PRICE FIFTY CENTS

FM AND TELEVISION

NOV. 1947

★ ★ Edited by Milton B. Sleeper ★ ★

TELEVISION FIELD EQUIPMENT

(See pages 3 and 33)

8th Year of Service to Management and Engineering

152-162 mc. Communication Equipment

With the *Power Saver* circuit

That means longer life for . . .

quick-heat tubes

Separate switches for transmitter filament and plate voltages mean less battery drain and greater tube life. This "Power Saver" circuit is only one of the examples of advanced engineering that makes Harvey 152-162 mc equipment outstanding.

RECEIVER MODEL 541

Characteristics:

Frequency Range — 152-162 mc.

Type — Crystal controlled, single conversion superheterodyne FM Receiver.

RF Stages — Two, insuring excellent sensitivity.

Single IF Amplifier — Latest design practices achieve high gain from a single IF without requiring double conversion.

Crystal Diodes — In discriminator and squelch circuits, reduce tube complement, size and weight of the unit.

Oscillator Control — Provision is made for plug-in oven-type crystal when required by operations of the equipment in extreme temperature variations.

Automatic Frequency Control — May be used where necessary for Fixed Central Stations.

Standby Drain — 6 amperes.

Power Supply — AC or DC "Plug-in" Type. No further electrical or mechanical changes required in receiver.

TRANSMITTER MODEL 542

Characteristics:

Frequency Range — 152-162 mc.

Exciter Stages — Latest miniature tubes used.

Tubes — All "Quick-heat" tubes except for Oscillator A.F. Amplifier and the single Phase Modulator.

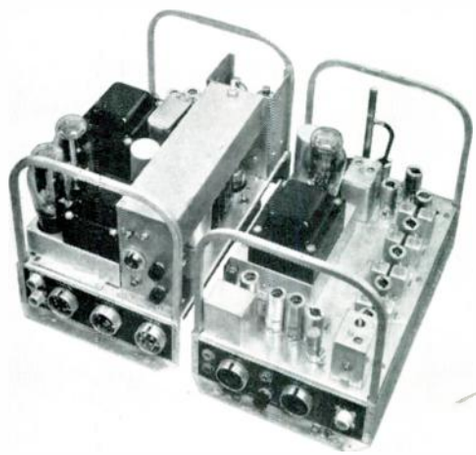
Final Amplifier — Push-pull, shielded parallel-line tank circuit, with a series-resonant link coupling circuit to antenna gives simple, effective and flexible antenna matching to mobile or fixed antennas.

Frequency Multiplication — 48 times, using "Quick-heat" tubes.

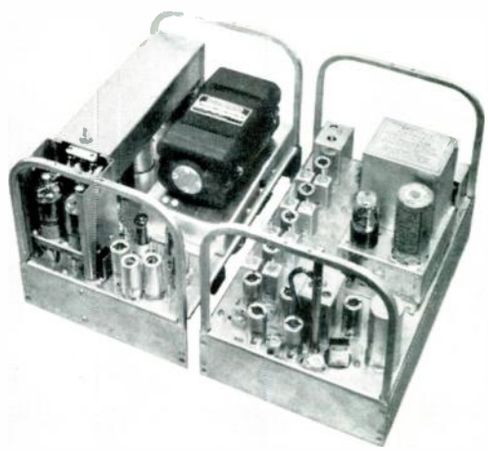
Power Output — 30 watts from AC or DC input. Standard deviation and pre-emphasis characteristics incorporated in the transmitter.

Standby Tube Drain — .45 amperes.

Power Supply — Change from AC to DC operation involves a simple tube change and "plug-in" of the DC power supply.



Transmitter (left) Receiver (right) shown with A.C. "plug-in" power supplies. (Front view.)

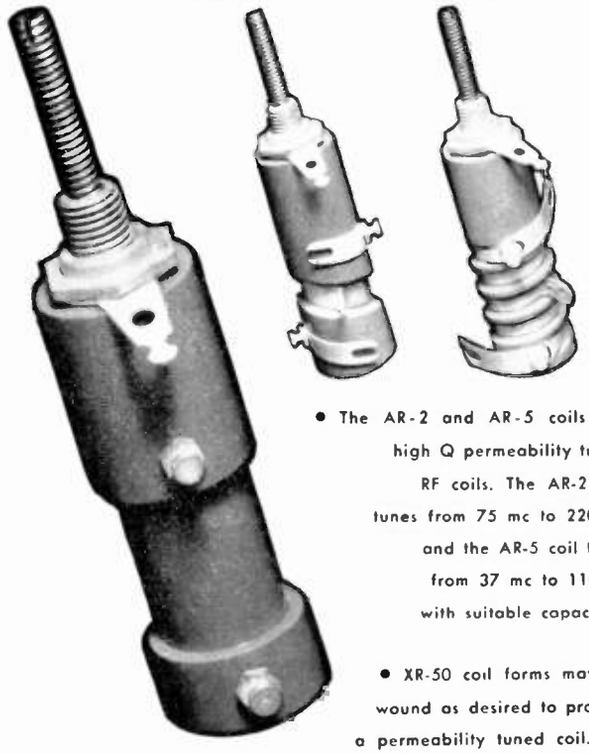


Transmitter (left) Receiver (right) shown with D.C. "plug-in" power supplies. (Rear view.)

HAR-CAM
HARVEY OF CAMBRIDGE

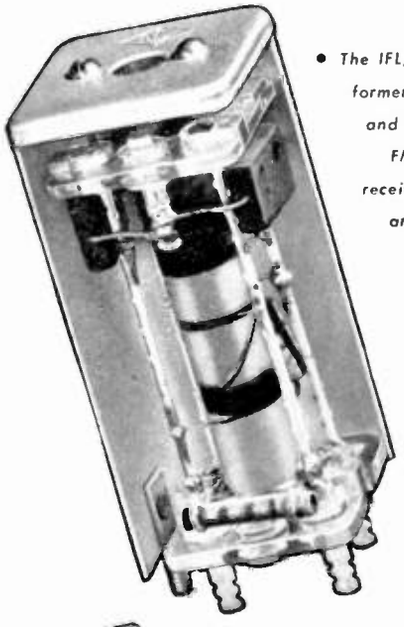
HARVEY RADIO LABORATORIES, INC.

443 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS



• The AR-2 and AR-5 coils are high Q permeability 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.

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



• *The IFL, IFM, IFN and IFO transformers all operate at 10.7 mc and are designed for use in FM or AM superheterodyne receiver. The transformer cans are 1⅜" square and stand 3⅛" above the chassis.*

• The IFL discriminator transformer is suitable for use in conventional FM receiver discriminator circuits and is linear over a band of ±100 KC.

QUALITY

PARTS . . .

TRADITIONAL

WORKMANSHIP . . .

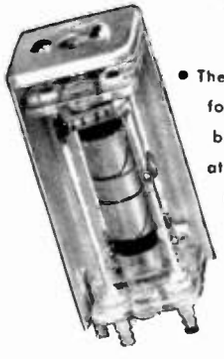
National

National parts have long been famous among manufacturers, engineers and laboratory workers for quality, workmanship, rugged construction and excellent electrical characteristics.

Through long practical experience, these men have all found that National parts can be relied upon for dependability and long life.

Whether you're building new equipment or modernizing an old installation, check your nearest National dealer for the latest in efficient parts.

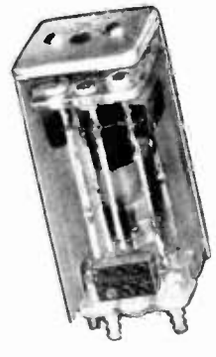
National Company, Inc.
Dept. No. 14
Malden, Mass.



• The IFM is an IF transformer with a 150 KC bandwidth at 1.5 db attenuation. Approximate stage gain of 30 is obtained when used with 6SG7 tube.

• The IFN is an IF transformer with a 100 KC bandwidth at 1.5 db attenuation. Approximate stage gain of 30 is obtained when used with 6SG7 tube.

• The IFO is an FM discriminator transformer of the ratio type and is linear over a band of ±100 KC.



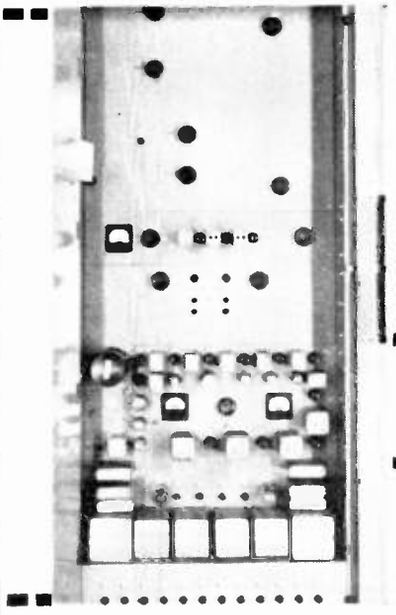
MAKERS OF LIFETIME RADIO EQUIPMENT

RAYTHEON'S 250 WATT FM TRANSMITTER

INCORPORATING THE NEW

Cascade PHASE SHIFT MODULATION

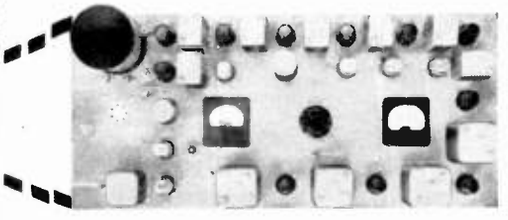
250 Watt FM Transmitter, also standard exciter unit for all higher power.



Thorough tests in actual competition with all other systems of modulation have proved the superiority of the Cascade Phase Shift Circuit—in signal quality, simplicity and dependability.

Raytheon's Cascade Phase Shift Modulation is a basically direct circuit which adds the phase shift of six simple stages to produce the required phase shift needed for high fidelity modulation—at an *inherently* lower noise level. This extremely simple circuit eliminates the major faults of other systems and brings important advantages never before possible (See features).

Carefully compare and you will buy Raytheon. *Place YOUR order now for Fall delivery.*



Above—Complete Cascade Phase Shift Modulator, Left—Front control panel of Transmitter.

YOU WILL WANT EVERY ONE OF THESE TEN IMPORTANT FEATURES . . . ONLY RAYTHEON CAN GIVE THEM TO YOU

1. **Simplified circuit design** thru the *Cascade* system gives stability and efficiency to Raytheon FM.

2. **Direct Crystal Control,** independent of modulation, gives positive and automatic control of the mean carrier frequency. No complicated electronic or mechanical frequency stabilizers are used. A single high quality crystal does the job.

3. **An inherently lower noise level** is achieved by Cascade Phase Shift Modulation which adds the phase shift of six simple stages.

4. **Very low harmonic distortion**—less than 1.0% from 50 to 15,000 CPS with 100 KC frequency deviation.

5. **Conservatively operated circuits** prolong tube life—prevent program interruptions.

6. **No expensive special tubes.** The modulator unit uses only inexpensive receiver type tubes of proven reliability.

7. **Unit construction.** There is no obsolescence to Raytheon FM Transmitters. Add an amplifier later to give the desired increase in power. All units are perfectly matched in size, styling and colors.

8. **Simple, very fast tuning.** Circuit can be completely tuned up in two or three minutes without external measuring instruments.

9. **Lasting economy.** Low first cost—low power cost—advanced engineering design—plus modern styling, guarantee years of satisfaction.

10. **Easy to service.** Excellent mechanical layout, vertical type chassis and full height front and rear doors make servicing fast and easy.

RAYTHEON MANUFACTURING COMPANY

Commercial Products Division

Waltham 54, Mass.

RAYTHEON

Excellence in Electronics

FM AND TELEVISION

★ ★ Edited by Milton B. Sleeper ★ ★

FORMERLY, FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 7 NOVEMBER, 1947 NO. 11

CONTENTS

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THIS MONTH'S COVER

New thrill in radio is going into action at a remote television pickup point. Space-saving in a submarine has nothing on a television field truck. Cabinets, mountings, and clamps hold everything from the big antenna dish and reels of camera cables to tripods, spare parts, and all the separate units into which cameras, controls, power supplies, and monitors are broken down. In this month's cover picture, RCA television engineers Lannes E. Anderson, at the camera, and Walter L. Lawrence, on the truck, are giving WBAL's equipment a final check to make sure that everything is in perfect working order.

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.

MEMBER, AUDIT BUREAU OF CIRCULATIONS ABC

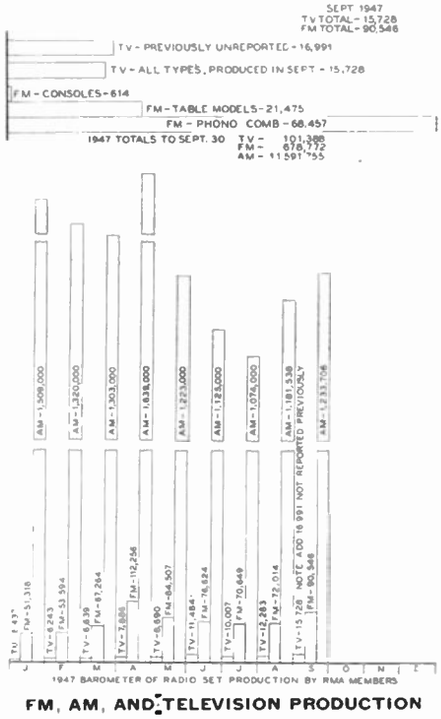
WHAT'S NEW THIS MONTH

Just back from an extensive trip to England on the Continent, facsimileman Milton Alden sent us the summary of his thinking on the matter of paper width which appears below. With Mr. Alden firmly convinced that economics dictate the choice of 4-in. transmission standards, and John V. L. Hogan insisting that a superior service can be rendered by 8-in. standards, *FM* AND TELEVISION maintains with equal vigor that the FCC should authorize commercial facsimile transmission of both kinds, because we believe that there will be adequate demand to support two quite different types of service, one limited economically to type and line drawings, and the other requiring, even at greater expense, the reproduction of photographs. However, here are Milton Alden's views:

JUDGING from current magazines and newspapers, it sometimes seems that too many decisions and actions are based on what the "country club" advertising man thinks. With his judgment biased by his income, his thinking may be in different terms than that of the average consumers.

When it comes to a new art in terms of a world market, anyone in the United States is apt to make the same error. As a matter of fact, we are even more apt to

(CONTINUED ON PAGE 40)



FM, AM, AND TELEVISION PRODUCTION

TELENOTES

WBZ-TV: Cornerstone of the Westinghouse radio and television center at Allston, a Boston suburb, was laid on October 16. Speakers were vice president Walter E. Benoit, WBZ manager W. C. Swartley, and chief engineer W. H. Hauser.

W2XJT: Experimental station at Jamaica, Long Island, N. Y., is now operating on channel 13 every Tuesday, Thursday, and Saturday evening. Station is owned by William B. Still.

Conventions: Elaborate plans for televising Republican and Democratic Conventions next summer at Philadelphia. Stations will share pickup and cable facilities, to assure maximum audience coverage. J. R. Poppele will act as coördinator of the committee appointed to handle the arrangements. Added stations and networks will be readied to carry this event.

DuMont: Has brought out a table model television and FM receiver with a 12-in. tube. Set has 24 tubes plus 3 rectifiers and tuning eye. Speaker is a 6-in. PM type. Price $445.

Memphis: Application for television has been filed by WDIA, owned by John R. Pepper and Bert Ferguson. DuMont and RCA equipment will be used, with a super-Pylon antenna on the present 380-ft. tower at 1125 University Place.

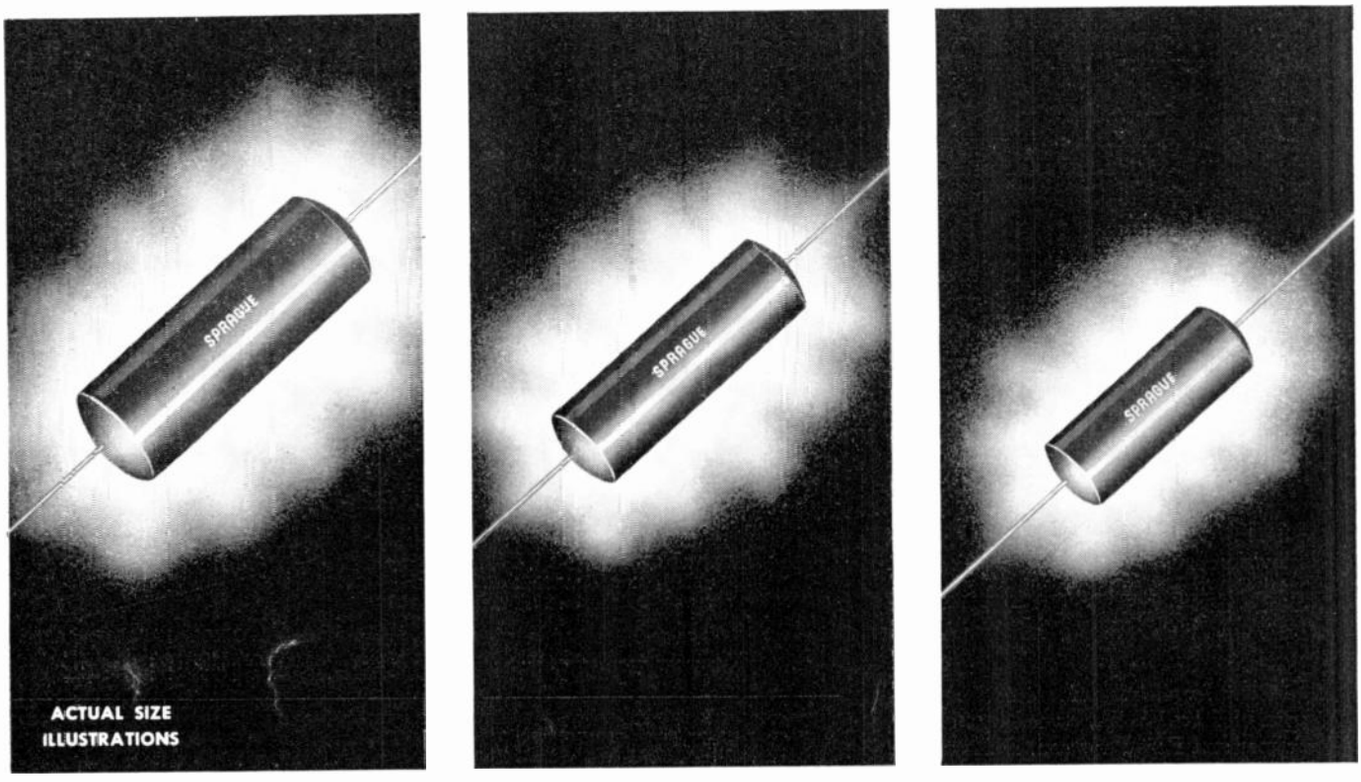
Stromberg-Carlson: In production on two television receiver models with 10-in. tubes. Seven push-buttons select stations in any given area. Price is $495. A 12-in. model, with FM and record-changer, is scheduled for delivery soon.

Cincinnati: An Intra-Video master antenna system will be installed at the Terrace Plaza Hotel, now under construction, by Langevin Manufacturing Corporation. Outlets will be provided in large suites, dining rooms, and cocktail lounges.

TV Applications: Filed with the FCC by Yankee Network for Hartford; Empire Coil Company, Parma, Ohio; Balboa Radio Corporation, San Diego; W. Albert Lee, Houston; Harold O. Bishop, Harrisburg, Pa.

WBRE: At Wilkes-Barre, Pa., 105 miles air line from New York City, has been picking up television programs at their FM site on Wyoming Mountain, and rebroadcasting them to receivers in the center of the city. Results indicate that a permanent installation would be highly successful.

A NEW ERA IN TUB

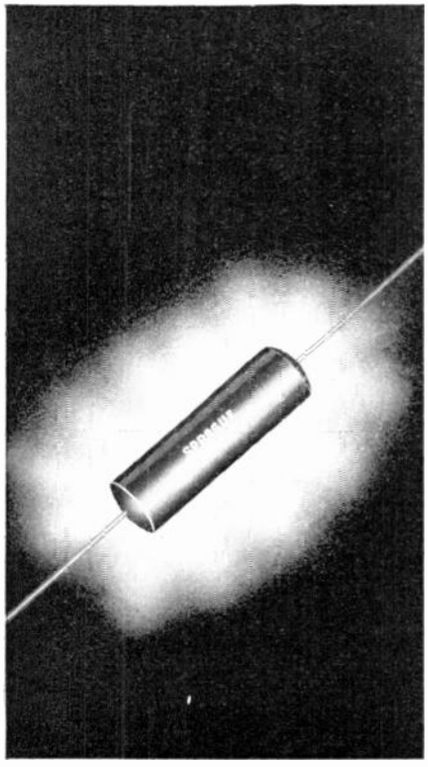


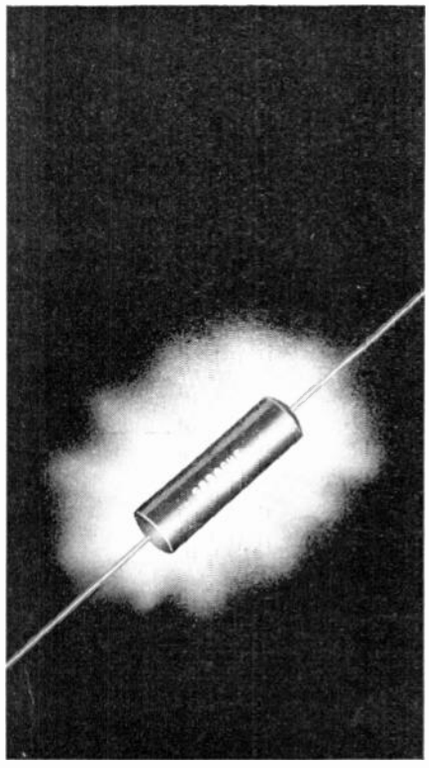
The *FIRST* truly practical, all-purpose *PHENOLIC*

One standard type for ALL conditions of use.

Pioneers of Electrical and Electronic Progress

ULAR CAPACITORS





Highly heat- and moisture-resistant

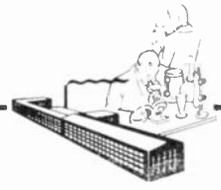
Non-inflammable

Conservatively rated for −40° C. to +85° C. operation

Small in size

Mechanically rugged

Moderately priced



— *MOLDED* paper tubulars

After more than four years of intensive research, plus one of the largest retooling programs in its history, Sprague announces a complete line of phenolic-molded paper tubular capacitors that offer far-reaching advantages for a long list of products ranging from home or auto radios and electrical appliances to military equipment. Their unique phenolic sealed construction assures maximum dependability even under extremes of heat, humidity and physical stress. Thus they have virtually universal application in modern equipment. In most cases the new Molded Tubulars are smaller and in no instance are they larger than ordinary Sprague paper tubular capacitors of equal rating.

Write for Sprague Capacitor Engineering Bulletin 210.

CAPACITORS **SPRAGUE** KOOLOHM* RESISTORS

Sprague Electric Company, North Adams, Mass.

*Trademark reg. U.S. Pat. Off.

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.

Mercury-Contact Relays comprising a contact arrangement sealed in glass, and surrounded by the operating coil. Unit is protected by metal housing, and is mounted on a standard octal base. Life expectancy is 1,000 million operations. This relay promises some new developments in power supplies. — Bulletin T2398, Western Electric Co., 195 Broadway, New York 7.

Signal Generator covers 1,200 to 4,000 mc., with unmodulated, pulse-modulated, or frequency-modulated output. Operates from 105–125 volts, 50–60 cycles. Designed for precision laboratory use. — Model P142, General Communications Co., Kendall Sq., Boston, Mass.

Selenium Cells for all kinds of rectifier requirements are covered in an 8-page compilation of characteristics, dimensions, and weights. — Radio Receptor Co., Inc., 251-A 19th St., New York 11.

Communications Equipment from tubes and circuit breakers to thermostats and voltage regulators, described in a 40-page bulletin of data and illustrations. — Bulletin B3610, Westinghouse Electric Corp., East Pittsburgh, Pa.

Standing Wave Detector for 23,000 to 27,000 mc. Vernier scale can be read accurately to .1 millimeter per division. Screw adjustments control penetration of the probe, and tuning of the coaxial section. Entire unit is gold-plated, and mounted in a metal case 4 by 5½ by 7⅝ ins. — De Mornay-Budd, Inc., 475-F Grand Concourse, New York 51.

Astronomic Time Switch for turning on tower lights in exact relation to seasonal sundown change. Each switch is set at the factory in accordance with latitude and longitude of city where it is to be used. Single-throw, double- or single-pole switch breaks 30 amperes at 125 volts. — Reliance Auto., Lighting Co., 1927-8 Mead St., Racine, Wisc.

Audio Equipment catalog showing a new console recorder and a complete line of amplifier units for recording and broadcast studio use. — Catalog CVK, Fairchild Camera & Inst. Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.

Tubular Paper Condensers for use in television and other cathode-ray tube circuits. Oil-impregnated, wax-filled, in capacities from .001 to .05 mfd., and DC working voltages from 2,500 to 10,000. Sizes range from ⅜ ins. diameter by 1½ ins. long to 1⅜ ins. diameter by 3 ins. long. — Aerovox Corp., New Bedford 25, Mass.

FM and Television Receivers recently announced include an FM-AM phono console, $325; 10-in. table model television receiver for sight and sound, $325 plus Federal tax and $55 installation and service charge; television-FM-AM-phono console, of more elaborate design, $695 plus Federal tax and $69 installation and service fee. — RCA, Camden 40, N. J.

Components Catalog, listing over 2,000 items in 52 pages. Many dimensional drawings are provided to aid designers. — Insuline Corp. of Amer., Long Island City 10, N. Y.

Recording Discs, both single and double-faced, in three grades for professional general, and reference use. — Sonic Recording Products, Inc., 50 Mill Road, Freeport 20, N. Y.

New Tubes for radio photo-electric circuits: 6AV6 miniature tube containing two diodes and a high-mu triode for detector, AVC, and resistance-coupled AF amplifier, operating on 6.3 volts, .3 amp.; 12AV6 of similar design but working on 12.6 volts, .15 amp.; 12AX7 slightly larger than regular miniatures, designed as a high-mu twin-triode amplifier with a mid-tapped heater for 6.3 or 12.6 volts; 6S8-GT combining three diodes and a high-mu AF triode for detection and amplification in FM-AM circuits; 5618 low-drain, filament-type miniature pentode, intended particularly as a doubler or tripler in mobile FM transmitters; 5653 phototube, S-4 response, for light-operated relays; 5652 twin-type phototube, intended particularly for facsimile recorders. — Individual technical bulletins available, RCA Tube Dept., Harrison 30, N. J.

Connectors of the rectangular-block design, carrying up to 45 or up to 92 contacts, including coaxial and twin-ax types. Pins are set into a junction shell box, while the female contacts are flush with an insulating block. Gear-and-rack or cam extractors are available. Intended for radio equipment and test assemblies. Catalog FMT, Cannon Elect. Dev. Co., Los Angeles 31, Calif.

FM-AM Receiver and automatic changer, with or without a wire recorder. Console model features push-pull amplifier, dia-cone speaker, and separate antenna connections for FM and AM. — Hoffman Radio Corp., Los Angeles, Calif.

Service Meter speeds up analysis of audio systems, permitting ready determination of faults, and their speedy correction — Altec Service Corp., F250 W. 52 St., New York 19.

Microwave Equipment catalog, and manual on microwave functions. All types of test equipment and standard components for the X and K bands are illustrated in detail, together with many special items. Manual section covers introductory concepts to microwaves and test equipment, measurements, and calibration. This catalog will be sent only in response to requests on company letterheads. — De Mornay-Budd, Inc., 475-F Grand Concourse, New York 51.

Antenna for railroad radio communications. Vertically polarized, full-wave, broadband design with a gain of 2.6 db over a half-wave dipole. Heights is 101 ins. for 122–126 mc., and 83 ins. for 152–162 mc. — Bulletin MS, Bendix Radio Div. of Bendix Aviation Corp., Baltimore 4, Md.

