PRICE FIFTY CENTS

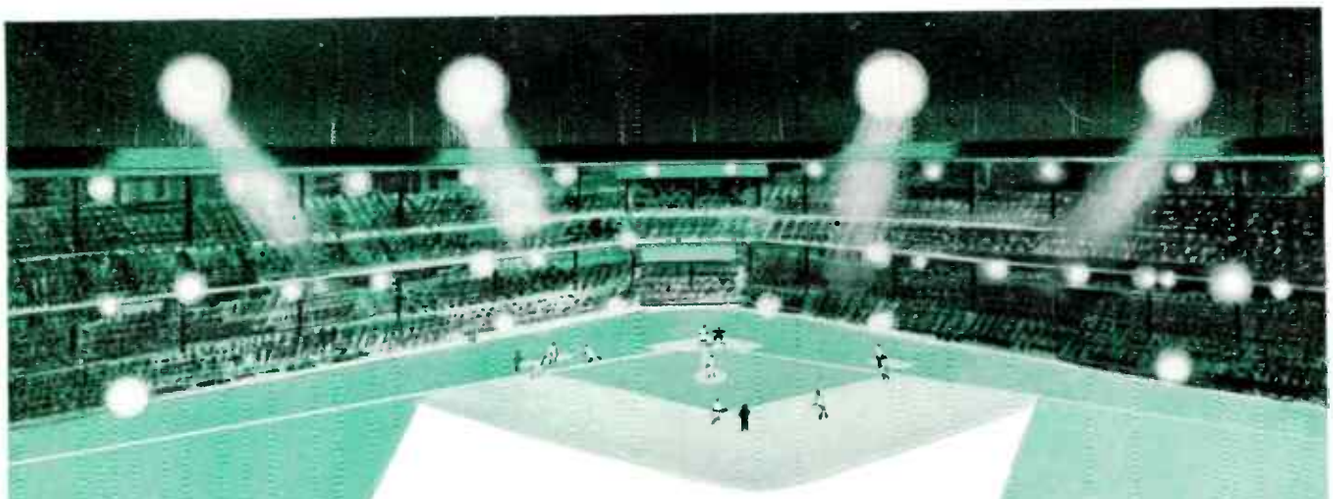
FM AND TELEVISION

OCT. 1947

★ ★ Edited by Milton B. Sleeper ★ ★

FM-AM SET PRODUCTION

7th Year of Service to Management and Engineering



Why
the *Lock-In* tube is at home
IN TELEVISION!

VERY HIGH FREQUENCIES . . . HANDLED WITH EASE

Sylvania Lock-In is *the* tube specifically engineered to more than satisfy the requirements of television equipment—handles very high frequencies with ease! Electrical features include: short, direct connections . . . fewer welded joints—less loss; getter located at top . . . shorts eliminated by separation of getter material from leads.

STAYS PUT IN SOCKET . . . MECHANICALLY RUGGED

Specially designed "lock-in" locating lug on each tube keeps it in place—assuring firm socket contact. Improved tube mount keeps elements ruggedly supported on all sides. There are few welded joints and *no* soldered joints—the elements can't warp or weave.

COMPACT . . . MADE TO FIT SMALL SPACES

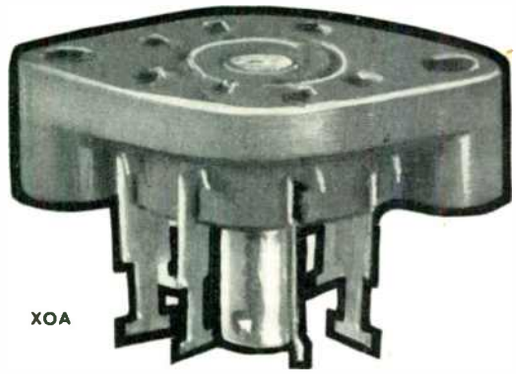
This famous Sylvania product is ideal for use in modern sets, where the tendency has been toward more compact units—has reduced overall height and weight. Has no top cap connection . . . overhead wires are eliminated! *See Sylvania Distributors or write Radio Tube Division, Emporium, Pa.*

SYLVANIA'S LOCK-IN TUBE . . .

. . . the radio tube whose electrical and mechanical superiority makes it the ideal choice for marine radar, equipment in the air, on the road, FM and television.

SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

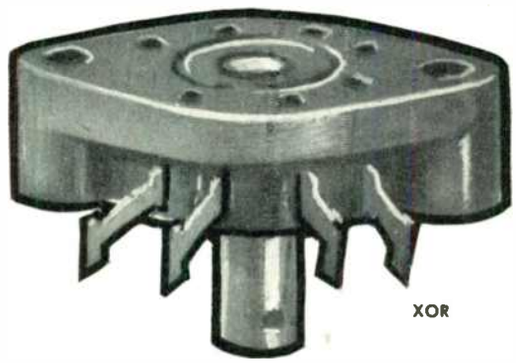


XOA

● The XOA Socket for Miniature Button 7-pin bases is mode of low-loss mico-filled bokelite. It mounts with two 4-40 screws. Terminols for the Type XOA extend axially from the socket. Type XOR is identicol to Type XOA, but has terminals extending radiolly. Short heavy terminols reduce contoct inductonce. Lawer effective capacity be'ween terminols reduces circuit capacity.

XOA Type Socket ..... Net Price..... $ .50

XOR Type Socket ..... Net Price ..... $ .50



XOR

● The XOS tube shield is a two-piece shield for Minioture Button 7-pin base tubes. It mounts with the XOA or XOR socket ond is ovoiloble in three sizes, XOS-1 (1-3/16" high), XOS-2 (1½" high), and XOS-3 (2" high).

XOS-1 Shield
Net Price..... $ .48

XOS-2 Shield
Net Price..... $ .48

XOS-3 Shield
Net Price..... $ .48

Special price quotations may be obtained for bulk orders. Please write for further information.

First-rate PARTS mean *first-rate* EQUIPMENT

National NC EST. 1914

If you're planning to build the type of precision-built equipment that will sell in today's competitive market, it will pay you to order National parts.

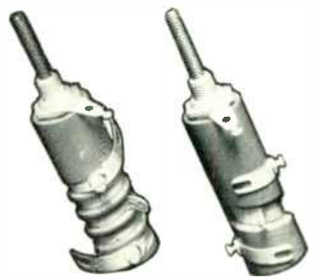
Through long practical experience manufacturers, engineers and laboratory research workers have all found that National parts can be relied upon for dependability and long life.

If you need good material and exacting workmanship in your parts, see your nearest National dealer today.

National Company, Inc.
Dept. No. 14
Malden, Mass.

XR-50

● XR-50 coil forms may be wound os desired to provide o permeability tuned coil. The form winding length is 11/16" and the form winding diameter is ½". The iron slug is ⅜" diometer by ½" long.

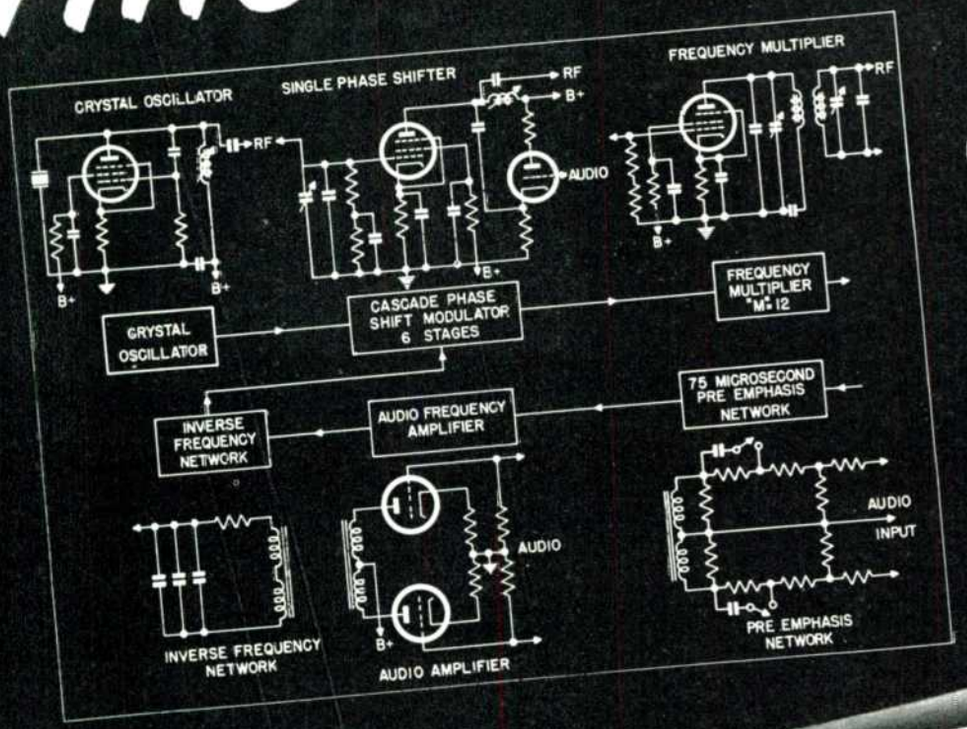


AR-5 AR-2

● The AR-2 ond AR-5 coils ore high Q permeobility tuned RF coils. The AR-2 coil tunes from 75 mc to 220 mc and the AR-5 coil tunes from 37 mc to 110 mc with suitable capacitors.

MAKERS OF LIFETIME RADIO EQUIPMENT

THIS PROVES IT!



Cascade

PHASE SHIFT MODULATION

RAYTHEON FM

IS BETTER...

12 Ways

BECAUSE IT:

1. Features direct crystal control
2. Gives the most desirable electrical characteristics
3. Contains fewest circuits, fewest tubes
4. Has the simplest circuits
5. Is easiest to tune and maintain
6. Has *inherently* the lowest distortion level

AND ELIMINATES ALL:

7. High orders of multiplication
8. Complex circuits
9. Expensive special purpose tubes
10. Discriminator frequency control circuits
11. Pulse counting circuits for frequency control
12. Motor frequency stabilizing devices

RAYTHEON

Excellence in Electronics

See your consulting engineer and write for fully illustrated booklet giving complete technical data and information. Write today to:

RAYTHEON MANUFACTURING COMPANY • *Commercial Products Division* • **WALTHAM 54, MASS.**

Industrial and Commercial Electronic Equipment, Broadcast Equipment, Tubes and Accessories

Sales offices: Boston, Chattanooga, Chicago, Dallas, Los Angeles, New York, Seattle

FM AND TELEVISION

★ ★ Edited by Milton B. Sleeper ★ ★

FORMERLY, FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 7 OCTOBER, 1947 NO. 10

CONTENTS

WHAT'S NEW THIS MONTH
Richard H. Lee 4

NEW PATTERN FOR INDUSTRY EMERGES
Milton B. Sleeper 17

FCC REVIEW OF RADIO PROGRESS
Hon. Charles R. Denny, Jr. 19

FM AS NEW DEAL FOR LISTENERS
Hon. Paul A. Walker 21

TELEVISION RF SIGNAL GENERATOR
Joseph Fisher 24

PRODUCTION METHODS VS. NEW CIRCUITS
Photos from Hallicrafters Factory 29

COLLINS FM TRANSMITTER DESIGNS
N. H. Hole 32

PLANNING AN FM BROADCAST STATION
R. S. Lanier 35

FM STATIONS IN THE U. S. A.
Official FCC Listings 39

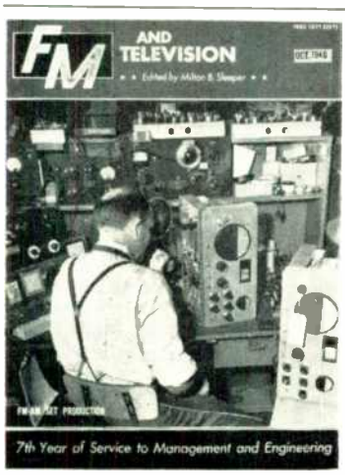
SPECIAL DEPARTMENTS
Telenotes 6
Products & Literature 8
Spot News Notes 22
News Picture 23
Advertisers' Index 55

★ ★ ★ ★ ★ ★

MILTON B. SLEEPER, *Editor and Publisher*

RICHARD H. LEE, *Advertising Manager*
STELLA DUGGAN, *Production Manager*
LILLIAN BENDROSS, *Circulation Manager*
Published by: FM COMPANY

Publication Office: 264 Main St., Great Barrington, Mass. Tel. Great Barrington 500
New York: 511 Fifth Avenue, New York 17, Tel. VA 6-2483
Chicago: MARIAN FLEISCHMAN, 360 N. Michigan Ave., Tel. STAte 4822
Pasadena: MILO D. PUGH, 35 S. Raymond Ave., Pasadena 1, Calif. Tel. Madison 6272
FM Magazine is issued on the 20th of each month.
Single copies 50¢ — Yearly subscription in the U. S. A. $5.00; foreign $6.00. Subscriptions should be sent to FM Company, Great Barrington, Mass., or 511 Fifth Avenue, New York 17, N. Y.
Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit. Payments are made upon acceptance of final manuscripts.

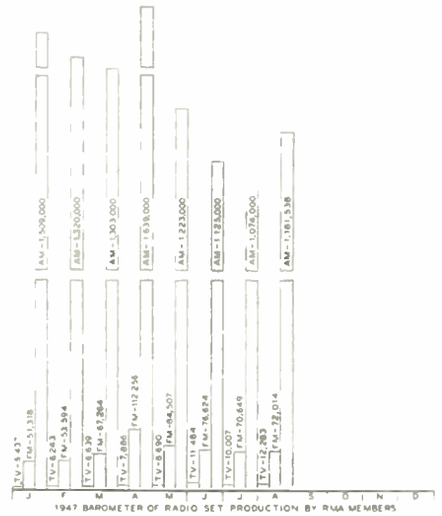


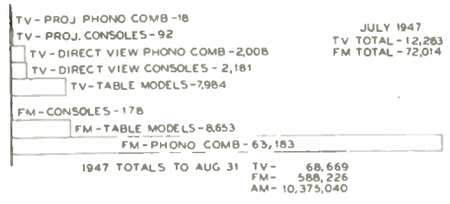
THIS MONTH'S COVER

This month's cover photograph, taken in the new Hallicrafters factory at Chicago, is a part of a series (pgs. 29–31) portraying modern production methods as they are set up to synchronize with the steady movement of production lines. These illustrations emphasize the fact that, today, advances in production and methods engineering are offsetting the increasing complications introduced by circuit development and added services to radio listeners.

Entered as second-class matter, August 22, 1945, at the Post Office, Great Barrington, Mass., under the Act of March 3, 1879. Additional entry at the Post Office, Concord, N. H. Printed in the U. S. A.

WHAT'S NEW THIS MONTH





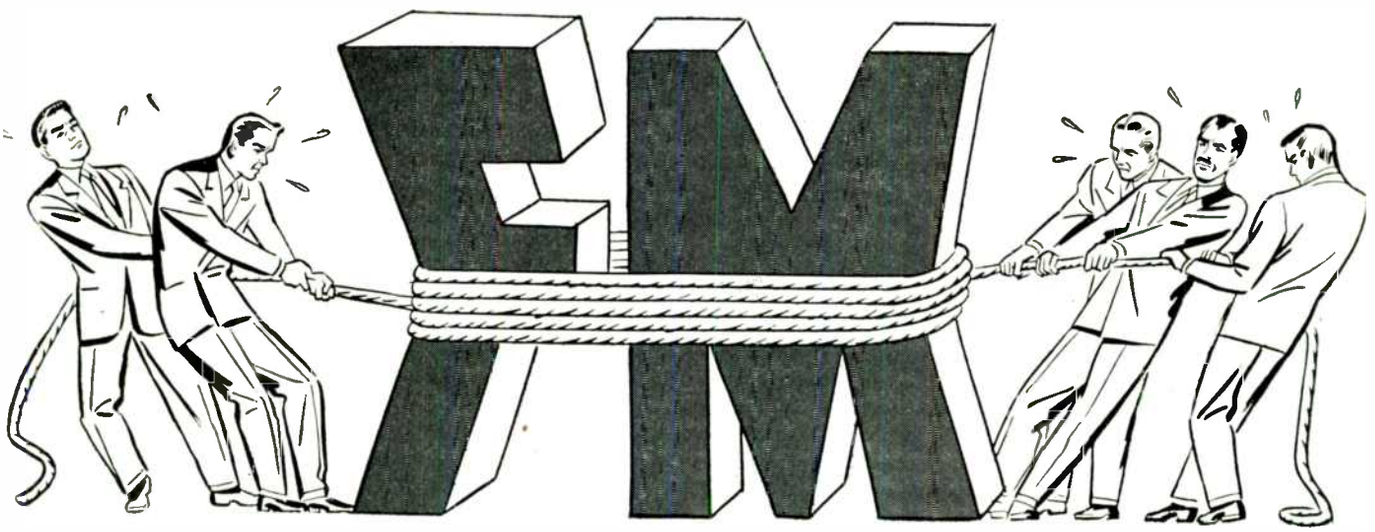
THE advertising manager of a magazine is seldom seen or even heard from by most of its readers. He's none the less important, however. At *FM* AND TELEVISION, for example, if we eliminated advertising revenue, we'd have to raise the subscription rate to almost $25 a year! So, even though you may never meet him, we'd like to introduce our new advertising manager, Richard H. Lee.

Dick was intended to be a lawyer, perhaps because his Father was an attorney in the renowned firm of Cravath, de Gersdorf, Swain & Wood. But after five years at the University of Richmond and University of Virginia, majoring in law, his old hankering for radio and airplanes got the best of him.

He knows the radio business in general, retail sales and broadcasting in particular, is a bug on FM, and a nut about television. His secret love is for Thunderbolts. He knows them from nose to tail, on the ground and in the air, because he taught hundreds of pilots all about them while he was supervising instructor of the AAF School at Republic Aviation.

Now, primed with information about what we're doing at *FM* AND TELEVISION, he's ready to help radio manufacturers with their problem of getting more results per dollar of advertising appropriation.

Don't Murder



Don't mess around with second-rate FM gadgets . . . when FM *DEMANDS* the high quality of

Pilotuner

Mr. Dealer! We earnestly urge: USE THE AMAZING FM PILOTUNER AS YOUR STANDARD OF COMPARISON, in testing ALL FM receivers and "tuners".

That's how you can avoid inferior, "rat-trap" equipment that simply *will not* and *can not* do justice to FM.

FM stations throughout America have acclaimed the PILOTUNER with all the raves in the book. It DOES THE JOB . . . because it's a QUALITY product, backed by Pilot Radio's unsurpassed practical experience in making FM sets.

Remember—we INVITE and WELCOME *legitimate* competition. We deplore ONLY that FM equipment which lacks integrity . . . which can do no good for the dealer, the consumer—or for FM itself.

The fate of FM—the glorious, most modern kind of broadcasting—is *in your trust*. Guard it well! Join the swing to the BEST FM . . . headed by the original PILOTUNER.

PILOT RADIO CORPORATION, 37-06 36th ST., LONG ISLAND CITY, N. Y.

Makers of PILOTONE VINYLITE RECORDS • PIONEERS IN SHORT WAVE • FM • TELEVISION

TELENOTES

WFIL-TV: Philadelphia Inquirer's station has issued a rate card with charges based on estimated receivers, showing rates for maximum of five, ten, fifteen, and twenty thousand sets. Present sponsors now total eight.

Farnsworth: New 10-in. table model will retail at $349.50, with $45 installation and guarantee fee.

WBEN-TV: Station at Buffalo, N. Y., has completed construction of a 122-ft. tower and 3-bay super-turnstile antenna on Hotel Statler. Transmission is scheduled early in 1948.

New C. P's.: Elm City Broadcasting Company, New Haven, Conn. was assigned channel 6; WDEL Inc., Wilmington, Del., channel 7; and Lacy-Potter Broadcasting Company, Dallas, Texas, channel 8.

WTMJ-TV: Lanny Pike has been named staff director. The son of Boston's Judge Elisha W. Pike, he has served as announcer, writer, producer, and director at New England stations.

New Models: Radio & Television, Inc. demonstrated a large screen receiver at the N. Y. Democratic Club on October 3. Picture size of 36 by 48 ins. is intended for hotels, clubs, and public places. Other models in production have 10-in. and 15-in. direct-viewing screens.

RCA-Fox: Contract between RCA and 20th Century-Fox provides for setting up a research center devoted to large-screen television. Project will be set up at Movietone studios in New York City.

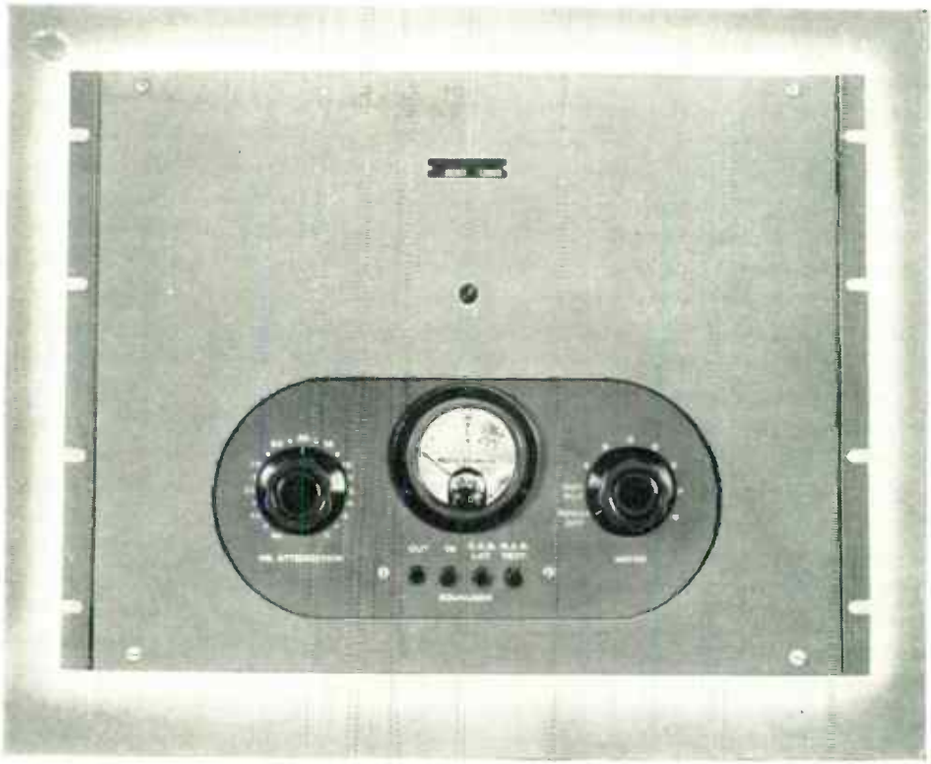
WOIC: Bamberger Broadcasting Service has ordered a 5-kw. RCA television transmitter for its station at 40th and Brandywine Streets, Washington, D. C. A 6-bay super-turnstile will be carried on a 300-ft. antenna. Operating on channel No. 9, 186–192 mc., with a gain of 7, range is expected to be 40 miles.

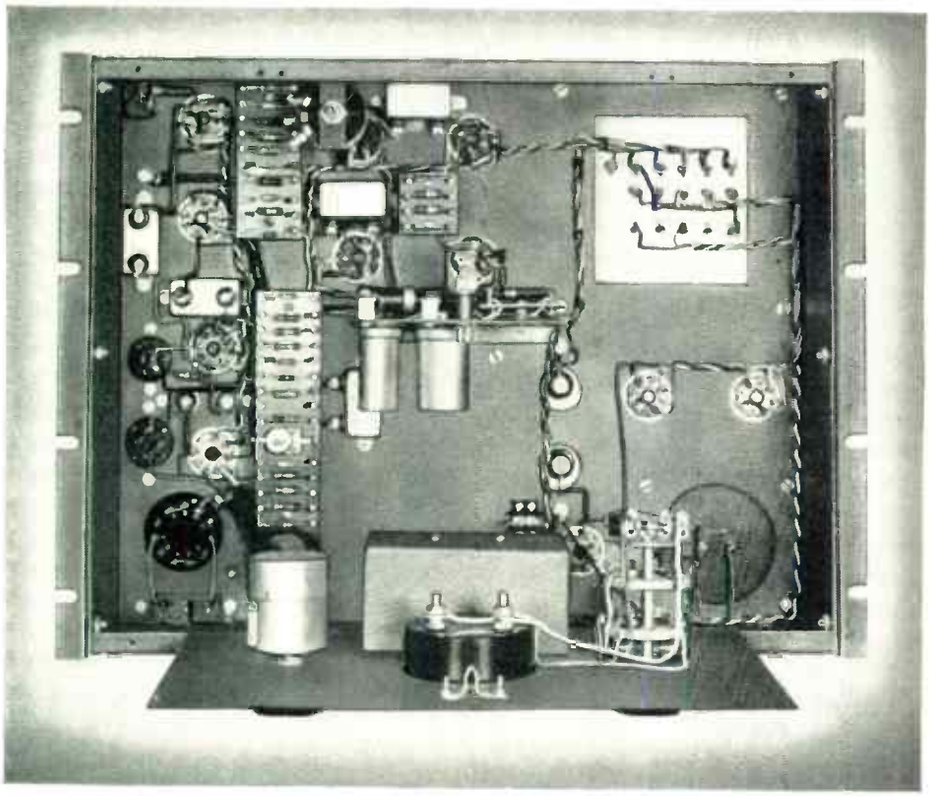
Price Reductions: U. S. Television Corp., 3 W. 61 Street, New York, has announced new prices on their large-screen television receivers. Reductions range from $480 on the 16-by 21-in. model formerly selling at $2275, to $450 on the 22½- by 30-in. model formerly priced at $2245.

Philadelphia: Range of WPTZ will be doubled when new 552-ft. tower, now under construction, has been completed.

Presto Presents Something New in Recording Amplifiers...

The new Presto 92-A is a 50-watt amplifier designed specifically for recording work. It answers the need for an amplifier of exceptional quality and performance, and includes a number of outstanding features thoroughly proved in operation:





1 Selector switch and meter provide both output level indicator (not for "riding gain") and plate current readings for all tubes.

2 Chassis is vertically mounted. Removal of the front panel gives access to all circuits without removing amplifier from rack.

3 The output stage has four 807's in push-pull parallel with an unusual amount of feedback. This produces ample peak power with low distortion and an extremely low internal output impedance for best performance from magnetic cutting heads.

Push buttons select any of these recording characteristics: flat, 20-17,000 cps, 78 rpm, standard NAB lateral, NAB vertical — all within an accuracy of ± 1 db. Distortion is only 1½% at full output.

PRESTO
RECORDING CORPORATION
242 WEST 55TH STREET, NEW YORK 19, N. Y.
Walter P. Downs, Ltd., in Canada

FREE! Presto will send you free of charge a complete bibliography and digest of all technical and engineering articles on disc recording published since 1921. Send us a post card today. Address Dept. A.

WORLD'S LARGEST MANUFACTURER OF INSTANTANEOUS SOUND RECORDING EQUIPMENT & DISCS

PRODUCTS & LITERATURE

So many new instruments, components, and materials are being brought out that space does not permit us to publish illustrated descriptions of them all. Accordingly, rather than selecting a few each month, we have established this new department of Products & Literature so that a great number of brief descriptions can be published. From these, you can select items which interest you, and send for catalogs or bulletins. We'll appreciate it if you will mention FM and TELEVISION in your requests.

FM-AM Phonograph in a cabinet design adaptable to modern decoration. Coaxial speaker, 20 watts output, inter-mix record changer. Price $695 for AC, $750 for AC–DC. — Model M, Freed Radio Corp., 200 Hudson St., New York 13.

FM Tuner Components, including tuning unit, dial, complete transformer kit, and punched chassis. — Bulletin FIO, Aeromotive Equipment Corp., 1632 Central, Kansas City, Mo.

Distortion Meter, small and light in design, for field or laboratory use. For measuring low-level AF voltages and determining noise and harmonic content. Also for measuring frequency and gain characteristics of amplifiers. For fundamentals of 50–15,000 cycles, and harmonics up to 45,000 cycles. — Model 400-F, Barker & Williamson, Inc., Upper Darby, Pa.

Ceramic Materials and their characteristics and applications are analyzed in detail in a 32-page booklet of much value to design engineers. — General Ceramics & Steatite Corp., Keasbey, N. J.

UHF Tube of the lighthouse type, for transmitters up to 2,500 mc. Suitable for studio-to-transmitter links. — Type GL-5648, General Electric Co., Tube Division, Syracuse, N. Y.

Public Address & Speech Equipment, including portable recording and play-back units. — Bulletin 1947, Bardwell & McAlister, Inc., Box 1310-B, Hollywood 28.

RF Chokes of miniature size, mounted by their tinned copper leads. Ranges are 3–20 mc., 7–35 mc., 20–60 mc., 35–110 mc., 75–190 mc., 160–350 mc., and 320–520 mc. First 3 are rated at .6 amp., and 1 amp. for the last 4. — Bulletin 133-F, Ohmite Mfg. Co., 4954 Flourney St., Chicago.

Equalizer for turntable equipped with separate tone arms for vertical and lateral recordings. Switch control connects either arm and cuts in correct equalization. — Bulletin EL3-1, Radio-Music Corp., Port Chester, N. Y.

Snap Slide Switch with Underwriters' rating of 3 amperes at 125 volts AC, SPST and SPDT types available. — Type RS-M, Elpar Co., Band and Marlton Ave., Camden, N. J.

Soldering Gun has a spotlight to illuminate work, switched on when heating trigger-switch is closed. One model has 100-watt single heat; the other has 35% continuous reserve heat. For 110 volts, 60 cycles. — Weller Mfg. Co., Easton 1, Pa.

Tone Arm designed for the G.E. variable reluctance pickup cartridge. Ball bearings carry rigid, non-resonant aluminum arm, with 24-gram pressure. — Model G-1, Barber & Howard, East Ave., Westerly 2, R. I.

Service Bench, shipped in prefabricated, knocked-down-form, gives servicemen a handsome piece of equipment at very low cost. Knee-hole design provides ample drawer space. Top is 7 ft. long, linoleum-covered, with large, sloping back panel to carry test instruments. — Sylvania Electric Products, Inc., Emporium 10, Pa.

Relays in a wide range of types and characteristics for AC and DC operation. Long telephone types, intermediate sizes, and miniature designs are illustrated in a new folder. — Amer. Relay and Controls, Inc., 2555 Diversey Ave., Chicago 47.

Tool Steels of all types and shapes. A new bulletin lists flats, squares, and rounds of all sizes in various grades of tool and high-speed steels, and shows the availability of each item at 18 different warehouse points. — Allegheny Ludlum Steel Corp., 2020-A Oliver Bldg., Pittsburgh 22.

Test Equipment for FM and television sets, to be used in factory production and service work. Three units are: Mega-Sweep, a wide-range sweeping oscillator with a carrier-frequency range of 50 to 500 mc.; Mega-Marker with a range of 19 to 29 mc. for television IF and a crystal oscillator at 10.7 mc. for FM IF; and Mega-Pipper giving 4 crystal-controlled marker frequencies to establish the picture and sound carriers and adjacent channel points. — Kay Electric Co., 34-M Marshall St., Newark, N. J.

Miniature Connectors for RG 58/U and RG 59/U cable. Length is 1¼ ins. by 23/64 in. diameter. Peak voltage rating is 500. — H. H. Buggie & Co., 2145-F Madison Ave., Toledo 1, Ohio.

Precision Resistors of miniature size, available with 2, 3, or 4 tapped sections and tinned copper leads. Single-section units have 150,000 ohms maximum resistance, and measure 1⅝ by ⅜ in. Standard tolerance is ±1%, although closer tolerance can be supplied. — Shalleross Mfg. Co., Collingsdale, Pa.

Multi-Range Meter, 20,000 ohms per volt, has 54 ranges. One row of buttons selects the function, while a similar row selects the range. Made in portable and laboratory models. — Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, Long Island, N. Y.

FM Transmission and Reception, a new Rider book on FM broadcast and receiving equipment and servicing, will be released shortly. 300 pages, $1.80, paper binding. — John F. Rider, Inc., 404 Fourth Ave., New York 16.

Anti-Drift Resistor, designed to offset drift in FM receivers during warm-up period. It is used with 2 conventional resistors in the screen grid circuit of the oscillator tube, automatically causing screen voltage to change in step with expansion of tube elements. — Keytone Carbon Co., St. Marys 6, Pa.

Mobile FM Equipment of very compact, single-unit design, for 152–162 mc. Output is 7 to 10 watts with transmitting battery drain of 20 amps., and standby drain of 9.2 amps. Small size and 27-lb. weight achieved by use of miniature tubes and a single vibrator supply for transmitter and receiver. Price $397.50. — Bulletin FM, Motorola, Inc., 4545 W. Augusta Blvd., Chicago 51.

Record Changer Manual of 400 pages gives detailed service information on 40 different types of wire, tape, and disc mechanisms. Price $4.95. — Howard W. Sams & Co., Inc., 2924 E. Washington St., Indianapolis 6M, Ind.

Relays in a wide range of standard and midget telephone types and sensitive and power designs for AC and DC. New bulletin gives characteristics and dimensions. — Catalog 7-F, Phillips, Control Corp., 612 N. Michigan Ave., Chicago 11.

Capacitance Bridge intended particularly for measuring inter-electrode capacity of vacuum tubes, covers 0–100 mmf. in 5 ranges. Measurement is at 465 kc. — Model 125-F, Sylvania Electric Products, Inc., 500 Fifth Ave., New York 18.

FM Simplified is the title of a new book by Milton S. Kiver. 347 pages, 5½ ins., cloth cover, price $6.00. Five sections cover FM fundamentals, receivers, transmitters, receiver alignment, and commercial receivers. All equipment described is for broadcast service. — D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3.

MODEL 646 • A Complete Receiver and Amplifier, Requiring Only a Loud Speaker

2 FM Bands, 10-Watt Amplifier

IF you have attended any of the important demonstrations of live-talent FM reception, you know the superior performance of the REL model 646 receiver. If you haven't, then "You ain't heard nothin' yet!"

Because of limited production and the elaborate tests each REL 646 must pass, we have offered these receivers only for use in special demonstrations and FM network broadcasting. Their rugged construction and precision design were intended for those applications.

Of course, they are equally suited for FM station monitoring, antenna and field-strength measurements, public installations, and for home use as well.

As new jigs and tools replace hand operations in the production of 646's, they are becoming available for such additional purposes. In fact, you can now order an REL 646 with the assurance of reasonably prompt delivery.

REMEMBER, the REL 646 is not just an FM tuner. It includes a built-in power supply and an amplifier that delivers 10 watts at less than 1½% distortion from 50 to 7,500 cycles, and is flat within 1 db from 30 to 15,000 cycles.

WHEN EXPERTS ARE LISTENING, WHEN YOU

MUST

DELIVER FLAWLESS FM PERFORMANCE, USE AN

REL model 646

There is ample evidence to show that this is sound advice, based on actual experience. Among the outstanding FM demonstrations before ultra-critical listening audiences, where REL 646's delivered flawless performance, there were:

1 Conference of the Institute of Radio Engineers, Hotel Mark Hopkins, San Francisco, November 6, 1946.

2 REL FM Clinic for Broadcast station managers and engineers, Long Island City, New York, January 20–23, 1947.

3 FM Association regional meeting, District 1, Hotel Ten Eyck, Albany, N. Y., April 14, 1947.

4 Dealers Group of the Electrical & Gas Association, Engineering Societies Building, New York City, June 19, 1947.

5 FCC's demonstration of FM network broadcasting for the International Telecommunications Conference delegates, Atlantic City, N. J., August 6, 1947.

6 Annual meeting of the FM Association, Hotel Roosevelt, New York City, September 12, 1947.

7 Annual conference of the National Association of Broadcasters, Hotel Ambassador, Atlantic City, N. J., September 17, 1947.

8 Annual conference of the West Coast Electronic Manufacturers Association and the Institute of Radio Engineers, San Francisco, week of September 22, 1947.

For design details, prices, and delivery information, address: RADIO ENGINEERING LABORATORIES, Inc., 35–55 Thirty-Sixth Street, Long Island City 1, N. Y.

RELIABLE ENGINEERING LEADERSHIP

FM BROADCAST RECEIVERS

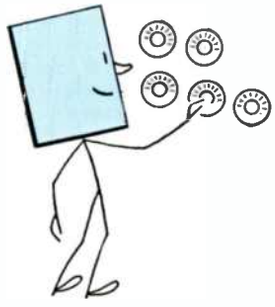
Why this team brings

Early in the history of radio telephony, it became evident that further growth and expansion depended on accurate means of controlling frequency. The first step toward solving this problem was taken in 1915, when a Laboratories engineer developed the first master oscillator circuit for radio transmission. In 1917 came the first crystal controlled oscillator using Rochelle salt crystal, and in 1921 the application of quartz crystals.

From that day on, the Bell Laboratories-Western Electric team has pioneered in piezoelectric crystals. New cuts, new circuit applications, new methods of growing synthetic crystals . . . all have been developed by the Laboratories, and all mass-produced by Western Electric.

Today it is only natural to look first to this team for the finest quartz and synthetic crystals for every service.

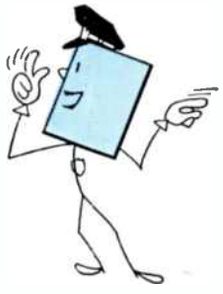
1917 A Rochelle salt crystal used by a Laboratories researcher to control an oscillator circuit was the granddaddy of all frequency control crystals.



