmission bandwidth required, to the audio frequency bandwidth is

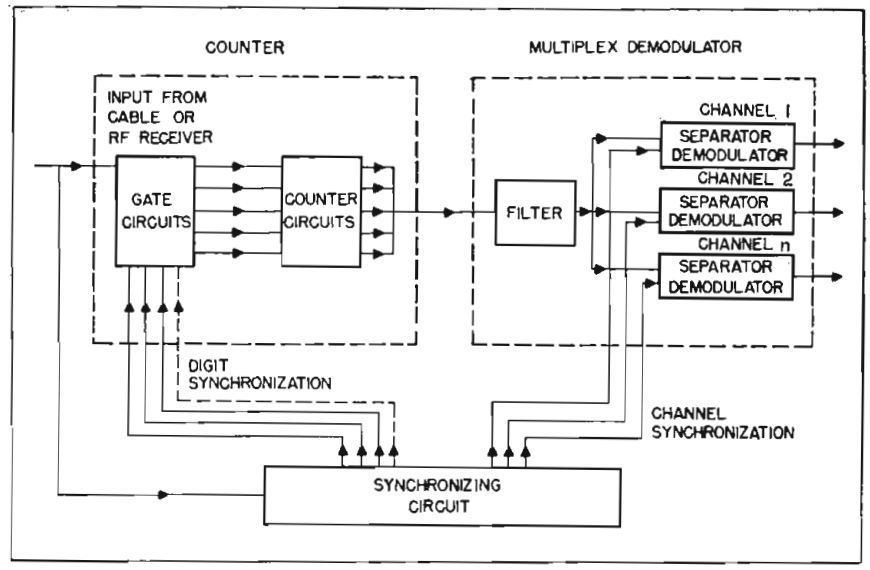
$$\frac{F}{f_h} = 1.8\ N \log_e \frac{80}{D} \quad (8)$$

For a distortion D of 3% which is a reasonable practical value for tlephone communication and corresponds to a 31 level system we obtain:

$$\frac{F}{f_h} = 6.25\ N \quad (9)$$

It should be noted that this corresponds to the case for a simple filter design for separating the audio band components from the pulse scanning components. Theoretically, if the ratio of pulse

Fig. 7—Block diagram of the receiver which is virtually the reverse of the transmitter



frequency to audio bandwidth $\frac{f_p}{f_h} = 2$ is utilized, the above expression becomes

$$\frac{F}{f_h} = 5\ N \qquad (10)$$

In other words the theoretical bandwidth for a thirty-one level PCM system is five times that of a single side band amplitude modulation system.

Several possible methods are available for producing PCM both as to generation and demodulation. A representative method has been described by A. H. Reeves in the reference cited and is illustrated by the block diagrams of Figs. 4 and 7. This corresponds to a multichannel PCM system and is applicable to a large number of channels although for simplicity a small number is shown in the illustration.

PCM Terminal Transmitter

The terminal transmitter which serves to both multiplex the individual audio channels as well as translate the channel information into a series of PCM pulses is indicated at Fig. 4. The terminal transmitter consists of four main units, (1) pulse width multiplexer, (2) quantizer, (3) binary counter and associated circuits, and (4) base pulse generator.

The modulating voltage applied to the channel modulators operates on the timing pulses supplied by the base pulse generator to yield a width-modulated pulse occurring in the proper time sequence. Signal voltages from the successive channels likewise yield width-modulated pulses which are added together in the mixer circuit yielding a pulse width multiplex series at the mixer output. This is illustrated in Fig. 5.

This series of pulses is fed to the quantizer circuit and each individual pulse allows the passage of a number of count synchronizing pulses corresponding to the width of that pulse. The maximum number of count pulses allowed corresponds to the maximum number of levels desired and is produced only by the pulse of maximum width.

The series of pulses obtained from the quantizer output must then be translated into a binary

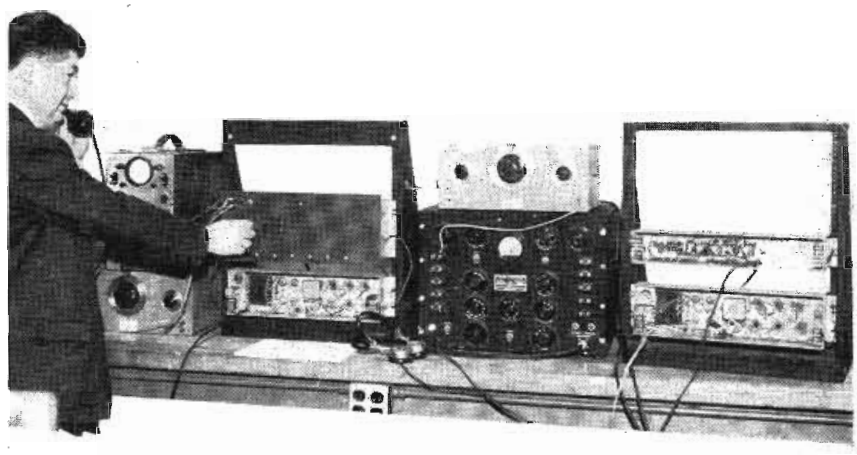


Fig. 9—General view of laboratory set-up for the complete PCM modulating system

number and this is the function of the binary counter shown. The counter can take many forms, the most familar being that of a series of "flip-flop" multivibrators interconnected so that each multivibrator turns over once for every two pulses applied by the preceding multivibrator. Associated with the binary counter are the necessary storage and gate circuits in addition to reset circuits.

A series of digit synchronizing pulses which have the same time characteristics as the ultimate transmitted pulses are applied to the gates in addition to the final voltage yielded by each individual multivibrator at the end of the count. Digit pulses are passed by the gates only when a potential corresponding to a full turn over of the individual multivibrator exists.

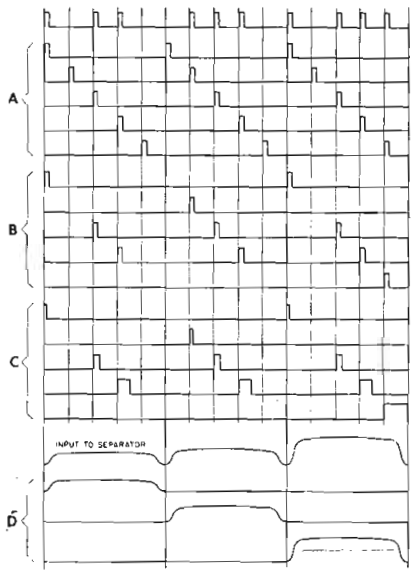
The storage circuit is necessary in order that a full count of the instantaneous level be received prior to setting up the ultimate binary count. The reset signals are, of course, utilized to recycle the counters for subsequent counting. As an example of the pulse rates utilized the data of Table III is representative for an 8 channel, 31 level PCM system with channel bandwidths of 3500 cycles.

The final output pulses corresponding to the proper binary count for each sample is then obtained from the appropriate shaper circuit for transmission over cable or modulation of the rf transmitter. An oscillogram illustrating the pulses derived from a system similar to that described is shown in Fig 6.

TABLE 3
REPRESENTATIVE PULSE RATES
8 CHANNEL PCM SYSTEM

Base pulse rate (channel synchronization)	8 kc
Count synchronization	1 mc
Digit synchronization	333 kc
Output pulse repition frequency	333 kc

Fig. 8—Wave form diagram



PCM Terminal Receiver

The terminal receiver functions to demodulate the PCM signal as well as to separate the individual channels from the multiplex pulse series. The system illustrated in Figure 7 is essentially the reverse of that described for the terminal transmitter. As indicated by the illustration the receiver consists of (1) synchronizing circuit, (2) counter circuit, and (3) multiplex demodulator.

(*Continued on page* 98)

Resin-Potting For Sub-assemblies

Bustan develops new casting compound in which circuits or complete plug-in components can be rigidly embedded for protection

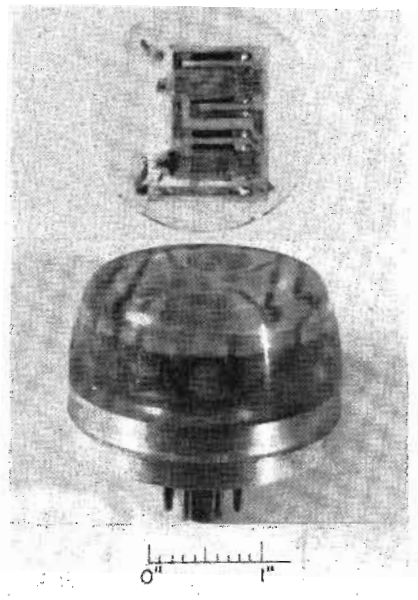
• A new technic for handling precision mechanical or electrical components of special electronic equipment has been developed at the National Bureau of Standards, and is based on potting the circuit components in a special casting compound. Due to the high impedance of the circuits involved, the electrical loss factor of the casting or "potting" compound was found to be a matter of major importance.

As reported by P. J. Franklin and M. Weinberg of the Bureau, a newly developed potting compound, known as NBS casting resin, can be used readily in many high-frequency devices requiring such mechanical-electrical insulation.

Many casting resins have been developed but few have the vital electrical properties for proper operation of high-impedance high-frequency equipment. This new casting resin embodies the required properties of mechanical and electrical stability and was formulated through a systematic variation of resin constituents.

The most important properties specifically desired of a casting resin when utilized at high frequencies in high impedance circuits are low power factor, low dielectric constant, short polymerization period at low temperature and atmospheric pressure, high impact strength, small volume shrinkage on polymerization, dimensional and electrical stability and low viscosity and surface tension, and hence may be poured through small openings.

Preparation of the casting resin is relatively simple. The components are mixed and placed immediately on a roll mill to prevent clumping. The mixture is rolled for approximately 16 hours and a



Upper view shows a commercial dual stage amplifier printed on a ceramic plate and embedded in the new casting resin. Below it is a plug-in multi-stage control unit

viscous dispersion is formed. With the addition of the proper quantity of catalyst to initiate polymerization, the casting resin is ready for use.

The liquid resin may be stored at 0°C for a few months without a catalyst, and for a few weeks with a catalyst, before the viscosity increases to a point where pouring is difficult. At room temperature, the catalyzed casting resin gradually increases in viscosity and must be used in a day or two. The cured polymer may be drilled or turned on a lathe.

By rigidly embedding electronic circuits or even complete plug-in-sub-assemblies, the compound provides excellent electrical insulation as well as protection against rough handling and deteriorating atmospheric conditions.

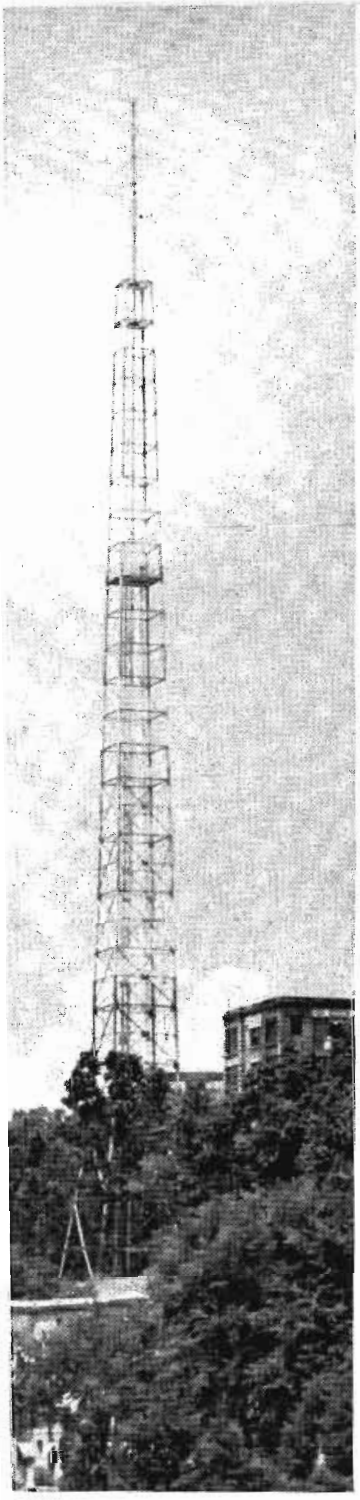
It is particularly well adapted for use with sub-miniature electronic equipment built by the printing technics recently reported. Several practical applications of resin-potted circuits at the Bureau have given operation comparable to that of conventionally constructed devices. The resin should be especially useful in high-impedance control devices in industries where it is necessary to provide protection against vibration, acid fumes, high humidity, and salt spray, as in steel mills, chemical and plating plants, etc.

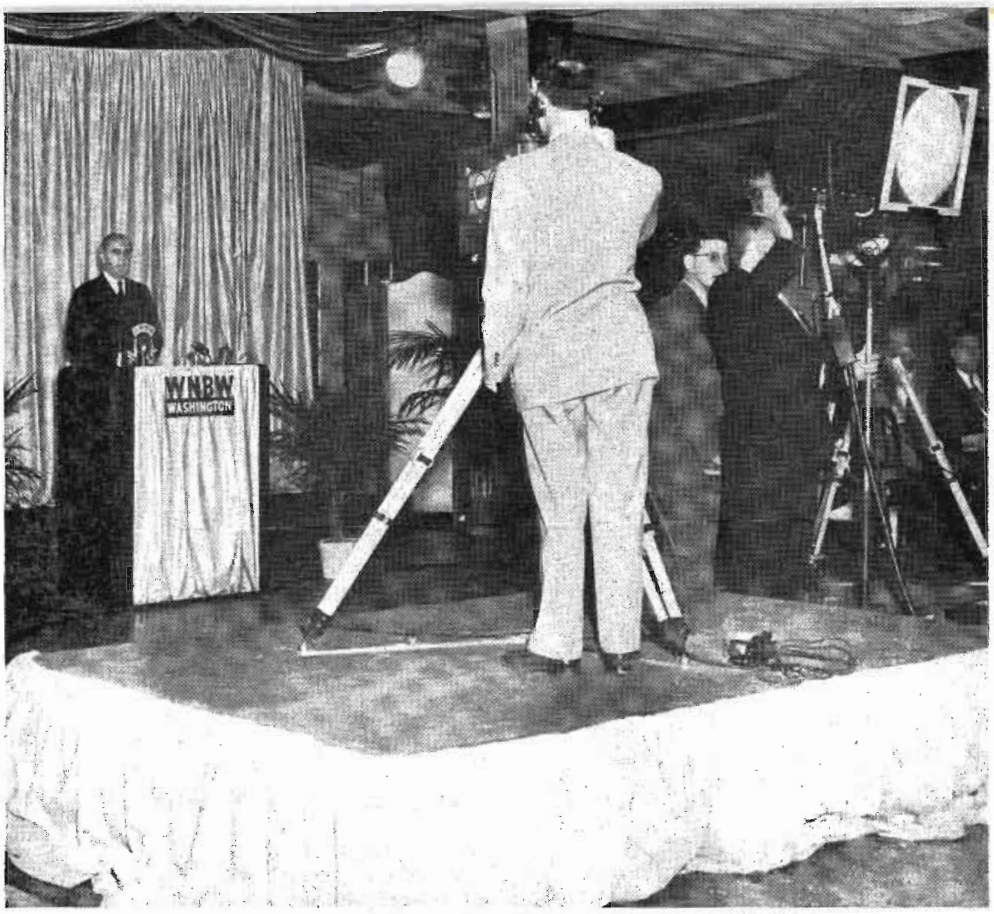
When objects are to be suspended within the center of the casting resin, it is advisable first to gel a portion of the casting resin and then to allow the gelled resin to support the sample. The mold is then filled completely with the casting resin and cured, after which the line of demarcation is invisible. Glass and properly lubricated metal molds have been used successfully. Silicone grease can serve as the lubricant.

Composition of Resin

This casting resin, cured at 50°C with 0.1% benzoyl perozide as the catalyst, has the following characteristics:

Compressive strength, lb/sq. in.	17,100
Izod impact, ft lb./in. of notch	0.228
Coefficient of thermal expansion per °C (approx)	11×10^{-5}
Water absorption (25 hours immersion) %	0.01
Volumetric shrinkage on polymerization %	8.0
Density of monomer	1.13
Heat distortion °C	68-70
Power factor (at 100 mc and 50% RH)	0.0004-0.0008
Dielectric constant (at 100 mc and 50% RH)	2.5
Dielectric strength (1/16 in. sample; volts/mil)	610-660
Volumetric resistivity (megohm-cm) less than	1017



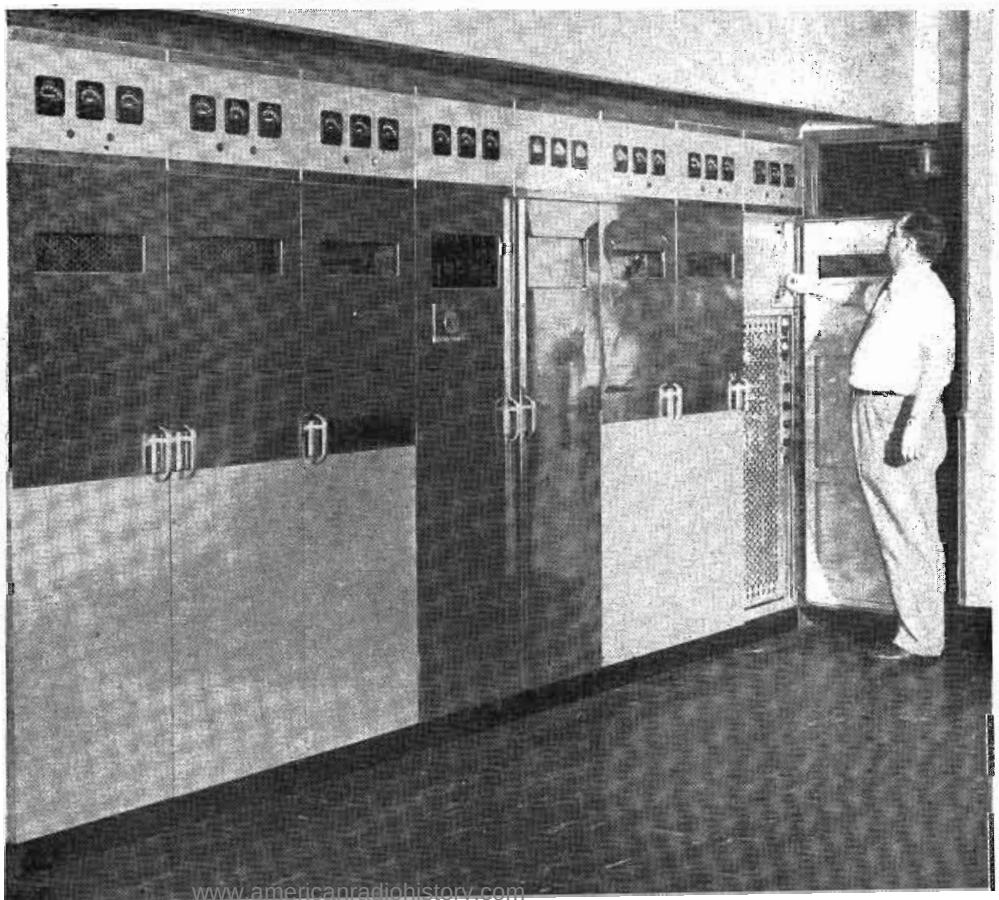


WNBW, Newest TV Outlet, Opens in Washington

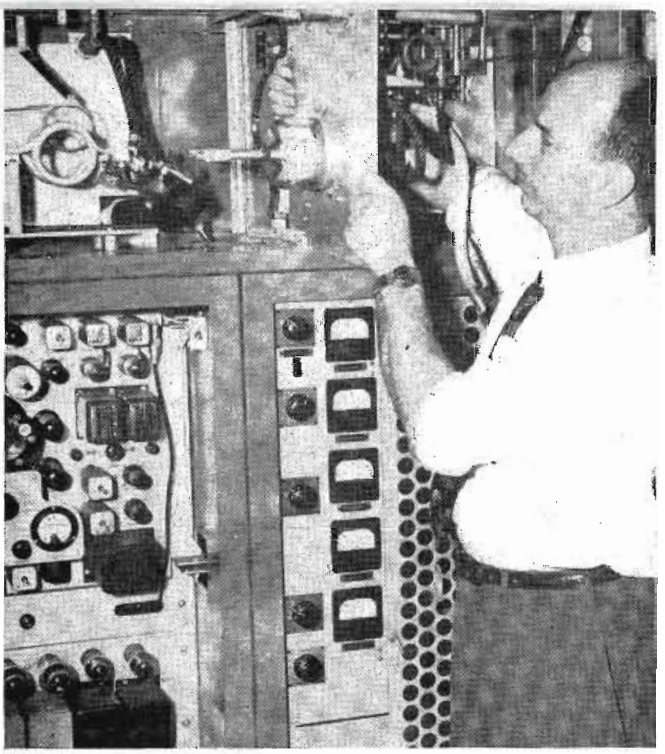
Above — WNBW's antenna, atop the Wardman Park hotel, rises 325 ft., gives NBC's new station, an effective radiated power of 20.5 kw

Top center—For the opening ceremonies an Image Othicon field camera was used

Bottom—Installed in the former Garden Room, the new TV transmitter is an RCA model TT-5A; there are eight sections



More or less jumbled up is equipment being used in preliminary test of Flying Spot Scanner, for still pictures and test pattern



WNBW depends upon an RCA type 8D21 tube in which all elements are internally water-cooled. Transmitter is on Channel 4

National Broadcasting Co.'s Capital station goes on the air simultaneously with first postwar RCA TV transmitter, and FM Broadcast

View of part of the WNBW control room, accessible through door in background in transmitter picture, bottom opposite page

WRC-FM, opened simultaneously, has an RCA type BTF-3B transmitter, uses the same antenna tower, power of 15 kw

Radar System for Airport Traffic and Navigation Control

By FRED J. KITTY, Project Engineer
Bendix Radio Div., Bendix Aviation Corp.

Bendix-Navy GCA, "Quonset Installation" combines advantages of many systems to provide for surveillance, height-finding and instrument approach — Part II

• The height-finding system components are in separate locations: (1) Atop the 67 ft. height-finder tower (Fig. 10) and; (2) In the indicator room (Fig. 11) in the building which houses the airport control tower. Two locations are separated by approximately 500 ft. Underground cables have been laid to interconnect the positions.

The 67 ft. height-finder tower is similar to the search tower in construction and arrangement, the dimensions being identical. The chief difference is that the height-finder tower has a trap door in the roof to permit entry into the radome, which houses the antenna. Mounted in a room at the top of the height-finder tower are the power distribution rack (containing the connector panel, the synchronizer, and the servo amplifier), the transmitter rack (containing the HV power supply, the transmitter-modulator, the synchroscope and the radar receiver), radio frequency transmission lines (rf plumbing), and the pedestal which drives and supports the radar antenna. The antenna is mounted on top of the pedestal immediately above the transmitter room. It should be noted that the power distribution and transmitter racks are very similar to those used in the Search System (Fig. 3 and 4.)*

Installed in the indicator room is the height-finder indicator rack (containing the height-finder indicator, and a power control unit which contains all switches required for remote operation of the search and height finding systems. The height-finder indicator rack is mounted adjacent and at right angles to the search indicator rack, so that one man (the Search Operator) may view and operate both indicators.

The master trigger for the entire system is derived from the search synchronizer. This trigger is applied to the height-finder synchronizer which is identical to the one used in the search set. In the synchronizer the master trigger is fed to four output channels which produce a negative trigger to operate the receiver S. T. C. (Sensitivity Time Control) circuit, a positive trigger to start the synchroscope sweep circuits, a positive trigger to operate the radar modulator, and a positive trigger to start the height-finder indicator sweep circuits. This last mentioned trigger is mixed in the synchronizer with the video output of the receiver so that only a single coaxial cable is required for transmission of this information from the height-finder tower to the indicator house.

Fig. 10—The height-finder tower, separated by 500 ft. from the indicator room in the airport control tower

The HV power supply is identical to the one used in the search system. However the unit is operated at 3.5 kv, 100 ma output instead of the higher power used in the search system. The application of the 3500 Vdc. to J2514 (Fig. 12) causes the pulse forming line to be charged to 7000 volts through the charging choke. When this point is reached the positive trigger from the synchronizer is applied to the 5C22 grid through a trigger amplifier circuit. This causes the line to discharge through the 5C22 and the pulse transformer. In discharging, the line produces a positive 7000 volt square pulse, ½ microsecond in length, half of which, or 3500 volts, is applied across the primary of the pulse transformer. The pulse transformer amplifies and inverts the input pulse, the resulting 12000 volt negative pulse being applied to the cathode of the 2J51 tunable magnetron.

This process is repeated 2000 times per second. The pulse transformer is designed so that the magnetron plugs into it, the two being held together by a knurled threaded collar. The 2J51 magne-

*See Tele-Tech, Aug. '47 Page 40 Part I of this article covered in general the overall system as well as a more detailed description of the Search System.

tron may be tuned to any frequency in the range from 8500 to 9600 mc, by means of a small worm and wheel which is part of the assembly. In this particular application the magnetron is tuned to 9150, ± 10 mc.

When the cathode of the magnetron is lowered 12,000 volts with respect to the anode, which is held at ground potential, by the application of the pulse, the tube goes into oscillation for the ½ microsecond interval during which the pulse is applied. A coupling loop extracts power from the magnetron for transmission through waveguide to the antenna. The peak power output from the magnetron is a minimum of 45 kw.

The 1B35 AJR. and the 1B24 TR. tubes fire at the start of each transmitted pulse and remain in this condition for the duration of the pulse. The ATR switch acts as a short in series with the transmission line when fired and thus permits the energy to proceed to the antenna with minimum loss. The TR. switch, which is in the receiver branch, when fired acts like an extremely high impedance in parallel with the transmission line. Thus the high power pulse is prevented from damaging the sensitive crystal detector (1N23B) in the signal mixer. Furthermore the transmitted energy proceeds toward the antenna with very little loss in the receiver branch.