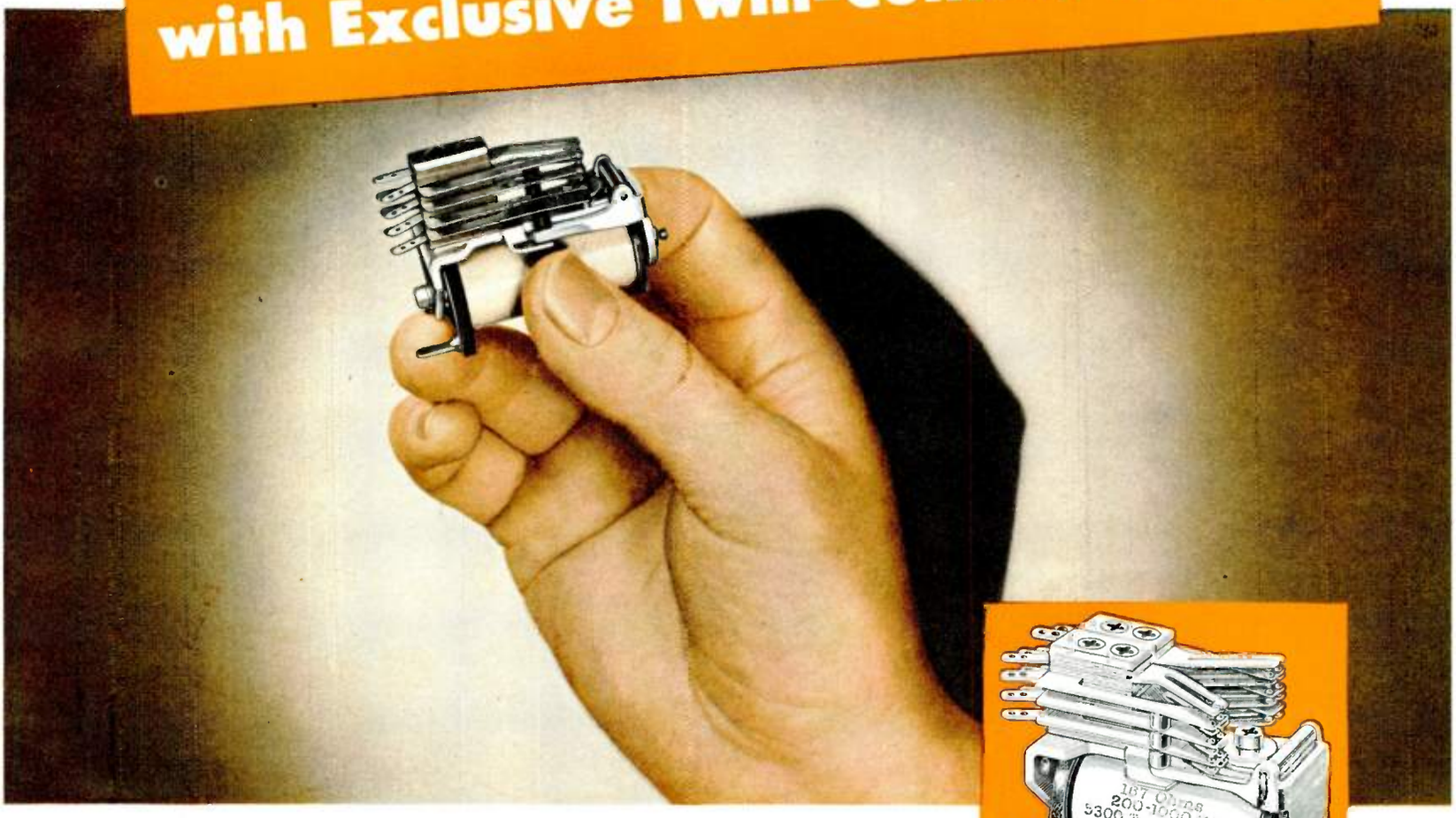
Sine Wave Clipper for examining frequency response and transients of AF circuits. By feeding clipper output into audio equipment under test, distortion can be seen in oscilloscope. — Bulletin F10, Barker & Williamson, Upper Darby, Pa.

Air Flow Switches to protect air-cooled tubes. If air-blast fails, the air flow switch opens, and operates relays to cut off power to tubes, and to signal the failure to the attending engineer. — Bulletin 101 MT, Coral Designs, Forest Hills, N. Y.

Molded Tubular Condensers of rugged design are non-inflammable, operate at −40° to +85° C., and are highly resistant to moisture. Produced in all popular capacities in 200, 400, 600, 1,000, and 1,600-volt types. Bulletin FT210, Sprague Electric Co., North Adams, Mass.

FM-AM Receivers, including a console model at $189.50, and three phono combinations at $249.95, $379.95, and $600. — Bulletin T, Westinghouse Electric Corp., Sunbury, Pa.

CLARE New Type "J" Relay Provides Sure, Positive Action with Exclusive Twin-Contact Design



● Here, at last, is a twin-contact design in which the chance of contact failure is actually reduced to the practical limit.

Exclusive design of the CLARE Type "J" d.c. Relay allows the twin contacts to operate independently of each other so that one contact is sure to close even when the other may be blocked by presence of dirt or grit.

This sensational new relay combines the best features of the conventional telephone-type relay with the small size and light weight developed during the war for military aircraft use.

Weighing little more than two ounces, slightly over two inches in length, it has the sturdy construction, large contact spring capacity, extreme sensitivity, and adaptability to a wide range of specifications for which CLARE Relays are noted.

Modern designers, working to develop close-coupled, compact equipment to meet today's streamlined standards, welcome this highly efficient combination of capacity and small size.

CLARE Relays are especially designed for jobs where ordinary relays won't do. If you have such a relay problem, Clare Sales Engineers are located in principal cities to help you work out a Clare "Custom-Built" Relay that will just fit your needs. Write: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. Cable Address: CLARELAY. *In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.*

All These Features . . . and More . . . Provided By CLARE Type "J" Relay

Independent Spring Contacts. Dome shaped contacts on movable springs; flat discs on fixed springs.

High Current-Carrying Capacity. Twin contact points of palladium. Rated current-carrying capacity: 4 amperes, 150 watts.

New Design Large Armature Bearing Area. Hinge type armature has new design bearing providing largest possible bearing surface. Pivot pin turns in cylinder of different metal which is full width of heelpiece.

Sensitive, Efficient Magnetic Structure. Heelpiece and other magnetic iron parts are exceptionally heavy for size of relay . . . provide highly sensitive and efficient magnetic path.

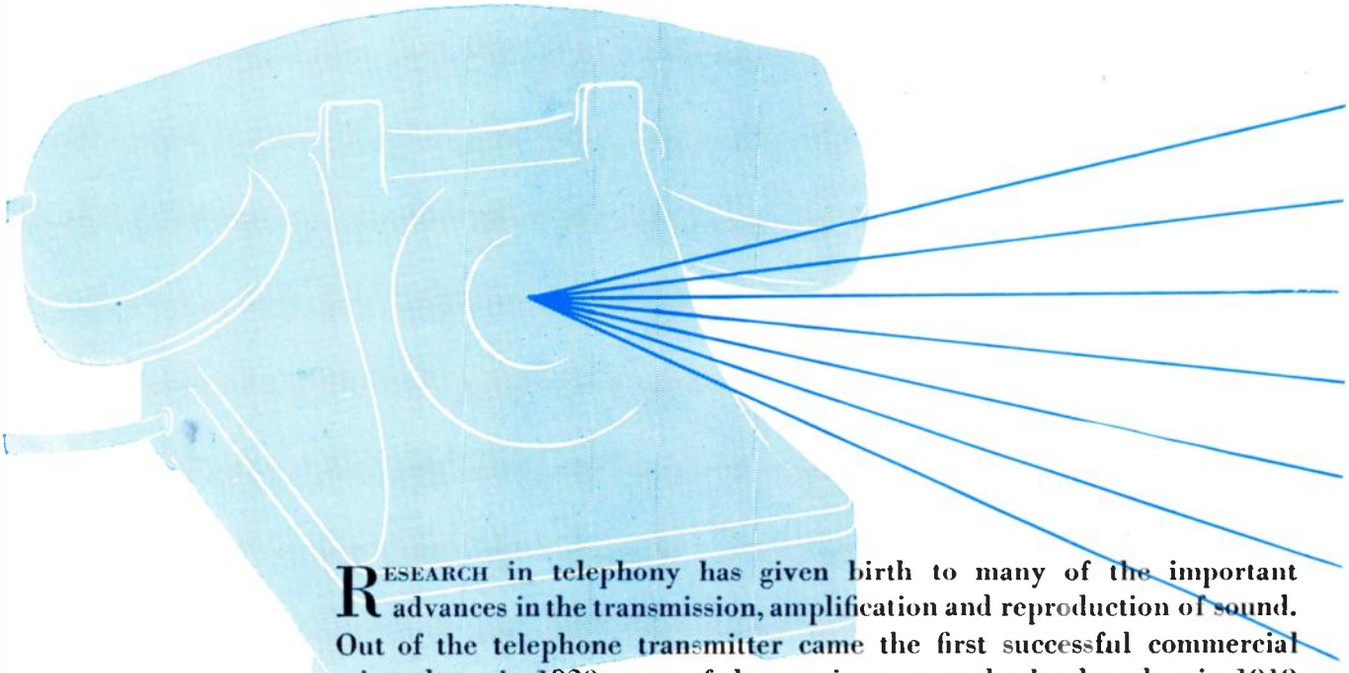
High Operating Speed. Designed for extremely fast operation . . . a minimum of one to two milliseconds.

Permits Handling Large Spring Loads. Power and sensitivity permit handling of large spring loads. Both single and double-arm relays available. Maximum of 10 springs on single-arm relay . . . 20 springs (10 in each pileup) on double-arm relay.

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical and Industrial Use

Why this team



RESEARCH in telephony has given birth to many of the important advances in the transmission, amplification and reproduction of sound. Out of the telephone transmitter came the first successful commercial microphone in 1920...out of the receiver came the loudspeaker in 1919 ...out of the vacuum tube repeater—developed for telephony in 1913—the modern science of electronics.

It is only natural that Bell Laboratories scientists and Western Electric engineers, working as a team to improve telephony, have pioneered in the design and manufacture of equipment in all of these fields which have sprung from the telephone.

Whether you are interested in radio broadcasting, mobile radio, sound motion pictures, sound systems, radar, hearing aids or radio telephony, you'll find it wise to look to equipment designed and manufactured to fill your needs by the Bell Telephone Laboratories-Western Electric team.

—QUALITY COUNTS—

can lead in all these fields

BROADCASTING
AM, FM

SOUND SYSTEMS
Public Address, Music Distribution, Wired Music

SOUND PICTURES

MOBILE RADIO
Police, Marine, Aviation, Railroad, Urban and Highway Service

HEARING AIDS

RADIO TELEPHONY
Overseas, Ship-to-Shore, Point-to-Point

RADAR

Put This Formula To Work For You

$$I = \frac{E}{IRC}$$

The formula $I = \frac{E}{IRC}$ is a favorite and easily-remembered solution to resistance problems. Radio and electronic Engineers know that IRC offers the most complete line of resistance products in the industry . . . a fixed or variable resistor for most every requirement . . . with uniform dependability proved by years of rigorous laboratory and field tests. Purchasing Agents and material control executives like IRC's service . . . "on-time" deliveries . . . factory stock-piles of the most popular types and ranges from which they can draw in emergency . . . IRC's distributor network, providing speedy, 'round-the-corner service for small order requirements.

Put this formula to work for you . . . check below the catalog bulletins in which you are interested—tear out this page, and mail it to us today with your letterhead, giving your name and title. International Resistance Company, 401 N. Broad Street, Philadelphia 8, Pennsylvania. In Canada: International Resistance Company, Ltd., Toronto, Licensee.

INSULATED COMPOSITION INSULATED WIRE WOUND RESISTORS
IRC types BT & BW

FINGER-TIP CONTROLS AND SWITCHES
IRC types H & SH

WIRE WOUND RESISTORS
IRC type MW

MATCHED PAIR RESISTORS

POWER RESISTORS

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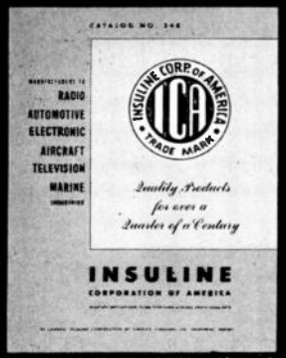

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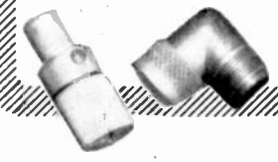

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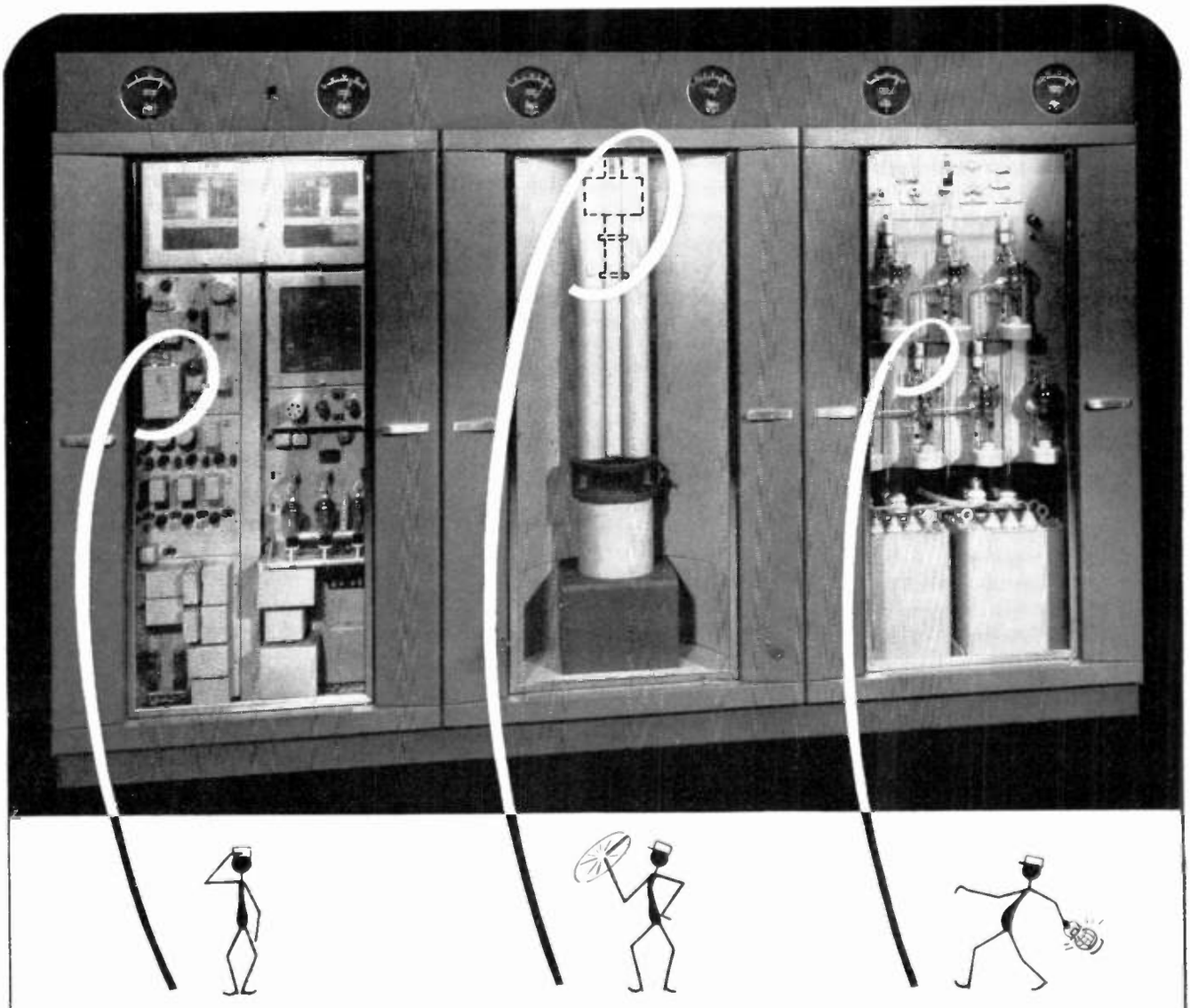

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— QUALITY COUNTS —

CCBS PLANS—TV RELAYS—FM-AM DUPLICATION

A Discussion of Current Topics Important to the Radio Industry

BY MILTON B. SLEEPER

MAYBE it's out of order to say much in an industry publication about the listeners' side of current controversies. Still, there's no getting away from the fact that broadcasting is a public service, and the total support of sponsored programs and the volume of set sales are determined by the Smiths and Jones, together with their sons and daughters — in other words, by the people at the listening end.

Super-Power AM Stations ★ We were thinking of the Smiths, and the Jones, and their kids when we read the statement by Victor Sholis of WHAS Louisville, in support of the proposal to set up 20 AM stations of 750 kw, around the USA. This plan, sponsored by the Clear Channel Broadcast Service group, was offered at the current FCC hearing on clear channels. Mr. Sholis said:

"We have the frequencies on hand. We have the technical know-how to operate at high power. We have the management ready to make the investment in facilities that will improve signals to millions of listeners. We have the largest radio audience in the world to serve. And, in the CCBS plan, we have an integrated, practical proposal not only to improve signals but also to provide, at long last, a choice of program services on a nationwide basis."

The coverage charts prepared by CCBS engineers may show the setup of twenty 750-kw. AM stations to be a sound and practical plan. But what will the listeners think of the service provided by it? Raymond Guy, NBC facilities engineer, testified that "the best that could be done would be to furnish at least four-sky-wave services of a fairly low order of reliability over most of the Country."

There was a time when people sat up until all hours to hear sky-wave transmission so unreliable that their sets were a sort of station grab-bag. But that was years ago. That was before people began to listen to FM, and to learn that the new, postwar kind of broadcasting gives solid reception of unvarying strength and clarity day and night. FM even adds some DX now and then as a bonus, too.

By the time a system of 750-kw. AM stations can be set up, there should be enough FM on the air for everybody to have reception of several programs, completely free of the static and fading characteristic of AM sky-waves.

All other adverse considerations aside, and there are many, it seems that the super-power plan is too late, by a number of years, to be of value to the public. Certainly, the number of listeners unable to get FM programs will be much too small to make the CCBS plan an economic success.

Television Relays ★ Just as this issue is going to press, we have word that AT&T's N. Y. – Boston relay is to start experimental operation on November 17. As we have been invited to attend the demonstration on that day, we shall have a report in the December issue of what takes place. According to Frank P. Lawrence, vice president of the Long Lines Department, "Among those taking part in the ceremonies will be Walter S. Gifford, president of the American Telephone and Telegraph Company, Dr. Oliver E. Buckley, president of the Bell Telephone Laboratories, and Paul A. Walker, acting Chairman of the Federal Communications Commission. They will participate in a television program over a combined coaxial cable-radio relay network extending between Washington and Boston."

This marks another step forward in the distribution of television programs, and paves the way to opening up southern New England as a market for receivers. Presumably, with programs exchanged between Boston and New York, it will soon be possible to take them off at intermediate points. Meanwhile, Westinghouse is pushing ahead on their television transmitter at Boston, and a CP has just been granted to the Yankee Network.

From Chicago comes word of another microwave television relay system. Capt. Bill Eddy, of Balaban & Katz station WBKB, is bringing in Notre Dame football games from South Bend, Ind., a distance of 70 miles. Using G.E. equipment, intermediate repeaters have been set up at New Carlisle and at Michigan City. About one-half the distance is covered by a water jump, from Michigan City to Chicago.

From now on, we can expect relay towers to crop up at high points all over the Country. Whether the projected coaxial cable lines will turn out to be microwave radio systems we don't know yet, but we strongly suspect that will be the case.

FM-AM Duplication ★ No one is prepared to venture a guess at this time as to what settlement will be reached between the American Federation of Musicians and the radio broadcasters. It appears that the AFM would like to stop all network programs on January 31. They have announced their intention of making no recordings after December 31.

The idea is that when programs are distributed to a number of stations, either by AM or FM, only one group of musicians is employed. AFM would like to have the American Tobacco Company, for example, put on Hit Parade Orchestras at each station now carrying that program. Obviously, this is impractical, because the equivalent of Mark Warnow and his musicians is not available at every city where the program is aired, and impossible because even the American Tobacco Company couldn't afford it.

A new bargaining point in the forthcoming negotiations is the establishment of a CIO musicians union. Many of the top members of AFM (AFL) are disgusted with the manner in which their union has flaunted public opinion and legislative action. Others, at the lower end of the scale, are coming to realize that they have gained nothing in employment by union actions which have brought their profession into nationwide disrepute.

From the listeners' standpoint, it is encouraging to see that FM and AM interests have been joined in a Special Industry Music Committee, formed to deal with the AFM. At the same time, the feeling prevails that the AM nets would willingly continue the ban on FM-AM duplication in exchange for union concessions.

Apparently the FM Association recognized this danger, for the directors have asked the FCC to adopt the rule that:

"No license shall be granted to an AM or FM broadcast station having any contract, arrangement or understanding, express or implied, with a network organization under which the station is prevented or hindered from, or penalized for, broadcasting in the same community such network programs simultaneously over AM and FM facilities which it owns."

This rule would not prevent the licensee from using his own judgment in the matter of duplication, but would give him entire control over operations of his station, as provided for in the Communications Act of 1934.

We most emphatically endorse the FMA recommendation. It is inimicable to public interest that broadcasters licensed for both FM and AM should contract to carry AM programs and, for some consideration or under some understanding, withhold them from FM listeners.

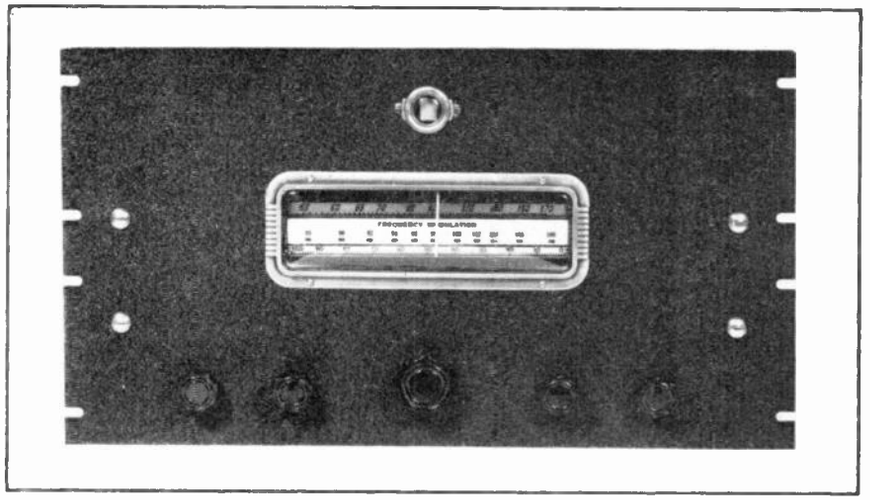


FIG. 1. COLLINS AUDIO PRODUCTS FM-AM TUNER WITH RACK-MOUNTING FRONT PANEL

THE C.A.P. FM-AM TUNER

FM and Short-Haul AM Performance Are Given Equal Emphasis

WILLIAM H. COLLINS*

SINCE the advent of FM, and the high audio quality made usable by the elimination of interference noise, there has been a general tendency to abandon serious effort to deliver the utmost quality possible from AM reception. The design of the FM-AM tuner to be described here, manufactured by Collins Audio Products, was planned in a unique manner. That is, the FM circuits were designed for maximum performance. Then the AM end was worked out to give equal results on reception from AM stations delivering live-talent programs with sufficient signal strength to knock down the background noise. The end result is a tuner which gives a quality of reception limited only by the signals fed into it on both FM and AM.

* President, Collins Audio Products, Inc., 118 A Park Street, Westfield, N. J.

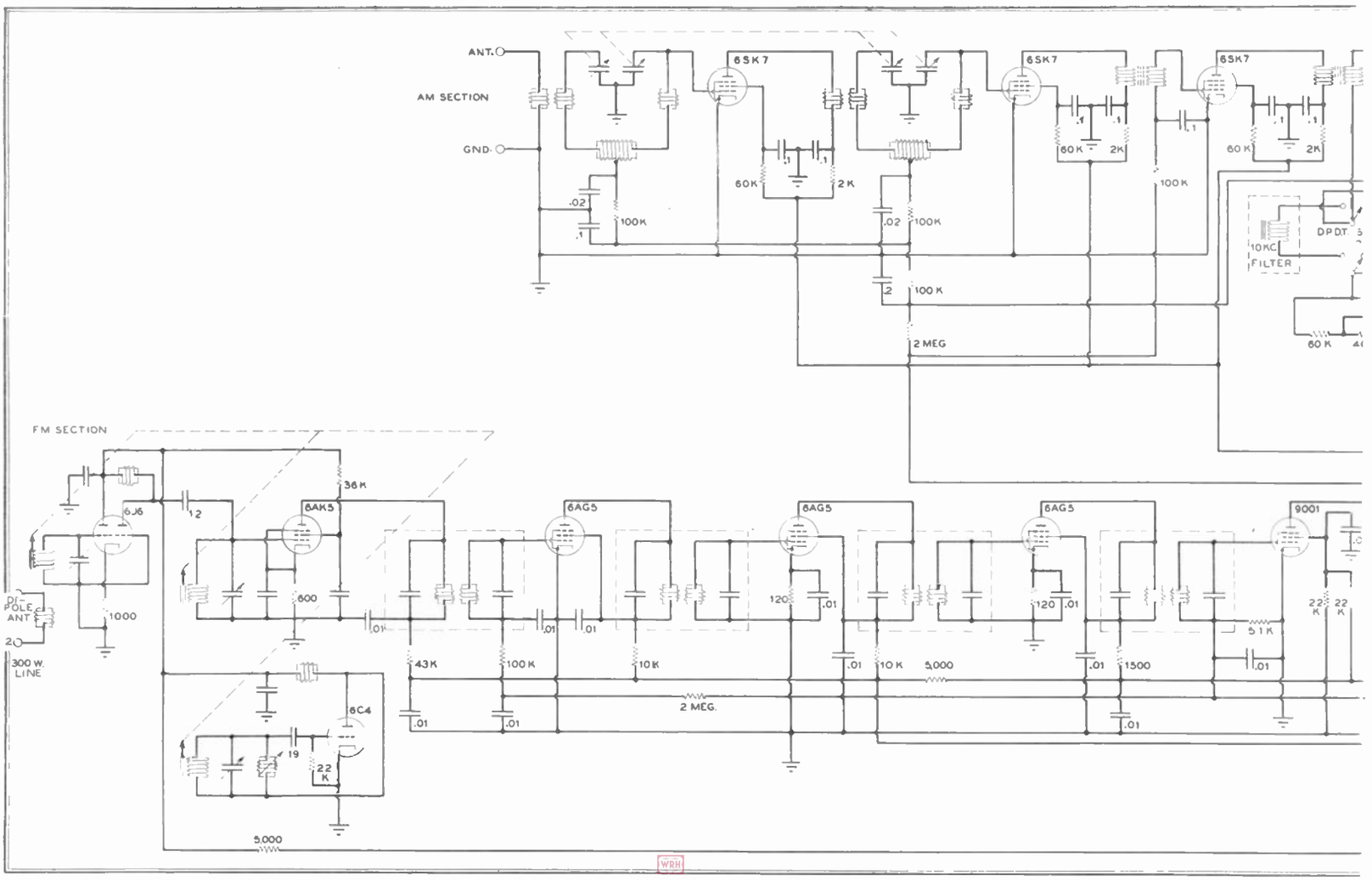
FM Section ★ In designing the FM section of this tuner, neither tubes nor components were spared as a concession to cost. The accent is on performance, throughout. This is evident in the accompanying photographs and circuit diagram.

For example, the inherent instability of variable condenser design for 88 to 108 mc., which plagued engineers after the FM band moved up, was acknowledged by our engineers, and that method of tuning was quickly dropped in favor of a new permeability tuning system.

The tuned circuits comprise Pyrex glass tubes, with the windings plated on the glass. Tuning is accomplished with powdered iron slugs moving through the tubes, and ganged together as a unit. Fig. 3 shows the driving pulley and rack-and-pinion arrangement for moving the slugs, at the right of the AM tuning condenser. The coils can be seen in Fig. 4, toward the right.

Careful design of the oscillator has brought drift in this circuit to the irreducible minimum. In production, the majority of these tuners show no perceptible drift. A further advantage is that no friction contacts are employed, as in

FIG. 2. SCHEMATIC OF THE C.A.P. TUNER. AM SECTION, WITH ITS OWN ANTENNA AND GROUND POSTS, IS ABOVE, WHILE FM SECTION,



variable condensers. Thus the development of noisy contacts is eliminated.

The FM section makes use of the new, miniature tubes in a genuine Armstrong circuit. In the front end, there are a 6J6 tuned RF amplifier, 6AK5 mixer, and 6C4 local oscillator.

In the course of our preliminary circuit development, we found that the overall gain and performance were greatly improved by the use of 3 IF stages. Accordingly, this extra feature was included, as shown in the diagram, Fig. 2.

While a considerable degree of limiting can be obtained with one stage, it still leaves much to be desired. This tuner has a cascade resistance-coupled limiter, using 9001 tubes. The 9001's were selected because their extremely low inter-electrode capacitances contribute to prompt and positive limiting action. Thus, limiting is obtained with signal inputs as low as 10 to 15 microvolts.

A 6AL5 miniature duo-diode is used as the discriminator. Its associated output coupling network provides 75 microseconds de-emphasis for linear audio response. From the discriminator output the signal is fed through the FM-AM Phono selector switch and thence to the volume control operating in the grid circuit of the 6J5 audio tube.