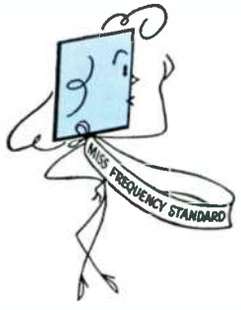
1924 Quartz crystal applied to frequency control of station WEAF by Bell Laboratories-Western Electric team greatly improved the quality of distant broadcast reception and laid foundation for more economical use of radio spectrum.

1927 Oscillating 100,000 times a second, a crystal served as the heartbeat of a clock far more accurate than any other timing device ever before made by man.

1933 Low - temperature - coefficient crystal cuts, utilizing for the first time specially selected shape, dimensions, and orientation characteristics, increased frequency stability, made temperature controls needless for certain applications.



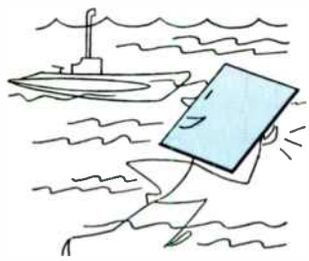
1934 "Traffic Cop" crystal filter designed by Bell Laboratories to act as separation unit for carrier systems. Led to today's 480 channel coaxial systems and single sideband radio transmitters.



1939 GT crystal serves as a "frequency model." Used for Loran, extremely accurate time signals (stable to 1 part in 10^{9}), and other applications requiring utmost frequency stability.

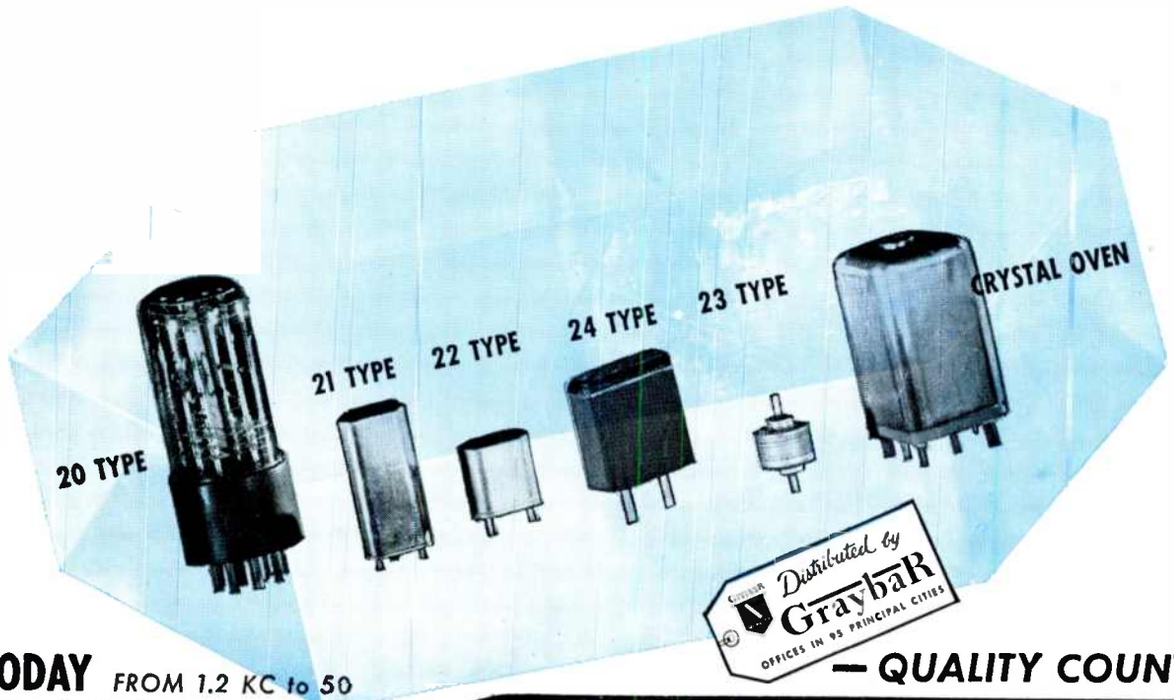
you more accurate frequency control

1942 Wire mounted crystal unit designed to withstand shocks and rough usage went into battle in tanks and with artillery. Western Electric produced over 10,000,000 of these.



1943 Synthetic ADP crystals, first mass-produced by this team, were also first applied by the team to underwater sound in Sonar. Change acoustic energy into electric and vice versa.

1947 EDT crystals — the first low-coefficient synthetics — are being grown on Western Electric's crystal farms to replace hard-to-get natural quartz.



TODAY *FROM 1.2 KC to 50* MC.—that's the extraordinary range covered by Western Electric's new line of crystal units for oscillator control. All are engineered to assure maximum frequency for a given design, with increased accuracy and stability.

— QUALITY COUNTS —

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

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

SIMPSON Model 260

World's Most Popular High Sensitivity

Volt-Ohm-Milliammeter

...with Roll Top Safety Case

At 20,000 ohms per volt, this instrument is far more sensitive than any other instrument even approaching its price and quality. Unequalled for high sensitivity testing in radio and television servicing and in industrial applications.

- Model 260 permanently fastened in Roll Top Case.
- Heavily molded case with Bakelite roll front.
- Flick of finger opens or closes it.
- Leads compartment beneath instrument.
- Protects instrument from damage.

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

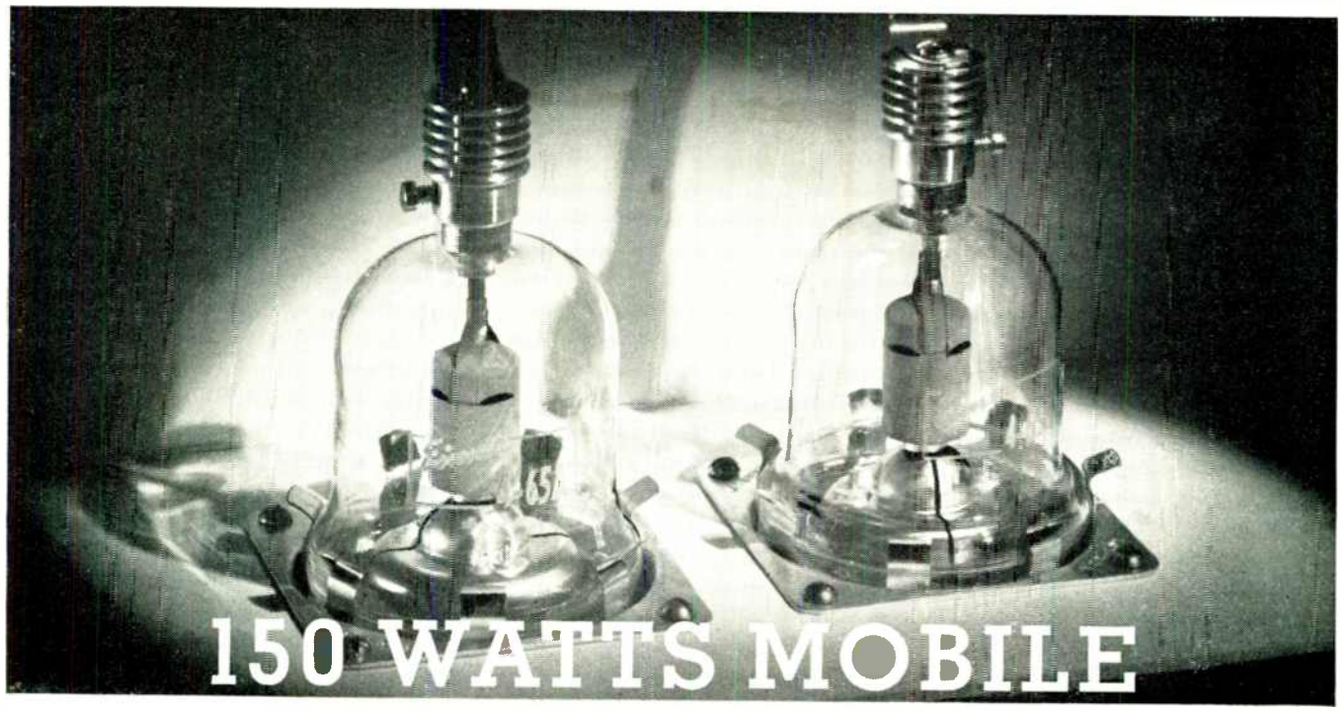
Ask your Jobber

SIMPSON ELECTRIC COMPANY
5200-5218 West Kinzie Street, Chicago 44, Illinois
In Canada, Bach-Simpson Ltd., London, Ont.

The Ranges

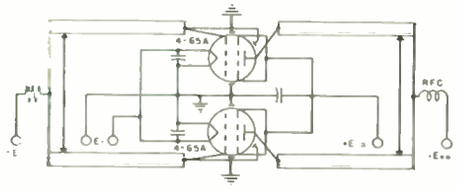
Volts D.C. (At 20,000 ohms per volt)	Volts A.C. (At 1,000 ohms per volt)	Output	Milliamperes D.C.	Microamperes D.C.	Amperes D.C.	S.O.B. Ranges	Ohms
2.5	2.5	2.5 V.	10	100	10	10 to	0-2000
10	10	10 V.	100			+52DB	(12 ohms center)
50	50	50 V.	500				0-200,000
250	250	250 V.					(1200 ohms center)
1000	1000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

Simpson
INSTRUMENTS THAT STAY ACCURATE



PUSH TO TALK

With the announcement of the new Eimac Tetrode type 4-65A, satisfactory high-power mobile transmission became a reality. Designed as a transmitting tube, with the transmitter man's problems in mind, the 4-65A provides stable operation over a voltage range of from 400 to 3000 volts. This characteristic alone enables continuity of system design, using the same vacuum tubes in the final stage of both the mobile and fixed station (two 4-65As will handle 150 watts input with 600 plate volts in the mobile unit, and operating at 3000 plate volts, in the fixed station, two 4-65As provide ½ kilowatt output).



SIMPLIFIED CIRCUIT FOR USE ABOVE 100-MC.

The tube is a "natural" for the 152-162 Mc. band. Its low interelectrode capacitances, compact structure, short electron transit time, high transconductance, together with being a tetrode allows simplification of circuit. Operation of the 4-65A can be continued up thru the 225-Mc. amateur band in either FM or AM service.

The 4-65A incorporates an instant heating thoriated tungsten filament, processed grids—controlling primary and secondary emission, and a processed metal plate—enabling momentary overloads without affecting tube life. All of the internal elements are self supporting without the inclusion of insulating hardware. Neutralization is normally unnecessary since practical isolation of the input and output circuits is achieved by the screen grid and its supporting cone. No special gear is required for installation, as the five pin base fits available commercial sockets.

In typical operation, class-C-telegrapny or FM-telephony, one 4-65A with a plate voltage of 600 volts, 125 milliamperes of plate current, and a plate power input of 75 watts will provide 50 watts of output with less than 2 watts of grid drive. In 1500 volt operation with an input of 190 watts, the output is 140 watts. With the plate voltage increased to 3000 volts and an input of 325 watts, an output of 265 watts per tube is obtained.

The 4-65A is amazingly versatile, being ideally suited for audio, television, r-f heating, and communication applications, stationary or mobile. It is priced at $14.50 each. Additional data may be had by writing to:

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

Follow the Leaders to

Eimac TUBES *The Power for R-F*

Export Agents: Frazar & Hansen, 301 Clay Street, San Francisco, 11, California

To insure performance of the 4-65A . . . severe mechanical tests are conducted—from withstanding a bump test to holding up under excessive vibration. Tests are carried even further . . . satisfactory shipment of the tube is insured by package drop tests.

Professional Service Directory

Jansky & Bailey
AN ORGANIZATION OF
Qualified Radio Engineers
DEDICATED TO THE
SERVICE OF BROADCASTING
•
National Press Bldg., Washington, D. C.

RAYMOND M. WILMOTTE, *Inc.*
Consulting Engineers
Radio and Electronics
PAUL A. DEMARS, *Associate*
1469 Church St., N. W., Washington 5, D. C.
Decatur 1234

FRANK H. McINTOSH
Consulting Radio Engineers
710 14th St. N.W., Wash. 5, D. C.
MEtropolitan 4477

ANDREW CO.
Consulting Radio Engineers
363 EAST 75th STREET, CHICAGO 19
Triangle 4400

RUSSELL P. MAY
CONSULTING RADIO ENGINEERS
★ ★ ★
1422 F Street, N. W. Wash. 4, D. C.
Kellogg Building Republic 3984

Preliminary surveys, management and operational consulting service based on practical experience with AM, FM and Facsimile.

Phone: EXecutive 3929
RADIO CONSULTANTS, Inc.
1010 VERMONT AVE., WASHINGTON 5, D. C.

• TELEPHONE BRIDGEPORT 5-2055 •
GARO W. RAY
Consulting Radio Engineers
991 Broad Street, Suite 9-11
Bridgeport 3, Conn.
LABORATORY: Hilltop Drive
Stratford, Conn. — Phone 7-2465
Instruments and Measurements

OUR 18th YEAR
Herbert L. Wilson
Consulting Radio Engineers
1018 Vermont Ave., N.W. NA. 7161
Washington 5, D. C.
•
1000 No. Seward St. HO. 6321
Hollywood 38, Calif.

ANDERSON & MERRYMAN
Consulting Rodio Engineers
715 American Bank Bldg. Tel. RAymond 0111
New Orleans 12, Louisiana
Suite 1726-28, 33 W. 42nd St. Tel. Wis. 7-9391-2
New York City

The
ROBERT L. KAUFMAN
ORGANIZATION
• Construction Supervision (FM-AM), Technical Maintenance, and Business Services for Radio Broadcast Stations.
Munsey Building Washington 4, D. C.
District 2292

CONSULTING
RADIO ENGINEERS
DIXIE B. McKEY
&
ASSOCIATES
1730 CONNECTICUT AVE. N.W.
WASHINGTON 9, D.C. ADAMS 3711

Radio Engineering Consultants,
Frequency Monitoring
Commercial Radio Equip. Co.
International Building • Washington, D. C.
603 Porter Building • Kansas City, Mo.

ERA COMPLETE Technical and Management Consulting Service
Immediate FM and VHF
Field Measurement Service Available
Engineering Research Associates, Inc.
Washington, D. C. Office: 1129 Vermont Av., N. W. *Phone:* EXecutive 4742
Laboratories: St. Paul 4, Minnesota *Phone:* NEstor 9601

ENGINEERING AND PATENT LIBRARIES
Bound volumes No. 11 and 12 of *FM* AND TELEVISION for January to June, 1946, and July to December 1946 are now being made up. Price, each, $5.50 plus 25¢ shipping charges.

Custom-Built
SPEECH INPUT EQUIPMENT
U. S. Recording Co.
1121 Vermont Avenue
Washington 5, D. C.
District 1640

THE WORKSHOP ASSOCIATES
INCORPORATED
Specialists in
High-Frequency Antennas
66 Needham St., Newton Highlands, Mass.
Bigelow 3330

FREQUENCY MEASURING SERVICE
Exact Measurements - at any time
RCA COMMUNICATIONS, INC.
64 Broad Street, New York 4, N. Y.

RATES FOR
PROFESSIONAL CARDS
IN THIS DIRECTORY
•
$10 Per Month for This Standard Space. Orders Are Accepted for 12 Insertions Only

Professional Service Directory

McNARY & WRATHALL
CONSULTING RADIO ENGINEERS
* * *
983 National Press Bldg. Di. 1205
Washington, D. C.

GEORGE P. ADAIR
Consulting Engineers
Radio, Communications, Electronics
1833 M St., N.W., Washington 6, D.C.
ENecutive 1230

KEAR & KENNEDY
Consulting Radio Engineers
1703 K St. N.W. REpublic 1951
Washington, D. C.

RATES FOR
PROFESSIONAL CARDS
IN THIS DIRECTORY
•
$10 Per Month for This Standard Space. Orders Are Accepted for 12 Insertions Only

WATKINS 9-5310
S. A. Barone Co.
Consulting Engineers
MECHANICAL—RADIO—ELECTRONIC
PRODUCT DEVELOPMENT & RESEARCH
Development Specialists in Circuits, Part Lists, Models, Manufacturing Drawings.
143-145 W. 22ND STREET, NEW YORK 11

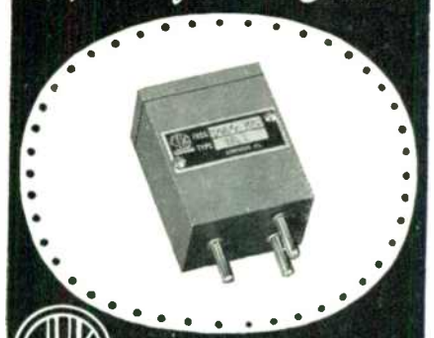
AMY, ACEVES & KING, INC.
Specialists in the
Design and Installation of
HIGH-GAIN
AM, FM, and TELEVISION
ANTENNA SYSTEMS
LOngacre 5-6622
11 West 42nd Street, New York 18, N. Y.

DALE POLLACK
FREQUENCY MODULATION
development and research
transmitters, receivers
communications systems
352 Pequot Avenue New London, Conn.
New London, 2-4824

WINFIELD SCOTT McCACHREN
AND ASSOCIATES
Consulting Radio Engineers
TELEVISION SPECIALISTS
PHILADELPHIA:
809B Windemere Ave.
Drexel Hill, Pa.
Sunset 2537-W
410 BOND BUILDING
Washington, D. C.
District 6923

FM AM **NATHAN WILLIAMS**
Consulting Engineer
20 Algoma Blvd.
Oshkosh, Wis.
Phone: Bl'khawk 22

Crystals for the Critical



"STABILIZED"

H11 FOR MARINE
and
AIRPLANE APPLICATION

The H11 is known the world over as the old standby for airplane and marine application. Frequency tolerance held to .004% over a wide temperature range. 3-pin base with pin diameter .156" and spaced .500" and .812". Can be supplied with two crystals or one crystal and a heater unit for maintaining constant temperature.

Write for Illustrated Folder

The JAMES KNIGHTS CO.
SANDWICH, ILLINOIS

IT'S **Wells** FOR **COAXIAL CABLE and CONNECTORS**

We have many types of coaxial cable in stock available for immediate delivery. It is all of the highest quality, government inspected material and is attractively priced.

All standard and British type connectors are carried in stocks adequate for the largest users. Send us your requirements or write for coaxial cable and connector listing 100A.

Our inventory of radio-electronic components is one of the world's largest. Write for special listings on relays, wire wound resistors, volume controls, wafer switches, micro-switches, transmitting tubes, mica and silver mica condensers, transmitting tubes, tube sockets, terminal strips, transmitting capacitors, oil filled paper condensers and wire.

WELLS SALES, INC.
320 N. LA SALLE ST., DEPT. TV-10, CHICAGO 10, ILL.

Now...

YOU can select a monitoring speaker to fit your needs

New Western Electric speakers for every broadcasting use

Now you can enjoy truly lifelike sound reproduction, unmatched tonal brilliance—in control rooms, clients' booths, offices, reception desks—with these small, wide range Western Electric loudspeakers.

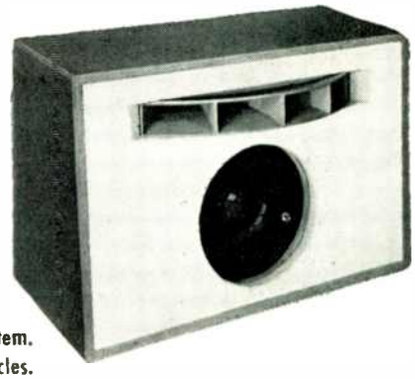
Designed by Bell Telephone Laboratories, they fill the requirements of every broadcaster for high quality reproduction regardless of power handling capacity.

For full details, get in touch with your nearest Graybar Broadcast Representative, or send the coupon to Graybar.

728B—12" direct radiator.
30 watts. 60—10,000 cycles.

756A—10" direct radiator.
20 watts. 65—10,000 cycles.

755A—8" direct radiator.
8 watts. 70—13,000 cycles.



757A — dual unit system.
30 watts. 60—15,000 cycles.

Distributed by GraybaR
OFFICES IN 95 PRINCIPAL CITIES

Western Electric

— QUALITY COUNTS —

Graybar Electric Company F-2
420 Lexington Ave., New York 17, N. Y.

Gentlemen: Please send me literature and information on the new line of Western Electric loudspeakers.

*Name*_____

Station _____

*Address*_____

*City*_____ *State*_____

NEW PATTERN FOR INDUSTRY EMERGES

FM, Television, and Facsimile Are Set to Edge Out AM, While Microwaves Are Replacing Land Lines

BY MILTON B. SLEEPER

EVENTS of the past thirty days presage the greatest changes in the history of radio. Rumblings now, they are no less forewarnings of a horizontal shake-up to be set in motion by the great number of new FM stations, the proving-in of wireless FM nets, expansion of television, the success of microwave television relays, progress of theatre television, and practical, low-cost facsimile recorders.

Quick Look ★ All this sounds complicated. It is. Scientific progress is introducing problems of management and application engineering faster than the industry's rate of assimilation.

What we don't know at this time is whether or not 1) advertising revenue will support added radio services, 2) equipment can be produced at popular prices, 3) dealers and servicemen can meet new technical problems and, finally, 4) the public will have the money and time to buy the equipment and to make use of it.

At this jumping off point, it's any body's guess as to what will happen. It's only certain that wrong guesses will be very expensive luxuries for those who make them.

EVERETT L. DILLARD, ENGINEER AND BROADCASTER, IS NEW FMA PRESIDENT

AFM ★ One current mistake has developed into a major headache. Its source is the Federation of Musicians, but the networks share in the responsibility.

AFM's Chief Heap-Big-Dumb-Chuck,[1] always so busy screaming that he has no time to listen, muffed the essential fact that FM is radio's first reason for reversing the AM trend toward more transcriptions and less live talent. Nor did he learn that, while live and recorded programs sound about the same on AM, the difference on FM is so great that FM listeners are complaining of transcribed programs, and are demanding more live shows.

This blunder was compounded by the AM nets. If they had gone into FM actively, they could have shown the AFM that they were supporting a return to live talent.

Now it comes out that the AFM edict against the use of live talent on FM nets merely sets the stage for the job that AFM is preparing to do on the AM networks.

FMA and NAB ★ The September conventions of the all-industry FM Association and the National Association of Broadcasters were both highly successful in point of attendance and in constructive results.

Judge Roy Hofheinz, the first president, accomplished successfully what no one else, probably, would have dared to undertake. Everett L. Dillard, who succeeds him, was an admirable choice. He is an engineer, a broadcaster, and a forward-thinking businessman.

High spots of the NAB session were the establishment of a code of ethics for broadcasters, the finest display of FM, AM, and television equipment ever assembled, and FCC Chairman Denny's speech (see pg. 19). Dissenting opinions on the Code voiced the fear that it would be used as a basis for new complaints. From where we sit and listen, we get the over-all impression that radio programs have sunk to the level of the tune we used to chant disrespectfully back in our grammar-school days: "Hark the herald angels sing — Johnson's pills are just the thing. Peace on earth and mercy mild; two for man and one for child."

Continental Network ★ Demonstrations of reception from the Continental FM Network and from C. R. Runyan's pioneer live-talent station provided a major education feature for those who attended the FMA and NAB Conferences. The FMA demonstration proved the flexibility of the net by the manner in which originating points were readily shifted from Allentown, Pa., at one end and Boston at the other, with a degree of dependability equal to wire-line operation.

As for the quality of reception as compared to AM, it can be described most simply as the difference between the reproduction and the simulation of the studio programs. After listening to live talent on FM, we apply the word "simulation" to AM in its dictionary definition: *Assumption of a superficial semblance.*

Theatre Television & Relays ★ RCA'S theatre television on a screen 6 by 8 ft., demonstrated at the NAB Conference, was really startling, both as to the fine quality of the images and the possibilities opened up by this development.

Of equal interest was the fact that the signals were coming to Atlantic City by radio relay. The illustration on page 20 shows the complete circuit of that relay

JUDGE ROY HOFHEINZ ORGANIZED FMA LAST YEAR, WAS THE FIRST PRESIDENT

[1] After 9 years in Chicago public schools, he failed to pass the 4th grade. For further details, see *FM* Magazine, Sept. 1942.

operated by RCA, Philco, and NBC.

Also on that page is a diagram of General Electric's new relay from New York City to Schenectady. We saw that in operation, too, with reception on a standard home receiver. It was excellent.

Television got another boost from FCC Chairman Denny (see pg. 19), who proposed at Atlantic City that television coverage can be extended now, at small expense, by putting in repeaters around principal television stations.

Facsimile ★ At the NAB Conference, broadcasters had their first demonstration of duplexed facsimile and sound.

This was done with Alden Products equipment, on transmission from the *Philadelphia Evening Bulletin's* station WPEN-FM. An added feature of convenience and paper economy was the switching circuit that automatically turned the recorder motor on or off when facsimile transmission started or stopped.

The New Pattern ★ Are broadcasters and manufacturers confronted with the necessity of going into FM, television, and facsimile as well? It doesn't appear so. As to AM, the best-informed opinion is that FM will gradually replace AM in the course of transition from an old system which was always inadequate, to a new method which has now proved to be superior on every count.

Television will compete with both aural broadcasting and the movies in areas where the density of population will support it. We cannot agree that all broadcasting will eventually be by television because 1) the cost of receivers and program distribution will not be low enough, and 2) sight-and-sound programs, like talking movies, have little meaning to those who can listen, but who do not find it convenient to look as well.

So home television will be challenged by competition from finer aural programs on FM, and from theatres which can combine television and movie entertainment. The theatres, with the means to use hilltop pickup installations, may even offer television in areas where signals are too weak for home reception.

Facsimile is the logical field for FM stations that cannot afford to go into television, and for those serving principally rural areas. A complete scanning installation costs less than a television camera, and programming is inexpensive.

As for the manufacturers — they will shift to FM receivers as fast as they bring their inventories of AM sets and components into proper relation to the increasing number of FM stations. Facsimile recorders, like record changers, will be made by specialists. Some sets will have terminals for connecting facsimile units. Others will have recorders built into the cabinets. Manufacturers who can afford to set up for television production, to install the elaborate test equipment necessary, and to organize adequate sales and service departments will expand greatly in that direction.

These are reasonable and conservative estimates of the unfolding pattern of radio progress.

PROPOSED REVISION OF TELEVISION AND COMMUNICATIONS ASSIGNMENTS

Released by the FCC on August 14, 1947

NON-GOVERNMENT
42.02–43.98 [1]

PROVISIONAL & EXPERIMENTAL
44.02
44.06

POLICE
44.10
44.14
44.18
44.22
44.26
44.30
44.34
44.38
44.42
44.46
44.50
44.54
44.58
44.62
44.64
44.70
44.74
44.78
44.82
44.86
44.90
44.94
44.98
45.02
45.06
45.10
45.14
45.18
45.22
45.26
45.30
45.34
45.38
45.42
45.46
45.50
45.54
45.58
45.62
45.64
45.70
45.74
45.78
45.82
45.86
45.90
45.94
45.98
46.02
46.06
46.10
46.14
46.18
46.22
46.26
46.30
46.34
46.38
46.42
46.46
46.50
46.54
46.58
46.62

POLICE, FIRE [2]
46.66
46.70
46.74
46.78
46.82
46.86

FIRE
46.90
46.94
46.98
47.02
47.06
47.10

HIGHWAY MAINTENANCE
47.14
47.18
47.22
47.26
47.30
47.34
47.38
47.42

SPECIAL EMERGENCY
47.46
47.50
47.54
47.58
47.62
47.66

PETROLEUM
47.70
47.74
47.78
47.82
47.86
47.90
47.94
47.98
48.02
48.06
48.10
48.14

POWER UTILITY & PETROLEUM [3]
48.18
48.22
48.26
48.30
48.34
48.38
48.42
48.46
48.50
48.54
48.58
48.62
48.66
48.70

POWER UTILITY
48.74
48.78
48.82
48.86
48.90
48.94
48.98
49.02
49.06
49.10
49.14
49.18

PROVISIONAL & EXPERIMENTAL
49.22
49.26

FORESTRY
49.30
49.34
49.38
49.42
49.46
49.50
49.54
49.58

FORESTRY & TRANSIT UTILITY
49.62
49.66
49.70
49.74
49.78
49.82

TRANSIT UTILITY
49.86
49.90
49.94
49.98

AMATEURS
50 54

TELEVISION
54–60 No. 2
60 66 No. 3
66 70 No. 4

NON-GOVERNMENT
72–76 [4]

TELEVISION
76 82 No. 5
82–88 No. 6

FM BROADCASTING
88–108

GOVERNMENT, FIXED, & MOBILE [5]
108–174

TELEVISION
174–180 No. 7
180 186 No. 8
186–192 No. 9
192–198 No. 10
198–204 No. 11
204–210 No. 12
210–216 No. 13

[1] Assignments in this band are given in detail on page 111 of the FM Handbook, published by FM Company, Great Barrington, Mass.

[2] Including municipally-owned utilities (such as water, electricity, gas, etc.) which make joint use of municipal fire or municipal police radio facilities.

[3] Including other industries requiring similar radio service.

[4] Future assignments are to be limited to fixed circuits which, as a result of an engineering study, may be expected to operate in this band on a non-interfering basis to the television service. Assignments in this band are given in detail on page 121 of the FM Handbook.

[5] Assignments in the 152- to 162 mc. part of this band are given in detail on page 134 of the FM Handbook.

FCC'S REVIEW OF RADIO PROGRESS

An Address before the National Association of Broadcasters, Atlantic City, September 17, 1947

HON. CHARLES R. DENNY, JR.*

A YEAR ago in Chicago I told you that the Federal Communications Commission is operating in a goldfish bowl. I assured you that it is our desire that at all times, you and the public generally shall know what the Commission is doing, what its policies are and the reasons therefor.

In a little while I am going to invite you again to step up and press your faces against the panes of the glass house in which we work. We shall pick up where we left off last year. We shall review what has happened. We shall examine new developments. You shall look inside our minds. You shall even see the Blue Book lying on the bench in the Commission meeting room. And you shall be able to judge for yourselves whether the sunlight of the year of operation pouring through the windows has bleached the bright blue cover.

But first I want to ask you to spend a few minutes with me in another part of the communications world.

International Telecommunications Conference ★ The Atlantic City conferences were called to re-write the Madrid Convention of 1932 and the Cairo regulations of 1938. This work had been delayed by the war. Today, we are dealing with problems which have been accumulating over the past decade, a period when changes in communications have taken place at an unprecedented rate.

In the Radio Conference which opened here in Atlantic City on May 15, we have completely re-written a book of over 225 pages of detailed technical regulations. The regulations contain numerous technical standards, provisions on licensing procedure, call signs, operating practices, matters relating to safety and distress, and a myriad of other subjects. But when the history of this radio conference has been written, I believe that three principal aspects of its work will stand out:

First, we will have adopted a world-wide allocation of bands of radio frequencies up to 10,500,000 kc. The 1938 Cairo allocation table stopped at 30,000 kc.

Second, we have planned practical machinery for putting the new allocation table into effect. Until now every country using frequencies simply notified the headquarters of the Union of the assignments made by it and these assignments were

"I TOLD YOU THAT THE FCC IS OPERATING IN A GOLDFISH BOWL"

entered on a master list with dates of notification and first use of the frequency assigned. There was no concerted international effort to make arrangements which would best conserve spectrum space. There was no planned sharing of frequencies on a time basis or a geographical basis. To meet this need we are providing for sessions of technical experts to engineer assignments on a world-wide basis. For the first time in history, these precious radio frequencies will be assigned on the basis of engineering principles, rather than on random notifications.

Third, we will have provided for a permanent board of experts — the International Frequency Registration Board which, starting with the newly engineered list, will consider every future assignment to determine whether the assignment will cause international interference.

The second conference in chronological order is the Plenipotentiary Conference which convened on July 1. Its task is the revision of the Madrid Convention, the basic treaty which lays down the broad principles on which the technical regulations are founded. Here again, the Atlantic City conferences have broken new ground. Until now the only central organization of the Telecommunications Union was a secretarial office in Berne, Switzerland which maintained the records of the Union and acted as a central clearing house for information. In 1932 this was adequate, but telecommunications have advanced at a rapid pace since then.

In the Plenipotentiary Conference we have provided for a permanent organization which can cope with international problems from day to day as they arise. The United Nations has recognized our Union as the specialized agency for international communications.

As we advanced in these two conferences, it became clear that the unexpected volume of work made it impossible to complete a full scale high-frequency broadcast conference at Atlantic City. No other international conference had ever before been held in this field. So we modified our plans and are proceeding with a preparatory conference which will lay a solid foundation for the final work which will be carried out at a resumed session scheduled for Mexico City in 1948.

To me, the coöperation, good will, patience, and perseverance of these delegates to these Atlantic City conferences have been inspiring. The representatives of 78 countries arrived in Atlantic City with varying interests and with widely differing initial positions. They sat down at the conference tables. They made friends with each other. They worked hard. They worked with great skill. They solved numerous technical problems of immense difficulty. They submerged their individual differences for the common welfare. The success of their efforts insures the orderly use and the maximum growth of communications throughout the world.

AM Broadcasting ★ Last year's prediction that this industry would outgrow the facilities of Chicago's Palmer House has proved accurate. Today you hold your twenty-fifth annual meeting in the largest convention hall in the land.

When I spoke last year, there were 1,384 AM stations in operation or under construction. During the year, we granted many additional stations bringing the total up to 1861. Of these, 936 were pre-war stations. The other 925, or 50%, have been authorized since October 8, 1945, the date when the FCC resumed its normal peacetime licensing functions.

As the result of those 925 postwar grants, 300 American communities now

* Chairman, Federal Communications Commission, Washington, D. C.

Editor's Note: This text is complete except for introductory remarks concerning the International Telecommunications Conferences.

for the first time are getting radio stations of their own.

The Commission continues to hold firm to what it considers to be a cornerstone policy of the Communications Act — that broadcasting is a competitive business. Accordingly, where we have before us a qualified applicant for an available frequency, we shall continue to make grants. We shall not attempt to fashion an umbrella with which to shelter this industry artificially from the consequences of free competitive enterprise.

Pending Applications ★ Having re-stated our basic policy I should like to address a sentence or two to the applicants whose cases are still pending before the FCC. Last year when I spoke, there were 659 AM applications pending. Today, despite the fact that the Commission has disposed of an unprecedented volume of cases there are 700 applications pending.

I would like to urge those 700 applicants to make a realistic reappraisal of the situation in the light of all available facts.

First, what does it actually cost to build a new radio station? A recent survey made by the Commission shows that in a community under 50,000 it costs an average of $34,000 to build a full-time station on a local channel. In the larger cities the average cost increased to $50,000. Add to this the cost of operating a station during the initial period. Then endeavor to make a careful estimate of whether the new station can be put on a profitable operating basis and how long it will take to do this. In this connection, the recent FCC survey made in April of this year covering 249 new post-war stations showed that about half of them were breaking even or making a profit. Further, the survey showed that if you are entering a community without radio service at present, your chances of success are twice as good as if you were entering a community where you will find competition.

These are business judgments. I have said that the Commission is not going to make them for you. It does not follow, however, that these business judgments should not be made. It is up to you applicants to make them.

The Mayflower Doctrine ★ Last year's convention in Chicago devoted considerable discussion to the question of whether the broadcaster should editorialize. I indicated that I believed that the Commission had an open mind and would be willing to re-examine its policies on this subject. Now a hearing has been ordered for January. I trust we shall have your coöperation in getting all points of view on this question and in arriving at a solution that will be to the best interest of the radio industry and the public.

The Blue Book ★ Now let's take a look at the Blue Book. Its cover is still solid blue. It has not been bleached. The Blue Book stands as fundamental FCC policy.

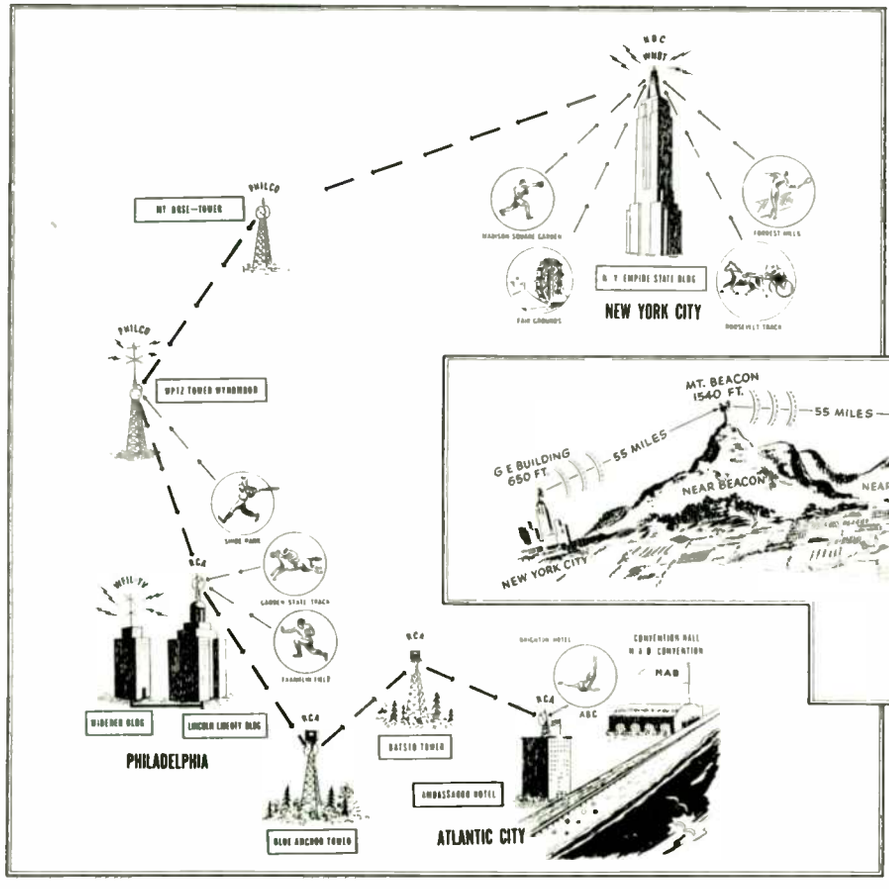
Those who have suggested that the color of the Blue Book is fading point to the fact that the Commission, after hearings, has renewed the licenses of six stations that received prominent mention in the Blue Book. Two things, however, are overlooked.