At the conclusion of the transmitted pulse the TR. and ATR. tubes return to their unfired state. The geometry of the ATR-TR plumbing is such that received echoes upon arriving at the receiver branch "see" an extremely high impedance in the direction of the magnetron and thus proceed through the TR tube to the receiver with very little loss. An attenuator in the main line to the antenna extracts a small amount of rf energy from the transmitted pulse and applies it to the AFC mixer (1N23B) for controlling the operation of the AFC circuit.

The echo signals received by the antenna are applied to the signal mixer crystal. Both the AFC and signal crystals are coupled to the output of a single type 2K25 Klystron local oscillator which operates at a frequency 30 mc above that of the magnetron. As

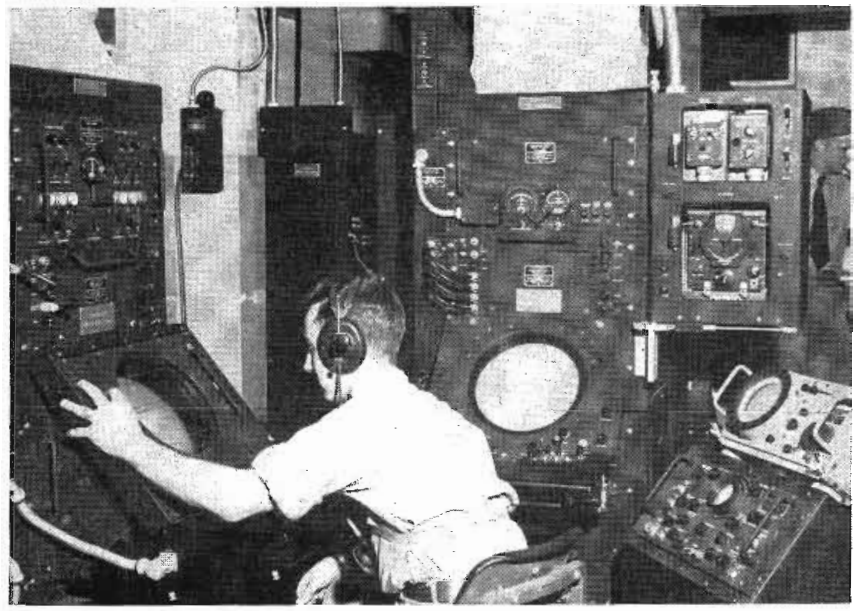


Fig. 11—The search Operator in his appointed position with the search indicator in the center. Operator is making adjustment on the height-finder indicator at left. DBF director finder and test synchroscope are on small table at the right

a result of the heterodyning action in the crystal detectors a 30 mc IF is obtained from each of the two mixer units. The output of the signal mixer is applied to the two-stage signal preamplifier and then to the receiver IF circuit, while the output of the AFC mixer is fed through the two-stage AFC preamplifier to the receiver AFC circuit. The two pre-amplifiers are identical in construction but the IF band pass characteristics are different for each. This is accomplished by different settings of three tuning slugs.

Antenna Feeders

The transmitter unit is electrically connected to the antenna by means of 1 x ½-in. waveguide (both rigid and flexible), a directional coupler, an adjustable impedance transformer and a rotating joint. All plumbing from the transmitter to the bottom of the antenna mount is fixed. The rotating joint is within the mount and all plumbing from this point to the dipoles is fixed with respect to the antenna and rotates with it as it is positioned in azimuth.

The antenna mount includes, in addition to the waveguide, the rotating pedestal, a rotation drive motor, and a synchro control transformer. The antenna is positioned in azimuth by the search operator's handwheel. The maximum rate of azimuth positioning is 5.75 rpm; which speed is obtained from the 3450 rpm (max.) drive motor through a planetary gear reduction system. A cam operated plunger type oil pump circulates an oil bath over the reduction gears. Slip rings and brushes at the bottom of the mount, similar to those used on the search antenna mount, provide for power and data voltage connections to the rotating portion of the height-finder antenna system. The rotating spindle of the mount turns on ball bearings, grease lubricated through standard fittings.

Fastened to the top of the antenna mount is an assembly consisting of a pair of hinged plates (to support the antenna and reflector) a 115v ac motor and reduction gearbox to drive the antenna mechanism, a tilt indicator, a handwheel to adjust tilt, a set of weights to balance the antenna system while it is in motion and various guys, braces and supporting plates.

The height-finder uses the same reflector as that used in the elevation antenna in the precision trailer with the exception that a small plate has been added at the top for attaching guy wires. This reflector, 14 feet in length, is aluminum sheet, using skin-stress construction, with the surface

secured to internal cross ribs by flush rivets. The reflector consists of two parts—an upper and lower half, held together with screws. Brackets are provided to support the antenna array. The parabolic reflecting surface of the reflector controls the azimuth pattern of the radiated beam, which is approximately 3.6° wide at the half power points.

The antenna array consists of a 14 ft. length of variable width x-band waveguide into which 199 probe-fed dipoles are mounted. The variable width waveguide is an aluminum extrusion of the type used in the GCA. The scan motor drives a pushrod parallel to the long dimension of the array through a 58:1 mechanical reduction linkage. Attached to the pushrod are pairs of toggles, one of each pair being attached to the stationary half of the guide, the other one of each pair being attached to the movable half of the guide. When the pushrod is driven, the toggles are actuated and cause the two halves, forming the variable width guide, alternately to approach and recede. This in effect causes the width (large dimension) of the guide to vary with the motion of the scan motor. Varying the width of the guide effectively changes the electrical length of the line and thus varies the phase of the rf energy feeding the dipoles which in turn varies the angle at which the beam is radiated. The dipoles are spaced slightly less than a half wavelength apart. The array is mounted vertically parallel to the long dimension of the reflector, and is fed at the top. The 14 ft. array results in a beam which is 0.6° wide in elevation, at the half power points.

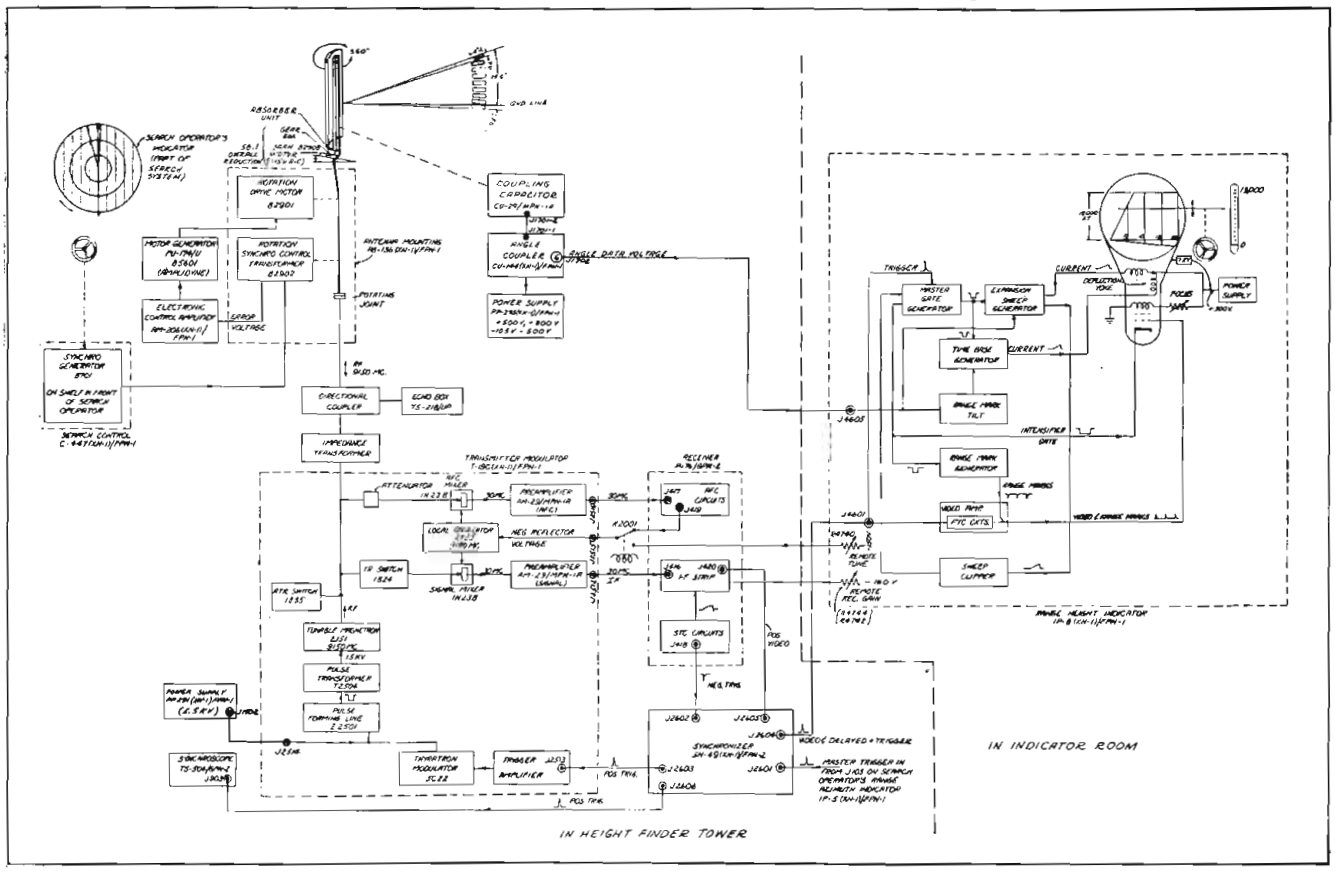
Scan System

At this point it might be well to define the term "normal to the antenna". This term is used to denote the condition which exists when the radiated beam is perpendicular to the array and obtains when the dipoles are all fed in phase. This is an undesirable condition since it results in an extremely high standing wave ratio, a situation which may cause loss of transmitted power and excessive magnetron frequency "pulling". Therefore the antenna and its associated scan system are designed so that scanning through the "normal" is avoided.

The guide spacing is so arranged that the antenna scans from a point one degree on the feed side of the "normal" to a point 21 degrees on the feed side. Thus the total scan is 20°. From this discussion it would appear that the beam scans from 1° above the horizontal to 21° above. But this is not true since the entire antenna array and reflector is mechanically tilted 1½° toward the ground. Thus the resulting scan is from ½° below the horizontal to 19½° above, this effect being accomplished without scanning through the "normal". A small indicator dial mounted on the hinged plates indicates the beam angle (referred to the horizontal) at the lower extremity of the scan. By this means the proper mechanical tilt may be set. An absorber unit, mounted at the load (bottom) end of the array, absorbs unused power and thus prevents reflections back to the transmitter.

As stated the antenna scan is mechanically linked to the drive motor through a 58:1 linkage. Since the motor runs at approximately 1740 rpm it can be shown

Fig. 12— Functional block diagram of the complete height-finder system



that the antenna beam is driven through ½ cycle of scanning per second. Since a complete cycle consists of two scans, one up and one down, the resulting rate of scan is 1/sec.

In order to cause the indicator to sweep in synchronism with the height-finder beam as it scans up and down, some device is required to translate the motion of the variable width waveguide, (which is not linear with respect to the beam motion) to a voltage which varies linearly with the beam angle. This voltage may then be utilized to control the vertical expansion of the indicator sweep so that the sweep and radiated beam are synchronized. This objective is accomplished through the use of the coupling capacitor and angle coupler which are mounted on the reflector-antenna assembly. The coupling capacitor is mechanically driven by the toggles varying its capacitance which with a fixed capacitor in the angle coupler, forms a capacity voltage divider circuit.

The output of a one megacycle oscillator is applied across the voltage divider circuit. The output of the voltage divider circuit, which varies as the coupling capacitor shaft rotates, is doubled and filtered, thence fed through the slip rings and 500 ft. of wire to the indicator. This system is designed so that the angle coupler can be adjusted to produce a dc voltage which varies linearly with the beam angle. This voltage swings from −25 to +125 volts, with respect to ground, as the beam swings from −½ to +19½ degrees. A power supply unit, mounted behind the reflector, supplies the following required regulated voltages for operation of the angle coupler unit: +500, +300, −105 and −500 volts.

The X-band directional coupler provides a convenient piece of rf test equipment. This device may be used to extract a small measured amount of transmitted energy from the system or to feed a measured amount of rf energy into the system. Thus various transmitter and receiver measurements are made possible. The directional coupler is of the bi-directional type so that energy may be fed to and extracted from the antenna as well as the transmitter.

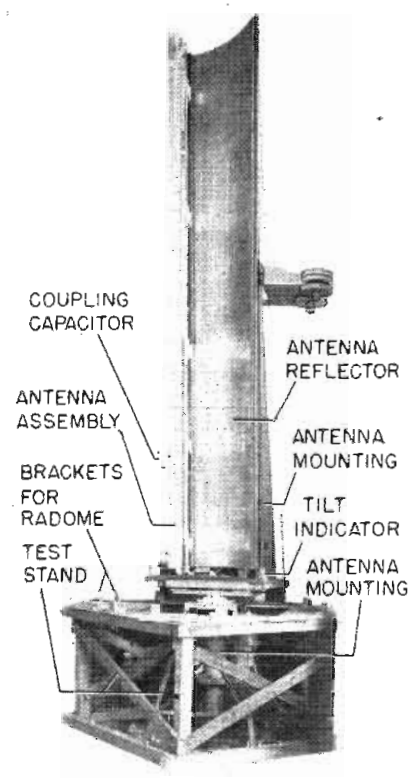


Fig. 13—Front view of height-finder antenna

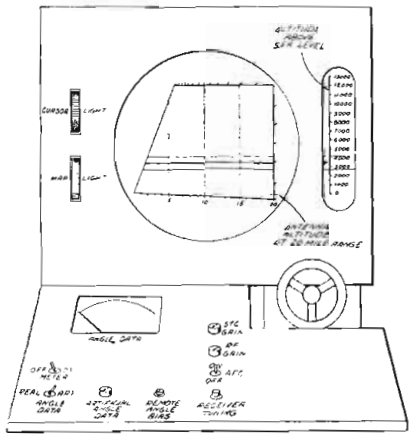


Fig. 14—Height-finder indicator presentation

The adjustable impedance transformer, commonly called "squeeze box", is simply a section of 1 x ½-in. guide whose width (long dimension) may be varied. This change in width has the same effect on the transmitter tube as a change in the length of the transmission line. Thus the phase of the standing wave at the magnetron may be adjusted so that variation of the transmitted frequency ("pulling") due to antenna scanning may be minimized. The echo box serves the same function as the one used in the search system; the only difference being that it is designed for X-band rather than S-band operation.

The receiver and synchroscope, mounted in the height-finder transmitter rack, are identical in construction and functioning to those used in the search system previously described.

The range-height or height-finder indicator utilizes a 12-in. cathode ray tube to provide an expanded elevation position (EPI) type of presentation of the sector of space scanned by the antenna beam. The indicator presentation is expanded so that the vertical component of the sweep is approximately 7.5 times what it would have been if expansion were not used. A single 20 nautical mile range is provided, with 5 mile range marks. Lines representing the two limits of scan and the 12000 feet altitude level as well as the 20 mile range line, are etched on an amber plexiglass map covering the face of the tube. Altitude is read from the cursor scale at the right of the presentation.

In operation, the cursor is adjusted by the handwheel to intersect the desired target. This operation causes the pointer to move to the correct altitude reading on the scale. Corrections have been incorporated to compensate for earth curvature and the slight refraction of the radar beam, so that actual altitudes above sea level, rather than altitudes relative to the radar are obtained. Range marks and angle marks have been etched on the map to aid in adjusting the indicator. Independent cursor light and map controls are provided for illumination balance and ease of operation. Controls are also provided on the indicator panel for adjusting and/or selecting Range Mark Brilliance, Brilliance, Vertical Centering, Horizontal Centering and F.T.C. (Fast Time Constant). On a shelf below the indicator are located receiver and indicator calibration controls. The receiver controls include S.T.C. gain, IF gain, AFC on-off and Receiver Tuning. (These controls are identical to the ones provided with the search system previously described.) An angle data meter provided with

(*Continued on page* 105)

Survey of World-Wide Reading

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

Velocity-Modulation Tube Developments in France

M. R. Warnecke (Bulletin de la Société Française des Electriciens, Paris, France, February, 1947, pp. 81-94)

The article presents a survey of recent developments in ultra-high frequency tubes and contains several velocity-modulation tube principles suggested in French patent applications filed by the author and his collaborators.

A velocity-modulation tube with cylindrically shaped electrodes, (Fig. 1), is being developed for television purposes. Fig. 2 illustrates a single-resonator, velocity-modulation tube using secondary emission. The density distribution of the secondary electron beam is identical with the density

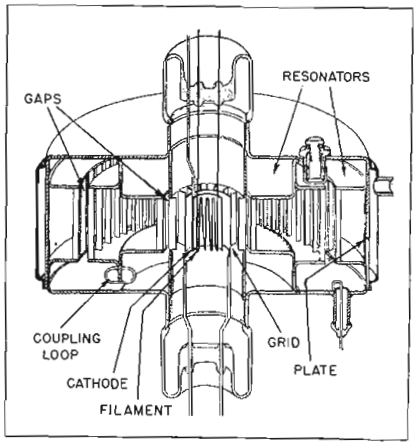


Fig. 1—Velocity-modulation tube with cylindrically shaped electrodes

modulation of the primary beam at the instant of impinging on the secondary emission electrode. It is essentially not changed during the travel of the secondary beam, as the average velocity of the secondary electrons is only slightly dependent on the velocity of the primary electrons. The secondary emission electron beam traverses the resonator cavity through openings spaced from those traversed by the primary beam.

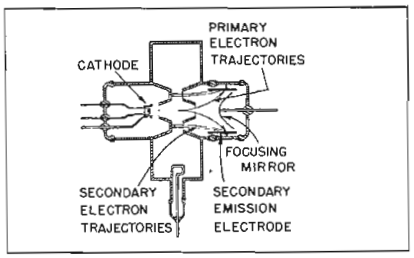
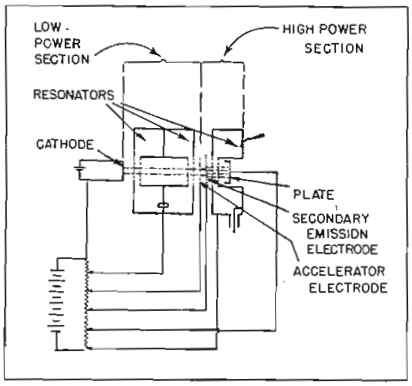


Fig. 2—Velocity-modulation tube with secondary emission electrode

Fig. 3 illustrates a velocity modulation tube with a secondary emission electrode interposed between two catcher grids. The bunched electrons leave the second resonator gap with a velocity inferior to the velocity corresponding to the constant accelerating voltage, while the electrons in the rarified sections of the electron beam leave the second resonator gap with a velocity exceeding the velocity

Fig. 3—Secondary emission increases modulation depth as well as beam intensity



corresponding to the accelerating voltage. The voltage of the following electrode is adjusted to accelerate the electrons by a suitable amount so that the secondary emission coefficient is larger for electron velocities of the bunched group than for electron velocities of the rarified electrons. Obviously the percentage electron density modulation is increased by passage of the beam through the electrode. The secondary emission electrode therefore not only increases the amount of electrons in the beam, it also increases the modulation depth of the beam by selective amplification.

In the "prionotron", (Fig. 4), the efficiency of a velocity-modulated tube is increased by modulating the

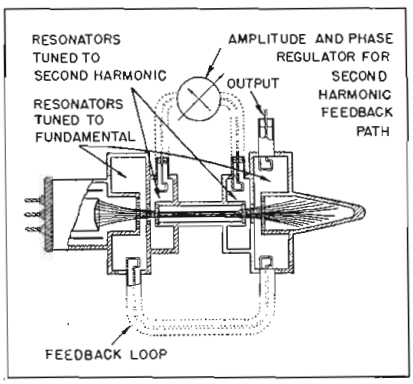


Fig. 4—In the "prionotron" the beam is modulated with the fundamental and the second harmonic to increase efficiency

beam not only with the fundamental, but also with the second harmonic in correct phase and amplitude. It is known that this procedure increases the maximum theoretical efficiency from 58% to 74%. Addition of further harmonics only slightly contributes to the operating efficiency. However, a limiting theoretical maximum efficiency of 100% is possible if all harmonies were present.

TM Wave in Two-Dielectric Wave Guides

S. Frankel (Journal of Applied Physics, July, 1947, pp. 650-655)

The propagation of a transverse magnetic wave, and in particular of the $TM_{0,1}$ mode, in a circular waveguide containing two coaxially arranged dielectrics, (Fig. 1), is studied. If an electron beam travels along the axis of this waveguide, interaction between the electron beam and the axial electric component of the electromagnetic field will occur, energy transfer* may take place. It is, however, desirable to reduce the phase velocity of the electromagnetic wave to approximately the velocity of the electron beam. The article demonstrates how the phase velocity of the electromagnetic wave in the evacuated central cylindrical region of the guide is slowed down by the presence of the surrounding ring-shaped dielectric of high dielectric constant.

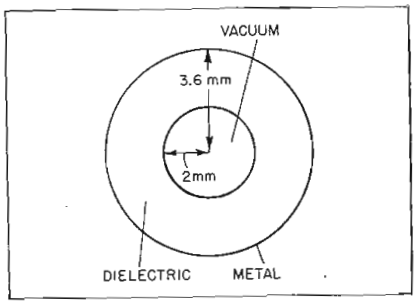


Fig. 5—Cross-section of cylindrical two-dielectric waveguide

By solving Maxwell's equations for the two media and by introducing the boundary conditions, it is established that the phase constant and consequently the phase velocity will be the same in both media. It will assume a value between those it would have in a waveguide filled completely with the dielectric or completely evacuated. Further relations between the phase velocity, the dielectric constants of both media and the diameters of the two dielectrics are derived so that a guide may be designed for a prescribed phase velocity.

The case of a guide in which a 48 mc $TM_{0,1}$ wave is expected to travel at one-tenth the velocity of light is investigated in more detail. For an inner radius of 2 mm and a dielectric constant of the surrounding dielectric of 200, the outer radius may assume the descrete values of 3.6, 6.9,.... mm. The field components for an outer radius of 3.6 mm are plotted in Fig. 2 as a function of the radius. One tenth of one percent of the total

*In the traveling wave tube energy is transferred from the electron beam to the electromagnetic wave.

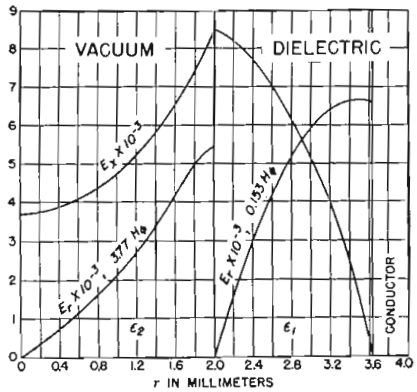


Fig. 6—Radial distribution of field components in cylindrical two-dielectric waveguide

transmitted power will be propagated in the central or evacuated region. The magnitude of the axial electric field component (in volts/cm) at the center of the guide will be equal to 5.77 times the square root of the peak transmitted power.—JZ

Design of Wide-Band RF Transformer

D. Maurice and R. H. Minns (Wireless Engineer, London, England, June, 1947, pp. 168-177 and July, 1947, pp. 209-216)

The properties of RF transformers covering a wide frequency band (in one instance from 100 kc to 150 mc) are investigated and design procedures and formulas are given. Shunt losses, leakage capacitance, shunt capacitance and leakage inductance are considered; their causes as well as their effects on the transformer performances are explained. Suggestions are made for the most suitable core shape, core material, optimum number of turns, best winding arrangement, etc. depending on the particular design requirements.—JZ

Electrons Radiate Light

F. R. Elder, A. M. Gurewitsch, R. V. Langmuir and H. C. Pollock (Physical Review, June 1, 1947, pp. 829-830)

A small spot of brilliant white light was observed with the 70- mev-synchrotron of the General Electric Co. As expected, high-energy electrons emit electromagnetic radiation,—some of it in the visible range of the spectrum,—when accelerated at right angles to their velocity.—JZ

Interlaced-Ribbon Cathode Structure

P. Tabrés and H. Barbault (Le Vide. Paris, France, March, 1947, No. 8, pp. 228-236, two articles)

It is proposed to shape cathodes by interlacing two ribbons, coated with emissive material in the manner illustrated. By this interlacing, a strong mechanical structure is obtained and the emitting cathode surface per unit length is increased considerably. Less heating power is required for the same cathode temperature, the effective cooling surface of the structure being considerably smaller than the emitting surface. For the same dimensions and heating power, an increase in emissive surface of 80% may be secured by the interlacing principle. Further increase in emitting surface may be obtained by using ribbons made from metal netting.

This structure is applicable to directly and indirectly heated cathodes and is recommended for gas-filled tubes, where space charge is compensated by the presence of positive ions. In indirectly heated cathodes several interlaced ribbon pairs are arranged around the heater filament or the filament passes through a set of holes at the axis of the ribbon structure. The filament may be insulated from the cathode by a narrow ceramic tube.

Measurements indicate that though the emission increases with the closeness of interlacing or decrease of distance d in the figure, the increase is negligible once the ribbons are fairly closely spaced and not much is gained by further compression.

Other measurements on the wattage required to heat the cathodes of various widths to a given temperature and life tests as function of cathode current are reported. The accompanying table lists the characteristics of several tested rectifiers incorporating the interlaced cathode structure; the last line refers to a grid rectifier.