Audio Output ★ It was deemed advisable to provide an audio stage on the tuner chassis to bring the output level of the tuner to a point where *all* the gain of associate power amplifier is not required, thereby reducing the tendency toward producing hum, by allowing the amplifier gain to be operated at lower volume settings. Then the difficulty does not arise in paralleling volume controls or terminating resistors, and unnecessarily loading the discriminator or detector circuits of the tuner. Also, a crystal pickup always prefers to look into a higher impedance load, preferably a grid circuit, and not a shunted volume control.

The output voltage of the tuner averages, therefore, 15 to 20 volts on peaks, which is sufficient to drive a single power tube of the beam power type to full output, if necessary. Power amplifier requirements are thereby minimized.

Power Supply ★ In the design of the power supply for this tuner, a great many points had to be taken into consideration. Firstly, it is a large tuner. Would the incorporation of the power supply on the same chassis make it too big? Would heat problems and frequency stability be a consideration? The tuner, as finally derived, is supplied as a complete unit on one chassis, with the power supply as an integral part. In order to provide constant voltage to the FM circuits, a VR-150 tube is employed. By careful design of the power transformer, with a 30% safety margin both for filament and high voltage windings, relatively cool operation is experienced, and it is always possible to hold one's hand on the transformer case. Oversize resistors are used in critical spots so that component failure is brought to a minimum. Although there are no potentials in the set above 250 volts, 400- and 600-volt tubular condensers are used throughout as a safety feature.

AF Amplifier ★ The Collins 10-B audio amplifier, is designed specifically for this tuner. It has its own power supply in a circuit that delivers 10 watts of undistorted output. The use of this amplifier is recommended with a high-fidelity speaker. However, any power amplifier that meets the fidelity requirements of a given installation can be used with the tuner.

AM Section ★ When AM signals fade or are broken up with static and co-channel interference, one receiver is about as good as another. However, differences in receiver performance show up sharply on AM signals strong enough to over-ride interference.

Two stages of RF bandpass amplification, with 6SK7's, are provided in the head end. Following these is another 6SK7 and 2 special RF coils which amplify the whole AM spectrum, but after the tuned stages.

The RF output feeds the diode section of a 6SQ7, the triode amplifier section of which is used as a DC amplifier. This amplifies the AVC voltage in excess of a minimum fixed bias of 4 to 5 volts, causing very positive AVC action on the RF stages. It also eliminates the possibility of overloading due to extremely powerful signals from nearby stations.

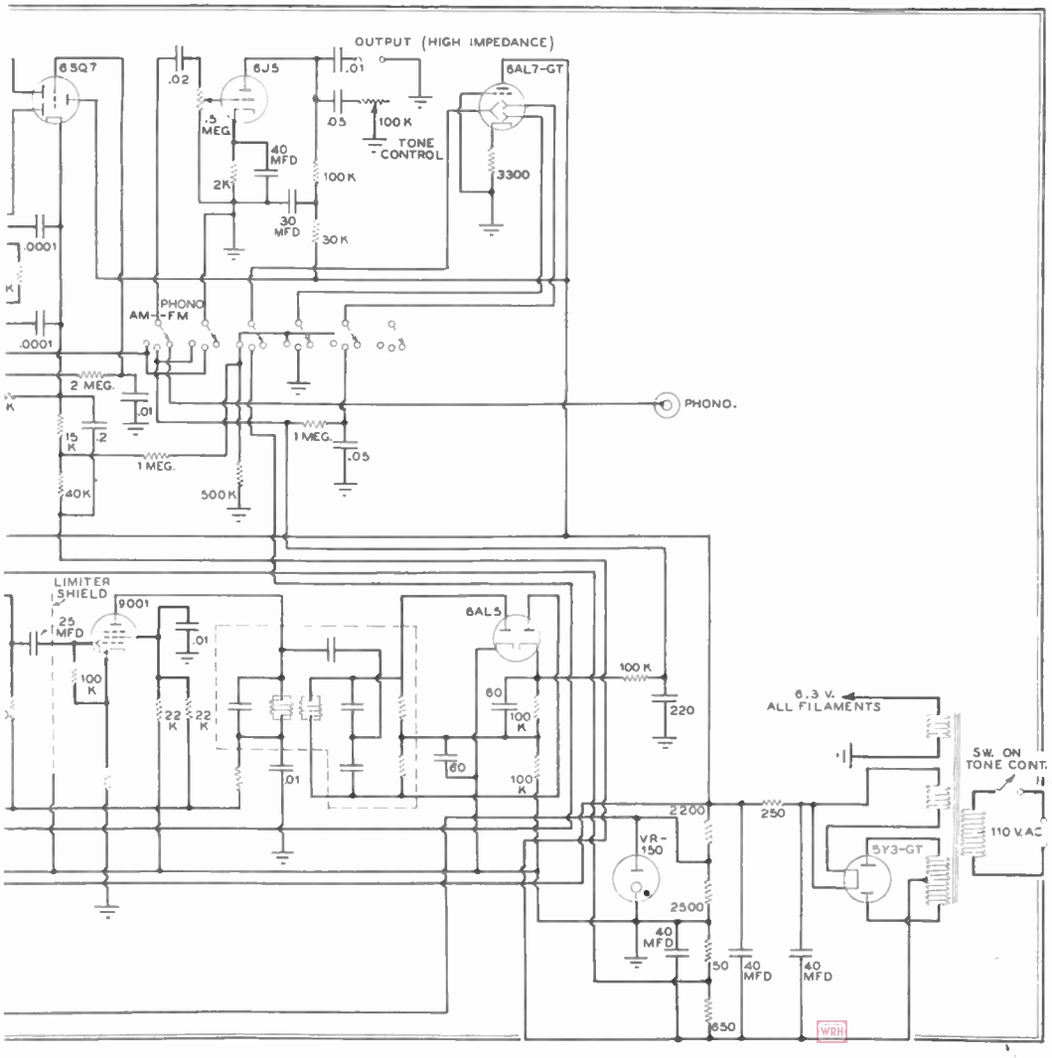
Alignment of the RF stages can be adjusted to produce varying degrees of bandwidth, from 10 kc. to 40 kc. Stock tuners are adjusted to the optimum band of 20 kc., and re-peaked if an individual customer desires a narrower or wider response. In this way, we can meet any special requirements.

Usual practice is to employ high-gain IF stages in order to achieve a substantial degree of selectivity and sensitivity. This precluded high-fidelity response because the IF transformers must be so sharply peaked to obtain maximum gain. In practice, the response is limited to a top of 4,500 to 5,000 cycles. However, the AM circuit employed in this tuner passes 10,000 cycles or more. It also eliminates those annoying image peeps and squeals that are commonly heard from receivers which lack adequate tuned or IF stages.

From the detector circuit, signals are fed through the wave-band switch to the 6J5 common audio tube. On the standard tuner chassis, a tone control is supplied in the plate circuit of the 6J5. This permits the attenuation of spurious high frequencies when encountered.

In order to provide the necessary accel-

WITH DIPOLE CONNECTIONS, APPEARS BELOW. CIRCUIT-WISE, THEY ARE INDEPENDENT



erating potential for the DC amplifier (the triode section of the 6SQ7) its cathode is operated at −80 volts. Therefore, a special power supply and bleeder network is furnished. The cans of the main filter condensers show a negative voltage with respect to ground and, in servicing, these cans should never be grounded.

Tuning Eye ★ A new tuning eye, type 6AL7-GT, is used for both FM and AM. Its performance on FM is particularly advantageous in that it allows precision tuning which is so important from a distortion viewpoint in FM reproduction.

Operation is accomplished by the application of voltages from the discriminator output and limiter circuit to the deflector plates of the tube. The circuit wiring to the tube is different in FM and AM, but these wiring changes are taken care of in the band switch.

Phono Pickup ★ A phonograph input jack is provided on the tuner chassis. This allows the first audio stage to be used as an amplifier for a crystal pickup. When specified, the tuner is equipped with an additional tube to furnish the equalization necessary for the new variable reluctance and magnetic pickups. This makes a very flexible tuning unit, with all the controls on one chassis.

AM Alignment ★ To align the AM section, connect the plus lead of a VT voltmeter to the chassis and the negative lead to the junction of the .5-megohm and 1-megohm resistors in the tuning eye circuit. These resistors are located on the terminal board adjacent to the 6SQ7 tube under the chassis. A voltmeter of 20,000 ohms per volt can be used in place of the VT meter.

Applying a 1,400-kc. signal from a signal generator, adjust the tuner to this frequency, and note the reading. Adjust the trimmers atop the main tuning condenser for maximum meter reading. Reset the signal generator and tuner to 600 kc. Only slight trimmer readjustments should be needed.

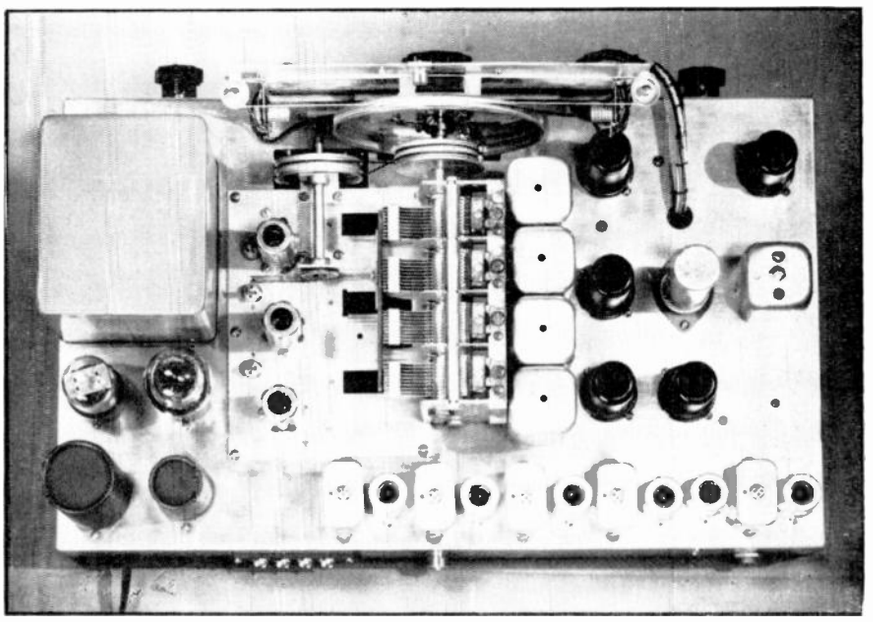


FIG. 3. TOP VIEW OF CHASSIS. FM TUNING DRIVE IS AT THE LEFT OF THE CONDENSER

The only other AM adjustment is on the 10-kc. filter, located on the chassis between the 6SQ7 and 6J5. This filter is preset at the factory for maximum 10-kc. rejection. If it is required, cut it in by turning the switch to the left, and turn the screw on the top of the can until the whistle is minimized.

FM Alignment ★ The FM section can be aligned with conventional test equipment. However, the use of the Harvey FM signal generator and oscilloscope is recommended for accurate alignment.[1] The IF frequency is 10.7 mc.

For those who do not have the rather elaborate test equipment required in the Harvey method, this simple method of alignment will be found quite accurate:

Disconnect the ground end of the 51,000-ohm resistor in the grid return of the 1st limiter and insert a 0-200 microammeter in series, grounding the positive side of the meter. The meter should be shunted with a 560-ohm, half-watt resistor and a .1-mfd paper condenser.

Should the above equipment not be available, the same results can be obtained by the use of a VTVM attached in this manner. Ground the positive side of the meter to the tuner chassis and attach the negative side to the junction of the 2-megohm and 100,000-ohm resistors in the AVC circuit.

If a signal generator is available, introduce its output through a 100-mmf. mica condenser to the 6AK5 converter grid after setting the signal generator to 10.7 mc. Using a non-metallic alignment screwdriver, turn the primary slug of the first IF transformer (underneath chassis) slowly, watching meter readings carefully. Adjust for peak reading. Continue this operation for all 4 IF transformers, both top and bottom slugs, until a maximum reading is obtained on the meter. Throughout this process, it will be necessary to reduce the output from the signal generator to avoid overloading, as that would result in inaccurate readings.

Now disconnect the signal generator and adjust the top slug of the discriminator coil for maximum rush. Next, tune in a station by obtaining maximum meter reading and adjust the bottom discriminator slug until both areas of the tuning eye are even.

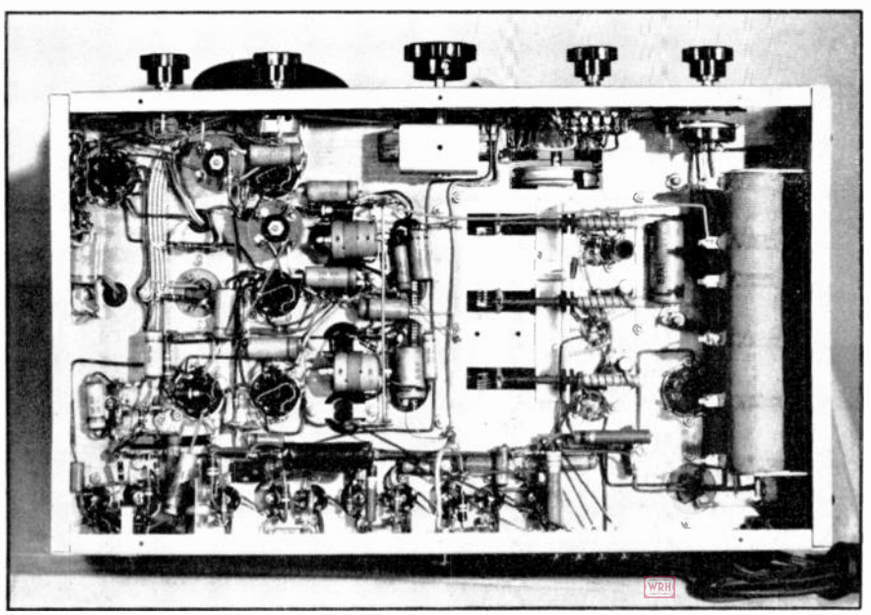
After this has been done, the RF and converter trimmers must be touched up by simply laying the output lead of the signal generator across the antenna lead-in. Tune generator to 88 mc. and adjust the converter trimmer carefully for maximum meter reading. This is adjacent to the 6AK5 tube on the top of the chassis. Then set the generator to 108 mc. and adjust the RF trimmer for maximum reading.

Finally, turn off the generator, tune to a station, and go over the IF transformers once again, adjusting ever so slightly for higher meter readings.

More accurate adjustment of the discriminator can be accomplished by measuring the voltage across each plate of the 6AL5 using the VTVM. These voltages should be the same.

[1] See *FM* AND TELEVISION, July, 1946 for complete instructions, or the FM HANDBOOK, first edition, chapter 11

FIG. 4. PERMEABILITY TUNING UNIT CAN BE SEEN IN THIS BOTTOM VIEW OF THE CHASSIS



44 TO 50 MC. FOR FM BROADCAST DEVELOPMENT

Text of a Brief to Be Presented at the Reallocations Hearing, November 17, 1947

BY MAJOR EDWIN H. ARMSTRONG*

THIS brief is directed to the question specified in the Commission's Order of September 19, 1947, viz., as to which category of radio service should be assigned the band from 44 to 55 mc.

The thesis of this brief, and of the testimony which I propose to offer at the hearing before the Commission, is that the public interest requires those bands to be assigned to frequency-modulation broadcasting, with special reference to the use of stations in those bands to broadcast programs capable of being picked up and rebroadcast by other FM stations.

Explanation of Appendix to This Brief ★ FM broadcasting was demonstrated to the radio industry as a whole in November, 1935, nearly twelve years ago. The regulation of its development to date has been administered under five different Chairmen of the Federal Communications Commission. The personnel of the Commission and its engineering and legal staffs have changed so many times that today no one in the Commission has first hand knowledge of the actions of the Commission which have affected, and in many instances retarded, FM development.

Since the Commission is about to make an important decision bearing on the future of FM, and since some of its members have but recently assumed office, it may be helpful to set down certain matters of history, together with references to where the source material of that history may be located. I have attempted to do that in the Appendix.[1]

It is apparent, from recent speeches of Chairman Denny and Vice-Chairman Walker, that the present Commission firmly believes that the future of aural broadcasting rests with the FM system. It is not so apparent why the FM system, recognized by the Commission as having such merit, has been so delayed in its introduction to the American public that only a small percentage of the people are enjoying its advantages 12 years after its effectiveness had been completely demonstrated.

Not least among the causes of the long delay in bringing FM to the public have been various unwise actions by the Commission, based on errors of judgment whose causes were of two kinds. One cause lay in incorrect engineering advice furnished to the Commission by its Engineering Division. The responsibility for the other cause rests with the radio industry. As the Appendix makes clear, relevant information concerning FM has been withheld from the Commission and in other instances information which was misleading has been given to it.

Much of the trouble has come about because the Commission, in making piecemeal decisions affecting FM, has not always appreciated that some of the interests appearing before it were anxious to prevent or slow down the development of FM and were using the machinery of the Commission for that purpose. It is to forestall further errors of the same sort that the Appendix has been written. Most of the facts have been testified to by me under oath on two occasions before the Senate Committee on Interstate Commerce. No attempt has ever been made to refute them.

In the Appendix the Commission will find listed some of the long series of difficulties and obstacles that have been placed in the path of FM development, including those that have resulted from the Commission's being misled by unsound engineering advice.

Some of the obstacles to FM have been placed so adroitly that it has been difficult to determine who placed them, or even in fact to realize the extent of the damage done by them until long afterward. The existence of such opposition to FM, however, is now recognized, and the Commission may well take note of the fact that the statement is being widely made that there is even today an organized attempt to block FM development.

Not all the misinformation that has been furnished to the Commission has been of a technical nature. It will be recalled that in January, 1946, at the hearing on Zenith Radio Corporation's petition to reallocate to FM the 42–50 mc. band, representatives of a number of manufacturing companies appeared in opposition, with the story that their production of FM sets for the market would be delayed should the petition be granted. One testified that his company would lose 75 million dollars worth of business; another testified that his company was already tooled up for production.

The Commission is aware that both those manufacturers, instead of making the FM sets they testified they were ready to make, proceeded to dump large quantities of obsolete AM equipment on the public. One of the companies did practically nothing in the way of FM set production for a year. A representative of the other company testified 6 months later that it was not in production on FM receivers and his testimony made clear that he knew of no plans for going into production. Other similar instances might be cited.

The First FM Network (1942-43) ★ The men who built up FM on the old band envisioned a system of high power stations located at high points and rebroadcasting the signals of one another to get large area coverage. The ability to operate such a network had been demonstrated successfully for fourteen months during the years 1942 and 1943, when three weekly paid programs were carried by a network embracing stations in Philadelphia, New York, Meriden, Schenectady, Worcester and Mount Washington. The Commission in its new setup of the FM structure completely altered this picture, reducing the power of the stations in the most active area and limiting their locations, so that

(CONCLUDED ON PAGE 42)

IN January, 1936, the FCC submitted to the Congress its "Report of the Engineering Department," covering radio progress during 1935, the year when Major Armstrong was out-performing 50-kw. AM stations over a distance of 85 miles, with a low-power FM transmitter. No mention was made of FM in the FCC report, but a brief reference discounted the usefulness of ultra-high frequencies because their service area would be "only a few miles, probably 2 to 10 miles depending upon the power, location of the transmitter, its efficiency, and the radio propagation characteristics of the surrounding terrain."

Now that it has been clearly demonstrated that the low band is needed for FM network operation and for wide-area rural FM coverage, the FCC proposes 1) to stop all low-band FM broadcasting, 2) to eliminate this band as television channel No. 1, and 3) to assign 44 to 50 mc. to emergency communications.[2]

Accordingly, great interest attaches to Major Armstrong's brief, to be delivered at the November 17 hearing and published here, in which he asks "the Commission not to prejudge the situation by foreclosing the present lines of FM development" and "to get the technical facts correct before undertaking to make a final determination of how the public interest, convenience, and necessity will be best served."

The text of the brief, appearing here, occupies 11 pages of a 56-page printed pamphlet which includes the detailed Appendix. We presume that copies of the complete pamphlet can be obtained from the FCC.

* Philosophy Hall, Columbia University, New York City.

[1] It is expected that copies of the material contained in the Appendix will be made available by the FCC, and can be obtained on request.

[2] The complete table of proposed frequency allocations appeared in FM & TV, pg. 18, Oct. 1947 issue.

SPOT NEWS NOTES

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

Donald K. deNeuf: Former operating vice president of Press Wireless is now chief engineer of the Rural Radio Network, recently authorized to build 6 FM stations to serve 40 communities in upper New York. Nine farm organizations are sponsoring the project, with Harold L. Creal as president. Headquarters are in Ithaca.

Wages: In radio factories have climbed from a 1939 average of 58.1 cents per hour to 68 cents in 1941 and $1.15 in 1947, representing an increase of exactly 98%.

Ames-Grindle: Additions to the engineering department of Nathan Williams, radio consultants at Oshkosh, Wisc., are Wallace T. Ames, formerly of the Technical Service Propagation Unit, Washington, D. C., and Carl E. Grindle, electrical engineering graduate of the University of Wisconsin.

Greater Flexibility: Industrial Television, Inc., Nutley, N. J., is building 2-unit television receivers. Tuning and associated circuits are in a small table cabinet, while the high-voltage circuits and the picture tube are contained in a separate cabinet. This type of design has special advantages that warrant careful study by television receiver engineers.

Los Angeles: Engineering and sales firm has been established by Burgess Dempster and R. B. Bonney at 2008 W. 7th Street, Los Angeles. Dempster was formerly with Magnavox, and Bonney with RCA.

Books Needed: Finland's Technical Institute, the Teknillinen Korkeakoulu, has appealed for contributions of technical books to replace those lost when its library was totally destroyed by bombing. Such gifts should be sent to the Legation of Finland, 2144 Wyoming Avenue N.E., Washington, D. C., where they will be forwarded to the Institute.

KVNJ: North Dakota's first FM station, at Fargo, is completing a handsome studio-transmitter building, and will go on the air by the end of November. Initial schedule will be from 3:00 to 9:00 P.M., with transmission on 92.3 mc.

Emission Types: In case you've forgotten the meanings of the emission type numbers used by the FCC, here they are:

A–0 — Constant carrier
A–1 — Continuous-wave telegraphy
A–2 — Audio-modulated telegraphy
A–3 — Telephony (speech and music)
A–4 — Facsimile
A–5 — Television

No type number has been assigned yet to Frequency Modulation.

New York: FCC, by 4 to 2 decision, withdrew proposed FM grant to *Daily News*, substituting Methodist Board of Missions. Other grants went to ABC station WJZ, WMCA, Inc., and Unity Broadcasting Corp. (ILGWU-AFL).

2,000 Stores: In the Gamble-Skogmo chain are carrying FM-AM combinations priced at $249.50. Called the Coronado Maestro model, these sets are manufactured by Belmont Radio, Chicago.

Not So Slow: Production and sale of FM receivers haven't moved so slowly in comparison to electric refrigerators. First boxes were put on sale in 1910, and by 1920 only 10,000 had been sold. FM set production last September was 9 times that 10-year total!

Dr. Benjamin E. Shackelford: Elected IRE president for 1948. He is manager of the license department of RCA's international division. Dr. Reginald L. Smith-Rose, superintendent of the radio division of the National Physics Laboratory, Teddington, England, was elected vice-president.

WBIB: FM station in New Haven, Conn., has installed speakers in the 3 elevators operating in the 12-story building where its studios are located. Thus, thousands of people are getting brief samples of static-free reception.

Joseph P. Maxwell: Renowned consultant on accoustics, studio design, and microphone placement, recently retired from Bell Laboratories, is now associated with Altec Lansing as consulting engineer.

Licensed Serviceman: Irresponsible and incompetent servicemen have put the bee on radio set owners in New York to the point where City officials propose to license them. RMA has asked for time to work out a counter-proposal for submission in January. It's hard to understand why manufacturers have been so indifferent to a condition throughout the Country that so directly affects both sales and goodwill. Auto companies, always smarter, have long featured authorized dealer service.

Norman E. Wunderlich: Executive director of Federal's radio division for the past two years has resigned to establish a consulting office and laboratory at 1337 Fargo Avenue, Chicago.

Bright Idea: The plug on your radio set won't be disconnected by playful animals, curious children, or housekeeping activities if it is the new locking type, just brought out by Neoline, Inc., 1318. Hewitt Street, Los Angeles. Once it is inserted, it can be removed only by pulling out a plunger in the center of the plug.

New FMA Members: Hallicrafters Co., Chicago; KVSO Ardmore, Okla.; KGBS Harlingen, Tex.; WHTN-FM Huntington, W. Va.; WLAN Lancaster, Pa.; KVNJ Fargo, N. D.; KSPI-FM Stillwater, Okla.; Hazeltine Electronics, N. Y. C.; WFML Washington, Ind.; KVFD Fort Dodge, Ia.; WMNE Boston; WGTR Worcester, Mass.; WBAR Chicago.

Stanley C. Kolanowski: New chief engineer of Stewart-Warner's radio division. Prior to joining S-W in 1935, he was with Operadio and Grigsby-Grunow.

Inadequate: RMA practice of reporting set production in units does not give a true industry picture. What counts is not unit production but dollar billing. This is particularly important now, because the unit prices of FM and television sets are so much higher than AM models that the number of units bears no relation to sales volume.

WCFC: First FM station in West Virginia has completed its new $100,000 studio building, and 245-ft. tower at Beckley. Operating from 10.00 A.M. to 10.00 P.M. on 101.3 mc., power of 3 kw. and elevation of 2,755 ft. will give WCFC a potential audience of 1,000,000 in Virginia, West Virginia, Kentucky, and Tennessee. General Manager is E. J. Hodel.

QSL Cards: With DX hunting revived as an active sport among FM listeners, REL is now including a package of QSL cards with each of their receivers. The idea is doubly good because FM stations gain much information from these acknowledgments.

Colorado State Police: Will soon have a Philco FM system of 110 mobile units and 20 fixed stations. Control points will be at Denver, Greeley, Pueblo, Grand Junction, and Durango. Equipment is described as employing a modulation band only one-half as wide as standard practice.

WHAM-WHFM: The selection of WHAM as call letters for Stromberg's AM station was purely fortuitous. But, as we learned from vice president William Fay, there's a story behind WHFM, call letters for the FM transmitter. Use of this call was originally denied by the FCC because it was already assigned to a ship. Further persuasion was unavailing. Stromberg persisted, the Commission continued to refuse — until the FCC suddenly discovered that the ship had been resting quietly on the bottom of the ocean during the long argument. So Stromberg got WHFM!

1: NEW FM TOWER FOR WBT, CHARLOTTE. 2: MOTOROLA FM FOR MOTORCYCLES. 3: DR. W. R. G. BAKER AND MARION CLAIRE AT WGNB

NEWS PICTURES

1. One of the 100-ton concrete piers for the 500-ft. tower being erected for WBT's 50-kw. FM station on Spencer Mountain, 12 miles south of Charlotte, N. C. Top of the tower will be 1,836 ft. above sea level. The present 1-kw. interim installation has been on the air since last February 23. Chief engineer M. J. Miner expects to start on high power early in 1948. Programs are beamed by radio relay to Spencer Mountain, since no telephone lines run up to the summit.

2. In this motorcycle installation, a 2-way Motorola FM unit, containing a compact transmitter and receiver, is mounted with storage battery in rear compartment, with antenna at side. The FM equipment, described as the Dispatcher model, draws 20 amperes during transmission, or 9.2 amperes on standby. Output is 7 to 10 watts, giving an operating range of about 15 miles. Radio unit is 17 by 8½ by 5¾ ins., and weighs 27 lbs.

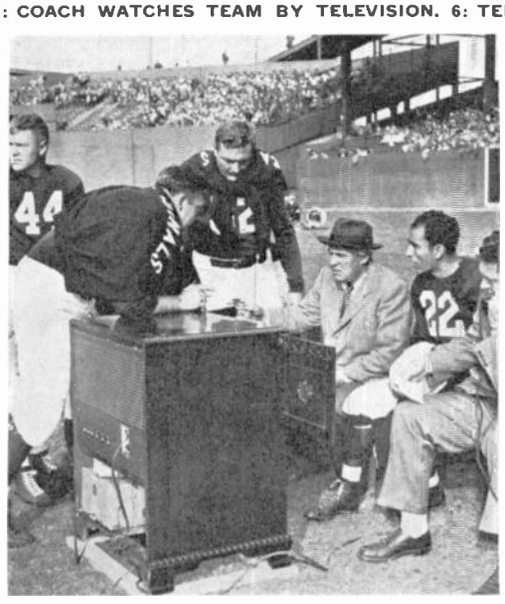
3. On October 15, WGNB Chicago staged an FM demonstration and technical forum for 500 dealers. Station director Marion Claire presided. Among those who addressed the meeting were Col. Robert McCormick, publisher of the Chicago Tribune, Major Edwin H. Armstrong, G. E. vice president, Dr. W. R. G. Baker, Hallicrafters president, William J. Halligan, former FMA president, Judge Roy Hofheinz, FMA executive director, Bill Bailey, and George Arnold, Jr. of Lee Broadcasting, Inc., Quincy, Ill.

