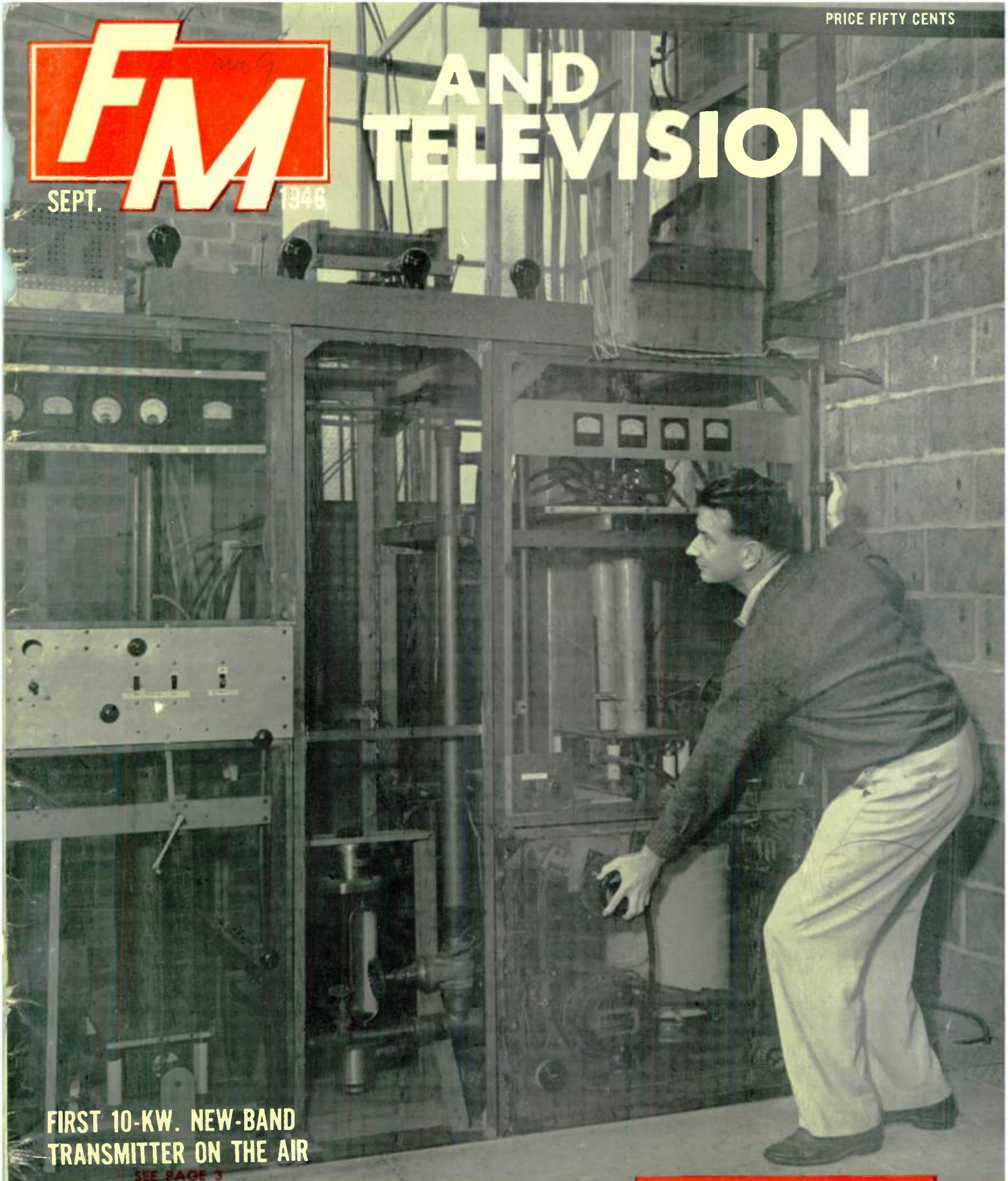
PRICE FIFTY CENTS

FM AND TELEVISION

SEPT. 1946



FIRST 10-KW. NEW-BAND TRANSMITTER ON THE AIR

SEE PAGE 3

Broadcast Station Issue

★ ★ Edited by Milton B. Sleeper ★ ★

FM AND TELEVISION Market Analysis No. 1

Components Used in FM Mobile Installations

The following parts list is presented to enable components manufacturers to visualize the market for their products created by the enormous expansion of FM mobile radio telephone services. The parts listed are required in a standard installation such as used for police cars, taxis, trucks, busses, private cars, and public utility service.

Production of these equipments in 1947 is estimated conservatively at 100,000, and is expected to exceed that figure by a substantial margin. Each mobile installation will require:

- 61 Mica condensers
- 12 Paper condensers
- 4 Electrolytic condensers
- 15 Variable air condensers
- 41 Carbon resistors, ½ watt insulated
- 38 Carbon resistors, 1 watt insulated
- 4 Wire-wound resistors
- 18 Vacuum tubes
- 7 Inductors
- 1 Dynamotor
- 1 Power supply vibrator
- 3 Relays
- 12 Receptacles, AN type
- 12 Plugs, AN type
- 22 Sockets
- 15 Transformers, air & iron cores
- 3 Quartz crystals
- 2 Variable carbon resistors
- 24 Miscellaneous ceramic insulators
- 2 Fuse holders
- 2 Glass fuses
- 8 Suppressors
- 2 Pilot lamps
- 2 Pilot light assemblies
- 1 Loudspeaker, PM type
- 1 Handset or microphone
- 3 Switches
- 1 Thermal circuit breaker
- 40 Ft. multi-conductor cable
- 8 Ft. solid dielectric transmission line
- 20 Ft. No. 4 primary cable
- 200 Ft. No. 20 hook-up wire
- 1 Vanadium steel antenna
- 1 Antenna mounting assembly
- 2 Steel cases
- 1 Steel control box
- Mounting hardware
- Bakelite terminal strips
- 180 Turret terminals

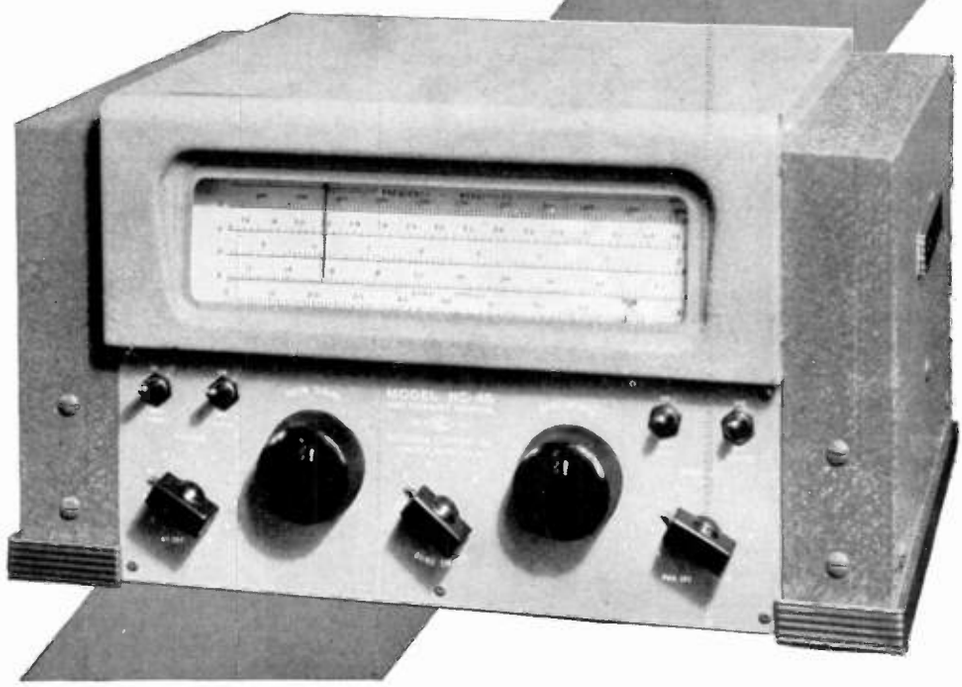
Note: If selective calling is used, 1 stepping relay, 4 holding relays, and other associated components must be added

Purchases of these components, to be built into FM mobile equipments during 1947, will reach a total of more than $10,000,000. This figure does not include stepping and holding relays and other parts for selective calling. Nor does it cover requirements for headquarters installations and auxiliary relay stations.

For the past six years, *FM* AND TELEVISION has been the principal, and almost exclusive source of technical data on the design of FM mobile radio telephone apparatus. Its coverage is complete in this actively expanding field.

Therefore, *FM* AND TELEVISION is the most effective advertising medium for reaching the executives, engineers, and designers who will select the suppliers for this $10,000,000 market. Plan to tell them about your products in the pages of *FM* AND TELEVISION Magazine.

"THE COMPLETE AND AUTHORITATIVE SOURCE OF INFORMATION ON FREQUENCY MODULATION AND TELEVISION"—SINCE 1940



NC-46

Clean modern styling combines with advanced electrical design to make the NC-46 an outstanding choice for the amateur. Workmanship is of traditional National quality in spite of moderate price. Features of the NC-46 include a series valve noise limiter with automatic threshold control, CW oscillator, separate RF and AF gain controls, and amplified and delayed AVC. Four coil ranges cover from 550 Kc. to 30 Mc. A straight-line-frequency condenser is used in combination with a separate bandspread condenser. Look over an NC-46 at your dealer's, study it inside and out. It's a lot of receiver for your money.

NATIONAL COMPANY, INC. **MALDEN, MASSACHUSETTS**

FM AND TELEVISION

FORMERLY: FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 6 SEPTEMBER, 1946 NO. 9

CONTENTS

★ ★ ★ ★ ★ ★

MILTON B. SLEEPER, *Editor and Publisher*
WILLIAM T. MOHRMAN, *Advertising Manager*
STELLA DUGGAN, *Production Manager*
Published by: FM COMPANY
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THIS MONTH'S COVER

This month's cover photo, the first taken in the world's most famous FM station since Pearl Harbor, shows the only 10-kw. new-band FM transmitter on the air. It is Major Armstrong's W2XEA, at Alpine, N. J. Standing before the copper screen cage is chief engineer Perry Osborn.

There's a special moral behind this picture. Taken more than one year after Paul Porter, then FCC chairman, said on August 17, 1945, that new-band FM transmitters would be "immediately available," it is a graphic reminder that public interest, convenience, and neces-sity are ill-served when Government administrators presume to direct science and industry by edicts and pronouncements.

In a year's time, only Major Armstrong has been able to build a 10-kw. new-band transmitter and put it on the air.

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

1. IFMB
2. FCC Blue Book
3. Railroad Radio

1. Whether the remaining members of FM Broadcasters, Inc. decide at the NAB Chicago Conference to continue as an appendage of AM-minded National Association of Broadcasters, or to recover their separate identity, it seems likely that a new organization of independent broadcasters will be formed.

That was the reaction to comments on this subject from industry leaders, published in the August issue of *FM and Television*. If such an organization is formed, much opinion favors admission of AM stations which are preparing to put their prime effort on FM programming and audience development.

That would put the new association into direct competition with NAB. A few years ago, when dissatisfaction developed within NAB ranks, an effort was made to form a new broadcast station group, but it fell through.

Such could be the case again. However, a sharp division is developing between broadcasters who pin their future hopes on FM, and those who prefer to ride along with AM. This may prove to be a sufficient reason for a real break in the ranks of the broadcasters.

Another difference is one of policy. AM Broadcasters have never taken an interest in the quality of reception afforded by AM sets. Their attitude has been: "We don't care how the programs sound, as long as sets are cheap enough so that everyone can have a radio."

FM broadcasters, however, are working with dealers to help them sell sets, and to assure proper operation in listeners' homes. They are even talking about setting up standards for receivers, and publishing their findings to protect listeners against phoney sets and low-grade reception. Whatever the outcome, the present discussions are bound to have a useful effect.

2. We have now decided what is fundamentally wrong with the FCC's Blue Book. We have come to the conclusion that it should have been composed by Frederic Wakeman. This decision is not based on a careful reading of the Blue Book. It wasn't that interesting, so we

(CONTINUED ON PAGE 59)

REL FM TRANSMITTERS GO ON THE AIR—

AND STAY ON!

Since VJ Day REL has successfully designed, produced and delivered new 88 to 108 megacycle Broadcast equipment to numerous Broadcast stations throughout the country. At present twelve such installations are in operation daily—some for as long as six months, and more are being installed regularly.

We have proven to the industry the importance of our record as the oldest and most experienced manufacturer in this field—*all to the benefit of REL customers in terms of equipment operating day-in-day-out at continued high efficiency of performance.*

To achieve this position takes years of hard work—it cannot be reached through so-called revolutionary developments insufficiently tested in the laboratory but rushed into field use with fond hopes that they will miraculously be made to work.

HERE IN PART IS REL'S RECORD OF PROVEN ACCOMPLISHMENT

FIRST

- ***To Build an Armstrong Phase Shift Modulator—1935***
- ***To Produce FM Broadcast Equipment Commercially—1936***
- ***To Successfully Install 50 KW FM Broadcast Transmitters for 42 to 50 Megacycles—in operation since 1940***
- ***To Deliver New Commercial FM Broadcast Transmitters for 88 to 108 mc.***
- ***To Design and Deliver FCC Approved Frequency and Modulation Monitors for 88 to 108 mc.***

AND WE'RE PROUD OF IT!

REL **RELIABLE ENGINEERING LEADERSHIP**

RADIO ENGINEERING LABS., INC.

Long Island City, N.Y.

ADVERTISERS INDEX

25B Speech Input Console assures highest quality FM studio control

Look at these features:

Neat modern styling.

Complete unit design—including table and NEW plug-in cables.

Uniform, noise-free, distortionless operation over a 15,000 cycle range.

8 low level microphone channels and 3 line level channels. Any 4 microphone channels and 3 line level channels—7 in all—can be used simultaneously.

2 high quality main amplifier channels that handle FM and AM programs simultaneously—plus separate monitor and cueing channel.

7 remote line input circuits—3 normalled through for program transmission or sending or receiving cue.

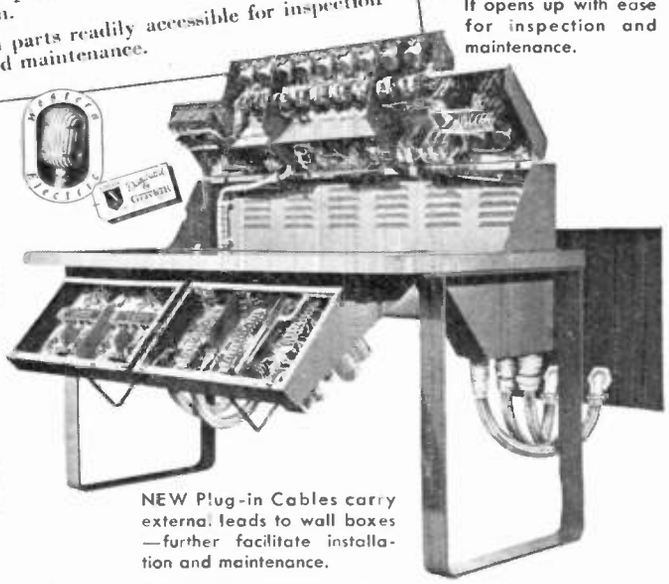
All controls arranged and coordinated for maximum operating flexibility and convenience.

Compact—only 36″ high, 35¼″ wide, 28¼″ deep.

Designed for maximum ease of installation—junction boxes supplied.

Completely wired for easy plug-in connection.

All parts readily accessible for inspection and maintenance.



It opens up with ease for inspection and maintenance.

The new 25B is a honey for FM. Designed by Bell Telephone Laboratories and made by Western Electric, it handles your FM and AM programs simultaneously. It's compact—easy to install—provides great flexibility at moderate cost. Whether your station is large or small, the 25B will give you the highest quality studio control.

Ask your nearest Graybar Broadcast Equipment Representative to tell you what a top number the 25B really is—or write to Graybar Electric Co., 420 Lexington Avenue, New York 17, New York.