Heater characteristics	Maximum average current	Maximum peak current	Maximum inverse voltage
2.5 V, 6.5 A, 16 W	0.6 A	2.5 A	7,500
5 V, 6.5 A, 32 W	1.25 A	5 A	12,000
4 V, 11 A, 44 W	8 A	40 A	400
5 V, 10 A, 50 W	1.6 A	7.5 A	16,000

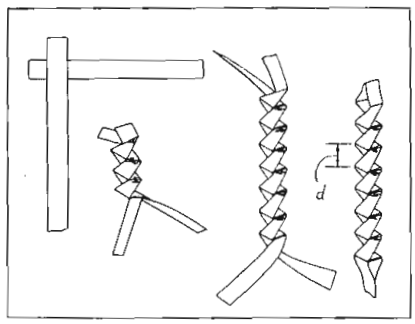


Fig. 7—Interlaced ribbon cathode structure

Average current density is 0.05 to 0.12 ampere/cm². This assures a lifetime exceeding 5000 hours. A cathode designed for 100 amperes peak current required 80 watts heating power, permitted an average maximum current of 20 amperes and had an average electron current density of 0.06 amperes per cm².

Silicon Rectifiers

J. H. Scaff and R. S. Ohl (The Bell System Technical Journal, Vol. XXVI, No. 1, pp. 1-30)

The development of silicon crystal rectifiers at Bell Laboratories during the last 12 years is traced. Improve-

ments developed in connection with the use of these crystals as converters in radar receivers and as detectors or rectifiers are set forth. Performance of various types of silicon crystal rectifiers is described.

Measurements on Small Piezoelectric Crystals

E. Burnstein (The Review of Scientific Instruments, May, 1947, pp. 317-327)

When investigating substances for their piezoelectric properties it is desirable to test small crystals, 1 to 3 mm cubes, which can be readily obtained. The Giebe-Scheibe method, the bridge method and the series impedance method are explained and their respective merits discussed. Data obtained for several tiny crystals are tabulated.—JZ

Design of AF Filters

(Wireless World, London, England, July, 1947, pp. 242-245)

It is sometimes desirable to attenuate a certain band of frequencies in order to compensate undesired resonance response of a pickup unit or to eliminate interference. Design data for the parallel-tuned rejector circuit and the series-tuned acceptor circuit as attenuation filters are given and a table to faciliate numerical evaluation of the formula is presented. A desired attenuation at a certain frequency and a desired minimum attenuation at another frequency are assured.—JZ

Transmission-Measuring Equipment

D. G. Tucker (Journal of the Institution of Electrical Engineers, London, England, Part III, pp. 211-216)

A highly frequency-selective measuring equipment for testing multichannel communication systems while in operation was designed. It permits establishment of the overall transmission loss or gain to 0.25 db at several frequencies within the transmission range without disturbing or being disturbed by normal operation.

A test signal at a frequency ω in one of the small gaps between adjacent channels is transmitted. To facilitate amplification and separation at the receiving end, the test signal is amplitude-modulated before transmission to a depth of about 20% to 50% with a frequency ω_0 between 20 cycles and 50 cycles. In the testing apparatus, (diagram), the received complex wave is filtered by a heterodyning method suggested by Barber* to separate the modulated test signal. The method involves beating the incoming wave with a wave of test signal carrier frequency ω. This wave is generated by a local oscillator, tuned to a frequency very close to ω, and synchronized** by the incoming complex wave. The oscillator output, a sine wave of frequency ω, is split, shifted in phase by plus and minus 45 deg., respectively, and applied to two ring modulators to be mixed with the complex input. As the following low-pass filters suppress all frequencies above ω_0, the desired signal will be the only signal passed; it will be in the forms indicated on the diagram.

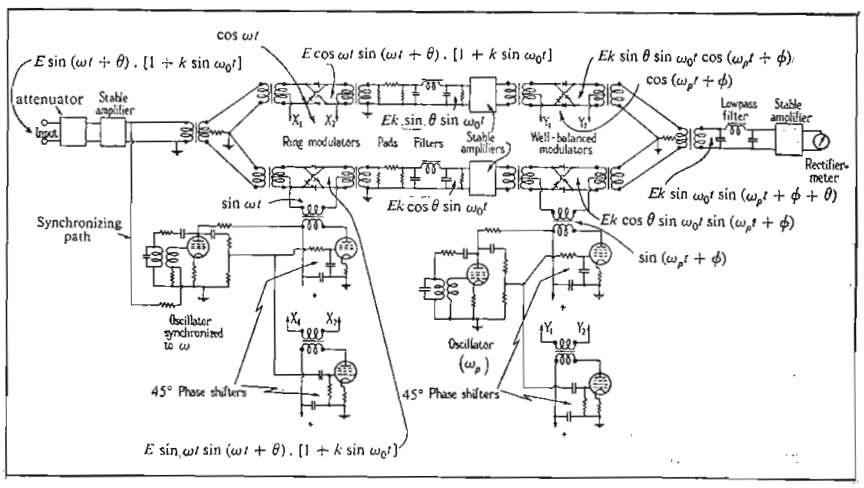
The two expressions in the diagram for the filtered waves contain the phase angle θ between the incoming signal and the locally generated signal; this angle cannot be considered constant. To eliminate dependence on the phase angle θ. Barber again heterodynes each channel with a locally generated signal shifted in phase by plus and minus 45 deg. In the present apparatus, the second heterodyning frequency ω_p (approximately 20 kc) is chosen considerably smaller than test frequency ω. Inspection of the formula in the figure will show that if the modulator outputs are added, the amplitude of the resulting wave is proportional to the product kE, the amplitude of the side band of the testing signal, which is of interest in the transmission measurement. A second low-pass filter suppresses harmonics of the second heterodyning frequency ω_p. A steady reading proportional to kE will then be obtained on an instrument with properly adjusted time constant.

A detailed account of the effects of phase-shifter accuracy, amplifier gain, modulator balance, and frequency stability on the performance of the frequency-selective transmission measuring equipment is given. An overall accuracy of 0.15 db was obtained with an experimental circuit indicating a long-term accuracy of 0.25 db.—JZ

*"Narrow band-pass filter using modulation", Wireless Engineer, May 1947, summarized, Tele-Tech, August 1947.

**See "Non-linear regenerative circuits", Wireless Engineer, June 1947, for an analysis of this method of extracting a pure tone from a mixed signal.

Fig 8—Apparatus for measuring transmission losses in multi-channel communication equipment while in operation



Testing Semi-Conductors

N. Malov (Journal of Physics, Moscow, Russia, Vol. X, No. 4, pp. 383-385)

The electrical properties of a semiconductor may be investigated by inserting the semi-conductor in a dielectric and mounting a perfect conductor an adjustable distance from the semiconductor. An electromagnetic wave is propagated through the dielectric, semi-conductor, dielectric and perfect conductor arrangement and the distance between the semiconductor and the perfect conductor adjusted until no reflected wave is detected in front of the semi-conductor. The distance between conductor and semi-conductor and the thickness of the semi-conductor in conjunction with the known properties of the dielectric determine the conductivity and dielectric constant of the semiconductor. Equations and tables for the evaluation of these properties are presented. The method does not require a constant generator output with changes in adjustments.—JZ

A High-Quality Recording Amplifier

K. Singer (Journal of the Society of Motion Picture Engineers, June, 1947, pp. 560-568)

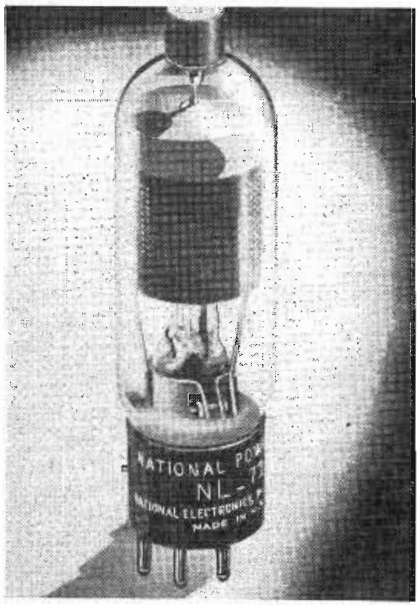
The high-quality, R-C coupled, three-stage, push-pull amplifier for recording channels incorporates a negative feedback path over all three stages. This feedback (about —35 db) connects the output of one channel to the input of the other channel introducing cross-coupling between the two sides of the push-pull arrangement to reduce cross-modulation. The amplifier performance is thus independent of tube matching. In the 60 to 8500 cycle frequency range, distortion does not exceed 0.5% at an output level of 40 db. Cross-modulation reduction of a 9000 cycle carrier modulated 80% with 400 cycles is 74 db. down at 40 db. output and 90 db. down at 38 db. output. Intermodulation is less than 2.4% at 40 db. output level and less than 0.5% at 38 db. output at all frequency combinations.—JZ

New Types of Electron Tubes

BEAM POWER TRANSMITTING TUBES

(Use Inquiry Card, Mentioning No. 801)

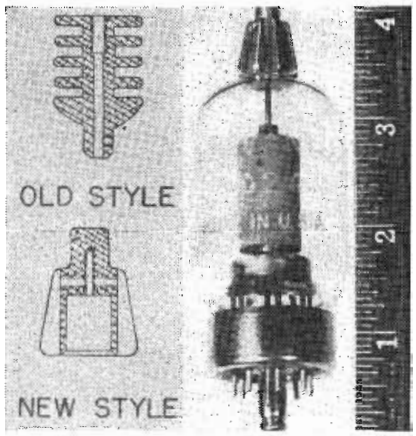
RCA - 2E24 (direct - heater) and RCA-2E26 (cathode) are beam power transmitting tubes for use at full input up to 125 mc and reduced input at considerably higher frequencies, as rf power amplifiers and frequency multipliers at 162 mc for radio-telephone applications. The 2E24 has a quick-heating, low-drain filament and low plate voltage requirements, particularly suited for portable operation. Its filament requires 4 watts at 6.3 volts. In a 162 mc. amplifier, a single 2E24 at a plate voltage of 350 V. can deliver 13.5 watts. As a 162 mc doubler the tube can deliver 6 watts; and as a tripler, 3 watts. The 2E26, because it has an indirectly heated cathode, is especially useful for standby operation. Operating within ICAS ratings as a single-ended, 162 mc amplifier, it can deliver 13.5 watts. When operated within CCS ratings, it delivers up to 9.5 watts.—**Tube Dept., Radio Corp. of America, Harrison, N. J.**



THRYATRON TUBE

(Use Inquiry Card, Mentioning No. 802)

Designed especially for igniter firing and motor control applications NL-710 thryraton is one of the highest current gas-mercury mixture tubes commercially available, being rated at 30 amps. peak, 2.5 amps. dc. The gas and mercury filling gives quick starting, uniform characteristics over wide temperature limits and minimizes the need for circuit "cushioning". Filament 2.5 V. at 9 amps.; max. peak inverse voltage 1250; max. peak forward voltage 1000; heating time 20 seconds; typical arc drop at 8 amps. peak 15 V.—**National Electronics Inc., Batavia Ave., Geneva, Ill.**



LOW POWER BEAM TETRODE

(Use Inquiry Card, Mentioning No. 803)

Features of the Sylvania Type 3D24 are: new style, top-lead heat radiator; high purity, Zirconium-coated graphite anode which accounts for clear glass radiation and less gas liberation at high temperatures. Class C telegraphy rating for continuous service up to 125 mc is 180 watts. Filament 6.3V. at 3 amps.; amplification factor 50; grid-to-plate capacitance .2 mmfd.; input capacitance 6.5 mmfd.; output capacitance 2.4 mmfd. —**Sylvania Electric Products Inc., Emporium, Pa.**

GAS FILLED RECTIFIER

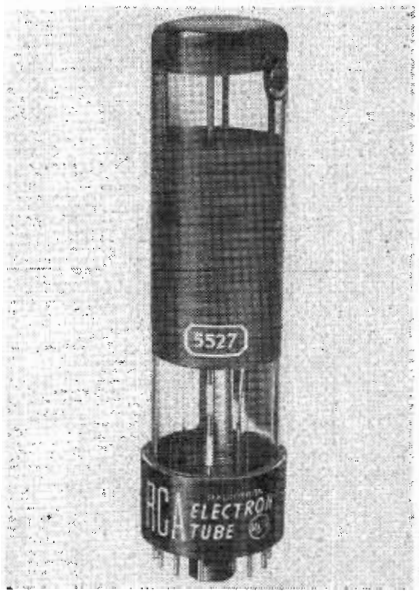
(Use Inquiry Card, Mentioning No. 804)

For applications requiring the dependability of rare-gas filled tubes EL 6B Xenon gas filled half-wave rectifier tube is useful for high power loads. Rectifiers using this tube may be built for dc output up to 440 V. 12.8 amps, single phase, or 650 V., 19 amps. polyphase.—**Electrons Inc., 127 Sussex Ave. Newark 4, N. J.**

MEDIUM-POWER VHF TRIODE

(Use Inquiry Card, Mentioning No. 805)

A compact, improved version of the popular HY75 type HY75A VHF triode has a useful power output 25% higher than the former and an extended frequency range to include the ¾ meter, as well as 1¼ and 2 meter bands. The tube is a highly efficient oscillator or amplifier at frequencies from 50 to 430 megacycles. It has an instant-heating thoriated tungsten filament. Filament 6.3 V at 2.6 amps.; Mutual transconductance 2400 micromhos; amplification factor 9.6; grid-to-plate capacitance 2.6 mmfd.; max. plate voltage 450 V.; max. plate current 90 ma.; plate dissipation max. 15 watts.—**Hytron Radio & Electronics Corp., Salem, Mass.**



TELEVISION CAMERA TUBE

(Use Inquiry Card, Mentioning No. 806)

Primarily intended for use in industrial applications, television, experimentation and demonstration, RCA-5527 Iconoscope is a small television camera tube with a mosaic diameter of 1.4 in. and a resolution capability of about 250 lines. It can provide a satisfactory picture with incident light levels as low as 500 to 1000 ft. candles. Spectral response of the photosensitive surface covers the entire spectrum. Electrostatic deflection and focusing eliminate the need for deflection coils and circuits. Filament 6.3 V. at 0.6 amps.; Overall length 9 in.; Grid No. 1 capacitance to all electrodes 7.5 mmfd.; signal electrode capacitance to all electrodes 5 mmfd.; grid No. 4 and grid No. 2 voltage max. 900; signal electrode voltage max. 900; grid No. 3 voltage max. 450.—**Radio Corp. of America, RCA Victor Div., Tube Dept., Harrison, N. J.**

TRANSMITTING TETRODE

(Use Inquiry Card, Mentioning No. 807)

4-65A is a small radiation-cooled transmitting tetrode having a maximum plate dissipation of 65 watts. Short, heavy leads and low interelectrode capacitances contribute to stable efficient operation at high frequencies. In typical operation (class C telegraphy or FM telephony) at a plate voltage of 400 V. and 1. amps. of plate current a power output of 28 watts is obtained with less than 2 watts of grid driving power. Operating at 2000 V. plate the tube will provide 200 watts power output in the same application. Thoriated tungsten filament 6 V. at 3.5 amps.; input capacitance 8 mmfd.; output capacitance 2.1 mmfd.; grid-plate capacitance .08 mmfd.—**Eitel-McCullough, Inc., San Bruno, Calif.**

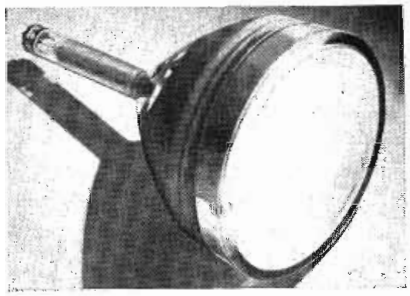
MINIATURE DOUBLE DIODE

(Use Inquiry Card, Mentioning No. 808)

Type 12AL5 is a compact, high-perveance twin diode designed for use as detector, discriminator, avc diode, clipper or low power rectifier. Low internal voltage drop makes it possible to obtain increased output voltage with a low-resistance diode load. Each diode unit, having its own plate and cathode connections, can be used independently. Resonant frequency of each unit is approximately 700 mc. In new equipment the tube replaces type 12H6GT. Filament 12.6 V. at 0.15 amps.; Plate-to-cathode capacitance 2.5 mmfd.; rms. plate potential per plate 117 volts maximum; peak inverse plate potential 330 V. max.; peak plate current per plate 54 ma. max.; dc output current per plate 9 ma.—**Hytron Radio & Electronics Corp., Salem, Mass.**

ANNOUNCEMENT

For the convenience of readers, all descriptions of new products have been assigned IDENTIFYING NUMBERS. For further information, please use the Prepaid Inquiry Card appearing at page 65 in this issue and *Identify the product by the number assigned to it.*



TELEVISION RECEIVER TUBE

(Use Inquiry Card, Mentioning No. 809)

Type 10FP4 ten-inch television tube is designed with an aluminum-backed, direct-view screen. In addition to increasing the clarity, brilliance and definition of the image, this aluminum backing prevents the development of ion spots and intercepts cathode glow. Magnetic focusing and deflecting is used, the required focusing coil current being about 100 ma under typical operating conditions. Max, anode voltage 10,000 V; max. accelerating electrode voltage 410 V.; max. control electrode voltage ± 125 V.; overall length 18 in.— **Tube Div., G-E Electronics Dept., Schenectady, N. Y.**

SUBMINIATURE TRIODE

(Use Inquiry Card, Mentioning No. 810)

About one watt of power at approximately 25% efficiency can be obtained in the Citizen's Radio band (460 to 470 mc.) with subminiature type CK608CX high mutual conductance triode, which measures 0.4 in. in diameter and 1½ in. in length. The tube will operate at reduced output up to 800 mc. or more. It has a 6.3 volt, 200 ma. heater.—**Raytheon Manufacturing Co., Special Tube Section, Newton, Mass.**

SUBMINIATURE ELECTROMETER

(Use Inquiry Card, Mentioning No. 811)

A recent design change in the Victoreen type VX-41 subminiature electrometer has reduced microphonics to a minimum, thus widening the scope of applications to include portable instruments and others subject to vibrations. It is useful in dc amplifiers where stability is important. Characteristics include: filament 1.25 V. at 10 ma.; grid current less than 10^{-15} amps.; grid resistance greater than 10^{15} ohms.—**Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, O.**

WEST COAST'S NEWEST FM BROADCASTER

San Francisco's new FM station KRON, just put on the air, is powered by an RCA 3 kw transmitter. Above is a view of the main studio as seen from the control room. Note the polycylindrical diffusers, arranged both vertically and horizontally along the walls. At the right, chief engineer R. A. Isberg makes an adjustment on the amplifier stage. The exciter stage is at his right and there is a third panel for power supply, not shown

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WASHINGTON

★ ★ ★ **Latest Electronic News Developments Summarized by Tele-Tech's Washington Bureau** ★ ★ ★

REALIGNMENT OF TELEVISION CHANNELS—Both FCC and TV industry engineers are giving intense study to the interference question with the possibility that television may have to give up at least one channel. As a result of the recent FCC-industry engineering conference, the FCC is expected to issue shortly its report on its studies of the problem and there is understood to be some leaning on the part of Commission staff members toward eliminating television channel No. 1 (44-50 megacycles). Frequency reassignment is being considered for TV and the other radio services to provide a buffer between the video medium and mobile radio communications.

MOBILE LICENSES AND FREQUENCIES—Even though the mobile radiocommunications services have been clamoring for speedy action by the FCC, the long-awaited hearings by the Commission on the changing of the mobile services—urban, highway, taxicab, bus, truck, and highway maintenance—from their present experimental basis to permanent status will not be held in early September but have been put off until October due to the fact of the continuance of the Atlantic City World Telecommunications conferences. The latter has necessitated the absence from Washington of the key commissioners who would conduct the hearings. Another important goal of these hearings is the assignment of more frequencies to the mobile services. Despite the delays, however, the flood of applications for the various mobile services continues rather undiminished.

MILITARY UNIFICATION—Little change in the research and development projects and procurement activities of the Army Signal Corps, Navy and Air Forces with regard to radio and electronic fields is slated as a result of the new Military Unification law. In fact, as a result of the coordination and standardization achieved during the war and carried on by the three services since V-J Day, the joint committees on research, procurement, equipment and nomenclature standardization and interchangeability of components have been functioning so well that unification was virtually achieved before it became a statute.

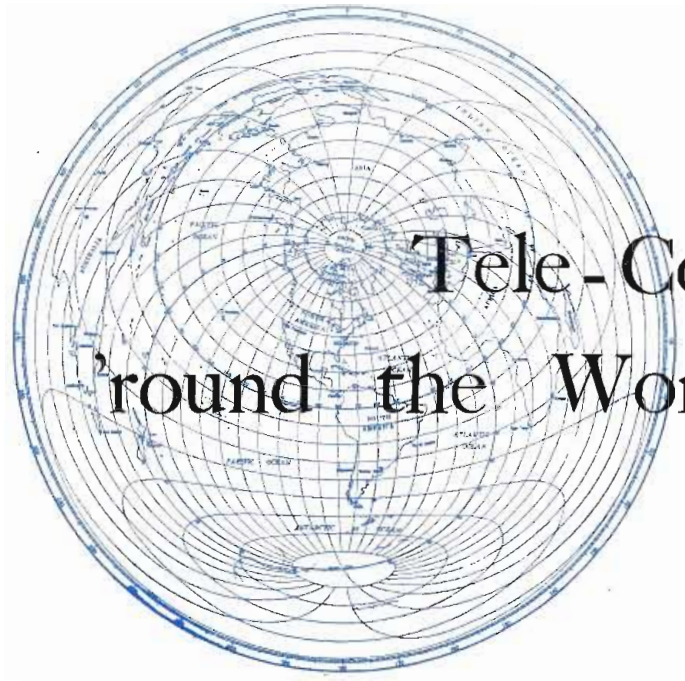
FCC RECLASSIFIES ENGINEERS—In a forward-looking step, so that broadcasting would not "be caught in the switches" of personnel training not keeping pace with rapid technological advances in radio, the FCC reclassification of broadcast operators into three categories will require all stations, except AM stations of not more than 1 kw power and FM stations, to employ at least one engineer-operator. Existing operators are not expected to be required to take new examinations but may have to undergo additional tests in television and FM for engineer-operator licenses.

DIATHERMY TV INTERFERENCE—The greatest interference to television actually has been in Channel No. 2 (54-60 megacycles), but in order to preserve the present system of "block" video broadcasting, this channel will not be cut from television allocations, according to FCC sources. The remedy planned is through the reassignment of frequencies of other services close to that channel aided by the additional space available in the event of the elimination of Channel No. 1. The major disturbances to Television Channel No. 2 have come from direct diathermy interference and diathermy and industrial heating harmonics, it was outlined to FCC in recent report by F. J. Bingley, Chief Television Engineer of Philco and Chairman of RTPB Panel No. 6. Other interference to this channel has arisen from amateur harmonics and to some extent from FM broadcasting, while there have been characteristics of insufficient image rejection from Channel No. 5.

SKYWAVE INTERFERENCE RULING—An early report by FCC on its studies of skywave interference to clear channel station from daytime outlets with clear channel coverage grants is slated because of strong protests by clear channel stations of the daytime outlets cutting into their territories. FCC is expected to cut down on license grants of daytime operators but not to call back or modify latter stations. No FCC decision before mid-winter on breakdown of clear channel assignments is anticipated. Hearings on clear channel assignments will be resumed Sept. 29.

MISCELLANY—New radio service with prospects of large usage has loomed—private non-common carrier marine radio service by tugboat fleets, yachts and motorboats having both their own land (fixed) and mobile systems. This presents question for FCC to map out engineering standards and service regulations to be formulated in hearings later in summer. Plan to iron out problems of interference between fixed and mobile service and amateurs and television stations in spectrum space between 42 and 88 megacycles evolved at FCC engineering conference, June 10-11. One issue was last year's plan for TV sharing with fixed and mobile while amateurs' harmonics from 27-28 mc band transmissions were under study.

ROLAND C. DAVIES, Washington Editor



Tele-Communications 'round the World

By ROLAND C. DAVIES,
Tele-Tech Washington Bureau

News of engineering matters of importance and of markets in various foreign fields

HIGH - POWERED SPANISH STATION—According to recent reports from Spain, the ambitious plan to set up an international commercial broadcasting station, the Inter-Continental Broadcasting Co., is fast approaching reality with antennas now being constructed for powerful transmitters on the Island of Poo at Mosula and Fernando. The big shortwave transmitters will have 200 kw output and be beamed toward Europe, the United States, South America and Africa. Central studios of the huge station are to be located in Madrid with direct communication to Mosula.

BRITISH RADIO EXPORTS—Latest figures on radio equipment exports by Great Britain reveal that activity in that field has considerably stepped up after the worst of the coal crisis which had cut down British exports by nearly 50%. Radio exports for May show that about $3,200,000 worth of equipment was shipped out as compared with $2,272,000 for April. Receivers, it was said, accounted for nearly half of the total radio exports and it is expected that overall shipments for June and July will show even higher totals.

HAITI'S RADIO MONOPOLY—A law was recently passed in Haiti over strong protests from the Chamber of Deputies and newspapers of that country, which it is said, virtually establishes a Government monopoly of all forms of radio broadcasting. The law, according to interpretations published in Haiti, will establish a state monopoly of radio stations of power greater than 5 kilowatts. According to one newspaper, the Haitian government is said to have found a group willing to build a highly powerful station in that country at a cost of about $1,000,000 and implied that the law was drafted at the instigation of this group which wants protection for its investment.

TURKEY TO ADD RADIO FACILITIES — Turkey's international communications system, generally considered inadequate for the country's needs, will be improved by the addition of two new radiotelephone and radiotelegraph stations, due to be completed in 1948.

BOLIVIAN BROADCASTERS—A Radio Broadcasting Department (Departmento de Radiodifusion), to function as part of the Office of Radiocommunications in the Ministry of Public Works and Communications, has been established by the Bolivian Government. The controls over the country's radio broadcasting stations, majority of which are privately owned, were established in order to effect more complete fulfilment of international agreements involving frequency assignments and operating regulations. To this end, the Department has been authorized to obtain equipment from U. S. manufacturers.

BROADCASTING IN AUSTRALIA—One of the world's most unusual educational broadcasting studios is being set up in Australia at Alice Springs (Northern Territory). It will be in a schoolhouse and will be connected by land-lines with the headquarters of the "Flying Doctor Service." Radio lessons broadcast from the school will be carried over a special radio network of the "Flying Doctor Service" to children living on isolated cattle ranches. The South Australian State education authorities and the Australian Broadcasting Commission are co-operating in the scheme, which is designed to supplement teaching by correspondence.