4. If you wondered what equipment is housed in the G. E. television relay tower shown on this page last month, here's your answer. These receiving reflectors are for the regular and emergency circuits coming up from New York City. On the opposite side of the tower room is a transmitter and a similar reflector to squirt the signals to the WRGB studio at Schenectady, where they are monitored and sent back to Hilderberg Mountain for transmission from the regular television broadcast station.

5. Jimmy Conzelman, coach of the Chicago Cardinals, found that the television cameraman can see more than is possible right on the field. Accordingly, he got Stewart-Warner to install a receiver for him, equipped with a hood to keep the outdoor sunshine from the screen. Now Coach Conzelman has television, direct vision, and information from his spotter, up in the stands, to help him.

6. Though England has only one television station, it appears from photograph furnished by B. I. S. that they go in for more elaborate shows and settings than we do. The 17-kw. transmitter at Alexandra Palace, London, transmits with 405 lines, compared with our 525.

4: G. E's. TELEVISION RELAY UNITS. 5: COACH WATCHES TEAM BY TELEVISION. 6: TELEVISION SHOW AT RADIOLYMPIA



MICROWAVE TELEVISION RELAY ANTENNA, SANDBAGGED TO KEEP IT STEADY IN THE WIND, IS MADE READY FOR REMOTE PICKUP

PLANS FOR TELEVISION AT WTMJ-TV

Outline of Plans for Technical Operations, Personnel, Time Sales, Promotion, and Programming

BY L. W. HERZOG*

FOREWORD

THIS outline of plans set up for *The Milwaukee Journal's* television project is divided into two parts: 1) preparations prior to T-Day, when WTMJ-TV will officially go on the air, and 2) operations during the first few months following T-Day.

T-Day, we hope, will be on December 3, 1947. However, this review of the many problems involved indicates that there is always a possibility that the opening day may be delayed.

In setting up our plans, we attempted to profit by the experience of others. During the past few years, frequent visits were made to television stations in New York, Philadelphia, Schenectady, and Chicago. This provided a good deal of worth-while information, but we have always been mindful of the fact that the operation of most of these stations would not represent our future activities exactly, because they, for the most part, will eventually be network originating points. For that reason, we have paid special attention to and have frequently visited Detroit and St. Louis where the News and the Post-Dispatch, respectively, have been operating stations for the past few months. We feel that their situation approximates ours in Milwaukee, and for that reason their activities will be referred to frequently in this outline.

Technical Operations ★ Since the technical end of television is extremely complex, it was essential to set forth very carefully the work to be done by the technical staff before T-Day. This effort was broken down into the following schedule:

Aug. 1-31: Assembly and installation of the main transmitter

Sept. 1-15: Preliminary testing of the main transmitter

Sept. 15-30: On-the-air tests of the main transmitter

Sept. 1-30: Preliminary field testing of relay pickup transmitter

Sept. 1-30: Installation of film camera chain and 16-mm. projector

Sept. 1-30: Outfitting of studio

Oct. 1-30: Continued checking of main transmitter operation

Oct. 1-30: Continued testing of field pickup equipment from various points in the Milwaukee area

Oct. 1-Nov. 15: Technical operations of the studio for programs, experiments, and demonstrations

Nov. 15-30: Studio rehearsals for T-Day

We have been experimenting with the possibilities of picking up Chicago television stations directly from specially designed receiving antennas installed on the tower at Richfield and on the tower at our Radio City Building.

Program Operations ★ These operations concern not only the developing of the actual program schedule of WTMJ-TV, but also the training of the staff and some measure of public demonstrations for publicity purposes. Here is our schedule:

Aug. 15-30: Interviews and contact work regarding performing rights and copyright clearance for live shows and film, and the development of talent for the various items of effort listed immediately following. In the matter of talent, we will work with both professionals and amateurs, and in the latter group we will work particularly with the little theatre groups in Milwaukee.

Sept. 1-30: Preliminary work with film

Sept. 15-24: Checking studio installations and preparation for Gimbel Brothers demonstration

Sept. 24-27: Demonstration at Gimbel Brothers store

Oct. 1-Nov. 30: Experimental remote pickups, two or three a week, approximately 18 hours of time weekly

Oct. 1-Nov. 15: Experimental work with

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live studio programs, approximately 12 hours a week. During this same period we will work in the studios with local advertising agencies and key advertisers approximately 3 hours per week. This will give the agencies an opportunity to become familiar with television technique
Oct. 15–Nov. 15: One Television Night per week, each show with its rehearsal to take about 5 hours of time. These demonstrations will be presented at Radio City auditorium studio for selected groups.
Nov. 15–30: Final rehearsals for the air shows to start December 3

Personnel ★ Compared to sound broadcasting, television takes a much larger staff of both technicians and program workers. Benefiting from the experience at St. Louis and Detroit, we will attempt to keep the staff of exclusive television workers at rock bottom by 1) training various individuals for a number of duties so they can be used where most needed, and 2) borrowing from the WTMJ and WTMJ-FM staff.

At the present time, we have 3 technical men who are 100% on television. One of these will act as the technical director, and on remotes will operate the microwave relay transmitter. The second will operate the main transmitter, and the third man will be the video control operator. On the program side, we now have the program director of WTMJ and WTMJ-FM, who will function as the program director of WTMJ-TV. He will be able to do this because we recently employed an assistant program director to handle most of the WTMJ and WTMJ-FM programming. We also have at the present time a man who has been handling various promotion assignments such as Radio City Nights. His work will be so arranged that he can act as the film director of WTMJ-TV. In addition to these, we have a competent staff of announcers, news writers, and office clerks whom we expect to call upon in the first few months to give some of their time to similar work in television.

The necessary additions to the staff and the approximate dates of employment are as follows:

1. Aug. 15: Cameraman No. 1
2. Aug. 15: Cameraman No. 2
3. Sept. 15: Audio control operator
4. Sept. 15: Production manager (will also act as director or assistant director)
5. Sept. 15: Program director and/or assistant director
6. Oct. 1: Special events manager (will also direct special events pickups)
7. Oct. 1: Microphone boom operator
8. Oct. 15: Video control operator No. 2
9. Oct. 15: Projectionist
10. Oct. 15: Floorman No. 1 (lights, scenery, props, etc.)
11. Oct. 15: Floorman No. 2
12. Oct. 15: Program assistant (utility)
*13. Oct. 15: Program director and/or assistant director
*14. Oct. 15: Program director and/or assistant director
*15. Nov. 1: Script writer and editor

* These positions dependent on amount and type of programs.

Set Distribution ★ Obviously, our goal will be to get as many sets installed as possible prior to T-Day. However, such sets, if they are not legitimately made and installed correctly, will be more of a liability than an asset. To this end we are guarding against fly-by-night operators offering sets for lower prices than the established manufacturers, and particularly those offering to take orders now with a deposit against future deliveries. We have contacted the three largest manufacturers in the field and find that their plans of procedure are much the same. These manufacturers won't come into a market until they have determined to their own satisfaction that the television station will do a good job. As soon as we get on the air with test material, they will send engineers to Milwaukee who will check our signal and our coverage. When they are sure that our picture signal is of satisfactory quality, they will start to train service organizations and will also hold dealer meetings.

Following the dealer meetings, they will survey the dealers' locations and will install demonstration receivers. They will get enough receivers into Milwaukee so that installations can be made prior to T-Day in dealer's homes, in public places, and in strategic locations. They will not be prepared, however, to install sets in the general run of private homes until after T-Day, but they have assured us that they will have plenty of sets on display in Milwaukee the day we go on the air.

Judging by experience in all other cities, the first wave of set installations goes into public places, principally taverns, cocktail lounges, and hotels. Home set sales start slowly but build steadily, whereas the installations in public places level off. Of course, when baseball goes on the air in the spring over television, there should be another spurt in tavern installations.

Sales Effort ★ In attempting to set up a rate card for television, we realize fully that at the start rates cannot be based on actual circulation. Although the number of viewers per television set is high compared to the number of listeners per radio set, the number of television sets will be comparatively low. The advertiser who buys television at the beginning will do so for prestige and experience. Our tentative setup shown below follows the general pattern in other cities. There is a separate charge for transmitter facilities, plus a production charge, depending upon the type of program and the amount of time required to rehearse and produce the show. It will be noted that there is no differential for day and night time, nor are we contemplating any frequency discounts. Furthermore, we are considering the idea of making rates subject to change on 30 days' notice. The proposed initial rate setup is as follows:

1. Transmitter Charge (day or night)

1 Hr.	$150
½ Hr.	90
20 Min.	75
15 Min.	60
10 Min.	45
5 Min.	30
1 Min. or less	20

2. Program Facilities Charges *

Studio

1 Hr.	$240	(incl. 5	hrs.	rehearsal)
½ Hr.	140	" 3	"	"
20 Min.	120	" 2½	"	"
15 Min.	100	" 2	"	"
10 Min.	80	" 1½	"	"
5 Min.	60	" 1	"	"
1 Min.	Rates on application			

Film

1 Hr.	$120	(incl. 3	hrs.	rehearsal)
½ Hr.	75	" 2	"	"
20 Min.	60	" 1½	"	"
15 Min.	38	" 1	"	"
10 Min.	35	" 40	min.	"
5 Min.	30	" 30	"	"
1 Min.	Rates on application			

* If allotted rehearsal time is not used, sponsor will be charged at rate of $100.00 per hour or fraction thereof for rehearsal or program preparation time.

3. Remote Pickups

Rates on request based on program conditions.

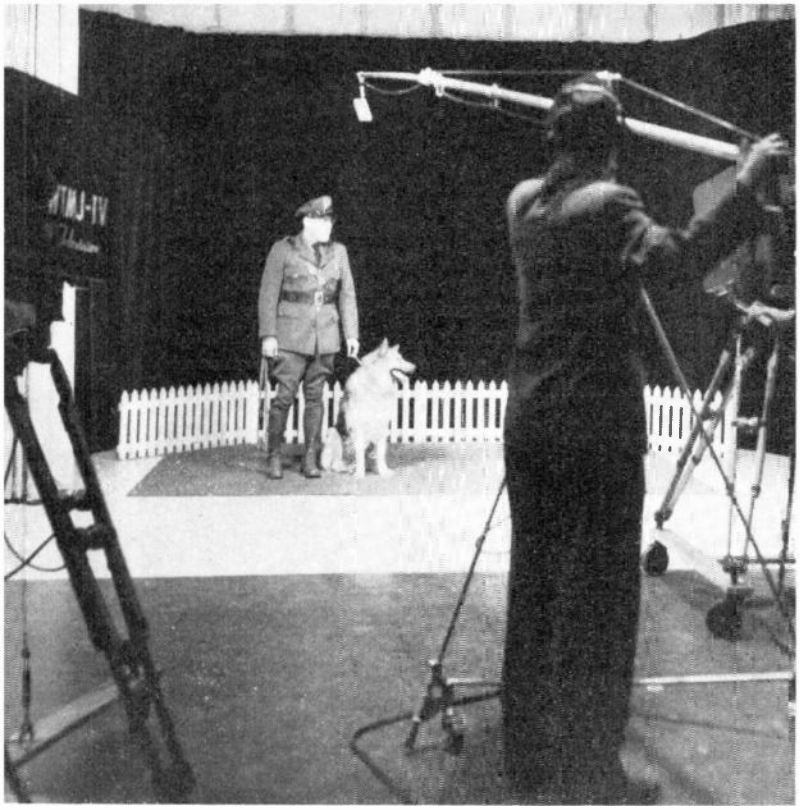
We are not planning to hire any special salesmen to sell television at the start. The present WTMJ sales force will undertake the job.

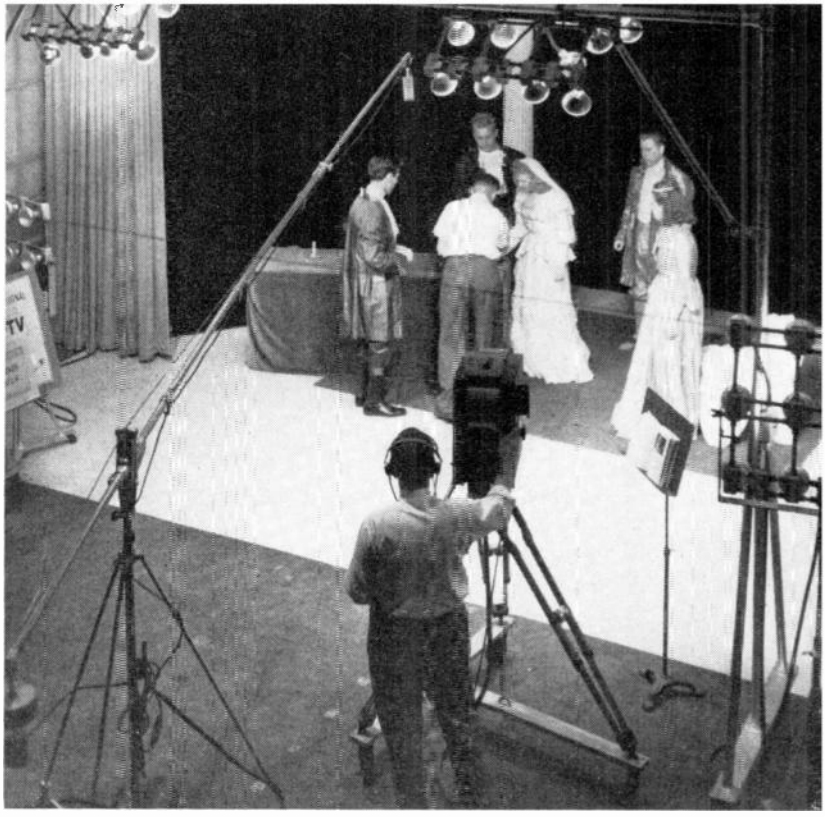
Promotion and Publicity ★ Promotion and publicity will be designed to reach three classes:

1. The general public
2. Television set distributors and dealers
3. Potential television advertisers

There will, of course, be some overlap because certain types of promotion designed for one group will also reach other groups. The following is a general outline of the proposed promotion and publicity up to T-Day. This is subject to change as detailed plans are prepared and submitted for approval.

1. The General Public: The first line of effort, of course, is through *Journal* news columns. Stories and pictures to keep the public informed of the progress at WTMJ-TV will continue until T-Day and will culminate in a special section on the Sunday before T-Day. Supplementing this are office advertising space, announcements over WTMJ and WTMJ-FM, *Journal* truck signs, displays in *The Jour-*





TO GET STARTED, WTMJ-TV WILL USE ITS FIELD CAMERAS IN THE STUDIO, TOO, UNTIL THE SPECIAL STUDIO CAMERAS ARE DELIVERED

nal building lobby and windows, and in the Radio City lobby. During the first part of the promotion period, the emphasis is being put on the slogan "Television Is Coming" and in the last stages this will be changed to "Television Is Here." During the month of November, public announcement will be made of the times when unofficial test programming is on the air.

Consideration will be given also to such paid media as car cards, billboards, window cards, and taxicab signs. Since T-Day will be a genuine civic event in Milwaukee, the possibility of obtaining the City Hall sign, lamp post signs, and signs over downtown bridges will be investigated. Another possibility to be considered is that of display signs, probably on easels, to be placed in 25 or 30 key retail radio stores and department store radio departments, carrying pictures and copy to be changed frequently. This effort should have a good effect on the public as well as the dealers.

Six weekly Television Nights are being planned for the Radio City Auditorium to which selected groups will be invited to hear a brief outline of our plans for WTMJ-TV and a demonstration of the equipment. Public officials, educators, members of service clubs, and other influential people will be chosen with the idea of securing audiences which will do us the greatest possible good.

Special attention will be given in this and in other ways to reaching those who should be interested in buying television receivers for taverns, hotels, and schools. In the case of taverns, which we know from the experience of other cities will be installing sets before T-Day, we shall work out a method of keeping them informed of the scheduling of test program periods.

2. Distributors and Dealers: Our promotion and publicity to this group is designed to get them interested in merchandising receivers actively, and to coördinate their advertising and promotion with our schedules. In this connection, we are notifying them of the scheduled test periods prior to T-Day. In order to keep the dealers informed regarding our program, we held a clinic in the Radio City auditorium, to which everyone interested in the sale of television receivers in the Milwaukee area was invited. Talks by members of our staff, a question-and-answer period, and demonstrations of equipment created great interest. Notices and other information are being sent to the trade through the bulletin of the Wisconsin Radio, Refrigeration & Appliance Dealers Association, and by direct mail.

Realizing the influence which the set manufacturers can bring to bear upon the dealers and distributors, we are already setting up a program of contacts which will help coördinate the activities of manufacturers in creating enthusiasm and organizing the dealers.

3. Potential Advertisers: Potential advertisers in the Greater Milwaukee area at the start will be limited to a relatively small group of key retail and wholesale organizations, together with those Milwaukee advertising agencies who have staffs of a size and with capabilities that can deal intelligently with television as a new advertising medium.

It is proposed to hold a clinic in the Radio City auditorium in advance of T-Day to which those organizations will be invited. At this clinic we will explain some of the problems as well as the potentialities of television, and will demonstrate the equipment. After this demonstration, we will offer interested advertisers and agencies the opportunity to come into the studio and to work out with our staff simple experimental television shows prior to T-Day.

In the national field, the best potential advertisers for WTMJ-TV are those organizations which have been using programs on television stations in other cities. Since they already have the know-how, the contact with them becomes a straight sales approach which will be handled by our regular sales department until such time as we have national representatives in the television end of the business.

OPERATIONS ON AND AFTER T-DAY

Program Schedule ★ Programs for T-Day and the first week of operation will not be representative of the regular schedule of WTMJ-TV. On T-Day, most of the programs will be special in nature. We hope to have Niles Trammell, president of National Broadcasting Company and other notables in Milwaukee for that occasion. This outline relates to the regular programming during the time we will have to originate all program material here in Milwaukee. During this pre-network period, we hope eventually to be on the air about 20 hours a week, although it is quite probable we will not hit that pace until sometime after regular, scheduled operation starts.

In planning our initial program schedule, we have taken into consideration the fact we will have only two cameras available at the start for live shows. This means that no studio shows can be produced during the same segment of a day when the cameras are being used on a remote pickup. In other words, if we are picking up a ball game in the afternoon, we cannot hope to have a studio program until night.

As we get into the final stages of our training and rehearsal, we may find our plans have been too ambitious, and we may have to reduce the schedule to a lesser

number of hours per day. If this becomes necessary, there will, of course, be some reduction in the size of the program personnel listed in this outline.

We are planning to be on the air only 5 days a week, from Wednesday through Sunday, at the start. In setting up this schedule, we are following the experience of others who have found that television takes such a large staff that, at the start, one full crew working five days a week can handle the schedule very efficiently and with little overtime. Therefore, Monday and Tuesday will be off-the-air days, except for one transmitter operator to keep a test pattern on the air so that the servicemen installing or adjusting television receivers will be able to check their work. Without such a test pattern these servicemen will, of course, be working entirely in the dark. Since the actual programming Wednesday through Sunday will not average more than 5 hours per day, it will also be necessary to keep the transmitter and test pattern on the air on those days before and after the regular transmission of programs.

It may be that we shall have to go on the air on T-Day entirely dependent upon our local program efforts, consisting of live studio programs, remote pickups, and film. While we expect to obtain television network service from NBC, that organization may not have its Chicago television outlet on the air before June 1948. And even then the method of physically transmitting the programs to Milwaukee has not been settled. Meanwhile, we have discussed with Chicago stations the possibility of exchanging programs for re-broadcast purposes, provided some means of transmission are found. We are currently checking the possibility of direct reception of Chicago stations at Richfield, utilizing a directional receiving antenna. The natural elevation at Richfield, plus the additional elevation to be made possible by our new 550 ft. FM tower, may give us a fair degree of dependable reception from Chicago.

Completion of Equipment Program ★ Original plans for the WTMJ-TV setup proposed equipment expenditures of $400,000 to be taken in three steps.

Step No. 1 was the minimum expenditure required to go on the air. All equipment under that step has been ordered, and should be delivered in time for T-Day.

Step No. 2 calls for an expenditure of about $170,000 to complete the television studio. Of this amount, $75,000 is for a new 500-ft. tower. This expenditure can be postponed for several years, we believe. The other equipment in Step No. 2, including three studio type cameras, will be ordered, and much will probably be delivered in 1948. However, we are already finding that the amount of studio programming we can do will be limited by the fact that the two portable cameras can't be at a remote spot and in the studio at the same time. Therefore, it may be necessary to order at least one studio camera and its associated control equipment for delivery as early as possible in 1948.

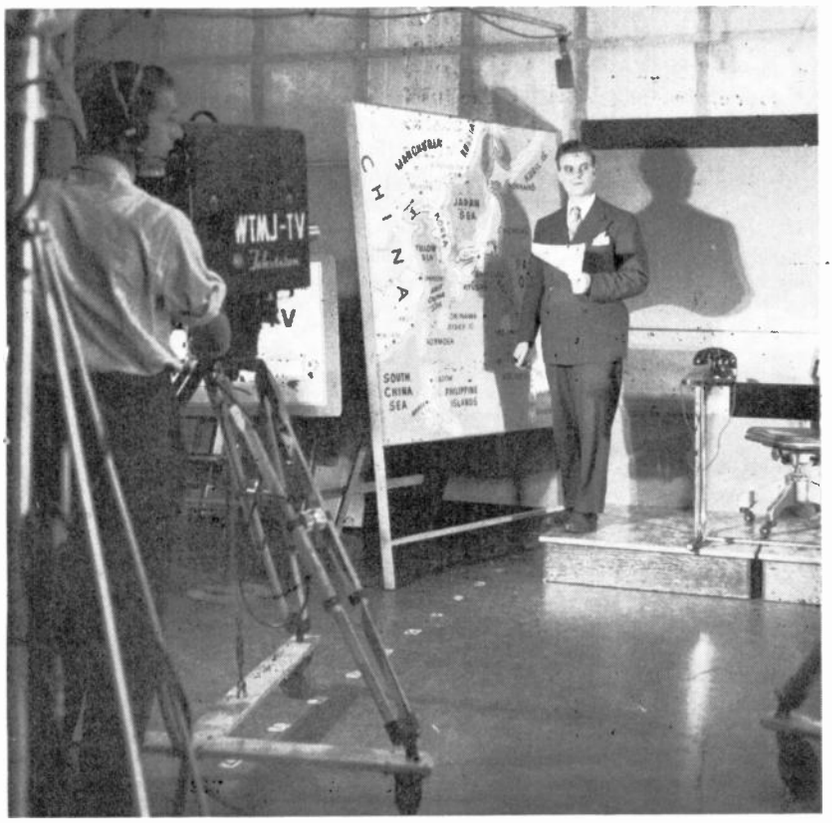
Step No. 3 is entirely concerned with the remodeling of our Radio City building to provide for production work rooms, talent quarters, television offices, and possibly additional studio space. While plans for this remodeling were scheduled to go forward during 1948, it is doubtful whether actual work on Step No. 3 will start before 1949.

Reports from Viewers ★ An essential activity in connection with the early days of WTMJ-TV will be surveys of the users of television receiving sets. Only by getting the reactions of those having sets can we determine what kind of a programming job is being done. Until there is a considerable body of set owners, we propose to follow the example of St. Louis and Detroit. The system they use, which has been very helpful, is to mail an advance weekly program schedule to each set owner. Attached to the program schedule is a report form which users can fill and return to the station, giving their views on the programming. Both cities mentioned have had a remarkably large percentage of returns.

Promotion of Set Distribution ★ Any specific plans for the promotion of set ownership after we start regular will depend to a large extent on the rate of sale. It may be desirable, in any case, to consider a certain amount of promotional advertising to sell television just as we sold FM when we brought it to Milwaukee in 1940 and 1941.

While this means assuming a considerable added responsibility, experience has indicated that such promotion by a station is highly effective in the initial period. Then, when enough sets are in use so that a substantial number of people have had their first look at television, the local dealers go into action.

TRAINING OF OPERATORS IN NEW CAMERA AND MICROPHONE TECHNIQUES IS IMPORTANT PART OF PREPARATION AT A NEW STATION. EXPERIENCED MEN ARE STILL SO SCARCE THAT STATIONS ARE HIRING THEM AWAY FROM EACH OTHER IN MANY CASES



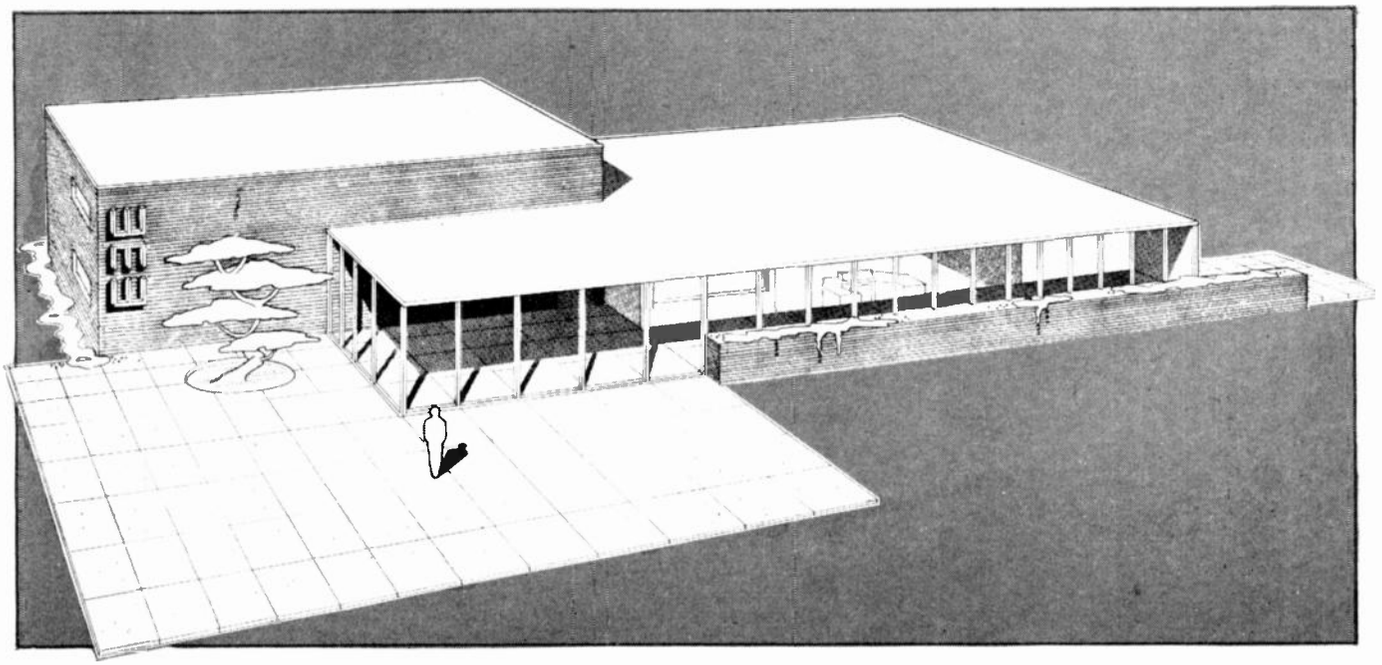


FIG. 4. THIS BUILDING IS DESIGNED FOR A 50-KW. FM TRANSMITTER. LIVING QUARTERS ARE PROVIDED ON THE SECOND FLOOR

PLANNING AN FM BROADCAST STATION

A Review of the Facilities Required and Modern Methods of Design — Conclusion

BY R. S. LANIER

Washroom ★ The FCC requires that a washroom be installed close enough to the operator on duty so that he will not find it necessary to be away from the control point more than a few minutes at any time. No stipulation as to the exact distance from the control desk is made nor is it required that the washroom open directly into the control room. However, if the operator has to go to the end of a long corridor, or to another floor a considerable distance from the transmitter, it is considered bad practice.

Storage Space ★ No transmitter building can operate efficiently without storage space. Spare tubes, test equipment, repair parts are essential and should not be piled in a corner because nothing better is provided.

In estimating the amount of storage space needed, it pays to go well over on the generous side.

In larger stations, special storage schemes may offer benefits. With a complex transmitter, for instance, the tube storage can be arranged on a functional basis, with racks constructed to hold an exact duplicate set of the tubes in the transmitter, arranged in corresponding order.

One type of storage sometimes overlooked is that for reports and other papers. Ordinary file cabinets are satisfactory. Built-in-cabinets, conveniently located to the control room, make an attractive solution.

Further improvements in efficiency and convenience can be achieved with the following types of storage:

1. Racks or drawers for easy storage and removal of the numerous blueprints needed in a broadcast station;

2. Closet and lockers for clothes and personal belongings of operating personnel;

3. Bookshelves or racks for engineering reference books, periodicals, and equipment catalogues. A library corner in the office or other convenient space is a great help to neatness and order, and puts the reference tools in a known location where they can always be found quickly by the operating force.

Workshop ★ A shop consisting of a substantial bench with adjacent storage space for tools and small parts should be included in every broadcast transmitter building.