First, they fail to take into account the real improvement made by the stations in question and their recognition, which we are convinced is sincere, of their public service responsibility.

Second, they misconstrue the purpose of the Blue Book. The Blue Book was issued to make known to the public and the industry some of the basic questions which we feel should be taken into account in developing program service in the public interest. It was issued to aid broadcasters in developing a consciousness of public service responsibility. In addition, we wanted to indicate the general outline of our licensing policy. The Blue Book was never intended to lay down by rigid rule the precise conditions under which licenses would be revoked. For improvements in the broadcast field must come in the first instance from the broadcasters themselves, from their appreciation of their own responsibilities to meet public requirements. Only when there is continued and flagrant disregard of these responsibilities does the licensing authority come into play.

In the final analysis the success of this industry and the success of the governmental licensing authority are not to be measured by the number of licenses issued or by the number of licenses revoked.

The important thing in broadcasting is what comes out of the loudspeaker. The renewal applications and other reports received since the publication of the Blue Book give evidence that you are becoming increasingly aware of your responsibilities to the public. Here in Atlantic City you are considering a detailed code by which you hope to raise the standards of your industry. In this objective we wish you every success. There is still much to be done. American radio is still too commercial.



LEFT: PHILCO-RCA TELEVISION RELAY

RIGHT: G.E.'S N.Y. SCHENECTADY RELAY

Frequency Modulation ★ Last year at this time

(CONTINUED ON PAGE 49)

FCC SEES FM AS NEW DEAL FOR LISTENERS

Address before the FM Association at New York City, September 12, 1947

HON. PAUL A. WALKER*

THE first Annual Convention of the FM Association heralds a new deal for the American radio listener.

The enthusiasm, the reports of accomplishment, the planning and the organizing at this convention are eloquent testimony to the impressive stature that Frequency Modulation has already attained and to the rapid strides it will make in the coming months.

FM Service ★ This convention spotlights the fact that American radio is moving closer and closer to the happy day when static, electrical noise, station interference, fading, and low-fidelity will be as passé as the horsecar, the high-wheel bicycle, the handlebar mustache and the cigar store Indian.

We are moving closer to the day when FM will make American radio more truly competitive, more truly democratic.

FM is one of the most brilliant discoveries of modern times. It is beginning to revolutionize American broadcasting.

Expansion ★ It is difficult for the layman to appreciate the far reaching change that is taking place in the broadcasting world. Here we have a completely new and different type of broadcasting. On VJ Day there were only 48 FM stations in the entire country. Today, despite the crippling scarcities of materials, equipment and labor, we have 278 FM stations on the air. Seven hundred more are, or soon will be, under construction. And more than 130 applications are pending before the FCC.

One year from today the number of FM stations on the air should be upwards of one thousand.

That will about equal the growth made by our familiar system of AM or Amplitude Modulation broadcasting in a whole quarter of a century.

Already, sixty million Americans live within the range of one or more FM stations. Note that I say "live within the range." I do not say that they are all hearing FM. Because of the lack of FM sets, very few of them are able to hear the new FM stations. All in all, comparatively few people know what those mysterious initials "FM" signify.

For too many folks, FM is still in the category of the sea serpent and the flying saucer.

"I CONGRATULATE THE . . . CONTINENTAL NETWORK FOR THEIR SPLENDID JOB"

The American people are entitled to know the facts about FM.

The Federal Communications Commission has a duty under the law to keep the public informed of the progress of all new electronic developments. We have in the past and we will continue in the future to pass on to the public information on FM so that they may be guided accordingly.

Advantages ★ I am glad to have the opportunity afforded by this convention to reaffirm the enthusiasm of the Commission for this new type of broadcasting and to call attention again to its merits.

The main advantages of FM are as follows:

1. FM is easier on the ears. It is virtually free from static and other electrical noise, from interference and fading.

2. FM has high fidelity. Its range brings all the tones and overtones of every instrument in the orchestra.

3. FM means more service. Most communities will be able to have more FM stations than they now have AM stations. Generally, the stations in a given community will be similar in the coverage they provide. That means that a station cannot rely on superior power, as at present, to compete for an audience. It will have to compete on the basis of excellence of programs. Here we have true equality of opportunity.

The opportunity for more stations also means that new people with new ideas can come into the field. It means a greater possibility of catering to minority tastes and of expanding discussion of controversial issues. All this makes for a fuller enjoyment of the rights guaranteed to us by the First Amendment.

Growth During 1948 ★ FM will be greatly accelerated during the coming year. I cite the following developments which indicate that the next year will be a banner year for FM.

1. The trickle of transmitting equipment is changing to a highly encouraging volume.

2. FM receiving sets are rapidly increasing in number. A serious problem has been the scarcity of FM receiving sets. Manufacturers delayed tooling up for FM while they concentrated on AM sets. That market is now rapidly becoming saturated. The manufacturers are being compelled to turn to FM in order to stay in business. Dealers and broadcasters all over the nation are crying for FM sets. Only about six hundred thousand FM sets have been produced so far this year. In the same period, the industry will produce some fifteen million AM sets. As that enormous productive capacity swings to FM, we can see why the future for the FM receiver is so bright.

But that is not the whole story. Receiver prices are coming down. Also coming on the market are low priced converters which can be attached to AM sets.

3. The network of 26 stations over which I am speaking from this Convention tonight is a thrilling manifestation of the enterprise, the boldness, and the imagination with which this industry has found another means of developing FM.

This network is employing direct radio pickup to supplement its wire circuits.

The successful operation of this network opens vast possibilities for establishing similar regional networks all over the nation. Even national networks are possible. Thus is added a tremendous stimulus to the growth of FM during the coming year.

(CONTINUED ON PAGE 51)

* Vice Chairman, Federal Communications Commisson, Washington, D. C. *Editor's Note:* This is the complete text of Mr. Walker's address.

SPOT NEWS NOTES

Items and comments, personal and otherwise, about manufacturing, broadcasting, communications, and television activities

Charles R. Denny, Jr.: Resigned October 8 as FCC Chairman, to become NBC vice president and general counsel, effective November 15. Consequently, hearing on the reallocation of the 44- to 50-mc. band, scheduled for October 13, has been continued to November 17. (See pg. 18)

Mr. Denny's resignation represents a very real loss to the radio industry. His keen understanding and sound judgment have won universal respect. His ability to reach decisions promptly has speeded progress. He has made friends everywhere, at home and abroad. We join them in wishing him success at NBC.

Lieut. Ben Demby: Reports that his Miami police radio system operated through the September hurricane without a single failure. The antenna on the court house held its own against winds up to 120 mph. This 155-mc. Motorola installation was the first in regular operation above 100 mc. (See *FM & TV*, May, 1945.)

Dr. W. L. Barrow: Appointed chief engineer of Sperry Gyroscope Company, Great Neck, New York. Dr. Barrow joined Sperry in 1943, after serving for several years as a consultant. Previously, he was on the staff of the electrical engineering department at M.I.T.

Railroad Radio: Two-way FM telephone service with the Bell System is available to passengers on New York Central's 20th Century Limited, throughout the 436-mile run from New York to Buffalo. Later, service will be extended all the way to Chicago.

ATS Awards: Annual awards of the American Television Society were presented at the Barbazon Plaza, New York, on September 26 to the Electric Association of Chicago for its advancement of television in that city, to the Dramatists Guild for the year's outstanding contributions to programming, to John R. Poppele for his work as president of TBA, and to George Shupert, former president of ATS, for his efforts in behalf of television.

H. B. Macartney: Vice-president of Hammarlund Manufacturing Company has resigned after 22 years of association with this concern. His future plans have not been announced.

Make Your Choice: Two highly informative booklets on facsimile should be read by everyone interested in this rapidly developing field. One is on 4-in. recording, by Alden Products Company, Brockton, Mass. The other, concerning 8-in. recording, is published by *The Philadelphia Inquirer*, Station WFIL-FM, Philadelphia. There is no charge.

FM-AM Tie-up: Pending completion of its own FM transmitter, AM station KCKN has been helping to build the FM audience in Kansas City by feeding its sports programs to Everett Dillard's KOZY, for simultaneous transmission. That's cooperation!

Two Anniversaries: Next month, *FM* AND TELEVISION will begin its 8th year of publication. And on November 13, your editor will celebrate his 50th birthday.

New Address: Rek-O-Kut Company offices and show rooms to 38-01 Queens Boulevard, Long Island City 1, N. Y.

More Television Channels: Successful operation of the Philco–RCA and the G.E. television relay systems is advancing the date when definite steps must be taken to provide more television broadcast channels. Looking back, it seems that CBS could have launched upper-band television commercially a year ago if they had not tied on the color issue. Now it looks as if upper-band service must be inaugurated soon, or it will not be ready in time. While sets would probably not provide dual-band reception, dual-band transmission appears entirely practical.

New Company: Hermon Hosmer Scott, Inc., with H. H. Scott as President, has been formed to produce the Scott dynamic noise suppressor, and to operate a laboratory in the service of licensees. Address is 385 Putnam Avenue, Cambridge, Mass.

H. R. Hurd: Named Manager of KSFH, San Francisco, the first of 6 FM stations projected by Pacific Broadcasting Company. KSFH is scheduled to go on the air this month with 15.8 kw. effective radiation.

WRCM: New Orleans FM station, whose REL antenna is the highest structure in Louisiana, weathered the 120-mph. hurricane, and won high praise from the Mayor for the 24-hour-a-day schedule maintained to assist in relief work at a time when atmospherics practically stopped AM.

Courageous: Mutual Broadcasting System has announced a survey plan to show "listenability," rather than microvolt ratings of broadcast stations signals. Plan seems complicated, but if surveys are to show within what limits AM signals are free of static and co-channel night-time interference, our guess is that they will never be published.

James Lawrence Fly: Elected to the board of directors of Finch Telecommunications, Inc. Directors Frank H. Battenus, Frank R. Brick, Jr., W. G. H. Finch, Herbert A. Kent, and Herbert R. Petty were re-elected.

Service Manual: There will be 94 set manufacturers represented in the 768 pages of receiver diagrams in Rider's Manual volume 16. Formerly published yearly, the Manuals will now come out 3 times a year, priced at $6.60.

Iowa Police: Will have a state-wide FM communications system, using G.E. equipment. First of the transmitters is being installed at Maquoketa. System will cover 70,000 square miles.

Patent Licenses: Philco is offering formal licenses to manufacturers on its collection of some 700 patents on radio and television inventions. RCA, G.E., and Westinghouse have already made patent deals with Philco.

VP on FM: Vox Pop, the famous audience-participation show, will be heard on FM during the Johnson-Hull tour of the U. S. Sponsored by American Express, Vox Pop will be aired from a different city each week. FM stations desiring to arrange for a guest appearance should write Parks Johnson in care of Coll & Freedman, 49 W. 51 Street, New York 19.

M. W. Scheldorf: Former G.E. expert on FM antennas for broadcasting and communications, has joined Andrew Company, Chicago. He will head up long-range antenna and transmission-line development.

WTRF-FM: Tri-City Broadcasting Company's station at Bellaire, Ohio, will be on the air November 1, on 100.5 mc.

Shortage of Engineers: H. N. Muller, manager of the educational department at Westinghouse, reports the supply of engineering talent as very short, and keenly sought after. Twice as many companies are interviewing graduates of engineering schools, offering pay far above prewar level. Shortage is expected to continue into 1950.

Television Relay System: Projected by Western Union is planned to connect WCBS-TV, New York, with *Philadelphia Evening Bulletin's* WPEN-TV. Unused facilities of N. Y.-Philadelphia system, now in operation, will be employed. Links from Philadelphia to Washington and Washington to Pittsburgh, now under construction for telegraph service, may also carry television programs. Original application to FCC is now being revised at the Commission's suggestion. W.U. relays are also projected from Pittsburgh to Albany, Cleveland, Detroit, Chicago, and St. Louis.

1: ARTIFICIAL CRYSTALS TO REPLACE QUARTZ 2: TERMINUS OF G.E. TELEVISION RELAY 3: GRADING LUMINESCENT POWDER

NEWS PICTURES

1. Bell Telephone Laboratories are growing artificial crystals to replace natural quartz. The new ethylene diamine tartrate crystals, although different from quartz in chemical composition, are equivalent in their piezo-electric characteristics. In commercial production, EDT crystals weigh about 1 lb.

2. This is the Hilderberg terminal of the G.E. television relay system, by means of which any program on the air in New York City can be carried to Schenectady. The tower, 125 ft. high, carries a room 26 ft. square, providing ample space for the receiving reflector antenna, and a similar one to beam the program to the WBRB studio.

In commercial practice, single towers will be used to carry the reflectors, with all the equipment mounted in a small box.

3. A setup at the Philips Laboratories, Irvington, N. Y., for research on luminous materials for cathode ray tube screens. This installation, called an elutriator, grades luminescent powder according to particle size. Actual separation occurs in the pair of cone-shaped chambers. Since they are of different diameters, the linear-flow velocity is different. The heavier particles are deposited in the smaller chamber, while those of intermediate size are retained in the other. The finest size passes through the overflow pipe into the lower beaker.

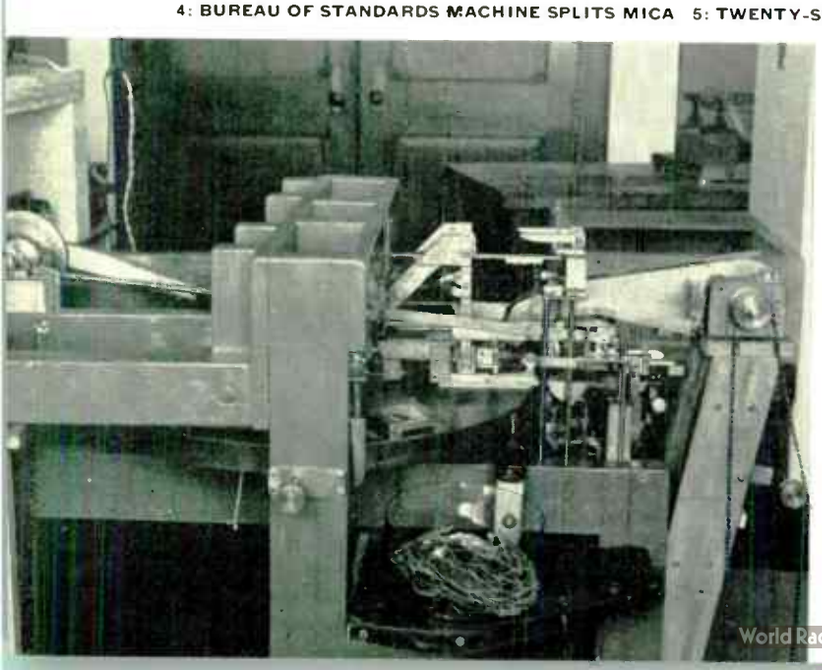
4. As a substitute for the laborious method of splitting mica for condensers by hand, D. W. Kessler and R. E. Anderson, of the National Bureau of Standards, Washington, D. C., have developed an automatic machine.

In operation, the mica block, held in a chuck, is moved forward against a splitter gage, which raises a film. As the chuck is withdrawn, two stripper blades pass under the raised film to separate it from the block. The loosened film is deposited in a receptacle. Six chucks operate successively. Quality and thickness control compare favorably with hand splitting. Machine-split films, however, showed less knife scratches.

5. With production of television broadcast equipment outstripping the supply of television engineers, RCA's engineering products division has put on a second 1-week course of intensive instruction.

Attending the recent course were: James Kyle WMBG, Earl Lewis WTVJ, K. A. West Ft. Monmouth, Hans Inslerman Ft. Monmouth, A. H. Saxton NBC Hollywood, Howard Luttgens NBC Chicago, S. E. Leonard WTAM, A. C. Anderson KTAR, Gilbert Rix WWJ, W. F. Coleman WTIC, A. E. Towne KSFO, Frank Bremer WAAT, Richard Blackburn WTHT, I. B. Robinson, Yankee Network, Leo Feller Signal Corps, Belmar, George Lewis WCAU, R. Craig WCAU, Louis Lewis WOI, C. R. Evans KSL, Philo Stevens WBEN, Carl Menzer WSUI, A. F. Reckart KNOK, Harold Bebe WSMB, Jack Leiteh WCAU, C. Robinson WCAU, David Martin WMAR.

4: BUREAU OF STANDARDS MACHINE SPLITS MICA 5: TWENTY-SIX BROADCAST ENGINEERS ATTEND RCA'S TELEVISION CLINIC



TELEVISION SIGNAL GENERATOR

6-Channel Crystal-Controlled Generator with Video & FM Modulation, for Testing Overall Television Receiver Performance

BY JOSEPH FISHER*

IN television receiver development and production testing there is a definite need for an RF source of signals, modulated with video and sound, but unaffected by multipath transmission or noise. When a receiver is connected to an antenna, the designer is faced with the problem of determining whether transients in a television picture are the result of phase distortion in the receiver, reflections from nearby objects, or distortion produced by a television station.

A monoscope unit in conjunction with a synchronizing generator, used to produce a standard video signal, is useful for designing amplifiers and deflection circuits. However, unless the video signal is modulated on a carrier, it is quite difficult to make an overall receiver test that will show whether performance is up to standard.

This new RF signal generator described here is designed to overcome those objections, and to produce a standard RMA television signal. All the standards, such as negative modulation, transmission of the DC component, percentage of the RF signal devoted to synchronizing pulses, depth and linearity of modulation, and crystal control of carrier frequency, are maintained.

The FM sound carrier, with a standard deviation of ± 25 kc., is 4.5 mc. higher in frequency than the picture carrier.

Layout ★ Fig. 1 shows the six channel generator which is housed in a cabinet rack 83 ins. high. The 6 upper units are the RF generators which produce the picture and sound carriers for the lower 6 television channels, from 44 to 88 mc. Each RF generator has its own attenuator and output connector. Directly below, is the video amplifier with controls for individually adjusting the percentage modulation and black level of each RF picture carrier. Next is the FM sound unit, which contains a switch for selecting either an internal or external audio as a source of sound modulation.

The unit below this contains the master power switches as well as three 6-position rotary switches by means of which any three RF channels can be operated simultaneously, or any one channel alone. The two bottom units are regulated power supplies.

Signal Circuit ★ Fig. 2 is a block diagram of the generator, tracing the signal through the various units. A unique method of obtaining the RF sound carrier is used, taking advantage of the fact that the difference in frequency between the picture and sound carriers is 4.5 mc. The FM sound unit contains a 4.5-mc. reactance tube oscillator which can be deviated by either

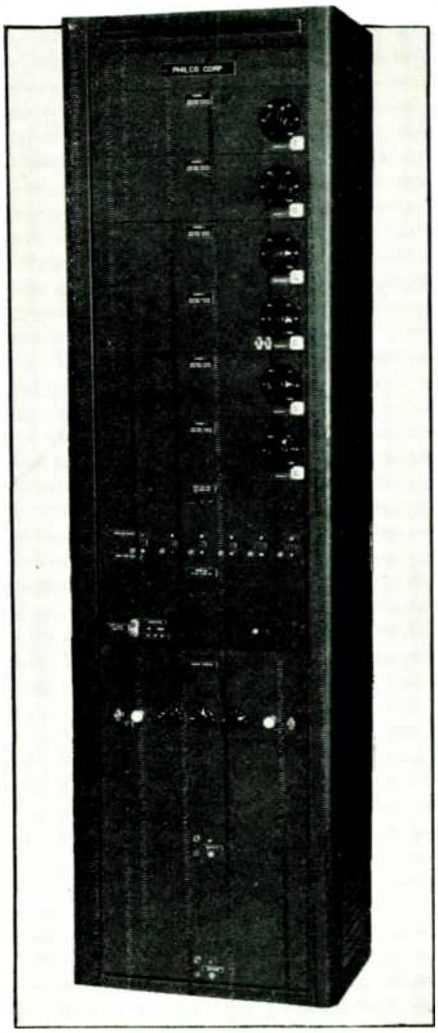


FIG. 1. 6-CHANNEL TV SIGNAL GENERATOR

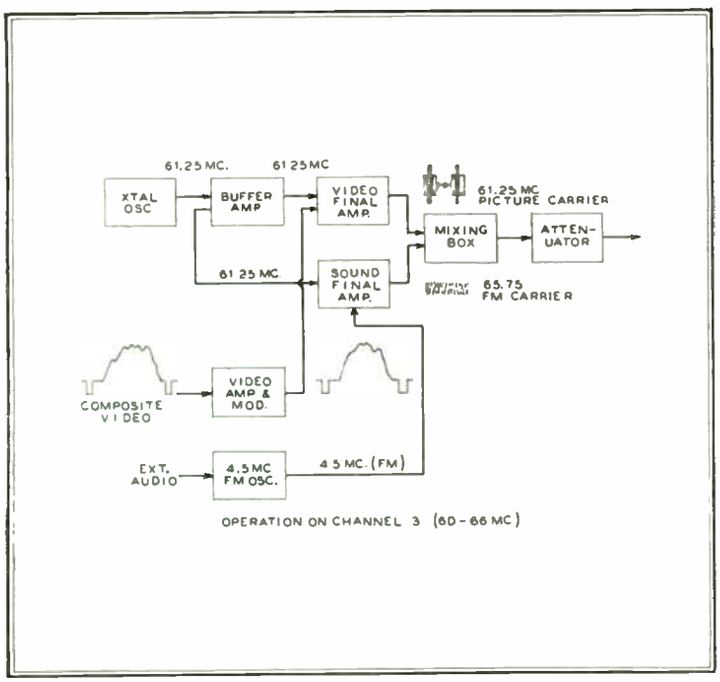


FIG. 2. BLOCK DIAGRAM OF THE VIDEO-AUDIO SIGNAL GENERATOR.

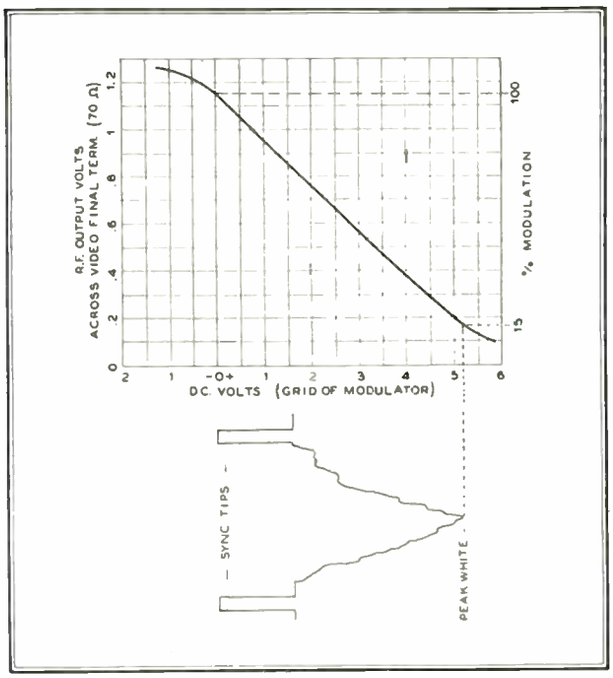


FIG. 7. CALIBRATION OF THE MODULATION PERCENTAGE

* Project Engineer, Research Division, Philco Corporation, Philadelphia 34, Pa.

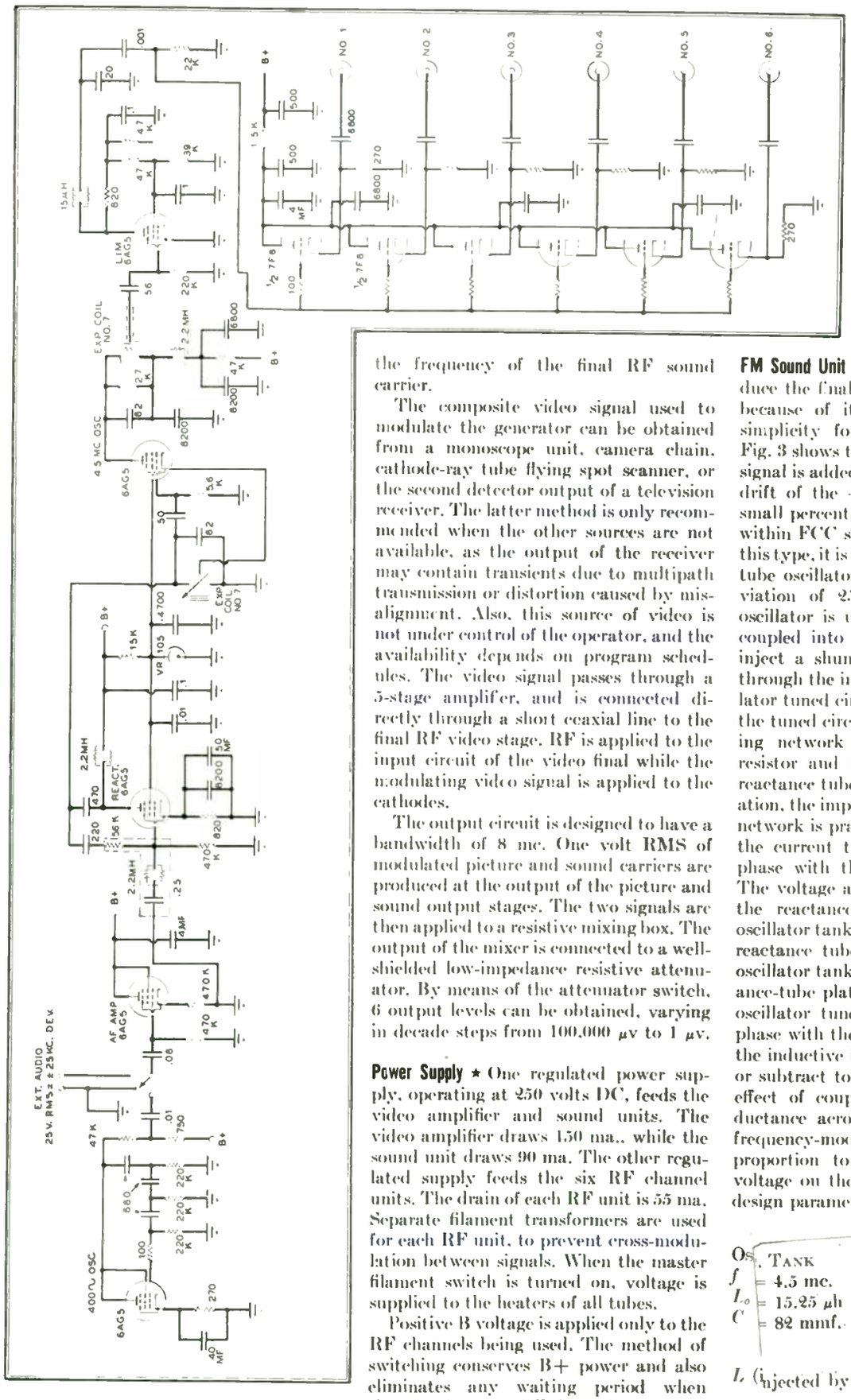


FIG. 3. CIRCUIT OF THE FM SOUND UNIT, EMPLOYING REACTANCE-TUBE MODULATION. ONE-HALF A 7F8 TUBE IS USED AS THE OUTPUT FOR EACH OF THE SIX CHANNELS, AT A LEVEL OF .7 VOLT RMS

a built in 400-cycle audio oscillator or an external source. This signal is distributed to the 6 RF channel units, and beats against the unmodulated picture carrier. The sum frequency produced then becomes the frequency of the final RF sound carrier.

The composite video signal used to modulate the generator can be obtained from a monoscope unit, camera chain, cathode-ray tube flying spot scanner, or the second detector output of a television receiver. The latter method is only recommended when the other sources are not available, as the output of the receiver may contain transients due to multipath transmission or distortion caused by misalignment. Also, this source of video is not under control of the operator, and the availability depends on program schedules. The video signal passes through a 5-stage amplifer, and is connected directly through a short coaxial line to the final RF video stage. RF is applied to the input circuit of the video final while the modulating video signal is applied to the cathodes.

The output circuit is designed to have a bandwidth of 8 mc. One volt RMS of modulated picture and sound carriers are produced at the output of the picture and sound output stages. The two signals are then applied to a resistive mixing box. The output of the mixer is connected to a well-shielded low-impedance resistive attenuator. By means of the attenuator switch, 6 output levels can be obtained, varying in decade steps from 100,000 μv to 1 μv.

Power Supply ★ One regulated power supply, operating at 250 volts DC, feeds the video amplifier and sound units. The video amplifier draws 150 ma., while the sound unit draws 90 ma. The other regulated supply feeds the six RF channel units. The drain of each RF unit is 55 ma. Separate filament transformers are used for each RF unit, to prevent cross-modulation between signals. When the master filament switch is turned on, voltage is supplied to the heaters of all tubes.

Positive B voltage is applied only to the RF channels being used. The method of switching conserves B+ power and also eliminates any waiting period when changing from one RF channel to another. The application of B+ is delayed 30 seconds after the master filament switch is turned on, by means of a thermal delay relay. This is done to prevent damage from surges and also to prolong tube life.

FM Sound Unit ★ The method used to produce the final sound carrier was adopted because of its frequency stability and simplicity for multi-channel operation. Fig. 3 shows the circuit. Since the 4.5-mc. signal is added directly to carrier, a slight drift of the 4.5-mc. oscillator is only a small percentage change of the sum, and within FCC standards. With a system of this type, it is necessary that the reactance tube oscillator produce the standard deviation of 25 kc. An electron-coupled oscillator is used with a reactance tube coupled into the tuned circuit so as to inject a shunt inductance. The current through the inductive branch of the oscillator tuned circuit lags the voltage across the tuned circuit by 90°. The phase-shifting network consists of the .056-ohm resistor and the input capacity of the reactance tube. At the frequency of operation, the impedance of the phase-shifting network is practically all resistive. Hence the current through this network is in phase with the oscillator tank voltage. The voltage across the input capacity of the reactance tube therefore lags the oscillator tank voltage by 90°, causing the reactance tube plate current to lag the oscillator tank voltage by 90°. The reactance-tube plate current coupled into the oscillator tuned circuit is, therefore, in phase with the oscillator current through the inductive branch, and can either add or subtract to this current. This has the effect of coupling a variable shunt inductance across the oscillator coil, and frequency-modulating the oscillator in proportion to the instantaneous audio voltage on the reactance tube grid. The design parameters were:

Osc. Tank	Phase Shifting Network
f = 4.5 mc.	R = 56,000 ohms
L_o = 15.25 μh	C = 10 mmf.
C = 82 mmf.	g_m = 4500 (Reactance tube)

$$L \text{ (injected by reactance tube)} = \frac{CR}{g_m} = \frac{10 \times 10^{-12} \times 56 \times 10^3}{4500 \times 10^{-6}} = 124\ \mu h$$

$$\text{Effective } L = \frac{L_o \times L}{L_o + L} = \frac{15.25 \times 124}{15.25 + 124} = 13.6$$

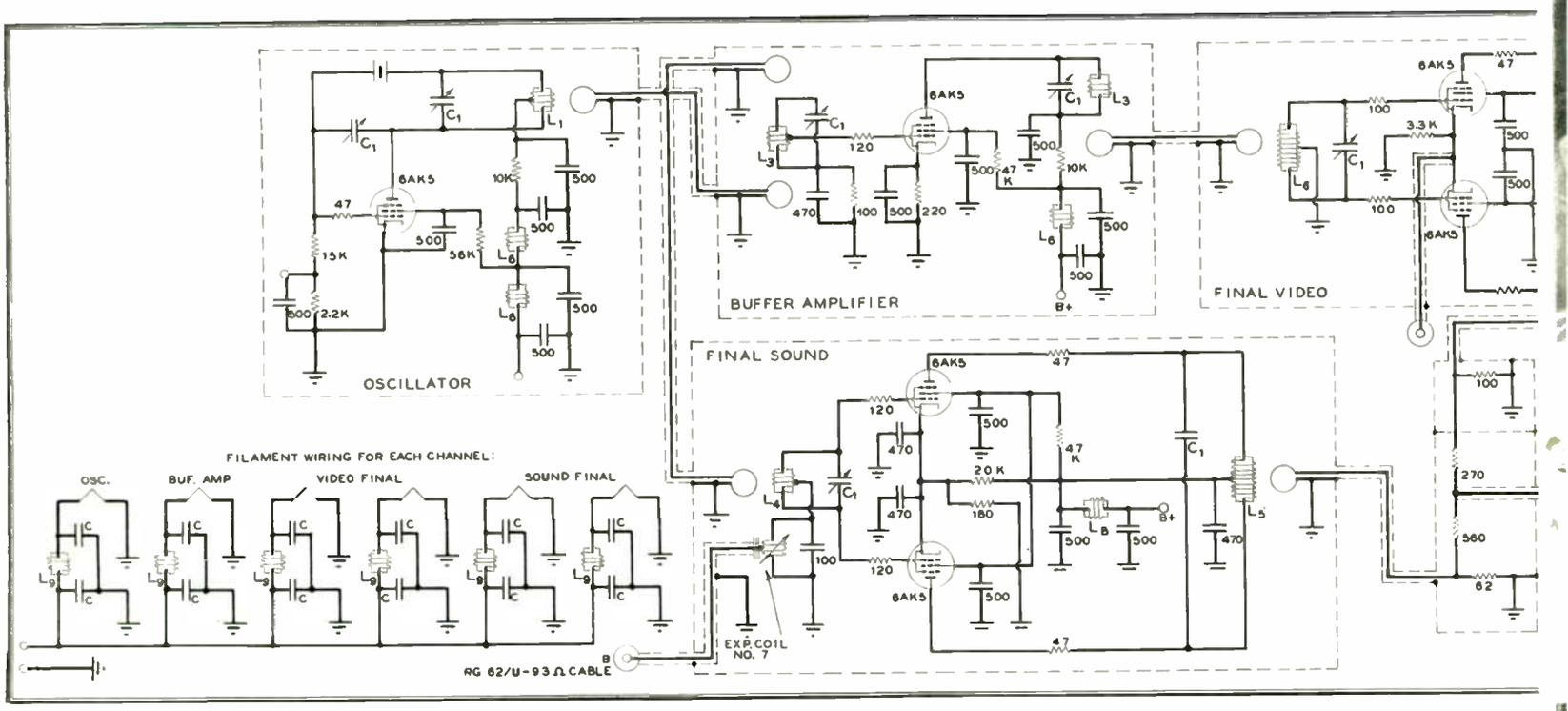


FIG. 5. THE CRYSTAL OSCILLATOR, BUFFER AMPLIFIER, AND FINAL VIDEO AND SOUND AMPLIFIERS FOR EACH CHANNEL ARE

$L = 13.6\ \mu h$
$C = 82$ mmf.
$f = 4.7$ mc.

Deviation = (4.7 mc. − 4.5 mc.) = 200 kc.

With the above circuit constants, a g_m change of 4,500 will produce a total deviation of 200 kc. The g_m curve of the reactance tube plotted against grid voltage is not linear over its entire range. To produce linear deviation therefore calls for operation on a restricted range of the g_m characteristic, and high L/C ratio in the oscillator tank. Very linear deviation to ± 50 kc. is obtained with this circuit. To achieve frequency stability, the screens of both the oscillator and reactance tubes are connected to a gas tube regulator operating at 105 volts. A cathode follower is used to feed the reactance tube grid since its low output impedance minimizes hum pickup. A limiter is used following the FM oscillator to remove any incidental AM modulation produced. The 4.5 mc. FM signal is distributed to the 6 RF channels through cathode followers, with an output level of 0.7 volt RMS.

Video Amplifier ★ The amplifier, shown diagrammatically in Fig. 4, requires a video input of 1 volt peak-to-peak (sync. negative), and has an overall gain of 6. Reference to the circuit diagram shows that the three final stages are repeated for each of the 6 RF channels. This is done so that the percentage modulation and black level controls can be adjusted individually for each channel. The first two stages are resistance-capacity coupled and common to each channel, while the third stage utilizes a cathode follower to distribute the signal. The cathode follower is used so as to preserve the high-frequency response which otherwise would be down considerably due to the high input capacity of the 6 tubes in parallel. The percentage modulation control maintains a uniform frequency response at all settings.

In this circuit the grid leak is returned to a divider on the cathode resistance to obtain the correct bias. This method of obtaining bias increases the effective input resistance of the stage and improves the low frequency response. The overall response of the amplifier to a 60-cycle square wave shows negligible distortion. The last stage of the amplifier is the modulator. Its performance will be described in connection with the final RF amplifier design.