BRITISH NATIONAL RADIO EXHIBIT — Plans for the fifteenth National Radio Exhibition in England, Oct. 1-11, 1947, are now in final stages. The exhibition, organized by the Radio Industry Council, will have a wider scope than in prewar years, embracing not only sound and vision broadcast receiving equipment, but also transmission and communications equipment, radar and the newest applications of electronics. Theatre-style television will be publicized on "Television Avenue", where BBC will operate a

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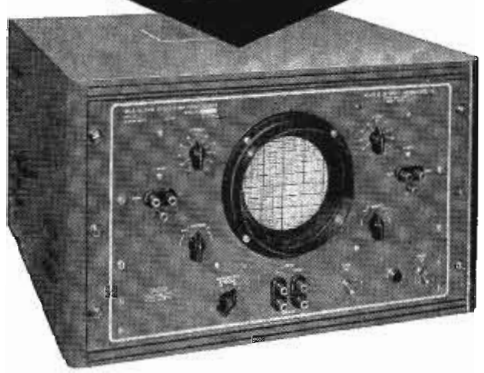
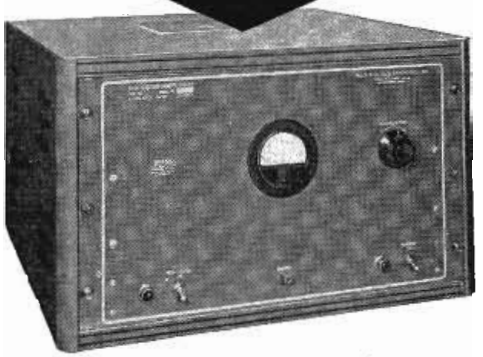


Type 281 as an independent unit

- A basic instrument for needs too specialized or advanced for equipment hitherto available.
- Choice of 4 kv or 8 kv accelerating potential; self-contained power supplies.
- Recordable writing rates of single transients exceed 4 in./μs.
- No amplifiers or time base, but coupling to all deflection plates, grid and cathode on front panel; direct connection to deflection plates on top of instrument.
- Relay-rack or cabinet mounted.

ITS NEW SUPPLEMENTARY HIGH-VOLTAGE POWER SUPPLY Type 286



Type 286 as an independent unit

- Exceptionally-safe for operator.
- Output potential continuously variable between + 18 kv and + 25 kv.
- Regulation within 5% for ± 10% line voltage change or 0 to 500 ma. load variation.
- Direct-reading output voltmeter accurate within ± 2% of full scale.
- Used in standard relay-rack or own dust-proof cabinet.
- May be fastened to Du Mont Type 281.

When combined

- FULL capabilities of the high-voltage Type 5RP-A Cathode-Ray Tube are realized.
- Excells the cold-cathode continuously-evacuated type tubes for photographic recording.
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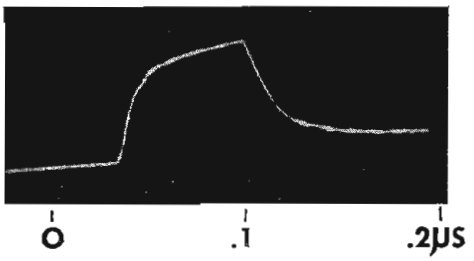

Details on request

DUMONT *Precision Electronics & Television*

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small theater to pick up programs broadcast from Alexandra Palace. The event will be the only major exhibition this year by British industry and buyers from all over the world are expected to attend.

ARGENTINA IMPORTS — With the recent ban by the Argentine government on importation of completed radio receivers, the U. S., Britain and other countries now furnishing sets to the South American country will have to make arrangements for shipping partially unassembled units to be completed there. A contract along those lines was recently negotiated by the Ultra Electric, Ltd. of Britain whereby the company's receivers, partially assembled, would be shipped to the Argentine's Henry Peabody and Co., the latter to be provided with test equipment and other materials for final assembly.

SPAIN TO HAVE FOUR 100-KW SHORT WAVE STATIONS — Four 100-kw short wave radio stations are to be installed at different locations in Spain by Marconi Espanola, associate of British Marconi, in the near future. Manufacture, assembly, testing and erection of the equipment will be carried out by the Madrid and Chelmsford factories working in close collaboration. Total cost of the equipment is estimated at 270,000 pounds.

CHINESE OVERSEAS RADIO SERVICES BEING EXPANDED — The Chinese Overseas Radiocommunications Service is to be expanded by installation of 12 radio transmitters for telegraph and telephone services. Power of the transmitters will vary from 5 to 25 kw, with 30 triple diversity high-speed receiving sets and 150 commercial receivers. The Marconi Company in England has been awarded the contract.

RADAR-RADIO MARINE AIDS FOR GREAT LAKES — Treaty discussions on the operation of Great Lakes marine radar and radio navigational aids are expected to take place in a number of sessions between the United States and Canada this year, according to a recent report which pointed out that the Canadian government is highly interested in an experimental radar and other electronic aid program now being conducted by the U. S. Lake Carriers Association. It was also said that the Canadian government has recommended the discussions as pointing the way to the best regulation of methods of operation and types of equipment to be used on ships sailing the Great Lakes between the two countries.

GREAT BRITAIN LEADS IN TOTAL INTERNATIONAL BC TIME — A survey of international short wave voice broadcasting, comparing the use of the medium by the United States with that of 55 other nations, has been released by the State Department. The survey showed that at the end of last year the Big Four nations — U. S., Russia, Great Britain and France — were the leaders in the number of hours of international broadcasts. Great Britain led with 16.56%, followed by the United States with 9.21%, Russia with 6.09% and France with 3.83%.

FRENCH RADIODIFFUSION PLANNING EXPANSION, TV NETWORK—Under the postwar expansion program of Radiodiffusion Francaise, French Government-operated radio broadcasting system, a "Radio House" will be built outside Paris near Pont de Serves for centralization of the organization's activities. Radiodiffusion is planning to extend its networks, it was reported recently, but is facing difficulties of equipment shortages except in locations where the organization has been aided in taking over facilities formerly operated by the U. S. Armed Forces Network.

Television broadcasts of Radiodiffusion are now being made on 450-line definition, black and white, until a country-wide system can be built up and higher definition accomplished.

Meanwhile, there has been considerable agitation aroused in France for separation of Radiodiffusion's activities from direct government control, somewhat on the pattern of the British Broadcasting Corp. However, it was said that developments toward separation of the agency appear dependent on whether Radiodiffusion can function financially on the license fees it receives from receiver use (a 500-franc license fee for individual receivers is charged) and at the same time maintain expensive experimentation in such services as television without asking for a government subsidy.

SWEDISH RADIO RECEIVER OUTPUT ON INCREASE—Postwar production of radio receivers and components in Sweden has been on the increase under the impetus of heavy wartime production, although no statistics on number of actual sets and parts have been made available since 1943. However, the potentialities of the Swedish home market and the country export possibilities, both for standard broadcast and television apparatus, were indicated in a report that American interests are negotiating with the city of Stockholm for a site for a new factory in order to increase its facilities for the manufacture of coaxial cable and other equipment.

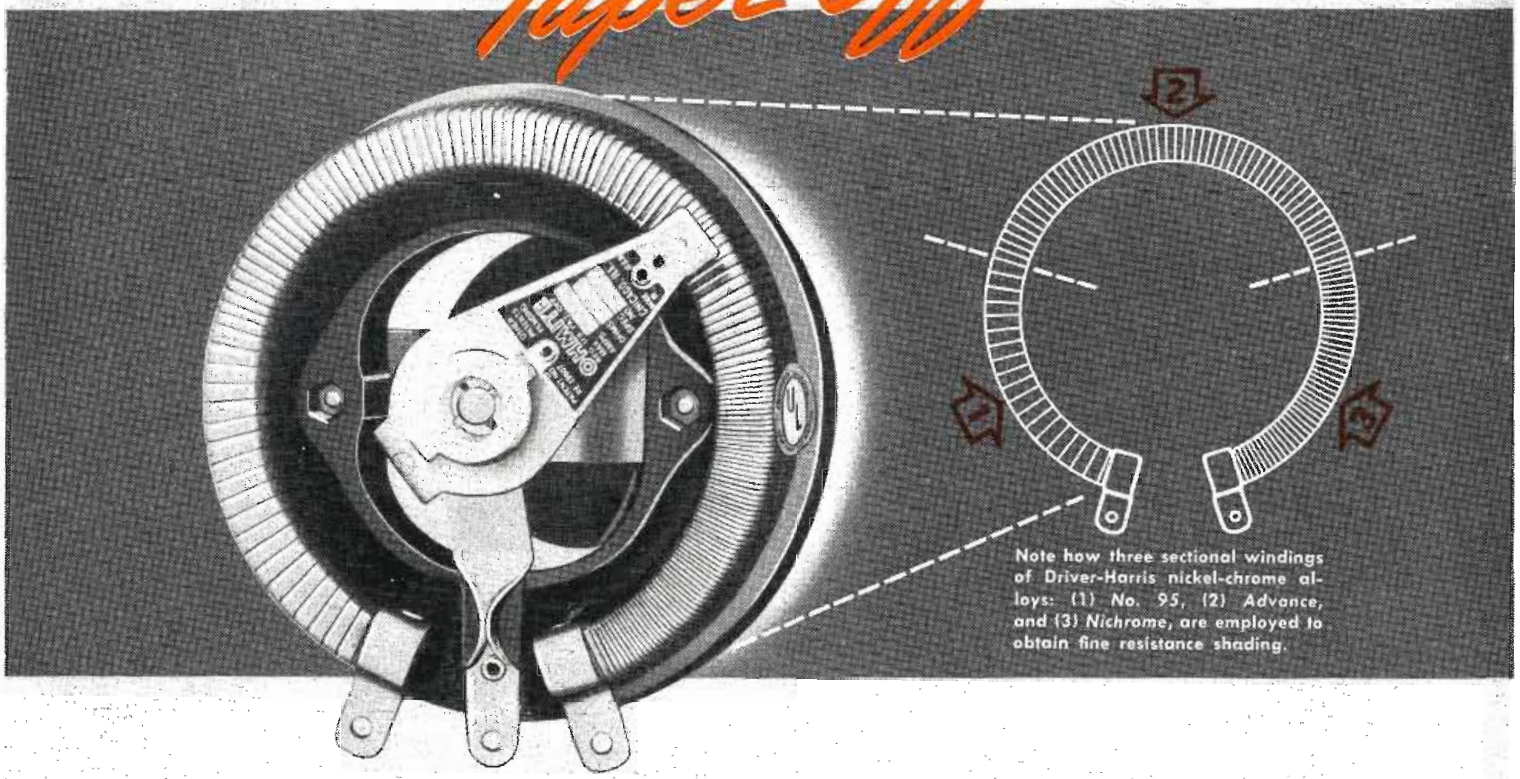
Sweden has the largest number of receiving set licenses in operation in relation to population of any country in Europe. The country's population at the end of 1945 was 6,673,956, and the number of radio licenses was 1,839,911. During successive five-year periods from 1930 Swedish radio set licensing increases have been "startling" and figures show that in the country in 1930 there were 482,305 receivers, and almost doubling in 1935 to 834,143, increasing to 1,470,375 in 1940 and 1,839,-911 in 1945.

The entire cost of the broadcasting service in Sweden is defrayed out of receiver license revenues. Of the 33 stations in Sweden, 18 are government-owned and the others, though privately-owned, are under government control. The government has also entered the frequency modulation field, having erected an experimental station in Stockholm.

BRITISH TO INSTALL RADAR AT LIVERPOOL—An order for a shore radar station at Liverpool, England, claimed to be "the first of its kind" has been placed with Sperry Gyroscope Ltd., according to a recent report. The equipment, it is said, will allow the Port of Liverpool to remain open under extreme weather conditions. Screens in the control room will indicate all buoys in the bay as well as enable plotting of the positions of all ships.

Resistance Control Problems

"Taper Off"



Note how three sectional windings of Driver-Harris nickel-chrome alloys: (1) *No. 95*, (2) *Advance*, and (3) *Nichrome*, are employed to obtain fine resistance shading.

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DRIVER-HARRIS Alloys

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In the 3-section, 500 watt Ohmite Model R Rheostat illustrated, three Driver-Harris nickel-chrome alloy wires—*Nichrome**—*Advance**—and *No. 95* are employed to obtain the fine shading of resistance desired. For other resistance combinations, there are more than 80 Driver-Harris *electrical resistance alloys* specifically designed to fill the numerous requirements of the Electrical and Electronic Industries.

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News of the Industry

FCC Abolishes Most Sharing in TV Bands

In order to abolish channel sharing in all but two television channels, FCC has adopted a proposal to eliminate Channel 1 (44-50 mc) entirely and give it to non-government, fixed and mobile services. There will thus remain only 12 television channels, instead of the original 13, and there is to be sharing in only Channel 7 (174-180 mc) and Channel 8 (180-186 mc).

The proposal which will become effective unless sufficient arguments against it to warrant a public hearing are filed by Sept. 15, comes as a direct result of the informal engineering conferences held in Washington June 10 and 11, and at which engineering and other opinion was overwhelmingly against any sharing in the TV bands.

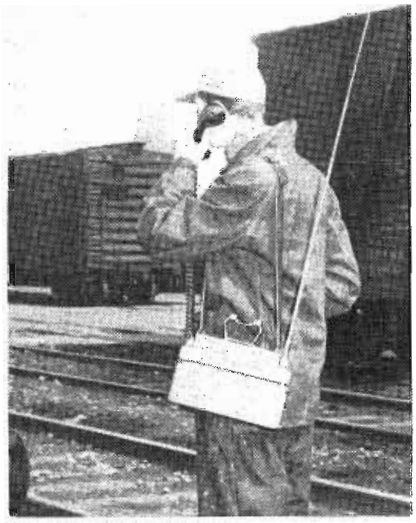
Under the proposed spectrum revision all non-government services which were to have shared with TV on Channels 1 through 5 and 9 through 13, are to be moved into the 44-50 mc band. This includes police, fire, highway maintenance, petroleum, power utility, forestry, etc.

Otherwise there is no change in existing television allocations which run from 54 to 72 mc (3 channels), 76 to 88 (2 channels), 174-180 (2 channels) and 186 to 216 (5 channels).

At present no television stations are operating on Channel 1 and there is only one CP outstanding.

Elimination of Channel 1 will necessitate re-allocations in 14 cities as follows: Ames, Ia.; Bloomington, Ind.; Cleveland; Columbus; Fall River; Harrisburg; Manchester; Racine; San Diego; Scranton; South Bend; Springfield, Mass.; Trenton and York, Pa.

For some time there has been the wish, that FM might someday fall heir to the No. 1 TV channel. With the allocation of other non-government services to this slot, however, later re-allocation appears remote.



Motorola Handie-Talkie

Supplementing its extensive line of police radio equipment Motorola, Inc., Chicago, has developed a special type of Handie Talkie and will make the unit available to the public. Weighing seven pounds, the unit is a compact crystal controlled FM transmitter and receiver powered with dry cells, may be arranged for storage battery 115V. ac operation. It is designed to operate in the 25-44 mc band.

Canada Dims Diathermy

Canada has clamped down on diathermy. After January 1, 1948 all such equipment must be frequency stabilized, harmonic-supressed and shielded.

Telecommunications Meet Will Wind up Sept. 28

With representatives of 71 nations continuously in session at Atlantic City, since the middle of May, the International Telecommunications Conference plans now to wind up its session September 28th. It is expected that shortly thereafter the conference will make public that part of the deliberations having to do with spectrum division and that a new table of allocations will be adopted. At the same time a new set of radio regulations superseding those adopted at the Madrid convention in 1934 also will be put in the record. Meantime a high frequency broadcasting conference was started on August 26. Little of the nature of its deliberations has as yet been released.

West Coast Conference

With 26 engineering papers on the agenda and a total of 24 exhibits by manufacturers combined meetings of the IRE and WCEMA (West Coast Electronic Manufacturers Association) are expected to draw record attendance. The IRE conference opens in the Palace hotel, San Francisco on Sept. 24 and concludes its six sessions on the 26th. WCEMA opens its exhibit in the Whitcomb hotel on Sept 25 for two days with a final day open to the public on the 28th. W. Noel Eldred, 395 Page Mill Road, Palo Alto, is looking after exhibit mat-

(*Continued on page* 84)

CONVENTIONS AND MEETINGS AHEAD

September 8-12—Second National Instrument Conference and Exhibit—Hotel Stevens, Chicago.

September 12-13—Frequency Modulation Association, National Meeting, Hotel Roosevelt, New York.

September 15-18—Annual convention National Association of Broadcasters, Convention Hall, Atlantic City.

September 24-26—West Coast IRE convention, Palace Hotel, San Francisco.

September 26-28—West Coast Electronic Manufacturers' Association third annual Electronics trade show, Hotel Whitcomb, San Francisco.

October 1-11—National Radio Exhibition, Olympia, London, England.

Oct. 20, 21—Fall meeting of U.R.S.I. Auditorium, Interior Dept., Wash., D. C.

October 20-24—Society of Motion Picture Engineers, Theatre Engineering conference, Hotel Pennsylvania, New York.

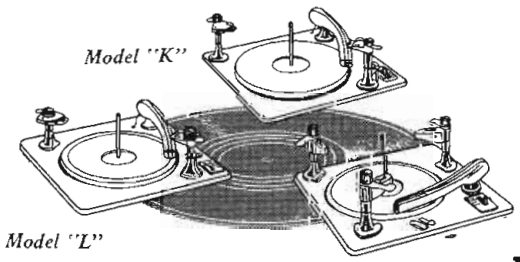
November 3-5—National Electronics Conference, Edgewater Beach Hotel, Chicago.

Nov. 17, 18, 19—Rochester Fall Meeting, RMA Engineering Dept. and IRE, Hotel Sheraton, Virgil M. Graham, Chairman, Sylvania Electric Products, 40-42 Lawrence street, Flushing, N. Y.

March 22-25—IRE convention and Radio Engineering show, Grand Central Palace and Hotel Commodore, New York.

Changer Performance

TO MATCH THE PERFECTION OF THE INSTRUMENT



Fine combination instruments are judged—and sold—by their over-all excellence of performance. It's important, then, that you select record changers to match the precision and beauty of your radio-phonograph combinations.

Seeburg builds three such changers. While each is designed for use in sets of varying price ranges, all are engineered to give simple, trouble-free operation.

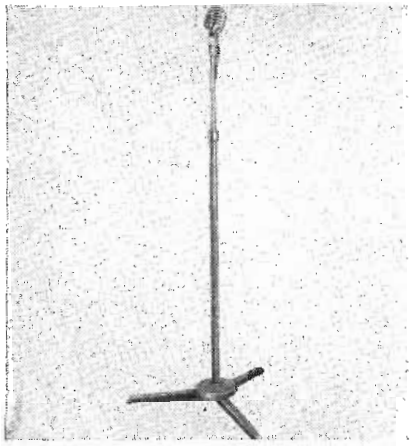
Back of every Seeburg changer is a broad, successful experience in the development and manufacture of all types of changing mechanisms—this is your assurance of dependable, gratifying performance.

Seeburg

RECORD CHANGERS ★ MUSIC SYSTEMS

J. P. SEEBURG CORPORATION
1500 N. Dayton St., Chicago 22

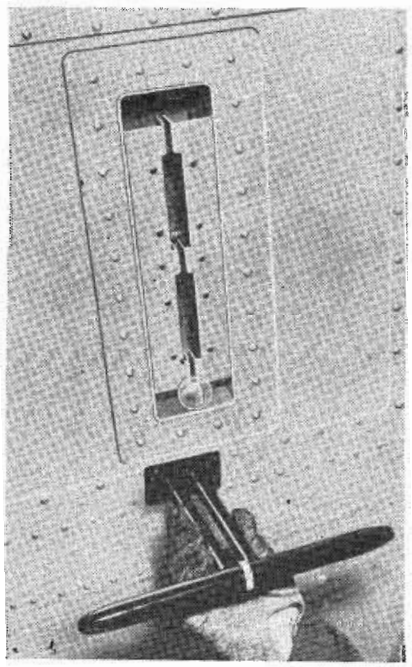
Communications Components



Microphone Stand

(Use Inquiry Card, Mentioning No. 812)

The Utility model 430 floor stand gives finger-tip control of shaft height from 36 to 65 in. by pressing and releasing a button. The shaft may be rotated without any adjustment. The stand has a sturdy die cast, 3-legged base with a leg spread of 17 in. Net weight is 7½ lbs.—**Electro-Voice, Inc., Buchanan, Mich.**



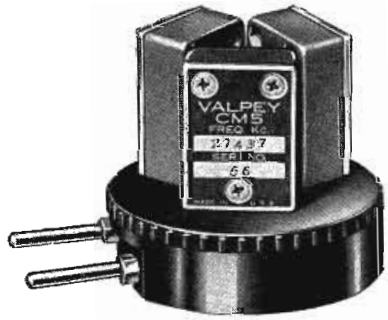
Aircraft Antenna

(Use Inquiry Cord, Mentioning No. 813)

Eliminating antenna aerodynamic drag RCA type MI-19727 streamlined slot antenna is a cavity resonating device suitable for transmission and reception in the 420 to 460 mc band. Producing the radiation pattern required for aircraft radar altimeters the antenna is designed for operation in high speed planes and replaces the protruding half-wave dipole now in use. The antenna consists of an aluminum cavity which is installed in the aircraft wing or fuselage. Illustration shows a comparison between the slot antenna (top) and the conventional half-wave dipole (bottom).—**RCA Victor Div., Camden, N. J.**

ANNOUNCEMENT

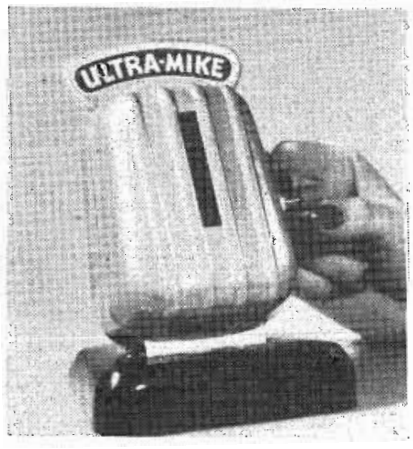
For the convenience of readers, all descriptions of new products have been assigned IDENTIFYING NUMBERS. For further information, please use the Prepaid Inquiry Card appearing at page 65 in this issue and *Identify the product by the number assigned to it.*



Crystal Changer

(Use Inquiry Card, Mentioning No. 814)

To facilitate rapid crystal change from one frequency to another the Valpey Xtalector mounts two or three crystals on a molded Bakelite structure which is rotatable by means of a knurled rim. The contact design does not add capacity or loading to the crystal; unused crystals are completely out of the circuit. The unit accommodates Valpey type CM5 crystals having .094 diameter pins with ½ in. spacing. It is supplied in two types to fit either ½ in. or ¾ in. sockets.—**Valpey Crystal Corp., Holliston, Mass.**



Miniature Transmitter

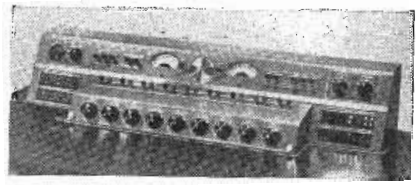
(Use Inquiry Card, Mentioning No. 815)

Ultra-Mike, a miniature microphone-transmitter containing its own power supply, utilizes an rf. oscillator modulated directly by the microphone. Transmission frequency is adjustable between 1200 and 1700 kc. The unit may be placed up to 75 ft. from a radio receiver tuned to its frequency. It uses a standard flashlight cell and a 45 volt B battery. Weight is 28 ozs. Applications include intra-plant communications, inventory recordings, home uses etc.—**Andrew Technical Service, 111 E. Delaware Place, Chicago 11, Ill.**

Coaxial Cable Relay

(Use Inquiry Card, Mentioning No. 816)

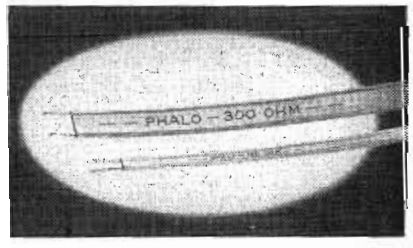
Primarily designed for switching a hf. antenna connection from receiver to transmitter this coaxial cable relay consists of a single pole, double throw switch with the current carrying elements contained in a cavity of the correct proportions to produce a characteristic impedance of 75 ohms with a low S.W.R. The switch is actuated by an electromagnet, which may be wound for 6, 12, 24, 32 or 110 volts dc or 115 or 230 volts, 60 cycles, ac. The relay has a capacity of 250 watts.—**Dept. CR3, Signal Engineering & Mfg. Co., 154 W. 14 St., New York 11.**



Speech Input Console

(Use Inquiry Card, Mentioning No. 817)

Designed particularly for broadcasters using FM or for AM stations planning FM, the 25B speech input equipment provides noise-free, distortionless operation over a 15,000 cycle range on dual program channels, capable of simultaneous operation on different programs. The console houses two complete main amplifier channels, pre-amplifiers, mixers, switching, indicating, monitoring and other control equipment. Terminals are provided for eight microphones or low level transcription circuits. Four pre-amplifiers with switching keys permit selection of either of two inputs for each amplifier.—**Western Electric Co., 195 Broadway, New York 7.**



Transmission Line

(Use Inquiry Card, Mentioning No. 818)

This low loss twin transmission line is insulated with polyethylene which is water-repellent, weather resistant and highly resistant to corrosion. For use as FM or television lead-in, the lines are available in 75, 150, and 300 ohms impedance.—**Phalo Plastics Corp., Worcester, Mass.**

HERE ARE SIMPSON'S "BASIC 3" PROFIT-MAKERS FOR SERVICEMEN...