The tools most commonly needed are those ordinarily used in repairing or rewiring radio equipment, plus a drill press and heavy vise. In the larger stations a small metal lathe may be useful, but complete machine shop equipment has been found unnecessary by the majority of broadcast stations. Covered storage space to protect expensive test equipment, should be included in the shop. With FM transmitters, shop storage space and transmitter room, or shop and heater room, may be combined conveniently.

No one should work in the vicinity of a high-power radio transmitter unless his full attention is on the transmitter. In addition, the safety regulations may require that the area in back of the transmitter be within an interlocked enclosure.

Office ★ The usefulness of an office in the smaller stations arises from the record-keeping activities that are imposed by law on every broadcast station. Storage of records and a place to prepare the required reports are just two of the functions that make an office desirable. It is possible to combine the office with other functions, such as the visitor's lobby or the operator's lounge.

There is another kind of value arising from the inclusion of an office for the chief engineer or transmitter supervisor. The technical heads of a broadcast station have a professional standing which should be recognized by the management and the general public. Proper office facilities are important as a recognition of the chief engineer's status.

Shower Room ★ After more storage space the shower room was one of the features most often mentioned as desirable by the broadcasters questionnaired on features of transmitter buildings.

Kitchenette ★ This is another convenience which has universally proved itself in the minds of operators, owners and builders of transmitter buildings. Naturally in a building with living quarters, a complete kitchen must be included. However, in a building without living quarters or a regular kitchen, the single-unit kitchenette with stove, sink, shelves, and refrigerator all in one compact, relatively inexpensive piece, gives the operators a place to "boil up a bite" while on duty. This has proved particularly valuable for operators on all-night watches.

Emergency Studio ★ Every broadcast transmitter which is separated from its studios faces the possibility of being cut off from the program source. Prolonged time off the air can be avoided if provision is made in the transmitter building for emergency program production. Various arrangements at the transmitter building will allow the station to get on the air on a more or less minimum basis:

1. Turntables and speech input equipment can be added to transmitter control desk. This is the simplest arrangement, and will generally be satisfactory for recorded music programming. The use of a microphone at the control desk may be unsatisfactory without acoustic treatment of the control room. The noise level produced by air cooling equipment may make a glass isolation screen in front of the transmitter desirable.

2. Turntables and speech equipment can be installed at transmitter control desk, with a separate acoustically treated room for microphone pickup. With such a room adjacent to the control room, a properly placed viewing window will make it possible for the transmitter operator to handle the turntables and to control the live pickup without leaving his position.

3. A complete emergency studio may be considered necessary. Naturally there is no limit, except the resources and needs of the station management, to the completeness of the studio equipment installed in the transmitter building.

Garage ★ The need for a garage at the great majority of transmitter buildings is obvious. Parking space is a further convenience for visitors and personnel.

Living Quarters ★ The provision of living quarters for at least a part of the operating personnel will pay off in inaccessible locations. Their inclusion as a part of the transmitter building, either from necessity or to increase the efficiency and attractiveness of the building for the operating force, was clearly indicated by broadcasters queried on this point.

Employees' Lounge ★ The employees' lounge is another building unit which adds greatly to the convenience of the operating force. It can be combined with the office, eating area, or shop and storage space.

Heater Room ★ The trend to single-floor layouts brings the separate heater room to the fore as a feature of the main floor plan in nearly every building where heating is required. In the smaller stations, the heater room can be combined with the shop and storage.

Transformer and Distribution Room ★ The larger transmitters, using separate high-voltage equipment, introduce the necessity for separate rooms or enclosures which embody the safety and isolation features required by FCC and Underwriters' regulations. Interlock systems and other safety measures for such rooms are ordina-

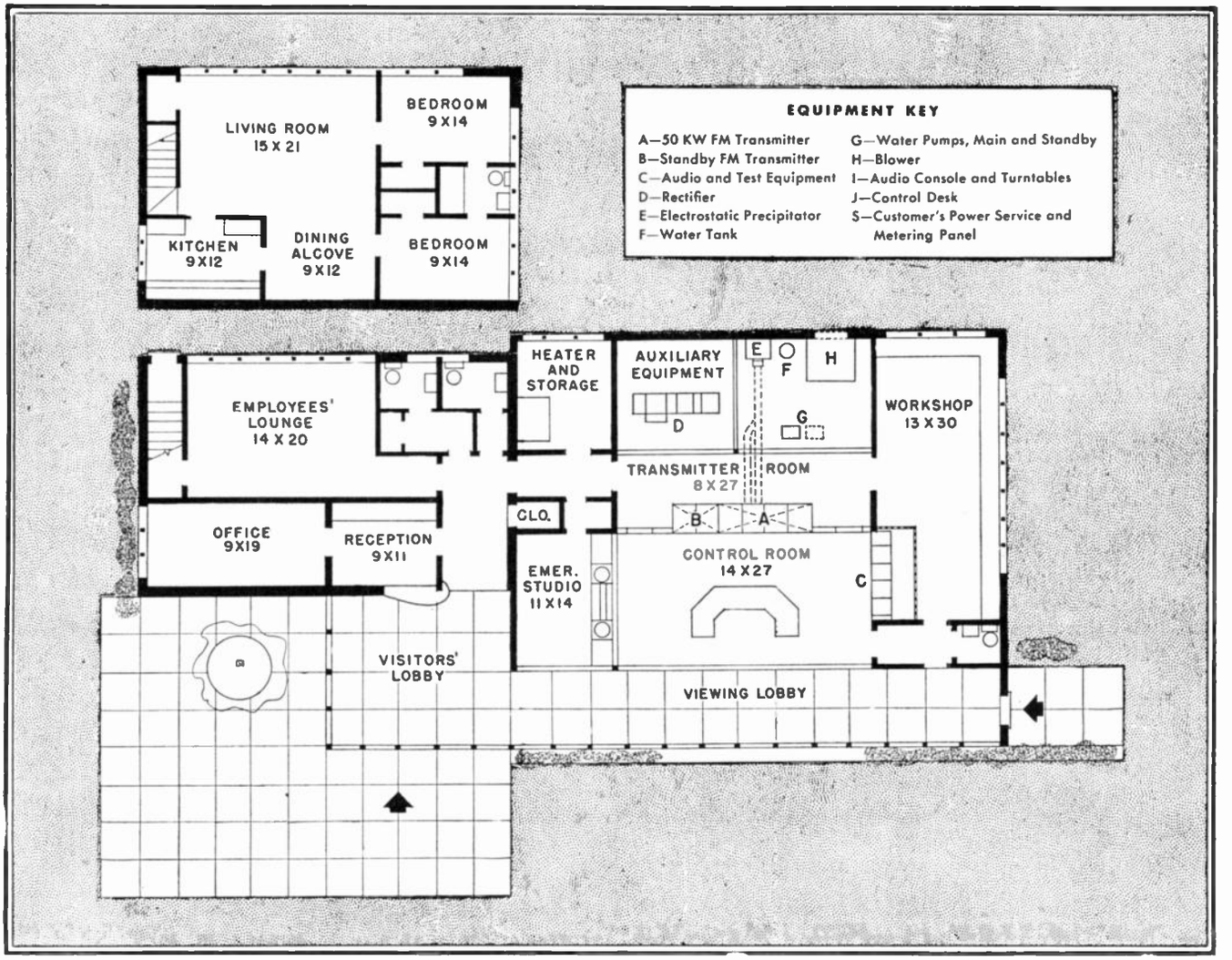


FIG. 5. FIRST & SECOND FLOOR PLANS OF ELEVATION DRAWING IN FIG. 4. NOTE FACILITIES PROVIDED FOR EFFICIENCY & CONVENIENCE

rily specified for each transmitter by the manufacturer. Interlocks on high voltage areas must not interrupt the building circuits, nor interfere with equipment which must be used while the transmitter is not in operation.

Viewing Lobby & Visitors' Lounge ★ The viewing lobby is a popular form of public relations effort for the reason, often pointed out, that transmitting equipment has beauty and drama for the general public. A transmitter with the line-up of units facing the operator, the high-power amplifier tubes visible through the front panels, and the rows of meters and controls are always impressive. The viewing lobby can be combined with an attractive, well furnished lounge.

Naturally, if you are going to show your building to the public, the operating area should be neat and straightforward in arrangement. The appearance of precision and efficiency which a well-arranged, well-kept transmitter area gives can be a valuable goodwill agent.

The principal problems in the arrangement of viewing lobbies are: a) provision of easy viewing combined with fool-proof separation of the operating and high-voltage areas from the public, b) arrangement of entrance and exit so that visitors can move easily through the building. The use of glass walls around the control area has proved a satisfactory way of solving these problems.

TECHNICAL ACCESSORIES

There are a great number of technical features than can be added to a transmitter building, the choice of which will be determined in most cases by individual needs, as interpreted by the technical specialists working on the building.

Emergency Power ★ The chance of losing primary power can be minimized in two ways:

1. Installation of standby diesel or gasoline-engine driven generating equipment large enough to operate the transmitter and auxiliaries. Such generating equipment should usually be placed in a separate building, for lower insurance rates.

2. Provision of an alternate power run, or connection to entirely separate commercial source, if such is available.

Emergency power has proved extremely valuable in the experience of many broadcast stations.

Communication System ★ Communication between different parts of the building becomes important in the larger installations. A telephone for both outside calls and building intercom should be placed on the control desk.

Recording Room ★ In combination studio-transmitter buildings, where disc recording is to be done regularly, a stable floor is essential in the recording room. Various construction methods are available for giving the floor a very low period of vibration and insulating it from disturbances in the rest of the building.

Shielded Test Room ★ In FM stations, a shielded test room may be found valuable to eliminate errors in adjusting monitoring and test equipment. The conventional grounded copper-mesh booth is usually satisfactory.

BUILDING SERVICES AND CONSTRUCTION

Heating ★ Transmitter buildings in colder climates can be heated by any of the conventional methods, but hot air and radiant systems have proven the most popular. Insulation pays off in transmitter buildings as in other types of buildings.

The subject most discussed in this connection is naturally the use of waste transmitter heat to heat the building. Many successful installations of this type have been made which have proved to be economical and practical. However, before you plan to use it, your architect and heating engineer should give careful consideration to the following:

1. In colder climates, waste heat should not be relied on as the sole means of heating the building. Most broadcast transmitters are turned off a part of the time, whereas in cold weather a building must be heated continuously.

2. In most cases in colder climates, the waste heat should be used to supplement the regular heating system rather than the other way around, since the regular heating system must have full capacity to cover those periods when the transmitter is turned off.

3. In summer, the waste heat must be discharged outside the building. This means that a system of control must be installed which can be used to discharge the waste heat in the summer, and to utilize it in the winter. When correlated with an air-conditioning system this can become elaborate and expensive.

4. A careful study of the cost of the required control systems sometimes shows that it is cheaper to exhaust the waste heat outside the building, winter and summer, and rely on a conventional heating system for the building.

Cooling ★ Wherever hot summer temperatures are encountered, a complete system for cooling the building and filtering the air will promote efficiency and will pay big dividends by increasing the reliability of the equipment. The minimum should be a system for exhausting the air in the whole building in summer, with provision for the entry of filtered air.

Construction Methods ★ The construction methods for a broadcast transmitter building are in most respects the same as those for other types of similar size. Choice of materials will depend on cost and availability in each locality, on building ordinances, and on the desires and resources of the station management.

Reinforced concrete and brick are the two most popular forms of construction for the larger buildings. Fieldstone, alone or in combination with concrete or wood, is economical in many areas, and can produce a substantial, attractive building in harmony with its surroundings.

For smaller buildings, wood has been found entirely satisfactory. Wood in combination with concrete is another practical and attractive possibility.

Fireproof construction is recommended not only as a safety measure, but to lower insurance rates.

It is required by the Underwriters' and FCC regulations that the metal frame of a transmitter and all associated equipment, as well as the frame of the transmitter building itself, be thoroughly grounded as a protection to operating personnel. In some cases this is combined with the RF ground for the transmitter. No large conducting bodies in a transmitter building should be left ungrounded. If metal lath is used on the walls, this should be bonded together at a number of points and connected to the grounding system, to form a practical shield against RF energy.

A hazard often overlooked is the RF induction in small metal parts of the building frame with consequently dangerous temperature levels, particularly when the antenna is close to the building. Wooden buildings with composition roofs are more often subject to this kind of danger. Heating of the nails in the roof, or even in the floors of the building may require some form of shielding or grounding system to eliminate this fire hazard.

ARCHITECTURAL STYLE

Finally, you must be satisfied that the whole style of your building represents your plans and policies. Satisfactory architectural style is based on two principles: a) It should follow naturally from the interior shape and function of the building, b) It must have pleasing order and harmony in the exterior to fit in with the site and with the materials used.

It is here that a less tangible element enters into the planning of your transmitter building, an element strongly personal but nevertheless inseparably connected with the success or failure of your business. This is the sense of permanence, of pride, of personal identification with the standing of your business in the community. It can be expressed in many ways, and certainly in a substantial and beautiful transmitter building. It is easy to pick out, in broadcasting as in other businesses, the organizations that achieve long-range success. Every aspect of their technical and organizational equipment expresses this same sense of permanence and pride.

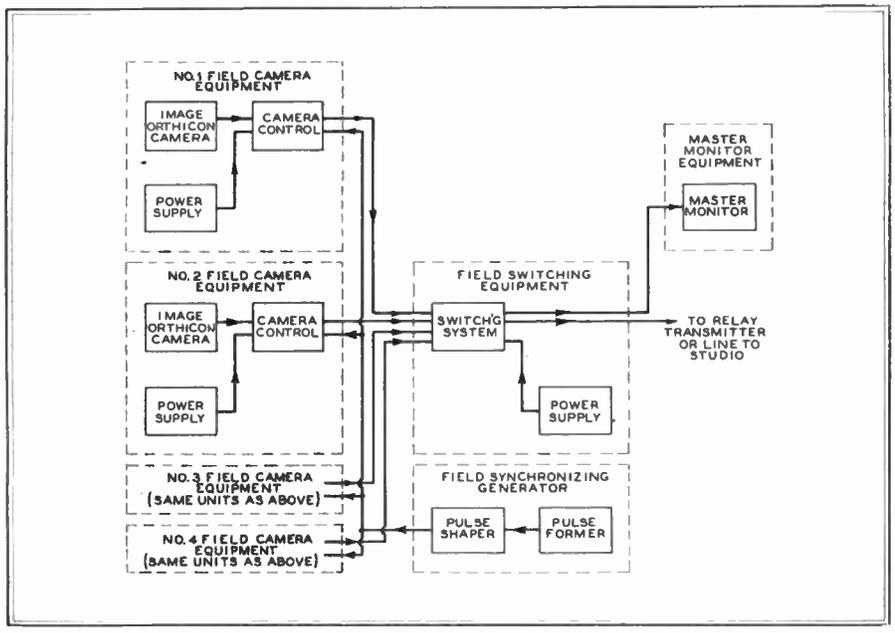


FIG. 1. SHADED PORTION OF DIAGRAM SHOWS UNITS DESCRIBED IN THIS ARTICLE

TELEVISION FIELD EQUIPMENT

The Camera, Camera Control, and Power Supply Units

BY JOHN H. ROE AND NORMAN S. BEAN*

FIELD cameras and their associated equipment provide the starting point for television broadcasting because, being portable in design and versatile in application, they can be used in conjunction with a relay transmitter for a wide range of outdoor events, or set up at the main station for studio programs.

This is the plan adopted at most of the new stations now going on the air. It is a quick method of getting started, even before studio facilities are set up on a permanent basis, and studio cameras and monitoring consoles are completely installed.

Complete field equipment, shown diagrammatically in Fig. 1, comprises:

1. One to four tripod-mounted cameras
2. A camera control and power supply for each camera
3. Switching system to shift from one camera to another, with its power supply
4. Synchronizing generator, comprising pulse-shaper and pulse-former units
5. Master monitor
6. Relay transmitter

Standard practice for field pickup service is to mount this equipment in a specially-constructed truck (see front cover) where it is carried on shock-absorbing racks to protect it from damage in transit. The rear of the truck can be used as a monitoring booth. Reels for camera cables are also mounted at the rear, with the central part fitted with racks for the relay transmitter, and compartments to take the cameras, relay reflector, tripods, and special gear.

Field Camera ★ The field camera, illustrated in Fig. 2 and in subsequent, detailed views, is an RCA TK-30A, designed to use the Image Orthicon tube. As the illustrations show, the camera is divided into two separate sections which plug together, and are secured by a quick-release mechanism. Each section has a carrying handle.

The lower section is the camera proper. The upper part is view-finder, equipped with a 5-in. picture tube which shows exactly what the camera tube sees. Figs. 7 and 8 show the arrangement of the two assemblies. This construction enables the operator to move the camera to follow the action, and at the same time monitor the picture quality. Camera and view-finder weigh 65 and 35 lbs. respectively.

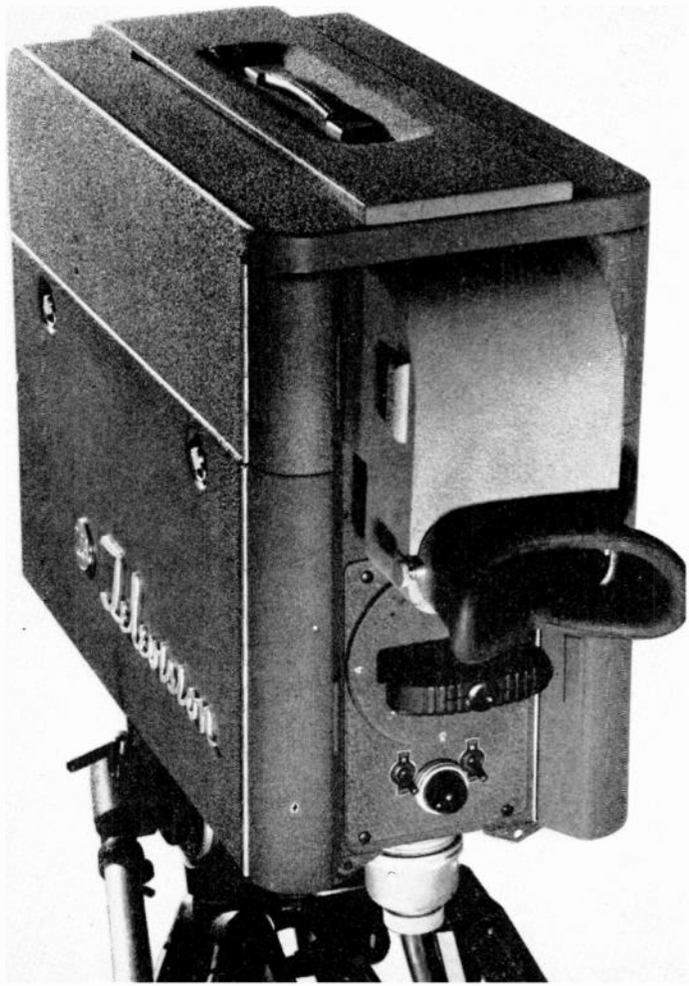
The camera can be operated up to 1,000 ft. from its associated control and power supply units. Standard practice is to supply a 200-ft. cable, but this can be extended readily. This cable, slightly less than 1 in. in diameter, contains 3 coaxial lines and 21 wires, carrying the video signal, power supply, and blanking, deflecting, monitoring, and inter-communications circuits.

Lens Turret ★ Four Kodak-Ecktar lenses are carried on a rotating turret, as shown in Fig. 6. The operating position is at the top. A handle at the rear of the camera, Figs 5 and 6, is rotated to select the lens desired, and a trigger switch incorporated in the handle cuts off the picture while the turret is being turned. By actual test, shifting lenses and refocusing requires only 1½ seconds.

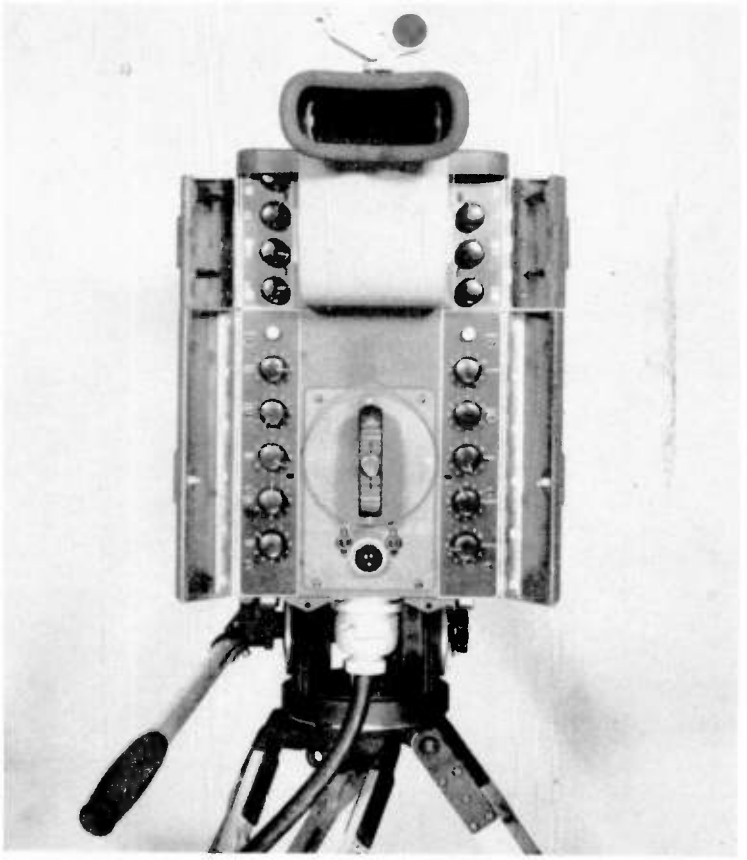
Focusing can be accomplished in two ways. First, there is the main focusing control in the right side panel. The knob can be seen in Figs. 5 and 6. Fig. 7 shows the gear train inside the panel. This engages a mechanism which moves the camera tube assembly, comprising the Image Orthicon, its yoke, focus and alignment coils, and the mu-metal shield.

The second control is provided by turning the barrels of the individual lenses. When desired, they can be prefocused, to eliminate further adjustments when the turret is rotated. For example, at a baseball game, the 50-mm. lens can be focused on the announcer, 3 or 4 ft. from the

FIG. 2. IMAGE ORTHICON FIELD TELEVISION CAMERA



* Television Engineering Department, Radio Corporation of America, Camden, N. J.



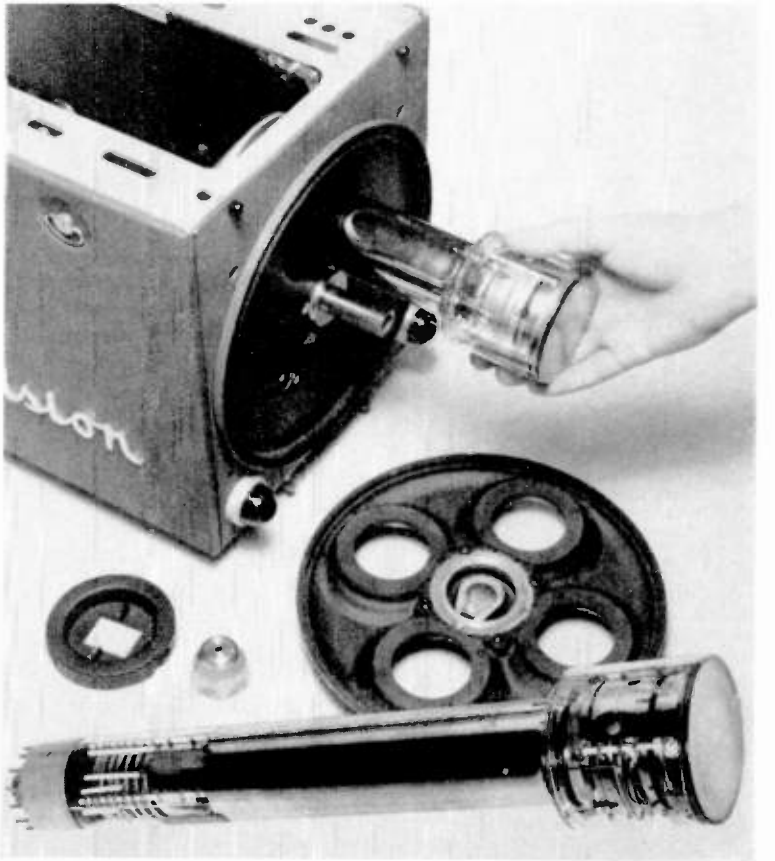


FIG. 3. REAR OF CAMERA, WITH DOORS OPEN TO SHOW CONTROLS. FIG. 4. IMAGE ORTHICON TUBE, AND METHOD OF INSERTING IT

camera, the 90-mm. lens on the infield, the 135-mm. lens on the outfield, and a telephoto lens on the scoreboard.

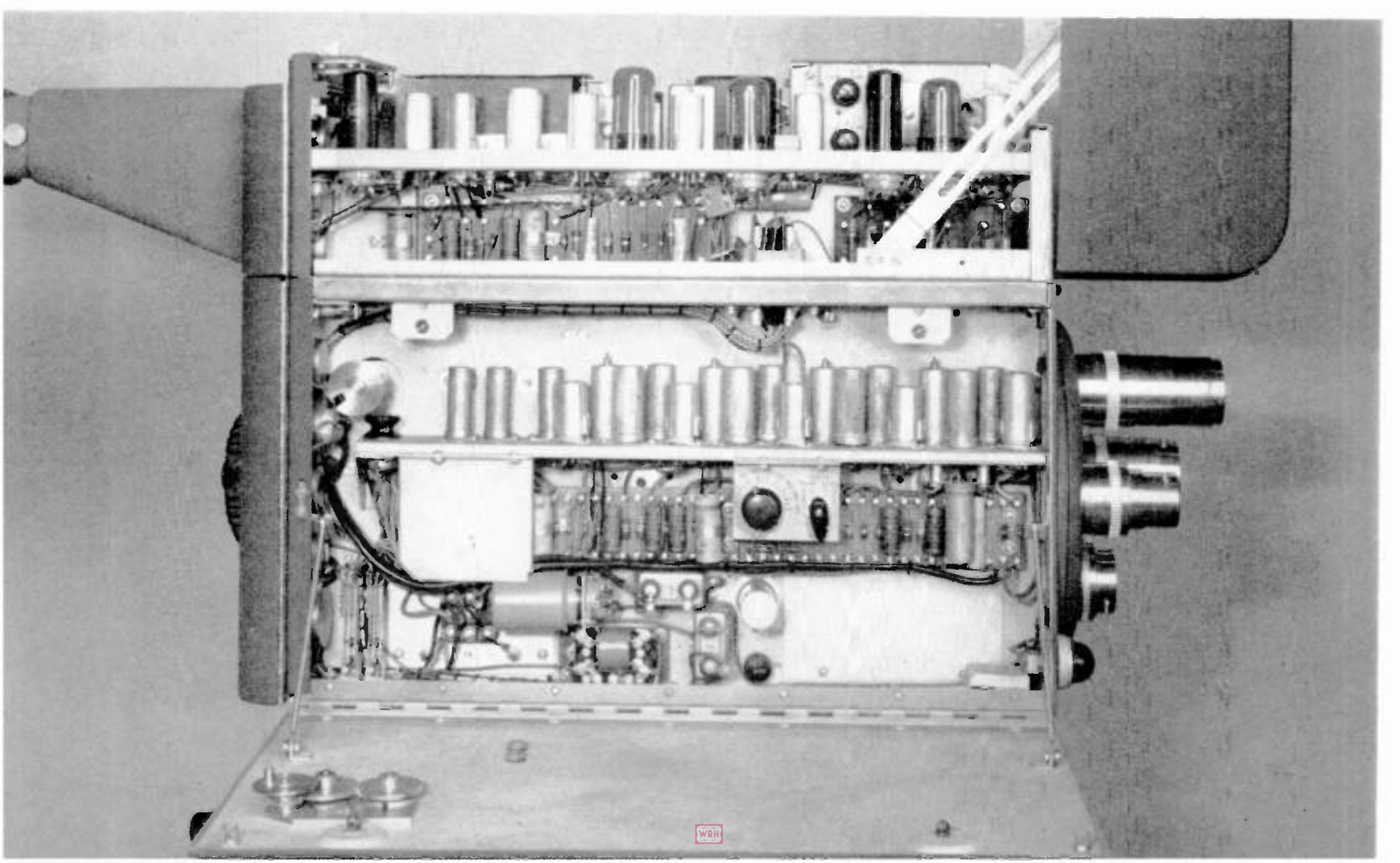
Or a small projector can be substituted for one lens. It would carry a 36-frame loop of 16-mm. still pictures with the station call letters, advertising announcements, test patterns, and program titles. The use of such a device eliminates the need of switching back to the main station.