NEW Plug-in Cables carry external leads to wall boxes—further facilitate installation and maintenance.

Western Electric

— QUALITY COUNTS —

ENGINEERING SALES

Mt. Vernon, N. Y.: Herman Smith, former president of Radio Essentials, Inc., has formed a new company, Herman H. Smith, Inc., to manufacture radio hardware and components.

Belden: Russell C. Bowen of Chicago, recently discharged from the 8th Air Force as a captain, will represent Belden Manufacturing Company in northern California and Nevada.

New York: Lybig Sales Corporation, with Arthur Lynch as president and J. Alan Biggs vice president, has been formed to handle national distribution and to serve as general sales manager, for manufacturers of radio equipment and components. Lines already signed up are Radio Music Corporation, Islip Radio Mfg. Corporation, and Taybern Equipment Company. Lybig offices are at 136 Liberty Street, New York 4. Arthur Lynch will continue as New York manager for National Company.

New York: Sam Harper, veteran rep whose headquarters are at 215 Fulton Street, New York 7, is back from the wars and on the job again, looking for lines to handle in the metropolitan area.

ECA: Edward Rojo: Former export sales manager of Andrea Radio Corporation, is now serving in the same capacity at Electronic Corporation of America, 170 53rd Street, Brooklyn, N.Y.

Times Telephoto: Export sales of facsimile and telephoto apparatus manufactured by Times Telephoto Equipment, Inc., subsidiary of *The New York Times*, will be handled by International Standard Electric Corporation, 67 Broad Street, New York City.

Chicago: George H. Timmings has resigned as sales manager of DX Radio Products, and has set up headquarters at 149 W. Ohio Street, Chicago, in preparation for handling radio lines as a manufacturers' agent.

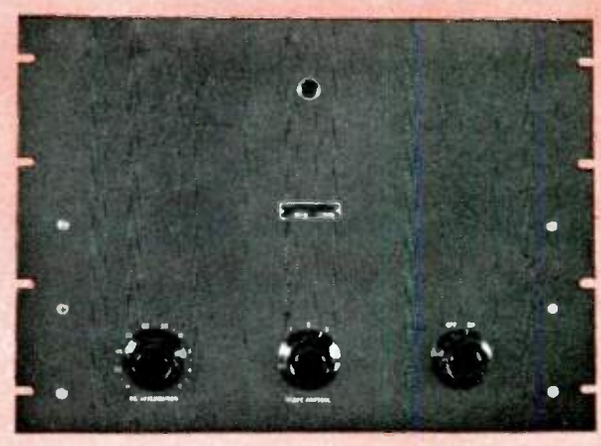
Philadelphia: New sales manager for Raymond Rosen's home appliance division is Felix Gross, ex-district manager for WPB.

Presto: Thomas B. Aldrich has succeeded R. C. Powell as general sales and advertising manager of Presto Recording Corporation. Aldrich, who joined Presto as

(CONTINUED ON PAGE 59)

ANOTHER FIRST FOR PRESTO

88-A RECORDING AMPLIFIER



PRESTO 88-A amplifier has three calibrated frequency response curves...one flat from 30 to 17,000...two with rising high frequency characteristics complement either the NBC "Orthacoustic" playback system or standard high fidelity transcription playback equipment.

THE *FIRST* recording amplifier capable of standardizing frequency response of instantaneous recordings so that they will complement the characteristics of high fidelity reproducing equipment now used in most broadcasting stations.

Instantaneous recordings made with the 88-A amplifier and the Presto 1-C cutting head equal the response of the finest commercial recordings and reproduce uniformly a range from 50 to 9,000 cps.

Ample reserve power makes it possible to obtain complete groove modulation at all cutting pitches without distortion. Delivery 30 days after order.

PRESTO

RECORDING CORPORATION

242 West 55th Street, New York 19, N. Y.

WALTER P. DOWNS, LTD., in Canada

WORLD'S LARGEST MANUFACTURER OF INSTANTANEOUS SOUND RECORDING EQUIPMENT

Here it is — 10

Achievement in high-power, air-cooled FM transmitters

ADVERTISER and audience winner, here is the completely self-contained 10-kilowatt FM transmitter that sets new standards of broadcasting for Class B services.

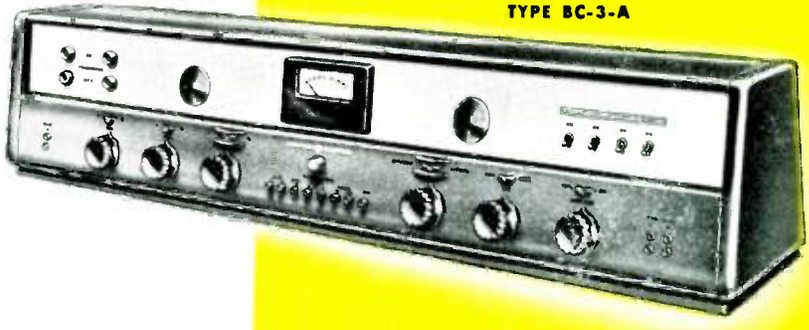
Combining high power with new advancements in circuit stability, program fidelity, and equipment reliability, type BT-4-A—with its Phasitron modulator—has every electrical and mechanical feature required by experienced broadcasters.

See your G-E broadcast sales engineer for the facts or write the *Electronics Department, General Electric Company, Syracuse 1, N.Y.*

BT-4-A

FINGER-TIP CONTROL FOR YOUR TRANSMITTER – Put your transmitter on the air—control your audio, monitoring, and power circuits—switch tower lights on and off—turn on sleet melters—from *one convenient point* with a G-E Transmitter Control Console. Write for descriptive folder.

TRANSMITTER CONTROL CONSOLE TYPE BC-3-A



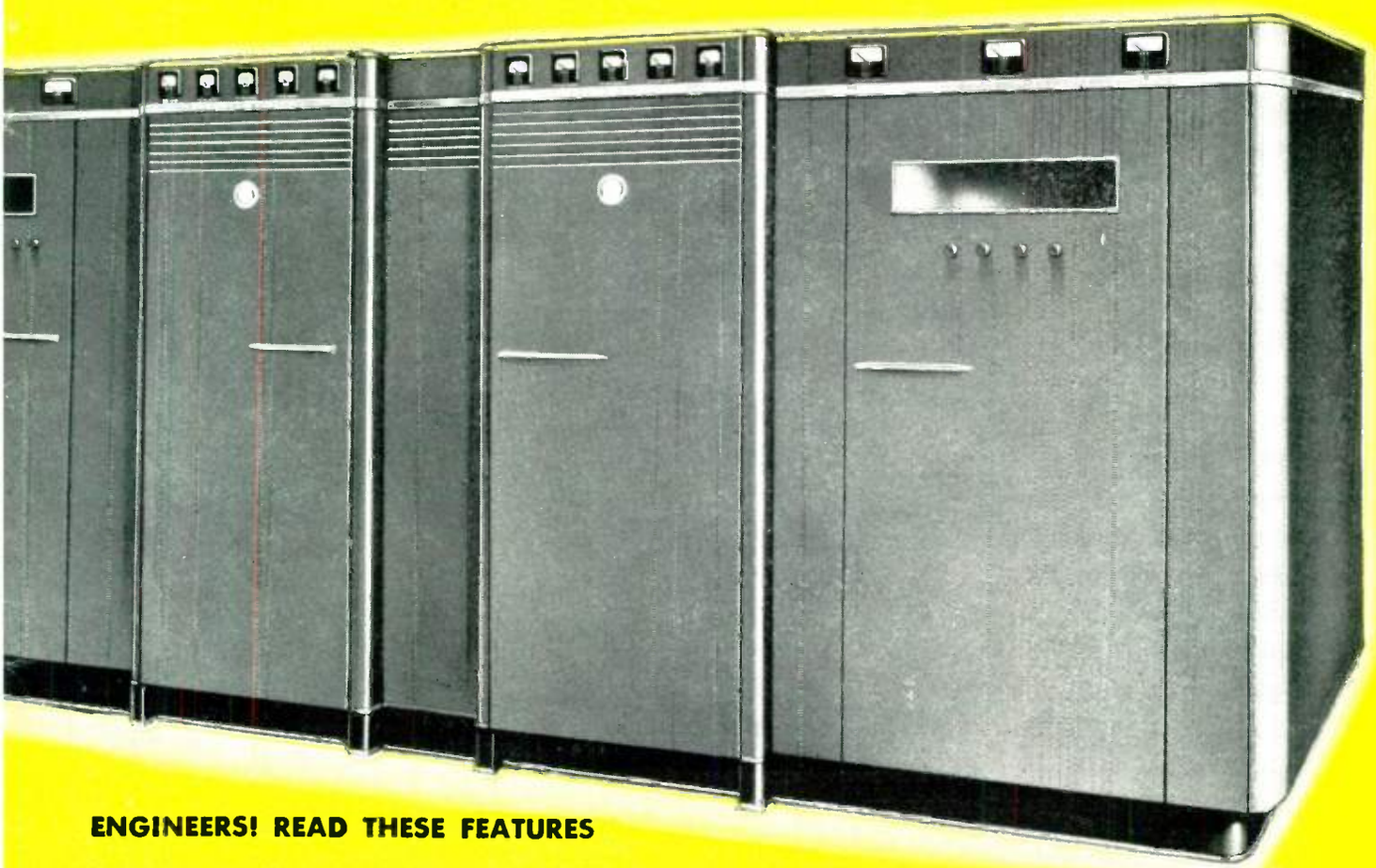
Have you placed your order yet?

STUDIO AND STATION EQUIPMENT • TRANSMITTERS

GENERAL ELECTRIC

160-E8-6614

kilowatts of FM



ENGINEERS! READ THESE FEATURES

● ***Phasitron Modulator*** — The *simple all-electronic* system with the G-E Phasitron tube • Produces a ±75-kc swing at output frequency with a frequency multiplication of only 432 • No frequency conversions • No spurious responses • Direct single-crystal control *independent of modulation.*

● ***Basic Circuit Features*** — Completely self-contained • Plate transformer and power equipment located inside cabinet • Clean-cut design • Only 43 tubes in complete transmitter (17 r-f tubes, 2 a-f tubes, 24 rectifier tubes) • Air-cooled tubes throughout • Grounded-grid high-power amplifier using new air-radiator GL-5518 triodes. • Minimum number of components and tuning controls • Direct crystal control with one crystal • Provision for circuit extension to control desk • Better power factor, lower power bills • Fully meets all FCC and latest proposed RMA standards.

● ***Block-Build to 50 KW*** — The G-E 10-kw FM transmitter includes a G-E 250-watt FM exciter and a G-E 3-kw FM amplifier • If you already have a G-E 250-watt exciter, add a 3-kw and a 10-kw amplifier • If you have a G-E 3-kw transmitter, add a 10-kw amplifier • For 50 kw, add a G-E 50-kw amplifier to the G-E 10-kw transmitter • No expensive equipment duplication • No obsolescence • No redesigning.

● ***Program Protection*** — Automatic and instantaneous reclosures on plate-circuit overloads and momentary power failures • Supervisory indicator lights throughout • Power input circuit breaker with high power-interrupting capacity • Instantaneous Delta-Wye switching for "high-low" power operation without program interruption • Individual filament-voltage control of power amplifier tubes for maximum life.

● ***Easy-to-get-at*** — Full length front and rear doors for "reach-in" accessibility • Plenty of room to work • Vertical chassis construction • Demounts into separate units that will go through standard 36" doorways and fit into freight elevators • Overall size only 75" high, 178" long, 38" deep.

● ***Safe*** — Positive electric interlock and mechanical grounding systems throughout • No oil-filled apparatus • No need for fire-proof vaults • Low line-supply voltage, 208/230 volts.

➡ ***YOURS FOR THE ASKING*** — Write today for a copy of the new specifications on the G-E 10-kw FM transmitter.

ANTENNAS • ELECTRONIC TUBES • HOME RECEIVERS

FM • TELEVISION • AM *See G.E. for all three!*

WRH

FINCH FACSIMILE TELEFAX MEANS

PICTURES and WRITING

by Radio or Telephone

FINCH FACSIMILE TELEFAX GIVES — to government, private business, public utilities and *individual homes* — a means of high-speed communication never before equalled for convenience, flexibility and dependability.

The two-way Telefaxer shown above — and now in production and use commercially — transmits and/or receives, by radio, 2760 square inches of pictures and text per hour or about 30,000 words — without one error! The speed by telephone reaches 918 square inches per hour. Definition is high and accuracy absolute.

The strong Finch patents assure to Finch customers the maximum of service, quality and protection. Write for full particulars.

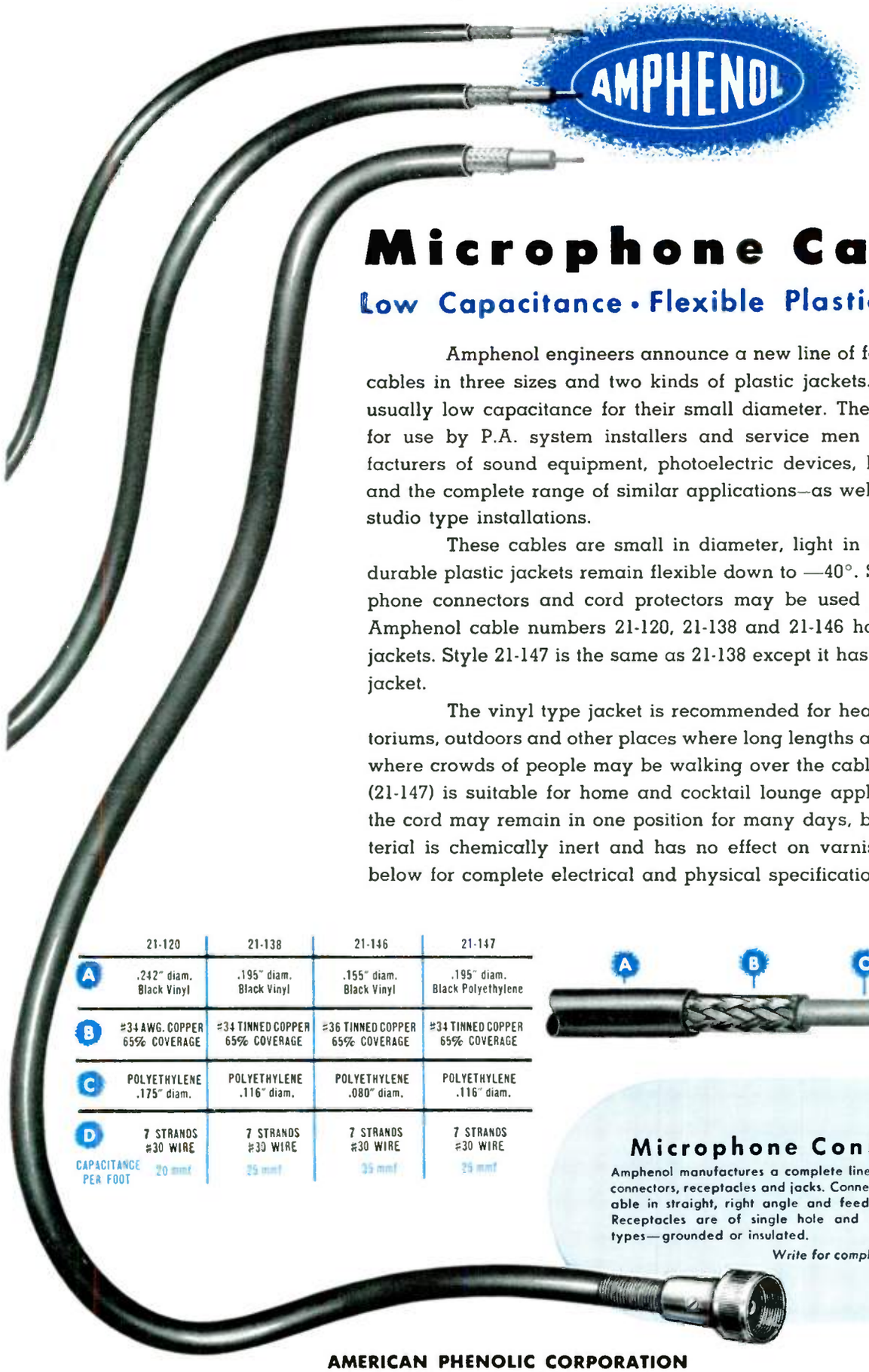
FINCH TELECOMMUNICATIONS, INC. • PASSAIC, N. J.