The serviceman who tries to "get along" with cheaply-made, run-of-the-mill test instruments is taking an outside chance on success. The business of radio servicing must be *built* from the bottom up on an endless succession of perfect jobs. Knowing what the trouble is, in a receiver, and knowing when that trouble is eliminated *can be no better than the test instruments that reveal them.*

The "Basic 3" Simpson instruments shown here are an extremely profitable investment for any serviceman. He needs all three and, in their price range, he cannot buy better anywhere else. In fact, in their price range they are unequalled. They will do more than many instruments selling for substantially more. These are facts easily demonstrable to any serviceman who will take the time to check up. And it is worth the time in the *cold cash of profits* to discover how Simpson engineering skill and uncompromising quality construction produce the *staying* accuracy for which Simpson instruments are famous.

MODEL 315 SIGNAL GENERATOR. Designed down to the most minute detail for highest accuracy, greatest stability, minimum leakage, and good wave form **$67.35**

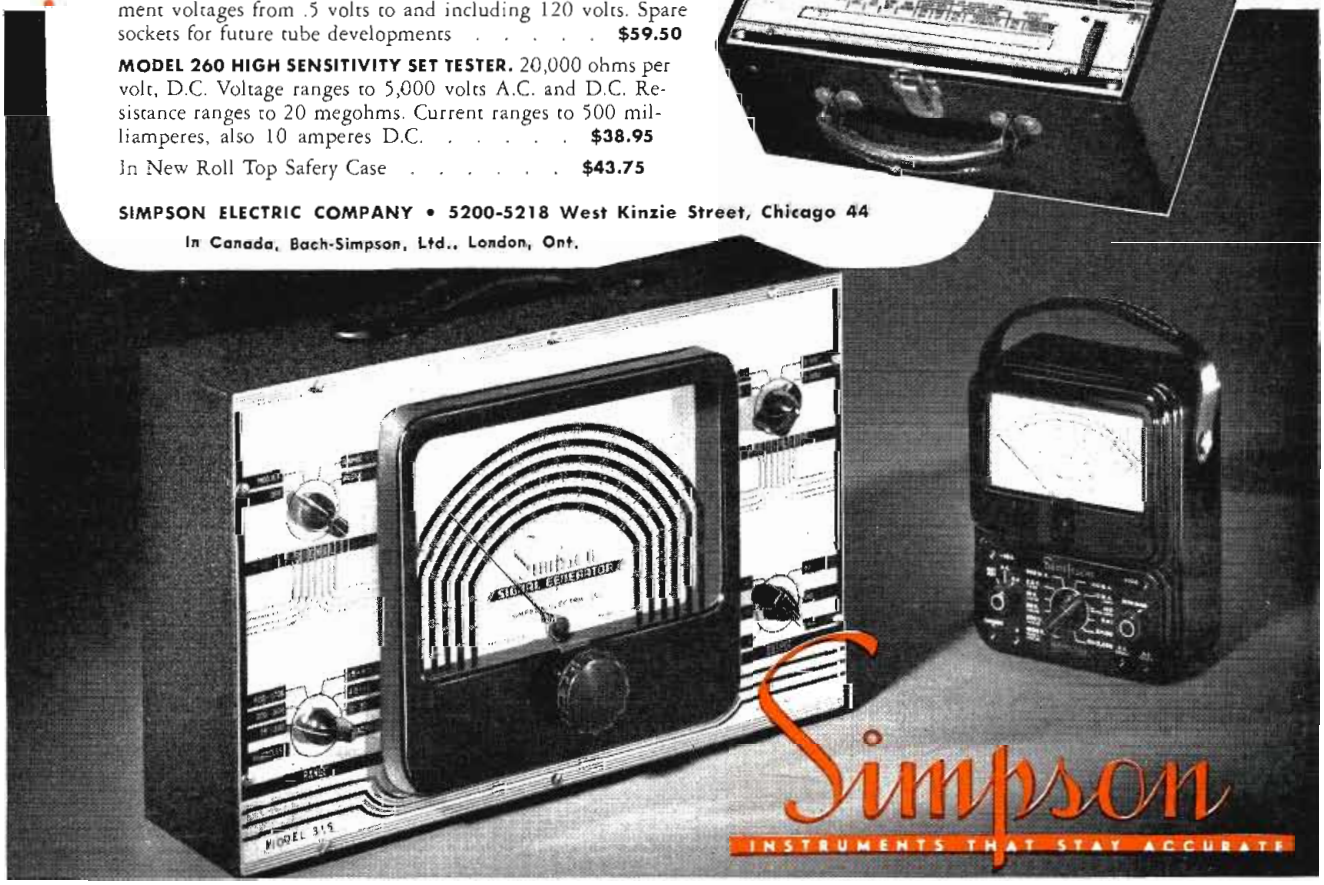
MODEL 305 RC TUBE TESTER. Tests all tubes. Provides for filament voltages from .5 volts to and including 120 volts. Spare sockets for future tube developments **$59.50**

MODEL 260 HIGH SENSITIVITY SET TESTER. 20,000 ohms per volt, D.C. Voltage ranges to 5,000 volts A.C. and D.C. Resistance ranges to 20 megohms. Current ranges to 500 milliamperes, also 10 amperes D.C. **$38.95**

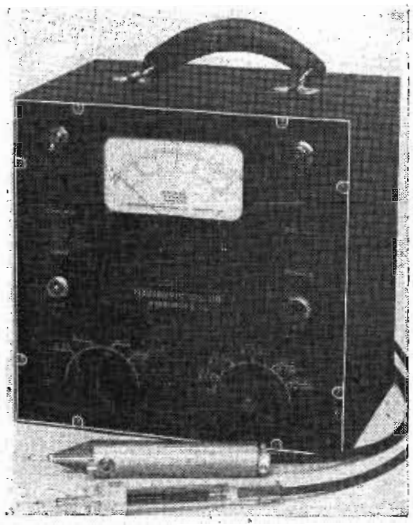
In New Roll Top Safety Case **$43.75**

SIMPSON ELECTRIC COMPANY • 5200-5218 West Kinzie Street, Chicago 44

In Canada, Bach-Simpson, Ltd., London, Ont.



Parts for Design Engineers



Vacuum Tube Voltmeter

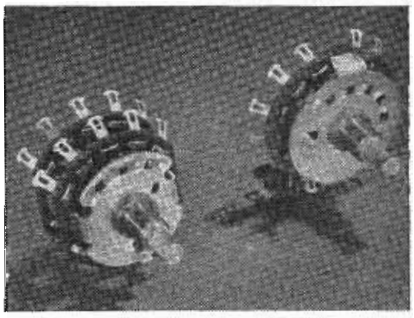
(Use Inquiry Card, Mentioning No. 819)

Model 730 vacuum tube voltmeter is a low-cost instrument, utilizing miniature tubes conservatively operated to extend their life, and having a power consumption of less than 1 watt. The unit has six ranges of 2.5, 10, 50, 250, 500, and 1000 volts with an accuracy of ±3% ac and dc. A switch permits positive or negative readings on dc. An rf probe is provided having a flat response to 120 mc. The attenuator utilizes 1% accuracy stabilized-film resistors to guarantee calibration over long periods of time. The meter is a rugged 1 milliamp. type.—**Allied Laboratory Instrument, Inc., 355 West 26 St., New York 1.**

Trimmer Core Forms

(Use Inquiry Card, Mentioning No. 820)

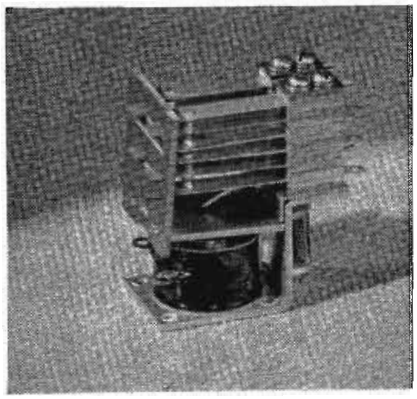
Placed in fitted metal sleeves, the molded Polytite trimmer electrode core forms serve as variable capacitors with good stability in hf. circuits where humidity and vibration are important factors. The cores are moisture repellent and carry a heavy dielectric coating. Polytite trimmer capacitors are suited for minimum capacity adjustments in tuned circuits and where bandspread tuning is used. Maximum capacity adjustment is from 20 to 40 mmfd.—**Stackpole Carbon Co., St. Marys, Pa.**



Band Switches

(Use Inquiry Card, Mentioning No. 821)

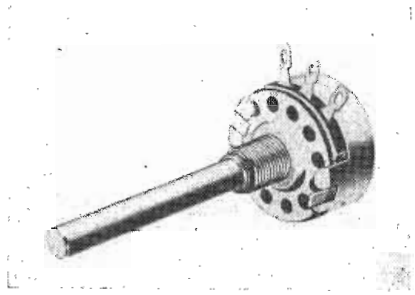
Designed for band tone control switching where medium and low torque indexing action is required, RSA-50 and RSA-60 circuit selector switches are useful where space is a factor. Both models are available in one or two section construction. The RSA-50 has up to 12 terminals on either side of the section and provides from 2 to 6 positions. The RSA-60 permits up to 10 terminals on either side and provides from 2 to 5 positions. Its narrow section design permits easy under chassis mounting.—**P. R. Mallory & Co., Inc., Indianapolis, Ind.**



Multipole Relays

(Use Inquiry Card, Mentioning No. 822)

Capable of handling almost any control circuit where currents do not exceed 12½ amps. at 115 volts ac, non-inductive, these small multipole relays can be supplied with make-before-break or with single or double throw contact action, singly or in combinations up to a maximum of 4-pole double throw. The movable pole pieces, made of phosphor bronze, will accommodate either ¼ in. silver contacts for currents up to 12½ amps., or ⅛ in. contacts for currents up to 8 amps. Coils can be furnished for shunt, series, ac and dc operation.—**Leach Relay Co., 5915 Avalon Blvd., Los Angeles 3, Calif.**



Potentiometer

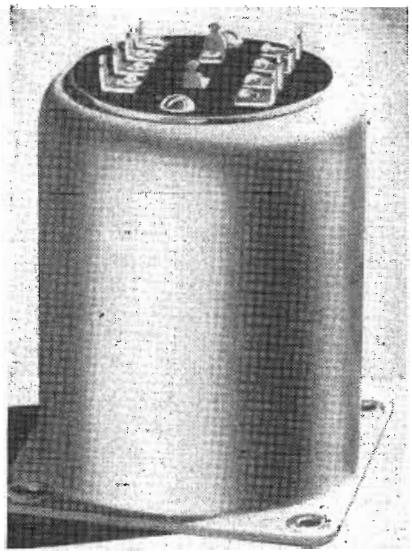
(Use Inquiry Card, Mentioning No. 823)

Type AB, 2-watt molded composition potentiometer for industrial and laboratory use has a large safety factor, provided by a thick ring, resistance element heat treated under pressure and unaffected by heat, cold, and moisture. The unit has low noise level, smooth taper, and high load-carrying ability. It is available in 16 stock values from 50 ohms to 5 megohms with linear taper. Five values from 0.1 to 2.5 megohms are available in clockwise logarithmic taper and three values are available in counter-clockwise taper.—**Ohmite Mfg. Co., 4974 West Flournoy St., Chicago 44, Ill.**

Oscillograph Projection Lens

(Use Inquiry Card, Mentioning No. 824)

Large-screen oscillograms for lecture and demonstration purposes are obtainable with the Du Mont Type 2088 projection lens which is intended for use with oscillographs provided with a Type 5RP-A high-voltage cathode-ray tube with extra-brilliant images. The lens flange has four mounting holes aligning with threaded holes in the front panel of oscillographs adapted for the 5RP-A tube. The projection lens is a two-element, symmetrical, objective lens with relative aperture of f/3.3 and focal length of 7.7 in. It projects an oscillographic pattern of an area up to 3 x 3 in. from the CR-tube screen to distances beyond 8 ft., resulting in a screen image up to approximately 12 x 12 ft. The axial light transmission is about 85%.—**Allen B. Du Mont Laboratories, 2 Main Ave., Passaic, N. J.**



Auto-Transformers

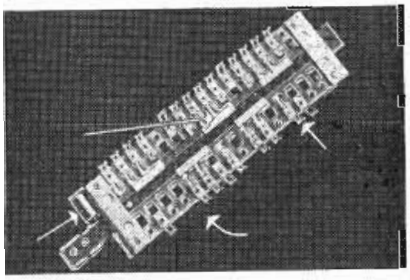
(Use Inquiry Card, Mentioning No. 825)

The 26A loudspeaker auto-transformer, one of a new line designed by Bell Telephone Labs., is useful in simplifying connection of multiple loudspeakers to the outputs of amplifying systems. It is capable of handling 16 watts of audio power, and is tapped for reducing outputs in 3 db. steps to .25 watts. Loudspeakers are operated in parallel, permitting individual adjustment of volume for each speaker. Frequency range of the units is from 50 to 15,000 cps. Also available are model 25A and model 27A, with 4 and 64 watts maximum power respectively.—**Western Electric Co., 195 Broadway, New York 7.**

Multiple Core Solder

(Use Inquiry Card, Mentioning No. 826)

There are three separate cores of flux in "Multicore" solder. Rapid melting results from the multiple core construction due to the thinner walls; total percentage of flux to solder is no greater than in conventional solder. Supplied in any alloy of normal specification and in any gage from 10 S.W.G. to 22 S.W.G. on 1-lb. or 7-lb. reels.—**British Industries Corp., 315 Broadway, New York 7.**



Slide Switch

(Use Inquiry Card, Mentioning No. 827)

This AM-FM slide switch of flat, horizontal design saves space and permits coils to be mounted directly over the switch, thereby reducing lead inductances. Double wipe silver plated spring brass clips assure constant pressure and low internal resistance. Contacts are also made of silver plated brass. The unit is available with 2 or 3 position index or without index, and is variable in length from a minimum of 5 clips per side to a maximum of 20 clips per side.—**Centralab Div. of Globe-Union Inc., Milwaukee 1, Wis.**

AMAZINGLY QUIET – **POWERFUL** – *Efficient*

Motor rumble — the bugaboo of all magnetic recorders and pick-ups—now reaches a new vanishing point in a revolutionary new motor developed by the Russell Electric Company.

Known as the Type 300 motor (Pat. No. 2071224), it combines high starting torque with high efficiency and flexibility. A 4-pole motor, it has a very low external field because of the large amount of iron in its core. Unmatched in design!

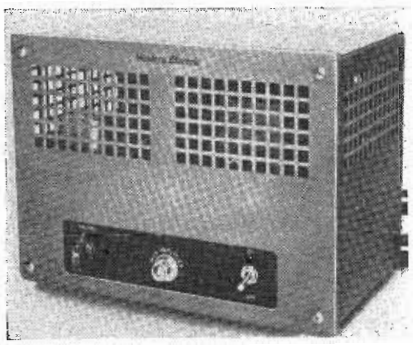
Lasting quietness is assured by a rabbeted stator that keeps rotor accurately centered and aligned —plus a precision dynamic balance.

Smooth, cool-running operation is assured by an efficient lubricating system and *two* cooling fans.

Prompt delivery now offered on Type 300 motor. Phone, write or wire for complete information.

340 West Huron Street • **RUSSELL ELECTRIC COMPANY** • Chicago, Illinois

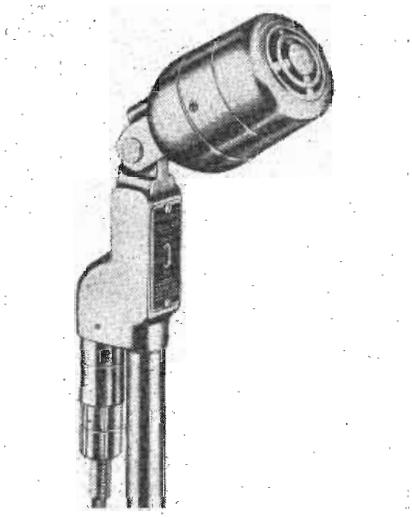
Sound and Recording Equipment



AC-DC Amplifier

(Use Inquiry Card, Mentioning No. 828)

Intended for wired program service and monitoring use the 114A amplifier offers the same high stability for dc operation as it does for ac. Internal noise of the amplifier is entirely independent of the line or grounding connection. It can be operated directly from telephone lines and meets the requirements of telephone companies. A separate isolating coil is therefore not necessary.—**Western Electric Co., 195 Broadway, New York 7.**



Dynamic Microphone

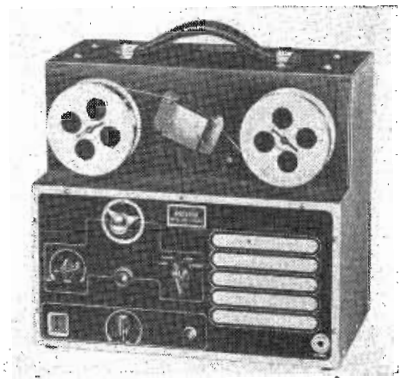
(Use Inquiry Card, Mentioning No. 829)

E-V 635 moving-coil dynamic microphone is omnidirectional below 2000 cps, becoming directional at higher frequencies. Frequency response is substantially flat from 60 to 13,000 cps. (plus or minus 2.5 db.) Output is—53 db. The unit uses an Acoustalloy diaphragm which withstands high humidity and extremes of temperature. An impedance selector switch permits choice of 50 or 250 ohms. Up to 90° vertical tilt possible.—**Electro-Voice Inc., Buchanan, Mich.**

Standard Test Record

(Use Inquiry Card, Mentioning No. 830)

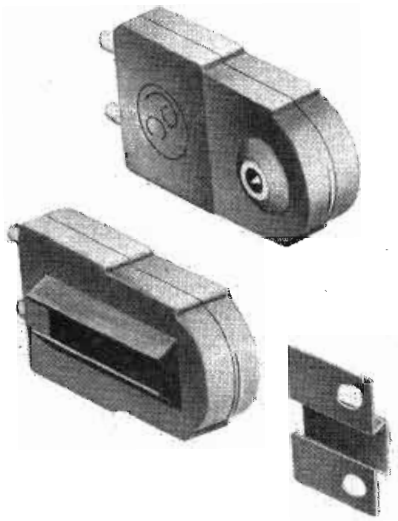
The Walsco standard test record for record changers and coin operated phonographs permits accurate adjustment to the proper set-down and tripping position of the pickup through use of three consecutive tones. Lead-in grooves are modulated from the outer edge in a series of three tones. Proper adjustment is obtained when only two tones are heard. Playing time of the 10-in. record is approximately 40 seconds. This makes it possible to obtain five change cycles in less time than it takes to play one regular record.—**Walter L. Schott Co., Beverly Hills, Calif.**



Wire Recorder

(Use Inquiry Card, Mentioning No. 831)

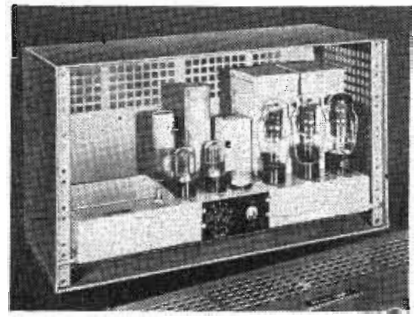
Designed for office use, the Peirce dictation machine is marketed complete with either microphone or foot control. The unit performs all functions of a standard wire recorder including the reproduction of music with a frequency response ranging from 150 to 5,000 cycles at ±3 db. A specially developed clutch permits frequent and immediate change from the listening to the talking position without danger of breaking the wire. Corrections are made by simply redictating over previous dictation on the wire. The recorder is supplied complete with two spools of wire and a high impedance dynamic microphone, hand or desk type.—**Peirce Wire Recorder Corp., Evanston, Ill.**



Cartridge Reproducer

(Use Inquiry Card, Mentioning No. 832)

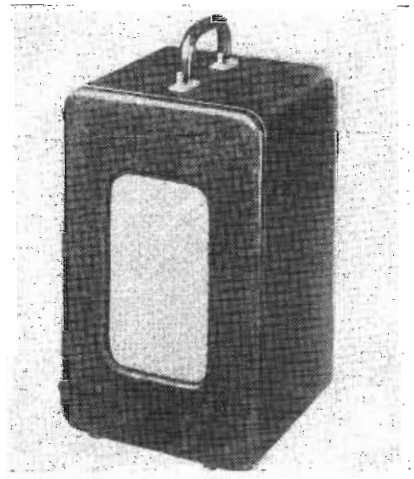
A compact version of the Pickering pickup, Model 120 M cartridge reproducer is designed to fit into practically any arm which will accommodate a crystal cartridge by means of the Keystone Clip mounting. The cartridge is a high-impedance magnetic pickup with a frequency response flat within 2 db from 40 to 10,000 cps, and an output voltage of 70 millivolts at a stylus velocity of 10 cm. per second. A sapphire stylus with a tip radius of .0027 in. is built in as an integral part of the unit. Temperature and humidity changes do not affect performance. The unit, when installed in a well-designed arm, will track with a pressure of 15 grams; tracking error can be adjusted to a minimum. An equalizer-amplifier Model 125 H, available for use in conjunction with the cartridge, raises the output voltage to 2.5 and permits adjustment of frequency characteristic. **Pickering Co., Inc., 29 West 57 St., New York City 19.**



P.A. Amplifiers

(Use Inquiry Card, Mentioning No. 833)

Model 142A amplier is one of a series for public address and sound distribution use. Output of the self-contained, ac-operated unit is 25 watts and frequency response characteristic meets FM requirements. Also available is model 143A with 75 watts output and the type 141A three-stage pre-amplifier for use in conjunction with either of the basic power amplifiers. A variety of input circuits can be accommodated by the units.—**Western Electric Co., 195 Broadway, New York 7.**



Portable Amplifier

(Use Inquiry Card, Mentioning No. 834)

Designed for recorded music, Webster-Chicago Model 66 amplifier has a push-pull circuit with three tubes and a rectifier. It delivers 8 watts output through an 8-in. Alnico 5 speaker. The unit has separate tone and volume controls, the on-off switch being on the tone control. It is especially suitable for use with model 65 portable record changer or as an external amplifier and speaker for model 80 wire recorder. Net weight of Model 66 is 18 lbs. Operation is from 105-125 volt, 50-60 cycle, ac.—**Webster-Chicago Corp., 5610 Bloomingdale Ave., Chicago 39, Ill.**

Acoustic Material

(Use Inquiry Card, Mentioning No. 835)

Useful for acoustical treatment, communication systems, drawer linings etc., Cellusuede rayon velour paper is available in black, maroon, green, brown, red and blue colors. The company is equipped to do slitting, sheeting, die cutting, press embossing and fabricating for special shapes and designs of the material to requirements.—**Cellusuede Products, Inc., Rockford, Ill.**

New Tubes on Page 63

available now . . .

MEISSNER AM and AM-FM TUNERS

For Superlative Reception

Designed for use wherever exceptionally high fidelity reception is desired, the new postwar Meissner AM and AM-FM Tuners are now available for your most exacting requirements. Both of these new precision designed components cover the broadcast band from 527 to 1620 kc. and the AM-FM Tuner also covers the FM band from 88 to 108 mc. At 105-125 volts, 50-60 cycles, power consumption is 80 watts for the AM-FM Tuner and 60 watts for the AM Tuner. See these quality units at your jobbers today or write for complete specifications to the address below;

CHECK THESE OUTSTANDING FEATURES

Frequency response of Tuners is flat within ±2 db from 30 to 15,000 cycles! Bass control provides 10 db boost at 40 cycles; treble control varies response from +12 db to −14 db at 10,000 cycles. Volume control has automatic bass compensation circuit to match the bass characteristic of the human ear.

Sensitivity of the Tuners is less than 10 microvolts. Selectivity for AM signals may be made either "broad" or "sharp". Output of the Tuners is 8 volts at the high-impedance terminals and .75 volts at the 500 ohm terminals. Hum level is 60 db below output. Phonograph input terminals are provided so that Tuner and its amplifier may be used with a record player. Any antenna with single lead-in wire can be used for AM signals. FM section designed for an antenna having a balanced 300 ohm transmission line.

AM-FM Tuner Tube complement; 9003 R. F. Amplifier; 6BE6 oscillator converter; 2-9003 I. F. Amplifiers; (456 kc); 6AL5 detector for AM section. For the FM section; 6AG5 R. F. Amplifier; 6C4 oscillator; 6AG5 converter; 3-6AG5 I. F. Amplifiers (10.7 mc.) 2-9001 limiters and 6AL5 detector. Two 6C4's are used for audio amplifiers, a 6U5/6G5 for tuning indicator and 5Y3GT/G for rectifier.

AM Tuner Tube complement; 6BA6; 6BE6; 2-6BA6; 6AL5; 2-6C4; 5Y3GT/G and 6U5/6G5.

Meissner

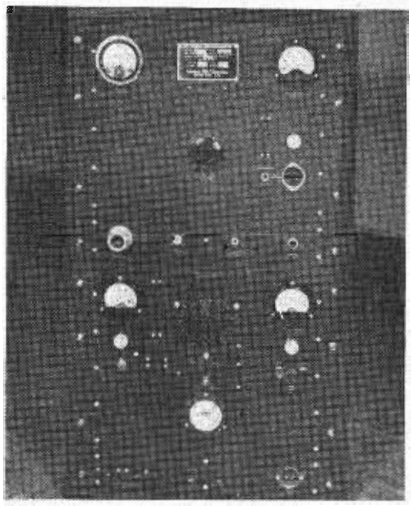
ELECTRONIC DISTRIBUTOR AND INDUSTRIAL SALES DEPARTMENT

MAGUIRE INDUSTRIES, INC.