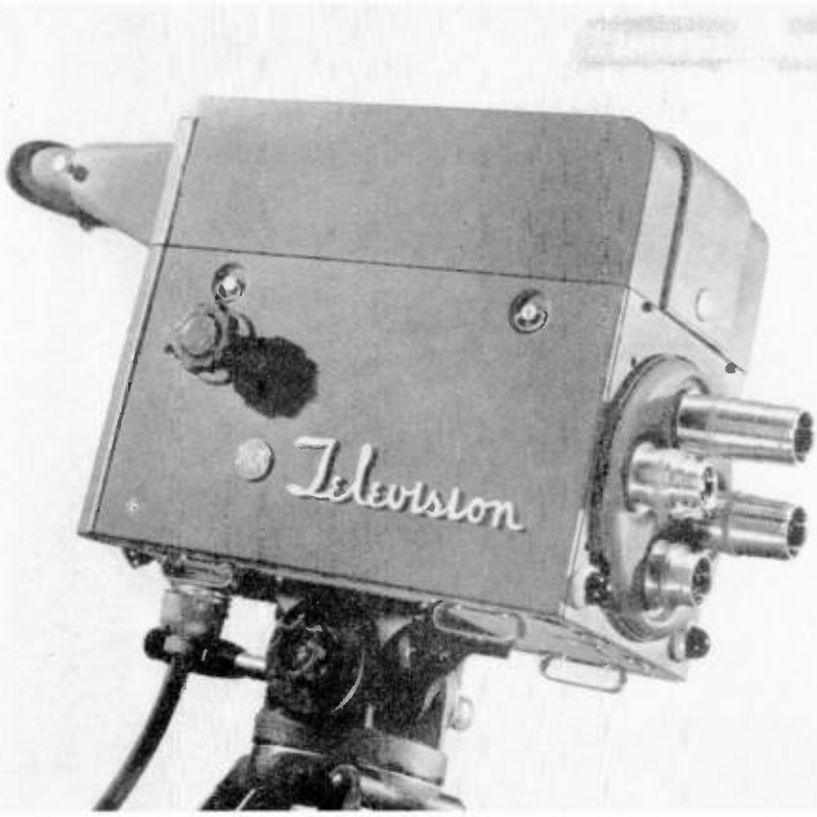
Camera Tube and Circuits ★ The Image Orthicon, Fig. 4, extends through the center of the camera section. It is inserted by removing the turret, and is covered at the front by a shield with a rectangular opening. Components of the scanning waveform generators and video output amplifier are mounted on vertical panels, as shown in Figs. 7 and 8.

Due largely to the extreme light sensitivity and small physical size of the 2P23 Image Orthicon, the camera has great depth of focus, and is surprisingly uncritical in operation. The sensitivity is so high that operation is possible with an F 3.5 lens at light levels as low as 1 ft.-candle. For example, at a football stadium, players are clear even in the deep shadows of a late fall afternoon.

The small size of the 2P23 mosaic makes

FIG. 7. RIGHT OF CAMERA AND VIEW-FINDER. NOTE THE FOCUSING GEARS THAT ENGAGE TUBE ADJUSTMENT WHEN SIDE IS CLOSED





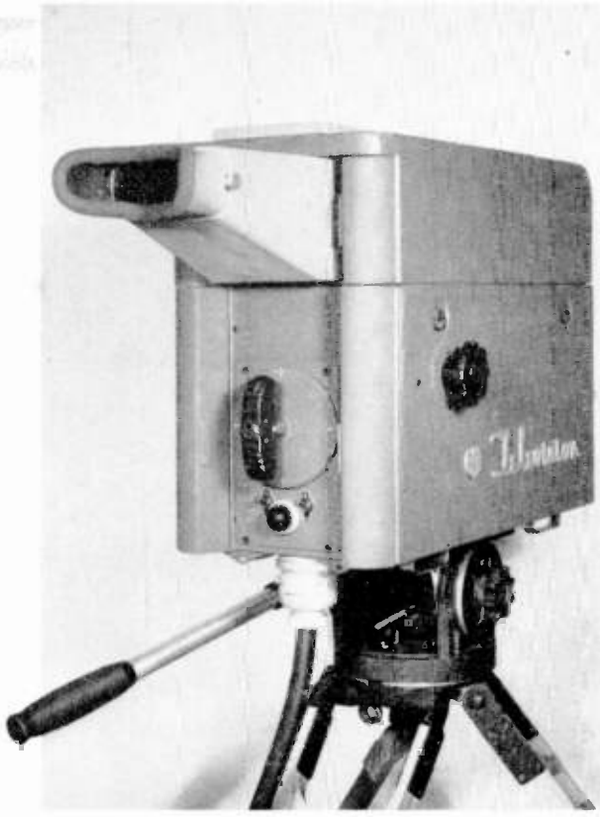


FIG. 5. VIEW OF LENS TURRET AND SIGNAL LIGHTS AT FRONT OF CAMERA. FIG. 6. BIG KNOB AT REAR ROTATES TURRET

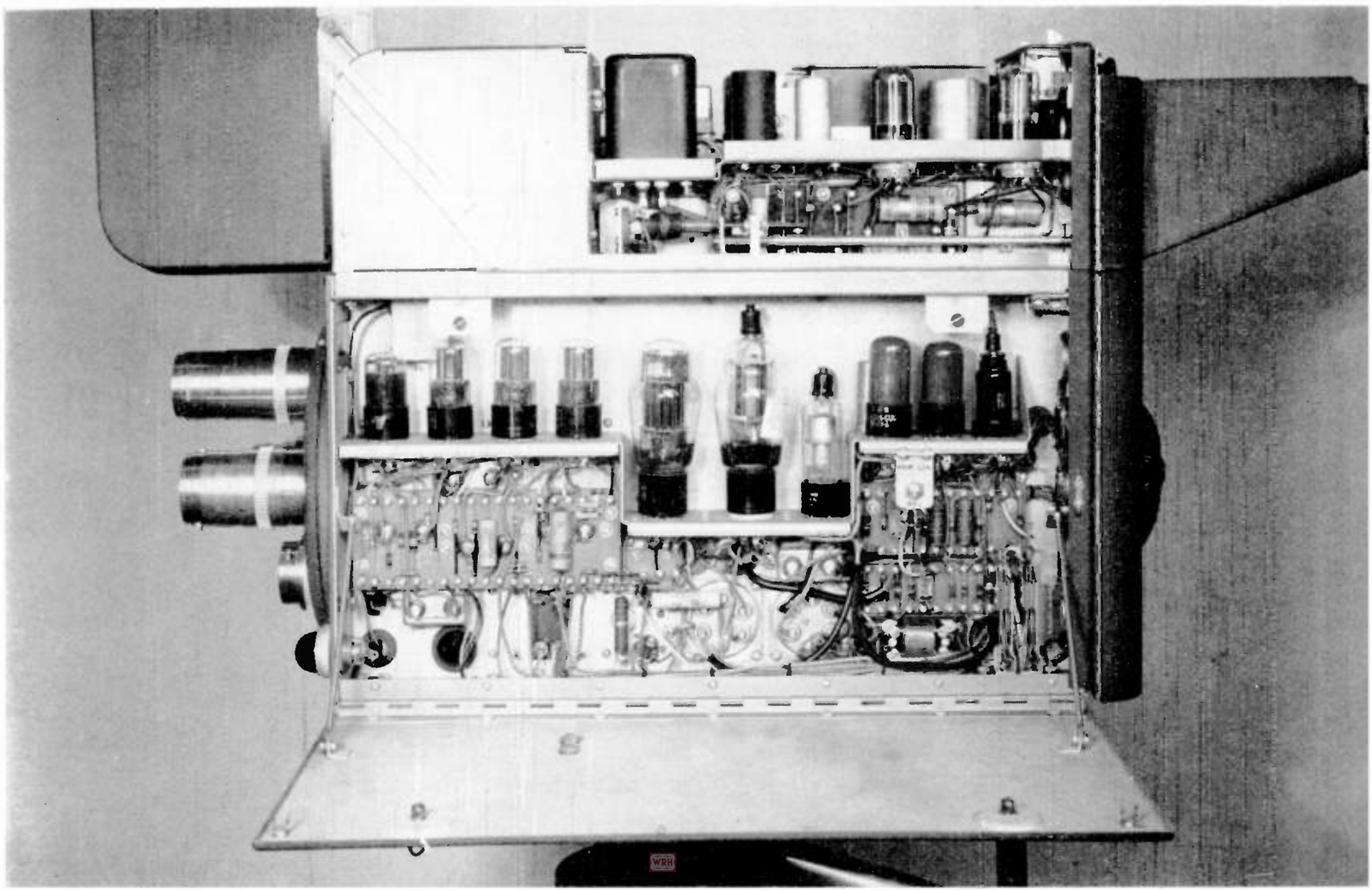
practical the use of lenses of relatively short length. By way of comparison, pre-war cameras required lenses of twice the focal length for the same field of view. Moreover, it was necessary to operate those longer lenses at large apertures, because of low sensitivity. At boxing matches, the depth of focus was less than the depth of the ring. With the new camera, everything in the ring and for several rows beyond the ring is in focus.

View-finder ★ Several views of the picture-tube view-finder are given in the accompanying illustrations. This device is not only a convenience, since it shows the operator the exact field viewed by the camera tube, but a practical necessity since, at low light levels, an optical view-finder is unsatisfactory.

The 5-in. picture tube has sufficient 2nd anode voltage to give an adequate picture for the information of the operator under normal outdoor conditions. Thus he is able to monitor the picture quality and focus the camera accurately.

Two types of viewing hoods are available, as indicated in Figs. 2 and 5. Either the straight-on or periscope type can be snapped on quickly. The latter, contain-

FIG. 8. COMPACT ARRANGEMENT OF CAMERA COMPONENTS IS POSSIBLE BY ASSEMBLING THEM ON BOTH SIDES OF VERTICAL PANEL

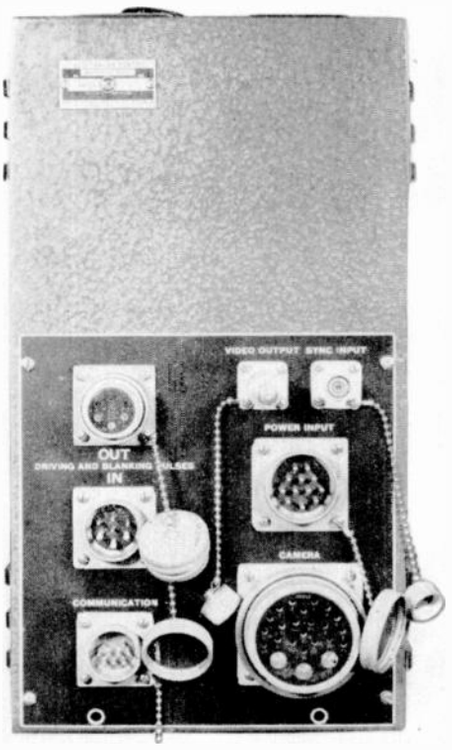


ing two 45° mirrors, is reversible, to accommodate the height of the operator. The device mounted on the hood, Fig. 3, is used as a gun sight to set the camera quickly on distant objects.

Camera Control Panels ★ All electrical controls for the camera and viewfinder are located behind hinged doors at the rear of the instrument, as seen in Fig. 3. Camera controls on the left panel, top to bottom, are for vertical and horizontal centering, image acceleration, and vertical and horizontal linearity. On the right panel are adjustments for alignment, projector light control (if a projector is used in place of one lens), camera output gain, and picture height and width.

There are corresponding adjustments on the upper panels for the viewfinder picture-tube.

All these controls are used only for making initial adjustments. During actual operation, the doors are closed over the controls, and electrical adjustments required while the operator is in action are made remotely, on the camera control unit. This leaves the operator free to devote his attention to the scene, and the mechanical focusing of the camera. Two red lights on the front and another at the rear of the camera signal that it is in operation.



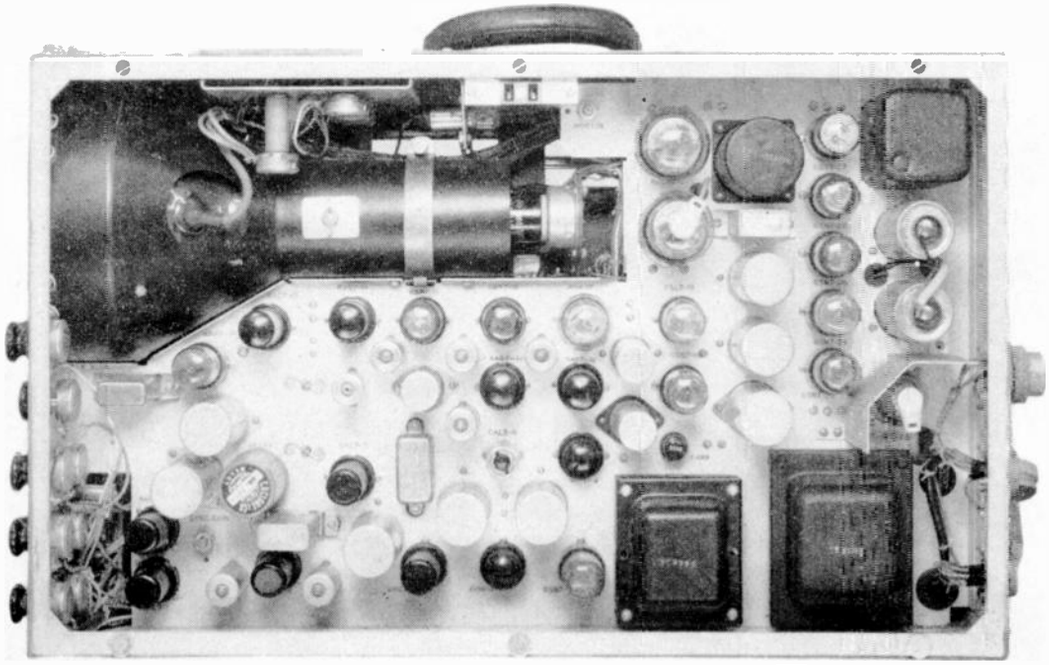
FIGS. 9 & 10. FRONT & REAR VIEWS OF CONTROL UNIT USED TO MONITOR FIELD CAMERA

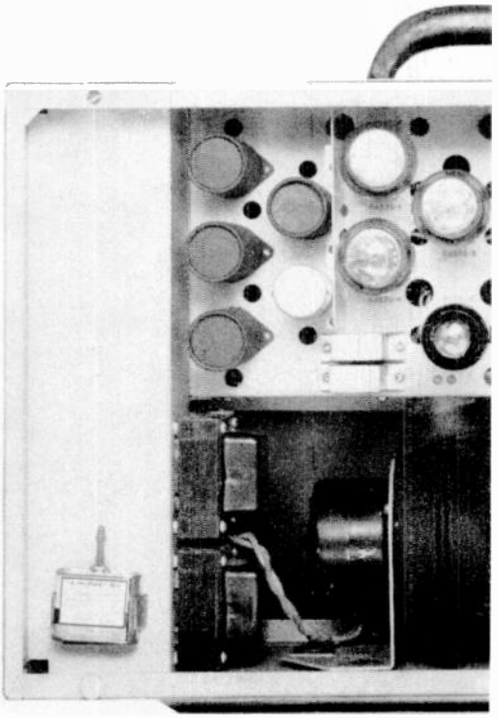
Camera Control Unit ★ The camera control unit, Figs. 9 to 12, makes it possible to observe and control the quality of the picture signals generated by the associated camera, even though the camera is at a point up to 1,000 ft. away.

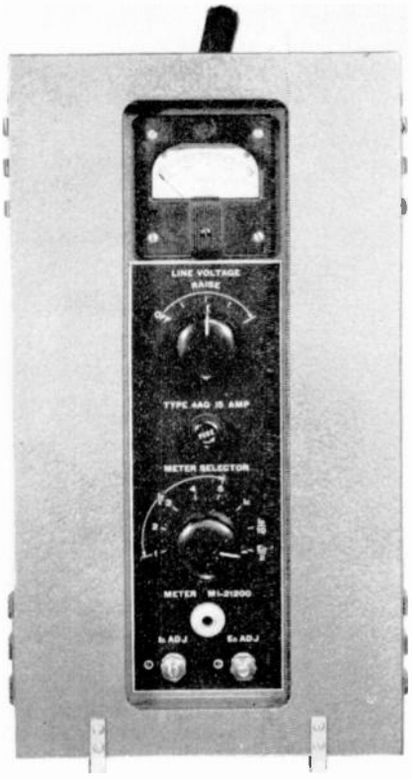
The 7-in. picture-tube, Fig. 9, is used as a monitor, and the 3-in. tube serves as a waveform monitor. Circuits include a picture signal amplifier driven by the preamplifier in the camera, pulse line amplifiers to feed driving signals to the camera, deflection generators for the monitor tube and the oscilloscope, a high-voltage supply for the accelerating potentials in those tubes, and the various circuit controls. The latter are divided between operating controls, Fig. 9, and less-used oscilloscope adjustments, recessed into the top of the case, Fig. 12.

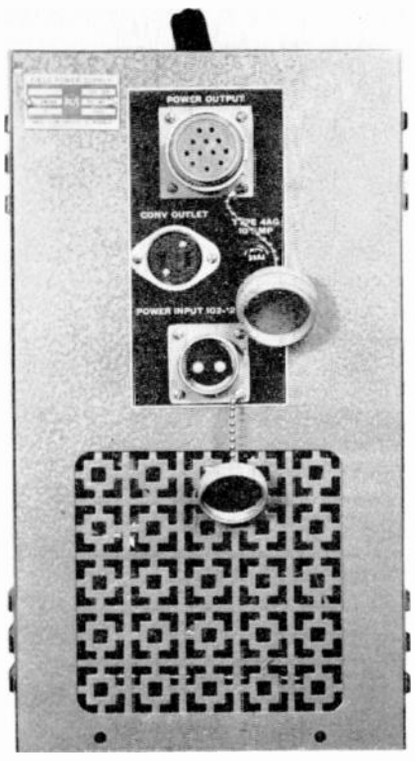
Two pulse line amplifiers, feeding camera deflection and blanking circuits, make it possible to operate several cameras at a remote point from a single sync generator. The 7CP4 monitoring tube requires magnetic scanning and electrostatic focusing. Considerable negative feedback employed in the vertical scanning circuit improves linearity and reduces the effect of variations in tube characteristics. The horizon-

FIG. 12, ABOVE: CONTROLS AT TOP OF CASE. FIG. 11, BELOW: INTERIOR OF CAMERA CONTROL UNIT, SHOWING MONITOR TUBE. FIG. 15. IN-









FIGS. 13 & 14. FRONT AND REAR OF POWER SUPPLY UNIT. NOTE LINE VOLTAGE SWITCH

tal scanning circuit employs the new 6BG6G as an output tube, and the 6AS7G twin triode as the scanning booster.

The horizontal sweep signal for the 3KP1 oscilloscope tube is generated in a standard thyration circuit using an 884 tube. Two sweep-frequency ranges are provided, one for vertical and one for horizontal scanning frequencies. Each range provides for viewing two or three blanking pulses. A 2X2A tube, in a conventional half-wave rectifier circuit, supplies the high voltage.

Functions of the picture signal amplifier are as follows:

1. A gain control for the picture signal.

2. Picture blanking signal is mixed with the signal from the camera.

3. It establishes the black level at the beginning of each scanning line by means of a "clamp" circuit.

4. When only a single camera chain is employed, it provides for the addition of the sync signal.

5. The output stage is a line amplifier capable of delivering 2 volts peak-to-peak composite picture and sync signal to a 75-ohm coaxial line, or 1.5 volts of picture signal only.

6. It provides a stage for introducing a fixed amount of gamma correction.

7. It also includes high-level driver stages for feeding the two monitoring tubes.

Fig. 11 shows the internal construction of the camera control. Tubes and major components are carried on a metal panel which runs down the center of the unit. On the other side are the wiring and the remaining components.

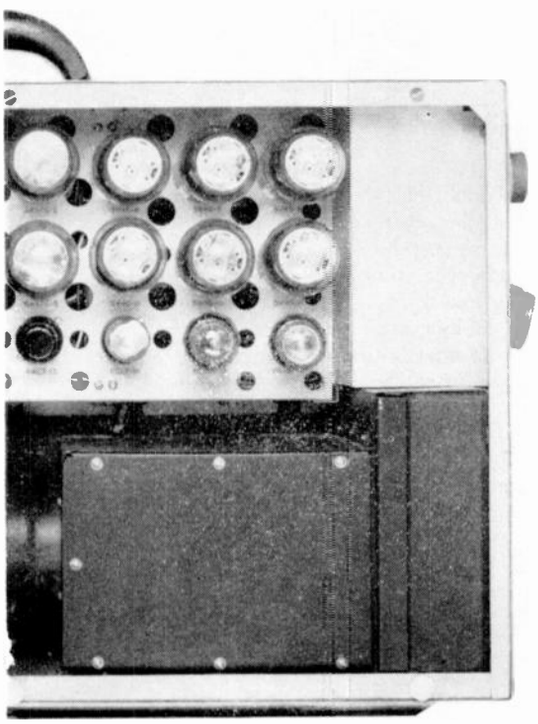
Power Supply ★ Figs. 13 to 16 show the power supply unit. Operating from 117 volts, 60 cycles, it delivers 950 milliamperes DC, adjustable from 270 to 285 volts. This output is maintained constant with load changes of 500 milliamperes, and input voltage variations of plus or minus 4 volts at any point on the primary tap switch. Proper input adjustment for line voltage of 98 to 129 volts is made by the switch and voltmeter on the control panel, Fig. 13.

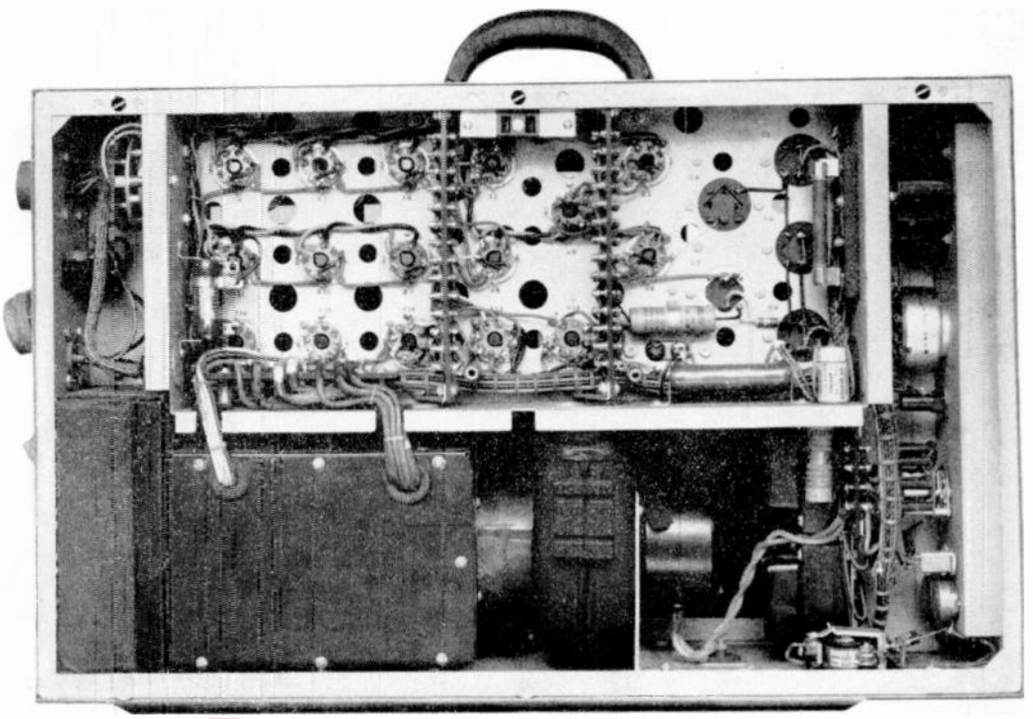
The main rectifier has six 5R4-GY's in parallel, feeding a 2-stage choke input filter. Five 6AS7-G's in parallel are used in the output as series voltage regulators. The series impedance of these tubes is controlled by a 2-stage DC amplifier. Voltage references are obtained from two OD3-VR-150 regulators. A similar type of regulating circuit is used to control the focusing coil current.

By the use of special construction, the power transformer has been reduced to 1/5 the size and weight of conventional designs of equal rating. This is due in part to the use of glass and silicone insulating materials which permit continuous operation at temperatures as high as 180° C. Figs. 15 and 16 show the transformer at the bottom of the case, and an exhaust fan which draws air from the upper tube compartment, and forces it through the transformer case. Dust is excluded by a filter on the intake.

Editor's Note: This is the first of a series of articles on television field equipment. The second will appear in a forthcoming issue.

TERIOR OF THE POWER SUPPLY UNIT. NOTE OILCAN FOR MOTOR. FIG. 16. BLOWER AND POWER TRANSFORMER OCCUPY LOWER SECTION





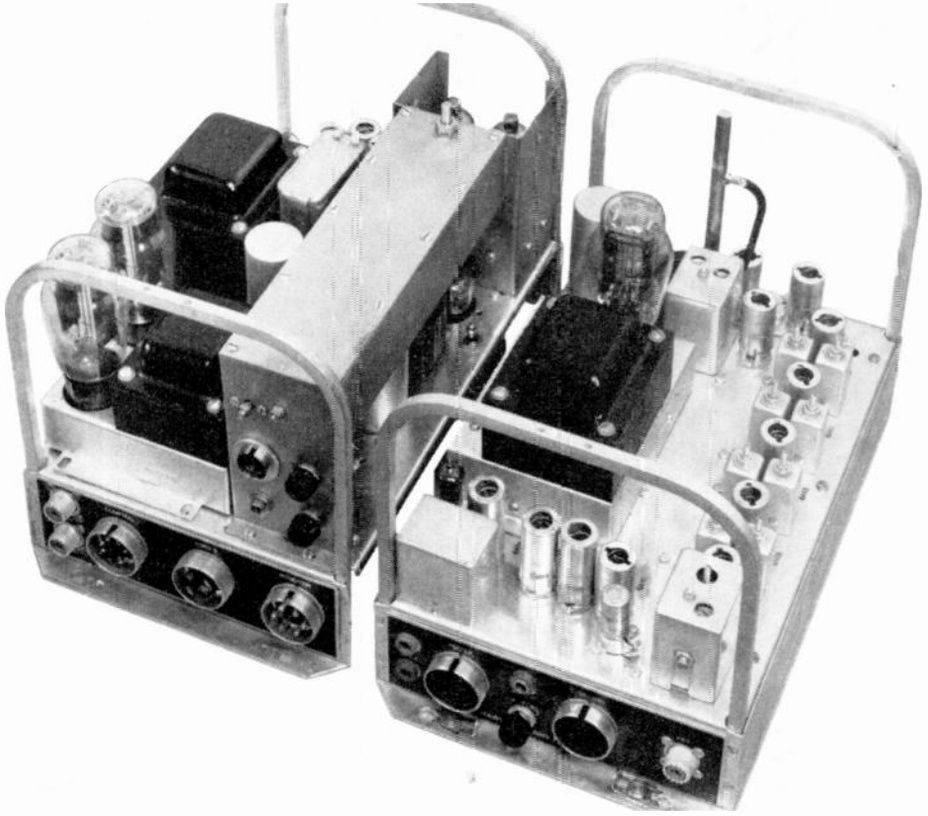


FIG. 1. TRANSMITTER AND RECEIVER WITH POWER SUPPLIES FOR FIXED, AC OPERATION

152-TO 162-MC. MOBILE EQUIPMENT

Harvey Radio Transmitter and Receiver Units for FM Communications

BY BERNARD J. COSMAN*

A NEW series of emergency radio equipment operating in the 152- to 162-mc. band has been developed by Harvey Radio Laboratories to meet the increasingly stringent technical requirements of two-way radio. Inasmuch as these requirements are often irreconcilable, compromises must be invoked which depend on the technical importance of each requirement.