RF Channel Design ★ Each RF channel is composed of five individually shielded units, namely: 1) harmonic mode crystal oscillator; 2) buffer amplifier; 3) final video amplifier; 4) final sound amplifier, and 5) attenuator, as shown in Fig. 5. The first four of these units are constructed of completely enclosed brass boxes with removable top and bottom plates. This construction is illustrated in Fig. 6. A subbase is mounted inside the box with the tubes located on top and the wiring components underneath. The fronts of the four boxes are bolted to a panel. Any of the units can be serviced by removing the top or bottom plates. Shield partitions are mounted in the lower half of the boxes to prevent feedback from output to input. Miniature tubes are used exclusively. Variable air condensers are used for tuning adjustments and the coils are constructed of copper tubing rigidly mounted to the tuning condensers to insure mechanical stability. Button con-

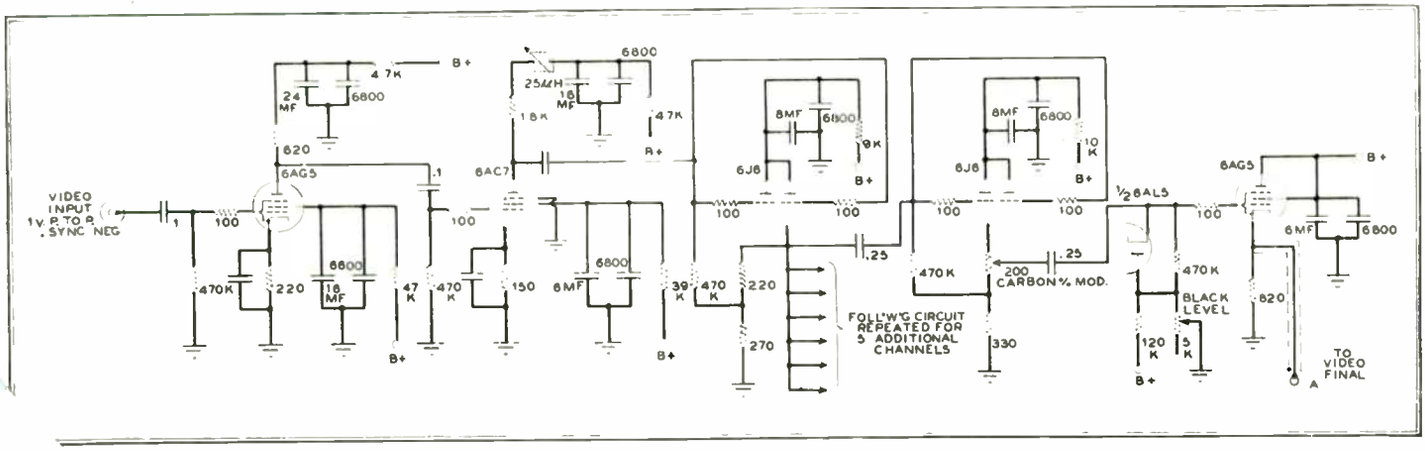
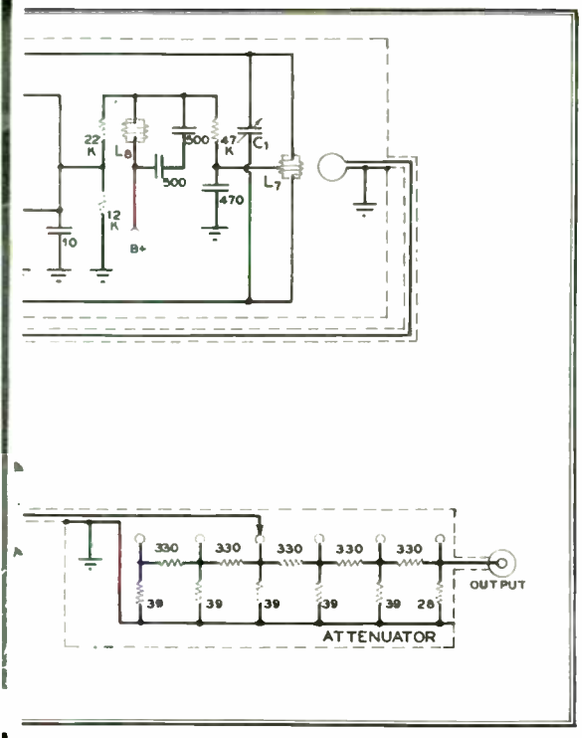


FIG. 4. THIS VIDEO AMPLIFIER CIRCUIT REQUIRES AN INPUT OF 1 VOLT PEAK-TO-PEAK, AND HAS AN OVERALL GAIN OF 6



MOUNTED IN BRASS BOXES, AS IN FIG. 6

COIL AND CONDENSER DATA FOR RF CHANNEL CIRCUITS

Ch.	Coil L-1		Coil L-2		Coil L-3		Coil L-4		Coil L-5		Coil L-6		Coil L-7	
		Tuning Cap.		Tuning Cap.		Tuning Cap.		Tuning Cap.		Tuning Cap.		Tuning Cap.		Tuning Cap.
No.	Turns	mmf.	Turns	mmf.	Turns	mmf.	Turns	mmf.	Turns	mmf.	Turns	mmf.	Turns	mmf.
1	9	3.2–20	9	3.2–20 +10	9	3.2–20 +10	9	3.2–20 +10	9	3.2–20 +10	9	3.2–20 +10	18	3.2–20
2	7	3.2–20	7	3.2–20 +10	7	3.2–20 +10	7	3.2–20 +10	7	3.2–20 +10	7	3.2–20 +10	12	3.2–20
3	7	3.2–20	7	3.2–20	7	3.2–20	7	3.2–20	7	3.2–20	7	3.2–20	14	3.2–20
4	5	3.2–20 +10	6	2–10 +4–30	6	2–10 +4–30	6	4–40	6	4–40	6	3.2–20 +10	6	3.2–20
5	5	3.2–20	6	3.2–20	6	3.2–20	6	3.2–20	6	3.2–20	6	3.2–20	9	3.2–20
6	4	3.2–20	6	3.2–20	6	3.2–20	6	3.2–20	6	3.2–20	6	3.2–20	8	3.2–22

NOTES:
1. Coils L-1 to L-6 inclusive are ¾ in. outside diameter, wound with tubing ⅛ in. outside diameter.
2. Coil L-7 is ½ in. inside diameter, wound with No. 14 enameled wire.
3. Condensers C_1 are Sickles padding condensers, 3.2 to 20 mmf.
4. Exp. Coil No. 7 is 9.9 to 24.2 microhenries.
5. Coil L-8 is a B+ choke.
6. Coil L-9 is a filament choke, self-resonant at 120 mc.
7. Link coupling between units is 70-ohm, double-shielded cable RG 39/U.
8. 500-mmf. condensers are Erie button condensers.

densers are used for RF bypasses, and all B+ and filament leads between units are filtered to prevent leakage. RF signal connections between units are made with 70-ohm double-shielded coaxial line. Heavy bus wire is used to wire plate and grid circuits, and 100-ohm resistors in the grid circuits prevent parasitic oscillations. All these precautions are taken to insure stability and reduce RF leakage.

Crystal Oscillator ★ There are various ways of obtaining a final RF frequency. One method is to use a low-frequency crystal and multipliers. A second is the use of an ordinary oscillator operating at carrier frequency. Or a harmonic-mode crystal oscillator can be used. The first method requires a number of tubes for frequency multiplication, with the possibility that harmonics of the lower frequencies will fall in the picture pass band and causing beat interference. The second method suffers from a lack of frequency stability, resulting in a loss of time in the laboratory required to check the frequency.

The harmonic mode crystal oscillator, operating directly at carrier frequency, has excellent frequency stability and has the further advantage that, should a component drift too much, which is rare, the oscillator does not change frequency but stops operating. The harmonic mode crystal oscillator circuit used in this equipment is shown in the RF channel circuit diagram of Fig. 5. The circuit is best understood by analyzing it as a Hartley oscillator, in which case the balance condenser from plate to grid would be turned to the minimum capacity position (3 mmf.) representing stray capacity coupling, and the crystal replaced by a small feedback condenser. Feedback from the top of the tank to the grid through the condenser which has replaced the crystal would maintain oscillation at a frequency determined by the $\angle C$ product of the tank. If the balance condenser is adjusted to have the same capacity as the feedback condenser, the RF voltage on the grid would be reduced to zero and the circuit would stop oscillating.

To analyze the circuit as it actually operates, the feedback condenser is replaced by the crystal. The equivalent circuit of a crystal may be represented as a series-resonant circuit paralleled by a fixed capacity. For the desirable mode of operation, the capacity of the balance condenser is adjusted to have the same capacity as the shunt capacity of the crystal. The only feedback path that can then maintain oscillation is the series-resonant circuit of the crystal which, at resonance, is a low-resistance path. As the shunt capacity of the crystal is around 15 mmf., the circuit must be designed to keep stray capacity to a minimum. When making circuit adjustments it is necessary to have a check point that will permit measurement of the oscillator strength without imposing additional loading. This is accomplished by by-passing a 2,200-ohm resistor in series with the grid leak. A 100-microampere DC meter connected across this check point to ground gives an indication of oscillator grid current.

Buffer Amplifier ★ The buffer amplifier is used to increase the level of the RF carrier distributed to the final picture stage, and also to keep the loading on the oscillator tank low. The grid and plate circuits are both tuned to carrier frequency. The stage uses cathode bias with an RC network in the input circuit to prevent the grid from being driven positive with respect to the cathode, and damaging the tube. The RF voltage from the top of the input coil to ground equals 1.3 volts RMS and the voltage across the plate coil is 7 volts RMS. All RF voltages on the four units in the RF chain were measured with a General Radio crystal galvanometer type 1802-A, a 5-mmf. condenser being connected in series with the high side.

To prevent cross modulation between sound and picture, the RF signal distributed to the final video stage is link-coupled to the output coil, while the RF distributed to the final sound stage is loosely coupled to the input coil.

Final Sound Stage ★ The 4.5-mc. signal with a standard deviation of ± 25 kc. is mixed with the RF carrier frequency in this stage. The RF signal is applied to the two grids in push-pull, while the 4.5-mc. signal is connected to the center tap of the grid coil. The 4.5-mc. signal has a level of 5 volts RMS on the grids, while the RF voltage developed between the top of the grid coil and ground is 0.8 volt RMS. The output circuit has a fairly high Q and is tuned to the sum frequency ($f_{carrier}$ + 4.5 mc.). Selectivity is necessary in this circuit to keep the carrier and difference signals, developed across the output tuned circuit, to a minimum. The level of the sound carrier from one plate to ground is 2.8 volts RMS, while 1 volt of RF signal is developed across the output link.

Final Video Stage ★ The final video stage has a push pull amplifier with cathode modulation. The input circuit is tuned to carrier frequency and the center tap of the coil is grounded, putting the two grids at ground potential for DC. The RF voltage is coupled to the input coil by means of a 1-turn link located in the center of the coil. RF voltage on the grids is out of phase and the voltage from grid to ground is 4.2 volts RMS. Modulating video voltage is applied directly to the two cathodes from the 6AG5 modulator tube, through a short length of RG 62/U coaxial cable. This type of cable was selected because its capacity is only 13 mmf. per foot. The input circuit is not damped as the only frequency present is the unmodulated RF carrier. The output circuit is also tuned to carrier frequency. Here, however, not only the carrier frequency but also the upper and lower side-band signals gen-

erated in the process of modulation are present. The modulating video signal contains components ranging from 30 cycles to 4 mc. Faithful transmission of a television picture requires that the output stage have a bandwidth of at least 8 mc. (± 4 mc. from carrier). To achieve this bandwidth, the tuned circuit in the output must be heavily damped. The following analysis shows the most efficient way of doing this for a single tuned circuit:

$Q = \frac{f_r}{2\Delta f}$ at a freq. $(f_r + \Delta f)$ or $(f_r - \Delta f)$ the voltage gain is 0.707 gain at resonance

$Z = Qx_L$ Impedance of tuned circuit being resistive at resonance

$Z = \frac{f_r}{2\Delta f} x_L \quad R = \frac{f_r}{2\Delta f} x_L$ where

$x_L = x_C$

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

f_r = carrier freq.

Δf = highest video modulating frequency

R = damping resistor

6AL5 DC restorer holds the sync tips at a constant voltage regardless of the AC content of the picture signal. The voltage on the cathode of the modulator is in phase with the voltage on the grid. The white content of the composite video signal drives the cathode of the modulator more positive with respect to ground, increasing the bias on the 6AK5 final RF amplifier tubes. This means that an increase in initial light intensity will cause a decrease in RF voltage which, by definition, is negative modulation.

Determining Modulation Percentage ★ Television standards require that the sync pulses occupy between 20 and 25% of carrier and that peak white reduce the carrier to 15% or less. Two methods are currently used by television stations to determine these values. The first method is to use a fast mechanical switch, such as a buzzer, across a diode load. This automatically establishes a ground or zero line, and the percentage modulation can be read directly from a scope. The second method commonly used is to couple some of the modulated RF directly to the vertical plates of an oscilloscope, in which case the complete RF envelope can be observed, and the percentage modulation measured. Neither of these methods is satisfactory for a test generator that produces only 1 volt of RF output. The first method is subject to erroneous results at low level, because of diode conduction at zero volts. The second method would require a special amplifier built into an oscilloscope, tuneable to all 6 channels.

The method used to adjust the modulation percentage correctly on this generator is based on the fact that the dynamic modulation characteristic is designed to be the same as the static or DC characteristic. To achieve this, the plate of the modulator is connected directly to B +, and the screens of the RF amplifiers are fed from a well-regulated voltage divider, bypassed for both video and RF. The method used to determine the modulation percentage is as follows:

A DC voltmeter is connected between the top of the black level control and ground, this point being available at a pin jack on the front panel. The coaxial line running from the final video to the resistive mixing box is terminated with a 70-ohm resistor and connected to a vacuum tube voltmeter. The DC voltage on the grid of the modulator is varied by means of the black-level control, in 1-volt steps, and readings are taken of RF output voltage on the vacuum-tube voltmeter. From this data, a modulation curve such as shown in Fig. 7 is plotted. The black level bias and modulation controls are then set so that operation is on the linear portion of the characteristic, and the RF signal has the desired percentage modulation. When the data for plotting the modulation curve is being taken, the video modulating signal is disconnected. Once the controls have been adjusted, it is only necessary to maintain a constant input to the video amplifier for correct operation. Performance using this method has been verified by coupling modulated RF through a special amplifier directly to the vertical plates of an oscilloscope, and observing the envelope.

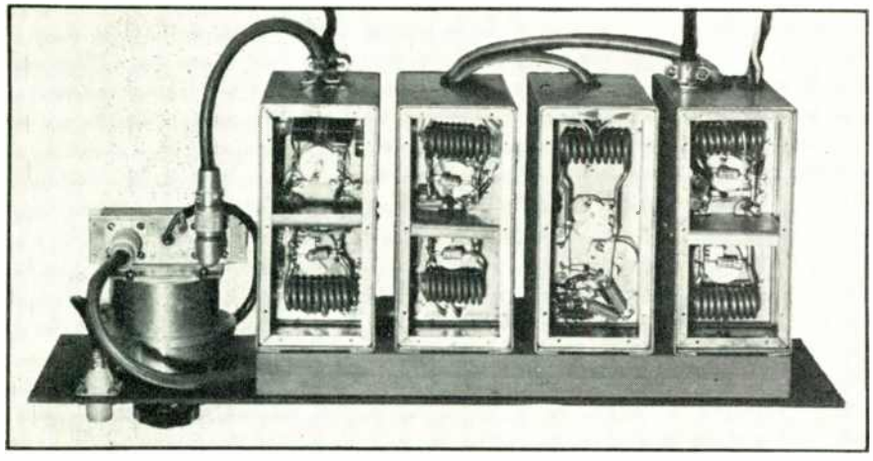


FIG. 6. ONE OF THESE SEPARATE RF ASSEMBLIES IS USED FOR EACH CHANNEL

Consistent with a given bandwidth, the largest value of R and the greatest gain is obtained by making x_L large. This calls for a high L/C ratio in the output circuit. Reference to the Table accompanying Fig. 5 shows that a relatively large number of turns are used in the output coil. The tuning condenser pads near its minimum capacity position, and is used for convenience in aligning the stage.

Television standards require that the tips of the sync pulses and the blanking level remain constant in amplitude regardless of the voltage variations of the picture signal. Capacity coupling from the modulator tube to the final RF amplifier cannot be used, with a varying picture signal, if the above-mentioned DC component is to be transmitted. For this reason, a cathode follower modulator is used with its DC output coupled to the final RF amplifier.

The video signal applied to the grid of the 6AG5 modulator has a polarity such that the sync pulses are negative. The

Output System ★ An RF signal of 1 volt is developed across both the final picture and sound stages. To prevent cross-modulation between the two carriers, the signals are fed to a resistive mixing box which attenuates the picture carrier to 100,000 microvolts and the sound carrier to 50,000 microvolts. The attenuator has a range of .1 volt to 1 microvolt in decade steps. The attenuator system is designed to terminate a 70-ohm coaxial line so the output cable can be connected directly to the antenna coil primary of a television receiver. The RMA has since standardized on balanced 300-ohm line. There are various methods that can be used to change an unbalanced 70-ohm line to a balanced 300-ohm line. One way is to connect a miniature pentode tube across the terminated 70-ohm line and design the stage to have equal plate and cathode impedances of 150 ohms. Short leads can then be connected directly to the antenna coil primary.

Testing Picture Quality ★ The coaxial line running from the video final is disconnected from the resistive mixing box and terminated with a 70-ohm resistor. The 1 volt RMS of modulated picture carrier is then applied to a 6AL5 diode detector, with a diode load of 2,000 ohms. The detected video is applied to the input of a good video monitor. The only distortion produced by the diode is a slight gamma compression, and the diode tube has in effect replaced the entire RF and IF circuits of a television receiver. The video monitor is switched from incoming video to detected video from the RF generator, in which case any phase or frequency distortion in either signal is readily apparent.

PRODUCTION METHODS VS. CIRCUIT DESIGNS

How Production Engineering Offsets the Costs of Increasingly Complicated Circuits

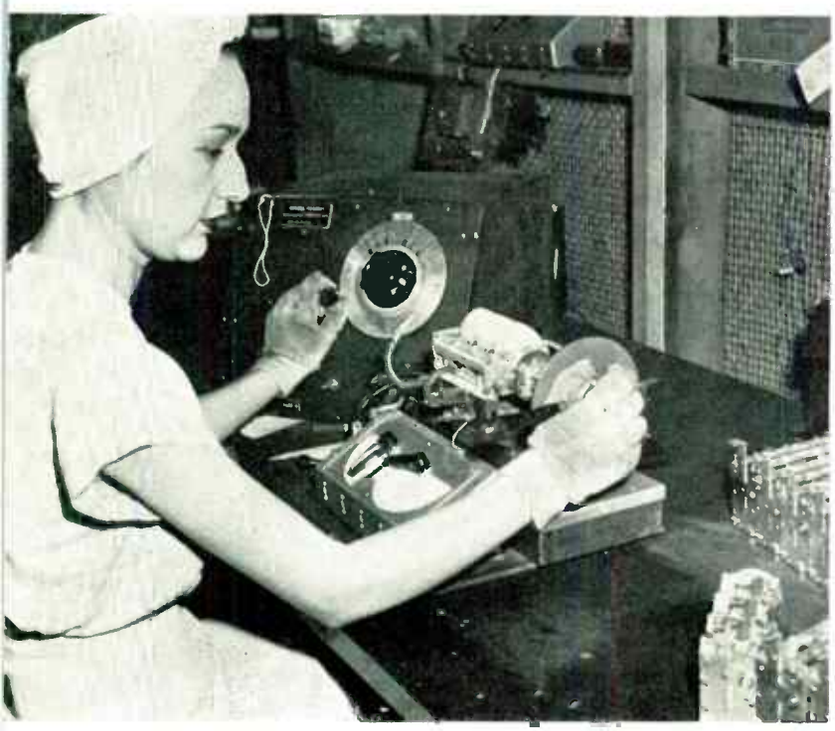
PHOTOGRAPHS FROM THE HALLICRAFTERS PLANT

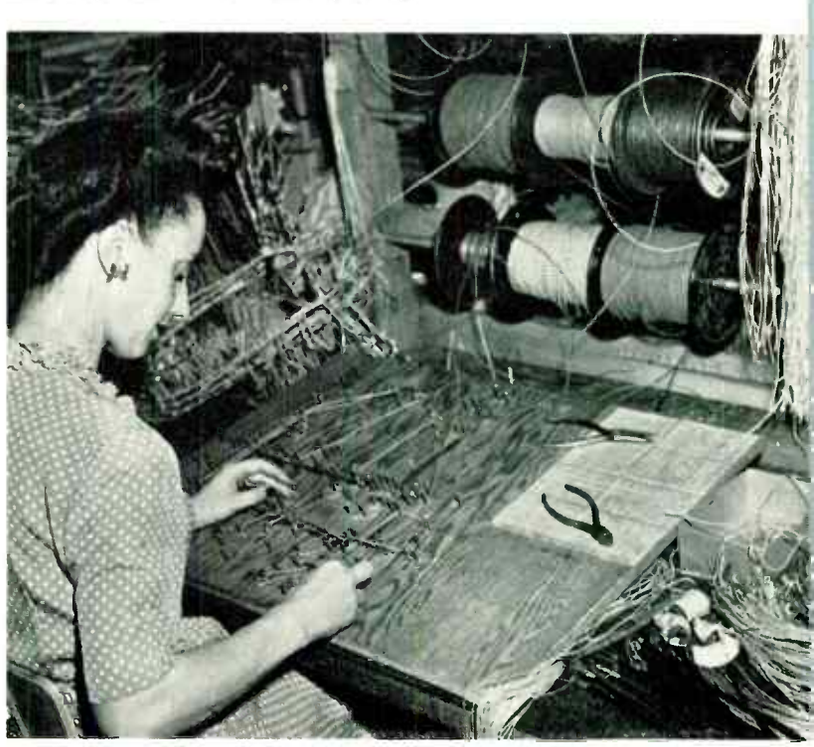
IT CAN almost be said today that the design of a receiver starts when the circuit work has been completed. Circuit engineers may complain that that statement is unfair. Nevertheless, it is the progress in mechanical design, methods, and production planning that makes possible the maintenance of relatively low prices for FM-AM receivers, despite their increasingly complicated circuits.

That is easy to understand when you consider that the Hallicrafters SX-43 model, for example, shown here in process of assembly, has enough parts in it to make 4 or 5 of the receivers selling at about the same price ($165.50) in 1927.

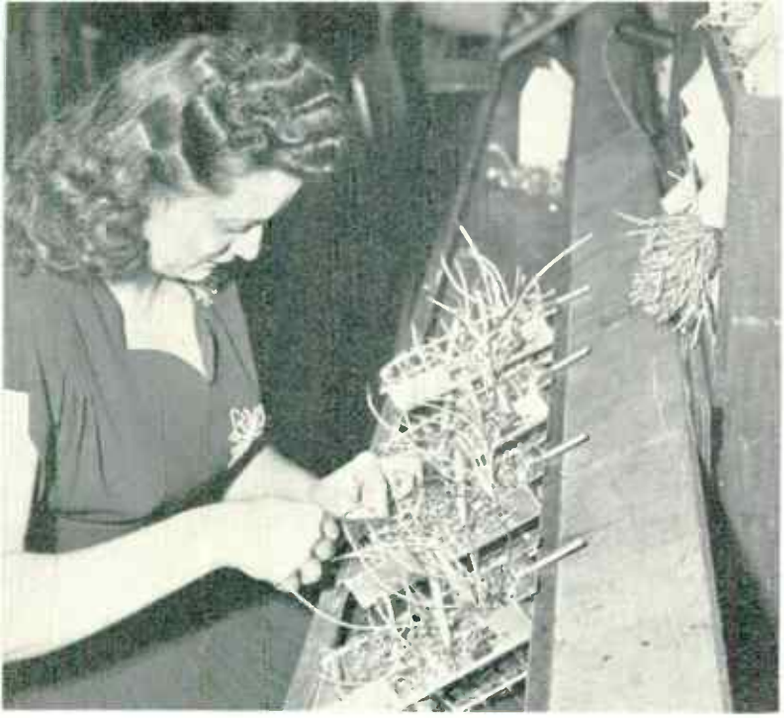
To be sure, resistors, fixed and variable condensers, sockets, tubes, and other components have dropped to a fraction of what they cost 20 years ago. However, that does not represent a net saving, because so many more are used per set. It hardly seems possible that the famous 5-tube Neutrodyne of those days contained a total of 3 coil and condenser assemblies, 2 neutralizing condensers, a grid condenser and grid leak, 1 bypass condenser, 5 tubes and sockets, 2 amplyfying transformers, and 2 rheostats. Oh, yes, there was also a phone jack after the first audio stage, and another to plug in a horn after the second stage.

That list hardly seems to add up to a radio set when you see, in the accompanying photographs, what goes on in a modern radio factory today!



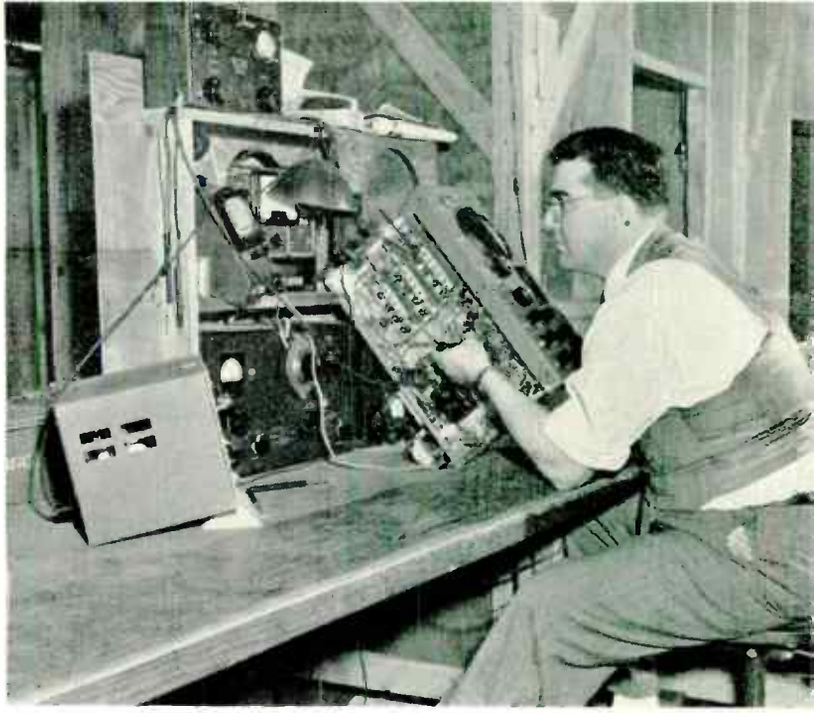


1: PRE-TESTING STOPS DEFECTIVE COMPONENTS BEFORE THEY REACH PRODUCTION LINES. 2: PRINCIPAL WIRES ARE CABLED
3: RIVETS REPLACE SCREWS AND NUTS FOR MOUNTING COMPONENTS AND HARDWARE. 4: ADDITIONAL RIVETING OPERATIONS

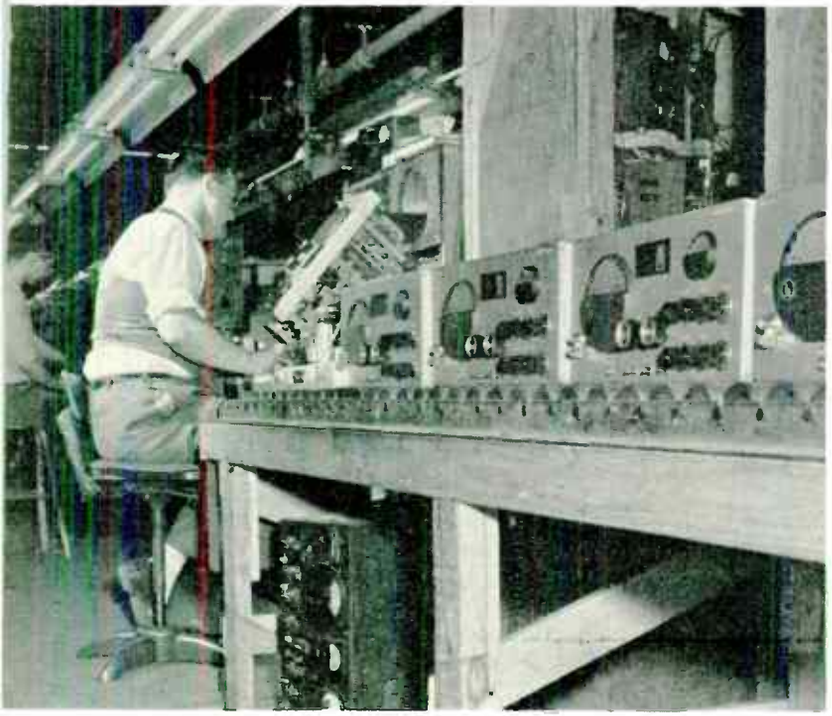


5. SWITCH SECTION SUB-ASSEMBLY IS WIRED BEFORE IT IS MOUNTED ON CHASSIS. 6: CHASSIS STARTS ON MAIN ASSEMBLY LINE

7: WORK IS DISTRIBUTED IN UNITS OF TIME, TO KEEP LINE MOVING STEADILY. 8: FREQUENT INSPECTION CATCHES ERRORS QUICKLY
9: COIL UNITS ARE ADDED HERE. 10: MOUNTING THE SHIELDS. LINES ARE PIPED FOR COMPRESSED AIR TO OPERATE SCREWDRIVERS



11: CIRCUIT CONTINUITY IS CHECKED AT END OF THE LINE. 12: OSCILLATOR ADJUSTMENT IS LAST STEP BEFORE TEST CAGES



13: FINISHED CHASSIS ROLL TO THE TEST CAGES. 14: LONG PRACTICE AND GOOD INSTRUMENT SPEED FIVE-BAND ALIGNMENT
14, 15: NO REPAIRS ARE MADE IN THE CAGES, FOR A FAST PACE MUST BE MAINTAINED. 16: APPROVED CHASSIS, READY FOR PACKING

COLLINS FM BROADCAST TRANSMITTERS

Mechanical and Electrical Details of Units Employing Phasitron Modulation

BY N. H. HALE*

THE series of Collins FM broadcast transmitters is comprised of a basic modulator unit with an output of 250 watts or 1 kw., and amplifiers of 3, 10, 25, and 50 kw. In both mechanical and electrical design, great emphasis has been put on simplicity, ruggedness, and accessibility. This is apparent from the accompanying illustrations.

Behind this design policy is the theory that the cost of repairs, replacements, and time off the air add up, over a period of years, to a total considerably in excess of the extra first cost of what may appear to be over-emphasis on dependability. But we believe it is more significant to describe this type of design as a sound investment from the point of view of station management and operations as well.

250-Watt and 1-Kw. Units ★ The basic 250-watt unit, Fig. 1, and the 1-kw. unit, Figs. 5, 6, and 7, are essentially similar except that the former uses two 4-125A tubes for the output, while the latter has two 4X-500F tubes. Thus the 250-watt unit can be used as a complete transmitter or as a driver for a 3-kw. amplifier which, in turn may be followed by 10- and 50-kw. amplifiers.

Or, by a slight modification and a change in the output tubes, the 250-watt unit becomes a 1-kw. transmitter. As a result of this arrangement, manufacturing economies have been effected, and deliveries accelerated.

Fig. 8 shows the 250-watt circuit, with the addition of the 3-kw. amplifier. Phasitron modulation was selected after an exhaustive investigation of a considerable variety of methods. It is a straightforward system, with a minimum number of tubes and circuits, as can be seen from the schematic. The plug-in crystal oven can be replaced in 10 seconds.

The complete modulator is carried on a panel at the center of the lower section, Fig. 5. It drops forward, as Fig. 6 shows, exposing the wiring and components. A close-up view of the Phasitron tube and its heavy magnetic shield is given in Fig. 2. The shield has a wall thickness of ¼ in. This, plus the thick steel screw cap, protect the tube from stray electric fields. The Phasitron can be removed by pulling on a small ejector knob below the shield.

Life expectancy of the Phasitron is several thousand hours, comparable to standard receiving tubes. It is built around a 6J5 cathode thimble and heating assembly, and operates at approximately the same values of voltage, current, and dissipation.

Tube Line-up ★ In the modulator section, a 6SJ7 is used as an oscillator, followed by a 6SJ7 buffer. Audio input is applied directly to the Phasitron coil. Four 6SJ7's serve respectively as a frequency doubler, 1st tripler, 2nd tripler, and amplifier. They are followed by a 6V6 tripler.

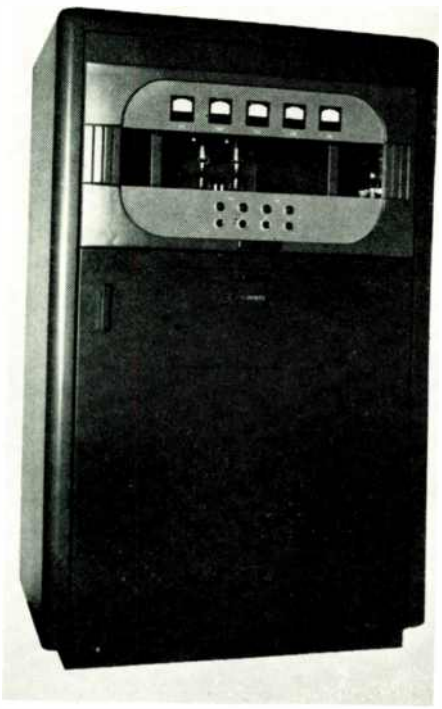


FIG. 1. THE 250-WATT FM TRANSMITTER

Output of the final 6V6 modulator tube drives two 829B power multiplifiers in cascade. Fig. 8 shows this arrangement, with two 4-125A's in the final stage. When the modulator unit is used as a 1-kw. transmitter, two 4X-500F's are used instead.

It is worthy of note that the different types of RF tubes total only five, *i.e.*, 6SJ7, 6V6, 829B, and 4-125A or 4X-500F. Moreover, the power amplifier tubes are operated at less than one-half their rated plate dissipation, a fact which contributes greatly to long tube life.

High efficiency of the power amplifier tubes and low harmonic radiation are achieved by the use of double-shielded push-pull output stages, and heavy Faraday screens. These can be seen in Fig. 4. Tank losses are minimized and excellent balance is obtained by means of a linear parallel-line output formed from 2-in. silver-plated brass pipe, as shown in Fig. 3.

Control Circuits ★ In the design of the control and overload circuits, protection with an absolute minimum of off-the-air time was the prime consideration. Thus, instead of relying on a single overload circuit-breaker in the main power line, a bank of 6 AC and 2 DC circuit-breakers are used to provide separate protection to the circuit elements.

This has a triple advantage. First, in many cases it is possible to make small repairs without shutting down the transmitter: second, under this arrangement, in the case of certain minor troubles, the transmitter merely drops down to reduced power instead of going off the air; and third, actuation of a circuit-breaker immediately indicates the circuit in which the fault has occurred.

Mechanical Features ★ With all doors closed, as in Fig. 1, the cabinet presents a smooth-looking appearance that belies the accessibility of the interior. Opening the main door, Fig. 5, gives access to the circuit controls and the Phasitron panel. The latter can be tipped forward, or the entire lower panel can be pulled down, as shown in Fig. 6. Moreover, the upper section can be reached by a door hinged at the top. A complete system of interlocks and mechanical grounding bars affords complete protection to personnel.

Two blowers, visible in Fig. 7, draw air through filters in the rear doors. Room air, drawn in by the blowers, passes down through the output tank assembly and around the final tubes, maintaining an ambient temperature of 45° C. The design of the transformers is heavy enough that their temperature rise is negligible.

All resistors with a dissipation exceeding 5 watts are of the plug-in type. Ratings are chosen so that no resistor is required to dissipate more than one-half that allowed by JAN free-air specifications. As a result of the consistently high factors of safety built into this equipment, the 250-watt transmitter can operate satisfactorily without air cooling. However, all larger types have blower interlocks to reduce power if blower trouble develops.

Specifications ★ These measurements and ratings for the 250-watt and 1-kw. units are in accordance with FCC requirements:

FREQUENCY RANGE: Any channel between 88 and 108 Mc.

POWER OUTPUT: 100–250 watts, and 250-to 1,000 watts.

LOAD: 40- to 80-ohm coaxial line; power

* Collins Radio Company, Cedar Rapids, Ia.

FIG. 2. MOUNTING OF THE PHASITRON.

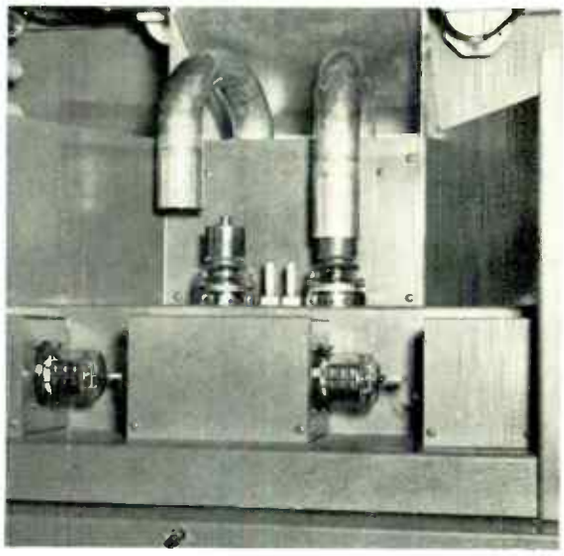


FIG. 3. DETAILS OF THE P.A.