936 N. MICHIGAN AVE., CHICAGO 11, ILLINOIS

EXPORT ADDRESS: SCHEEL INTERNATIONAL
4237 N. LINCOLN AVE., CHICAGO 18, ILL. CABLE—HARSCHEEL

New Lab and Test Equipment



Thyratron Modulator

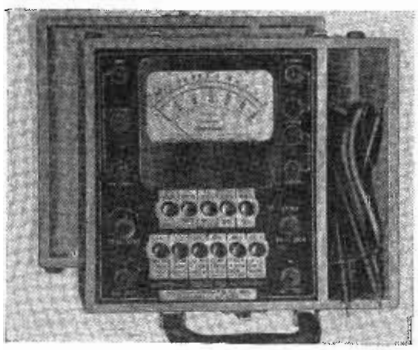
(Use Inquiry Card, Mentioning No. 836)

Designed for investigations in the fields of pulse power geueration Dormitzer model 12 thyratron modulator is a laboratory tool useful for hf. studies on rf equipment, transmission lines, waveguides etc. and for industrial development. The instrument has a peak pulse power of 250,000 watts and requires a trigger of 200 volts (posit.). Minimum pulse duration is 1 microseeond, maximum being 6 microseconds. A repetition rate up to 4000 p.p.s. can be obtained. Peak pulse voltage is 5 kv into 50 ohms impedance. Tube complement consists of 2-705 A rectifiers, 1- 4C35 hydrogen thyratron, and 1- 3B26 clipping diode. The modulator is designed for operation on 115 volts, 60 cycles, ac and consumes 700 watts.—**Dormitzer Electric & Mfg. Corp., 782 Commonwealth Ave., Boston 15, Mass.**

Audio Sweep Generator

(Use Inquiry Card, Mentioning No. 837)

Based on the automatic beat-frequency principle model 182A Audiomatic generator, in conjunction with a standard oscillograph, gives visual indication of the entire frequency-amplitude characteristic of the circuit being tested. The instrument includes a slow sweep rate from 5 to 8 seconds, especially useful for speaker testing. Hand cranking of the frequency dial, formerly required, is no longer necessary.—**Clough Brengle Co., 6014 Broadway, Chicago 40, Ill.**



Push-Button Multi-Tester

(Use Inquiry Card, Mentioning No. 838)

Series 858 multi-master makes possible pushbutton laboratory and field testing, covering 54 ac and dc ranges. Sensitivity of the instrument is 20,000 ohms per volt, using a 50 microamp., 4½ in. rectangular meter. A row of 6 buttons provides: 8 dc voltage ranges to 6,000 v. at 20,000 or 1000 ohms per volt, 8 ac ranges to 6000 v. at 1000 ohms per volt, 8 dc current ranges to 12 amps., 6 ohmmeter ranges to 600 megohms, 8 db ranges from —26 to +70 db., and 8 output ranges to 6,000 volts. The instrument is available as model 858-P (portable) in solid hardwood case or as model 858-L for laboratory use, housed in a shallow bakelite case. Both models are supplied complete with internal batteries and test leads.—**Precision Apparatus Co., 92-27 Horace Harding Blvd., Elmhurst, L. I., N. Y.**

ANNOUNCEMENT

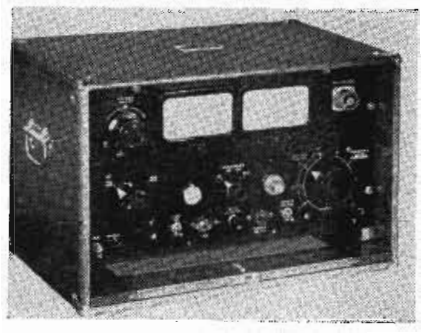
For the convenience of readers, all descriptions of new products have been assigned IDENTIFYING NUMBERS. For further information, please use the Prepaid Inquiry Card appearing at page 65 in this issue and *Identify the product by the number assigned to it.*

Vacuum Tube Voltmeter

(Use Inquiry Card, Mentioning No. 839)

Model 110 vacuum tube voltmeter is provided with a heat loop on all critical resistors to avoid overheating during soldering and is fungus-proofed to maintain stability and accuracy over a long period of time. The instrument has dc ranges of 3- 30- 150- 300- 600- 3000-15,000 volts, ac ranges of 3- 30- 150- 300 volts for use up to 300 megacycles, and resistance ranges of 1000- 10,000-100,000- 1 meg.- 100 megohms.—**Elcetronie Mfg. Co., 140 South Second St., Harrisburg, Pa.**

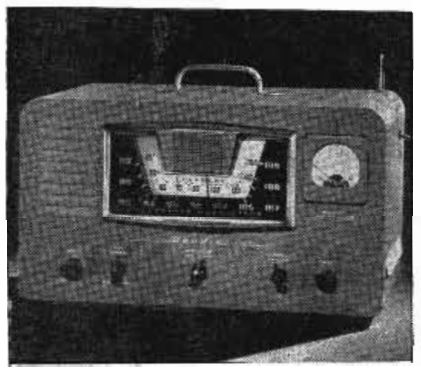
Look For New Tubes On Page 63



Insulation Tester

(Use Inquiry Card, Mentioning No. 840)

Insulation resistance of power cables, transformers, capacifors, switches and wiring assemblies can be measured at any desired dc voltage up to 10 kv with the model 184 insulation tester. Breakdown voltages can also be accurately determined. Resistances ranging from 0.1 to 50,000 megohms may be read directly on a megohmeter scale at open circuit voltages of 0.5, 1, 5, and 10 kv, or may be calculated in ranges from 0.3 to 20,000 megohms from voltmeter and microammeter readings at auy test voltage from 100 to 10,000 volts. Either method may be selected by a switch. Leakage current ranges are 30, 150, 300, and 1500 microamps. The tester operates from 115 volt, 60 cycle ac. — **Radio Frequency Laboratories, Inc., Boonton, N. J.**



Field Strength Indicator

(Use inquiry Card, Mentioning No. 841)

To facilitate installation of FM receivers in homes and check on possible dead spots, the FactoMeter is a portable AM-FM receiver, equipped with a small, telescopic antenna and precision meter which accurately translates the strength of the incoming signals on the anteuua. The device is suited to home demonstrations and eliminates the guesswork in FM installations.—**Bendix Radio, Baltimore 4, Md.**

Voltage Calibrator

(Use Inquiry Card, Mentioning No. 842)

For use with all models of cathode-ray oscillographs type 264-A voltage calibrator provides a method for measuring peak-to-peak voltage of any signal being viewed on the oscillograph screen. Output is essentially a square wave the amplitude of which is continuously variable from 0 to 100 volts by means of a direct-reading linear potentiometer in parallel with four-step decade output attenuator. Overall accuracy of output voltage is within ±5% in each range. The calibrator is housed in a metal cabinet 8 in. wide x 5¾ in. deep x 4½ in. high and weighs 5 lbs.—**Allen B. Du Mont Laboratories, Inc. Passaic, N. J.**

STRAIGHT-LINE FEED
. . . Low Residual Inductance
. . . Higher Resonant Frequency
AEROVOX SERIES 1690
Mica Capacitors

● The *brand new* Aerovox Series 1690 molded-in-bakelite mica capacitor is intended specifically for circuits where inductance must be kept at a minimum. It is designed for least possible residual inductance, low r.f. losses and lower r.f. resistance and impedance. What's more, it provides increased KVA ratings for given capacitor sizes.

Such units can be advantageously applied as blocking capacitors in transmission lines; as tank capacitors for high-frequency oscillators; as by-pass capacitors for ultra-high-frequency currents; and as coupling or by-pass capacitors in induction-heating circuits.

Exceptional compactness for given KVA ratings; exceptionally-low-loss operation; ability to withstand constant duty and heavy overloads—for these and other reasons this latest Aerovox development marks a new performance standard for severe-service capacitors.

ACTUAL SIZE

Featuring . . .

● Rounded hardware—round nuts tightened by spanner wrench supplied; round washers; spherical lock nuts. Elimination of sharp edges and corners that might cause corona loss.

● Fine threads for terminal studs, insuring maximum contact and minimum resistance.

● Silver plating for all conducting members, minimizing skin resistance.

● Body of XM or yellow low-loss bakelite molded about mica section for thorough sealing and extreme ruggedness.

● Mica section of carefully selected mica and foil. Designed for straight-line path for ultra-high-frequency currents.

● Several times the size of the well-known Series 1650 bakelite-molded transmitting capacitors. Dimensions: 2⅜" w. x 2⅛" d. x 1⅜" h., and 4¾" overall between rounded terminal tips.

● Available in ratings up to 20,000 volts D.C. Test, or 10,000 volts operating. Capacitance values up to .001 mfd. at the highest voltage rating.

● *Interested? Write for detailed information. Meanwhile, submit that capacitor problem for our engineering collaboration.*

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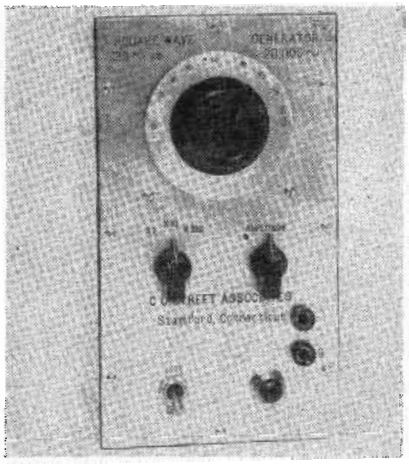
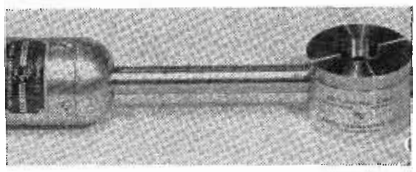


Square Wave Generator

(Use Inquiry Card, Mentioning No. 843)

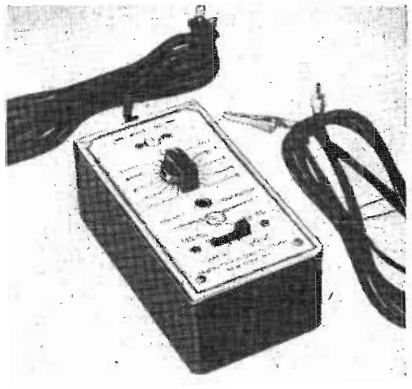
Designed for checking the square wave response of audio, rf and IF circuits, resonant peaks in speakers, phase shift in amplifiers, etc., this new square wave generator has a range from 200 to 20,000 cycles and a maximum output of 2.5 volts. Rise time is 1.5 microseconds, output impedance 3000 ohms. The unit is supplied complete with voltage regulated power supply in a walnut cabinet with dimensions of 5 x 5 x 9 in.—**Sterling Electronic Laboratories, 151 East 70 St., New York 21.**



Artificial Ear Coupler

(Use Inquiry Card, Mentioning No. 844)

For use in obtaining response characteristics of earphones model M-112 artificial ear coupler is a two-piece stainless steel structure which provides either a 2 cc closed chamber for calibrating insert type phones or a 6 cc chamber for standard size earphones. The unit has a side opening for insertion of the microphone end of the Massa GA-1002 sound pressure measurement equipment. If this equipment is not available a Model M-101 standard microphone may be inserted as pressure responsive element. Due to the high acoustic impedance of the microphone no "soft diaphragm" correction is needed for the chamber volume to frequencies beyond 20,000 cycles.—**Massa Laboratories, Inc., 3868 Carnegie Ave., Cleveland 15, Ohio.**



Pocket Signal Generator

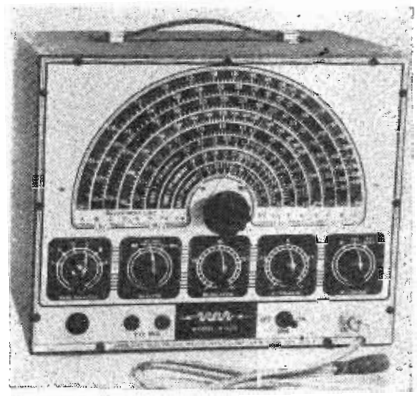
(Use Inquiry Card, Mentioning No. 845)

This compact, low-cost signal generator is suitable for production line testing and alignment as well as for portable applications. Model 710 provides two frequencies for broadcast band alignment, 550 kc and 1500 kc. For IF alignment, either 456 or 465 kc is available. The unit is equipped with trimmers for recalibration. Operation is from 115 volt, ac or dc.—**Radio City Products Co., 127 West 26 St., New York 1, N. Y.**

Electronic Volt Ohmmeter

(Use Inquiry Card, Mentioning No. 846)

This compact, self-contained, battery-operated electronic volt-ohmmeter has an input impedance of 15 megohms, shunted by 10 mmfd. capacity. Six ac and dc voltage ranges are provided at 0-3, 12, 30, 120, 300, and 1200 volts. Resistance is covered from 1 ohm to 1000 megohms in 6 ranges. The instrument uses a 1S5 tube. Two size C flashlight cells and a miniature type 45 volt battery are required. The unit weighs 5¼ lbs.—**Hickok Electrical Instrument Co., 10606 Dupont Ave., Cleveland 8, Ohio.**



Signal Generator

(Use Inquiry Card, Mentioning No. 847)

The model A-200 signal generator covers an rf frequency range from 100 kc to 25 mc on fundamentals and to 75 mc on harmonics, in eight bands. External modulation or 440 cycle internal modulation is provided, modulation percentage being continuously adjustable from 0-100%. Output is controlled by a 3-step attenuator and a continuously variable fine attenuator. The instrument uses a 6SN7 tube as rf oscillator, a 6SH7 af oscillator and modulator, a 6SH7 cathode follower output, and a 6X5 rectifier. It operates on 105-120 volt, 50-60 cycles, ac.—**Approved Electronic Instrument Corp., 142 Liberty St., New York 6.**

Cathode-Ray Oscilloscope

(Use Inquiry Card, Mentioning No. 848)

Quick "plug-in" interchange of three different types of cathode-ray tubes having varying degrees of persistence is made possible in the RCA model WO-60C oscilloscope by merely detaching the built-in light shield. The instrument, intended for general purpose and industrial applications, is constructed of heavy duty components which will withstand shock and vibration. Weighing only 31 lbs., it comprises bigh gain amplifiers, calibrated attenuators, oscillators, and internal power supplies. It will handle input voltages up to 850 volts peak to peak. Unusually low frequency response permits observation of wave forms from 0.5 to 300,000 cycles. Timing may be either sinewave or sawtooth.—**Radio Corp. of America, RCA Victor Div., Camden, N. J.**

ADP Crystal Growing

Editor, Tele-Tech: We have read with interest the articles in the July 1947 issue of Tele-Tech entitled "Trends in Development of Parts and Components" by Chester I. Soucy and are writing this letter to direct your attention to a misunderstanding concerning the ADP crystal.

Mr. Soucy is quite correct in his assumption that the ADP crystal indicates the possibility of improvement in crystal electromechanical transducers.

As to the origin of the ADP crystal Mr. Soucy seems to be under some misapprehension. In his article he credits the Bell Telephone Laboratories with the development of the ADP crystal and gives as his authority for this an article by W. P. Mason entitled "ADP and KDP Crystals" in the July 1946 issue of the Bell Laboratories Record. Careful reading of this article, however, reveals that Dr. Mason and the Bell Telephone Laboratories do not claim the development of the crystal. The fact is that the ADP crystal was developed by the Brush Development Company.

Early in the war the superiority of ADP over Rochelle salt for underwater transducer applications was recognized by Brush and Brush recommended it to the Navy and the Bell Telephone Laboratories. The Navy responded enthusiastically and requested The Brush Development Company and the Bell Telephone Laboratories to cooperate in speeding the development of such transducers and methods for the production of large quantities of crystal. Bell Telephone Laboratories assigned some highly qualified men to the job and there was complete exchange of information between the two companies including disclosure by Brush to Western Electric Company of the former's growing methods and plant design. Large scale ADP crystal growing facilities were setup by The Brush Development Company and Western Electric to meet the heavy war time demand for these crystals mostly for underwater transducer use. The Western Electric facilities were dismantled following the war but the Brush facilities are still in operation for commercial as well as government requirements.—THE BRUSH DEVELOPMENT CO.

J. P. Arndt, Jr.

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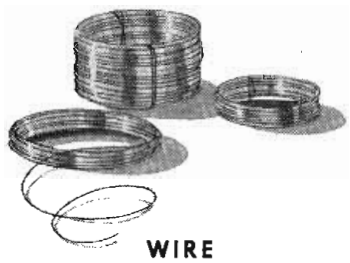
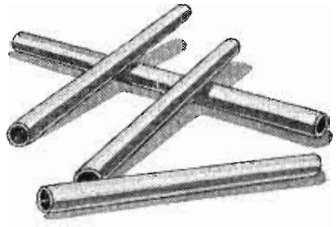
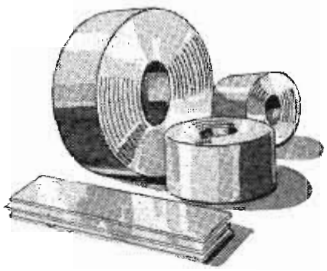
(Silver or precious metal bonded to base metal)



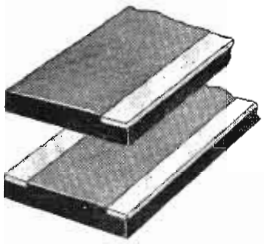
WIRE



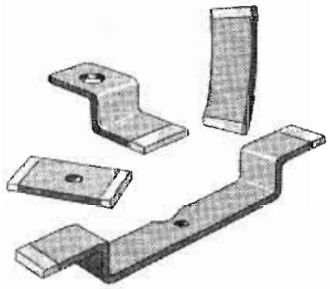
TUBE



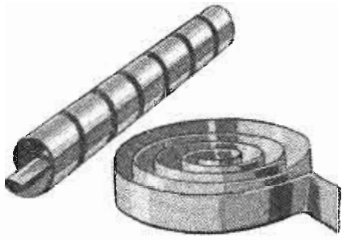
SHEET



INLAY METALS



CONTACTS



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Atlantic City Hears Armstrong's FM Program

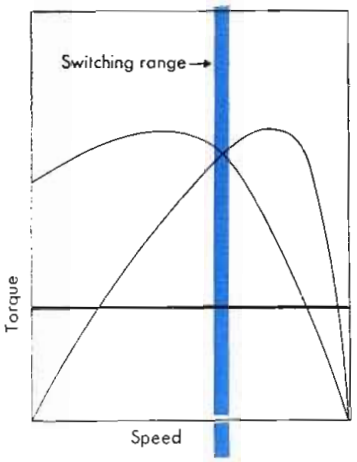
Representatives of 77 nations attending the International Telecommunications Conference in Atlantic City early in August were given a practical demonstration of the possibility of FM program relaying. Programs originating in Major Armstrong's Alpine (N. J.) station, W2XEA-W2XMN, were received by station WOAB-FM in Atlantic City over an airline distance of 116 miles, and re-broadcast for the delegates. Programs were picked up on a receiver a short distance from the seaside city and carried by high-fidelity wire circuit to the transmitter, a 3-kw Federal Telephone and Radio Corp. unit. Engineering involved in the set-up was carried out under the direction of S. L. Bailey of Jansky & Bailey, Washington consulting engineers.

West Coast Conference

(*Continued from page 72*)

ters. Following is the tentative technical program for the IRE conference:

Technical Problems of Military Radio Communication, John Hessel, Signal Corps Engineering Labs.
Applications of Electronics to Underwater Ordnance, Ralph D. Bennett. Naval Ordnance Lab.
Experimental Determinations of Mutual Impedance of Antennas, F. R. Abbott, US. Navy Electronics Lab.
A New Pulse-Time Telemetering System, J. N. Davis, Sylvania Electric.
Microwaves in Ordnance Work, F. G. Suffield, Allison Associates.
Telemetering Guided Missile Performance, James C. Coe, U. S. Naval Air Missile Test Center.
A 50,000-Watt FM Transmitter for 100.5 mc, Leigh Norton, Eitel-McCullough.
Susceptibility of FM Receivers to Interfering Signals, D. E. Foster. Hazeltine Research of California.
Frequency Modulation, Detectors, S. W. Seeley, RCA Industry Service Lab.
Limiters and Discriminators in FM Receivers, W. G. Tuller, M.I.T.
A VHF Bridge for Impedance Measurements, Robert Soderman, General Radio.
A Pulse Counter Type FM Station Monitor, David Packard and Norman Schrock, Hewlett-Packard.
Supersonic Flaw Detection, Donald Erdman, Tripplett and Barton.
Electronic Gage Methods and Apparatus, R. L. Sink, Consolidated Engineering.
Equivalent Networks for Waveguide Problems. J. R. Whinnery, Univ. of Calif.
The New York-Boston Radio Relay, J. L. Mc Rae, Bell Labs.
High Quality Loud Speakers, J. K. Hilliard, Altec Lansing.
A Solution of the Antenna Problem, C. Lanczos, Boeing Aircraft.
The Proton Linear Accellerator, L. W. Alvarez, Univ. of Calif.
The Electron Linear Accellerator, W. W. Hansen, Stanford Univ.
Oscillation and Gain Properties in New Types of Travelling Wave Tubes, L.M. Field, Stanford Univ.
Resnatron Design, W. W. Salisbury, Collins Radio.
Radio Wave Propagation in the FM Broadcast Band, K. A. Norton, National Bureau of Standards.
A 5 KW Television Transmitter, J. E. Keister, J. W. Downie, H. B. Sancher and L. M. Ewing, General Electric.
A Modern Television Transmitter, C. D. Kentner, RCA Labs.
Receiving Antennas for FM and Television.



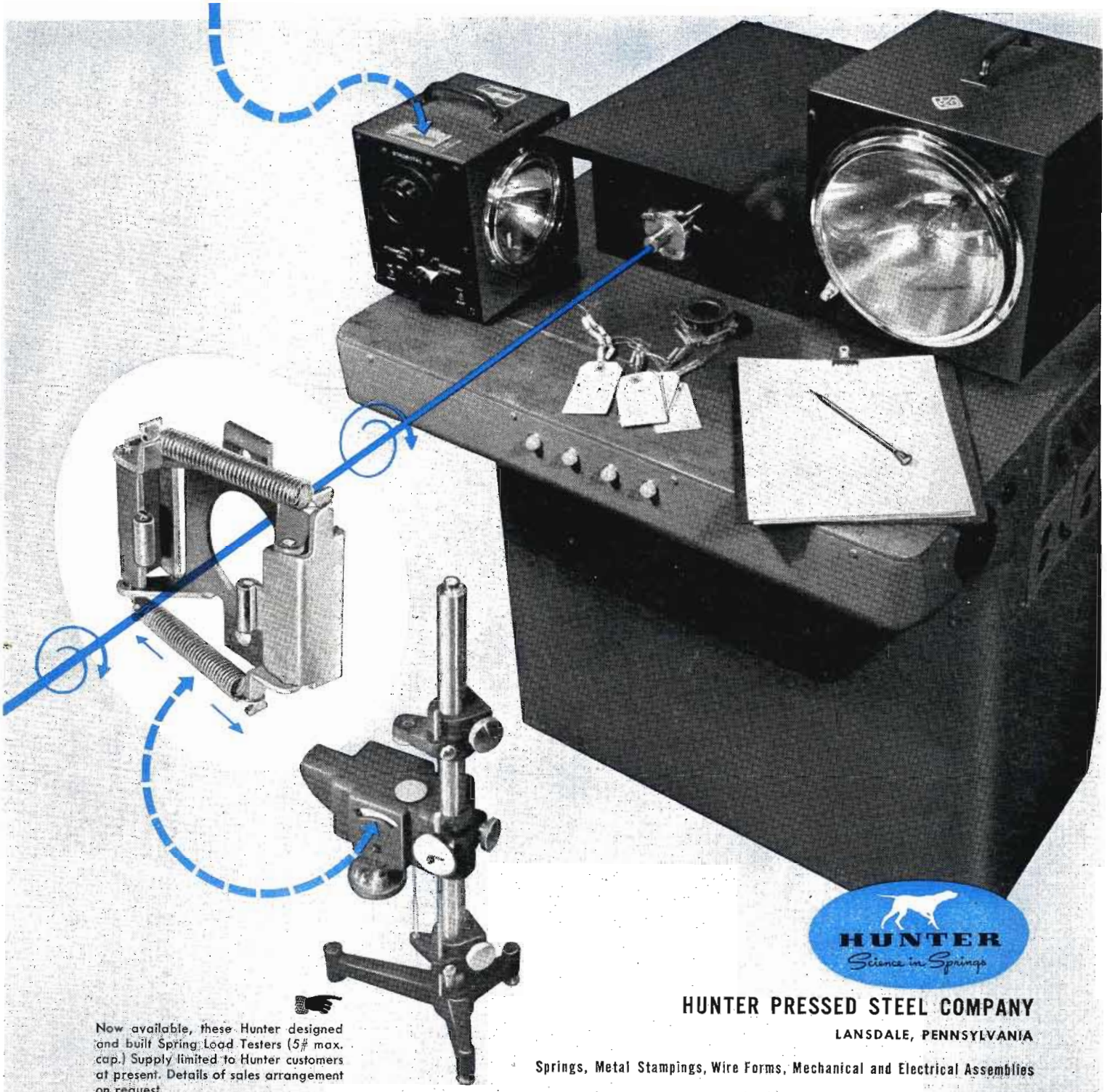
There's More to Spring Design than Spring Designing

Example: One of the bugaboos of capacitor motor design is to switch out the starting winding at the right time . . . not too soon else the motor will jockey between starting and running windings . . . not too late or the starting winding may burn out.

Ordinarily, a tendency to switch out at the wrong speed is not apprehended before the motor is tested, and at that stage can be costly in terms of assembly time. If you are a motor manufacturer you *can* eliminate the possibility of trouble by using Hunter springs, quality-controlled and color-coded to match variations in your centrifugal mechanisms.

The centrifugal mechanism is not merely a riddle in spring design. It is more accurately a matter of engineering strategy. Hunter, has, in addition to its spring designers, a separate complement of *electrical* and *mechanical* engineers. These men can be maneuvered quickly into position to aid spring designers. Hunter also brings to bear on your problem the only testing equipment of its kind, especially devised by the Hunter Special Apparatus Division for attaining *your* objective.

More information about this special service for motor makers (or anyone with a similar centrifugal application) is yours on request.



Now available, these Hunter designed and built Spring Load Testers (5# max. cap.) Supply limited to Hunter customers at present. Details of sales arrangement on request.

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FCC Studies Pay of Broadcast Engineers

To staff and maintain the 924 AM broadcasting stations and the 7 networks that link them, requires the combined efforts of 15,000? 35,000? 50,000? The compensation paid to these individuals each week totals $1.5 million? $2.5 million? $3.5 million?