After an intensive survey our communications engineering group set up the following specifications as the prime requisites of a two-way system:

1. Receiver quieting signal of less than 1 microvolt for mobile and fixed installations

2. Receiver standby drain from storage battery of not more than 6 amperes at 6 volts

3. At least 1 full watt of audio power output into an efficiently-housed loud speaker to provide enough sound to override high ambient sound levels usually encountered on fire trucks or in automobiles moving at very high speed

4. Crisp and clear speech reproduction free from the muffled boominess of certain types of receivers in which the high frequencies are over-attenuated to create an illusion in signal-to-noise ratio and intelligibility

5. A squelch action free from crash and other noises which have been found so objectionable in conventional equipment. There should be no trace of noise or other transients introduced by the squelch circuit when an incoming carrier starts or stops

6. Mobile transmitter power output of at least 25 to 30 watts

7. Mobile transmitter standby battery drain zero if possible. In any event, the drain should not exceed 1 ampere at 6.0 volts

8. No delay should be required in speaking into the mike after pressing the mike button

9. Instant convertibility of either receiver or transmitter from AC to DC operation with no wiring or mechanical alterations other than pulling the one plug-in type power supply and plugging in another

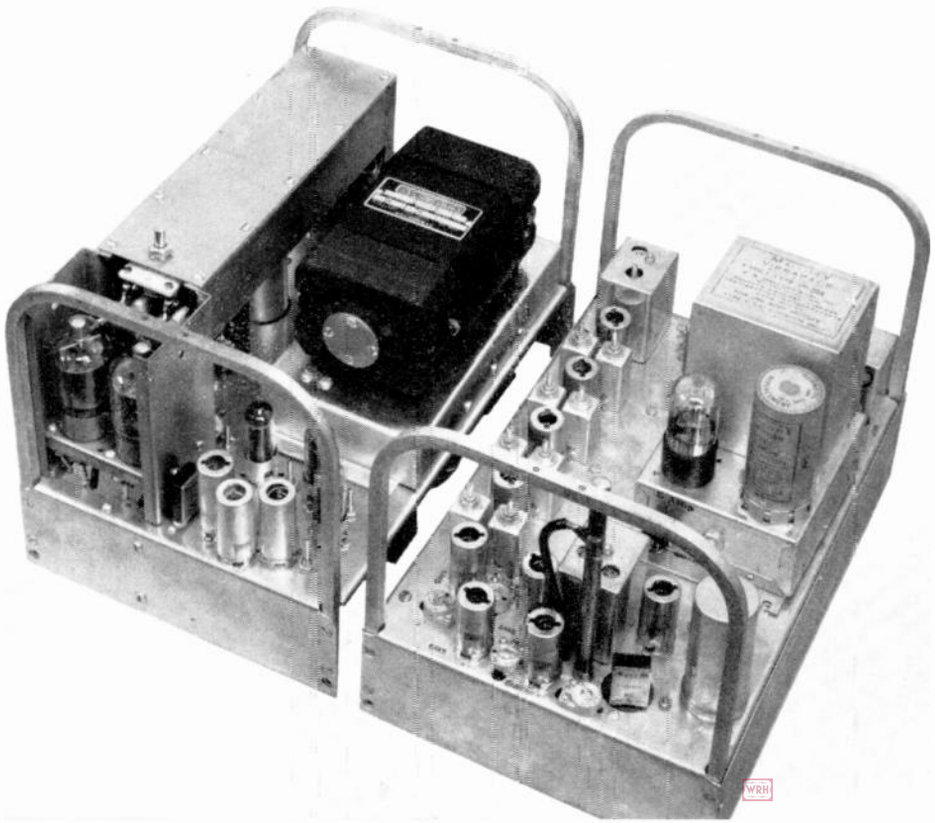
10. Combined standby drain from battery should not exceed 7 amperes at 6 volts DC

11. All operating trimmers and controls must be reached without removing the unit from the car deck or from the station cabinet

12. All components must be completely accessible and simple to replace

Low price and miniature size are the two other requirements seemingly at odds with the twelve points above. It is extremely doubtful, however, that reducing *unit* cost by decreasing power output, substituting less efficient and higher-drain tubes, and the consolidation of receiver and transmitter into one unit actually will reduce the long term, overall cost to the buyer who expects to get the same measure of performance from the single unit system. Experienced users of emergency radio have been clamoring for low standby drain for good reasons. They have the practical, user's proof that the higher standby drain in mobile units requires

FIG. 2. REAR VIEW OF MOBILE UNITS, WITH GENEMOTOR AND VIBRAPACK POWER SUPPLIES



* Chief Engineer, Harvey Radio Laboratories, Inc., 443 Concord Avenue, Cambridge, Mass.

expensive, high-current generators in order to keep batteries from being too rapidly discharged. They also know that a dead battery also puts the engine out of service. The importance of low battery drain was further emphasized during the recent forest fires in Maine, New Hampshire, and Massachusetts, when police cars were out on 24-hour duty for several days, and in locations where there was neither time nor equipment to recharge batteries.

Transmitter Unit ★ The transmitter is of the crystal controlled phase-modulation type, with standard pre-distortion and pre-emphasis characteristics for the emergency services. Carrier frequency deviation is nominally plus or minus 20 kc., obtained from the phase modulator by frequency multipliers totaling 48 times. Views of the AC and DC types are given in Figs. 1, 2, and 7, with a bottom view in Fig. 5, and the schematic in Fig. 3.

The entire FM exciter unit, including a 6AQ6 Pierce crystal oscillator, 6AQ6 audio preamplifier, 6AQ6 phase modulator, and the quadrupler, tripler, and doubler stages, is mounted on a small removable sub-panel plate measuring approximately 3 by 4 ins. Miniature, and yet completely serviceable construction and components have been built into this exciter plate, which is removed from the main chassis by unsoldering a few cabled wires from a lug-board and unscrewing easily accessible self-tapping screws. Globar miniature resistors and dogbone condensers in low voltage points add greatly to serviceability on the one hand and to vibration resistance on the other.

The standby drain of the mobile transmitter unit has been reduced to 1 ampere by the use of proven types of quick-heater tubes. Although the first multipler, 6AK5 is not a quick-heater, all other tubes in the multiplier, driver, and final stages are either the 2E30 Hytrons, equivalent to a 6AQ5 or a 6V6GT, or type 5516 Hytrons. In mobile use, the quick-heater filaments are energized when the operator lifts the microphone from its hang-up switch box mounted on the dash, thereby leaving the filaments fully lit during the entire time the mike is out of its hanger. Thus, when the operator wishes to transmit, he does not have to wait until the tubes heat up, and there is no strain on the tubes caused by the application of plate power before the filaments have come up to normal operating temperature. Even though this warm-up period is only of the order of 1 second for a fast tube, continued premature application of the high plate voltage does have a serious effect on tube life.

When AC operation is desired, as in fixed station operation, the type 2E30 multipliers are replaced with type 6AQ5 tubes and the type 5516 driver and push-pull final amplifiers are replaced with the type 2E26. This is shown in Fig. 3. A toggle switch on the chassis marked

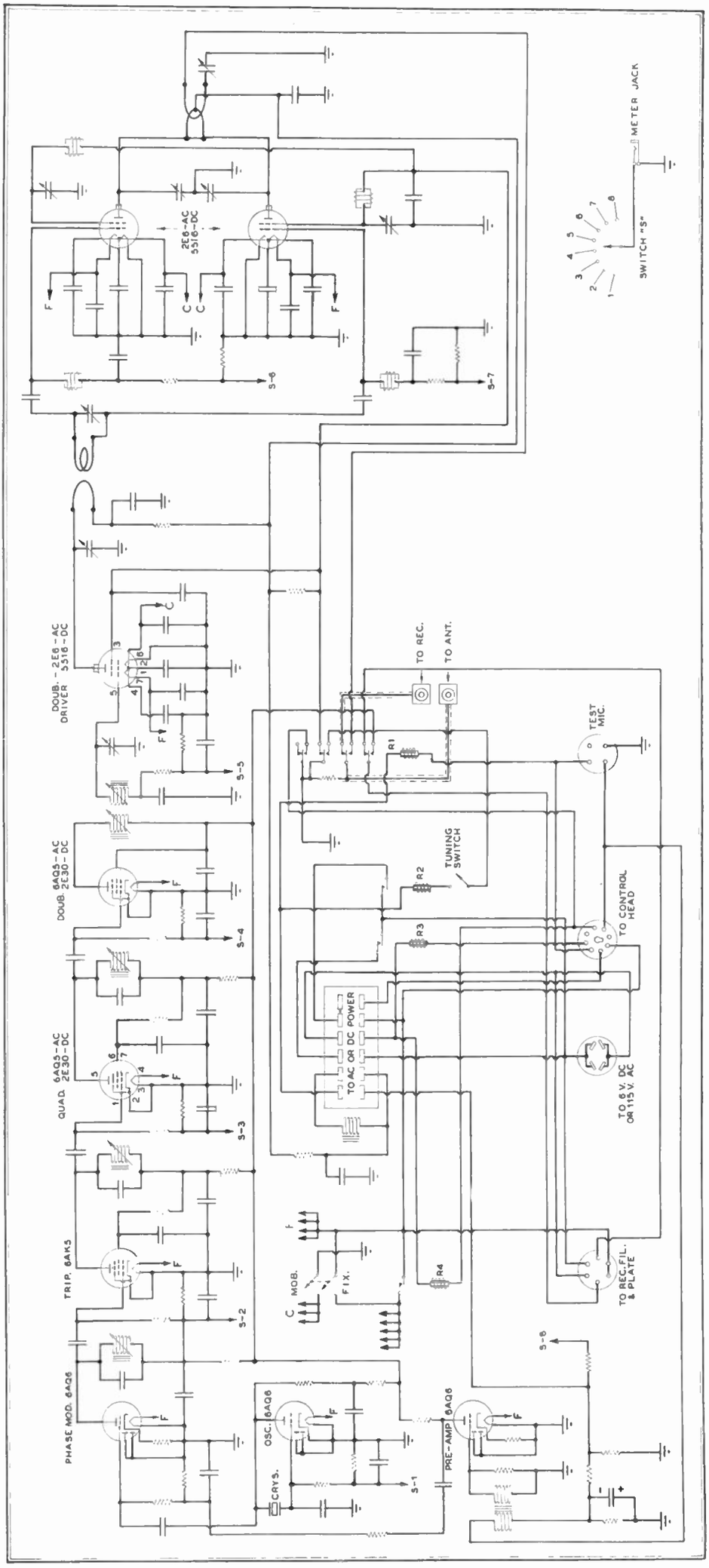


FIG. 3. SCHEMATIC DIAGRAM OF THE 152- TO 162-MC. TRANSMITTER

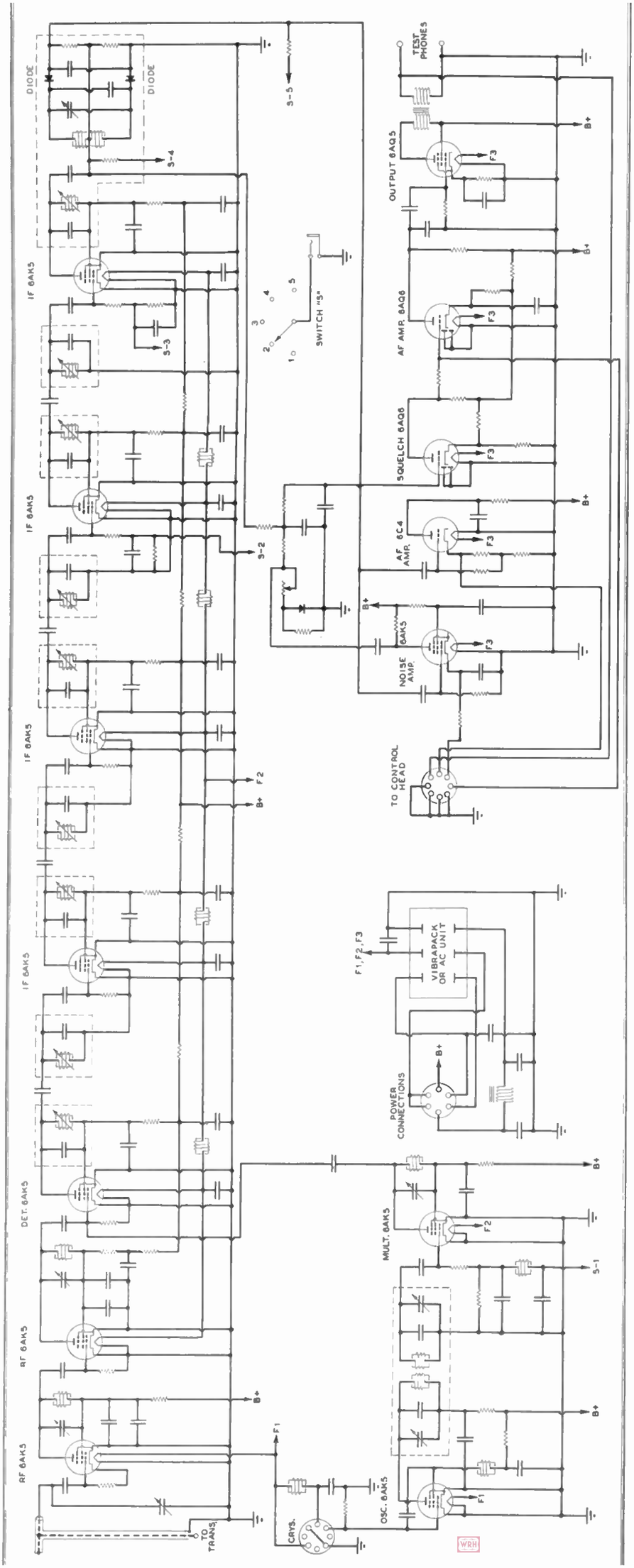


FIG. 4. SCHEMATIC DIAGRAM OF THE 152- TO 162-MC. RECEIVER

MOB.-FIX. arranges the necessary filament power wiring when changing from DC to AC operation.

The last doubler in the multiplier chain is a type 5516 or 2E26, supplying sufficient power to drive the two 5516 or 2E26 tubes in the straight-through push-pull final stage. Because there is an internal capacitance difference between the 5516 and the 2E26, a variable condenser whose variation value equals the difference in capacitances between the 5516 and 2E26 is connected in the circuit to compensate this difference.

The final plate tank is a shielded, two-wire, shorted transmission line about .1 wavelength long, and resonated by the push-pull tube output capacity plus a small balanced butterfly variable condenser which tunes the band from 152 to 162 mc. The shorting bar is a plate silver-soldered to the solid brass silver-plated lines, thus eliminating contact difficulties at a high current point.

A small output coupling loop, supported by the shorting plate as a bearing, is centered between the two line rods, and is connected by a shaft to the front panel of the line box. This permits rotation of the loop in the field of the lines in order to vary the coupling to the antenna circuit. The inductance of the loop is resonated by a variable condenser. Consequently, the circuit permits simple resistive loading of the final tank without detuning difficulties. These difficulties are often caused by reactances reflected by the coupling circuit or by the reactive component of the input impedance of the transmission line leading to the antenna when the antenna is improperly matched, or when, with a given standing wave ratio due to mobile antenna matching, the line is not of such a length that its input impedance appears resistive. Power output on either AC or DC has been measured by several means as being in excess of 30 watts.

Metering is accomplished by an 8-point switch by which a 50-microampere meter can be connected in each circuit drawing grid current, and also in the final amplifier plate circuit.

Transmitter Relays & Connections ★ As Fig. 3 shows, there are 4 relays on the transmitter chassis. Relay R1, drawn in the normal RECEIVE position, is the transmit-receive control, operated by the microphone switch. It connects the antenna to the receiver tubes.

R2 is the dynamotor START relay, and is actuated when R4 has closed. R3 is the POWER ON relay, operated by a switch on the volume control.

R4, when actuated by lifting the handset from the hangup switch, excites the quick-heater filaments in the transmitter. Thus the filaments are heated before the operator presses the push-to-talk button.

Fig. 3 shows the 12-contact connector for the power supply. Either the AC rectifier unit, Fig. 1, or the DC Genemotor

unit, Fig. 2, can be plugged into this connector from the top of the chassis. According to the power supply used, the MOB.-FIX. switch is opened or closed.

The tuning switch is normally closed, and is only opened when the transmitter is being tuned up.

Four connectors are provided on the chassis. At the extreme right in Fig. 3 is the microphone connection used when adjustments are made on the transmitter. To the left are connections for the receiver volume and squelch, microphone, and transmitter control, located on the control head. Next is the connector for plugging in 115 volts AC, or the positive side of the 6-volt DC line. The negative side comes in by grounding the chassis to the car. Finally, at the extreme left, are connections for the receiver filament and plate power.

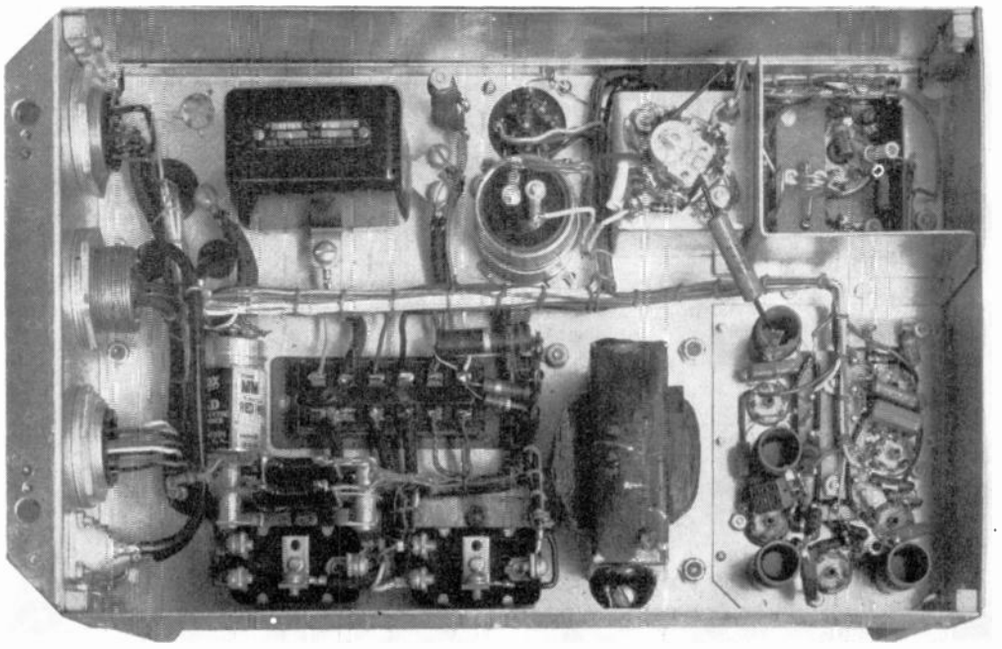


FIG. 5. BOTTOM VIEW OF TRANSMITTER SHOWS VERY COMPACT EXCITER ASSEMBLY

Receiver Unit ★ The receiver design represents a radical departure from previous practice, principally in the elimination of the double-conversion techniques, the introduction of highly efficient miniature tubes throughout, and the utilization of crystal diodes in the discriminator and squelch circuits. An acceptable signal-to-noise ratio is obtained through the use of two 6AK5 RF stages with conventional coil and condenser coupling circuits. Tuned lines, as interstage coupling devices, were ruled out because it was felt that no electrical advantage could be obtained through their use with the 6AK5 tube at these frequencies. The transit angle loading of the 6AK5 input for low plate power drain reduced the potential line *Q*'s to the point where the added mechanical complexity rendered it impractical and uneconomical to use.

Resonant by-passing techniques have been used freely in the RF stages because of their superior electrical and decoupling characteristics. Care must always be exercised in the design of resonant by-passing circuits because, being resonant, they are effective only over a small band of frequencies. At higher frequencies, they present an increasing inductive reactance which can make the circuits being decoupled responsive to other frequencies. In this case, however, the selectivity of the antenna transformer, which is a capacitance-tuned, .1-wavelength, shorted coaxial line, tapped at about 60 ohms for connection to the antenna line, will not allow sufficient spurious signals at higher RF frequencies to come through to the RF amplifier.

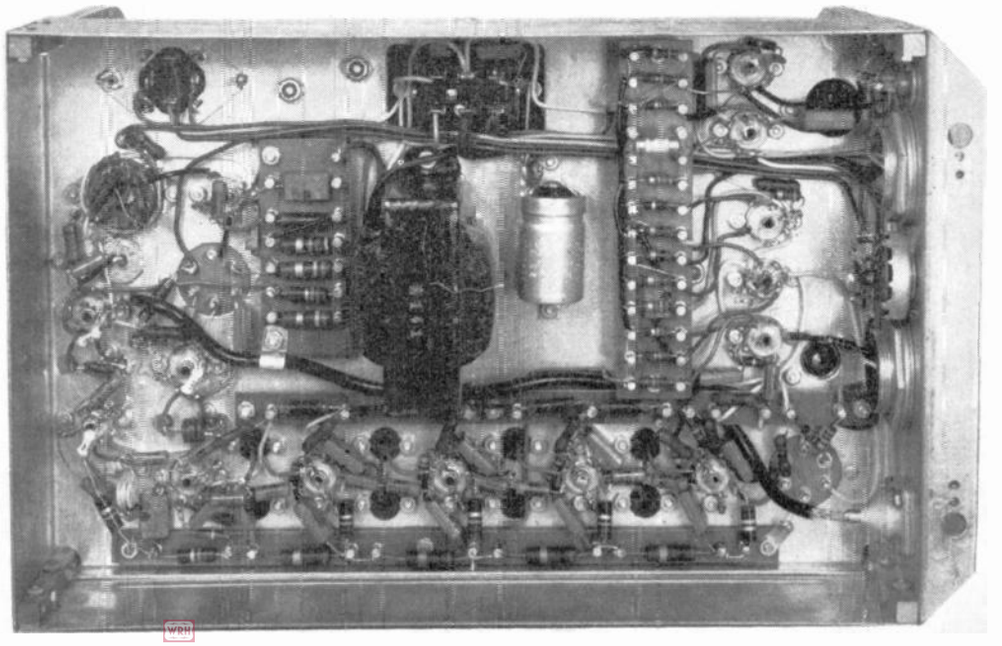
The mixer is of the Van der Bijl detector type, using a 6AK5, again as a compromise between high conversion-gain and highest signal-to-noise ratio. It was not felt that a lower noise mixer circuit could be used economically because of the necessity for more stages elsewhere in the receiver. Consequently, the overall noise figure contributed by the high noise, high-gain mixer preceded by two RF stages was considered a satisfactory compromise among the various factors involved, the more important of which were power drain and equipment cost.

The IF system, operating at 5.3 mc., is arranged without AVC action so that the effective bandwidth is somewhat reduced at very low signal levels, thereby improving the noise ratio at the fringe. Adequate gain without regeneration or other instability is achieved by utilizing the IF strip as conventionalized in radar receivers. Here particular attention is paid to the methods of decoupling each stage from all others. All plate and screen circuits are fed through cascaded RC decoupling networks, while the filament circuit of each stage is fed through an LC decoupling cascade, so that direct interstage common coupling is reduced far below the point of regeneration. Mutual inductance feedback coupling is made virtually zero through the use of individually and closely shielded plate and grid circuit coils. Mutual capacitance feedback coupling is minimized by virtue of the length of the IF strip and by suitable placement of all hot IF components and terminals.

The coupling coefficient for the IF stages is set at very slightly under the critical value, and the LC ratio was chosen lower than that which would be dictated by maximum stage-gain considerations for the following reasons:

The IF coils are individually shielded and slug-tuned, and therefore were made capacitively coupled through very small ceramic condensers. These coupling condensers are less than 1 mmf. in capacity because of the small value required for critical coupling. Since they are very difficult to obtain in values held to a 10% tolerance or better, the coupling condenser becomes more and more of a problem as the LC ratio is increased to get more gain for a given bandwidth. Furthermore it was felt that manufacturing tolerance on this coupling capacitance would not be close enough if incidental wiring capacitances were used as the source of interstage coupling, although the stage gain could have been doubled by resorting to that

FIG. 6. RECEIVER WIRING, AS SEEN UNDER THE CHASSIS, IS SURPRISINGLY ACCESSIBLE



technique. The criterion governing this choice was not that of bandwidth per se for the desired signal channel, but was dictated by consideration of making all manufactured receivers identical as far as their adjacent and alternate channel rejection abilities were concerned.

The discriminator is of the conventional Foster-Seeley type, arranged in one small can together with a pair of matched Sylvania crystal diodes. These diodes have been the subject of considerable controversy and unwarranted criticism in the communications industry. They are neither short lived nor expensive, and they maintain their characteristics very well unless subjected to excessive heat when being soldered in. It has been found reasonable to expect just as much and, in some cases, more life from them than from vacuum tube diodes. They have the great advantage of saving space, weight, and battery drain.

The squelch circuit also uses a single crystal diode to control, in the conventional manner, a type 6AQ6 DC bias control tube. A type 6C4 is used as a cathode follower type first audio tube to transmit at low impedance the audio signal from the discriminator through the control cables to the volume control. The control head or volume control point can be as much as 200 ft. away from the receiver because the shunting effect of the cable capacitance does not affect the frequency response of the cathode follower output. Conventional receivers are limited in control ability to not more than 20 ft. because of the high-frequency attenuation in the control cables, unless special remote control devices are used.

A second type 6AQ6 is used as a squelch-biased audio amplifier and feeds a type 6AQ5, equivalent of the 6V6GT, audio power amplifier.

Power supply is obtained through a 6-prong Jones socket into which may be plugged a complete Vibrapack supply or a transformer-rectifier supply.

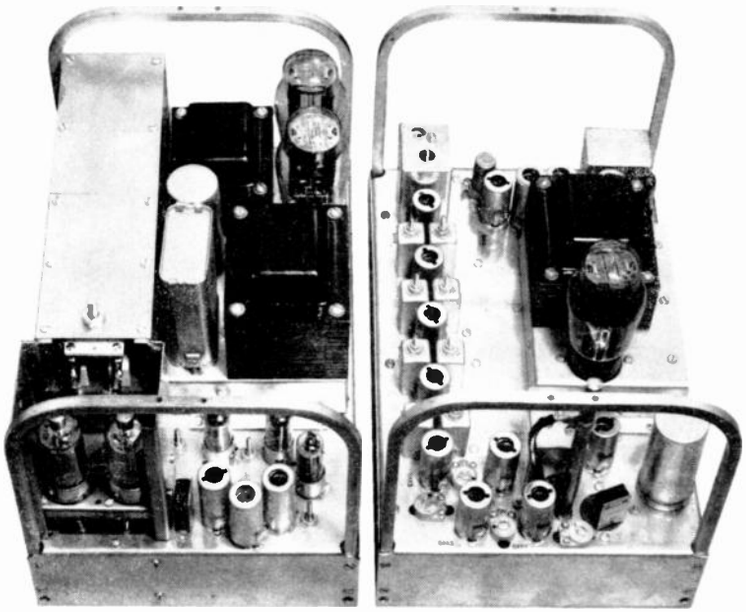


FIG. 7. THE PLUG-IN AC SUPPLIES CAN BE REMOVED AND REPLACED FOR MOBILE USE

Frequency control is by a crystal operating at the 16th subharmonic of the mixer injection frequency. A type 6AK5 is used as an oscillator-quadrupler and another type 6AK5 as a second quadrupler. An octal crystal socket is used to accommodate a type FT-243 crystal, or a small crystal oven.

Metering of the quadrupler grid current indicates crystal activity and allows proper tuning of the oscillator quadrupler interstage circuit. Limiter grid currents can be metered, as well as discriminator primary tuning and secondary zeroing. A standard 50 microampere tuning meter with plug jack and selector switch is provided for this purpose.

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

misjudge in these present times because of our high level of living and spending. Because we have a dollar to spend today, we think in terms of always having dollars to spend.

Now in Europe, people are saying that we are living in a fool's paradise. The question most often asked is — "Can we avoid a depression?" — "How serious will it be?"

The consequence of this thinking is that anyone trying to design or produce anything that is to have world distribution — not only in prosperous times, but in the economic dips and valleys — will find it highly desirable to make it economical in the first costs and in its operation.

The Marshall Plan — if it is anything that can be stated in a paragraph — is an attempt to improve the economy of all Europe by implementing a freer exchange of merchandise. Help is being offered to the countries that can help themselves by establishing customs unions and doing other things that help minimize the barriers to a freer interchange from country to country. In other words, there are at least two things needed in Europe today: a freer interchange of goods and material, as well as a freer interchange of information.

Presumably, then, there are a number of places where facsimile would fit in, if it fulfilled the qualifications of economy. Facsimile can be effective in putting out information and in serving areas in which there is more than one language. Facsimile broadcasts, with pertinent, illustrative sketches, would be instrumental in holding bilingual, news-hungry people together. Two- or three-language broadcasts attempting to do the same job would prove boring.

Similarly, there are many instances in international conferences where facsimile has a place. Some of the long periods of translations in one language after another could be replaced by a permanent facsimile recording in the several languages. The fact that you can read faster than you can speak would considerably speed the process.

This is mentioned simply as an illustration to indicate that one's thinking in world products should not be confined only to the uses with which one is familiar in this Country.

Habits of various countries in Europe vary in many ways from America. Consequently, radio broadcasting, as we know it, is not as effective a means of disseminating information there as it is in the United States. In France, for example, the real recreation of a large part of the population is eating, drinking, and conversation. Radio isn't as important in every day living there as it is here. Nor are their programs as compelling.

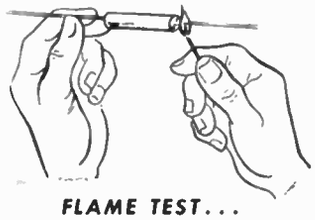
As for facsimile, it becomes clear from investigation in almost every field of application that what our Company has been advocating for the United States in facsimile standards (RMA standards of 4.1 ins. recorded line) can meet nearly any situation in any part of the world.

There are many parts of the world in which home recording on a large scale will be impossible, but where facsimile bulletins, reproduced on large master recorders, with recording space 16 ins. wide by 32 ins. high, could be very effective, particularly when multiplexed with sound.