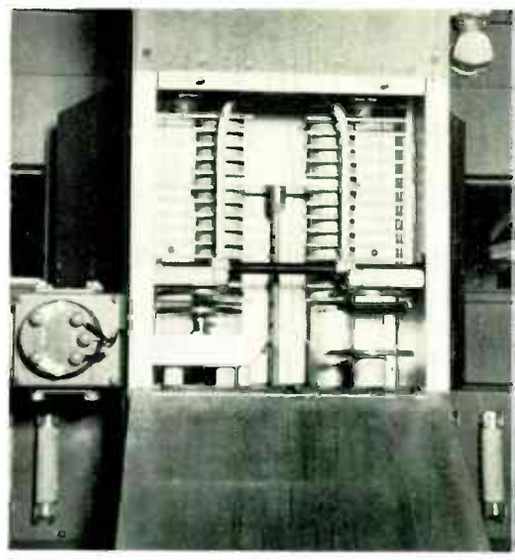


FIG. 4. SHIELD BETWEEN FINAL TANK AND COUPLING

factor, 866 to 1.0 (Other output arrangements are available.)

STABILITY: Better than ±250 cycles per second.

SWING: 0 to 133% modulation.

FREQUENCY RESPONSE: Flat within 1 db from 50 to 15,000 cycles.

PRE-EMPHASIS: Standard 75- microsecond pre-emphasis network supplied with the transmitter.

DISTORTION: Less than 1% from 50 to 15,000 cycles at 100% modulation.

AUDIO LEVEL: Approximately +12 dmb for 100% modulation at 400 cycles.

AUDIO INPUT IMPEDANCE: 600 and 150 ohms, balanced to ground.

NOISE LEVEL: FM, better than 65 db below 100% modulation; AM, better than 50 db below a level representing 100% amplitude modulation.

LINE VOLTAGE: 208–230 volts single-phase for the 250-watt unit; 208–230 volts 3-phase for the 1-kw. unit.

VOLTAGE LIMITS: 190–240 volts.

LINE FREQUENCY: 60 cycles normal, 50 cycles on special order.

POWER DEMAND: 1.5 kva., 94% power factor at 250 watts output; 3 kva., 90% power factor at 1 kw. output.

3-Kw. Amplifier ★ The 3-kw. amplifier, designed to be driven by the 250-watt exciter, is the first in the series of Collins units for providing increased output. Fig. 8 shows the elementary circuit.

The exciter is coupled to the power amplifier stage by link coupling through RG-17/U transmission line. Standard 1⅝-in. coaxial line is used for the RF power output.

Type 7C26 triodes in push-pull are employed as grounded-filament amplifiers, with cross-neutralization to provide maximum stability.

Motor-Driven Tuning ★ A special feature of convenience and safety is the extensive use of motor drives for the tuning adjustments. In the complete 3-kw. installation, for example, the following adjustments can be made by the group of motor controls:

1. Exciter plate tuning
2. Exciter transmission-line tuning
3. Exciter output coupling
4. Power amplifier grid tuning
5. Power amplifier plate tuning

FIG. 5. LOWER DOOR GIVES ACCESS TO TUNING CONTROLS.

FIG. 6. LOWER PANEL AND UPPER DOOR OPEN.

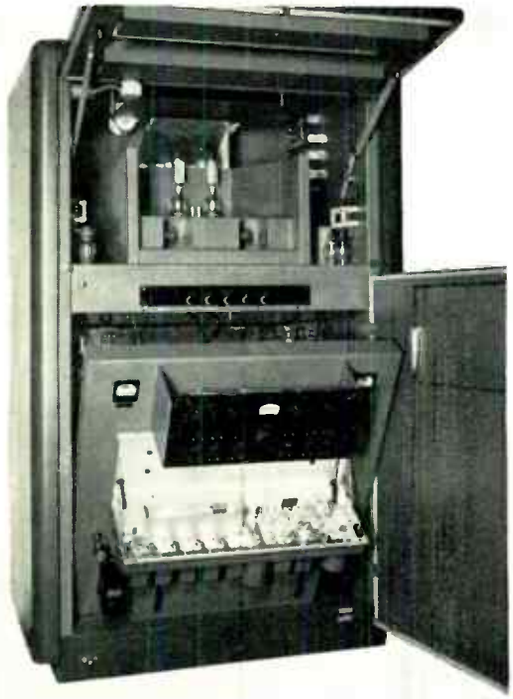
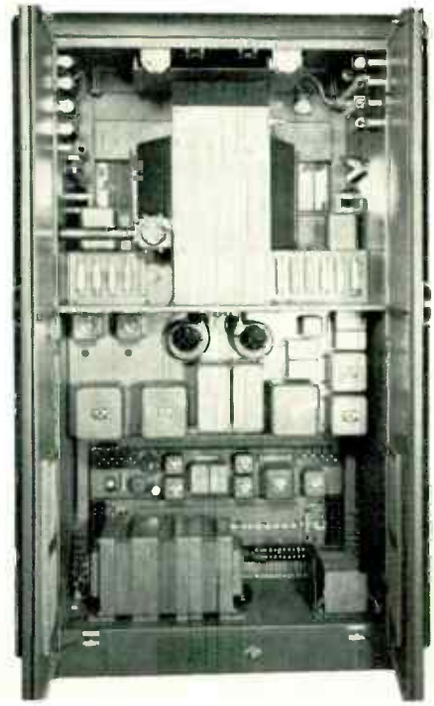


FIG. 7. REAR VIEW



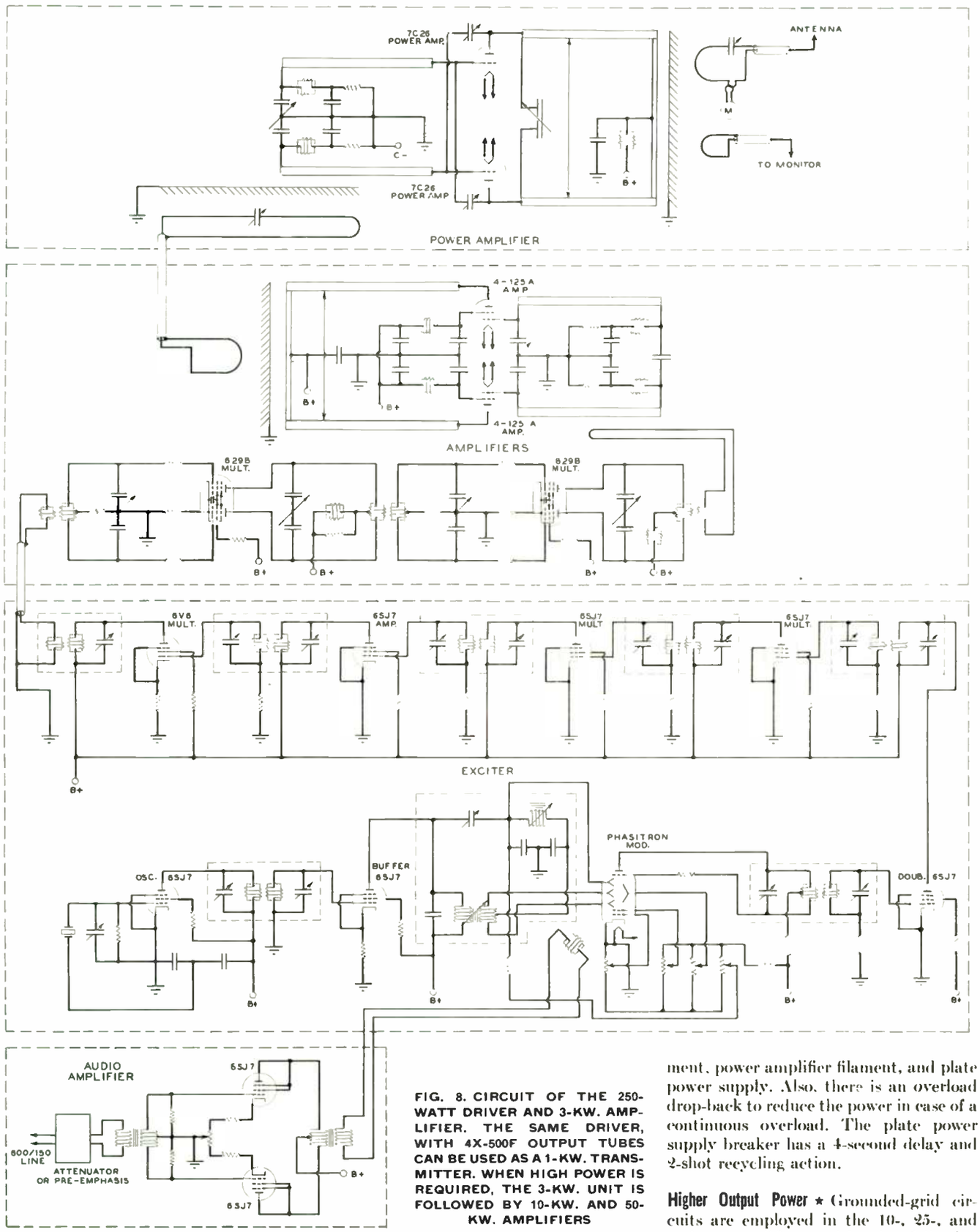


FIG. 8. CIRCUIT OF THE 250-WATT DRIVER AND 3-KW. AMPLIFIER. THE SAME DRIVER, WITH 4X-500F OUTPUT TUBES CAN BE USED AS A 1-KW. TRANSMITTER. WHEN HIGH POWER IS REQUIRED, THE 3-KW. UNIT IS FOLLOWED BY 10-KW. AND 50-KW. AMPLIFIERS

6. Transmission-line tuning
7. Power amplifier output coupling

The action of these drives can be controlled accurately, assuring precision settings of the tuning elements.

Circuit Protection ★ The amplifier is also protected by circuit-breakers in the individual circuit elements. One DC relay is used as an under-drive protection in the grid circuit, while the other is for overload protection in the plate circuit. The magnetic circuit-breakers are in the following circuits: air-blower, control, rectifier filament, power amplifier filament, and plate power supply. Also, there is an overload drop-back to reduce the power in case of a continuous overload. The plate power supply breaker has a 4-second delay and 2-shot recycling action.

Higher Output Power ★ Grounded-grid circuits are employed in the 10-, 25-, and 50-kw. amplifiers, with the following tubes:

10 kw. — 2-3X2500 A3
25 kw. — 4-3X2500 A3
50 kw. — 2-3X12000 A3

In each case, the 3-kw. amplifier drives the 10-kw. unit which in turn, can be followed by the 25- or 50 kw. final stage.

PLANNING AN FM BROADCAST STATION

A Review of the Facilities Required and Modern Methods of Design

BY R. S. LANIER*

WHATEVER kind of building you put up to house your broadcast transmitter, you are going to live with it constantly, day in and day out, for a long time to come. If it fails, even in small ways, to give the transmitter the proper conditions for trouble-free, efficient operation, or if it throws needless obstacles in the way of maintenance and servicing, the cost in time, money, and peace of mind will continue to grow as long as you use the building.

The information here has been assembled as an aid in planning a building that will not cause the needless expense of dissatisfaction, and will be, in every respect, a "home" for your transmitter.

IN preparing this extremely valuable summary of factors entering into the planing of an FM station, the author drew upon results of an elaborate questionairing of broadcast engineers. Also, the following consultants contributed from their extensive experience: Adolph B. Chamberlain, chief engineer, CBS; Royal V. Howard, director of engineering, NAB; James L. Middlebrooks, facilities engineer, ABC; Robert C. Deigert and David N. Yerkes of the architectural firm of Deigert & Yerkes; J. R. Poppele, vice-president, WOR; and John W. Ragsdale, associate editor, "Architectural Forum".

PRELIMINARY PLANNING

Expert Assistance ★ Secure expert help in planning and construction. Each management will face a different problem in choosing technical guidance. The available sources upon which you may draw are:

The manufacturer of the transmitter, for full installation details, technical requirements of the transmitter, and assistance in installing and testing it;

Your chief engineer and his staff, for adaptation of the technical facilities to your own needs and plans;

The architect, for planning the building itself in accordance with your needs and resources, for coördinating the technical requirements with the various building and contracting services, and for supervising actual construction;

The consulting radio engineer, for advisory services which include preparation of the FCC reports and applications, technical advice on all the special problems of installation and proof of performance, or even taking over the complete job of planning your transmitter installation and supervising the whole job until you are in operation;

The building contractor and various subcontractors, who are responsible for the actual erection of your building.

Coordinated Effect ★ Your chief engineer and your architect or builder, together with a specialist on your transmitter or your radio consultant, must plan all the technical features of the installation, and produce a complete set of working drawings for the building and its equipment.

Architects Deigert and Yerkes emphasize the need for this coöperation: "The planner of the transmitter building is engaged in arranging the various rooms and building functions to produce a good, workable structure; the engineer is interested in the technical requirements and auxiliary services for the transmitter. The two must work together closely, to fit the plumbing, heating, structural, and electrical features into a unified whole with the transmitter services, or they will not produce a plant that really works."

Planning Reduces Costs ★ A good, workable building that will provide all the essential services is not necessarily expensive, but it must be well planned from the beginning. With additional money you can buy additional services and conveniences, but a basically excellent building need cost no more, and indeed often costs less.

Good planning saves money in several positive ways: by preventing mistakes that are costly to rectify; by making efficient use of building materials in a sensible, well-engineered building structure; by arranging the building so that it is easy to maintain and operate. "In the past, many transmitter buildings suffered from lack of advance planning," says J. R. Poppele. "The industry is now well aware of the importance of careful layout and design."

CHOOSING A SITE

Basic Factors ★ The basic formula for site selection is signal strength and coverage versus cost of land, construction, and operation.

Adequate coverage is the first necessity for the success of any broadcast station. With two or more sites to chose from, you can balance improved coverage against the factors listed below:

ZONING RESTRICTIONS: Visit your municipal or county government early in your negotations to find what building restrictions, if any, apply to the site.

ROADWAYS: Will you need additional roadways? How much will they cost?

WATER: Is fresh water available? Must you sink a well to unknown depths in search of water, with possibly very high costs?

SEWAGE: What provision must be made for sewage disposal?

POWER: Will primary power be easy or difficult to bring in? What about an alternate source of primary power?

PROGRAM CIRCUITS: What is necessary to bring in program circuits?

DRAINAGE: Unless your building is specifically adapted to a marshy site, does the land drain properly with the heaviest precipitation to be expected?

SOIL AND FOUNDATION CONDITIONS: Are there any unusual conditions that will make construction difficult and costly? Will soil give the ground screen reasonable efficiency?

TRANSMISSION LINE: Are there any problems in the proposed transmission line run?

TOWERS: Is there a convenient location for the erection of your antenna tower? Check the Civil Aeronautics Authority for any restrictions on antenna heights at the site you are considering.

ACCESSIBILITY: Will the site have unusual construction and operation costs because of inaccessibility?

Land Required ★ An FM station will fit on a small tract of land because it does not require acreage for an antenna ground system. Little more than the building plot, with parking area and appropriate landscaping, will accommodate the majority of FM stations, provided the antenna tower can be erected on or near the building. However, bear in mind the desirability of exercising control over property in the immediate vicinity of the tower as a protection against the future erection of a structure which might affect the propagation of your FM signals.

Mid-City Site ★ The excellent coverage and operating convenience of FM installations in tall city buildings must be weighed against the following:

Are there any zoning restrictions or building ordinances against installation of the transmitter in the building, or the antenna on top of it? Will the building

* Western Electric Company, 195 Broadway, New York City.

support the antenna? Will the transmitter overload the floor at the chosen location? A preliminary study by competent engineers on these points is good insurance against huge unforeseen expense. Structural alterations on modern skyscrapers can be very expensive.

Can you get the transmission line to the roof without interference with other tenants? A top-floor installation makes this easy but such space is not always available.

Is the power cabling to the transmitter floor large enough? Will there be large variations in the power consumed by other tenants, causing irregular supply voltage? A separate power run to the top floor of a tall building is another expensive item. What about building services such as heat and elevator service during your after-midnight operation?

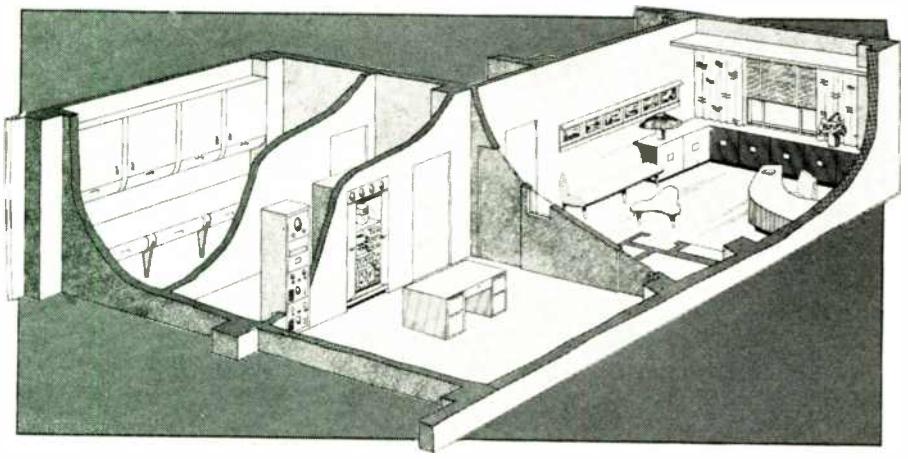


FIG. 1. TRANSMISSION FACILITIES PLANNED FOR A 250-WATT FM STATION

Mountain Top Locations ★ As everyone knows, FM and television are going to the mountains for antenna height. A mountain top is generally a very inaccessible site. Its usual advantage, besides coverage, is low land cost. Here the items that offset this:

Water, roadways, power, and program lines are often difficult and expensive to bring in. The building will cost more, because of the distance both labor and materials must travel.

Severe weather conditions may require special weatherproofing. A study should be made of the maximum wind velocities and rainfall at the proposed site, and related to the details of building construction such as structural strength, heating, and the design of walls, windows, and doors to withstand driving wind and rain. Cost of operation will be higher because of inaccessibility. Complete living facilities for personnel will be necessary, particularly in areas where snow may block the roads.

The ideal site is a mountain top near a city, with consequent short roadways, water, power and signal runs. Station KPEM at Portland, Oregon has an excellent site in this respect with its mountain overlooking the city.

LAYOUT OF THE BUILDING

Studio-Transmitter Plans ★ The combination of transmitter and studios may effect certain economies in urban locations. However, mountain-top FM transmitters must usually be separated from the studios.

The different situations are as follows: Combined studio and transmitter installations are advisable for FM stations in tall city buildings. On the other hand, many new stations, particularly of low and medium power, have found that a combined installation in a suburban district is practical and economical.

Style of Transmitter Facilities ★ Should a transmitter building be a showplace, or just an enclosure for the transmitter and operators?

If you have looked over the field to see what kind of building to put up, you are probably in a muddle about these two opposing concepts.

If your building will be in a remote location, seldom seen by any persons except the operating force, it is obvious that no extra money should be spent merely to give it public appeal. Careful planning and sound architecture, however, do pay off heavily, even in remote locations. The difficulties of the site make it even more important and prudent to think carefully in advance, to coördinate the planning of persons involved in the building, and to put up a permanently satisfactory building that will be easy to maintain, with all the facilities necessary for efficieney of the operating force.

On the other hand, if your transmitter building is seen regularly by a large number of people in your community, the building becomes a permanent advertisement for your station, establishing in the minds of your listeners the character of your organization. The minimum response to this situation should be a building with a clean, well-balanced exterior appearance, well-kept approaches, architecture neither pretentious nor dowdy. A smart looking building need not cost substantially more than a cluttered, ugly, ramshackle type. Again it is expert planning that counts.

Each management must make a decision, based on its resources and the probable benefits in goodwill to be obtained, as to just how far it wants to go beyond this minimum toward a more effective use of the transmitter building in the public relations scheme of the station. Many arrangements are possible, ranging from the use of a glass wall on the control area, a fairly inexpensive and often most effective way of "showing the works" to the public, up to fountained gardens, beautifully furnished visitors' lounges, and raised viewing lobbies that circle the whole transmitter area.

Functional Units ★ Architecturally speaking, a transmitter building can be divided into the unit functions and features shown below:

FUNCTIONAL UNITS OF A BROADCAST TRANSMITTER BUILDING

1. Essential	Transmitter Room
	Control Room
	Washroom
	Storage Space
	Work Shop
	Heater Room
2. Desirable	Office
	Shower Room
	Kitchen or Kitchenette
	Emergeney Studio
	Garage
3. Optional	Living Quarters
	Employees' Lounge
	Transformer and Power Distribution Room
	Viewing Lobby or Visitor's Lounge

Planning of the interior layout can be based on the selection of the building units or rooms to take care of your particular needs and problems.

The transmitter room and control room are the heart of any transmitter building, and they should be designed first, to accommodate the transmitter and to provide for installation of the services necessary for operation and maintenance. Choice of the other building units or rooms required for your installation can then be made. These additional rooms should be added around the transmitter and control rooms to provide proper and efficient operating flow to the various parts of the building. The transmitter room and control room are discussed in detail below, after which the other building units are taken up in the order shown in the above.

Transmitter Room ★ The floor space must be sufficient for the transmitter itself, and in addition must provide room around and above it for easy servicing. In back of the transmitter there must be room to open any swinging doors, plus additional room to allow the operator, with portable test equipment or small power tools, to pass the opened doors.

The front of the transmitter will face into the control room.

The larger transmitters, which include auxiliary high voltage or cooling apparatus in separate units, will ordinarily have recommended transmitter room layout plans supplied by the manufacturer. Layout of a transmitter room with a number of auxiliary units is based on: (1) short inter-unit connections; (2) separation of equipment that must be attended in operation from dangerous high voltage equipment; (3) provision of proper insulation and separation for high voltage wiring runs.

monic shunts are contemplated, careful consideration should be given to the maximum length of stub that would be required, and vertical space allowed accordingly.

After scaling the room and preliminary placing of the main transmitter units on paper, the plan must be studied from the point of view of the operator. Can he reach control points quickly and easily? Is there room for all normal maintenance, testing and service? Obvious, but sometimes overlooked: are the doors to the transmitter room large enough for the largest unit of apparatus to be installed?

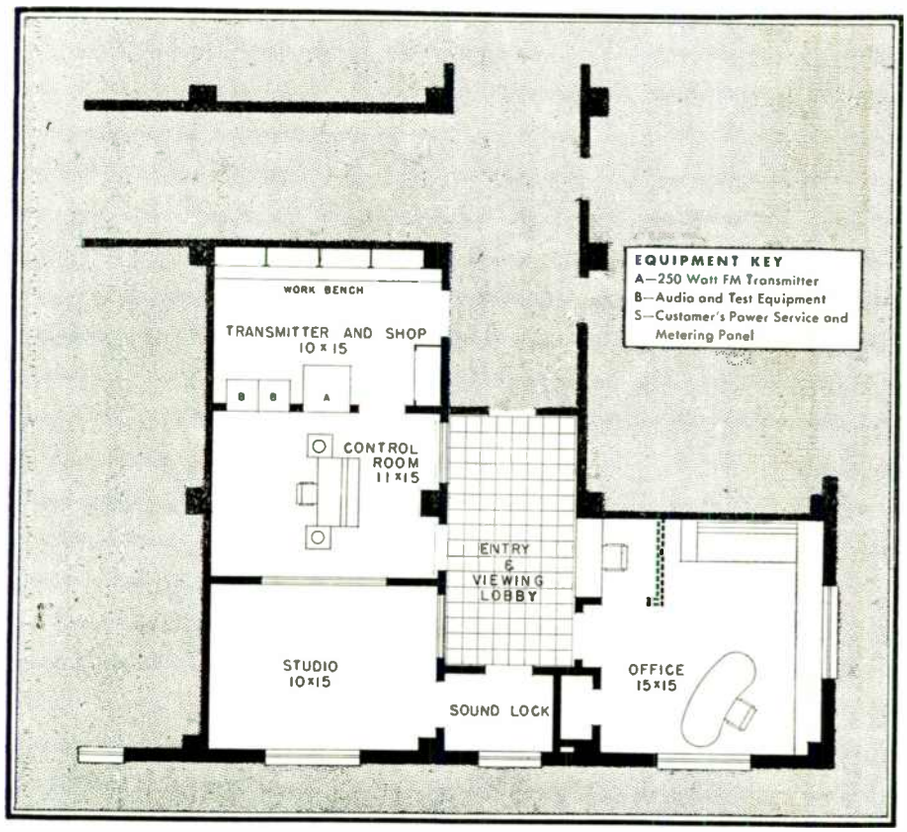


FIG. 2. PLAN FOR THE ARRANGEMENT IN FIG. 1, FOR OFFICE BUILDING LOCATION

The enclosure of high voltage equipment in separate rooms with interlock switches on all entry doors should be planned in accordance with FCC and Underwriters' regulations. These regulations should be studied to make sure that any layout plan of high voltage equipment is in order.

The ceiling height in the transmitter room must include a margin of several feet over the standing height of the transmitter itself. A minimum over-all ceiling height of 12 ft. for FM transmitters is advisable. This is to allow for:

1. Access space for servicing meters and other equipment near the top of the transmitter.

2. Room for discharge of heat from the tops of small and medium size transmitters.

3. Room for transmission line and harmonic shunt line stubs installed on or near the top of the transmitter. If har-

(For placement of the transmitter units with respect to the control desk, see section on Control Room.)

In the layout of the transmitter room, as in every feature of a transmitter building, the anticipation of probable expansion is one of the surest forms of long-range economy. All of the experts agree that every person going into the broadcast business should take a hard look ahead at his future and lay definite plans in the transmitter building for the changes he hopes to make. As stated by R. V. Howard: "Every small- or medium-power transmitter building should allow for expansion to higher power, if the owners have any hope for normal expansion and growth of their business." In the transmitter room, this means sufficient space for a larger transmitter, and any secondary units required. Such additional floor space costs very little per square foot. A wall of glass brick, unit partitions, or other easily removable construction is one of the simplest and most popular methods of facilitating future expansion.

After the layout, the next major planning job for the transmitter room is that of supplying dirt-free air to the transmitter and auxiliaries, and keeping ambient temperature at the proper levels.

Dust Removal ★ As pointed out by A. B. Chamberlain: "It is cheaper, as well as more satisfactory, to supply dirt-free air to the transmitter than to have operating personnel periodically engaged in cleaning the air for your transmitter room. Simple filters on the air intake of the transmitter cabinet will often be sufficient, particularly if a slight positive air pressure is maintained inside the cabinet. On the other hand it may be desirable to filter the air for the whole room, or the whole building. If the transmitter is not enclosed in a separate room, precaution may be necessary against entry of dirt when outer building doors are opened."

With the larger air-cooled transmitters, which draw air from outside the building, close control of dust becomes of paramount importance. An electrostatic precipitator at the air intake will give assurance of clean air for cooling purposes. Various types of filters can also be used on the intake with somewhat lower effectiveness, but they will give satisfactory service.

Ambient Temperature ★ The disposal of waste heat in a broadcast transmitter, so as to keep the internal temperature at a safe operating level, is one of the principal design factors for which the manufacturer makes provision. The planner of the building must consider, in addition, the comfort of operating personnel. Thus, the general considerations are:

1. In a building cooled by mechanical refrigeration, waste heat should not be added to the load on the cooling equipment, but discharged outside. The waste heat will almost certainly overload the cooling equipment.

2. The same will be true if the cooling air for the transmitter is taken from a building area cooled mechanically.

3. Thus the separate treatment of transmitter heat is highly desirable, especially in warm climates and with mechanical refrigeration used to cool the building.

4. By enclosing the area behind the front panel of the transmitter as a separate room, dust, ventilation, and heat disposal can all be handled on the most efficient basis, with the operator's comfort assured.

Control Room ★ The space in front of the transmitter, or the room into which the transmitter faces, must be used as the control room. The central feature is the

control desk, so placed that the operator on duty can monitor the transmitter conveniently during operation.

The transmitter and the racks of audio and test equipment around the control desk must be arranged so that they are easily seen, with ample space for movement of personnel. The accompanying sketches have been prepared to show the various basic plans for single-unit transmitters and multiple-unit transmitters. The following principles should guide the layout of the control room:

1. The operator must be able to see the indicators of the most essential meters (although not necessarily to read them accurately) without leaving the control desk.

2. The minimum distance between desk and transmitter should allow for easy passage of the operator between the two with the transmitter doors open. This requires approximately 5 ft.

3. As units are added to the transmitter, the control desk must be moved back from the transmitter front to give the operator a proper view of all the units. Thus the average distance between control desk and transmitter in medium power installations is 8 to 10 ft.

4. As more units are added to the transmitter, a rectangular or semicircular arrangement becomes desirable, to bring all the units within proper viewing distance of the operator.

5. Not only the transmitter itself, but auxiliaries such as phasing equipment, monitors, noise and distortion meters, line and limiting amplifiers, should be visible and readily accessible to the operator.

6. The auxiliary units listed above must be arranged so that the operator can get in back of them easily, with ample space for servicing or maintenance.

Controls for maintaining temperature, ventilation, and lighting, all adjusted to the requirements of continuous occupation, require careful study.

Acoustic treatment of the control room walls and ceiling has become general practice, in order to lower the noise level for improved program monitoring efficiency and additional comfort to the operator.

A feature of the control room often overlooked is the provision of convenient space for a typewriter.

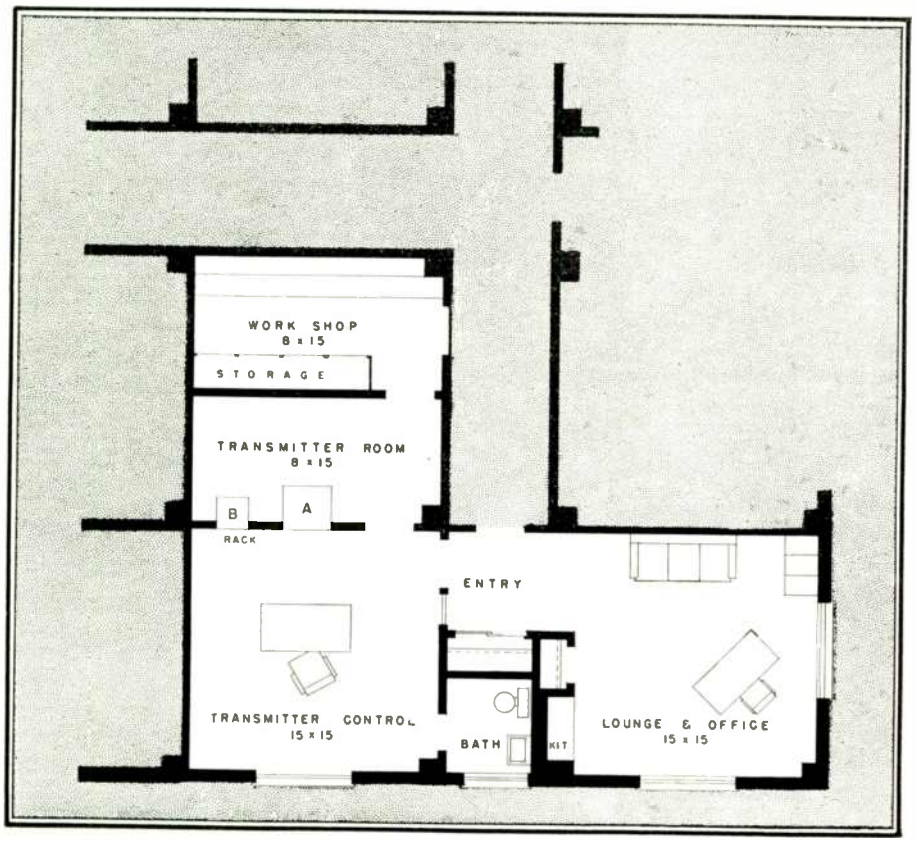


FIG. 3. AN ALTERNATE PLAN, ALSO ADAPTABLE TO A SEPARATE TRANSMITTER BUILDING

Special Services ★ Next in order are plans for proper and economical installation of the following services to the transmitter and associated equipment:

- Incoming primary power
- Incoming program lines
- Interunit connections
- Outgoing transmission lines
- Lighting circuits
- Air ducts for cooling larger transmitters
- Gas equipment for pressurizing transmission line

It is in the placement and arrangement of these items that many buildings go wrong, with consequent expensive alterations, or inefficiency caused by difficult maintenance and operation. The technical specialist, and the architect or building contractor must work closely together in making thorough advance plans for all these services. For such planning, "accurate and complete installation drawings of the transmitter and auxiliaries are priceless to the designer," says J. L. Middlebrooks. "They are the best insurance against costly hindsight."

Each building and each transmitter will present an individual problem. The following considerations should be noted:

Terminal boards and overload control points such as power distribution panels, fuse boxes, and circuit breaker panels, should be placed so that they are readily accessible to the operator on duty.

Incoming program and power lines should be brought in to separate, centrally located terminal boards. If these lines run near an AM antenna, they should be buried to reduce interference.

Inter-unit connections should be planned with particular care. A drawing showing every electrical and transmitter circuit in the building should be prepared, to provide assurance that plans have been made for all necessary circuits.

The builder has a choice of a number of methods for installing transmitter power and audio circuits:

CONDUIT: Commercially available conduit can be a) buried in poured cement floor, after which relocation of wiring is difficult and costly, b) run under the floor if there is a crawl space or basement, in which case changes require cutting holes in the floor and disconnecting the conduit, c) run under a false floor or in "Q" floors.

DUCTWORK: Many forms of metal ductwork are commercially available. This is a very popular device for installing transmitter wiring. Ducts generally have a rectangular cross section and removable top. Many types are supplied with an integral shielding barrier which can be used to separate speech circuits from power circuits, making other shielding unnecessary.

Ducts can be: a) laid in poured concrete floors, b) installed under false floors: c) hung from the floor if there is a crawl space or basement.

TROUGHS OR RACEWAYS: Troughs or raceways formed in poured cement floors provide another method for installing inter-unit wiring. The wire can simply be laid in the trough. Some kind of steel plate cover must be added, and if speech and power circuits, or high and low level circuits, are run in the same trough, shielding is required.

After design of the transmitter room and control room, the other building units can be added to the plan.

The conclusion of Mr. Lanier's article will appear next month.

FM BROADCASTING STATIONS IN THE U. S.

FCC List of Stations Operating, Construction Permits, and Conditional Grants, Sept. 25, 1947

* indicates station on the air. P indicates Construction permit
G indicates Conditional Grant.