Address All Correspondence to Sales Office: 10 E. 40 St., New York 16, N. Y.

Mfrs. also of the Finch Rocket Antenna for FM stations

finch

First in Facsimile



Microphone Cables

Low Capacitance • Flexible Plastic Jackets

Amphenol engineers announce a new line of four microphone cables in three sizes and two kinds of plastic jackets. All are of unusually low capacitance for their small diameter. They are designed for use by P.A. system installers and service men and for manufacturers of sound equipment, photoelectric devices, home recorders and the complete range of similar applications—as well as for regular studio type installations.

These cables are small in diameter, light in weight and the durable plastic jackets remain flexible down to —40°. Standard microphone connectors and cord protectors may be used with any type. Amphenol cable numbers 21-120, 21-138 and 21-146 have black vinyl jackets. Style 21-147 is the same as 21-138 except it has a polyethylene jacket.

The vinyl type jacket is recommended for heavy use in auditoriums, outdoors and other places where long lengths are required and where crowds of people may be walking over the cable. Polyethylene (21-147) is suitable for home and cocktail lounge applications, where the cord may remain in one position for many days, because the material is chemically inert and has no effect on varnishes. See table below for complete electrical and physical specifications.

	21-120	21-138	21-146	21-147
A	.242" diam. Black Vinyl	.195" diam. Black Vinyl	.155" diam. Black Vinyl	.195" diam. Black Polyethylene
B	#34 AWG. COPPER 65% COVERAGE	#34 TINNED COPPER 65% COVERAGE	#36 TINNED COPPER 65% COVERAGE	#34 TINNED COPPER 65% COVERAGE
C	POLYETHYLENE .175" diam.	POLYETHYLENE .116" diam.	POLYETHYLENE .080" diam.	POLYETHYLENE .116" diam.
D	7 STRANDS #30 WIRE	7 STRANDS #30 WIRE	7 STRANDS #30 WIRE	7 STRANDS #30 WIRE
CAPACITANCE PER FOOT	20 mmf	25 mmf	35 mmf	25 mmf

Microphone Connectors

Amphenol manufactures a complete line of microphone connectors, receptacles and jacks. Connectors are available in straight, right angle and feed-through styles. Receptacles are of single hole and mounting plate types—grounded or insulated.

Write for complete information.

AMERICAN PHENOLIC CORPORATION

CHICAGO 50, ILLINOIS

In Canada • Amphenol Limited • Toronto

The World's Largest Single Source of:

COAXIAL CABLES AND CONNECTORS • INDUSTRIAL CONNECTORS, FITTINGS AND CONDUIT • ANTENNAS • RADIO COMPONENTS • PLASTICS FOR ELECTRONICS

EVERYTHING NEW FOR FM —

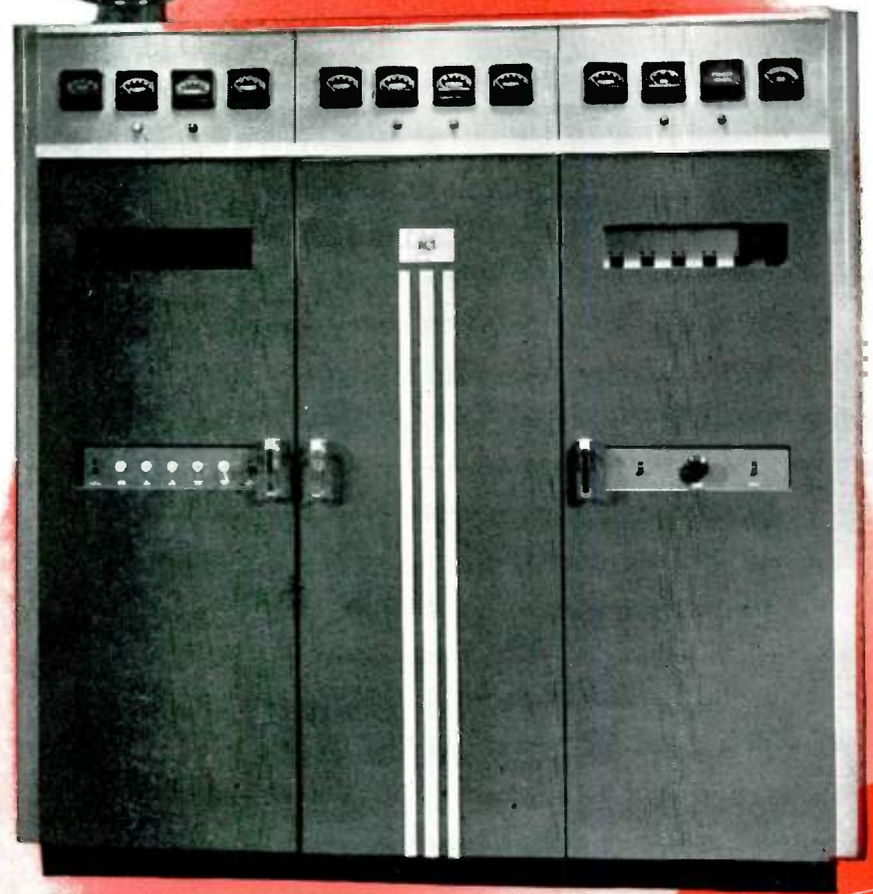
for NEW operating economy....

NEW RCA POLYDIRECTIONAL MICROPHONE

(Type 77D)—The polydirectional feature helps you obtain better balance, clarity, naturalness, and selectivity in studio pickups.

By means of a screw adjustment at the back of the microphone a variety of non-directional, uni-directional, and bi-directional characteristic patterns can be produced. Undesired sound reflections can be quickly eliminated merely by switching to the proper pattern. A three-position, VOICE-MUSIC switch permits the selection of the best operating characteristic.

This lightweight, multi-purpose microphone is finished in two-tone umber grey.



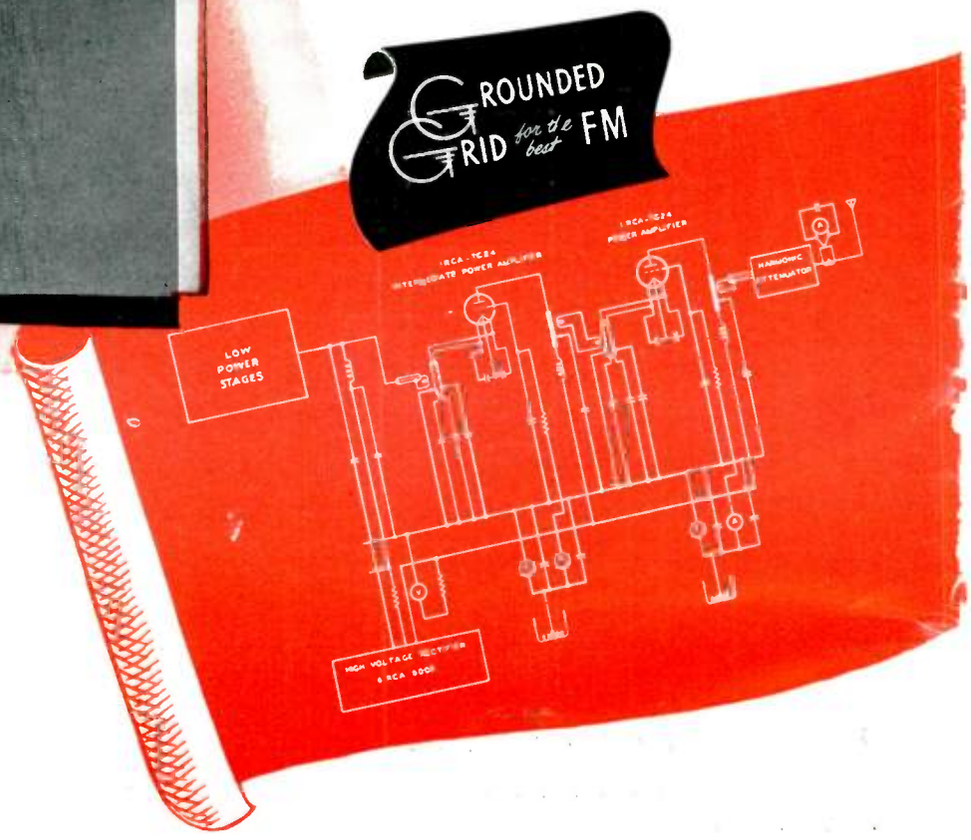
NEW RCA TRANSMITTERS

RCA's line of FM transmitters (250 watt, 1, 3, 10, 25, and 50 kw) are completely new from exciter to power amplifiers—new circuits, new tubes, and a new type of construction.

The frames of all power sizes have been standardized thus assuring uniformity of dimensions, appearance, and easing installation problems. When increased power is desired, you merely add an amplifier. Appearance is equal to that of a single unit. Curved-end pieces add to the finished appearance.

A new, hollow base frame provides space for inter-unit wiring, and eliminates the need of wiring through units or conduits in the floor.

Air filters, flush-mounted centralized control panels, and concealed hinges are other features of the new RCA construction—*standardized* to assure you a better product at lower cost.



NEW CIRCUITS

The new RCA Grounded-Grid amplifier circuits are at once simpler and more stable than any heretofore employed. As the name indicates, the grid of the tube is at r-f ground potential (instead of the filament as in conventional transmitters). The drive is applied between cathode and ground, either element being at the necessary d-c bias potential.

Special tubes have been developed for these circuits. Neutralization is either unnecessary, depending on frequency, or, if necessary, very easily achieved.

Other advantages: easier tuning, fewer tube types to stock, smaller, less-expensive tubes, lower operating costs, less distortion, and better program quality.

RCA's new "Direct FM" circuit for the exciter is something entirely different, too.

—from MICROPHONE to ANTENNA

NEW convenience, and NEW performance

THE NEW RCA equipment shown here is merely indicative of the advances that have been made by RCA in FM broadcast equipment. Similar improvements have been made on every item that goes into a completed broadcast station, including test and measuring equipment, monitoring assemblies, turntables, and recorders.

The resumption of broadcast-equipment construction, after wartime restrictions, offered us a unique opportunity to design an entirely new line—integrated in every detail. The various units incorporate all the latest FM improvements that have grown out of RCA's advanced war work on communications equipment for the armed forces.

If you are planning to build a new FM station, we believe that "RCA all the way" will help you to make it a *better* station. You will be assured of the same efficiency, convenience, operating economy, and performance that have made RCA's AM equipment the undisputed first choice of broadcast stations for the past decade. Radio Corporation of America, Camden, N. J.

NEW RCA CONSOLETTE

(Type 76-B2)—Provides a complete high-fidelity audio system for FM, AM, and television at a price even the smallest station can afford.

Compact (39 by 17 by 10½ inches), it includes all the amplifying control and monitoring equipment needed to handle two studios, an announcement and a control-room microphone, two turntables, and six remote lines.

It enables simultaneous auditioning and broadcasting from any combination of the studios, turntables, or remote lines. The talk-back system is independent of program channel—no feed-back. Emergency amplifier and power supply circuits help prevent time off the air.

Differs from two previous RCA models now giving satisfactory service in more than 300 stations primarily in its frequency response—now extended to 15,000 cycles.

NEW RCA SUPER TURNSTILE ANTENNA

The advantages of this antenna make up an impressive list. A few include: high-gain, permits the use of a lower transmitter power for a given coverage, full performance at any frequency from 88 to 108 mc, handles up to 20 kw, easy to install, wide band, pretuned at factory, no field adjustments whatever, a standardized low-cost "packaged" item—comes complete, de-icer units easily added, fewer end seals, entire structure can be grounded.

In addition, it has the usual advantages of any turnstile antenna: an inherently circular field pattern, low wind resistance, and simple, inexpensive, single-pole mounting.

The antenna, because of its relatively high gain and extended band width, is also ideal for television. Naturally, since it is of the turnstile type, both sound and picture transmitters can be fed into the same antenna.

FM BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DIVISION, CAMDEN, N. J.

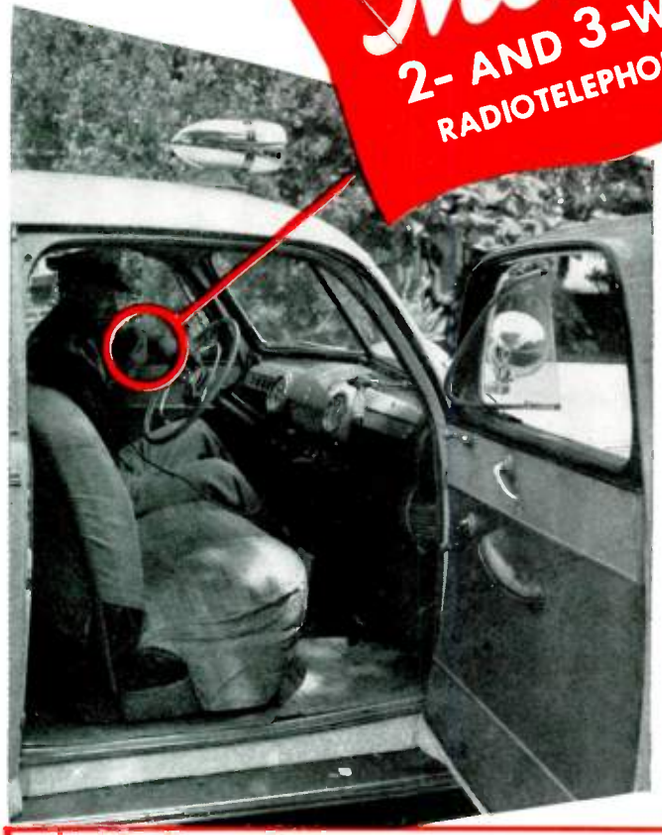
from MAINE to CALIFORNIA
from FLORIDA to OREGON

the UNDISPUTED

favorite

in

POLICE RADIO



Motorola
2- AND 3-WAY F-M
RADIOTELEPHONE SYSTEMS

For the past 5 years over 80% of all Police Radio equipment installed has been Motorola

Yes, it's a fact—Police from coast to coast prefer Motorola over all other types of equipment 4 *to 1!* These figures aren't merely based on a survey, they are based on *actual sales records.* There's a reason for Motorola's outstanding popularity—it's Motorola's outstanding superiority. Consider, for example, these important features:

1. **SIMPLICITY**—It doesn't take an electronic technician to operate a Motorola Radiotelephone. Any man on your force can use it *without special training.*
2. **EFFICIENCY**—Motorola has increased range and power, enabling patrols to maintain contact with the central station up to 50 miles.
3. **RELIABILITY**—Motorola Radiotelephone has been *proved* in thousands of applications. It is standard equipment for Fire Departments, public utilities, railroads, bus lines and Police Departments across the country.

ADD MOTOROLA TO YOUR FORCE

The terrain you service may present a particular problem, but Motorola engineers can solve it. Write today for specific recommendations concerning your particular application. No obligation, of course.