The possibilities of such equipment for group viewing were brought home to me particularly while in Ostend, Belgium. While walking through the streets I noticed a large group of people around a store window. As I drew closer, I noticed

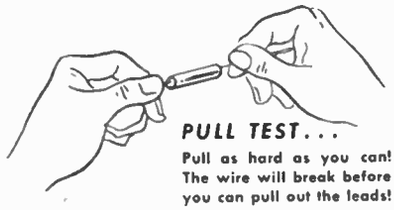
(CONCLUDED ON PAGE 44)

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!

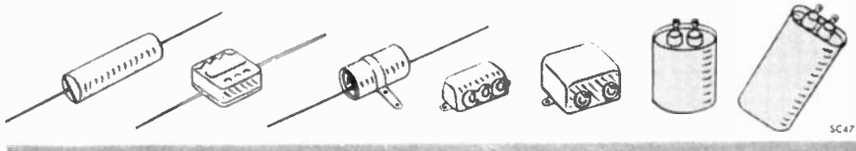
SANGAMO Type 30 *Plastic Molded Paper Tubular Capacitors are Definitely Superior!*

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



SC478A

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD • ILLINOIS

(CONTINUED FROM PAGE 21)

the linking up of such stations into rebroadcasting networks has been made much more difficult.

Continental Network ★ However, in spite of the chaos resulting from the change in the band, the FM system has been rebuilt and an FM network brought into being. That network is furnishing music of far better quality than any of the AM networks. It is demonstrating an ability to operate more economically within the region that it serves than an AM network, and it is growing rapidly. The reason for the economical operation is that a large part of its coverage is obtained by stations rebroadcasting one another, something that cannot be done on an AM system.

While that is not perhaps the most elegant way of interconnecting FM stations, it is now available, it is working, it is the least costly way of doing the job, and beamed relays on a public service basis, if available at all, are not available to most of the stations because of their locations — to say nothing of the matter of cost to newly organized small stations.

Part of the network is served by telephone lines, where the transmission is limited to approximately 8,000 cycles per second; whereas the radio part of the network is capable of handling the full audible range of 15,000 cycles. Most of the Commissioners are familiar, through personal observation of demonstrations, with the superiority in the quality of reproduction of the direct radio relay.

Possibly the Commission expected the large number of stations with small area coverage to be linked together by 15,000 cycle wire circuits, in accordance with the plan outlined in an article appearing in *FM* AND TELEVISION of February, 1945, and entitled "15,000 Cycles for All Networks." However, it now appears that no such 15,000-cycle circuits are in existence. The Continental Network has been advised in writing by the American Telephone & Telegraph Company that such lines, if ordered, could be made available in one year. Inquiry was made of representatives of the Telephone Company as to the reason for this situation, and the information was given me that the networks had advised the Telephone Company that they had no need for 15,000 cycle lines and did not want them. Is anything more needed to prove that even today the networks are not interested in bringing the advantages of FM service to the public?

The networks will continue in their present state of mind about FM until competition forces them to change it. The first step in providing that competition has been taken by the Continental Network, which is held together in some of its most important places by five of the old band transmitters located on high points, where they give wide area coverage.

It was proposed a year ago January, when none but very low power transmitters were available for the new band, to order the high power stations on the old band off the air. That movement failed when the absurdity of it was pointed out. Had it been successful, there would be no Continental Network today. If the Commission now puts these stations off the air, before some equally effective and economical method of linking up an FM network is provided, another delay in the development of FM will have resulted from the Commission's action.

The Continental Network as it exists, and the opportunity for other networks, which the Commission itself appreciates, to get started in other parts of the country, presents the Commission with a situation that was not before it at the time when it made the present frequency allocations. That situation is an important one and deserves full consideration by the Commission.

No one knows just how the FM networks will develop as additional stations take advantage of the opportunity to rebroadcast the low band stations and, where the distances are shorter, the high band stations. The field is one in which the best results can only be obtained by reasonable freedom for experimentation.

There is no doubt that the low band signals are more reliable for rebroadcasting, at the distances generally involved, than most on the high band. Many of the stations on the Continental Network, which rebroadcast the transmission from Alpine on the low band, cannot get dependable reception from Alpine on the high band — despite the fact that, according to the curves made from Mr. Norton's theoretical calculations, there should be ample signal strength for rebroadcasting purposes on the high bands.

The reason for this is simple. The calculations made by Mr. Norton are based on certain assumptions about the characteristics of the atmosphere. No doubt under ideal conditions Mr. Norton's assumptions might be fulfilled and the signal levels be as he predicted them, but in the world of reality we have weather, and that Mr. Norton seems to have forgotten about. Where there are changes in meteorological conditions his assumptions simply do not apply. Atmospheric changes are much more disturbing in the high band than in the low, and dropouts on the high band occur more frequently, and are of much greater magnitude, than on the low band.

Westhampton Beach Tests ★ For some months, comparative recordings have been made at Westhampton Beach, 70 miles from Alpine, of the transmissions of the two Alpine stations, one on 44.1 mc. and the other on 92.1 mc., each having an effective power in excess of 100 kw. An analysis of the recordings and the recordings themselves will be presented at the hearing, and the Commission and its staff are invited at any time to examine the equipment and listen to the signals.

The tests at Westhampton, taken together with confirmatory tests made at other places, prove beyond doubt that the action of the Commission in moving FM broadcasting from the low band to the high band was based upon erroneous conclusions as to the relative efficiency of transmission on the two bands.

Sporadic E and F2 Interference ★ In still another aspect the situation presented to the Commission at this hearing is different from that presented at the previous hearings on allocations in that the ionospheric disturbances that Mr. Norton stressed do not present as great a problem in reception for rebroadcasting as in the case of reception with home receivers. The testimony will show that, where such disturbances are present to any substantial degree, their effect can be greatly reduced by a number of simple means that are available in rebroadcasting.

In its notice of Proposed Rule Making, adopted August 14, 1947, the Commission proposes to allocate the 44-50 mc. band to non-government fixed and mobile communication services such as police, fire, transit utility and special emergency services. I realize fully the importance of giving those services the amount of space that they need in the radio spectrum. But their problems are not going to be solved, or even much advanced, by a stopgap allocation of one television channel.

Moreover, the emergency services, because of their low antenna heights and other characteristics, must be capable of operating reliably on extremely weak signals, and they must operate 60 minutes per hour. Interference that would be inconsequential in broadcasting cannot be tolerated in emergency services, where even a small delay might render them useless and have the most serious consequences.

It is essential for the Commission, in the discharge of its statutory duties, to ascertain the facts concerning propagation in the various frequency bands, in order that its decision in this case and future cases may not be prejudiced by the errors that resulted from acceptance of the Norton testimony, now thoroughly discredited, and now known by every one in the industry to be discredited.

What I am asking the Commission to do is in substance the same as what I asked it to do in January, 1940, when it looked as if further allocations to FM might be blocked off at the television hearing. I am asking the Commission not to prejudge the situation by foreclosing the present lines of FM development; and I am asking the Commission to get the technical facts correct before undertaking to make a final determination of how the public interest, convenience, and necessity will best be served.

Zenith Gives You More Real

DEMONSTRABLE VALUE

First in Style, Performance, Features...That's why it's the industry's most copied line!

Model 9HO88R

It's *value* that counts in radio sales today . . . and that's why Zenith radios and radio-phonographs are so easy to sell.

Zenith gives you *features* you can actually demonstrate . . . *tone* and *performance* prospects can hear for themselves . . . *style leadership* proved by the industry's many copies and adaptations of Zenith design.

Yes, compare them all, and you'll agree that Zenith is first in *salability* . . . with features, performance, styling and downright value made possible only by the knowledge and experience gained in 31 years of Radionics Exclusively.

Here Are Style and Value Sales Features Zenith Gave You First

- **THE COBRA TONE ARM . . .** Perfected record tone. The tiny filament gently floats in the record grooves, reproducing every note, every shading.
- **SILENT-SPEED INTERMIX CHANGER . . .** Changes both 10 and 12 inch records intermixed, so as to provide an almost continuous flow of music.
- **TILT-OUT CONTROL PANEL . . .** This Zenith design, now widely copied, brings the entire control panel into an accessible, easily viewed position.
- **GLIDE-OUT PHONOGRAPH . . .** A touch of the phonograph door glides the entire record-changer unit out within easy reach.
- **2-BAND ZENITH-ARMSTRONG FM . . .** FM at its best—wide-band, true fidelity, static-free FM as developed by Major Armstrong and Zenith Engineers.
- **THE RADIORGAN . . .** Radio's most demonstrable tone control. 64 different tonal effects provide just the tone emphasis desired.
- **AMPLE RECORD STORAGE SPACE . . .** The big storage compartment in the Zenith Console combination cabinets is an important feature. Show it to your prospects!
- **FLAT-TOP CABINET . . .** The entire top may be used for flowers, vases, books or decorative pieces. There are no lids to lift to operate either the radio or the phonograph.

Keep An Eye On

Zenith Radio Corporation • 6001 Dickens Ave • Chicago 39, Ill.

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 40)

the center of attraction was a little sound "magic lantern" type of machine in which Mickey Mouse style pictures were being shown. Here was entertainment — sound and something to watch — and a large group gathered to watch, simply because entertainment was rare and not possible to a large part of the population. Now facsimile programs multiplexed with sound, or even simplexed, would not only entertain the people but be an effective method of informing them.

In England there are now over 800,000 listeners to radio who do not own radio sets. They are, however, supplied with radio programs through a system called rediffusion, which consists of a speaker and a switch to select the choice of two programs from a wire service. This may be connected direct to the broadcasting studio or a receiver and common amplifier in the neighborhood. This service costs two shillings (about 50¢ in our money) per month. The providers of this service figure this is the largest amount their subscribers can afford.

The larger part of the increase in BBC listeners is on this service rather than owning sets, or renting them which is another practice in England. It is, of course, assumed that sooner or later purchasing power of these people will expand, and it is thought that facsimile could be very vital to them, but it doesn't take any imagination to realize that if their equipment is too costly, or it's paper requirements are too expensive, there will never be an extensive facsimile service in England.

And so, once again, the less expensive, simpler recorder found in the 4-in. size is the only equipment so far developed in the acceptable price range for renting or purchasing. Further, the 4-in. recorder ties in hand and glove with the master recorder that enlarged the 4-in. programs 4 times, so large groups can view them.

From studies in the United States as well as abroad, it is evident that when facsimile comes into its own it will be a *combination of wired and broadcast service*. Any engineer knows that when you go to wider standards of transmission, frequency requirements are increased. This would again raise the costs of wire broadcasting by requiring a higher quality of transmission line than the regular telephone lines, as well as requiring the use of more expensive receiving equipment.

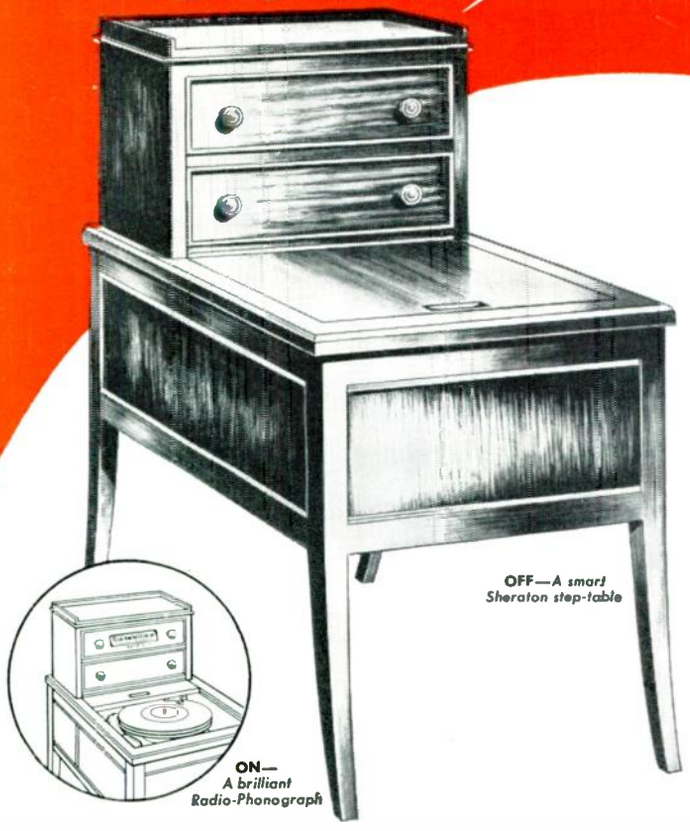
Beside the facsimile recorders for homes and public places, there are throughout the world all kinds of needs for point-to-point communications. It is of importance to the military in Switzerland, to the police in England, and as we jump in imagination to South America or the Orient, we visualize the imperative need it will fill in communications to private and other interests in remote parts of civilization where equipment must be cheap, simple, and free from maintenance troubles. In every instance analyzed, the 4-in. recorder and the master recorder will do the job rather completely.

It's self-evident that if standards of facsimile equipment in this country are such that this same facsimile equipment can perform real service the world over, it can be made in substantial quantities with the very minimum costs so necessary for world acceptance. It is of course true that line operating voltages vary from country to country, and that equipment would not be completely identical — but this does not in any way negate the fact that a large part of the equipment or its elements can be similar and interchangeable.

The world is getting smaller every day. The recent war emphasized the problem of narrow and wide-gauged railroad tracks. With the closer ties of today, interchangeability becomes very important.

One might easily take the position that the United States is going to set the pattern in facsimile and that because of our more-or-less lush prosperity, we might inadvertently set uneconomical standards that will limit and cramp the uses of facsimile in the rest of the world. The purpose of this report has been to bring the situation to your attention while standards and practices are still in their formative stage.— *Milton Alden*

Only Bendix Radio has it!



THE *Invisible* RADIO-PHONOGRAPH WITH THE *Phantom Dial!*

NEVER HAS A CHAIRSIDE RADIO PACKED SO MUCH SALES APPEAL!

Here's the set that sells on sight. Women welcome the smart decorator-styled step-table that enhances any room and does not reveal its identity as a radio-phonograph until the knob is turned. The Phantom Dial glows right through the mahogany finish when the drawer pull is turned—slide back the tabletop, and there's the fully automatic record changer that plays 12 records! It's a selling natural *at the surprisingly low price of* $159.50*—and it could come only from Bendix! No wonder the Bendix franchise is one of the most sought-after in the industry!

*Slightly higher in Western states.

Attractive full color display for floor and window use helps sell this unusual radio-phonograph

A line of Leaders at Every Price Level!

BENDIX RADIO

BENDIX RADIO DIVISION of
BALTIMORE 4, MARYLAND

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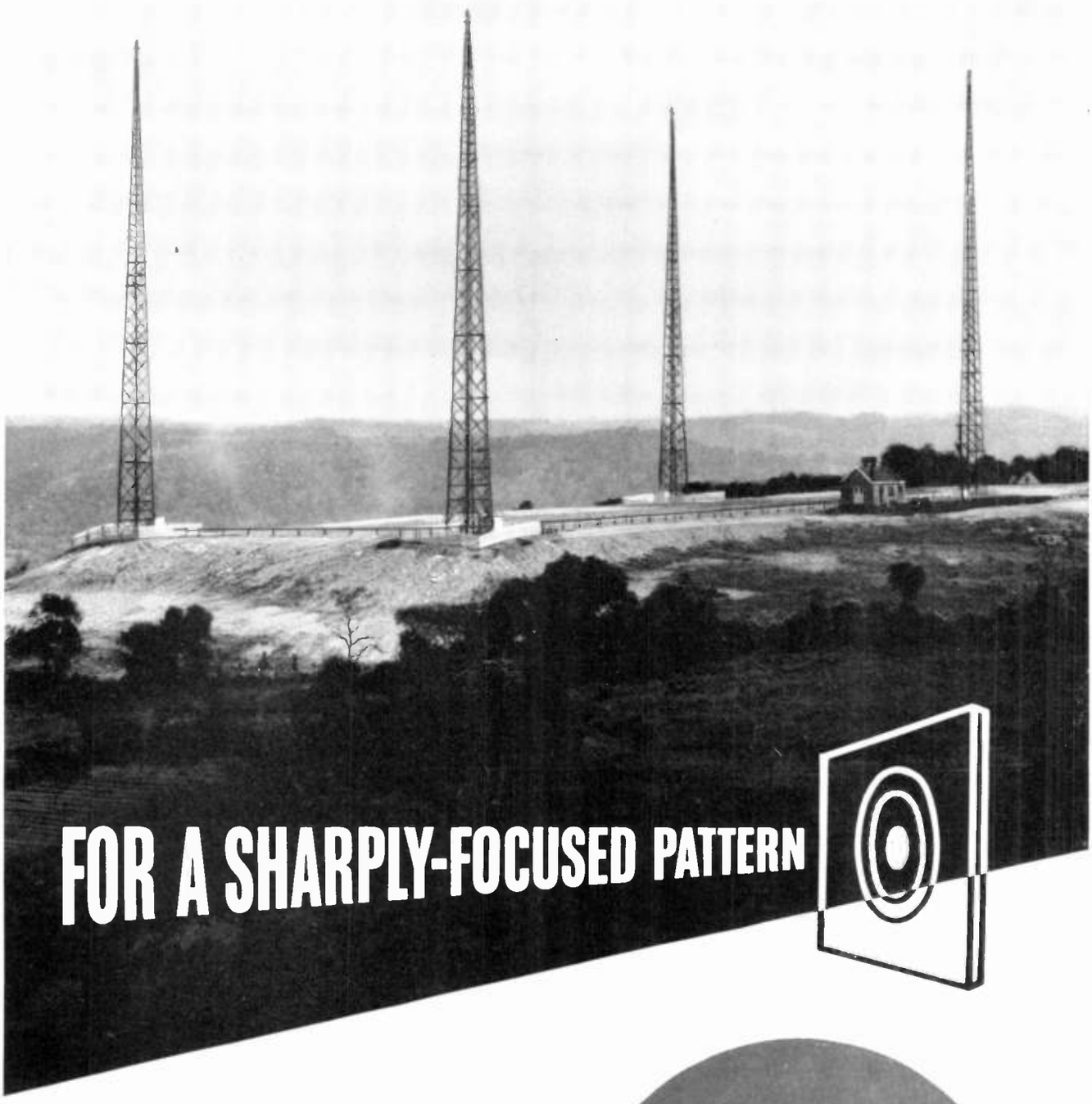
AVIATION CORPORATION



Typical of Blaw-Knox cooperation with radio engineers is this new directional array of four 200-ft. self-supporting, base-insulated towers, which permits the station to "throw its voice" in specified directions. In addition to acting as an AM radiator, one tower also supports an FM clover-leaf antenna.

If your plans call for a new station or increasing the efficiency of your present equipment, Blaw-Knox engineers stand ready to apply a wealth of experience in tower design to your advantage.

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
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BLAW-KNOX
Antenna
TOWERS

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

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.	5 D 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)

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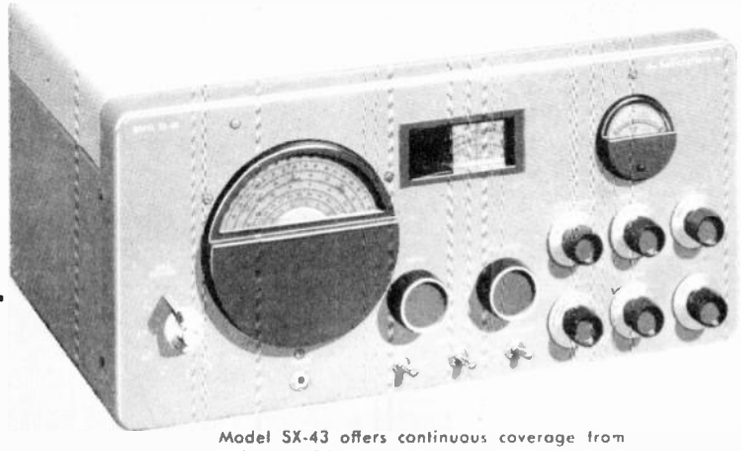
SX-42

Model SX-42 offers the greatest continuous frequency coverage of any communications receiver . . . from 540 kc to 110 Mc. Combines in one superbly engineered unit a top-flight VHf and FM receiver, standard and short wave broadcast receiver and high fidelity phonograph amplifier. With six bands; band six covers from 55 to 110 Mc

$275.00

FOREMOST



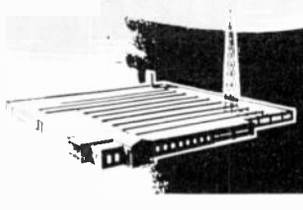
SX-43

Model SX-43 offers continuous coverage from 540 kc to 55 Mc and has an additional band from 88 to 108 Mc. AM reception is provided on all bands, CW on the four lower bands and FM on frequencies above 44 Mc. In the band of 44 to 55 Mc, wide band FM, or narrow band AM (just right for narrow band reception) is provided. Here is an extraordinarily versatile, sensitive receiver at a price that will attract all discriminating FM listeners.

$169.50

in FM

BY EXPERIENCE and accomplishment, Hallicrafters can claim to be among the first and the foremost in FM advancement. More than six years ago Hallicrafters had developed very high frequency equipment capable of operation on the new FM bands of 88 to 108 Mc. The new Models SX-42 and SX-43, direct outgrowths of this pioneering continue to maintain Hallicrafters foremost position in this specialized field. FM engineers, technicians and all concerned with the progress of FM are invited to listen to these models, for a demonstration of a new, high quality in FM reception.



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1947

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DON'T BLAME FM!

Get a Genuine FM Tuner—Get a

BROWNING ARMSTRONG FM CIRCUIT TUNER

NOISE? If you hear background noise on FM reception, don't blame FM! That trouble comes principally from inadequate noise-limiting action in the tuner. All BROWNING Tuners use Armstrong dual limiter and discriminator circuits, giving the most complete noise suppression of any FM circuit yet devised. Check this point before you buy ANY FM tuner.

RANGE? You don't need to wait for distant stations to increase their power before you can hear them where you live. All BROWNING models have highly sensitive tuned RF circuits to bring in stations that can't be heard at all on ordinary sets. And that extra signal booster amplifies weak signals so that full noise-limiting effect can be obtained.

FADING? It's true that weak FM signals vary in strength at times. However, most complaints of "fading" in FM reception are due to poor sensitivity and lack of adequate limiting action in the receivers. As long as there's enough signal to put 10 microvolts into a BROWNING Tuner, the volume from the loudspeaker will remain at constant level.

AM, TOO? Yes, you can have your choice of BROWNING FM-AM models, or those with FM only. The FM-AM Tuners, employing separate RF and IF tuning systems, provide AM reception far superior to what you have heard from conventional AM receivers. When you want special programs on AM, you will hear them at their very best on a BROWNING FM-AM Tuner.

PHONO? A record-player can be operated with any BROWNING Tuner. The phono switch is located on the front panel, while the terminals for the record-player are arranged conveniently at the rear of the chassis. One control regulates the volume of both the radio and phonograph. Thus you can use any type of record-player you choose.

HOW MUCH? Considering their outstanding design and performance, BROWNING FM-AM and straight FM Tuners, whether for cabinet or rack mounting, are moderately priced. They aren't cheap, but the few dollars of extra cost buy a world of satisfaction in added listening pleasure. For complete technical details and prices, write:

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Finch Telefax

provides high-speed, accurate communication . . . by wire or radio

Finch Telefax Duplex Unit transmits or receives exact facsimiles of written or printed messages, drawings, photographs, signatures, etc. Leased wire rates are authorized under A.T.&T. tariff, F.C.C. No. 135, effective May 4, 1946.

Also Make:

FACSIMILE BROADCAST TRANSMITTING EQUIPMENT
FACSIMILE HOME RECORDERS
MOBILE FACSIMILE RECORDERS
FACSIMILE DUPLICATING MACHINES
FINCH ANTENNAS FOR FM STATIONS

FINCH TELECOMMUNICATIONS, INC.

Address all inquiries to Sales Office

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The New Motorola FM Handie-Talkie Completely Portable Transmitter and Receiver

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The Motorola FM Handie-Talkie is a complete seven pound crystal-controlled radiotelephone transmitter, receiver and power supply in a single compact housing. Easily carried in the hand, over the shoulder or as a back-pack; it's rugged, dependable—powerful.

AN IDEAL EXTENSION FOR YOUR 25-44 MC SYSTEM

Designed to provide reliable 2-way communications from 1 to 4 miles between FM Handie-Talkie units, the range is greatly increased when working with a Central Station. Range in excess of twenty miles when operating with towers, or elevated locations.

MAXIMUM COMPACTNESS WITH COMPLETE ACCESSIBILITY FOR EASY MAINTENANCE

- Exceptional receiver sensitivity attained through unique cellular construction, new sub-miniature tubes and superhetrodyne circuit employing crystal control.
- Each stage a plug-in working unit—a Motorola feature that means new ease of maintenance.
- Shielded cell for each unit to provide stability and freedom from spurious responses.
- High quality, instrument type construction for low-cost maintenance and dependable performance.

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Illustrated folder gives you all the facts and specifications on this new radio miracle. You will find dozens of uses for your specific application. WRITE TODAY!

Motorola FM HANDIE-TALKIE

$250.00 PER UNIT

Motorola Inc. ● CHICAGO 51—COMMUNICATIONS AND ELECTRONICS DIVISION
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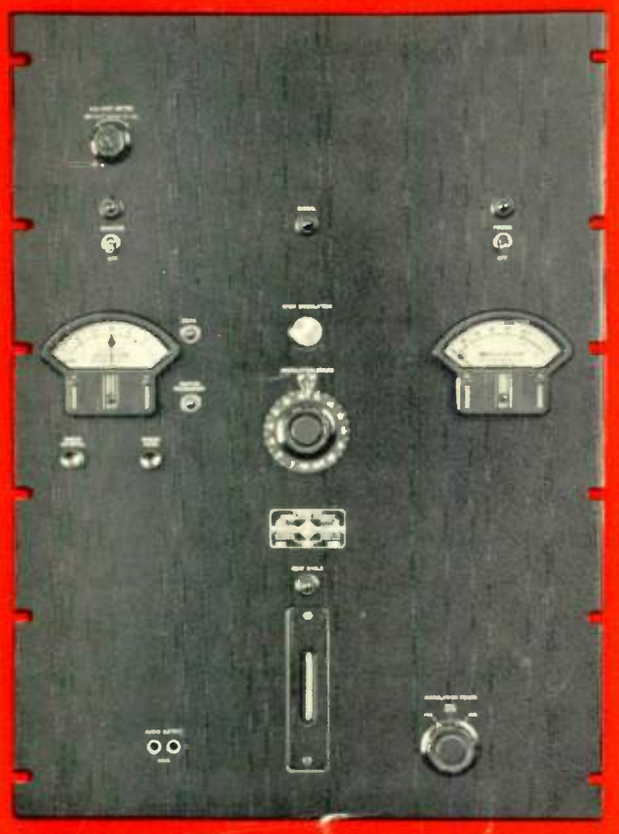

for FM and TELEVISION

In announcing the new Type 1170-A FM Monitor, General Radio brings to a conclusion a development project to make available to FM and Television stations a monitor with the same simplicity of operation, high stability and accuracy, and many-year reliability found in standard AM monitoring equipment in use in hundreds of G-R equipped stations. The G-R FM Monitor is here. It has been designed with the same engineering care . . . manufactured under the same rigid standards . . . and tested with the same thoroughness as all other G-R broadcast equipment. FM and Television stations can use it with the same confidence that AM engineers have shown in G-R equipment ever since monitors became a necessary adjunct to broadcasting.

Percentage Modulation meter, calibrated from 0 to 133 per cent. Additional db scale. Switch selects positive or negative peaks or full-wave indication. For FM, 100% modulation corresponds to 75 kc deviation; for television, internal adjustment changes calibration to 100% at 25 kc deviation.

Frequency Deviation meter calibrated in 100-cycle divisions from —3000 to +3000 cycles. To compensate for long-time drifts and to bring monitor into check with frequency measuring services, zero reading is adjustable over ±3000 cycle range.

Modulation Indicator Level is set by this dial; lamp flashes when modulation level exceeds that to which dial has been set. Dial range 0 to 120% modulation.

R-F Input Level is indicated on this behind-panel meter. Signal and center-frequency meter pilot lamps illuminated when input level is sufficient, and extinguished when level drops too low.

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- **CONTINUOUS MONITORING** — Continuous indication of center frequency — requires restandardization only once a day, *not before each measurement*.
- **REMOTE MONITORING** — Equipped for several remote monitoring circuits and for use with a recorder.
- **HIGH STABILITY** — 200 cycles (2 parts per million), or better, with a daily check of electrical zero of meter.
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- **LOW RESIDUAL DISTORTION** — Less than 0.2% at 100 k.c. swing — accurate for measurements to as low as ½ per cent.
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- **REMOTE INDICATORS** — Circuits and terminals provided for remote indicators for
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  - Percentage-modulation Meters
  - Over-modulation Lamp
  - 600 ohm Unbalanced Aural Monitor
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TYPE 1170-A FM MONITOR (either frequency range) . . . $1625

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