ALABAMA

		Mc.	Eff. Kw.	
ANNISTON				
WHMA-FM	Harry M. Ayers	100.5	19	P
BIRMINGHAM				
WAFM	Voice of Ala. Inc	99.5	540	P
*WBRC-FM	Birmingham Bcstg Co	102.5	560	P
WDXE	Johnston Bcstg Co	104.7	40	P
WSGN-FM	Birmingham News Co	93.7	370	P
WTNB-FM	Thomas N. Beach	106.9	276	P
GADSDEN				
*WJBY-FM	Gadsden Bcstg Co Inc	103.7	1.5	P
HUNTSVILLE				
WHBS-FM	Huntsville Times Co	95.1	10	P
LANETT				
*WRLD-FM	Valley Bcstg Co	102.9	10	P
MOBILE				
WABB	Mobile Daily Newspaps.	107.9	51	P
WALA-FM	Pape Bcstg Co	94.9	102	P
WKRG-FM	Giddens & Rester	99.9	3	P
WMOB-FM	Nunn Bcstg Corp	97.5	8.8	P
MONTGOMERY				
WCOV-FM	G. W. Cavington, Jr.	94.5	15.5	P
WMGY-FM	Dixie Bcstg Co	107.5	6	P
*WSFA-FM	Montgomery Bcstg Co	103.3	29.7	P
TUSCALOOSA				
WUOA	University of Ala.	91.7	14.2	P
WJRD-FM	James R. Dass, Jr.	101.3	3.2	P

ARIZONA

PHOENIX				
KPSC-FM	Sun Country Bcstg Co	98.5	8	P
TUCSON				
KRZI	Sun Country Bcstg Co	99.5		G

ARKANSAS

FORT SMITH				
KFPW-FM	Southwestern Hotel Co	94.9	9	P
KFSA-FM	Donald W. Reynolds	107.7	140	P
KRKN-FM	Ark.-Okla. Bcstg Corp	102.1	33	P
KWHN-FM	KWHN Bcstg Co. Inc.	104.1	43	P
SILOAM SPRING				
KUOA-FM	KUOA, Inc	96.5*	2.6	P
WEST MEMPHIS				
	West Memphis Bcstg	105.9		G

CALIFORNIA

ALAMEDA				
*KONG	Times-Star Pub Co	104.9	0.75	P
BAKERSFIELD				
KERN-FM	McClatchy Bcstg Co	94.1	9.3	P
BERKELEY				
KRE-FM	Cen'l Calif. Bcstrs	102.9	6.8	P
	E. Ogden Driggs	99.3		G
BEVERLY HILLS				
KHRB-	Beverly Hills Bcstg Co	103.9	0.76	P
BIG BEAR LAKE				
	Big Bear Lake Bcstg Co	96.7		G
BURBANK				
KWIK-FM	Burbank Bcstrs Inc	94.3	0.53	P
CHICO				
KHSL-FM	Golden Empire Bcstg Co	101.1	11	P
COLTON				
	San Bernardino Bcstrs	94.3		G
EUREKA				
KRED	Redwood Bcstg Co Inc	96.3	4.6	P
FRESNO				
KARM-FM	The Geo. Harm Station	101.9	24.5	P
*KRFM	J. E. Radman	93.7	69.9	P
KSEQ	Tulare-Kings Counties Radio Assoc.	99.5	3.2	P
KTXD	McClatchy Bcstg Co	97.9		G
KFEY	Pacific Bcstg Co	95.5		G
HOLLYWOOD				
KNX-FM	Columbia Bcstg Sys Inc	93.1	230	P
LONG BEACH				
KNOB	The Cerrites Bcstg Co	103.1	0.32	P
LOS ANGELES				
KCLI	Cannan & Callister Inc	105.1	36	P
KECA-FM	American Bcstg Co Inc	95.5	290	P
KFAC-FM	Los Angeles Bcstg Co	104.3	270	P
KFI-FM	E. C. Anthony, Inc	105.9	265	P
KFVD-FM	Standard Bcstg Co	99.5	14.9	P
*KHJ-FM	Don Lee Bcstg System	101.1	4.8	
KKLA	Echo Park Evan. Assn.	97.1	58	P
KMGM	Metro-Goldwyn-Mayer	98.7	49	P
KMPC-FM	Station of the Stars	100.3	460	P
KOMB	Cons. Bcstg Corp Ltd	101.9	10.5	P
*KRKD-FM	Radio Bcstrs Inc	96.3		G
KTML	The Times Mirror Co	103.5	165	P
KVUN	Unity Bcstg Corp of Cal.	94.7	44	P
*KUSC	Univ. of So. Calif.	91.5	2.9	P
MADERA				
	Madera Bcstg Co	103.9		G
MARYSVILLE				
KMYC-FM	Marysville-Yuba City Bcstrs	99.9	4.7	P
KSVA	Sacramento Valley Bcstrs	101.5	38	P
MERCED				
KYOS-FM	Merced Bcstg Co	97.5	2.9	P
MODESTO				
KBEE	McClatchy Bcstg Co	103.3	3.4	P
	KTRB Bcstg Co Inc	104.1		G
MONTEREY				
KDON-FM	Monterey Peninsula Bcstg	94.5	3.4	P
OAKLAND				
*KWBR-FM	Warner Bros.	97.3	10	P
KLX-FM	Tribune Bldg. Co	101.3	20	P
	KROW, Inc	95.7	3.6	P
ONTARIO				
*KOCS-FM	The Daily Report	93.5	0.31	P
PALO ALTO				
*KPNI-FM	Peninsula Newspaps.	101.7	0.77	P
	Cardinal Bcstg Co	97.7		G
PASADENA				
*KAGH	Rose Bowl Bcstrs	98.3	0.42	P
KWFM	So. Calif. Bcstg Co	102.7	14.7	P
REDDING				
KVCV-FM	Golden Empire Bcstg Co	103.9	1	P
REDLANDS				
	Redlands Bcstg Co	103.9		G
RICHMOND				
*KRCC	Contra Costa Bcstg Co	104.5		G
RIVERSIDE				
*KPOR	The Bcstg Corp of Amer.	97.5	20	P
SACRAMENTO				
*KCRA-FM	Central Valleys Bcstg	96.1	49	P
*KFBK-FM	McClatchy Bcstg Co	96.9		G
KROY-FM	Harmca, Inc	94.5	12.6	P
*KXOA-FM	Sacramento Bcstrs Inc	107.9	9.3	P
KSCU	Sacramento School Dist	90.9	0.37	P
SALINAS				
KSLI	Luther E. Gibson	96.9	9.4	P
SAN BERNARDINO				
KMBT	The Sun Co	99.9	6.4	P
*KFXM	Lee Bros. Bcstg Co	95.1	.047	P
SAN BRUNO				
KSBR	Radio Diablo, Inc	100.5	250	P
SAN DIEGO				
KFSD-FM	Airfan Radio Corp Ltd	94.1	33	P
*KFMB-FM	The Jack Cross Bcstg Co	101.5		G
KSDO	Union Tribune Pub Co	96.5	48	P
KSON-FM	Studebaker Bcstg Co	104.7	16	P
KLIK-FM	Balboa Radio Corp	92.5	20	P
SAN FRANCISO				
*KJBS-FM	KJBS Broadcasters	98.9	35	P
KPAF	Pac. Agri. Fndation Ltd	103.7	44	P
*KRON	The Chronicle Pub Co	96.5		G
*KFSH	Pacific Bcstg Co	94.9	15.8	P
KSFO-FM	The Assoc. Bcstrs	98.1	14	P
*KGO-FM	American Bcstg Co Inc	106.1	1.6	P
KPO-FM	Nat'l Bcstg Co Inc	99.7	45	P
	Sundial Bcstg Corp	102.1		G
KALW	San Francisco Schaal Dist	91.7	11.5	P
SAN JOSE				
*KLOK-FM	Valley Bcstg Co	98.5	10	P
KRPO	FM Radio & Telev. Corp	92.3	340	P
*KSJO-FM	Santa Clara Bcstg Co	95.3	1	P
SAN LUIS OBISPO				
KVEC-FM	The Valley Elec. Co	99.9	16.7	P
SAN MATEO				
KSMO-FM	Amphlett Printing Co	93.3		G
KVSM-FM	San Matea County Bcstrs	100.9	0.38	P
SANTA ANA				
KVOE-FM	The Voice of the Orange Empire Inc Ltd	96.7	1	P
SANTA BARBARA				
KTMS-FM	News Press Pub Co	98.3	0.38	P
SANTA CRUZ				
	Monterey Bay Bcstg Co	107.7		G
SANTA MARIA				
*KRJM	Santa Maria Daily Times	103.1	.336	P
SANTA MONICA				
KCRW	Santa Monica Schaal Baard	89.9	0.46	P
SANTA ROSA				
KSRO-FM	Ruth W. Finley	102.5		G
STOCKTON				
*KGDM-FM	E. F. Peffer	92.9	39	P
TURLOCK				
KTUR	Turlock Bcstg Graup	100.9	1	P

COLORADO

DENVER				
*KLZ-FM	KLZ Bcstg Co	94.1		G
KOA-FM	National Bcstg Co	95.7		G
PUEBLO				
	Rocky Mountain Bcstg	98.1		G

CONNECTICUT

BRIDGEPORT	See Propased Decisians			
DANBURY				
WLAD-FM	The Berkshire Bcstg	98.3	0.15	P
	See Propased Decisions			
HARTFORD				
*WDRC-FM	The Conn. Bcstg Co	93.7	7	
*WTIC-FM	Travelers Bcstg Service	96.5	9.5	
WONS-FM	The Yankee Network	102.9	10.2	P
WTHT-FM	The Hartford Times	106.1	5.6	P
MERIDEN				
WMMW-FM	Silver City Crystal	95.7	7	P
NEW BRITAIN				
*WKNB-FM	The New Britain Bcstg	103.7	20	P
NEW HAVEN				
*WBIB	Calany Bcstg Corp	100.7	20	P
WNHC-FM	Elm City Bcstg Corp	99.1	20	P
WEMI-	Conn. Radio Faundatian	107.9	20	P
WAVZ-FM	New Haven Bcstg Corp	95.1	20	P
NEW LONDON				
*WNLC-FM	Thames Bcstg Corp.	99.5	20	P
STAMFORD				
WSTC-FM	Western Conn. Bcstg	96.7	0.5	P
WATERBURY				
WBRY-FM	American Republican	102.5	10.2	P
	The Mattatuck Bcstg Co	105.3		G

DELAWARE

WILMINGTON				
WILM-FM	Delaware Bcstg Co	99.5	20	P
WTUX-FM	Pt. Frere Bcstg Co	107.3	16	P
WDEL-FM	WDEL, Inc	93.7	15.3	P
WBRB	Wilmington-Tri State Bcstg	96.1	20	P

DISTRICT OF COLUMBIA

WASHINGTON				
*WASH	Commercial Radio Equip	97.1	15	P
WHMB	Theodore Granik	100.3	19	P
*WINX-FM	WINX Bcstg Co	96.3	20	P
WMAL-FM	The Evening Star Bcstg	107.3	20	P
WOL-FM	Cowles Bcstg Co	98.7	20	P
WCFM	Potomac Bcstg Corp. Inc	99.5	20	P
WQQW-FM	Metropolitan Bcstg	103.5	20	P
*WRC-FM	Nat'l Bcstg Co Inc	93.9	20	P
*WWDC-FM	Capital Bcstg Co	101.1	20	P
WTOP-FM	Columbia Bcstg System	105.1		G

FLORIDA

BELLE GLADE				
WSWN-FM	Seminole Bcstg Co	92.1		G
CLEARWATER				
	Springtime City Bcstg	1001.1		G
DAYTONA BEACH				
*WNDB-FM	News Journal Corp	94.5	8.5	
	W. Wright Esch	97.5		G
FORT LAUDERDALE				
WGOR	Gore Pub Co	106.5	9.6	P
JACKSONVILLE				
WJAX-FM	City of Jacksonville	95.1	130	P
*WJHP-FM	The Metropolis Co	96.9	34	P
WMBR-FM	Florida Bcstg Co	96.1	20	P
WPDQ-FM	Jacksonville Bcstg Corp	99.7	36	P
MIAMI				
*WIOD-FM	Isle of Dreams Bcstg Co	97.3	54	P
WWPB-FM	Paul Brake	101.5	8.5	P
WMIM	Everglades Bcstg Co	99.9	11	P
*WQAM-FM	Miami Bcstg Co	94.9	49	P
WGBS-FM	The Fort Industry	96.3	27	P
	Tropical Bcstg Co	102.9		G
WTHS	Tech. High School	91.7	0.4	P
MIAMI BEACH				
WKAT-FM	WKAT, Inc	93.1	306	P
	Mercantile Bcstg Co	93.9		G
ORLANDO				
WHOO-FM	Orlando Daily Newspaps	96.5	47	P
WLOF-FM	Hazlewood, Inc	100.3	65	P
	Orlando Bcstg Co Inc	92.3		G
PALM BEACH				
*WWPG-FM	Palm Beach Bcstg Corp	97.9	22	P
PENSACOLA				
*WCOA-FM	Pensacola Bcstg Co	98.9	5.5	P
ST. PETERSBURG				
WTSP-FM	Pinellas Bcstg Co	102.5	37	P
TALLAHASSEE				
*WTAL-FM	John H. Phipps	103.9	0.71	P
TAMPA				
WFLA-FM	The Tribune Co	93.3	46	P
*WDAE-FM	Tampa Times Co	105.7		G
WEST PALM BEACH				
WJNO-FM	WJNO, Inc	98.7	49	P

GEORGIA

ATHENS				
WGAU-FM	J. K. Patrick Co	99.5	4.4	P
ATLANTA				
WCON-FM	Constitution Pub Co	98.5	20	P
WSB-FM	Atlanta Journal	104.5	50	P
WATL-FM	Atlanta Bcstg Co	97.5	40.4	P
WAGA-FM	Liberty Bcstg Corp	103.3	20	P
WFWM	Wilson and Cape	99.9	49	P
*WGST-FM	Ga. School of Tech	94.1	345	P
*WBGE-FM	General Bcstg Co	95.5	20	P
AUGUSTA				
WFMV	The Augusta Chronical	103.7	15	P
WRDW-FM	Augusta Bcstg Co	105.7	30	P
CEDARTOWN				
WGAA-FM	N. W. Georgia Bcstg Co.	96.1	5.5	P
COLUMBUS				
WDAK-FM	Radio Columbus Inc	107.9	10.4	P
*WGBA-FM	Georgia-Ala. Bcstg	95.1	9.4	P
*WRBL-FM	Columbus Bcstg Co	93.3	12	P
DECATUR				
	Dekalb Bcstg Co	92.9		G
WEAS-FM	Eurith D. Rivers, Jr.	106.3		G
DUBLIN				
WMLT-FM	Dublin Bcstg Co	98.1	2.5	P
GAINESVILLE				
	N. E. Georgia Bcstg Co	101.7		G
LA GRANGE				
WLAG-FM	La Grange Bcstg Co	104.1	5.1	P
MACON				
*WBML-FM	Middle Ga. Bcstg Co	100.7	32	P
*WMAZ-FM	Southeastern Bcstg Co	99.1	32	P
WNEX-FM	Macon Bcstg Co	96.9	41	P
MOULTRIE				
WMGA-FM	John F. Pidcock	103.5	14	P
NEWNAN				
WCOH-FM	Newnan Bcstg Co.	92.3		G
ROME				
*WRGA-FM	Rome Bcstg Corp	105.5	1.4	P
WLAQ-FM	News Pub Co	107.3		G
WBIX-FM	Rome Radio Bcstg	104.9		G
SAVANNAH				
*WSAV-FM	WSAV, Inc	100.3	11	P
*WTOC-FM	Savannah Bcstg Co	97.3	43	P
WCCP-FM	Carter C. Petersan	95.5	7.1	P
	A. C Neff	96.5		G
TOCCOA				
*WLET	R. G. LeTaurneau	102.9	10	P
VALDOSTA				
WGOV-FM	E. D. Rivers	92.5	7	P

IDAHO

BOISE				
*KIDO-FM	KIDO, Inc	106.1	7	P
KDSH-FM	Boise Bailey Bcstrs	98.1		G
IDAHO FALLS				
KID-FM	Idaho Radio Corp	103.3		G
NAMPA				
*KFXD-FM	Frank E. Hurt & Son	101.9	2.5	P
POCATELLO				
*KSEI-FM	Radio Service Corp	96.5	1.8	

TWIN FALLS				
KTFI-FM	Radio Bcstg Corp	99.7	3	P

ILLINOIS

ALTON				
	Ill.-Alton Bcstg Co	99.9		G
AURORA				
WBNU	The Copley Press Inc	103.9	1	P
BLOOMINGTON				
*WJBC-FM	Bloomington Bcstg Corp	101.5	45	P
BROOKFIELD				
*WRGK	George M. Ives	103.1	0.25	P
CANTON				
	Fulton County Bcstg Co	100.9		G
CARBONDALE				
WCIL-FM	So. Illinois Bcstg	100.7	3	P
CENTRALIA				
WCNT-FM	Hobart Stephenson	96.5		G
CHAMPAIGN				
WDWS-FM	Champaign News-Gazette	97.5	27	P
CHICAGO				
*WBBM-FM	Columbia Bcstg System	97.1	10	
*WDLM	Moody Bible Inst.	95.5	20	
*WGNB	WGN, Inc	98.7	20	
*WGNB	WGN, Inc	98.7	20	P
*WEHS	WHFC, Inc	97.9	12	
WEHS	WHFC, Inc	97.9	16	P
*WEFM	Zenith Radio Corp	99.5	12	
WANF	Amgtd. Bcstg Sys. Inc	105.9	19	P
WENR-FM	American Bctsgs Co Inc	94.7	15	P
WBIK	Balban & Katz Corp	96.3	17	P
WCFL-FM	Chicago Fed. Labor	104.3	22	P
WAAF-FM	Drovers Journal Pub	103.5	12.5	P
WVAC	UAW-CIO Bcstg Corp	105.1	20	P
WMAQ-FM	National Bcstg Co Inc	101.1	25	P
WGES-FM	Radio Station WGES	93.9	20	P
WFMF	WJJD, Inc	100.3	17	P
WSBC-FM	Station WSBC	101.9	31	P
*WBEZ	Bd. of Education	91.5	14.5	P
WCTF	Chicago Theo. Seminary	89.9	75	P
DECATUR				
*WSOY-FM	Commodore Bcstg Inc	98.7	31.2	P
E. ST. LOUIS				
WTMV-FM	On The Air Inc	102.5		G
ELGIN				
WGNN	The Copley Press Inc	94.3		G
ELMWOOD PARK				
WLEY	Elmwood Pk Bcstg Corp	107.1	0.32	P
EVANSTON				
*WEAW	No. Shore Bcstg Co Inc	96.7	0.665	P
	Sentinel Radio Corp	106.3		G
FREEPORT				
*WFJS	Freeport Journal Stand.	102.5	9	P
HARRISBURG				
WEBQ-FM	Harrisburg Bcstg Co	99.9	4.2	P
HERRIN				
WJPF-FM	Orville W. Lyerla	98.5	20	P
JOLIET				
WLHN	The Copley Press Inc	92.7		G
KANKAKEE				
*WKIL	Kankakee Daily Jrnl.	100.7	60	P
MARION				
	Harry L. Crisp	101.7		G
MT. VERNON				
WMIX-FM	Mt. Vernon Radio & Tel	94.1	15.2	P
OAK PARK				
	Commander Industries	93.5		G
	Village Bcstg Co	102.3		G
	Gale Bcstg Co Inc	98.3		G
PEORIA				
*WMBD-FM	Peoria Bcstg Co	92.5	16	P
WMMJ-FM	Mid-State Bcstg Co	96.5	10	P
WWXL-FM	Cent'l Ill. Radio Corp	94.1	20	P
WIRL-FM	Ill. Valley Bcstg Co	95.7	51	P
WEEK-FM	W. Cent'l Bcstg Co	93.3	20	P
QUINCY				
*WQDI	Quincy Newspaps Inc	105.1	13	P
WTAD-FM	Lee Bcstg Co Inc	99.5	53	P
ROCKFORD				
WROK-FM	Rockford Bcstrs Inc	97.5	44	P
ROCK ISLAND				
WHBF-FM	Rock Island Bcstg Co	98.9	36.6	P
SPRINGFIELD				
WTAX-FM	WTAX, Inc	103.7	6.7	P
*WCVS-FM	WCBS, Inc	102.9	25	P
	Radio Springfield	104.5		G
URBANA				
*WIUC	Univ. of Illinois	91.7	0.1	P
WAUKEGAN				
WKRS	Keystone Print. Serv.	106.7	12	P

INDIANA

BLOOMINGTON				
WFIU	Trustees of Ind. Univ.	90.9	45	P
COLUMBUS				
*WCSI	Syndicate Theatres	93.7	31	P
CONNERSVILLE				
WCNB	News-Examiner Co	100.3	7.7	P
CORYDON				
	Robert P. O'Bonnon	92.1		G
CRAWFORDSVILLE				
	Journal Review	102.9		G
ELKHART				
WTRC-FM	Truth Pub Co Inc	100.7	21.6	P
EVANSVILLE				
*WMLL	Evansville On the Air	94.5	20	
WMJF	Tri-State Bcstg Corp	102.5	20	P
WIKY-FM	So. Central Bcstg Corp	104.1		G
FT. WAYNE				
WFTW-FM	Ft. Wayne Bcstg Inc	103.7	10	P
WGL-FM	Farnsworth T & R Corp	105.3	20	P
WKJG-FM	No. Eastern Ind. Bcstg	106.1	20	P
*WOWO-FM	West'ghouse Radio Sta	96.1	20	
HAMMOND				
WJOB-FM	So. Shore Bcstg Co	92.3	20	P
INDIANAPOLIS				
*WABW	Assoc. Bcstrs Inc	94.7	20	
WMHC	The Wm. H. Block Co	97.1	19.5	P
WVNA	Scripps-Howard Radio	93.1	20	P
WIBC-FM	Indiana Bcstg Corp	95.5	20	P
WISH-FM	Capital Bcstg Corp	98.7	20	P
WIRE-FM	Indianapolis Bcstg Inc	92.3	20	P
WFMM	Universal Bcstg Co	96.3	20	P
WFBM-FM	WFBM, Inc	97.9	20	P
KOKOMO				
WKMO-FM	Kokomo Bcstg Corp	99.9	31	P
LAFAYETTE				
WFAM	WFAM, Inc	95.1	12	P
MARION				
WMRI	Chronicle Pub Co Inc	105.9		G
MUNCIE				
WLBC-FM	Donald A. Burton	104.1	8.6	P
NEW CASTLE				
*WCTW	Courier-Times Inc	103.1	0.34	P
SHELBYVILLE				
WSRK	Shelbyville Radio Inc	101.3	5	P
SOUTH BEND				
*WSBF	South Bend Tribune	101.3	20	
TERRE HAUTE				
WTHI-FM	Wabash Valley Bcstg	99.9	20	P
WBOW-FM	Banks of the Wabash	101.1	20	P
WABASH				
	Syndicate Theatres	97.5		G
WASHINGTON				
	Washington Radio Inc	106.5		G

IOWA

AMES				
	Iowa State College	91.3	8.3	P
ATLANTIC				
KCON	Continental Bcstg Co	106.5		G
BURLINGTON				
*BKUR-FM	Burlington Bcstg Co	92.9	20	P
CEDAR RAPIDS				
KCRK	The Gazette Co	96.9	48	P
CLINTON				
KROS-FM	Clinton Bcstg Co	96.1	10	P
COUNCIL BLUFFS				
*KSWI-FM	Nonpareil Bcstg Co	96.1		G
CRESTON				
KSIB-FM	Southwest Iowa Bcstg	107.3		G
DAVENPORT				
WOC-FM	Tri-City Bcstg Co	103.7	47	P
DES MOINES				
KIOA-FM	Independent Bcstg Co	98.5	20	P
	Capital City Bcstg Co	94.1		G
KSO-FM	Murphy Bcstg Co	97.3	154	P
KRNT-FM	Cowels Bcstg Co	104.5	160	P
WHO-FM	Central Bcstg Co	100.3	134	P
DUBUQUE				
WDBQ	Dubuque Bcstg Co	103.3	10	P
KDTH-FM	Telegraph-Herald	100.5	180	P
FORT DODGE				
KFVD-FM	Northwest Bcstg Co	102.7		G
IOWA CITY				
*KSUI	The State Univ. of Io.	91.7	16.5	P
KEOKUK				
*KOKX-FM	Keokuk Bcstg Co	102.7		G
	The Gate City Co	98.5		G
MASON CITY				
KGLO-FM	Lee Radio Inc	101.1	260	P
MASCATINE				
KWPC-FM	Muscatine Bcstg Co	99.7		G
SHENANDOAH				
	KFNF, Inc	103.3		G
SIOUX CITY				
*KSCJ-FM	Perkins Bros. Co	94.9	280	P
WATERLOO				
KXEL-FM	Josh. Higgins Bcstg	105.7	540	P

KANSAS

GARDEN CITY				
	Albert B. Pyatt	99.3		G
HUTCHISON				
KIMV	Hutchison Pub Co	105.7	40	P
*KWBW-FM	Nations Center Bcstg	93.1		G
KANSAS CITY				
*KSBS	Sunflower Bcstg Sys.	105.9	43	P
KCKN-FM	The KCKN Bcstg Co	106.7	20	P
LAWRENCE				
KXKX	The World Co	105.1	2.5	P
MCPHERSON				
	The McPherson Bcstg Co	103.3		G
TOPEKA				
*KTSJ	Topeka State Journal	99.5	33	P
*WIBW-FM	Topeka Bcstg Assn Inc	102.5	2.9	
WREN-FM	The WREN Bcstg Co Inc	94.1		G
WICHITA				
KWBB-FM	Wichita Beacon Bcstg	97.9	48	P
KFH-FM	Radio Station KFH Co	100.3	180	P

KENTUCKY

ASHLAND				
WCMI-FM	Ashland Bcstg Co	93.7	4.4	P
BOWLING GREEN				
WBON	Bowling Green Bcstg Co	101.1	8.4	P
HENDERSON				
*WSON-FM	Henderson Bcstg Co Inc	99.5		G
HOPKINSVILLE				
*WHOP-FM	Hopkinsville Bcstg Co	98.7		G
LEXINGTON				
WLAP-FM	American Bcstg Corp	94.5	3	P
	Fayette Bcstg Co	92.9		G
*WBKY	Univ. of Kentucky	91.3	2.3	
LOUISVILLE				
*WRXW	WAVE, Inc	95.1	15	P
WBOX	Northside Bcstg Corp	100.7	29.8	P
*WCJT	WHAS, Inc	99.7	24	P
OWENSBORO				
WOMI-FM	Owensboro Bcstg Co Inc	92.5	20	P
WVJS	Owensboro on the Air	96.1	45	P
PADUCAH				
*WPAD-FM	Paducah Bcstg Co Inc	96.9	17	P
*WKYC	Paducah Newspaps Inc	93.3	32	P
WINCHESTER				
WINW	Winchester Sun Co Inc	100.1	0.77	P

LOUISIANA

ALEXANDRIA				
KALB-FM	Alexandria Bcstg Co	96.9	3	P
*KPDR-FM	Central La. Bcstg Co	99.7	55	P
BATON ROUGE				
*WBRL	Baton Rouge Bcstg Co	98.1	20	
	Modern Bcstg Co	104.3		G
WLCS-FM	Air Waves Inc	101.1		G
WLSU	State Univ. of A & M	91.7	1.8	P
LAFAYETTE				
KLOV-FM	Evangeline Bcstg Co	96.1		G
MONROE				
*KMLB-FM	Liners Bcstg Stations	104.1		G
NEW ORLEANS				
*WTPS-FM	Times Picayune Pub Co	95.7	270	P
*WRCM	Supreme Bcstg System	97.1	61	P
*WSMB-FM	WSMB, Inc	102.7	158	P
*WWLH	Loyola University	100.3	190	P
WDSU-FM	Stephens Bcstg Co	105.3	200	P
WDSW	Deep South Bcstg Corp	93.7	40	P
SHREVEPORT				
KTBS-FM	Radio Station KTBS	96.5	47	P
KRMD-FM	Radio Station KRMD	101.1		G
KWKH-FM	International Bcstg	94.5		G

MAINE

BANGOR				
WGUY-FM	Guy Gannett Bcstg Ser.	93.1	10.8	P
LEWISTON				
WCOU-FM	Twin City Bcstg Co Inc	93.9	13	P
	Lewiston-Auburn Bcstg	102.9		G
PORTLAND				
WGAN-FM	Guy Gannett Bcstg Ser.	101.9	3.6	P
WMNE	The Yankee Network	100.5	23	P

MARYLAND

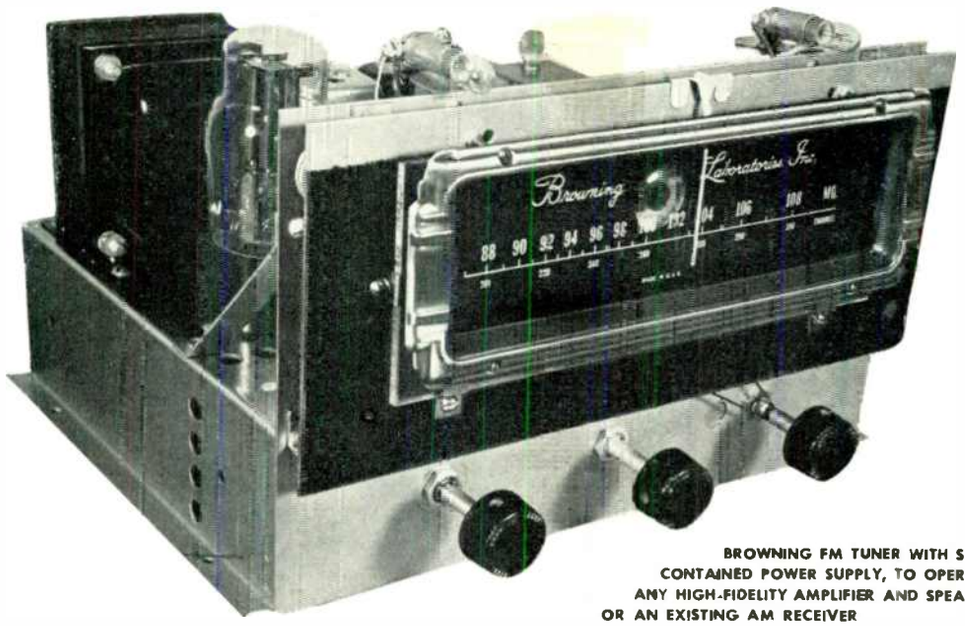
ANNAPOLIS				
WJWD	The Capital Bcstg Co	99.1	16.6	P
BALTIMORE				
WCAO-FM	Monumental Radio Co	102.7	20	P
WCBM-FM	Baltimore Bcstg Corp	93.1	15	P
*WITH-FM	Maryland Bcstg Co	104.3	20	P
WMCP	Belvedere Bcstg Corp	94.7	20	P
WFBR-FM	Baltimore Radio Show	101.9	20	P
WASA	The A. S. Abell Co	97.9	20	P
BETHESDA				
WBCC-FM	Broadcast Management	103.1		G
BRADBURY HTS.				
	Chesapeake Bcstg Co	96.7	0.42	P
CUMBERLAND				
WTSH	The Tri-State Bcstg Co	102.9	2.2	P
	Cumberland Bcstg Co	106.9		G
FREDERICK				
*WFMD-FM	The Monocacy Bcstg Co	101.5	2	P
HAGERSTOWN				
*WJEJ-FM	Hagerstown Bcstg Co	104.7	1	P
SALISBURY				
WBOC-FM	The Peninsula Bcstg	97.5	12	P
SILVER SPRINGS				
*WGAY-FM	Tri-Suburban Bcstg	102.3	0.44	P
WHIP	Montgomery FM Bcstg	103.9		G

MASSACHUSETTS

BOSTON				
*WMNE	The Yankee Network	100.5	10	
BOSTON				
*WGTR	The Yankee Network	99.1	9.5	
*WBZ-FM	West'ghouse Radio Sta	92.9	20	
WEEI-FM	Columbia Bcstg Co	103.3	20	P
WHDH-FM	Matheson Radio Co	94.5	20	P
WNAC-FM	Yankee Network Inc	98.5	19.5	P
WUNY	Unity Bcstg Corp	102.5	20	P
WTTR	Templetone Radio Mfg	104.1	20	P
WCOP-FM	Mass. Bcstg Co	100.7	20	P
BROCKTON				
WAZV	Cur-Non Company	107.1	0.8	P
WBKT	Plymouth County Bcstg	106.3	0.8	P
WBET-FM	Enterprise Pub Co	97.7	0.8	P
CAMBRIDGE				
*WXHR	Harvey Radio Lab	96.9	20	P
CHICOPEE				
WACE-FM	Regional Bcstg Co	100.3	3	P
FALL RIVER				
*WSAR-FM	Fall River Bcstg Co	103.7	20	P
*WCFR	Narragansett Bcstg Co	100.9	0.3	P
FITCHBURG				
WEIM-FM	M. G. Meyers, Et Al	104.7	18	P
GREENFIELD				
WHAI-FM	John W. Haigis	98.3	1	P
HAVERHILL				
WHAV-FM	The Haverhill Gazette	92.5	20	P
HOLYOKE				
WHYN-FM	Hampden-Hampshire Corp	93.1	3.5	P
LAWRENCE				
WLAW-FM	Hildreth & Rogers Co	93.7	17	P
LOWELL				
WLLH-FM	Merrimac Bcstg Co Inc	99.5	12.2	P
NEW BEDFORD				
*WFMR	E. Anthony & Sons Inc	98.1	20	P
WBSM	Bay State Bcstg Co	97.3	20	P
WBIL	S. Eastern Mass Bcstg	99.3	0.88	P
NORTH ADAMS				
WMFM	James A. Hardman Corp	97.5	1	P
PITTSFIELD				
WBEC-FM	Western Mass. Bcstg	94.3		G
WBRK-FM	Greylock Bcstg Co	101.5	12	P
SALEM				
WESX-FM	North Shore Bcstg Co	92.1	0.5	P
SPRINGFIELD				
WMAS-FM	WMAS, Inc	94.7	3.2	P
*WBZA-FM	West'ghouse Radio Sta	97.1	20	P
WSPR-FM	WSPR, Inc	97.9	14	P
WSFL	Springfield Bcstg Co	101.9	10	P
WEST YARMOUTH				
	E. Anthony & Sons	94.3		G
WORCESTER				
*WTAG-FM	WTAG, Inc	96.1	20	
	Worcester Bcstg Co	95.1		G

MICHIGAN

ANN HARBOR				
*WPAG-FM	Washtenaw Bcstg Co	98.7	2.2	P
WUOM	Regents of U. of Mich	91.7	13.5	P
BATTLE CREEK				
*WELL-FM	Federated Publications	102.1	20	P
BAY CITY				
*WBCM-FM	Bay Bcstg Co Inc	96.1	32	P
BENTON HARBOR				
WHFB-FM	Palladium Pub Co	99.9	9.2	P
DEARBORN				
WRAM	Herman Radner	103.9	0.48	P
	Suburban Bcstrs	100.3		G
DETROIT				
WJR-FM	The Good Will Station	96.3	24	P
WAIW	UAW-CIO Bcstg Corp	101.9	52	P
	King-Trendle Bcstg Corp	101.1		G
*WJLB-FM	Booth Radio Sta	97.9	20	
*WJLB-FM	Booth Radio Sta	97.9	30	P
*WWJ-FM	Evening News Assn	97.1	10.5	
*WJBK-FM	James F. Hopkins Inc	93.1	33	P
WDLW	Knight Radio Corp	95.5	20	P
WDFM	Wolverine State Bcstg	105.9		G
WTTL	Telaire Co	99.5		G
	Lincoln Bcstg Co	94.7		G
	Woodward Bcstg Co	107.5		G



BROWNING FM TUNER WITH SELF-CONTAINED POWER SUPPLY, TO OPERATE ANY HIGH-FIDELITY AMPLIFIER AND SPEAKER OR AN EXISTING AM RECEIVER

GENUINE FM RECEPTION IS DIFFERENT

Static Elimination: To the general public, Frequency Modulation means, among other advantages over AM, the virtual elimination of static.

That is one of the special features of the FM circuits invented by Dr. E. H. Armstrong.

And that is one of the special features of BROWNING FM tuners, because all models employ the genuine Armstrong limiter-discriminator circuits. Actually, BROWNING Tuners employ highly-perfected cascade limiters which cut out static and noise on FM reception right down to the point where signals are so weak they aren't worth listening to, anyway.

We want to emphasize, however, that because a tuner or a complete receiver can bring in FM stations, it does not follow that it can eliminate static. Not at all! Some of them have practically no static-limiting action on FM. Others only start to limit on strong, local signals.

We are heartily in accord with the idea of making FM reception available to listeners of limited means. However, we are finding that more and more people who intended to spend only a few dollars are proud to own a BROWNING Tuner when they hear it in operation, and discover the finer enjoyment of genuine FM reception, with full noise-limiting action. The following models are available for prompt delivery:

BROWNING FM TUNER

Model RV-10 — Tunes 88–108 mc. Self-contained power supply, to operate any power amplifier and speaker.

Model RV-11 — As above, with rack-mounting panel.

BROWNING FM-AM TUNER

Model RJ-12 — 88–108 mc. FM, 535–1650 kc. AM

Model RJ-14 — As above, with rack-mounting panel.

Model PF112 — Power supply unit for RJ-12 or RJ-14.

For complete details and prices on these genuine FM tuners, address:

BROWNING LABORATORIES, Inc.