Less than one in a thousand in the communication field has an accurate knowledge of the number of persons employed in sound broadcasting, how they are divided as to duties and their average compensation. Only recently FCC issued the results of the second and most comprehensive survey, made by means of questionnaires to broadcasting stations. The data represent conditions as of February 1947.

The total of all employes was 34,831 and they were paid $2,408,246 per week. They fall into eight groups as follows:

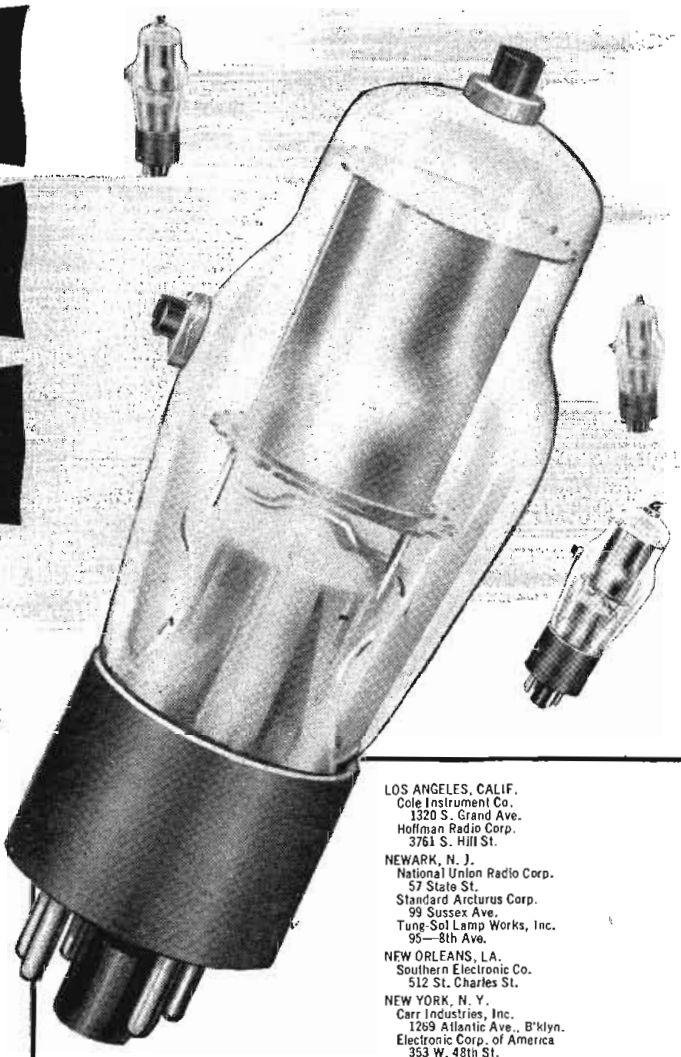
CLASSIFICATION	AVERAGE WK. COMP.
Gen. officers & assistants	$171
Clerical	40
Program employes	67
Commercial employes	103
Promotion and publicity	79
Building service employes	39
Misc.	64
Technical	73
Chief engineers and supervisors	91
Studio engineers or technicians	...
Holding 1st Class R. telephone licenses	76
Others	73
Transmitting engineers or technicians	
Holding 1st Class licenses	61
Others	51
Research and Development Engineers	104

Excluding executive, supervisory and non-staff personnel the 24,513 employes received an average of about $61 per week. Within the averages given here there were substantial variations. The average broadcast worker puts in about 39 hours a week, with the program employes working shorter hours, about 37, and the technical employes working about 41 hours a week.

Conference Delegates Study Mobile Radio

Delegates from many of the 71 countries attending the first postwar International Telecommunications Conference, at Atlantic City, are being shown the latest improvements in highway and urban radiotelephone equipment through a series of demonstration tours conducted by the Federal Telephone and Radio Corp.,

ELECTRONIC EQUIPMENT BARGAINS



JOBBERS
WHOLESALERS
MANUFACTURERS

Large inventories of valuable electronic tubes, devices and equipment are being offered by the WAA Approved Distributors listed herewith for your convenience. Alert commercial buyers are taking advantage of this big bargain opportunity. Why not fill *your* present and future requirements from these available stocks. Act now—while inventories still permit wide selection.

Purchase of this surplus equipment has been greatly simplified. The Approved Distributors appointed by WAA were selected on a basis of their technical background and their ability to serve you intelligently and efficiently. Write, phone or visit your nearest Approved Distributor for information concerning inventories, prices and delivery arrangements. You'll find you can "Save with Surplus."

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Technical Apparatus Co.
165 Washington St.

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Carroll & Cecil Sts.

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Tobe Deutschmann Corp.
863 Washington St.

CHICAGO, ILL.
American Condenser Co.
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Belmont Radio Corp.
3633 S. Racine Ave.

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Clifton, N. J., manufacturing associate of the International Telephone and Telegraph Corp.

An automobile equipped with a Federal mobile radiotelephone system, operating in the 152-162 mc band, covered the route between Atlantic City and Philadelphia, giving the delegates a first-hand demonstration of the characteristics and potentialities of voice transmission between a moving vehicle and a conventional telephone subscriber located a considerable distance away. When the Federal demonstration car was within approximately 15 miles of the city of Philadelphia a delegate would pick up the handset from the control unit, call the Bell System's mobile service operator in Philadelphia and place a call to his legation in Washington, his consulate in New York City, his native country, or the ITC headquarters in Atlantic City.

Field Intensity Data from 'copter

The use of a helicopter in taking field-intensity measurements for the broadcasting industry has long been considered feasible, but the first application of this technic, insofar as is known, was made by Hector R. Skifter, president of Airborne Instruments Laboratory, Inc., Mineola, N. Y., in obtaining data pertinent to the application of the North Jersey Broadcasting Co. (WPAT, Paterson, N. J.) for nighttime privileges on its present channel.

Skifter needed accurate measurements of the vertical plane radiation pattern of a conflicting station causing greatest interference in order to compute the sky-wave arriving at Paterson. In the past, such measurements have been taken by making a series of airplane flights through the field of radiation, recording field intensity at points fixed by reference to the ground and the altimeter. Not only was this method time consuming, but it was somewhat inaccurate as well, for ground references were, at best, approximate.

Mounting an RCA 308-B field intensity meter in the second seat of a Bell two-place helicopter, and having one vertical flight made from 0 to 5800 feet elevation over

a preselected point on the ground, the needed data was collected with ease and accuracy. No altitude recording equipment was required, for the pilot noted and jotted down the reading of the field intensity meter every 200 feet rise.

Loggers Seek Space

Stressing an acute need for a special radiotelephone service and classification of its own to meet its communications needs in remote and comparatively inaccessible regions of operations, the huge $2½ billion logging industry has filed an application with the FCC requesting the Commission to set up a new radio service for the logging and forest industries and to allow operation of the new system in the 30-40, 70-80 and 150 mc bands.

The system would not only be completely divorced from the Forestry Conservation Service, which is a government-operated radiotelephone system, but in its application the logging industry requested that the Commission turn over four Forestry Conservation channels to the new system in any future allocations actions by the FCC.

TV for United Nations

United Nations may go in for television in addition to the local and international radio facilities which have been proposed (see page 25). A proposal covering cameras and all other necessary equipment to cost a total of $1,749,891.00 is under consideration. The service contemplates "teletranscription", for filming important proceedings directly from the face of a television monitor, as well as the usual picture and sound broadcast service.

Radar on 100 Ships

Since the beginning of the year, the Radiomarine Corporation of America has installed its CR-101 (3.2 centimeter) radar system on nearly 100 vessels, both those flying the American flag and of several foreign nations. A feature of some of the Radiomarine radar installations has been their use on vessels of the Inland Waterways Corp., Mississippi Valley Barge Lines, and a Coast Guard cutter in the mapping of the Ohio

and Mississippi Rivers. The foreign purchasers of RMCA radar have included Sweden and Norway as the largest, together with Holland, Italy, Russia and Turkey. General Trujillo, President of the Dominican Republic, had his presidential yacht equipped with the Radiomarine radar system.

FCC Shifts Engineers

Federal Communications Commission has engineered a change in its engineering department. There are to be no more branch chiefs; assistant engineers have been put in charge of four new divisions. George S. Turner has been promoted to assistant chief engineer, taking the place of George E. Sterling when he was moved up to chief engineer. The new divisions are: Common carrier, to be headed by Marion H. Woodward; marine radio and safety, headed by William H. Krebs; field engineering and monitoring, headed by George S. Turner; radio operator and amateur, headed by George K. Rollins. In addition, a new radio section of the common carrier division was formed, under the direction of John A. Russ.

British Theater TV

The British are getting ready to go ahead with theater television. An experimental license has been issued to J. Arthur Rank, movie tycoon, to permit him to beam his own television programs to a theater. Ultimately it is contemplated that five theaters in the west of London may be linked together for the showing of films and sporting events, the latter by direct pick-up.

Sound Laboratory

To undertake an extensive research on problems of sound recording and reproduction, Duotone Co., 799 Broadway, New York, is to establish a new sound laboratory near Red Bank, N. J. The purpose is to supply factual information on all types of present sound equipment.

Switchcraft Doubles

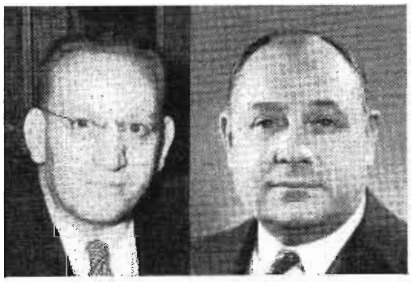
Switchcraft, Inc., has moved into new quarters at 1328-39 No. Halstead street, Chicago. The new plant is double the size of the old one.

PERSONNEL

Orrin E. Dunlap, Jr., has been elected vice-president in charge of advertising and publicity for the Radio Corp. of America. Dunlap has been associated with RCA since 1940 when he became manager of information and in 1944 director of advertising and publicity.

Sam Norris has been made executive vice-president of Amperex Electronic Corp., Brooklyn, N. Y. Since 1942 he has been sales manager of the company.

Dr. John N. Mrgudich has been appointed research director of the electrical divisions of Winchester Repeating Arms Co. and Bond Electric Corp., New Haven, dry cell manufacturers. He was formerly director of research and associate chief engineer of Burgess Battery Co., Freeport, Ill.



Dr. John Mrgudich Harold B. Richmond

Harold B. Richmond, chairman of the board of General Radio Co. and recently elected chairman of the board of the Scientific Apparatus Makers of America, had the honorary degree of doctor of engineering conferred upon him by Norwich University. The honor is in recognition for his pioneer radio service, his work on guided missiles and his interest in engineering education.

Donald A. Quarles, director of apparatus development of Bell Telephone Laboratories, has been elected a vice-president. He has been associated with the Bell System since 1919.

Paul Larsen has returned to Johns Hopkins University, Silver Springs, Md. He has been on several months leave of absence, working as a consultant for the Bureau of Ordnance, USN.

Paul H. Hunter, formerly an associate Editor of Tele-Tech, has joined

the test engineering department of the Western Electric Co. He is located at Winston-Salem, N. C.

Dr. A. C. Krueger has joined the staff of Airborne Instruments Laboratory, Mineola, N. Y. in the capacity of supervising engineer of the antenna design section. He was formerly development engineer, guided missiles project, Republic Aviation Corp, and with the Manhattan Project at University of Chicago.

Rear-Admiral Stanley F. Patten has joined the staff of DuMont Laboratories as administrative assistant to the president. He will headquarter at Clifton, N. J.

Edward A. Miller has been elected vice-president in charge of engineering of the Acme Electric Corp., Cuba, N. Y. He joined Acme in 1930.

Howard C. Schubert has been appointed senior engineer of United States Television Corp., New York. He has been associated with Dumont and IT&T and during the war worked in the radiation laboratories of MIT.

Stephen J. Deitz has been made head of the sales engineering department for the industrial control division of the Lange Mfg. Corp., New York. He was formerly associated with the Ripley Co.

Langevin Changes Style

Except on the west coast, Langevin Co., Inc., henceforth is to be known as the Langevin Mfg. Corp. West coast offices in Los Angeles and San Francisco will retain the old name and function in the capacity of a sales and engineering service for products of the new corporation. East coast headquarters remain at 37 west 65th Street, New York.

NAB's 25th Meet

National Association of Broadcasters is preparing for its greatest convention. The gathering is to be held in Atlantic City, Sept. 15-18 and will be the 25th annual function. There is to be an extensive exhibit with the wares of 25 equipment manufacturers and 12 transcription companies and program service organizations on display.

NEW BOOKS

Radar System Engineering

Edited by Louis N. Ridenour with 32 contributing authors. Published 1947 by McGraw-Hill Book Co., New York, for the M.I.T. Radiation Laboratory Series. 748 Pages; $7.50.

The basic material, the collective work done at a great many places; industrial, military and college laboratories is described here. The Radiation Lab. of M.I.T. operating under a NDRC contract undertook to prepare a complete record of the vast amount of work done on Radar and associated subjects. This book, the first in a series of 28, is intended to serve as a general treatise and reference work on the design of radar systems. It deals primarily with microwave pulse radar, since the overwhelming majority of this work has been concerned with such equipment. The superiority of microwaves for almost all radar purposes is now clear.

The first eight chapters are intended to provide an introduction to the field of radar and a general approach to the problems of system design. Chapters 9 through 14 take up the leading design considerations for the various important components that make up a radar set. These chapters are so thorough in their treatment that Chap. 15, which gives two fairly detailed examples of actual system design, can be quite brief. Chapters 16 and 17 take up two new and important ancillary technics that are not dealt with fully elsewhere in the Series: moving-target indication and the transmission of radar displays to a remote indicator by radio means.

Electronic Engineering Patent Index—1946

Published 1947 by the Electronics Research Publishing Co., 2 W. 46th St., N.Y.C. 476 Pages; $14.50.

A compilation of electronic engineering patents issued in the U. S. during 1946, this is the first of a proposed annual series, designed to provide engineers with a convenient guide to the new electronics patents issued each year by the U. S. Patent Office.

Approximately 2000 patents were granted on electronic components, circuits, and manufacturing processes ranging over the general fields of industrial applications, communication, broadcasting, facsimile, television, navigational aids, instrumentation, etc. These patents were issued under more than ninety official subject classifications, which have been used as the system of arrangement in the book. This references provides an excellent means for keeping abreast of the art.

Bessel Functions

Vol. III and Vol. IV of the Annals of the Computation Laboratory of Harvard University by the Staff of the Computation Laboratory, Covering Tables of the Bessel Functions of the First Kind of Orders Zero and One; and Tables of the Bessel Functions of the First Kind of Orders Two and Three. Published by the Harvard University Press in 1947, Vol. III, 694 pages; Vol. IV, 662 pages; each $10.

The tables of J_0 (x) and J_1 (x) comprising Volume III of the Annals and the tables J_2 (x) and J_3 (x) comprising Volume IV were computed by means of the Automatic Sequence Controlled Calculator. The tabulation is carried to 18 decimal places, with a wide range of argument and order and fine argument intervals. Volume III also contains an introduction describing the computational techniques employed and the method of interpolating within the tables.

Electronic Engineering Principles

By John D. Ryder, Prof. of Electrical Eng., Iowa State College. Published by Prentice-Hall, 70 Fifth Ave., N.Y.C. — 1947. 397 pages. Price $6.65.

The author, an educator who has had long experience in the industrial design of electronic equipment for commercial use, has produced a book that covers the fundamentals of electron tube operation that will serve either as a text or reference on this subject for either engineering students or engineers in the field. A tube is a device that creeps into practically all industrial operations, and this book treats electronics as an independent subject, divorced from radio applications. It should nevertheless serve admirably as a basic reference for communication engineers as well.

It treats direct applications of ballistic principles, fundamentals of thermal omission and space charge rectifiers. Vacuum triode analysis is divided into two parts: for small signals, and for large signals. Secondary emissions and applications. Basic gaseous conduction rectifier circuits, gas control tubes and control circuits, and photoelectric devices are covered in the final chapters.

Hubbell Adds Three

Richard W. Hubbell and Associates, television, radio and motion picture consultants with offices in New York, Cincinnati, Washington and Hollywood, has added three new associates. They are Dr. Alfred N. Goldsmith, former RCA vice president; Thomas H. Hutchinson, NBC's first director of television programs, former production manager for RKO Television; and Philip Booth, latterly director of the Westchester Playhouse, Mt. Kisco, N. Y.

Antenna Consultants

Arthur Dorne, supervising engineer, and Joseph Margolin, engineer, with the antenna design section of Airborne Instruments Laboratory, Mineola, have left that organization to establish their own business as consultants. The firm of Dorne and Margolin has established headquarters at 126 North Ocean Avenue, Freeport, L. I., N. Y.

TECHNICAL DATA

PARTS AND COMPONENTS

A 4-page leaflet dealing with servicemen's essential items is available from Dept. F, JFD Mfg. Co., 4117 Fort Hamilton Parkway, Brooklyn 119, N. Y. The bulletin covers: dial pointers and knobs, phone radio switches, pick-up adapters, jacks and plugs, connectors, cables, diverse switches, stroboscope discs, noise suppressors, interference filters, antenna loops, etc.

RENEWABLE FUSES

The new Economy "time delay" renewable fuses and renewal links, manufactured by Economy Fuse & Mfg. Co., 2717 Greenview Ave., Chicago 14, Ill., are described in a 16-page catalog. The fuses are designed to offer superior protection in the 135-200% load range, where time delay is most needed. The catalog shows knife blade and ferrule type fuses and contains size data and time delay curves for 250 and 600 volt fuses.

VOLTAGE REGULATORS

A 16-page catalog describing principles of operation and technical specifications of electronically controlled voltage regulators and Nobatros has been issued by Sorenson & Co., 375 Fairfield Ave., Stamford, Conn. The booklet is illustrated with performance curves and pictures of various models of a line of available electronic equipment.

MERCURY RELAYS AND SWITCHES

Unaffected by dust, dirt, and moisture hermetically sealed plunger type mercury relays have no exposed moving parts, eliminate contact pitting and give trouble-free long-life performance. The operating principle, materials and construction types and ratings of Hermaseal relays are explained in bulletin PS-10 available from Hermaseal Co., Inc., Elkhart, Ind. Long life with uniform contact resistance and without open arcing is characteristic for the hermetically sealed tilt type mercury switches manufactured by the same company, Bulletin MS-1 covers 11 types of these switches and gives their ratings.

FILE MANUAL

A convenient purchasing guide and reference booklet published by Grobet File Co. of America, Inc., 421 Canal St., New York 13, lists 3,566 different patterns, sizes and cuts of hand and machine files, riffles ,rotary and deburring files, and Swiss hand files.

CONTACT SPRINGS

Containing detailed dimensional drawings of three groups of standard Contact Springs for conventional spring stack-up in a wide range of circuits, this specification sheet on contact spring assemblies, available from P. R. Mallory & Co., Inc., Indianapolis, Ind., permits solution of standard contact assembly problems

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ELECTRONIC ENGINEERING HANDBOOK

By Ralph R. Batcher, E.E. and William E. Moulic

Written and published as a day-in day-out working tool for engineers interested in electronic applications in the industrial and communication fields. Edited by Ralph R. Botcher and William Moulic, this book contains the writings of the foremost men in the particular phases of electronics covered by the book. Yet its messages are presented in a manner easily understood by any engineer with a basic knowledge of electrical principles.

From fundamentals the book proceeds logically through detailed discussions, covers every important circuit and essential application.

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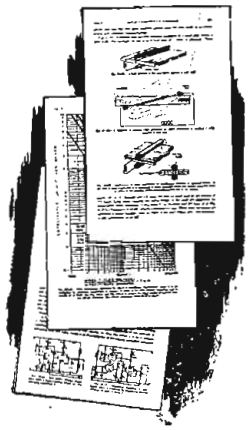

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- *Principles of Rectification*
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- *Low Frequency Amplifiers*
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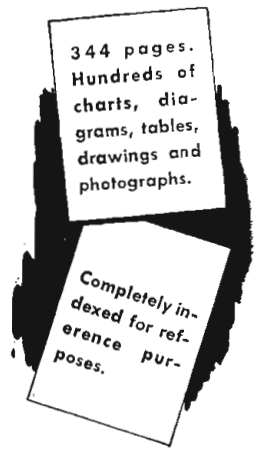
ELECTRONIC CONTROL HANDBOOK

By Ralph R. Batcher, E.E. and William E. Mo...

Here is a valuable storehouse of reference material on the *fundamentals* of electronic control principles used in industry. Here is the first and only single source providing the essential data you must have to accurately appraise the value and specify an electronic control device. Electronic contrals are everywhere today cutting manufacturing costs, speeding production and improving quality of products. This book gives you autharitative, factual information from which you can safely conclude when, how and where they can improve efficiency in your plant.

The condensed contents listed below give a general idea of the material in this book, but nothing less than your personal inspectian of the volume itself will enable you to appraise its constant value. That is why we have arranged to send you a copy of the book at our risk, for your five day perusal. Send for it by using the convenient coupon below. Today.



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RELAY CATALOG

Introducing several relay innovations such as relays with replaceable coils, snap action switch relays, etc. catalog No. 10-A, published by Guardian Electric Mfg. Co., 1621 W. Walnut St., Chicago 12, Ill., illustrates a wide variety of standard ac and dc relays including sensitive, multiple contact, small size, dual contact power type, midgets, coil spring contact, general purpose, industrial and aeronautical, and midget telephone types. Charts give operating and contact data. Mounting instructions and dimensional diagrams are included for each type.

CARBONYL IRON POWDERS

Finding application in the form of cores in high frequency magnetic fields carbonyl iron powders play an increasingly important part in all sorts of communication devices, television and broadcast receivers and transmitters, fm devices, carrier telephony etc. An excellent short treatise on the properties, composition, and application of these powders has been prepared by the Antara Div., General Aniline & Film Corp., New York, N. Y. The 32-pg. booklet contains illustrations of the more important characteristics, microphotographs, hysteresis curves for various grades, a collection of useful formulae, and a short bibliography of engineering papers.

COMMUNICATION EQUIPMENT

Booklet B-3610, available from Westinghouse Electric Corp., P.O. Box 8668, Pittsburgh 30, Pa., provides designers of communication and electronic equipment with a quick list of products available for their use. Products described in the 44-pg. catalog include circuit breakers, electronic tubes, instruments, transformers, rectifiers, switches and relays, motors, blowers, capacitors, thermostats, heaters, electronic air-cleaners and regulators. Application data and performance curves are included.

BUYING GUIDE

Over 10,000 radio and electronic products are included in the 1947 catalog, issued by Allied Radio Corp, 833 West Jackson Blvd., Chicago 7, Ill. Special emphasis is placed on equipment for industrial maintenance, research and production requirements. The 164-pg. booklet contains detailed listing of electronic tubes, test instruments, transformers, resistors, capacitors, rheostats, relays, switches, rectifiers, tools, wire and cable, batteries sockets, generators, power supplies, and other types of equipment. An electronic sound equipment section list public address and high fidelity sound equipment, microphones, speakers, phonographs, recordchangers etc. The line of "Knight" radio receivers also is presented.

PULSE COUNT MODULATION SYSTEM

(*Continued from page 52*)

The synchronizing circuit extracts from the incoming pulse series the synchronizing information for producing the various control pulse series such as digit synchronization, channel order and channel synchronization. The input signal is likewise applied to gate circuits in conjunction with the digit synchronizing voltages in order to break down the code series of pulses into individual pulses corresponding to the actual digits transmitted. This is illustrated in the waveform diagram of Figure 8.

If a code pulse and digit pulse occur simultaneously the gate circuits produce output. The individual digit pulses actuate a counter circuit which produces a pulse whose width corresponds to the weight of the digit applied. Thus for a 5 pulse PCM system a total of 5 counters would be used with each counter producing successively an output pulse twice the width of the preceding counter. In this example the pulse width produced by the fifth counter would be sixteen times the width of the first counter; preceding counters would produce pulse widths having the relative weight of 8, 4, and 2 respectively.

The output of the counters is connected in parallel in such a manner as to obtain the sum of the counter pulses produced. This signal is then passed through a filter which removes the high frequency components and is then applied to the multiplex demodulator which serves to separate the individual channels and translate the energy variation into the appropriate audio signal.

Simplified systems of PCM transmission corresponding in general to the method described have been constructed in the laboratory. Figure 9 illustrates such a simplified system which has been developed for experimental purposes.

Tests which have been run with PCM transmission have tended to confirm the advantages previously indicated. In particular the telegraphy type characteristics of the system have permitted transmission over relatively inefficient transmission paths, such as poor cable, without destruction of the intelligence carrying characteristics. A similar attractive characteristic can be expected over radio transmission paths where severe fades as well as multipath reflection is to be expected.

On the basis of the experimental results obtained to date the PCM method of transmission would seem to offer attractive possibilities for application to radio and wire transmission circuits particularly for multichannel operation over long relay paths. These applications are being investigated at present.

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UN Facilities

(*Continued from page 28*)

in the Army Command Administrative Network (ACAN) during the recent war. Automatic volume adjusting amplifiers will enable transmitters to operate at a higher percentage of modulation without distortion. Special radio paths tried and proven in wartime will skirt around erratic regions on the earth's surface. These and many other new methods designed to increase the efficiency and quality of international communications and to conserve spectrum space, will be used by the United Nations telecommunication network.

The heaviest written record traffic is expected to flow between the main European branch and United Nations headquarters in New York A station in South America, pos-

sibly Rio de Janiero, will comprise the third point of the triangular written-record network. There is a strong possibility that a newly developed facsimile system capable of transmitting intelligence at the rate of 5000 words per minute may replace the 100 WPM radioteletype system. For this network, duplex multi-channel systems are planned. For normal operation these circuits would use a 2 kw suppressed-carrier single side-band transmitter. However, when the circuit becomes difficult to operate, due to propagation troubles or climatic vagaries, a 50 kw amplifier may be switched into the circuit at each end of the loop to force a more powerful signal through the erratic areas. These amplifiers are designed so that they may be used in broadcast service if necessary.