GALVIN MFG. CORPORATION • CHICAGO 51
COMMUNICATIONS AND ELECTRONICS DIVISION

F-M & A-M HOME RADIO • AUTO RADIO • CAR HEATERS • PHONOGRAPHS • TELEVISION • "HANDIE TALKIES" • POLICE & AIRCRAFT RADIO

The Action Is *Forward*

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BACK NUMBERS OF *FM* AND TELEVISION

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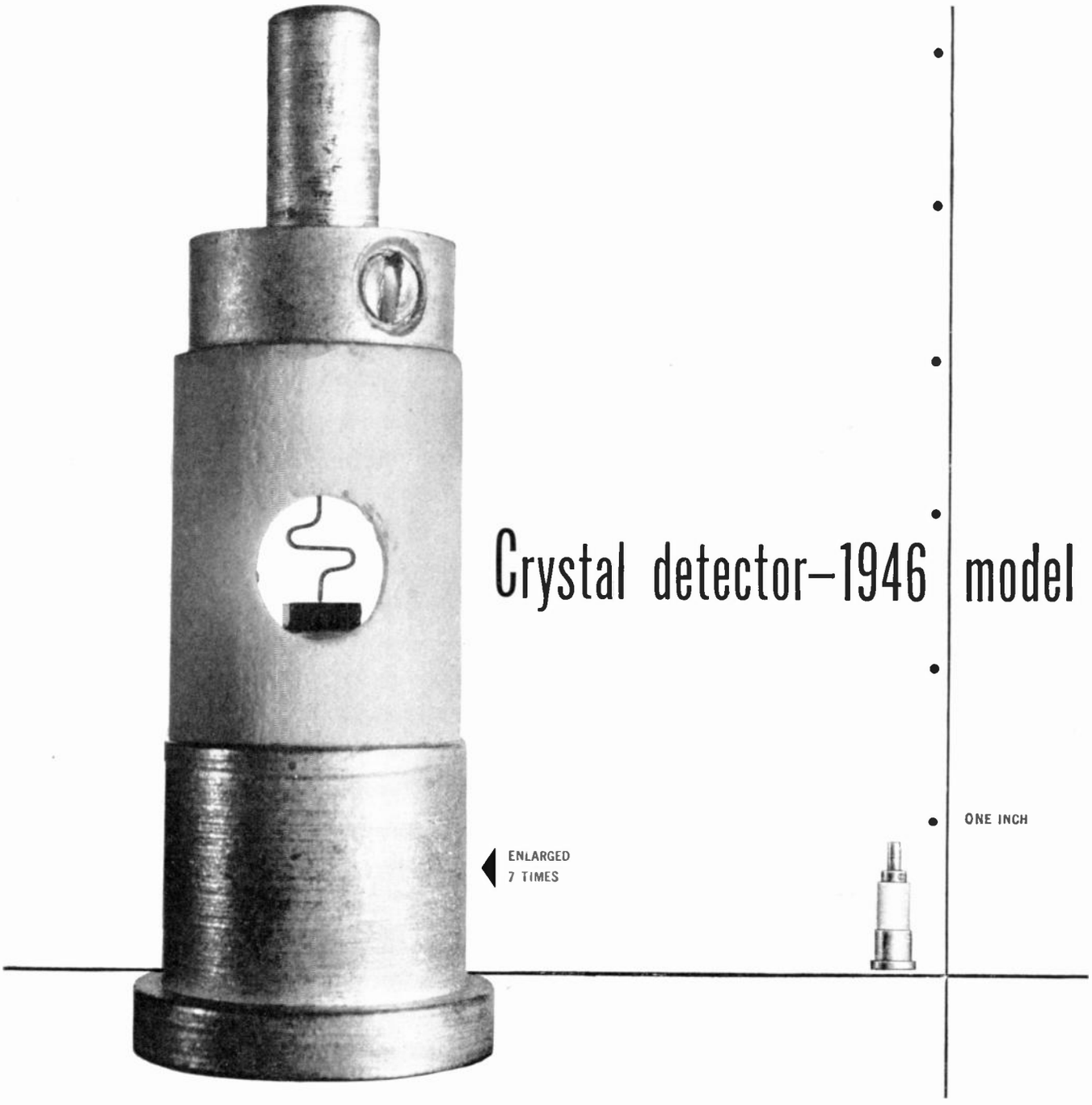

Crystal detector—1946 model

Remember the crystal detector in the first radios — hunting for the right spot with a cat's whisker? For years the detector lay discarded in favor of the vacuum tube. But when microwaves came, and with them the need to convert minute energy to amplifiable frequencies, a Bell Laboratories' scientist thought back to the old crystal.

Silicon of controlled composition, he discovered, excelled as a microwave detector. Unlike the old-style natural crystals, it was predictable in performance, stable in service. From 1934 to Pearl Harbor, the Laboratories developed silicon units to serve microwave research wherever needed.

Then Radar arrived. The silicon crystal came into its own, and found application in long-distance microwave Radar. Working with American and British colleagues, the Laboratories rapidly perfected a unit which the Western Electric Company produced in thousands. It became the standard microwave detector.

Crystal detectors are destined to play a big role in electric circuits of the future. They will have an important part in Bell System microwave radio relay systems. In various forms, they may reappear in radio sets. Here again Bell Laboratories' research has furthered the communication art.

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NOTES ON STARTING AN FM BROADCAST STATION

Engineering Counsel—Rates and Potential Revenue—Program Sources—Building an Audience—Interesting Advertisers

BY MILTON B. SLEEPER

IT IS not possible to set forth specific cost information for those without previous AM experience who are planning to enter the FM broadcast field. There are too many variable elements involved. A plan which would meet the conditions in one area would be completely misleading if applied perhaps 100 miles away. A plan for a commercial station, projected for the purpose of showing a profit, would not fit the needs of an educational station, or of a coöperative undertaking to be supported by a social or labor organization, or by popular subscription.

FCC regulations, and their interpretation by the Commission in the case of a specific application are controlling factors which must be considered in terms of the venture under consideration.

The First Step ★ Therefore, the first step to be taken by an individual or group planning to enter FM broadcasting without past experience in this field is to engage an engineering consultant.

The functions of an engineering consultant are:

1. To assist the principals in crystallizing their ideas concerning the purposes and policies of the proposed station.

2. To appraise the possible success of the venture as to available capital, capital investment required, operating expense, potential revenue, and contingencies.

3. To recommend the location of the studios and transmitter, and to relate the problems of antenna height, transmitter power, coverage, studio-to-transmitter connections, and FCC regulations.

4. To present the requirements for originating programs, building a record library, and making the necessary connections with a network.

5. To recommend and estimate the cost of studio facilities, transmitter, tower, incidental equipment, and a studio-to-transmitter connection if it is needed.

6. To outline the operating staff required, to estimate their salaries, and to explain the effects of union contracts which may be necessary.

7. Finally, to file an application for a construction permit, and to handle any problems which may arise at the FCC in connection with the application.

From this outline, it will be clear that a capable engineering consultant is not merely a radio engineer, nor is a man qualified in this capacity merely by having worked in a broadcast station. Few, if any, manufacturers' salesmen are equipped with the necessary information and experience. But there are specialists who can measure up to the qualifications set forth here.

Market Appraisal ★ An approximate determination of potential income for any new broadcast station is extremely difficult to make for an independent FM station. In the case of FM, where the building up of an audience must be paced by the delivery and purchase of FM receivers, a time table estimate of potential income is difficult indeed. Furthermore, the availability of network programs is still an uncertainty.

The only basic information of real significance is that which can be obtained from the rate card of an AM station in a location comparable to that of the projected FM station. The coverage area and the audience of the AM station can then be compared to the population within the proposed area of the FM station. Here, FM offers a great advantage over AM, since the FM coverage is constant, day and night, while AM coverage is reduced greatly after sunset.

Figures on retail sales by counties are available from the Bureau of the Census, Washington, D. C. Studies of retail sales in the area under consideration will disclose additional pertinent facts. Also, the volume of local and national advertising carried by newspapers serving the area should be examined.

Program Expense ★ Radio programs, without benefit of network service, must be made up largely of local talent, recordings, and news. The first of these is of special, personal interest to an FM station's audience. Its composition will include contributions from members of social and political organizations, churches, schools, and colleges. Handled skillfully, these can be developed into an interesting and entertaining program source. As the station's audience increases, sponsors can be found for many of these programs. In other cases, expenses will be paid for remote pickups.

Very practical assistance will be rendered by any of the transcription services in connection with the choice of recordings. After the initial recordings have been obtained, comments from listeners will help to direct subsequent acquisitions. It is of paramount importance that the recordings do justice to FM broadcasting. No transcription should be accepted if it lacks sufficient fidelity to distinguish it from those heard on AM reception. Transcriptions are now available which, when transmitted on FM, cannot be distinguished from live talent.

News reports can be obtained from any of the several news services. It will probably be possible to obtain news reports edited for radio broadcasting. These can be used as is, or further edited by the station's newscaster.

Plans for initial program composition must be made with the utmost care and thoroughness. The word will get around very quickly that the new station is excellent, if it is, or otherwise, if it is not. If the report is that "you must get an FM set to hear the new station," audience building will get off to a quick start. The comment that "I bought an FM set, but there's nothing good on the new station" can do inestimable damage.

Building the Initial Audience ★ When the first FM station is installed in any area, the management is confronted with the task of building an audience from scratch. It must be assumed that the only FM receivers are in the local radio stores.

Therefore, the station and the radio dealers have a common interest in the sale of FM sets. With only a few sets in the area, the station's immediate problem is to have the largest possible number of people listen to each receiver. As for the dealers, prewar experience showed that the most effective promotion on FM sets was the demonstration of FM reception.

Here is a promotion package for a new FM station to offer that will bring quick results in set sales for dealers, and will build an audience at the same rate of speed:

Offer each of several radio stores a 15-minute demonstration program, timed either to increase store traffic during an otherwise quiet period, or when traffic is heaviest, depending upon the conditions at the individual store. In return for the announcement of the dealer's name on the program, the dealer must feature the time of the demonstrations in his newspaper advertising, and in store-window banners, giving the station's call letters and frequency. These demonstration periods should include:

1. A very brief account of the station's plans to provide entertainment of superior quality.

2. Sound effects which take advantage of FM fidelity, such as breaking a glass tumbler, sawing wood, a ticking clock, ringing a telephone bell and a large gong,

hammering nails, firing a revolver, and blowing a police whistle.

3. High-fidelity transcriptions of familiar selections including a piano selection, a negro spiritual, and a brass band. Formal or unfamiliar music is not recommended for this purpose.

Several scripts, written to tie these elements together, will give enough variety that they can be repeated many times. No effort should be made in the scripts to "sell" FM. The contrast between the FM reception and what people have come to accept on AM is the most convincing argument for buying FM receivers!

Moreover, the sales made by the radio dealers as a result of these demonstrations will quickly justify a charge for station time, and thus bring in the first revenue.

Arrangements for these demonstrations should not be limited to a single store. They should be made with radio, furniture, department, record, and musical instrument dealers in various parts of the station's service area, and for both daytime and evening periods.

Nor are these the only opportunities to reach large numbers of people with individual sets. Business and service clubs, women's clubs, church organizations, and public schools welcome demonstrations and special programs with announcements in which the organization is mentioned. Music teachers welcome the opportunity to have their star pupils perform over the air, and without charge. This is also true of musical instrument stores which offer lessons to their customers.

Proven Methods ★ There is no intention to infer that these are original suggestions. They were used in 1940 and 1941 when the first FM stations went on the air. The methods described proved highly successful then. They are just as effective now.

Here, for example, is a detailed account of a series of demonstrations given in 1940 by the Yankee Network and the R. H. White department store in Boston. This text appeared in the November, 1940 issue of *FM* Magazine:

When Aaron Goldberg, manager of the radio department at R. H. White's in Boston, made up his mind to use Stromberg-Carlson receivers to push up his fall volume of radio sales, he determined to get the idea of extra-quality home entertainment across to his customers in a way that would wow them. And wow them he certainly did!

His primary purpose, of course, was to launch FM sales. There were other things he wanted to accomplish, also. He wanted to gain the prestige for his radio department of taking the lead in promoting a new radio development and to bring radio-minded people to the R. H. White store. Obviously, to address two groups, one in the afternoon and the other in the evening, would take less man-hours than talking to several hundred people individually. And finally, he wanted to get the names and addresses of those who, after hearing an FM demonstration, were definitely prospects for FM sets.

Accordingly, the coöperation of the Yankee Network was enlisted. While their program department laid out the plan of a special demonstration to be broadcast from Paxton, and wrote the script, a dipole antenna of the conventional sort was erected on the roof of the store, and connected to the auditorium. This gave perfect, noise-free reception of W1XOJ, 43 miles distant, despite the fact that the store is in the DC section of Boston, where receiving conditions are unfavorable in the extreme. [W1XOJ is now WGTR.]

Announcements were run in the R. H. White newspaper advertisements, inviting the public to attend the demonstration in the afternoon or in the evening, when the radio and furniture departments are open until 9:00 P.M. On the stage of the auditorium, three Stromberg-Carlson FM-AM consoles were put on display, marked with prices and brief descriptions large enough to be read by the audience.

A piano was set up at the center of the stage. A microphone, connected by telephone wires to the broadcast studio, was located where it could pick up the piano. This completed the arrangement.

At both demonstrations, the auditorium, holding about 400 people, was filled. After brief remarks of introduction, one of the receivers was turned on, and Frequency Modulation spoke dramatically for itself.

The broadcasting of sound effects led up to the high spot of the performance: the Magic Piano. The announcement, "Now we return you to the auditorium of the R. H. White Company," was the cue for Harry DeAngelus, seated at the piano, to play "Stardust." Suddenly, in the middle of the piece, a stir went through the audience. People leaned forward in their seats, and others rose to see what had happened on the stage for, while the music seemed to be coming from the piano, Mr. DeAngelus was not playing. In fact, he had turned around and was looking into the wings. Then he swung back to the keyboard, and his hands picked up the music again.

The audience was mystified. Apparently this was a player piano, and he had been only making the motions of striking the notes. Again, he stopped playing, and the music continued. The next time he resumed, a spotlight was turned on him and, when he stopped, the spot was shifted to one of the FM receivers. Some of the people knew then what had been going on, but others did not understand until, at the end of the second selection, the announcer explained what had taken place.

The set-up was this: the pianist at the studio listened to the piano in the auditorium through the microphone wire connections. When he picked up the tune on the studio piano, the pianist at the auditorium stopped. Thus they alternated their playing without a pause. So perfect was the reproduction by FM, and the piano is a most difficult instrument to reproduce by radio, that the only way it was possible to determine the origin of the music was to watch the pianist on the stage.

The script which was used is presented through the courtesy of The Yankee Network. It can be changed readily and adapted to suit any similar occasion!

(*Organ Crescendo*)

ANNOUNCER:

Nights shall be filled with music — with songs and words, words, words, millions of them — bringing you news, drama, education, information, syncopation. . . . Radio — culmination of man's desire to conquer space. Radio — that leaps around the earth on waves of light — and brings the world within your touch. . . . Radio — that's everywhere at every time. . . . Radio — moving always forward, widening its scope — spreading its illuminating influence.

The story of radio is the story of man's progress, the story of his unending search for knowledge and expression. From the time of primitive smoke signals and the code of jungle drums to the red blast of trumpets heralding the approach of kings, to the time of Marconi and the first crude wireless key, radio has developed and perfected itself into a precious instrument of rare beauty.

Tonight, for the first time in Boston, Frequency Modulation is being demonstrated to the retail public. Tonight, The Yankee Network, in coöperation with the R. H. White Company, brings you a graphic demonstration of radio's newest and greatest achievement — Frequency Modulation. Signalizing this new era in the science and art of broadcasting, The Yankee Network and the R. H. White Company of Boston present to the general public and the retail trade a demonstration of this marvel called — Frequency Modulation. A glowing testimonial to man's mastery of the elements — for this great new Frequency Modulation conquers nature — eliminating static, minimizing interference — radio in its perfection — listen, as Frequency Modulation proves its birthright.