750 Main Street, Winchester, Massachusetts

***In Canada:* Measurement Engineering, Ltd., 61 Duke Street, Toronto, Ontario**

WDTR	Bd of Education	90.9	2	P
EAST LANSING				
WKAR-FM	Michigan State College	90.5	8.8	P
ESCANABA				
WJPG	John P. Norton	94.7		G
FLINT				
WFDF-FM	Flint Bcstg Co	95.1		G
WAJL	Advertiser Press Inc	107.1	0.32	P
	Booth Radio Sto	99.9		G
GRAND RAPIDS				
*WFRS	Grand Rapids Bcstg	92.5	10.5	P
WJEF-FM	Fetzer Bcstg Co	93.7		G
*WLAV-FM	Leonard A. Verstuis	96.9	54	P
GROSSE POINT				
	Grosse Point Bcstg	98.3	0.5	P
JACKSON				
WIBM-FM	WIBM, Inc	92.3	16.0	P
LANSING				
WJIM-FM	WJIM, Inc	97.5	53	P
MT. CLEMENS				
*WMLN	Macamb Pub Co	106.3	0.34	P
MUSKEGON				
WKBZ-FM	Ashbacker Radio Corp	106.5	46	P
*WMUS-FM	Greater Muskegon Bcstrs Inc	100.5	3.2	P
OWOSSO				
WOAP-FM	Argus Press Co	103.1	1	P
PONTIAC				
WCAR-FM	WCAR, Inc	103.5	20	P
PT. HURON				
WTTH	The Times Herald	99.1	22	P
ROYAL OAK				
WEXL-FM	Royal Oak Bcstg Co	104.3	18.4	P
SAGINAW				
*WSAL	Saginaw Bcstg Co	98.1	15	P
WYANDOTTE				
WJJW	Wyandotte News Co	103.1	1	P

MINNESOTA

DULUTH				
	SEE Superior, Wisc			
MANKATO				
KYSM-FM	So. Minn. Supply Co	103.5	47.0	P
MINNEAPOLIS				
WLOL-FM	Ind't Merchants Bcstg	101.3	34	P
*WTCN-FM	Minn. Bcstg Carp	97.1	400	P
KBTR	Bethesda Free Church	98.5		G
ROCHESTER				
*KROC-FM	So. Minn. Bcstg Co	94.7	20	P
ST. CLOUD				
KFAM-FM	Times Pub Co	104.7	50	P
ST. PAUL				
*KSTP-FM	KSTP, Inc	102.1	545	P
WMIN-FM	WMIN Bcstg Co	99.5	65	P
WEAX	Elmer A. Benson	100.3		G
WINONA				
KWNO-FM	Winona Radio Serv	97.5	55	P

MISSISSIPPI

CLARKDALE				
	Birney Imes, Sr.	99.1		G
GULFPORT				
	WGCM Bcstg Co	101.5		G
JACKSON				
WJDX-FM	Lamar Life Ins. Co	102.9	100	P
MERIDIAN				
	Birney Imes, Jr.	98.5		G

MISSOURI

CAPE GIRARDEAU				
KFVS-FM	Oscar C. Hirsch	101.3	2.5	P
CLAYTON				
*KFUC-FM	Evan. Lutheron Synod	104.1		G
KXLW-FM	St. Louis County Bcstg	101.1		G
JEFFERSON CITY				
KWOS-FM	Capital Bcstg Co	98.5	9.7	P
JOPLIN				
*WMBH-FM	Joplin Bcstg Co	96.1	140	P
KANSAS CITY				
KCFM	KCMO Bcstg Co	94.9	54	P
*KMBC-FM	Midland Bsctg Co	100.5	20	
*KMBC-FM	Midland Bsctg Co	100.5	30	P
WHB-FM	WHB Bcstg Co	102.1	46	P
*KOZY	Comm. Radio Equip.	98.1	20	
KENNETT				
KBOA	Kennett Bcstg Corp	92.1		G
ST. JOSEPH				
KFEQ-FM	KFEQ Inc.	92.3	63	P
ST. LOUIS				
KSD-FM	Pulitzer Pub Co	96.1	34	P
*KXOK-FM	Stor-Times Pub Co	93.7	40	P
*WIL-FM	Missouri Bcstg Co	97.3	32.3	P
*WEW-FM	St. Louis Univ.	95.1	68	P
*KWK-FM	Thomas Patrick, Inc	99.1	360	P
KWGD	Globe Democrat Pub Co	98.1	218	P
KUBR	Unity Bcstg Corp of Mo.	106.7	40	P
KSLH	Bd. of Education	91.5	12.5	P
SPRINGFIELD				
KGBX-FM	Springfield Bcstg Co	92.9	50	P

NEBRASKA

LINCOLN				
*KFAB-FM	KFAB Bcstg Co	97.9	11	P
KFOR-FM	Cornbelt Bcstg Corp	102.9	22	P
OMAHA				
KBON-FM	Inland Bcstg Co	98.7	330	P
*KOAD	World Publ Co	92.9	380	P
KWOW	Radio Station WOW	99.9	21	P
	Central States Bcstg	104.1		G

NEVADA

LAS VEGAS				
KENO-FM	Nevada Bcstg Co	103.9	0.33	P
RENO				
KSAV	Soviers Electr. Prod.	103.9	0.76	P
KWRN	Reno Newspapers	95.5	10	P

NEW HAMPSHIRE

CLAREMONT				
*WLOB	Claremont Eagle Inc	106.1	1.5	P
KEENE				
	WKNE, Corp.	107.9		G
MANCHESTER				
WMUR-FM	The Radio Voice of N. H.	95.7	3.3	P
WVMA	Harry M. Bitner	101.1	3.4	P
NASHUA				
WOTW-FM	Nashua Bcstg Corp	106.3		G
PORTSMOUTH				
WFMI	WHEB Inc	107.3	20	P

NEW JERSEY

ALPINE				
*WFMN	Edwin H. Armstrong	93.1	6	
ASBURY PARK				
WJLK	Asbury Park Press	94.3	1	P
*WCAP-FM	Radio Industries Bcstg	107.1	0.7	P
ATLANTIC CITY				
WFPG-FM	Neptune Bcstg Corp	98.5	15.5	P
*WBAB-FM	Press-Union Pub Co	100.7	13	P
BRIDGETON				
WSNJ-FM	Eastern States Bcstg	98.9	20	P
CAMDEN				
WANQ	American Quartz Labs	100.9		G
ELIZABETH				
WPOE	Radio Elizabeth Inc	96.7	1	P
WEMF	Union Bcstg Ca	95.9		G
GREEN BROOK	Twp.			
*WXNJ	Harold O. Bishop	103.9		G
NEWARK				
*WAAT-FM	Bremer Bcstg Corp	102.7	13.5	P
WFMO	Fidelity Media Bcstg	103.1	0.36	P
	Newark Bcstg Corp	92.7		G
WBGO	Bd. of Education	91.1	2.4	P
NEW BRUNSWICK				
WHNM	Home News Pub Co	93.5	0.58	P
	Chanticleer Bcstg	98.3		G
SOUTH ORANGE				
WSOU	Seton Hall College	89.5	0.25	P
PATERSON				
WWDX	Passiac Daily News	107.1	0.19	P
See Proposed Decisions				
TRENTON				
WTOA	Mercer Bcstg Co	97.5	11.3	P
	Trent Bcstg Corp	100.1		G
WATCHUNG				
	C. H. Winans	105.5		G

NEW MEXICO

ALBUQUERQUE				
KKMA	FM Radia Bcstg Co	101.7		G

NEW YORK

ALBANY				
WROW-FM	Hudson Valley Bcstg	93.9	2.1	P
WRWR	Champlain Valley Bcstg	95.9	2.7	P
BATAVIA				
	Batavia Bcstg Corp	94.3		G
BAY SHORE				
WBEY	Coastal Bcstg Co	95.9		G
BINGHAMTON				
*WNBF-FM	Clark Assaciates	100.5	10.5	
WFET	Binghamton Press Co	98.1		G
	So. Tier Radio Serv.	107.7		G
BRONX				
*WFUV	Fordhom University	90.7	3.5	P
BROOKLYN				
*WNYE	Bd. of Ed. of NYC	91.5	20	P
BUFFALO				
*WBEN-FM	WBEN Inc	106.5		G
*WEBR-FM	WEBR Inc	96.9	15	P
*WBNY-FM	Roy L. Albertson	92.9	48	P
	Clark Associates Inc	102.5		G
WWOL-FM	Greater Erie Bcstg Co	104.1	20	P
	WGR Bcstg Corp	93.7		G
CORAM				
WFSS	Suffolk Bcstg Corp	103.1	0.34	P
CORNING				
*WKNP	Corning Leoder Inc	106.1	4.2	P
CORTLAND				
WKRT-FM	Cortland Bcstg Co Inc	99.9		G
ELMIRA				
WENY-FM	Elmiro Star-Gazette	106.9		G
ENDICOTT				
WENE-FM	Empire Newspaps.-Radio	101.7		G
FLORAL PARK				
*WSHS	Sawanhaka High School	90.3	0.35	P
GLEN FALLS				
WXTR	Warren Bcstg Corp	103.9		G
HEMPSTEAD				
*WHNY	FM Bcstg Corp	98.3	1	P
HORNELL				
*WWHG	The W. H. Greenhow Co	105.3	10	P
ITHACA				
*WHCU-FM	Cornell Univ.	97.3	40	P
JAMESTOWN				
WJTN-FM	James Bcstg Co Inc	93.3	9.5	P
KINGSTON				
	Kingston Bcstg Corp	94.9		G
LOCKPORT				
WKWC	Lockport Union Sun	99.3	0.34	P
MASSENA				
WMSA-FM	The Brockway Co	105.3	5	P
MINEOLA				
WHIA	Harry D. Fornari	105.5		G
MT. VERNON				
WHBJ	Hudson Bcstg Sys	106.3	0.3	P
NEW ROCHELLE				
WGNR	New Rochelle Bcstg Ser.	93.5	1	P
WIFM	Radio New Rochelle Inc	94.3		G
NEW YORK	SEE also Proposed Decisions			
*WBAM	Bamberger Bcstg Serv.	98.7	15	
*WNYC-FM	Municipal Bcstg System	93.9	15	
*WGHF	Wm. G. H. Finch	101.9	10.3	P
*WCBS-FM	Columbia Bcstg Sys	101.1	5	
*WQXQ	Interstote Bcstg Co	96.3	11.5	
*WMGM	Marcus Loew Agency	100.3	20	
*WABF	Metropolitan Bcstg & Television Inc	99.5	15	
*WGYN	WGYN, Inc	97.9	4	P
*WNBC-FM	National Bcstg Co	97.1	1.60	
WCUV	Columbia Univ.	89.9	20	P
NIAGARA FALLS				
*WHLD-FM	Niagara Falls Gazette	98.5	20	P
WJJL-FM	John J. Laux	96.1		G
OGDENSBURG				
WSLB-FM	St. Lawrence Bcstg Corp	106.1	13.7	P
OLEAN				
	WHDL, Inc	100.7		G
ONEONTA				
WDOS-FM	Oneonta Star Inc	99.1	4.2	P
OSWEGO				
WOPT	Patlodium-Times Inc	104.7	3	P
POUGHKEEPSIE				
WHVA	Poughkeepsie Newspaps	104.7	2.3	P
ROCHESTER				
*WRNY-FM	Monroe Bcstg Co Inc	97.9	27	P
*WHFM	Stromberg-Carlson Co	98.9	20	
*WHEF	WHEC Inc	96.5	20	
ROME				
WKAL-FM	Copper City Bcstg Corp	95.7	32	P
SCHENECTADY				
*WBCA	Capitol Bcstg Co Inc	101.1	6	
*WGFM	General Electric Co	99.5	6	
SYRACUSE				
WNDR-FM	Syracuse Bcstg Co	102.5	8.5	P
*WFBL-FM	Onondaga Radio Bcstg	93.1	8.5	
*WAGE-FM	WAGE Inc	98.5	1.6	P
*WSYR-FM	Central N.Y. Bcstg	94.5	9	P
WRPA	Radio Projects Inc	107.3	8.5	P
WOLF	Civic Bcstg Corp	104.1	8.5	P
TROY				
WTNY	The Troy Record Co	92.3	13	P
*WTRI	Tray Bcstg Inc	102.7	3.5	P
UTICA				
WKCJ	Utica Observer-Disp.	103.3	8.5	P
*WRUN	Rome Sentinel Co.	105.7	4.3	P
	Richard Balch	93.7		G
*WIBX-FM	WIBX, Inc	96.9	9	P
WATERTOWN				
WWNY-FM	The Brockway Co	100.5	14.4	P
WHITE PLAINS				
*WFAS-FM	Westchester-Bcstg Co	103.9	0.12	P
YONKERS				
WYON	American Quartz Lab	102.3		G

NORTH CAROLINA

AHOSKIE				
WPBN	Parker Bros. Inc	101.9	42	P
ASHEVILLE				
*WLOS-FM	Skywoy Bcstg Corp	104.3	8.8	P
*WISE-FM	Radio Station WISE	102.5	9.6	P
WSKY-FM	Radio Asheville	101.5	16.2	P
WWNC-FM	Asheville Citizen Times	106.1		G
BURLINGTON				
*WBBB-FM	Alamance Bcstg Co	101.1	34	P
*WFNS-FM	Burlington Graham Bcstrs	93.5	1	P
CHARLOTTE				
*WBT-FM	Southeastern Bcstg Co	99.9	160	P
WIST	Surety Bcstg Co	104.7	50	P
*WAYS-FM	Intercity Adv. Co	107.7	20	P
WSOC-FM	Radio Station WSOC	103.5	38	P
CONCORD				
WEGO-FM	Wayne M. Nelson	96.5	3.8	P
DURHAM				
WDNC-FM	Durham Radio Corp	105.1	36	P
WDUK-FM	WDUK Inc	102.5		G
FAYETTEVILLE				
WFNC-FM	Cape Fear Bcstg Co	98.1	12	P
GASTONIA				
WGNC-FM	F. C. Tadd	101.9	11.1	P
GOLDSBORO				
*WGBR-FM	E. Carolina Bcstg Co	93.3	20	P
GREENSBORO				
WFMY	Greensboro News Co	97.3	23	P
WBIG-FM	N. Carolina Bcstg Co	92.3	14	P
*WCTP	Capitol Bcstg Co	98.7	48	P
*WGBG-FM	Greensboro Bcstg Co	100.3	36	P
GREENVILLE				
WGTC-FM	Greenville Bcstg Co	99.1		G
HENDERSON				
WHNC	Henderson Rodio Corp	107.3		G
HICKORY				
WHKY-FM	Catawba Valley Bcstg	102.9	180	P
	SEE Also Winston-Salem			
HIGH POINT				
WHPE-FM	High Pt. Enterprise	95.5	37	P
*WMFR-FM	Radio Station WMFR	99.5	38	P
MORGANTOWN				
WMGN	Beatrice Cabb	94.3	0.88	P
NEW BERN				
WHIT-FM	Coastal Bcstg Co	103.7	2.9	P
RALEIGH				
WPTF-FM	WPTF Radio Co	94.5		G
*WRAL-FM	Capital Bcstg Co Inc	101.5	54	P
WNAO-FM	News & Observer Pub	96.1	25	P
REIDSVILLE				
	Reidsville Bcstg Co	98.3		G
WFRC-FM	Piedmont Carolina Bcstg	106.1		G
ROANOKE RAPIDS				
WCBT-FM	WCBT Inc	98.5	10	P
ROCKY MOUNT				
	William Avera Wynne	92.1		G
WCEC-FM	Josh L. Horne	100.7	33	P
SALISBURY				
*WSTP-FM	Piedmont Bcstg Corp	106.5	23.2	P
SHELBY				
WOHS-FM	W. Carolino Radio Corp	96.1		G
STATESVILLE				
*WSIC-FM	Statesville Bcstg Co	105.7		G
WASHINGTON				
WRRF-FM	Tar Heel Bcstg System	102.9	29	P
WILMINGTON				
WLDX	Wilmington Star-News	93.9	37	P
WMFD-FM	Richard Austin Dunleo	96.3	13	P
WILSON				
*WGTM-FM	Penn Thomas Wotson	106.7	20	P
WINSTON-SALEM				
*WAIR-FM	WAIR Bcstg Co	93.1	32	P
WSJS-FM	Piedmont Pub Co	104.1	48	P
*WMIT	Gorden Gray	106.9	200	
C. P. HICKORY				
WMIT	Gorden Gray	106.9	200	P

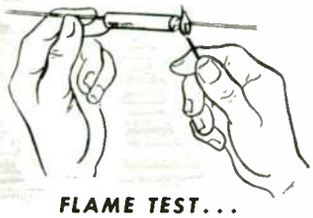
NORTH DAKOTA

FARGO				
KVOX-FM	KVOX Bcstg Co	99.9	8.5	P
*KVNJ	Northwest Bcstg Co	92.3		G

OHIO

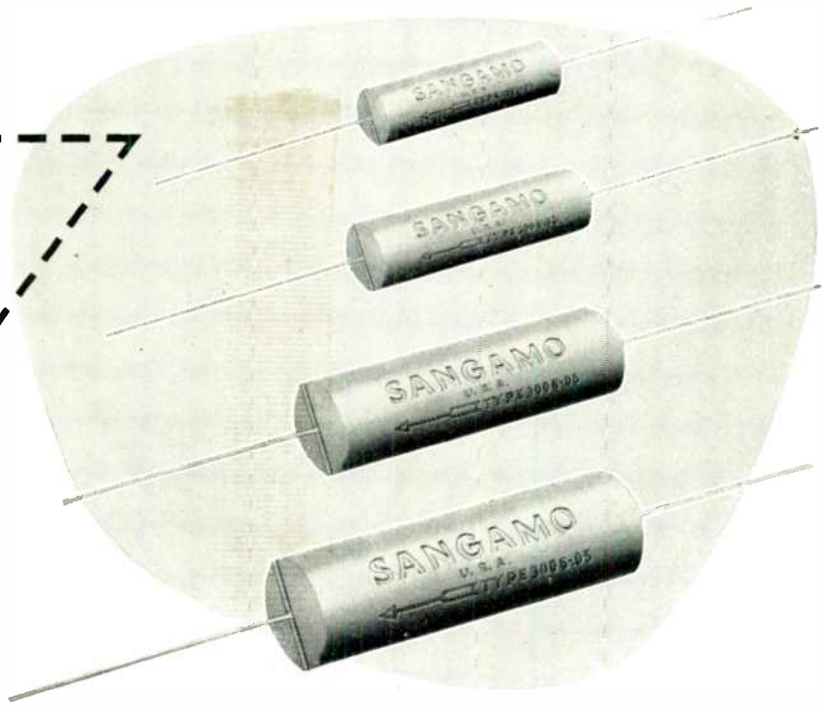
AKRON				
	SEE Proposed Decisions			
ALLIANCE				
*WFAH	Review Pub Co	101.7	1	P
ASHLAND				
*WATG	Beer & Koehl	101.3	10.2	P
ASHTABULA				
WICA-FM	WICA Inc	103.7	48	P

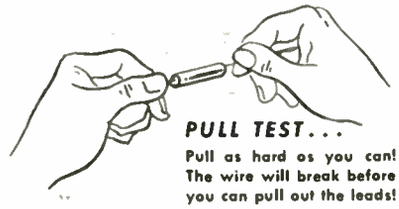
TESTS PROVE IT



FLAME TEST...
Burn it with a match! It won't harm this capacitor—no wax to run . . . nothing to burn.

WATER TEST...
Dip it in boiling water! Try this too, with an ordinary wax tubular. Then test both.





PULL TEST...
Pull as hard as you can! The wire will break before you can pull out the leads!

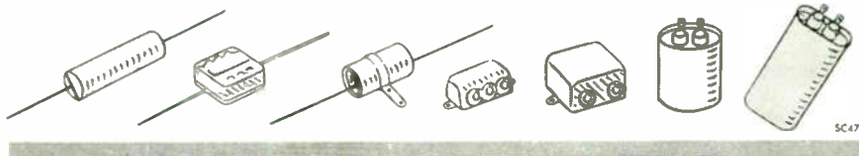
SANGAMO Type 30 *Plastic Molded Paper Tubular Capacitors are Definitely Superior!*

The surprising tests pictured above clearly demonstrate the ability of the Sangamo Type 30 Molded Paper Tubular Capacitors to deliver better performance and greater dependability under usual service conditions. Sangamo is *first* to develop paper tubulars —molded, like micas, in a thermo-setting plastic! The same advantages gained by molded micas are now available in these new plastic molded paper tubulars: capacity values are permanently sealed in —moisture is sealed out; the life of these capacitors is prolonged; no way to melt at higher temperatures; and their molded case resists damage to the cartridge. These advantages mean better characteristics, longer life and more dependable performance.

Sangamo Plastic Molded Paper Tubular Capacitors are readily applicable wherever ordinary paper capacitors are used—they can even be applied at higher temperatures! They are economical too—since they give longer life and more satisfactory performance.

Radio service men will readily appreciate the many improvements embodied in the *new* Sangamo Type 30 Capacitors. *They are definitely superior.*

Write for the new Sangamo Capacitor Catalog



SANGAMO
ELECTRIC COMPANY
SPRINGFIELD • ILLINOIS

ATHENS				
WAMS	The Messenger Pub Co	107.3	16.5	P
BELLAIRE				
WTRF-FM	Tri-City Bcstg Co	100.5	20	P
CANTON				
WAND-FM	P. C. Wilson	92.5	14	P
*WCMW-FM	Stork Bcstg Corp	94.9	15	P
WHBC-FM	Ohio Bcstg Co	94.1	25	P
CHEVIOT				
*WVAW	Suburbon Bcstg Inc	96.7		G
CINCINNATI				
*WCTS	Cincinnoti Times Stor	101.9	12.6	P
*WLWA	The Crosley Corp	101.1	9	P
WSAI-FM	Buckeye Bcstg Co	102.7	16	P
WCPO-FM	Scripps-Howard Radio	105.1		G
	Cinnco Bcstg Co	104.3		G
CLEVELAND				
	SEE olso Propased Decisions			
*WBOE	Bd. of Educotian	90.3	10	P
CLEVELAND HEIGHTS				
WSRS-FM	Somuel R. Sague	95.3	1	P
COLUMBUS				
*WELD	Radia Ohio Inc	97.1	20	
*WELD	Radia Ohio Inc	97.1	60	P
WHKB	United Bcstg Co	98.7	26	P
WVKO	Sky Woy Bcstg Co	94.7		G
	The Crosley Corp	96.3	17	P
WRFD-FM	Peoples Bcstg Corp	97.9		G
WECI	Copital Radio Inc	93.1		G
WCOL-FM	The Pixley's	92.3	33	P
DOVER				
WTUS	The Tuscora Bcstg Co	107.1	0.7	P
ELYRIA				
	SEE Proposed Decisions			
FINDLAY				
WFIN-FM	Findlay Radio Co	100.5	8.2	P
FOSTORIA				
*WFOB	Lowrence W. Harry	105.5	0.45	P
FREMONT				
*WFRO	Robert E. Wolf Co	99.3	0.3	P
HAMILTON				
WMOH-FM	Ft. Homilton Bcstg Co	103.5	8.7	P
LAKEWOOD				
WLAL	United Goroge & Serv.	100.1	0.25	P
LIMA				
WNXC	NW Ohio Bcstg Co	102.1	20	P
WLOK-FM	Ft. Industry Co	103.3		G
MARION				
WMRN-FM	The Morion Bcstg Co	106.9	2.3	P
NEWARK				
*WCLT	Advocate Print. Co	100.3	8.5	
PAINESVILLE				
	William H. Miller	101.7		G
PORTSMOUTH				
WPAY-FM	The Scioto Bcstg Co	104.1	7	P
RAVENNA				
WKRV	Record Pub Co	92.1		G
ROSCOE				
	Cashocton Bcstg Co	103.1		G
SPRINGFIELD				
*WJEM	Champion City Bcstg	103.9		G
STEUBENVILLE				
*WSTV-FM	The Volley Bcstg Co	103.5	2	P
TIFFIN				
*WTFM	Joy R. David	98.3	0.45	P
TOLEDO				
*WSPD-FM	Fart Industry Co	101.5	20	P
*WTRT	Unity Corp Inc	99.9		G
WEAL	Ohio-Mich. Bcstg Corp	107.9	20	P
WTOL-FM	Community Bcstg Co	104.7	20	P
WTDS	Toledo School Dist.	91.3	0.8	P
WARREN				
*WRRN-FM	Nied & Stevens	107.9	3.2	P
WOOSTER				
*WWST-FM	Wooster Repub. Print.	104.5	13	P
YOUNGSTOWN				
*WFMJ-FM	WFMJ Bcstg Co	105.1	50	P
*WKBN-FM	WKBN Bcstg Corp	98.9	19	P
ZANESVILLE				
	SE Ohio Bcstrs Inc	107.7		G

OKLAHOMA

ARDMORE				
KVSO-FM	John F. Easley	93.7	8.2	P
CLINTON				
KOAK	W. Oklohoma Bcstg Co	107.5		G
DURANT				
KSEO-FM	Democrat Print. Co	107.3	2.9	P
ENID				
KCRC-FM	Enid Radiophone Co	102.7		G
LAWTON				
	Okla. Quolity Bcstg	101.3		G
MUSKOGEE				
*KMUS	Muskogee Bcstg Co	101.5	6.5	P
*KBIX-FM	Okla. Press Publ. Co	98.5	9.7	P
NORMAN				
KOKU	State Univ. of Oklo.	90.9	7	P
OKLAHOMA CITY				
*KOCY-FM	Plaza Court Bcstg Co	94.7	176	P
*WKY-FM	WKY Radiophone Co	98.9	190	P
*KTOK-FM	KTOK Inc	104.3		G
*KOMA-FM	KOMA, Inc	105.9	190	P
KSUW	Sooner Bcstg Co	101.9	33	P
KOKH	Oklo. City Bd. of Edcu	90.1	0.7	P
OKMULGEE				
	Donald W. Reynolds	93.5	0.41	P
SHAWNEE				
KGFF-FM	KGFF Bcstg Co	97.5	7.8	P
STILLWATER				
KSPI-FM	Stillwoter Pub Co	93.9	3.1	P
KOAG-FM	Oklo. A & M College	91.7	42	P
TULSA				
KFMJ-FM	Fred Jones Bcstg Co	98.1	34	P
*KTUL-FM	Tulso Bcstg Co	97.1	170	P
*KAKC-FM	Public Rodio Corp	95.5	8.2	P
KIHE	W. Centrol Bcstg Co	99.5	185	P
*KWGS	Univ. of Tulso	90.5	1	P

OREGON

ALBANY				
KWIL-FM	Centrol Wilomette Bcstg	101.7	0.71	P
ASHLAND				
KSBO	Siskiyou Bcstg Co	103.1	0.27	P
EUGENE				
KORE-FM	Eugene Bcstrs Sto	104.7		G
KUGN-FM	Volley Bcstg Co	99.1	8	P
KRVM	School Dist. #4	90.1	0.4	P
GRANTS PASS				
KGPO	S. Oregon Bcstg Co	96.9	2.2	P
MEDFORD				
KMED-FM	Mrs. W. J. Virgin	105.1	0.95	P
KYJC-FM	Medford Printing Co	92.7		G
PORTLAND				
KALE-FM	KALE, Inc	98.7	220	P
KEX-FM	West'ghouse Rodio Sta	92.3	56	P
*KGW-FM	Oreganion Pub Co	100.3	51	P
KOIN-FM	KOIN, Inc	101.1	210	P
*KPFM	Bcstrs Oregon Ltd	97.1	1.53	P
*KPRA	Poc. Rodio Adv. Ser.	95.5	3.2	P
KXL-FM	KXL Bcstrs	103.5	39.9	
	Hinson Boptist Church	104.3		G

PENNSYLVANIA

ALLENTOWN				
*WSAN-FM	Lehigh Volley Bcstg	99.9	8	P
*WFMZ	Penn-Allen Bcstg Co	95.9	1	P
WKAP-FM	Allentown Bcstg Co	100.7	9	P
ALTOONA				
WFBG-FM	The Goble Bcstg Co	103.7	3.9	P
WAPJ	Altoono Bcstg Co	96.5		G
BETHLEHEM				
*WGPA-FM	Bethlehems Globe Pub	95.1	10	P
WEST-FM	Assoc. Bcstrs	107.9	16	P
BRADFORD				
WESB-FM	Brodford Publicotions	97.5	2.7	P
BUTLER				
WBUT	Eagle Printing Co	103.9		G
WISR-FM	Butler Bcstg Co	97.7	0.66	P
CLEARFIELD				
WCLR	Airplone & Morine Ins	99.1	7.4	P
DU BOIS				
WCED-FM	Tri-County Bcstg	102.1	6	P
EASTON				
WEEX	Easton Pub Co	98.3	1	P
ERIE				
*WERC-FM	Presque Isle Bcstg	99.9		G
	WLEU Bcstg Co	97.9	20	P
HARRISBURG				
*WHP-FM	WHP, Inc	97.3	4	P
*WABX	Horold O. Bishop	100.9	0.107	P
HAZELTON				
WAZL-FM	The Hozelton Bcstg	93.9		G
JOHNSTOWN				
WJKT	WJAC Inc	95.5	2.2	P
WARD-FM	Centrol Bcstg Co Inc	105.3	14	P
LANCASTER				
*WLAN-FM	Peoples Bcstg Co	96.9	20	P
*WGAL-FM	WGAL Inc	101.3	16	P
LEBANON				
WLNP	Rodio Lebanon FM & T	104.1		G
WLBR-FM	Lebonon Bcstg Co	100.1		G
LEWISTON				
WMRF-FM	Lewiston Bcstg Co	97.9	2.25	P
McKEESPORT				
*WMCK-FM	Mon-Yough Bcstg Co	104.9	0.5	P
MEADSVILLE				
WNJD	H. C. Winslow	100.3	3.5	P
NEW CASTLE				
WKST-FM	WKST Inc	101.1	9.2	P
NORRISTOWN				
	Raholl Bcstg Co	92.1		G
OIL CITY				
WDOE	The Derrick Pub Co	98.5	20	P
WKRZ-FM	K. E. Rennekomp	105.9	6.5	P
PHILADELPHIA				
*WPEN-FM	Wm. Penn Bcstg Co	98.1	20	
WIP-FM	Penn. Bcstg Co	93.3	18	
WIBG-FM	Seo'brd. Rodio Bcstg	94.1	17	P
*WCAU-FM	Phil. Record	102.9	20	
*KYW-FM	West'ghouse Rodio Sto	92.5	20	
*WFIL-FM	Triongle Pub Co	102.1	20	
WUSE	Unity Bcstg of Po.	103.7	20	P
	WDAS Bcstg Sto Inc	96.5		G
WHAT-FM	Independence Bcstg	105.3	20	P
WFLN	Fronklin Bcstg Corp	106.1	20	P
WJUN	Junto, Inc	91.7	20	P
PITTSBURGH				
*KDKA-FM	West'ghouse Rodio Sta	92.9	6.5	
*WMOT	WWSW, Inc	94.5	20	
WCAE-FM	WCAE Inc	96.1	12	P
KQV-FM	Allegheny Bcstg Corp	98.1	20	P
WKJF	W. Va. Rodio Corp	93.7	20	P
WJAS-FM	Pittsburgh Rodio Sup.	99.7	20	P
WPIT-FM	Liberty Bcstg Co	101.5	20	P
POTTSVILLE				
WPPA-FM	Pottsville Bcstg Co	101.9	2.8	P
WPAM-FM	Miners Bcstg Ser	95.5	5.1	P
READING				
WEEU-FM	Hawley Bcstg Co	92.9	9	P
SAYRE				
WCKA	Soyre Printing Co	96.7		G
SCRANTON				
WGBI-FM	Scranton Bcstrs	101.3	7.5	P
WARM-FM	Union Bcstg Co	105.7	6	P
WQAN-FM	The Scronton Times	92.3	7.2	P
	Summit Corp	93.7	3	P
	Radio Anthrocite Inc	96.1		G
SHAMOKIN				
WANR	Shroyer Radio Corp	107.1		G
WISL-FM	Radio Anthrocite Inc	102.9		G
SHARON				
*WPIC-FM	Sharon Herald Bcstg	102.9	26	P
STATE COLLEGE				
*WEHR	Penn. Stote College	90.9	35	P
STROUDSBURG				
	Pocono Bcstg Co	96.7		G
SUNBURY				
WKOK-FM	Sunbury Bcstg Corp	94.1	4.4	P
UNIONTOWN				
WMBS-FM	Fayette Bcstg Corp	105.7	1.5	P
WNIQ	Uniontown Newspops	106.5	1.1	P
WASHINGTON				
	Woshington Bcstg	104.3		G
WEST CHESTER				
WWCH	State Teachers Coll.	91.3	2.4	P
WILKES BARRE				
*WBRE-FM	Lewis G. Boltimore	98.5	2.2	P
*WIZZ	Scranton-Wilkes-Borre			
	Pittson Bcstg Co	103.3	2.5	P
WILK-FM	Wyoming Volley Bcstg	107.3		G
WILLIAMSPORT				
WRAK-FM	WRAK, Inc	100.3	3.2	P
	Lycoming Cty. Bcstg	105.1		G
YORK				
*WSBA-FM	Susquehanna Bcstg Co	103.3	20	P
WRZE	White Rose Bcstg Co	98.5	8	P
WNOW-FM	The Helm Cool Co	105.7		G

PUERTO RICO

RIO PIEDRAS				
	P. R. Commun. Author.	92.3		G
SAN JUAN				
WSJN	Rodio Americos Corp	97.7	0.33	P
	Martinez-Rodrigues Bcstg	99.9		G

RHODE ISLAND

PAWTUCKET				
WFCI-FM	Powtucket Bcstg Co	101.5	20	P
PROVIDENCE				
WJAR-FM	The Outlet Co	95.5	20	P
WPRO-FM	Cherry & Webb Bcstg	92.3	20	P
WEAN-FM	Yonkee Network Inc	94.1	19.8	P
WLIV	Coloniol Bcstg Co	107.7	7.7	P
WPTL	Providence Bible Inst.	91.5	2.5	P

SOUTH CAROLINA

ANDERSON				
*WCAC	Wilton E. Holl	101.1	33.2	P
CHARLESTON				
*WTMA-FM	Atlontic Coost Bcstg	95.1	49	P
WCSC-FM	John M. Rivers	96.9	36	P
COLUMBIA				
WISP	Surety Life Ins. Co	94.5	150	P
FLORENCE				
WHUH	George M. Hughes	94.1		G
WOLS-FM	Florence Bcstg Co	106.1		G
GREENVILLE				
WFBC-FM	Greenville News	93.7	160	P
*WMRC-FM	Textile Bcstg Co	94.9	79	P
WVGS	Greenville Bcstg Co	92.5		G
GREENWOOD				
WCRS-FM	Grenco Inc	95.7	6.5	P
LANCASTER				
WLSC	Lancoster Bcstg Co	107.3	9.4	P
NEWBERRY				
WKDK-FM	Newberry Bcstg Co	97.1		G
ROCK HILL				
WRHI-FM	York County Bcstg	97.5		G
SPARTANBURG				
WORD-FM	Sporton Rodio/Bcstg Co	100.5	14	P
*WSPA-FM	Sportonburg Adv. Co	98.9	262	P

SOUTH DAKOTA

SIOUX FALLS				
KTJW	Tri-State Bcstg Co	97.3		G
KELO-FM	Midcontinent Bcstg	102.9		G

TENNESSEE

BRISTOL				
*WOPI-FM	Radiophone Bsctg Sta	96.9	10.4	
CHATTANOOGA				
*WAPO-FM	WAPO Bcstg Ser	95.7	37.2	P
WDOD-FM	WDOD Bcstg Co	96.5	42	P
WVUN	Unity Bcstg of Tenn	98.1	4.2	P
WAGC-FM	Tenn. Volley Bcstg	101.1	37	P
CLARKSVILLE				
WCLC	Leaf Chronicol Co	106.7	3.1	P
WJZM-FM	Campbell & Sheftall	101.9	2.1	P
CLEVELAND				
WBAC-FM	Robert W. Rounsoville	92.1		G
JACKSON				
*WTJS-FM	Sun Pub Co Inc	100.7	48	P
WJKX	Jackson Bcstg Co	104.7	12	P
JOHNSON CITY				
WJHL-FM	WJHL Inc	100.7	9.7	P
KINGSPORT				
WKPT-FM	Kingsport Bcstg Co	98.5	44	P
KNOXVILLE				
WKPB	Knoxville Pub Co	93.3	20	P
*WROL-FM	S. E. Adecock	97.3	76	P
	Scripps-Howard Rodio	103.7		G
WBIR-FM	Rodio Sto WBIR	100.3		G
MEMPHIS				
WPLO	WMPS Inc	97.9	186	P
WHHM-FM	WHHM Bcstg	106.9	49	P
*WMC-FM	Memphis Pub Co	99.7	515	P
WMFA	Rodio Bcstrs Inc	97.1	37	P
WREC-FM	Hoyt B. Wooten	102.7		G
WMFI	Fonny B. Wilson	104.3		G
NASHVILLE				
WSIX-FM	WSIX Bcstg Stotion	97.5	65	P
*WSM-FM	Nat'l Life & Acc. Ins	103.3	8.5	
WNYS	Nashville Radio Corp	107.5		G

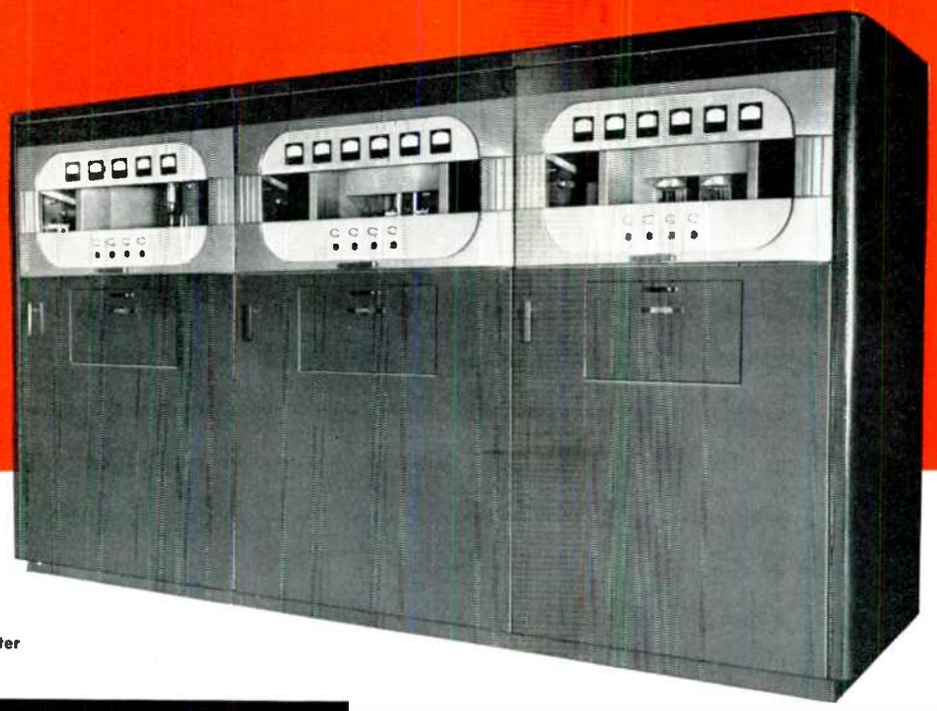
TEXAS

ABILENE				
*KR8C-FM	Reporter Bcstg Co	96.9	46	P
	Citizens Bcstg Co	98.3		G
AMARILLO				
KGNC-FM	Plains Radio Bcstg Co	104.3	50.4	P
KFDA-FM	Amarillo Bcstg Corp	100.3	3.2	P
KVAI-FM	Plains Empire Bcstg	93.1		G
AUSTIN				
KTBC-FM	Texas Bcstg Corp	92.3		G
KNOW-FM	Frontier Bcstg Co	95.5		G
BEAUMONT				
*KRIC-FM	KRIC, Inc	99.5	19	P
	Beaumont Bcstg Corp	93.3		G
BELTON				
KMHB	Mory Hardin-Bayler Col	97.1	2.9	P
BROWNSVILLE				
KVRO	Brownsville Herold	107.1		G
COLLEGE STATION				
*KAMT	A & M College of Tex	94.1	2.8	P
DALLAS				
KRLD-FM	KRLD Radio Corp	92.5	46	P
*WFAA-FM	A. H. Belo Corp	97.9	43	P
KIXL-FM	Variety Bcstg Co	104.5	34	P
WRR-FM	City of Dallos	101.1	59	P
KSKY-FM	Sky Bcstg Serv.	106.9		G
DENTON				
KDNT-FM	Harwell V. Sheppord	106.1	3.1	P

(Continued on poge 54)

Collins

Dependability in FM



The Collins 734A
10,000 watt FM
Broadcast Transmitter

Built for Continuous Performance

Operating reliability and efficiency are your assurance of economical operation. In Collins FM transmitters each stage has been carefully designed for maximum efficiency. The requirements of every component were determined and generous safety factors allowed. You can depend on a Collins transmitter to give you continuous efficient performance.