Studio requirements for the United Nations headquarters radio center will constitute a minimum of twelve for efficient program production. In order to schedule program facilities for various parts of the world, it will be assumed that the most likely listening hours will be from 6. P. M. until midnight, local time. This will allow transmitters and antennas to do double duty by switching from one part of the world to the other in synchronism with diurnal changes, thus achieving mass broadcasting on a worldwide basis with a minimum of technical facilities.

The United Nations telecommunications facilities as proposed is not particularly extensive when compared with the combined broadcasting facilities of all nations. It is just large enough to achieve its principal mission; that of tying together the various governmental and private dissemination facilities in the various countries of the world.

In anticipation of expansion of the proposed system to an eventual world-wide communications belt-line, the plan is designed to allow great flexibility so that is requirements demand, additions may be made. Eventually, other UN radio centers in the Far East, the Middle East, the Equatorial Zones, and other areas of the earth

less affected by radio disturbances will be added. Such a world communications belt-line would give the United Nations more complete coverage since almost all countries would then have a high-powered UN station nearby.

Philco Television

(*Continued from page 40*)

mirror attached to the front of the cabinet and the neck should preferably obstruct as little as possible of the cone of light. The plane mirror again must be so situated as to intercept all the light emanating from the correction plate and to redirect it suitably on the screen. The top of this mirror must be low enough so as not to obstruct the bottom of the screen from the viewer. This mirror need not, of course, be absolutely vertical but could be at a slight forward or rearward angle. However, minimum depth considerations and the convenience of mounting make a vertical mirror desirable.

One further point should be noted here, namely, that the angle of tilt of the screen has been so arranged as to give a slight upward slant of 1° to 2° to the principal direction of the light coming from the screen. This feature enables viewers sitting at normal viewing distances to see the picture under optimum illumination conditions when sitting down and at an eye level of 45 to 50 in. Also, viewers standing up at the back of a room (20 ft) will see the picture equally well at an eye level of 60 to 70 in.

One of the many advantages of this type of cabinet design is that the distance between the screen and the eye of one adjusting the controls is the maximum possible in a completely self-contained receiver. The screen (at the rear) and controls (at the front) are separated by the maximum amount to allow for the greatest possible viewing distance when operating the controls at arm's length. This is an important consideration with large pictures.

The folded optical system necessitated the development of what is known as the keystone projection system. Since the screen is on a slant and not perpendicular to the axis of the optical system, a

trapezoid would be produced on the screen instead of a rectangle. In the keystone projection a trapedoidal shaped picture is developed on the cathode ray tube screen as shown in Fig. 10. From the object in the shape of a trapezoid, the rays pass through the lens (L) and project a rectangular image. The object screen and image screen are so placed in relation to each other that $\tan \beta = m \tan \alpha$ where m is the reciprocal of the magnification $\beta = l_2/l_1$. The dimensions of the image rectangle are $h_1 \times w_1$ and the object trapezoid is $(h_2' + h_2'')$ in height with the width varying from w_2' to w_2''.

The geometric center of the rectangle is the point where the two diagonals cross, and is equidistant from the top and bottom. In the trapezoid, the geometric center is also where the two diagonals cross, but in this case the center is farther from the top of the figure than from the bottom. Because of this linearity distortion, it is necessary to adjust the vertical linearity electrically on the face of the tube so that rays coming from the center of the trapezoid will also coincide with the center of the rectangular projected picture.

In this keystone projection system combination, the primary image appears on the spherical face of the cathode ray tube. While the discussion up to this point has concerned projection from a flat face to a flat screen, the same principles apply when projecting from a spherical face. The approximate size of the primary image in the Philco set is as follows: height —2 1/16 in., width at bottom—2 9/16 in., width at top—2 31/32 in. The tube is placed at a small angle β to the axis of the optical system, in order to focus correctly and project a rectangle on the screen. In the Philco set, α is 24° 30′, and m is 6.7, so β is 3° 54′.

One method of obtaining a trapezoid on the face of the tube is to deflect the beam from its horizontal course to strike the tube face obliquely. Deflection of the electron beam is made possible by producing a magnetic field at right angles to it. Two bar magnets are placed on the edge of the tube face, one on each side. One set of poles on the magnets produces a mag-

netic field at right angles to the electron beam, resulting in deflection of the beam upward to strike the tube face at an acute angle, to achieve the trapezoid. However, the image is now too high on the face of the tube and is centered by deflecting the beam downward before it is deflected upward to the face of the tube. Another magnetic field, opposite in direction to the original field, is produced to accomplish the latter.

The magnetic field nearer the gun is relatively weak and has curved flux paths due to the use of point poles, while the field nearer the tube face is relatively strong and has straighter flux paths. Each field introduces a certain amount of keystoning, displacement, and curvature of the horizontal lines. The opposed fields are so disposed as to cancel out the curvature, and most of the displacement, while leaving the required amount of keystoning.

In order to permit adjusting the cathode ray tube to its correct position relative to the other optical elements, it is mounted in a frame which provides for adjustments axially for focusing, and rotationally about two axes, each perpendicular to the optical axis. These adjustments are entirely independent of each other.

The development of this new projection receiver was the product of cooperative work by a large number of individuals in the Research and Engineering Laboratories of Philco Corporation and its subsidiaries. The list is too long to include in an article of this sort, but we wish to acknowledge all these contributions as vital to the finished product.

Airport Radar

(*Continued from page 59*)

an On-Off switch, is incorporated for reading real and artificial angle data fed to the indicator. By means of the REAL-ART ANGLE DATA Switch either the real angle voltage from the Angle Coupler or the artificial data (controlled by the Artificial Angle Date knob) may be selected. This device is used in the initial lineup of the indicator.

The video and trigger from the transmitter house are fed into

J4601 (Fig. 12). The trigger is amplified and applied to a one shot multivibrator which produces, for each trigger, the necessary negative gates for operation of the horizontal and vertical sweep generators, for intensification of the tube during the sweep period and for operation of the range mark circuit. The gate length is approximately 250 microseconds long corresponding to a range slightly greater than 20 nautical miles. Each negative gate to the horizontal sweep generator switches the circuit on and allows it to produce a sawtooth current waveform through the horizontal deflection coil.

This coil wound on an iron-core deflecting yoke placed around the neck of the cathode ray tube, produces a magnetic field which varies uniformly with time and therefore deflects the spot from left to right across the face of the screen with uniform velocity. The vertical sweep generator is very similar to the horizontal sweep generator. It is driven by the same negative master gate, uses the same general circuit and operates in the same manner. However the grid of the sweep tube instead of being returned to a positive supply voltage, is returned to the angle data voltage. Because of this vertical sweep amplitude will depend upon the instantaneous angle voltage (as well as the adjustment of the expansion control). This voltage is controlled by the antenna scanning motion and is directly proportional to the instantaneous elevation of the antenna beam.

The net result of this is to drive a current sawtooth, with varying amplitude, through the vertical deflection coil, which operates in a manner similar to the horizontal coil. This combination of vertical and horizontal driving waveforms produces a sweep which reproduces on the indicator screen the scanning motion of the radiated beam. The range mark tilt circuit is incorporated to provide for adjustment of the range marks perpendicular to the ground line on the indicator map.

The negative gate to the range mark circuits serves as a switch to allow operation during the sweep period. The function of

these circuits is similar to those discussed in the search indicator. The exception is that only 5 mile range marks are produced. The video amplifier used in this indicator serves the same purpose as the one described in the search indicator.

Built into the indicator chassis are power supply circuits to provide the following required voltages; +7000, +300, +150 and −150.

The hand crank on the search indicator which operates the cursor (to intersect any desired target) also a synchro generator which is connected to a synchro control transformer (geared to the height finder antenna mount). If the two synchros are in synchronism there is no error voltage, the antenna is aimed in the desired direction and it does not rotate. When the crank is turned, an error voltage is produced by the synchro control transformer. This error voltage is amplified by the servo amplifier and applied to the servo motor generator (amplidyne). The output of the amplidyne is fed to the rotation drive motor which then turns in the direction which will reduce the error voltage to zero, at which point the antenna is aimed in the desired direction.

(Part III will cover the precision landing portion of the AN/FNP-1 equipment).

Tracking Charts

(*Continued from page* 47)

of the charts in Figs. 2 and 3 respectively. Example: Assume: $F_1 = 28$ mc, $F_2 = 16$mc, $f_i = 4$mc, $C_1 = 32$ mmf, and $C_v = 66$ mmf. Let it be required to find C_p, C_s, and the fixed oscillator inductance L_0. $A = (28 + 4) / (16 + 4) = 1.6$, $B = 4 / (16 +) = 0.2$. From Fig. 2, we find $C_p/C_v = .0331$ or $C_p = .0331 \times 66 = 2.18$ mmf. From Fig 3, we obtain $C_s/C_v = 6.385$ or $C_s = 6.385 \times 66 = 421.4$ mmf. $L_0 =$

$$L_0 = \frac{1}{4\pi^2 f_2^2}\left(\frac{1}{C_p + C_1} + \frac{1}{C_s}\right) = 2.0035\,\mu h$$

If the ratio of the intermediate frequency to the low end of oscillator frequency (B) is less than 0.1, the circuit paramenters in the alternative tuning systems of Fig. 5 then have approximately the

same values as in the conventional tuning systems when the oscillator tuning ranges (A) are equal in both cases.

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T V Interference

(*Continued from page* 45)

least share, some of the frequencies reserved for but not now used by the government in the region 162-174 mc? Price of FCC and also of the secretariat of IRAC, reported that in this band each channel was 50 kc. wide and 4 channels comprise a group. The groups of channels listed below are allotted to the following government agencies: Commerce (Weather) 4, CAA 6, Agriculture 5, Justice 13, Interior 14, War (non-military) 3, FCC 1, Treasury 3, Commerce 3. In the band 216-220 mc, Agriculture 3, CAA 2, FCC 2, Interior 2, Justice 3, Treasury 2, War Dept. 2, Commerce 1, Telemetering 4.

It was admitted that, while contracts have been let for some radio equipment for these frequencies, there is very little use of these channels by the government now. Ray Guy asked if this liberal distribution of frequencies to the various agencies had to be supported by actual needs when requests were presented to IRAC.* The general impression was that FCC has one representative on IRAC, (Miles) and that government needs only were looked after in the closed sessions of this committee. Sterling, chairman of the conference, said he would investigate the possibilities for commer-

*If a government agency wants a frequency assignment it files an application with IRAC. opies are sent to the members, all government agencies. The Army and Navy, the dominant influence in IRAC, coordinate in examining the application (this usually takes 2 weeks). If no member opposes, the application is granted. There appears to be no real show of necessity required. It is not evident if the FCC member would be bound to vote against the request if the frequency was badly needed for commercial use. At any rate the FCC has only one vote. Appeals from IRAC decisions have to be taken directly to the president of the U. S. The basic idea of public convenience and necessity seems to be over-ridden by the idea of national security. This is understandable only in war-time and when the government agencies involved are our Army and Navy.

cial use of the frequencies in question.

Among the allocation schemes suggested just before the conference adjourned was one offered by Wofford, FCC, which gives to TV 15 channels and swaps some government frequencies for TV frequencies. It is: 44-50 mc Fixed and Mobile; 50-56 Govt.; 56-60 Amateurs; 60-88 Govt.; 88-108 FM; 108-162 no change 162-168 Fixed and Mobile; 168-174 Govt.; 174-264 fifteen TV channels; 264-368 Govt. This involves, of course, a change in the present low TV band.

The conference adjourned with the satisfying knowledge that the engineers of the industry had had the opportunity of discussing among themselves and, what is more important, with the FCC engineers, interference experiences and future needs of their groups. They expect the FCC to do what is possible to improve the conditions described. They are heartened by the prospect of securing more elbow-space in the high-frequency spectrum through the cooperation of the government agencies now holding these frequencies. The next step will be meetings of the FCC engineering department in which industry engineers will be ready to offer assistance in working out a plan which will benefit all of the services using the frequencies in this important portion of the radio spectrum.

Broadcasting in Russia

(*Continued from page* 33)

reached in April 1946.) It is difficult to say how many of these sets are capable of receiving shortwave broadcasts, which is the case for a fraction of the confiscated German sets and some of the newly fabricated Soviet receivers.

Most of the Russian listeners depend, as we said, upon the wire transmission of programs. It has been reported that 7,300,000 loudspeakers are licensed today for individual or collective reception; thanks to the steady extension of the relay networks and the mass production of new loudspeakers, their number is expected to reach about ten million by 1950.

The amateur movement in the Soviet Union which started in 1924 has always been encouraged by the authorities. They even offered free licenses to those who carried on interesting experiments. Every year an All-Union Exhibition of Radio Amateurs is being organized; in 1939, more than 1100 Russian amateurs displayed their inventions, 500 of which were awarded valuable prizes. Amateurs took an active part in the development of new technics; they served in many scientific expeditions in the Arctic and especially during the war as skilled technicians of the Red Army.

An information published in 1941* estimated the number of Russian radio amateurs at nearly 500,000 which seems to be an exceedingly high figure. However, almost every important city today has its radio club. Quite recently, a Central Radio Club has been founded in Moscow, which numbers 400 radio amateurs representing all the Republics of the Soviet Union. Its chairman is Ernest T. Krenkel, known as radio operator of the 1937 Papanin Polar Expedition; one of its prominent members, Major-General Nikolai Baikouzov, a noted expert in aviation radio communication, is said to have a collection of no less than 10,000 QSL cards. The Club possesses modern radio and television equipment, a technical laboratory, work and repairshops. Every month its shortwave and television sections arrange courses, lectures, discussions, experiments, and competitions. The shortwave station maintains contact with 120 radio clubs of the U.S.S.R. as well as with many radio amateurs in other countries.

New Experiments

Radio coverage of the immense territory is far from being accomplished. The Soviet authorities thus are looking for new devices capable of connecting collective farms, machine and tractor service stations in rural districts. Russian engineers have recently completed tests of an experimental radio relay station, specially designed for rural communities where no electric power is available. These

*Cf. Monthly Bulletin of the International Broadcasting Union, June 1941 p. 194.

stations are operated by wind power and can serve up to one hundred loudspeakers. The first model was ready in February 1946, and twenty others were under construction, all of them equipped with a new "windmill engine" produced at one of the Kiev factories.

Likewise, the need of hundreds of new local stations makes Frequency Modulation of special value for the Soviet Union. The Soviet Government plans to introduce FM within the next few years, and to establish FM transmitters all over the country. Experiments already are being carried out by the Ministry of Communications; an FM transmitter has been set up in Moscow, in the Central Telegraph Building, and rebroadcasts on 46 Mc—from 5 p.m. to midnight—the programs of the long and medium wave stations.

Television Developments

The Soviet Union also recognizes the vast possibilities of television, if only for political and educational purposes. The Television Center in Moscow, which had to be closed during the war, resumed its experimental work in December 1945; it televises operatic and dramatic scenes, concerts, ballets and topical films. The main studio, designed for stage performances, is said to be large enough for the production of programs with 100 actors, dancers or singers. The television antenna is placed on the top of the 486 ft. Shukhov Tower.

The present system provides a definition of 343 lines with 25 complete pictures per second. But the director of the Center, F. Bolshakov, declared that a new and improved system with 625 scanning lines should be introduced as soon as possible.

Plan 1948 Start

A new Television Center is to be installed in the "Palace of Soviets" in Moscow. The studios will be ready in 1948, and will enable the simultaneous transmission of several television programs. The projected antenna will be 975 ft. high, and increase the range of the Moscow telecasts to 62 miles. Television studios and transmitters also are planned for Leningrad, Kiev and Sverdlovsk; a coaxial

cable will connect the largest cities.

Soviet scientists and engineers also are experimenting with the use of television for other purposes. Video-telephone equipment has been set up in the scarlet-fever department of the Moscow Clinical Institute of Infection Diseases. It enables visitors to see contagious patients, whom they are not allowed to approach, while they are speaking to them over the telephone.

Television is also used for industrial purposes, in particular for watching on the screen the smelting process of pig iron and steel in blast and open-hearth furnaces. Considerable funds have been appropriated to expand the application of television in the Soviet industry and to provide it with modern television instruments.

Rebuilding of the Radio Industry

Before the war, the Soviet radio industry had a rather limited capacity. Sets, loudspeakers and other parts were produced in about fifteen factories; all the development work—an American expert, Ray C. Ellis, reported—was done by a central government planning agency, associated with the Moscow and Leningrad Universities, and by the National Academy of Science in Moscow.

The invasion of Russia by German troops forced the Soviet Government immediately to transfer all industrial equipment from the "front line" to the Eastern regions. Within four months, from June to October 1941, the whole radio industry had been evacuated to Central Siberia, and in spite of incredible difficulties, shipments of radio material could be resumed in January 1942.

The number of radio factories has almost doubled during the war, with many new ones established in Siberia and other remote places. In 1944 some of the plants, Ellis states, were moved back to the West into modern buildings which were reconstructed with modern equipment. The factories in Moscow, Leningrad and Riga (State Experimental Plant) have been restored, and new ones built in Alexandrovsk, Kiev, Odessa, Vo-

TELE-TECH

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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.

ronej, Sverdlovsk (Ural), and Ordzhonikidze (Caucasus).

It can thus be assumed that the Soviet radio industry will be in a position to produce most of the radio material the country needs, including dozens of transmitters, three million receiving sets—the yearly production is scheduled to increase up to 925,000 in 1950—and at least as many loudspeakers.

According to official information, the output of broadcast receivers reached the prewar level by April 1946; the Kiev plant "Transsignal" produced about 30,000 sets from 1944 to September 1946, and the Riga plant about 20,000 in 1946. This year, ten various types of radio sets, including one auto radio, will be put on the market. Some of them are intended for mass production such as two 5-tube sets called "Record" and "Salut", a 6-tube battery receiver "Rodina" specially designed for rural use, and a 7-tube set with magic-eye.

In addition, there exist a few more intricate models: "Moskva" with 10 tubes, frame-antenna, pick-up and record-changer, "Super VEF-M-557" with eleven tubes, and "Leningrad" with twelve tubes, long, medium and short wave range. Table models are priced from 1,000 to 1,500 rubles, consoles from 2,000 to 3,000, and sets with shortwave parts from 2,000 to 3,000 rubles. (The regular exchange rate is about five rubles for one dollar.)

The laboratories in Ordzhonikidze are developing at present three types of television sets for the new 625 lines system. The first of them is designed for television reception only, the two others are combined for broadcasting and television (the latter with large-screen projection). 85,000 of these sets will be produced within the next three years.

The Soviet Radio enters today a new phase of development which will provide the country with new and better facilities. In spite of the progress accomplished, much work remains to be done, both in the technical and in the program field. This is substantiated by a recent statement which nobody could suspect of being anti-Russian — the Central Committee of the All-Union Communist Party adopted in January 1947 a "Decree for the Improvement of Central Broadcasting". Although recognizing the merits of the radio organization, it insists on a systematic action to ameliorate immediately the technical facilities, in particular the relay networks in the villages, and the quality of radio programs.

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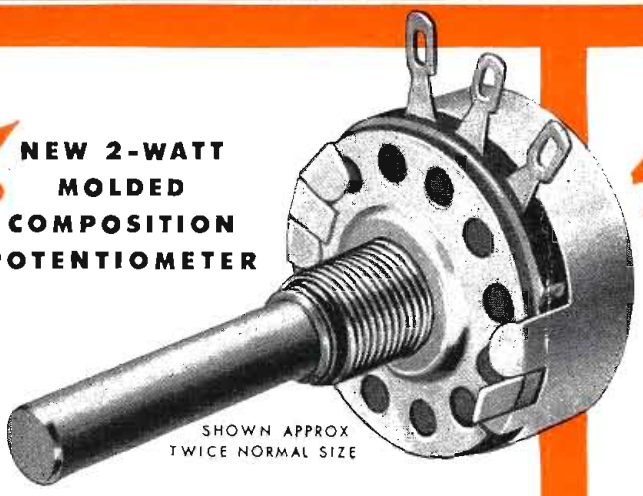

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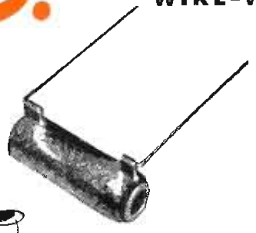

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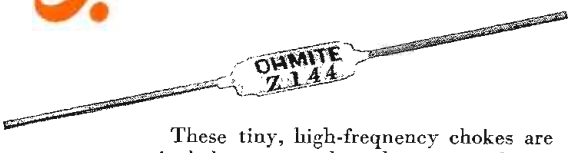

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1R5	Pentagrid Converter	—	Filamentary type. Mixer tube and oscillator in superheterodyne circuits. For portable receivers.
1S4	Power Amplifier Pentode	3S4	Filamentary type. For battery receivers.
1S5	Diode-Pentode	—	Filamentary type. High voltage gain. For broadcast receivers.
1T4	Super-Control R-F Amplifier Pentode	—	R-F or i-f amplifier in battery-operated receivers.
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3Q4	Power Amplifier Pentode	3Q5-GT	Filamentary type. For 3-way battery portable receivers.
3S4	Power Amplifier Pentode	1S4	Filamentary type. For battery portable equipment.
3V4	Power Amplifier Pentode	3Q4	Filamentary type. Similar to 3Q4, but has preferable basing arrangement. For 3-way battery portable receivers.
6AG5	R-F Amplifier Pentode	—	Sharp cutoff characteristic. High transconductance and low input and output capacitance. I-F video amplifier or r-f amplifier up to 400 Mc.
6AK5	R-F Amplifier Pentode	—	Sharp cutoff characteristic. High transconductance, low input and output capacitance, and low input conductance at high frequencies.
6AK6	Power Amplifier Pentode	6G6-G	Singly or in push-pull in output stage. A-F power output 1.1 watts per tube.
6AL5	H-F Twin Diode	—	High perveance makes it particularly useful as an F-M detector.
6AQ5	Beam Power Amplifier	6V6	For automobile and ac-operated receivers.
6AQ6	Duplex-Diode High-Mu Triode	6SZ7	Combined detector, a-f amplifier, and avc tube.
6AT6	Duplex-Diode High-Mu Triode	6SQ7	Combined detector, amplifier, and avc tube.
6AU6	R-F Amplifier Pentode	6SH7	Sharp cutoff characteristic. High transconductance and low grid-plate capacitance. Limiter for FM receivers.
6BA6	R-F Amplifier Pentode	6SG7	Remote cutoff characteristic. High transconductance and low grid-plate capacitance. For r-f and i-f stages of FM and AM receivers.
6BE6	Pentagrid Converter	6SA7	Mixer tube and oscillator in superheterodyne circuits. For FM and AM receivers.
6BF6	Duplex-Diode Triode	6SR7	For use as a combined detector, amplifier, and avc tube. For auto and ac-operated receivers.
6C4	V-H-F Power Triode	—	Class C amplifier and oscillator. Class C output about 5.5 watts at moderate frequencies, 2.5 watts at 150 Mc.
6J4	U-H-F Amplifier Triode	—	Primarily for use as grounded-grid amplifier up to 500 Mc. Transconductance 12000 micramhos, mu 55, low capacitances.
6J6	Twin Triode	—	Particularly useful as mixer or oscillator up to 600 Mc.
6X4	Full-Wave Rectifier	6X5	High-vacuum type. For use in auto and ac-operated receivers.
12AT6	Duplex-Diode High-Mu Triode	12SQ7	For use in compact ac/dc receivers.
12AU6	R-F Amplifier Pentode	12SH7	Sharp cutoff characteristic. Limiter tube for ac/dc FM receivers.
12AU7	Twin Triode Amplifier	12SN7-GT	Separate terminals for each cathode, and mid-tapped heater for 6.3- or 12.6-volt operation. Mixer oscillator, multivibrator.
12AW6	R-F Amplifier Pentode	6AG5	Sharp cutoff characteristic. R-F amplifier for ac/dc FM receivers.
12BA6	R-F Amplifier Pentode	12SG7	Remote cutoff characteristic. For use in compact ac/dc receivers.
12BE6	Pentagrid Converter	12SA7	For use in compact ac/dc receivers.
26A6	R-F Amplifier Pentode	12BA6	Remote cutoff characteristic. Features high transconductance. For 12-cell storage-battery operation.
26C6	Duplex-Diode Triode	12AT6	Combined detector, amplifier, and avc tube. For 12-cell storage-battery operation.
26D6	Pentagrid Converter	12BE6	Mixer tube and oscillator. For 12-cell storage-battery operation.
35B5	Beam Power Amplifier	35L6-GT	High power sensitivity and high efficiency for use in output stages of ac/dc receivers.
35W4	Half-Wave Rectifier	35Z5-GT	High-vacuum type. Heater tap for panel lamp. For use in compact ac/dc receivers.
45Z3	Half-Wave Rectifier	—	High-vacuum type. Heater rating, 0.075 ampere at 45 volts. For 3-way battery portable receivers.
50B5	Beam-Power Amplifier	50L6-GT	For output use in ac/dc receivers. Maximum-signal power output, 1.9 watts.
117Z3	Half-Wave Rectifier	—	High-vacuum type. For supplying rectified power to 3-way battery portable equipment.
1654	Half-Wave Rectifier	—	High-vacuum, filamentary type. Maximum peak inverse rating 7000 volts, filament current 0.05 ampere.
9001	Sharp Cutoff U-H-F Pentode	—	R-F amplifier or detector in U-H-F service.
9002	U-H-F Triode	—	U-H-F detector and amplifier. May be used as oscillator in superheterodyne receivers at frequencies up to 500 Mc.
9003	Remote Cutoff U-H-F Pentode	—	Useful as a mixer or as an r-f or i-f amplifier in U-H-F service.
9006	U-H-F Diode	—	For U-H-F service as rectifier, detector, or measuring device. Resonant frequency, about 700 Mc.

For additional technical data on these types, refer to the RCA HB-3 Handbook, or write RCA, Commercial Engineering, Section R63-1, Harrison, N.J.

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