Clotilda Zappala, charming young New England coloratura soprano, sings one of the loveliest and most colorful arias in all of the world's great operatic literature — enjoy the complete perfection of reproduction afforded by FM as Miss Zappala, accompanied by Francis J. Cronin, sings —

(*The Bell Song from the Opera "Lakme" by Delibes*)

This afternoon it is our pleasure to present to you a man who has contributed much to the development and perfection of Frequency Modulation. Speaking from the auditorium on the third floor of the R. H. White Company store in Boston, where four hundred people have assembled to see as well as hear this demonstration, we present one of radio's pioneers, Paul

A. deMars[1], Vice-President in charge of Engineering for The Yankee Network. Mr. deMars.

MR. DEMARS:

Ladies and Gentlemen —

In the fall of 1935, Major Edwin H. Armstrong, the scientific genius who had previously contributed the three outstanding inventions in radio, demonstrated his latest development to the Institute of Radio Engineers in New York City. Terminating a lifelong study to eliminate static from the radio, he disclosed a system of broadcasting virtually free from static and interference, and capable of transmitting programs with quality heretofore undreamed of. Called Frequency Modulation, as distinguished from the present method known as Amplitude Modulation, the system is now familiarly known as FM.

How FM differs in principle of operation from the present system is mainly of interest and concern to engineers and scientists and is too technical to discuss here. It is sufficient to say that new type transmitters and receivers are required.

Recognizing the outstanding capabilities of FM, the Federal Communications Commission, in May of this year, authorized commercial broadcasting on 40 new wavelengths in the high frequencies.

New FM broadcasting stations are under construction, or are being planned all over the country, and there are already about 20 in operation. [Note: this was 1940]

In this auditorium, you are listening to John Shepard, 3rd's pioneer FM station of New England. This station is the most powerful of its kind in the world and is located in the town of Paxton, Mass. — beyond Worcester — and broadcasts programs 16 hours daily from The Yankee Network, the Colonial Network, The Mutual Broadcasting System and NBC.

Although this is the only FM station that at present serves all of Massachusetts and Boston, other FM stations are planned for this region and there is no question that FM will not only broadcast present programs, but will also provide new services in this area.

The number of new stations technically possible is virtually unlimited, and the owner of an FM receiver is assured of not only better reception, but a greater variety of entertainment.

Now then, what specifically is offered to the owner of an FM receiver?

Reception without static — without noise — without interference.

Reception unmarred by crashing roars when lightning streaks the sky.

Reception free from the all-too-familiar buzzes, crackles and frying occasioned by your neighbor's electric razor, oil burner, kitchen mixer, or vacuum cleaner.

Reception without the chattering, the squawking, the unwanted programs in the background of your favorite station.

Reception with a naturalness and realism in the reproduction of music, speech and sounds beyond the capabilities of the present methods.

The program in the demonstration that follows originates in the studios of The Yankee Network in Boston, where it is transmitted by Frequency Modulation to Paxton and then broadcast to the listening audience.

You are listening here in this auditorium to reception of radio transmission transmitted twice over a distance of about 45 miles and received in one of the noisiest areas of Boston for broadcast reception.

But note the crystal-clear tone, despite the adverse local conditions. This is the quality of service that the owner of an FM receiver can expect in his own home.

The following demonstration is intended to convince you here in this auditorium of the merits of FM by letting FM speak for itself.

ANNOUNCER:

Thank you, Mr. deMars.

The perfection in the reproduction of sounds that is made possible through transmission by Frequency Modulation can perhaps best be demonstrated by producing a series of sounds frequently used in everyday radio programs. Notice in the following series of reproductions the great clarity in tone and the full range of sound that is clearly audible. First, the sound effects engineer will ring a ship's bell — the type in common use on sailing vessels — it is made of cast brass, is twelve inches in diameter, and will be struck with a clapper seven inches long. Listen —

(*Strike Ship's Bell*)

Our next sound effect is perhaps one of the most difficult in the sound engineer's entire repertoire to reproduce. Only through Frequency Modulation is it possible to recreate the wide tonal range of the sound of sawing wood.

(*Effect*)

Perhaps the next most difficult effect to convey over the radio is the accurate reproduction of a carpenter's hammer striking a three-inch flat-headed nail. Listen for the ping of the hammer — a sound which only Frequency Modulation can reproduce in all its naturalness.

(*Effect*)

We'll let you guess at this one!

(*Effect: Pouring Drink*)

Perhaps the smallest and most infrequently used instrument, yet one whose sound is most difficult to produce, is the triangle. Listen to it now.

(*Effect*)

Listen now to the rich tones of a large Chinese gong — made of hammered brass. Note particularly how long the aftertones hang on. Frequency Modulation recreates this for you now.

(*Effect*)

The colorful and lively bolero, "Le Sevillana," by Guiseppe Ferraro, is a vertical transcription, made especially for broadcast purposes. It is a composition of brilliant tone patterns that, in unrestrained good spirits, employ the full instrumental range of Harry Horlick's orchestra. Listen to it now and notice the perfect reproduction to the full tonal range.

(*Le Sevillana 60–098*)

We now return you to the auditorium of the R. H. White Company store, where Harry DeAngelus is waiting to play a piano medley.

(*Stardust — Beer Barrel Polka*)

(*Piano at R. H. White auditorium and at studio alternate in playing this music.*)

Those in the R. H. White Company's auditorium have just witnessed a remarkable demonstration. We might have called those numbers the marvel of the Magic Piano, for the pianist in the auditorium and a pianist here in the studio alternated in playing the medley just completed — yet so wonderful is the reproduction made possible through transmission by Frequency Modulation that the studio audience could not tell whether they were listening to radio reception from the studio piano or to the piano on the stage before them, except by watching the pianist's hands — a further tribute to the perfection of this marvelous new system of broadcasting.

This evening's presentation is concluded as Francis J. Cronin, New England's premier organist, employs the full resources of the grand studio organ in playing a skillfully arranged medley of familiar overtures —

(*Medley of Overtures, organ*)

And so we conclude another "famous first" in the history of broadcasting. This afternoon for the first time in Boston, The Yankee Network, in coöperation with the R. H. White Company, has presented this broadcast, marking a new milestone in the development of radio — Frequency Modulation. And marking also the first time that Frequency Modulation has been demonstrated to the retail trade and the general public through a retail outlet — the R. H. White Company. Frequency Modulation, the sensational new perfection in radio reception, is the newest and greatest achievement of radio science — another forward step in man's mastery of the elements.

Noiseless, staticless, free from interference, Frequency Modulation brings you radio at its perfect best — doubling your enjoyment, ever widening and increasing the scope of your best form of entertainment — Radio!

You may see a complete line of the amazing new Frequency Modulation receivers on display at the R. H. White Company in Boston. Remember that the

[1] Now associated with Raymond Wilmotte, consulting radio engineer, 1469 Church Street N. W., Washington 5, D. C.

world is at your finger tips when a radio is at arm's length and in radio reception, Frequency Modulation means perfection.
(*Station Break*)

Reaching Advertisers ★ While efforts are under way to build the listening audience, it is also necessary to reach prospective sponsors. They, too, must be educated both as to the superiority of FM over AM broadcasting, and FM's greater impact on listeners.

One way to launch a drive for sponsors is to give prospective advertisers and agency executives an FM demonstration, and to follow that up with invitations to use the station facilities, without charge, for the actual broadcasting experimental programs.[2] The studio and program techniques of FM are completely different from AM practice. Producers, script writers, and performers have much to learn about FM. Specifically, the realism of FM reception makes possible the use of many effects, devices, and innovations that would fall flat on AM.

Since special FM techniques can be worked out only by trial and error, an "experimental FM workshop" period is of the greatest value to prospective sponsors, and offers listeners an interesting insight into program development.

In the December, 1940, issue of *FM* Magazine, there was published the following account of a luncheon at which the advertising fraternity of Boston was officially introduced to FM broadcasting. Here is the report:

On October 22nd (1940), at a Boston Advertising Club luncheon given in honor of John Shepard, 3rd, nearly 400 advertising managers and agency executives listened without moving or speaking during a demonstration of FM from Paxton. Not only that — they burst into applause when Clotilda Zappala, at the other end of the 90-mile circuit, finished singing Delibe's Bell Song!

When such a group of hard-boiled radio critics, accustomed to asking, "So what?" in response to the most enthusiastic proponent of a new idea, applaud something coming from a loudspeaker, it has to be a very extraordinary performance indeed. There is no doubt but that many a consultation followed this first formal introduction of FM to advertising executives, in which the question has been asked: "What changes will FM bring to the technique of radio broadcasting?" Certainly this demonstration left no doubt in any listener's mind that FM now, having reached the state of commercial perfection, performs a service distinctly superior to that of AM broadcasting.

When the demonstration was over, and John Shepard, 3rd had modestly accepted the ad men's sincere applause, some of the more technically-minded went up to see just what kind of special equipment had been used. Expecting that the Yankee Network engineers had gone overboard in setting up some kind of super receiver that would be far beyond the means of the average home listener, they were almost disappointed at its simplicity. The receiver itself was just one of the new G.E. table model tuners, connected to a small amplifier unit, and a big Waite speaker, required to fill the enormous Georgian Room of the Statler Hotel.

As many a radio man knows, this is one of the world's worst spots to demonstrate radio reception, even from the nearby Boston stations. But here was the simplest, most elementary rig, bringing in an actual reproduction of the original studio program with nothing added by way of noise or distortion, and nothing omitted through failure to transmit or receive the full audio range.

The announcement that John Shepard, 3rd, would be the guest of honor, and that he would provide a demonstration of FM reception, brought the largest attendance on record at a Boston Advertising Club luncheon. Many of the executives displayed the curiosity of people seeing television for the first time — but with this significant difference: Those who came to hear FM went away with the certain knowledge that this was not a scientific curiosity, but a newly perfected service now available to the public, in the form of an important improvement for which an immediate need already exists. Certainly, everyone who attended the luncheon was impressed with the conviction that FM provides a great advancement as a medium of advertising, as well as of home entertainment.

The first speaker was Linus Travers, vice president in charge of sales and production for the Yankee Network. He, in turn, introduced Paul A. deMars, Yankee's chief engineer, who conducted the demonstration from Paxton. The script followed the lines of the text published in *FM* Magazine for November, 1940, and included the use of the Magic Piano. In this case, a piano was set up at one end of the dining room. A spotlight was put on the floor, so that the shadow of the pianist was thrown up on the wall where it could be seen by those at the opposite end. When he stopped playing, and the music continued without interruption, people began to stand up to see what was taking place. A buzz of conversation went through the room, particularly noticeable because the audience had been so completely silent and attentive throughout the demonstration. The people were heard to remark: "Why, you can't tell when you're hearing the piano on the stage or the studio piano coming from the loud speaker!"

This was indeed the final and convincing evidence of FM's true and perfect reproduction at the loudspeaker of what goes into the studio microphone.

The Postwar Period ★ By using methods of the sort described here, interest in FM broadcasting was built up quickly to the point where, although FM sets were started in production very slowly, over 500,000 receivers were sold in 1941, most of them going into areas surrounding Boston, New York City, Philadelphia, Detroit, and Chicago. That figure will be exceeded many times in 1947. Therefore, new FM audiences and advertising revenue can be built rapidly by those stations which undertake carefully planned promotion, and back up their initial efforts with programs which provide the finer entertainment which FM makes possible.

Here is the FM program policy set forth by Walter J. Damm, general manager of WTMJ and WTMJ-FM, owned by "The Milwaukee Journal".

1. If the public is going to buy FM sets, it needs an incentive — therefore, FM programs must be distinctly worth while and fill a genuine need.

2. It follows that FM program schedules must be entirely independent from AM schedules. FM's advantages of high fidelity reproduction and freedom from static are, alone, not enough in most cases to make people switch from AM to FM.

3. FM should be programmed to meet the radio desires of discriminating listeners who enjoy good music. Both sustaining and commercial programs should utilize the high fidelity advantage of FM to the utmost. In this respect, we believe that there is a place for electrical transcriptions, as well as live talent, on FM programs. Experience has shown that the new high-fidelity electrical transcriptions now available to the broadcasting industry are remarkably well adapted to FM. They will provide the means of presenting famous artists and musical groups which cannot otherwise be heard over individual FM stations until FM networks become feasible.

4. While music should be the basis of FM schedules, we recognize that drama, news, special events and children's programs have their place in the daily lives of radio listeners.

5. We believe that daily luncheon and dinner concerts of uninterrupted music should be scheduled, as these two periods will make it possible for the listener to enjoy the benefits of FM to the utmost. The dinner concert, particularly, should fill the wishes of many set owners who have hungered for a program of music and not one made up of 15-minute units, ranging from children's programs to dramatics, sports and news.

6. We believe that by concentrating on music during the afternoon, FM will attract set owners who do not care for the continuous procession of dramatic shows now on the air. Herein lies an opportunity for the FM broadcaster to awaken interest in daytime radio among set owners who do not listen to AM stations.

7. Lastly, we believe that the FM broadcaster should always model his programs according to the listening public's demands and should not permit himself to be swayed from his set course by the idiosyncrasies of the advertiser and the advertising agency. Steadfast adherence to a policy based on genuine public service can open up a listening field of unbelievable proportions.

[2] This method was used with great success by the DuMont television station WABD. For details, see "Why the Other Five Letters Weren't Mailed" by Samuel H. Cuff, *FM* AND TELEVISION, Nov. 1944.

TRANSMITTERS USING PHASE-SHIFT MODULATION

Link 250-Watt Unit for Community Service, and 1-Kw. Transmitter Which Can Be Followed by Power Amplifiers

BY WILLIAM FINGERLE, JR.*

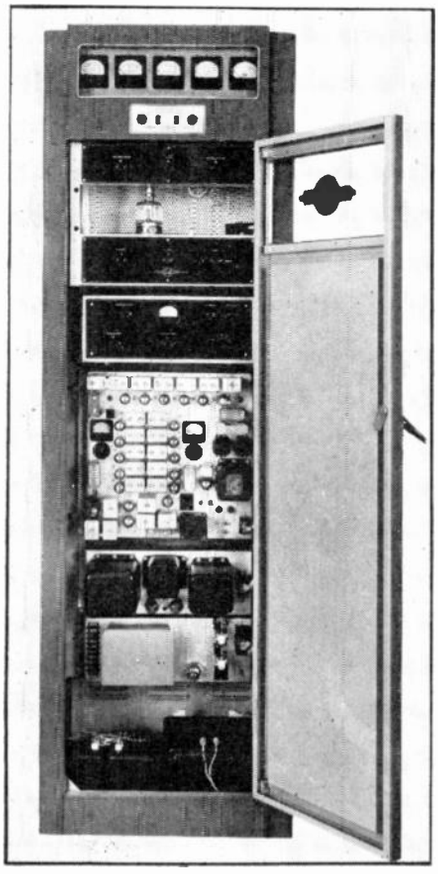


FIG. 1. A 250-WATT FM TRANSMITTER DESIGNED FOR COMMUNITY STATIONS

TO COMPLETE its activities in the manufacture of Frequency Modulation equipment, Link Radio Corporation has designed and is currently in production on three types of FM broadcast transmitters for the 88- to 108-mc. band. This series comprises single-unit transmitters of 250 watts and 1 kw., and an amplifier which, when driven by the 1-kw. equipment, has an output of 3 kw. In addition, a 10-kw. amplifier is under development. All of these units are designed to equal or exceed RMA and FCC standards for frequency response, noise, and distortion. Other standard requirements as to power, line voltage, and frequency, input level, monitor output level, and transmission line impedance have been adhered to rigidly. The resultant designs, therefore, are capable of integration with accessory equipment designed to the same standards.

Preliminary engineering discussions of FM broadcast coverage and service problems emphasized the need, from the standpoint of economics, for two basic designs. These are 1) a transmitter of 250 watts, designed specifically for low-cost community service, and 2) a 1-kw. transmitter so designed that it can be used alone, or as a driver for succeeding power amplifier stages, either installed as original equipment or added subsequently.

250-Watt Transmitter ★ Figs. 1 and 2 show the extremely compact arrangement of the complete 250-watt equipment, following the general appearance of standard Link communications transmitters.

The basic element of this transmitter, and of the 1- and 3-kw. models also, is an exciter and driver unit with an output of 50 watts at the carrier frequency. This unit is contained in two chassis; the exciter proper and the driver. The output of

* Assistant Chief Engineer, Link Radio Corporation, 125 W. 17th Street, New York, N. Y.