Lasting Economy

The 10 kw 734A (shown above) consists of three basic units—a model 731A 250 watt exciter unit, a 3 kw intermediate amplifier, and a 10 kw grounded grid amplifier. The economy of thorough engineering is apparent both in the moderate initial cost and in the low operating expense. Each stage functions with high efficiency, thus a minimum number of stages is required. Only 33 tubes are utilized in the entire transmitter, *with only ten different tube types.* Low maintenance costs are assured by the use of highest quality components operated conservatively.

Advanced Circuit Design

Frequency stability is within ± 250 cps. All circuits are metered. Exciter, intermediate amplifier and power amplifier stages utilize motor tuning. Forced air ventilation is provided for each cabinet. The vertical chassis can be tilted forward for servicing the rear side. Fuseless circuit protection is provided in both a-c and d-c power channels.

Distortion is less than 1.5% at 100% modulation over the range of 50-15,000 cps. The frequency response is flat within 1.0 db over the same range.

Twenty-five or fifty kw operation is accomplished simply by adding amplifier bays. Write us for a complete, descriptive bulletin giving detailed information.

NATIONAL RADIO WEEK, OCTOBER 26—NOVEMBER 1

FOR THE BEST IN FM, IT'S . . .

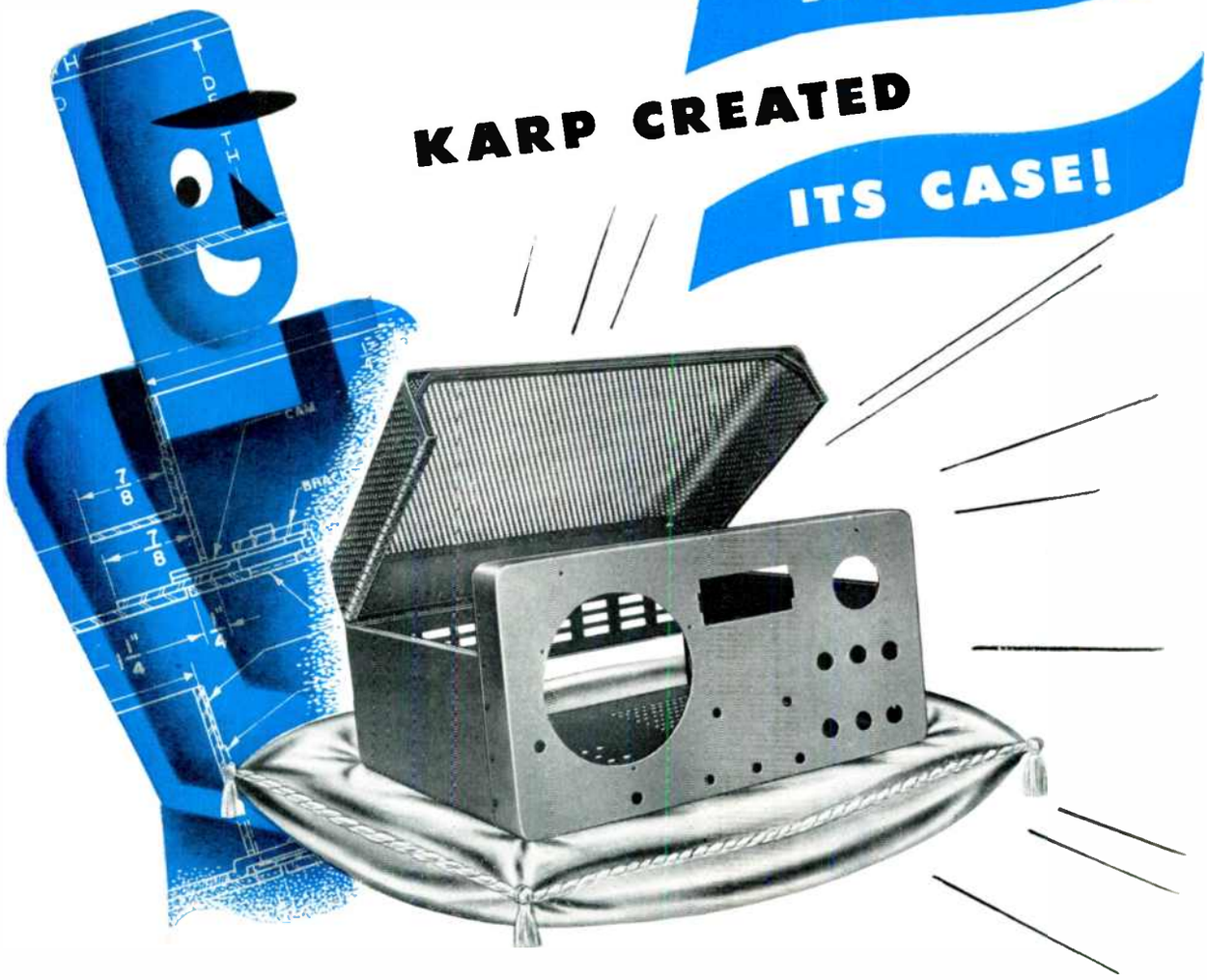
COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 West 42nd Street, New York 18, N. Y. **458 South Spring Street, Los Angeles 13, California**

HALLICRAFTERS CREATED A JEWEL

KARP CREATED ITS CASE!



THE HALLICRAFTERS SX-43 RECEIVER is being hailed as another great advancement in communications equipment. We're glad of the part we have contributed to its success by fabricating a cabinet worthy to house this superior apparatus.

You can be sure there's a reason when manufacturers of exacting standards come 1000 miles and more for cabinets, housings and enclosures by Karp The big reason is that Karp-constructed cabinets not only enhance the appearance and market value of equipment, but afford real long-run economy as well.

Karp cabinets are so painstakingly, so uniformly constructed that they save you time and money by their ease of assembly in your plant. Show us your blueprints. Get our quotations. Write for new brochure.

Any Metal • Any Gauge • Any Specification • Any Quantity • Any Finish

KARP METAL PRODUCTS CO., INC.

126 - 30th STREET, BROOKLYN 32, NEW YORK

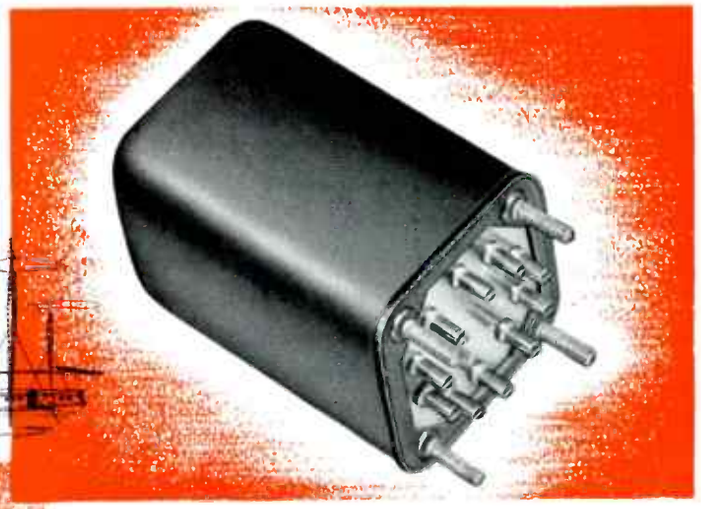
Custom Craftsmen in Sheet Metal

AUDIO TRANSFORMERS *for* UNIFORM RESPONSE LOW DISTORTION IN 3 FREQUENCY RANGES

Write for Catalog showing complete new stock line

Full Frequency Range

30 to 15,000 Cycles, provides uniform response over this entire band with ± ½ db up to 10 watts of audio power, within ± 1 db over 10 watts. Standard RMA impedances. Hum balancing coil structures and nickel alloy shielding. Included are Input, Output, Driver, and Modulation Transformers; Modulation Reactors. *Sealed in Steel* construction, stud mounting, with pin-type terminals.



Public Address Range

50 to 10,000 Cycles, frequency response within ± ½ db up to 10 watts of power, within ± 1db over 10 watts, throughout this range. Secondary impedances match 600 and 150-ohm lines, 16, 8 and 4-ohm reproducing systems. Listed are Driver and Output Transformers. *Sealed in Steel* construction, flange mounting, with solder lugs or wire leads.

Communications Range

200 to 3,500 Cycles, affords response with variations not exceeding ± 1 db over the range of voice frequencies. For use with 600 or 150-ohm lines. Input, Output, Driver and Modulation Transformers offered. *Sealed in Steel* construction, flange mounting, with wire leads or solder lugs.

CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

3501 ADDISON STREET • CHICAGO 18, ILLINOIS

FCC REVIEW OF PROGRESS

(CONTINUED FROM PAGE 20)

there were 66 FM stations in operation. Today there are 278. 700 additional ones have been authorized.

Friday night the Commission's Vice Chairman, Commissioner Paul A. Walker, speaking before the FM Association in New York, reaffirmed our faith in FM broadcasting.[1] I will not repeat the points which he made there, but there is one thing I would like to emphasize.

There is a spot on the horizon which AM broadcasters will be well-advised to note. It is the Continental Network. This is a network of 27 FM stations. For the most part these stations are not tied together by wire. One FM station picks up from the air and rebroadcasts the programs of another station. The rebroadcast signal is again picked up at a point farther down the line and again retransmitted.

This FM network will grow, and still others like it will spring up.

Here may be a clew to what the FM service of the future will look like. We may, in the not-too-distant future, have FM sets with, say, 10 push buttons which could be marked as follows: the first four would bring you on FM the programs of the established nationwide networks. (I know that this depends on Mr. Petrillo and the four networks getting together, but I hope this can be done in the near future.) The next two buttons might bring you via FM the programs of established independents.

But the last four buttons could bring you something entirely new to the aural radio art. For example, Button 7 might be labelled "Classical Music" and bring you an FM network joined together by direct radio pickup. Any hour of the day or night when you want good music you would only have to push this button.

Button 8 might be labelled "Dance Music" and would bring you popular tunes at any hour of the day or night.

Button 9 might be labelled "Features" and could bring women's programs, children's programs and other attractions.

The last button might be simply marked "News" and by pushing it you would get a 15-minute news summary at any hour.

If FM should take this trend it would bring us within sight of the long-sought goal of giving the radio listener what he wants when he wants it.

Again I urge AM broadcasters who have not applied for FM to reexamine their position.

Television ★ Last year I told you that, in our judgment, television is destined to become the greatest mass communication medium of them all. Psychologists have established that we learn 9 times faster through the eye than through the ear. The potentialities of visual broadcasting are unlimited. Television magnifies many times the power of radio to instruct, to entertain, and to sell.

A good base has been laid upon which to build a sound television system.

Here is the television picture as of today: 12 stations are operating in 8 cities. Fifty-six more stations are authorized and under construction, and when these are built 41 cities will have television.

Receivers are now coming off the production lines at a rate of 11,000 per month. I am told that they are being bought as soon as they reach the dealers' shelves. Transmitting equipment can now be procured without unreasonable delay.

Where do we go from here? Are only 41 American cities to have a monopoly on television? Pictures of television sets are appearing in magazines that circulate throughout the land. Soon the good people of Memphis, Birmingham, Kansas City, Denver, Atlantic City, and a hundred other cities are going to start asking: "When do we get television?"

It is our clear duty — yours and mine — to do everything within our power to see that this new service reaches the maximum number of American communities.

To this end we earnestly solicit your suggestions as to what can be done to bring television to a greater number of American homes. We are anxious to mold our policies so as to facilitate your entry into this field.

(CONTINUED ON PAGE 50)

[1] The full text of Commissioner Walker's address appears on page 21 of this issue.

FCC REVIEW OF PROGRESS

(CONTINUED FROM PAGE 49)

What are the barriers that today stand in your way? For the most part they are economic. Many of you, while willing to plow into television a reasonable share of your returns from AM broadcasting, have found that you just cannot afford it. Among other things, you would have to provide a transmitter, an antenna, cameras, a film pickup, and studios. And more costly still, you would have to arrange for the origination of programs.

Suppose it could be arranged for you to enter television simply by installing a transmitter and an antenna. Suppose, instead of building studios and buying cameras and a film pickup for the origination of programs of your own, you could, initially at least, rely upon a network for program service? In those areas which today are not traversed by coaxial cables and where no network television service is available, suppose one station in a large community could do the programming and distribute it to transmitters that you would build in smaller adjacent communities and link to the key transmitter by radio relay? Several stations in different communities might share a common central studio or a mobile pickup unit and move it from place to place for the origination of programs.

Thus, little clusters of television stations might be spawned in various parts of the country. Then, as the coaxials and microwave relays reach across the nation, these little networks might be joined together and a nationwide television service would emerge.

In this way television might be nursed through the tender period of its infancy. Once there was sufficient economic support, licensees would be expected to acquire their own cameras and studios so as to make possible the origination of television programs in their own communities.

Surely this would be a radical departure from the present plan as we have known it in aural broadcasting. But perhaps a radical departure is necessary if we are to fulfill our obligation to bring television service to homes throughout this country. At least these ideas appear to me to be worthy of consideration and we would like to have your views as to what can be done.

International Broadcasting ★ At the Atlantic City conferences we have become acquainted in some detail with the plans of the rest of the world in the field of international broadcasting. With but one exception, the nations are expanding their activities in this field. Unfortunately, the one exception is the United States of America. We have been reducing our international broadcasting at a rapid rate. At the beginning of the war, we had 13 shortwave transmitters in this country

(CONCLUDED ON PAGE 51)

FCC REVIEW OF PROGRESS

(CONTINUED FROM PAGE 50)

which were used principally for programs to South America and Western Europe. During the war, after the Government entered the field, we had over 40 transmitters in operation. By 1944 we were broadcasting over 1,000 hours of programs per week in 40 languages and dialects. The Voice of America was beaming programs to every corner of the earth.

Then began the downward spiral. A year ago our programming had declined to 432 program hours per week in 21 languages. Today our operation has been reduced to 232 program hours per week. The United States now occupies a poor third place in international broadcasting. The Voice of America has become a whisper.

Now, in speaking to you about this situation I am, of course, aware that of the 2,000 broadcasters at this meeting, only 7 hold shortwave licenses. Nevertheless, as broadcasters you have a duty even above and beyond your duty as citizens to take steps to insure that the United States plays its proper rôle in this important field.

The swift march of events has placed upon our country a heavy responsibility in world affairs. We must prove equal to the task. The world wants to know what America is doing; what America is thinking. We must make known our way of living, our system of government, and the policies which guide our international affairs.

We here have an obligation to do everything within our power to strengthen the Voice of America. The voice that reaches out from our shores must be firm and clear. It must speak the truth in all the basic tongues of mankind. It must be heard throughout the world. The Voice of America must play its part in the fulfillment of the prophecy that "Nation shall speak peace unto nation."

FM AS NEW DEAL

(CONTINUED FROM PAGE 21)

I congratulate the organizers of this Continental Network for their splendid job of pioneering. I hope that other groups over the country will be inspired to set up similar networks.

4. We must remember that the public acceptance already accorded FM has been without benefit of the popular live musical programs of the established AM networks. It is alleged that this has been because of the controversy between the networks and the American Federation of Musicians. To me, it is unthinkable that something constructive cannot be done so that this controversy can be solved in the very near future. Duplication of programs will be a substantial aid to FM.

However, I do not agree that the whole future of FM turns on duplication. I think that FM broadcasters should proceed to develop programs specifically for

(CONCLUDED ON PAGE 52)

(Continued from page 44)

EDINBURG				
KURV-FM	James C. Looney	104.9	0.69	P
EL PASO				
KIDE	Independent School	91.7	2.15	P
FORT WORTH				
WBAP-FM	Carter Pub Inc	100.5	50	P
KFTG	Lone Star Bldg	105.3	15	P
KTSN	Tarront Bcstg Co	96.3		G
GALVESTON				
KLUF-FM	The Klub Bcstg Co	98.7	9.2	P
GOOSE CREEK				
KREL-FM	Tri-Cities Bcstg Co	92.1	1	P
HARLINGEN				
KVKO	Valley Pub Co	98.3		G
*KGBS-FM	Horbenito Bcstg Co	94.7	9	P
HOUSTON				
KUHF	Univ. of Houston	91.7	9.6	P
*KPRC-FM	Houston Post Co	102.9	57	P
*KTRH-FM	KTRH Bcstg Co	101.1	350	P
KCOH-FM	Lee Segol Bcstg	105.1	46	P
*KOPY	Texas Stor Bcstg	97.9		G
KXYZ-FM	Harris Cnty Bcstg Co	96.5	177	P
KHCO	Earl C. Honkomer	106.1		G
LAREDO				
KPAB-FM	Laredo Bcstg Co	96.5		G
LONGVIEW				
KLTI	R. G. LeTourneau	105.9	9.1	P
LUBBOCK				
KFYO-FM	Plains Radio Bcstg	99.5	13	P
	Caprock Bcstg Co	96.3		G
	Lubbock Bcstg Co	107.9		G
LUFKIN				
KRBA-FM	Darrell E. Yates	95.5	2.9	P
McALLEN				
KVMR	Valley Even. Monitor	100.9		G
ODESSA				
KECK-FM	Ector County Bcstg	97.5		G
PORT ARTHUR				
KPAC-FM	Pt. Arthur College	101.9		G
RAYMONDVILLE				
	Pryer Dillard	101.7		G
SAN ANGELO				
KGKL-FM	KGKL Inc	94.5	3.3	P
SAN ANTONIO				
*KISS	The Walmoc Co	99.5	170	P
*KYFM	Express Pub Co	101.5	330	P
*WOAI-FM	Southland Inds.	102.5	156	P
KSBL	Southern Bcstg Co	98.1	200	P
KTSA-FM	Sunshine Bcstg Co	104.1	250	P
KABC-FM	Alamo Bcstg Co	97.3		G
KSTE	Mercury Bcstg Co	94.7		G
	Raoul A. Cortez	96.3		G
	Mission Bcstg Co	92.9	48	P
TEMPLE				
KTEM-FM	Bell Bcstg Co	107.5	7	P
TEXARKANA				
*KCMC-FM	KCMC, Inc	98.1	40	P
TYLER				
*KGKB-FM	E. Texas Bcstg	101.5	4.3	P
	Rose Capitol Bcstg	97.3		G
VERNON				
KVWC-FM	NW Bcstg Co	98.7	8	P
WACO				
WACO-FM	Frontier Bcstg Co	98.7		G
WESLACO				
KRGV-FM	KRGV Inc	93.7		G
WICHITA FALLS				
*KTRN	Times Pub Co	97.3	28	P
KWFT-FM	Wichito Bcstrs	99.9	9.5	P
KWFA	Texoma Bcstg Co	94.1	9.5	P
	Wichtex Bcstg Co	106.5		G

UTAH

OGDEN				
KOPP-FM	James B. Littlejohn	103.9		G
SALT LAKE CITY				
*KDYL-FM	Intermountoin Bcstg	98.7	0.9	P
*KSL-FM	Rodio Ser. Corp of Utah	100.3	8.5	P

VERMONT

RUTLAND				
WSYB-FM	Philip Weiss Music	107.1	0.1	P

VIRGINIA

ALEXANDRIA				
*WPIK-FM	Potomac Bcstg Corp	98.3		G
ARLINGTON				
WEAM-FM	Arlington-Fairfax Bcstg	106.3		G
BRISTOL				
WCYB-FM	Appalachian Bcstg	105.3		G
CREWE				
WSVS-FM	S. Va. Bcstg Carp	104.7		G
DANVILLE				
*WBTM-FM	Piedmont Bcstg Corp	97.9	32	P
FRONT ROYAL				
WLON	Hoyle Borton Long	95.1	16	P
HARRISONBURG				
*WSVA-FM	Shenandoah Volley Bcstg	100.7	36	P
LYNCHBURG				
*WLVA-FM	Lynchburg Bcstg	97.5	3.7	P
WWOD-FM	Old Dominion Bcstg	107.9	20	P
NEWPORT NEWS				
*WGH-FM	Hompton Rds. Bcstg	96.5	38	P
NORFOLK				
*WTAR-FM	WTAR Radio Corp	97.3	33	P
WLRU	Lorus & Bros. Co	102.5	6	P
WLOW-FM	Commonwealth Bcstg	105.3		G
WCAV-FM	Cavalier Bcstg Corp	103.3		G
PORTSMOUTH				
WVOP	Portsmouth Stor Pub	98.9	32	P
*WSAP-FM	Portsmouth Radio	99.7	49	P
RICHMOND				
*WCOD	Havens & Mortin Inc	98.1	46	P
WRVA-FM	Lorus & Bros Co	94.5	25	P
WLEE-FM	T. G. Tinsley, Jr.	102.9	21	P
WRNL-FM	Richmond Radio Corp	102.1	43.7	P
WRMV	S. Bcstrs Inc	106.9		G
ROANOKE				
WDBJ-FM	Times World Corp	94.9	11.8	P
WROV-FM	Radio Roanoke Inc	103.7	3	P
WSLS-FM	Roanoke Bcstg Corp	99.1	4.7	P
SUFFOLK				
WLPM-FM	Suffolk Bcstg Carp	107.7	10.2	P
	Suffolk News Co	106.1		G
WINCHESTER				
*WINC-FM	R. F. Lewis, Jr.	92.5	13.4	

WASHINGTON

LONGVIEW				
*KWLK-FM	Twin City Bcstg Co	103.9	0.41	P
SEATTLE				
*KING-FM	Western Waves Inc	94.9	48	P
KIRO-FM	Queen City Bcstg	100.7	7.7	P
KOMO-FM	Fishers Blend Sta	98.9	4.5	P
*KRSC-FM	Rodio Sales Corp	98.1	15	P
KFMU	Luthern Church Seottle	102.9		G
TACOMA				
	Tribune Pub Co	97.3		G

WEST VIRGINIA

BECKLEY				
*WCFC	Beckley Newspops	101.3	3	P
*WJLS-FM	Joe L. Smith, Jr	99.5	31.7	P
WWNR-FM	Rohall Bcstg Co	98.1		G
BLUEFIELD				
*WHIS-FM	Daily Tel. Print. Co	104.5	186	P
CHARLESTON				
WGAZ	Doily Gazette Co	98.5		G
CLARKSBURG				
WPDX	Clorksburg Bcstg Corp	95.1		G
WBLK-FM	News Pub Co	101.9		G
HUNTINGTON				
WHTN-FM	Greater Huntington Radio Corp	100.5	53	P
WPLH-FM	Huntington Bcstg	102.5	38	P
LOGAN				
*WLOG-FM	C. Frey & R. Greever	103.3	2.3	P
MORGANTOWN				
WAJR-FM	West Vo. Rodio Corp	99.3	1	P
PARKERSBURG				
	Ohio Volley Bcstg	106.5		G
WHEELING				
*WWVA-FM	West Va. Bcstg Corp	98.7	11.3	P
WEWK-FM	Community Bcstg Inc	97.3	14	P

WISCONSIN

BELOIT				
*WBNB	Daily News Pub Co	107.3	8.7	P
DELAFIELD				
WHAD	State Radio Council	90.7	9.3	P
EAU CLAIR				
*WEAU-FM	Central Bcstg Co	94.1		G
GREEN BAY				
*WJPG-FM	Green Boy Newspaps	101.1	14.4	P
WTAQ-FM	WHBY Inc	102.5	14	P
	The Journol Co	92.3		G
GREENFIELD				
WWCF	Wm. C. Forrest	94.9	37	P
JANESVILLE				
*WJNS	Gozette Printing Co	99.9	20	P
LA CROSSE				
*WKBH-FM	WKBH Inc	93.1	76	P
MADISON				
WIBA-FM	Badger Bcstg Co	101.5	207	P
*WHA-FM	State Radio Council	91.5	9.3	P
MARSHFIELD				
WMFE	Doirylond's Bcstg Ser	103.9	1	P
MERRILL				
WLIN	Alvin E. O'Konski	101.7		G
MILWAUKEE				
WEMP-FM	Milwaukee Bcstg Co	94.1	35	P
WMAW-FM	Midwest Bcstg Co	102.1	31	P
*WTMJ-FM	The Journol Co	93.3	20	P
WISN-FM	Hearst Radio Inc	102.9	310	P
WMIL	Myles H. Jones	95.7		G
NEENAH				
	Neenoh-Menasha Bcstg	98.5	9.4	P
OSHKOSH				
WOSH-FM	Oshkosh Bcstg Co	92.9	3.5	P
RACINE				
WRJN-FM	Racine Bcstg Corp	100.7	15	P
RICE LAKE				
*WJMC-FM	WJMC Inc	96.3	4.4	P
SHEBOYGAN				
WHBL-FM	WHBL Inc	100.3	15	P
STEVENS POINT				
WSTN	Dairyland's Bcstg Ser	94.3		G
SUPERIOR				
*WDUL	Hood of the Lokes Bcstg	92.3	20	
WAUSAU				
WRAI	Record Herald Co	97.9	6.5	P
WSAU-FM	The Journal Co	95.5	46	P
WISW	Central Bcstg Co	104.7		G
WISCONSIN RAPIDS				
WFHR-FM	Wm. H. Huffmon	103.3	2.1	P
WRPO	Dairyland Bcstg Ser	99.3		G

WYOMING

CHEYENNE				
*KFBA	Frontier Bcstg Co	101.1	9.5	P

The following are proposed assignments, subject to final decisions by the FCC:

BRIDGEPORT	Harry F. Guggenhein	101.5	20	
	Horold Thomas	99.9	20	
	Bridgeport Herold	97.5	20	
DANBURY	The Fairfield Bcstg	94.3		
PATERSON	No. Jersey Bcstg Co	104.3	8	
NEW YORK	WMCA Inc	92 3	10	
	News Syndicate Co	105.1	17	
	Unity Bcstg Corp of NY	103.5	5	
	Americon Bcstg Co	95 5	6.5	
AKRON	Summit Radio Corp	97.5	20	
	Allen T. Simmons	96.5	19.5	
CLEVELAND	Clevelond Bcstg Co	98.5	15.5	
	Teloir Co	106.5	20	
	United Bcstg	100.7	20	
	Scripps-Howord Radio	102.1	20	
	WGAR Bcstg Co	99.5	20	
	U.A.W.-C.I.O. Bcstg	103.3	20	
	Notional Bcstg Co	1057	20	
	WJW, Inc	104.1	7.5	
ELYRIA	Elyrio Loroin Bcstg	104.9		

ADVERTISERS INDEX

Adair, George P.	15
Alden Products Co.	53
American Phenolic Corporation	53
Amy, Aceves & King, Inc.	15
Anderson & Merryman	14
Andrew Company	4, 14
Barone, S. A., Company	15
Bell Telephone Labs.	10, 11, 16
Bendix Aviation Corp.	46
Browning Laboratories, Inc.	41
Chicago Transformer Co.	48
Collins Radio Company	45
Commercial Radio Equip. Co.	14
Drake Mfg. Company	55
Eitel-McCullough, Inc.	13
Engineering Research Assoc., Inc.	14
Finch Telecommunications, Inc.	55
Graybar Electric Co.	10, 11, 16
Harvey Radio Labs, Inc.	*Inside Back Cover*
James Knights Company, The	15
Jansky & Bailey	14
Karp Metal Products Co., Inc.	47
Kaufman, Robert L.	14
Kear and Kennedy	15
May, Russell P.	14
McCachren, Winfield Scott	15
McIntosh, Frank H.	14
McKey, Dixie B. & Assoc.	14
McNary and Wrathall	15
Merit Coil & Transf. Corp.	6
Motorola, Inc.	*Back Cover*
National Company, Inc.	1
Pilot Radio	5
Pollack, Dale	15
Presto Recording Corp.	7
Radio Consultants, Inc.	14
Radio Engineering Labs. Inc.	9
Radio Music Corp.	3
Ray, Garo W.	14
Raytheon Mfg. Co.	2
RCA Communications, Inc.	14
Sangamo Electric Co.	43
Simpson Electric Co.	12
Stanwyck Winding Co.	55
Surprenant Mfg. Co.	46
Sylvania Electric Products, Inc.	*Inside Front Cover*
U. S. Recording Co.	14
University Loudspeakers, Inc.	54
War Assets Admin.	56
WASH-FM	52
WBEN-FM	51
WCFC	49
WELD	50
Wells Sales, Inc.	15
Western Electric Co.	10, 11, 16
WFAA-FM	51
WGHF	50
Williams, Nathan	15
Wilmotte, Raymond M.	14
Wilson, Herbert L.	14
WMRC-FM	52
Workshop Associates, The	14

Authorized WAA Electronics Distributors

EASTERN

Automatic Radio Mfg. Co., Inc.
122 Brookline Ave.
Boston, Mass.

Carr Industries, Inc.
1269 Atlantic Ave.
Brooklyn, New York, N. Y.

Tobe Deutschmann Corp.
863 Washington Street
Canton, Mass.

Electronic Corp. of America
353 West 48th Street
New York, N. Y.

Emerson Radio &
Phonograph Corp.
76 Ninth Ave.
New York, N. Y.

General Electric Co.
Bldg. 267; 1 River Road
Schenectady, N. Y.

General Electronics, Inc.
1819 Broadway
New York, N. Y.

Hammarlund Mfg. Co., Inc.
460 West 34th Street
New York, N. Y.

Hytron Radio & Electronics Corp.
76 LaFayette St.
Salem, Mass.

Johanns & Keegan Co., Inc.
62 Pearl St.
New York, N. Y.

Newark Electric Co., Inc.
242 West 55th St.
New York, N. Y.

Radio Parts Distributing Co.
128 West Olney Road
Norfolk, Va.

Smith-Meeker Engineering Co.
125 Barclay Street
New York, N. Y.

Standard Arcturus Corp.
99 Sussex Ave.
Newark, New Jersey

Sylvania Electric Products, Inc.
Emporium, Pa.

Technical Apparatus Co.
165 Washington St.
Boston, Mass.

Tung-Sol Lamp Works, Inc.
95 Eighth Ave.
Newark, New Jersey

W. & H. Aviation Corp.
Municipal Airport
Rochester, New York

MIDWESTERN

American Condenser Co.
4410 N. Ravenswood Ave.
Chicago, Ill.

Belmont Radio Corp.
3633 S. Racine Ave.
Chicago, Ill.

Electro-Voice, Inc.
Carroll & Cecil Streets
Buchanan, Michigan

Essex Wire Corp.
1601 Wall Street
Fort Wayne, Indiana

E. F. Johnson Co.
206 Second Ave., S. W.
Waseca, Minnesota

SOUTHERN

Navigation Instrument Co., Inc.
P. O. Box 7001, Heights Station
Houston, Texas

Southern Electronic Co.
512 St. Charles Street
New Orleans, La.

PACIFIC

Cole Instrument Co.
1320 S. Grand Avenue
Los Angeles, Calif.

Hoffman Radio Corp.
3761 S. Hill Street
Los Angeles, Calif.

JOBBERS
WHOLESALERS
MANUFACTURERS

You'll save—save—save when you purchase surplus electronic equipment from these Approved Distributors. They are offering electronic tubes, devices and equipment which were declared surplus by the Armed Forces. Fill your needs—*now*—while inventories still permit large purchases and wide selection.

Purchasing of this equipment has been simplified to a high degree. These WAA Approved Distributors were selected on a basis of 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".

OFFICE OF AIRCRAFT AND ELECTRONICS DISPOSAL

WAR ASSETS ADMINISTRATION

Offices located at: Atlanta • Birmingham • Boston • Charlotte
Chicago • Cincinnati • Cleveland • Denver • Detroit • Grand Prairie,
Tex. • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock, Ark.
Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York
Omaha • Philadelphia • Portland, Ore. • Richmond • St. Louis • Salt Lake City
San Antonio • San Francisco • Seattle • Spokane • Tulsa 1322

Carefully Engineered

For quality reproduction, it's FM. For quality reception of FM, it's Harvey's 193-R. Carefully engineered, built with precision components, the 193-R is FM's finest receiver. For a full technical discussion, see "FM And Television" for June, 1947, or write to Harvey for a copy of the article.

For Relaying

One microvolt sensitivity and 250 Kc. bandwidth make the 193-R an ideal relay receiver. The 193-R is used in WXHR for relaying high fidelity FM programs of the Continental Network. These programs originate in Washington, D. C. and are rebroadcast by WXHR, Harvey's station, serving Eastern New England.

For Monitoring

Characteristics:

Frequency Range: 85 to 115 Mc.

Circuit: Double Superheterodyne; I. F.'s 10.7 and 4.6 Mc.

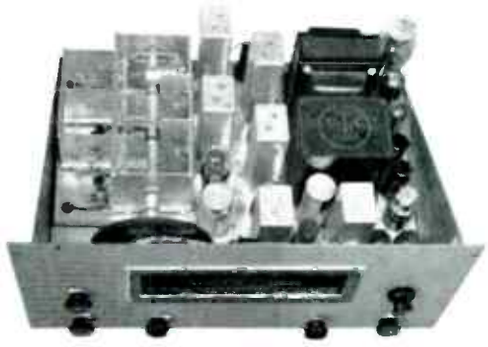
Audio: 10 to 40,000 cycles flat response and low output impedance insures good loudspeaker damping and excellent response to transients.

Sensitivity: RMA quieting signal of 1 microvolt.

Squelch Circuit: Fully electronic.

Size: Cabinet, 21½" x 10½" x 15"; Panel, 8¾" x 19" for standard rack mounting.

Model 193-R



Price: $490 f.o.b. Cambridge, Massachusetts

HAR-CAM
HARVEY OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.

443 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

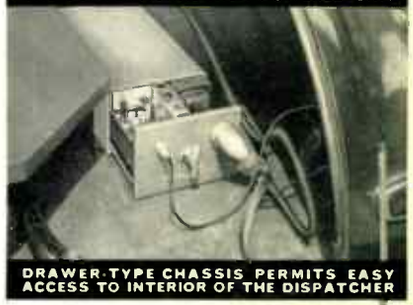
RUMFORD PRESS
CONCORD, N. H.

NEW

LOW COST—NOISE FREE 2-WAY RADIOTELEPHONE FOR URBAN AREAS

Motorola FM DISPATCHER

WITH P.S. "PRECISION" SELECTIVITY



The DISPATCHER-Another FIRST for Motorola

The Motorola DISPATCHER is a compact, single-unit mobile radiotelephone transmitter and receiver specifically designed for use in noisy urban areas. Easy to install and maintain, with exceptionally low battery drain and highest sensitivity, the Motorola DISPATCHER is the FIRST radiotelephone unit especially and effectively designed for urban communications. The DISPATCHER comes to you as a tried and proved communications tool—after two years of design and field performance testing. It's a Motorola masterpiece!

P. S. . . . "Precision" Selectivity

Now your conversations can be conducted without interference from other radiotelephones, ignition noise, sparking trolley contacts or any other electrical noises radiated in urban areas. P.S. does it—"PRECISION" SELECTIVITY—the sensational Motorola development that gives you the absolute maximum of protection against off-channel interference of *all* types.

GET THE COMPLETE STORY

WRITE for illustrated, descriptive brochure giving you all the many features and specifications of the new Motorola DISPATCHER—WRITE TODAY.

The Motorola FM HANDIE-TALKIE IS HERE!

Now you can have instant, constant communications wherever a man can go. Smaller than a brief case, easily carried in the hand, the Motorola FM HANDIE TALKIE is the eagerly awaited answer to hundreds of communications problems. *Send for descriptive booklet.*

Motorola Inc.

COMMUNICATIONS AND ELECTRONICS DIVISION

CHICAGO 51, ILLINOIS • *IN CANADA: ROGERS MAJESTIC LTD., TORONTO—MONTREAL*