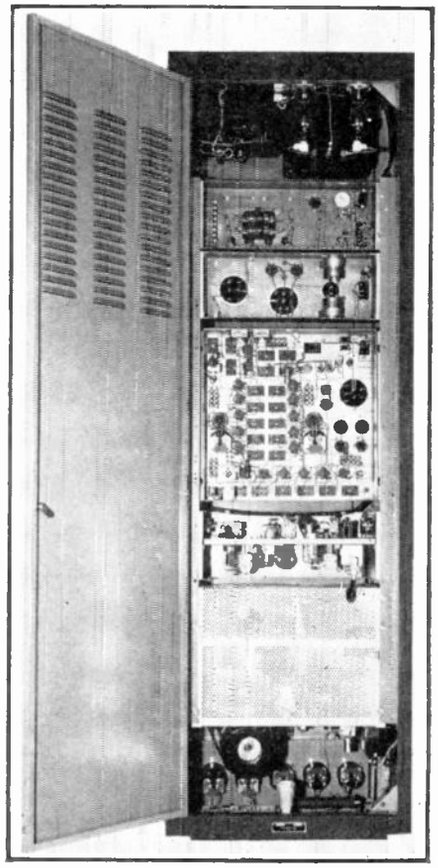


FIG. 2. REAR VIEW OF THE 250-WATT SINGLE-UNIT FM INSTALLATION

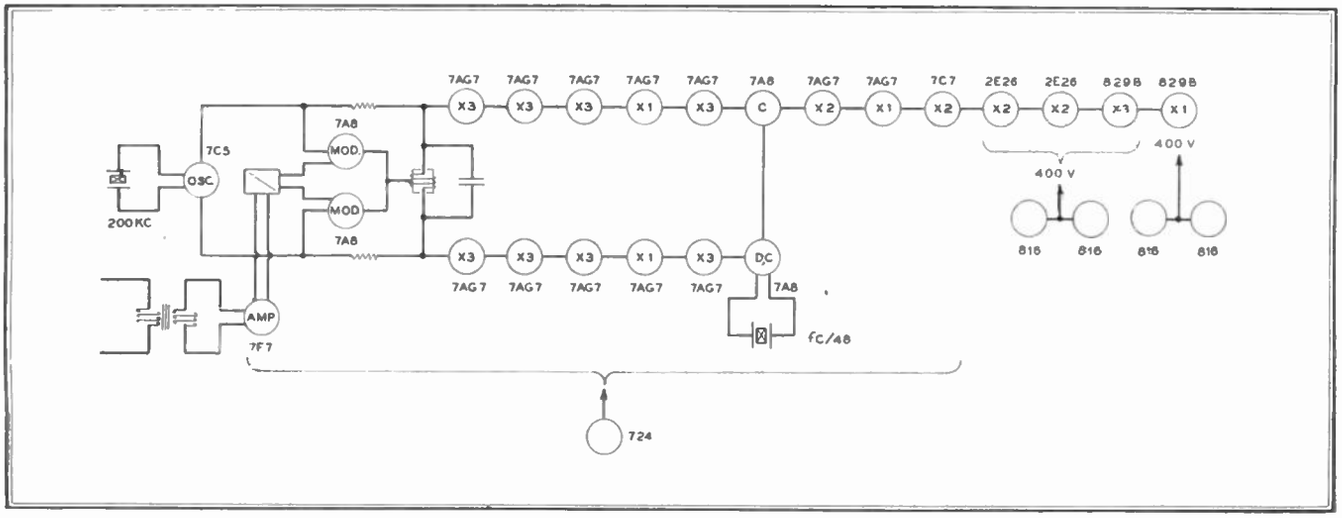


FIG. 3. BLOCK DIAGRAM OF THE PHASE SHIFT MODULATOR USED AS AN EXCITER FOR TRANSMITTERS OF ALL RATINGS

the first chassis, which is approximately 1 watt on 1/6 the carrier frequency, is multiplied and amplified in the driver unit to 50 watts on the carrier frequency.

Generation of modulated signals is accomplished by a form of the Armstrong phase-modulation system,[1] corrected to give a flat overall frequency response characteristic. Fig. 3 is a block diagram of the exciter and the 250-watt amplifier. The output of a 200-kc. crystal oscillator is applied both to a balanced modulator and to the first tripler grids of each of two parallel frequency-multiplier chains. The output of the modulator is also connected to these grids in such a manner as to give a *differential* modulation effect when an audio voltage is applied to the modulator grids. That is, the signal transmitted to the input of one multiplier chain is phase-modulated 180° out of phase with respect to the other.

These signals are multiplied in frequency by a factor of 81 times, thus producing a frequency of 16.2 mc. The output of one chain (arbitrarily, the one with

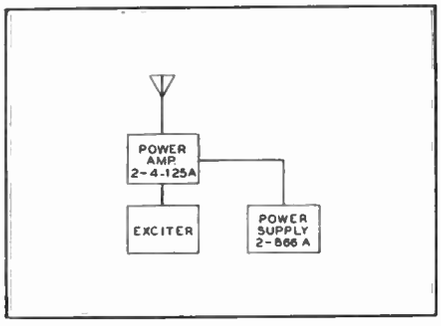


FIG. 4. BLOCK DIAGRAM OF THE COMMUNITY TYPE 250-WATT TRANSMITTER

an instantaneous increase in frequency) is converted to a lower frequency by beating it against a signal on 1/48 of the carrier frequency. Assuming a carrier frequency of 96 mc., this second frequency would be 2 mc., thus giving a beat signal of 14.2 mc. with an instantaneous change in frequency still in the *increase* direction. This signal is then subtracted from the output of the other chain in a converter stage with a resultant output of 2 mc., frequency-modulated to the extent of the sum of the deviation in each multiplier channel. Any reasonable change in the frequency of, or noise on, the 200-kc. source will therefore be cancelled out since it is in the same direction in both chains. The carrier frequency is controlled only by the second crystal, which requires normal care in design and application to obtain the desired carrier frequency stability. The phase-modulated 2-mc. signal is multiplied to 1/6 the carrier frequency by a series of three doubler stages. Located on this chassis are also metering circuits and a power supply.

Additional frequency multiplication and power amplification are provided by the driver chassis, which contains a doubler, tripler and an 829B driver stage. This chassis carries a meter and meter-switching circuit, and tuning adjustments. The types of tubes used and their functions in the circuit are indicated in Fig. 3.

Although the exciter described above is currently in production, standardization in design of these chassis units will permit other types of exciters, currently under development, to be used should noticeably superior performance be achieved.

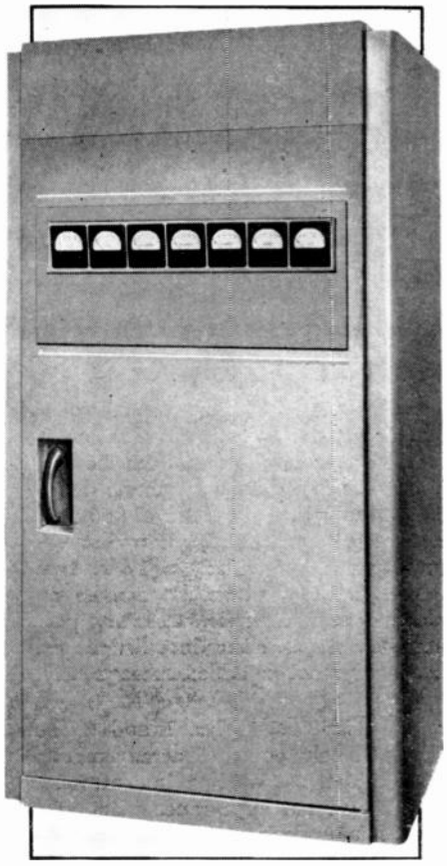


FIG. 5. THE 1-KW. TRANSMITTER. OTHER VIEWS ARE GIVEN IN FIGS. 7 AND 8

The power output is raised to the 250-watt level by a push-pull amplifier employing two type 4-125A tetrodes. Conventional lumped-constant circuits are utilized, and the circuit is neutralized by tuning out the screen lead inductances. A small blower, directed toward the tube envelopes, insures safe operation.

All controls are brought out to the front edge of the chassis and the operator is protected from accidental contact with the plate circuit by a perforated metal screen visible in the illustrations. This power amplifier unit is also of the rack-mounting type. The output of the amplifier is normally intended to be coupled to the antenna by RG 17/U cable, and is therefore brought to a connector designed for this type of line.

A separate unit in the transmitter contains a small 6-watt DC supply, which powers the modulator, crystal oscillator, first multiplier, and monitor filaments. There is also a rack-mounted 400-volt, 250-milliampere power supply to energize the driver plates, the final amplifier screens, and the monitor. Power control and protection are accomplished by relays and fuses located on a control chassis. All of these chassis are equipped with plugs providing rapid disconnect for servicing.

The complete equipment is contained in single cabinet 24 ins. wide, 15 ins. deep, and 78 ins. high. A glass-protected, illuminated meter panel runs across the top. At the bottom are the power supply for the final amplifier, filament and plate power switches, and pilot lights. Forced ventilation is provided by a blower mounted on the rear door of the cabinet, thus insuring low temperature rise during long periods of operation. Since accessibility of all components and tubes is of prime importance, full length front and rear doors are provided.

1- and 3-Kw. Transmitters ★ For more powerful installations, consideration was given to customer requirements for custom-built installations, future power increases, and other special factors which vary in accordance with conditions at each individual station. Unit-style construction, based on standard cabinets 42 ins. wide, 26 ins. deep and 78 ins. high, was therefore adopted. This can be seen in Fig. 5. The 1-kw. transmitter is built into one of these units, while the 3-kw. transmitter, Figs. 7 and 8, comprising a 1-kw. transmitter used as a driver for a 3-kw. amplifier, requires two such units. Block diagrams of these units are given in Figs. 6 and 9. A 10-kw. amplifier, occupying two more standard-size units, can be added at any time to the 3-kw. installation.

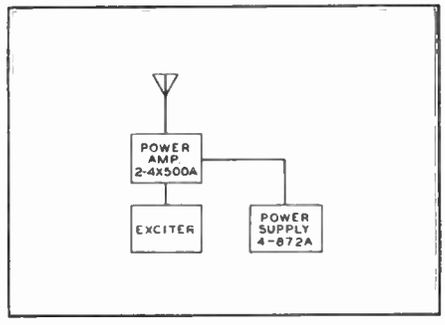


FIG. 6. NOTE CHANGE IN OUTPUT TUBES AND POWER SUPPLY FOR 1-KW. TYPE

As can be seen from the views of the 3-kw. transmitter, individual chassis construction is employed to provide maximum accessibility to all components. In the 1-kw. unit, at the left in Fig. 7, the exciter, multiplier-doubler, DC filament supply, and intermediate voltage supplies are the same as those used in the 250-watt transmitter. The power is raised to the desired level by a push-pull amplifier employing two type 4X500A external-anode tetrodes which are cooled by pres-

[1] For a detailed explanation of this modulator, see THE STANDARD FM HANDBOOK, Chapter 2 Part 5, or FM AND TELEVISION, June, 1945.

sure-type blowers. The plate circuit of the amplifier is of transmission-line design, and is tuned by means of a small variable capacitor shunted across the plate end of the line. Rough tuning is accomplished by positioning a shorting bar at predetermined locations along the line.

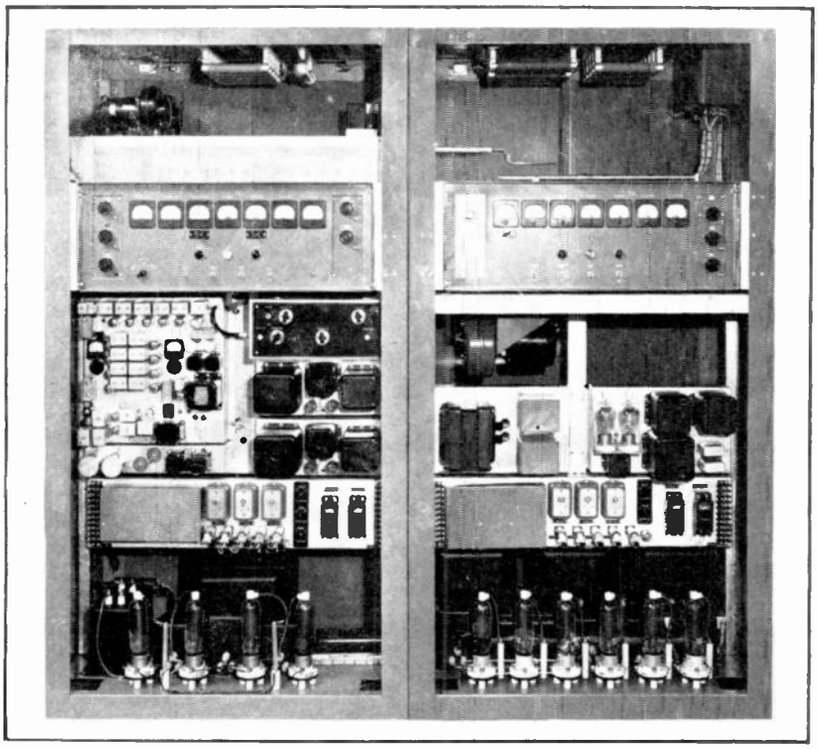


FIG. 7. LEFT, FRONT OF 1-KW. UNIT, WITH 3-KW. AMPLIFIER AT THE RIGHT

Protection of the power supplies and tubes is provided by means of underdrive and overload relays, a time delay relay, and magnetic circuit breakers. In addition, a step-starting system, with a low-voltage position for tuning the final amplifier, is coördinated with an overload system which, when operated, permits the transmitter to drop back to half-power and make several attempts to restore normal operation before locking itself off the air. In such an event, manual operation is then required to re-apply plate voltage to the transmitter. Another time delay relay restores the protective system to normal after a short interval.

A control panel located above the bottom of the cabinet contains the meters, power controls, and tuning controls for the transmitter. This panel is hinged to provide accessibility to the meter terminals and control connections. It is located behind a small door within the large door covering the front of the transmitter. Thus the controls can be operated while the equipment is on the air without exposing the operator to live circuits.

When an output of 3 kw. is desired, the basic 1-kw. transmitter is used, without modification, as a driver for an amplifier employing two type WL473 triodes in a push-pull grounded-grid circuit. The amplifier frame is completely self-contained; the power supply, direct-driven blowers, relay panel, control panel, and amplifier are logically arranged for maximum accessibility and convenience.

Transmission-line type circuits are used for cathode, plate and output tuning. In the cathode circuit, rough tuning is obtained by positioning a shorting bar, and fine tuning by means of a trimmer condenser, as in the 1-kw. amplifier plate. The plate circuit tuning is adjusted by means of a shorting bar actuated by a rack-and-pinion drive. The amplifier tubes and their plate circuit are mounted within a shielded enclosure to obtain maximum efficiency and stability. Neutralization is not required, due to the use of the grounded grid circuit design.

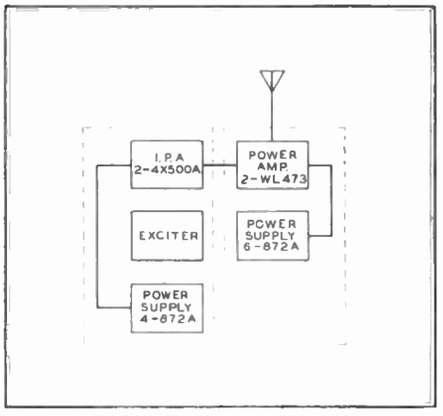


FIG. 9. SETUP FOR 3-KW. TRANSMITTER

The output circuit is intended to be coupled to a standard 50- or 70-ohm, 1⅝-in. coaxial transmission line. A built-in diode voltmeter provides continuous measurement of the power delivered to the amplifier load.

Protection of the tubes and circuits is obtained by underdrive and overload relays in a manner similar to that employed in the 1-kw. driver. In addition to stop control of the plate voltage, power control of the amplifier is designed to be integrated with that of the 1-kw.

(CONCLUDED ON PAGE 44)

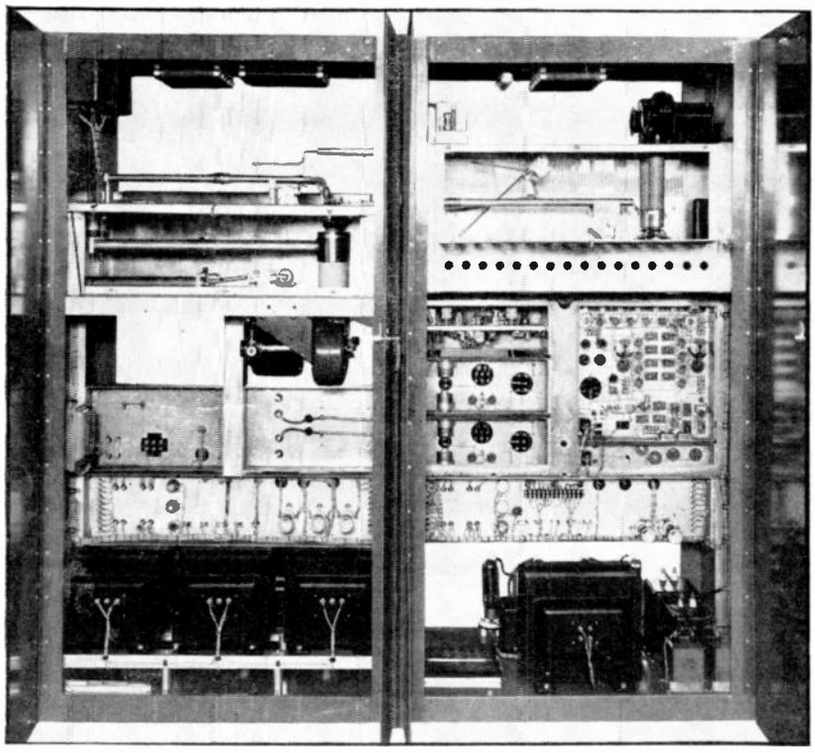


FIG. 8. REAR VIEW OF THE BASIC 1-KW. TRANSMITTER AND 3-KW. AMPLIFIER

VOLUME COMPRESSION FOR FM BROADCASTING

A Practical Discussion of the Purposes and Results, and Details of the Raytheon Volume Limiter

BY W. E. PHILLIPS*

THERE has been much discussion in engineering circles as to the advisability of using volume compression in Frequency Modulation broadcasting. The view has sometimes been expressed that the use of volume compression defeats one of the fundamental advantages of FM. An attempt will be made to analyse the advantages and disadvantages and to present the results of practical experience in a number of FM stations.

Dynamic Range & Noise Level ★ One of the advantages which was early claimed for FM broadcasting was the extended dynamic range made possible by the new system. FM transmission, unlike AM, does not have a 100% modulation limitation above which the distortion rises very rapidly. Obviously, an amplitude-modulated carrier is limited in the degree of modulation by the 100% negative limit at which the carrier disappears. If this point is exceeded, the distortion rises very rapidly since a portion of the intelligence in the signal envelope is missing. Serious interference from side bands extending into adjacent channels likewise results.

The situation in an FM transmitter is considerably different in that the maximum modulation to be used for any given case is an arbitrary value. If this value is exceeded, no sharp or sudden increase in distortion results, although the transmission may then exceed the channel width.

It is possible to secure overall transmitter noise levels somewhat lower in FM transmitters than are usually considered necessary in AM transmitters. Dynamic range is the difference between the highest level to be transmitted and the level of inherent noise. The comparatively large dynamic range of the FM system has been sighted as a great advantage. Thus, the proposal to limit this dynamic range by the use of volume compression would not, at first thought, seem logical. Nevertheless, a number of FM stations have used volume compression with such excellent results that it becomes necessary to consider some of the factors which are related to conditions of home radio reception.

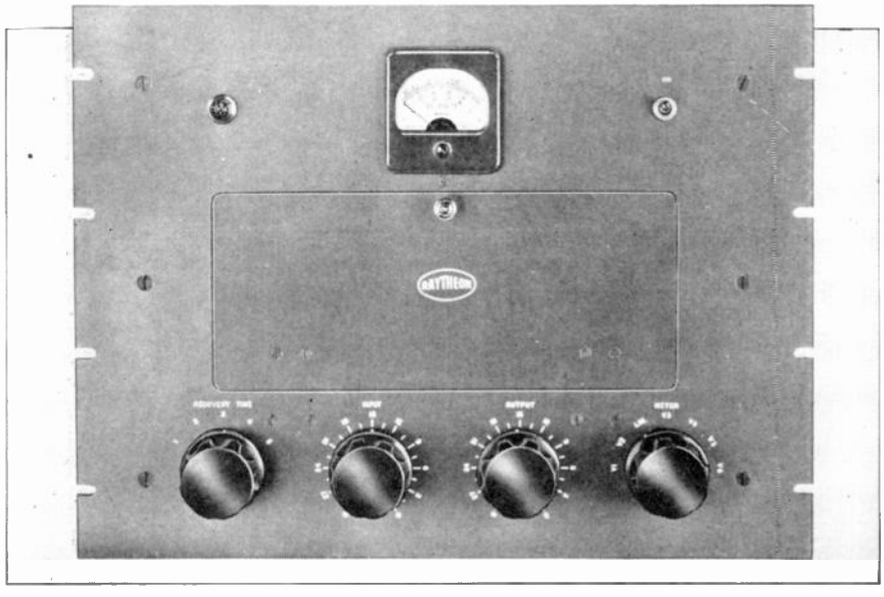


FIG. 1. FRONT PANEL OF THE VOLUME LIMITER RECOMMENDED FOR FM STUDIOS

Perhaps the most important factor to be considered is the limitations imposed by the environment of the listener. Certainly, not all listening is done under the ideal conditions afforded by an acoustically treated room having a low noise level. Since the noise level of the entire transmitter-receiver system is that of the link having the highest noise, there is no benefit to be obtained by having the transmitter and receiver capable of a 70-db volume range if this range is to be limited in the listener's home to 40 db, for example, by background noise[1] and maximum permissible volume of reception. It thus becomes necessary to accept some workable compromise on dynamic range in practically every receiver installation. This allowable range is narrower, in almost all cases, than that required by FCC standards for FM transmitter installations.

Use of Compression ★ It is well known that different types of programs permit varying degrees of compression before it becomes objectionable. Much of this compression of volume range is normally done by skilled operators who attempt to anticipate very low passages or very loud passages in the program material, and make gain adjustments which will limit the variation in loudness to a reasonable amount. This practice has been widely criticized, especially by orchestra conductors and musicians who complain bitterly that their efforts to attain artistic expression are largely defeated. These complaints usually come from the artists, however, and not from average listeners. Indeed, it appears that the compromise is beneficial from the listeners' standpoint and would be preferred over the original rendition.

Experimental Determination ★ It has been found experimentally that the dynamic range available to a listener in the audience of a concert hall may be very much smaller than the range available in a radio broadcast of the same performance. For example, a listener sitting in a concert hall at what might be termed an average location is surrounded by a large number of people who are breathing, shuffling programs, coughing, and making other small disturbances. The level of this noise may be as much as 20 decibels higher than the softest passages played by the orchestra. Due to psychological influences upon the listener, he is usually not disturbed greatly by this loss of the low passages, and it appears that they are very largely supplied by inference and sight and other effects upon the hearer.

This can be shown by placing the microphone at such an average location in the concert hall and listening to it at a location far removed from the scene. The result is usually wholly unacceptable because of the background noise level, echoes, reverberations, and similar effects. The principal thing which is missing in this experiment is that the listener, by being removed from the scene, loses his power to discriminate against unwanted sounds. In actual practice, microphones are located so as to pick up the minimum amount of noise from the audience.

* Broadcast Equipment Division, Raytheon Mfg. Company, 7517 N. Clark Street, Chicago, Ill.

[1] On the standard noise scale, noise in the average home is rated at approximately 25 db, but ordinary conversation may step the noise level up to 56 db.

A number of experiments have been tried in setting gain controls to accommodate the loudest passages and allowing all other levels to fall where they may. Invariably, these experiments have been abandoned by going back to the time hon-

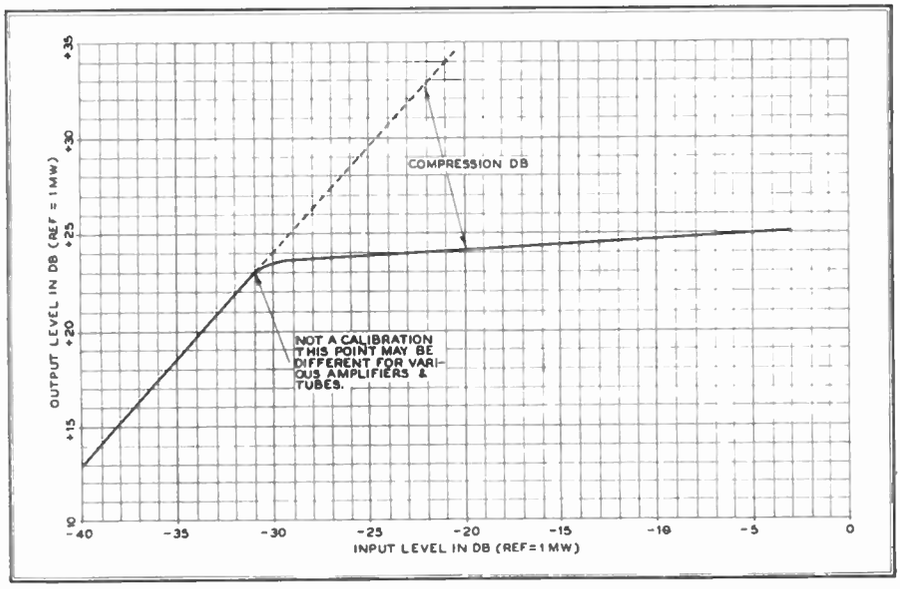


FIG. 3. COMPRESSION EFFECT OBTAINED BY THE USE OF THE VOLUME LIMITER CIRCUIT

ored custom of compressing volume by riding gain. There is no completely satisfactory solution to the problem of riding gain and no automatic device can do the job as well as a skilled operator. Nevertheless, a great deal of the work can be performed automatically by vacuum tube circuits and, if the desired amount of compression is reasonably small, the automatic device probably does it better.

Even though there is no definite 100% overload point in FM transmitters, there are definite limitations in both transmitter deviation capability, receiver deviation acceptance, and allowable channel width. If either transmitter or receiver modulation capability is exceeded, distortion will result. Even though both were designed for greater than the normal value, the channel width serves as a specific limitation. It can thus be seen that the upper limit of volume level is almost as rigorously restricted in FM as in AM broadcasting and that the lower volume level limit will be, in most cases, determined by conditions in the listener's home. It would therefore appear just as logical to use volume compression in FM broadcasting as in AM broadcasting.[1]

Limiter Characteristics ★ A volume limiter must meet certain performance requirements in order to produce the effects required. It should, of course, have a low noise level, excellent frequency response, low intermodulation distortion, and a nearly flat compression curve above the bend. It should be so arranged that the controls can be adjusted to give the proper amount of compression and the desired gain and output level.

Recovery time is important, and, for best results, should be variable to permit optimum results with different types of program material. As determined by a large amount of practical experience with volume limiters in many stations, the recovery time should be adjustable over a range of .2 to 1 second.

Effects of Pre-Emphasis ★ It is standard practice to use high-frequency pre-emphasis in FM transmitters with compensating de-emphasis in the receiver. The use of pre-emphasis is predicated upon the assumption that the energy at high audio frequencies present in speech and music is small and that a rising transmitter frequency characteristic can be used without danger of overload. This assumption, in the author's opinion, is not always justified for certain types of program mate-

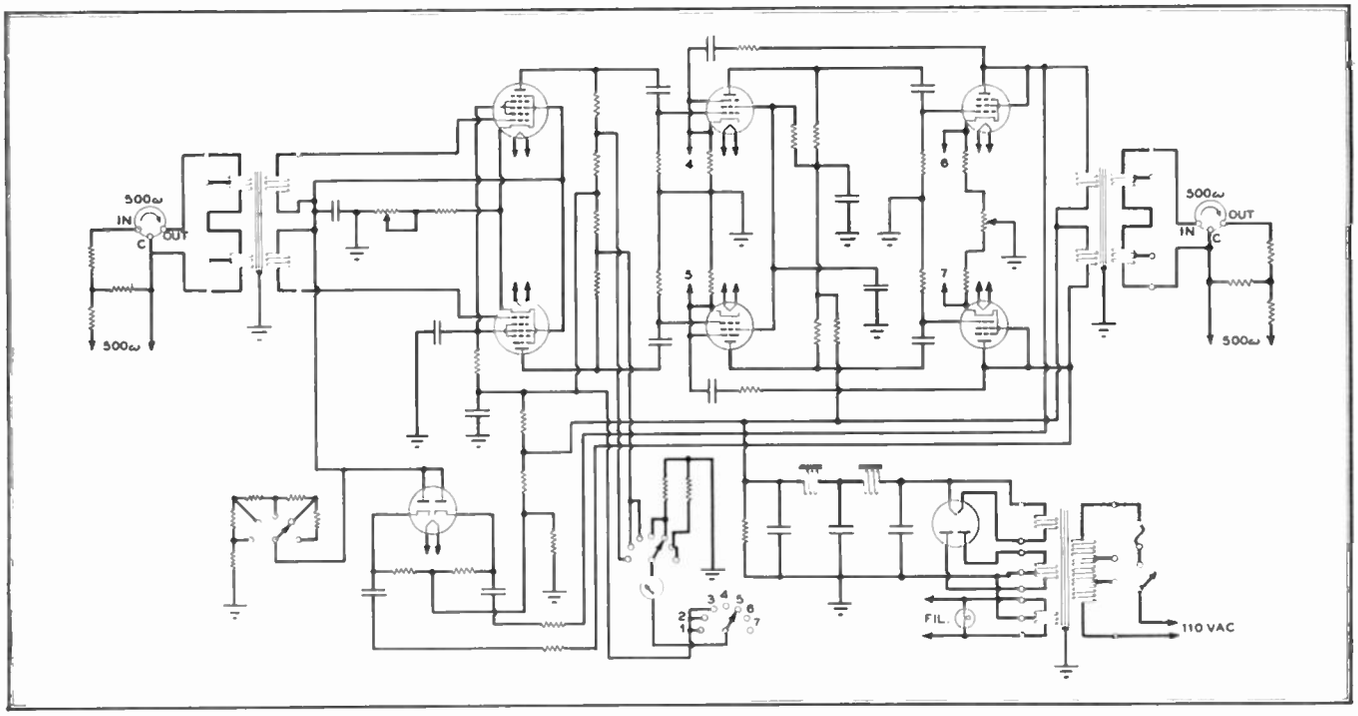


FIG. 2. SCHEMATIC DIAGRAM OF THE RAYTHEON VOLUME LIMITER. NUMERALS ON SWITCH REFER TO TUBE CONNECTIONS

[1] The basic necessity for increasing the volume on soft passages transmitted by AM lies in the fact that, at such times, the power output of the transmitter is reduced, thus increasing the signal-to-noise ratio at the receiver. Thus, increasing the gain at the studio serves to keep the received signals at a level sufficient to prevent the noise from over-riding the program.

Such a limitation is not imposed on FM broadcasting. The power output is constant at all program levels, and only the frequency swing is affected by variations in the level. Therefore, the signal-to-noise ratio is constant, regardless of program level. It is only necessary to maintain the lowest level of FM program transmission above the ambient noise at the point of reception. — EDITOR

rial. Sound effects, such as jingling keys, clinking coins, or crackling paper often produce sharp transients with a high amplitude at frequencies of 10 kc. or more. Such sounds, even when picked up at levels which cause almost no indication on a volume indicator meter, may result in serious over-modulation, and cause the carrier to deviate far beyond the channel limits. This effect is, of course, greatly aggravated by the pre-emphasis which further increases the sharpness of the transients.

Because of this effect, it has been the usual practice to reduce the average level by several decibels to prevent transient over-modulation.

Thus, the gain in signal-to-noise ratio obtained by using pre-emphasis may be partially lost due to transient peaks. A volume limiter at least partially restores this loss in average level.

Results at Receiver ★ If a transmitter is adjusted to just 100% modulation on peaks, and the modulation integrated over a period of several minutes, it will be found that the average level is amazingly low. This is particularly true of program material such as speech or piano music. This average level may, in many cases, run as low as 10 or 15%, and represents a startling waste of transmitter capability under such conditions.

It has been observed in a number of instances that there is a decided listener preference for a station using a limiter over another station not using a limiter, everything else being equal. The listener, because of the higher average program level, assumes that the difference is due to the fact that one station is more powerful than the other and he may select the stronger. Thus, a station not employing limiter control suffers a competitive handicap.

A volume limiter, of course, must be used with discretion and skill. Best operating practice seems to be to use not more than 3 to 6 decibels of compression, and to not use compression at all during the transmission of certain of the better programs.

Based upon the experience of stations which have used limiters for FM, and upon some of the more general considerations, it appears that the use of a volume limiter serves a highly useful purpose, and it is to be expected that this device will find a permanent place in modern FM broadcasting.

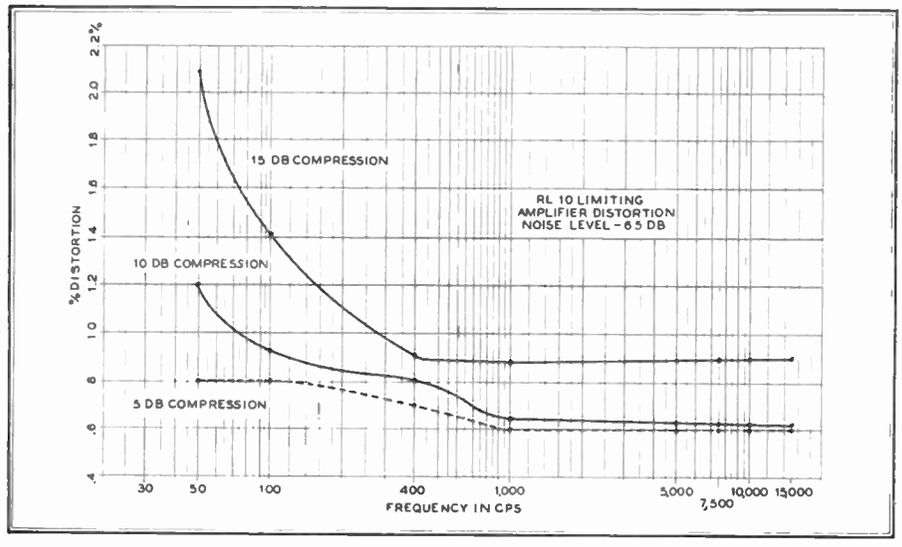


FIG. 4. TYPICAL DISTORTION CURVES FOR VALUES UP TO 15 DB OF COMPRESSION

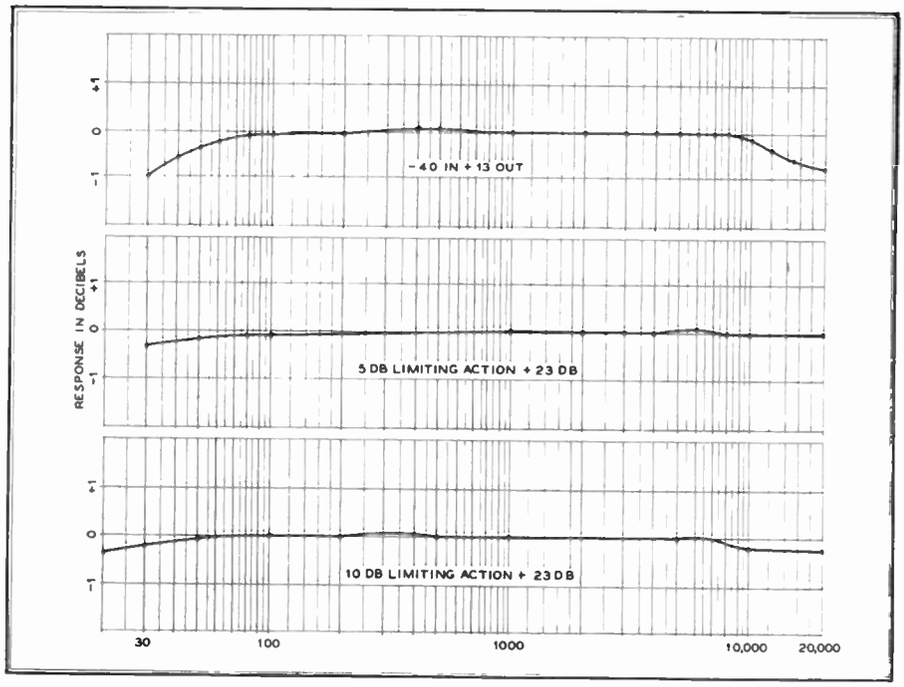


FIG. 5. FREQUENCY RESPONSE IN DB FOR THREE TYPICAL CONDITIONS OF OPERATION

Raytheon Volume Limiter ★ The accompanying curves show the characteristics of the Raytheon model RL-10 volume limiter, designed to meet the specific requirements of FM broadcasting. Fig. 1 shows the front panel, measuring 19 by 14 ins., and Fig. 2 the wiring diagram. Knobs across the panel, from left to right, control the recovery time, input, output, and the meter switch.

Recovery time is variable in steps of .2 to 1 second. With input and output impedances of 600 ohms, the gain is 43 db when both attenuators are set at zero.

The amplifier design provides a compression ratio of 10 to 1. That is, a 10-db increase in input level above the compression point produces a 1-db increase in output. This is plotted in Fig. 3, the input-output curve, taken at an arbitrary input level.

At a reference level of 1 milliwatt-600 ohms, the power output is rated at approximately + 23 db. This is at a single-frequency input, with the adjustable output attenuator set at zero at the point of limiting, and the fixed output pad omitted. Output noise is 60 db below the output level of +23 db when the input is at the limiting point, with both adjustable attenuators set at zero, and the fixed output pad omitted.

Fig. 4 shows typical percentage distortion curves for values up to 15 db of compression. On a complex program wave, distortion is held to less than 1% under all conditions at compression values up to 5 db. Distortion of single-tone input below compression is less than 1%. At 5 db compression it is below 1.5% for frequencies of 50 to 200 cycles, and below 1% at frequencies above 200 cycles.

A very flat frequency response is provided under all operating conditions, as shown in Fig. 5. From 30 to 15,000 cycles, the response is within 1 db of the value at 1,000 cycles.

The tube compliment consists of two 1616's or 6L7's, two 6SJ7's, two 6F6's, a 6F6, 6H6, and 5U4G. The unit operates from 110 to 125 volts, 60 cycles. Total weight is approximately 42 lbs.

SPOT NEWS NOTES

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

Historical Note: Commenting on Warner's new picture "Night and Day," offered as a commemorative of two decades of talking movies, *Life* complained that "the only bright spot is the sound which, after 20 years of progress, is every bit as good as it was 10 years ago." That's more than can be said of AM broadcasting. As for FM, we can only say that, in this respect, radio does have a second chance.

FM Power Tubes: General Electric has issued specifications on forced-air-cooled tube GL-5517 for FM transmitters. Two of these tubes will be used in the output of G.E. 10-kw. installations. At 108 mc., a pair of GL-5518's operated under class C grounded-grid conditions are rated at 12.9 kw. useful power output, with 6,000 volts on the plates.

FM Salesman: Equipped with a jeep-mounted FM console, C. M. Smith, Jr., director of engineering at WMIT Mount Mitchell, is giving demonstrations of FM reception from Gordon Grey's station. Included in his schedule was the Radio Conference of the Southern Baptist Conference, where Commissioner Durr was the principal speaker.

Television Call Letters: FCC will permit the use of hyphenated call letters for television stations. Thus, AM station KOB, of Albuquerque, N. M., will use KOB-TV for its television affiliate.

Sal Barone: Former chief engineer of Press Wireless Mfg. Corporation has set up laboratory and pilot model facilities in a newly acquired building in mid-town New York. This new organization offers facilities to broadcasters, manufacturers, and communications companies for engineering design, development, and research. Prior to the war, Barone was associated with REL in the manufacture and installation of FM broadcast stations.

WSB: The *Atlanta Journal* has joined Broadcasters' Facsimile Analysis, bringing the total number of participating stations up to 24, of which 15 are newspaper broadcasters. Hogan facsimile equipment, manufactured by G.E., will be supplied to the station.

Paul W. Kesten: Who joined CBS as director of advertising and promotion in 1930, and rose to the position of vice chairman of the board, has resigned "to do some of the things I didn't have time to do when I had the energy, or the energy to do when I had the time." We hope he'll return to the industry for, however violently we disagreed with him, we have always admired his ability to put on a good show.

Railroad Radio: Western Electric engineers have been riding freight trains on tests with FM equipment operating in the 152- to 162-mc. band. Runs were made on Northern Pacific lines over the Cascade Mountains between Seattle and Yakima, a distance of 145 miles, and over the 180-mile stretch from Seattle to Portland. On the 2.2% grades in the Cascades, radio was used with particular success to coordinate throttle positions in the engine at the front end of a mile-long train and another cut in at the middle.

Buffalo: C.P. for a television station to operate on 66 to 72 mc. has been issued to WBEN, Inc. Video power will be 14.4 kw. and aural power 7.2 kw., with an antenna 378 ft. high.

Charles E. Thompson: Washington radio attorney who was associated with the late George B. Porter, has joined the law office of Andrew G. Haley, 1703 K Street, N.W., Washington, D. C.

WGYN First in New York: With the completion of its RCA bat-wing antenna 950 ft. above the ground, WGYN is the first FM station in New York City to operate at its full, assigned power in the new band. Its output, at 96.1 mc., is equivalent to 20 kw. from an antenna 500 ft. high. Daily program schedule, from noon to 10:00 p.m., has already begun. Station is located at 70 Pine Street, in the financial district.

Powder Metallurgy: Earl S. Patch and C. Robert Talmadge, formerly sales manager and assistant chief engineer, respectively, of Micro-Ferrocart, have opened a consulting office at 4 South Street, Stamford, Conn. They will handle work concerned with the manufacture and use of powdered metals for electrical and mechanical applications.

ILGWU: Presenting arguments in support of its FM application before the FCC, United Broadcasting Corp., a subsidiary of the International Ladies Garment Workers Union, announced that the wealthy ILGWU was prepared to underwrite an order for $1,000,000's worth of FM receivers, to help build an FM audience quickly in New York City.

Loudspeaker: Preparing to meet new demands for speakers suitable for use in FM receivers, Altec-Lansing has added a new 12-in. model 600 to their multicell line. A seamless paper cone handles frequencies up to approximately 2,000 cycles, at which point an aluminum diaphragm takes over. Field magnet is Alnico V, power rating 18 watts, depth 5 ins., voice coil impedance 10 ohms, weight 12 lbs.

Worcester, Mass.: Plans to erect a television station under C.P. issued last May have been abandoned by the Worcester Telegram Publishing Company, and the permit has been cancelled by the FCC.

Lea Act: If U.S. District Attorney J. Albert Woll, son of AFL 2nd vice president, is permitted to prosecute AFM's test of the Lea Act, one of two things will happen: if the Lea Act is found unconstitutional, Woll will be accused of pulling his punches because AFM is affiliated with AFL. If the Lea Act is upheld, AFL will claim it was unfair to put him in the position of attacking a cause espoused by his own father. Surely there is someone to take his place in this case who is not so closely connected with the defendant.

More Production: With demand for its new FM sets running ahead of its Chicago plant capacity, Zenith has moved production of four receiver models to the Zenith-owned Wincharger factory at Sioux City, Ia.

Speed: Laurels for record time in getting an FM station on the air go to KTHT-FM, Houston, the first in Texas with scheduled programs. On August 8th, Judge Roy Hofheinz phoned REL to discuss purchase of a transmitter. The order was placed on the 13th, and a 250-watt unit was shipped at once. A 3-element turnstile followed two days later by plane. Installation was made by the Mayray Company, REL representatives in New Orleans, and the station went on the air August 22nd. Present schedule is 3:00 p.m. to 9:00 p.m., on 98.5 mc. Power will be increased next month to 1 kw.

Tube Manual: A new tube manual, covering 94 different types, including Phasitron and Lighthouse tubes, has been published by General Electric Company, Schenectady, N. Y. The expanding binder contains 600 pages of data on typical circuits, applications, and operating conditions. Price is $2.

WCFC: First FM station in West Virginia is a 250-watt G.E. transmitter at Beckley, owned and operated by Beckley Newspapers Corporation. Scheduled programs started August 15th. Pending completion of a new $100,000 studio-transmitter building started last March, WCFC will operate on 250 watts at 101.1 mc. Later, power will be increased to 3 kw. Extensive newspaper announcements of the new station have featured Leonard Asch's punch line: "If you buy a new radio without FM, you'll obviously have an obsolete radio." E. J. Hodel is manager of the station, G. W. Yozell is chief engineer.

Charles Huber: Appointed Chief of FM Section of FCC's Legal Department, succeeding Samuel Miller who has been moved up to head the new Hearings Section. Mr. Huber was counsel of the FM and television hearings in New York City.

10-Kw. FM Transmitter: A pre-production model of Western Electric's type 506 B-2 upper-band FM transmitter, working into a dummy antenna, is in operation at Whippany, N. J.

Attleboro, Mass.: Plastimold Corporation, manufacturers of radio cabinets and other molded products, has been purchased by Emerson Radio & Phonograph Corporation.

Towson, Md.: Bendix Aviation has applied for a C.P. for a 100-watt experimental television transmitter to be operated on 600 to 620 mc.

Purchased: Entire common stock of Kurman Electronics Corporation, Long Island City, N. Y., has been purchased by Clarostat. Kurman products include relays, timing motors, and clocks. New president is Victor Mucher, with Nathan Kurman vice president in charge of research.

AEPEM: New officers of Association of Electronic Parts & Equipment Manufacturers are: chairman, Roy S. Laird, sales manager of Ohmite; vice chairman, Leo A. Thayer, assistant sales manager of Belden; treasurer, Miss H. A. Staniland, sales manager of Quam-Nichols; executive secretary, Kenneth C. Prince, Chicago attorney.

Rochester: Radio production at Stromberg-Carlson up to the middle of August surpassed any prewar year, and the plant is booked to capacity well into 1947. Employment is double the 1941 level.

WTMJ-FM: The FCC has granted *The Milwaukee Journal's* original application for rural coverage, now referred to as expanded metropolitan coverage. According to Walter Damm, all the equipment is on order and ready for delivery.

Facsimile Synchronization: Patent 2,404,571, covering a method of continuously synchronizing facsimile scanners and recorders, has issued to Capt. W. G. H. Finch, president of Finch Telecommunications, Inc.

Light Metals: An exhibit of aluminum and magnesium products, both semi-finished and fully fabricated, has been opened by Edw. S. Christiansen Company at 30 Rockefeller Plaza, New York City. Purpose is to show latest design and production techniques.

WBKB: Balaban & Katz, operating television station WBKB, Chicago, has applied to the FCC to change from 60 to 66 mc., to 66 to 72 mc.

Edward R. Jahns: Appointed chief electrical engineer at Templetone Radio Mfg. Corporation, New London, Conn. Previously, he was associated with Pilot Radio, on FM receiver design.

Hindsight & Foresight: "Price controls during the war period could have been beneficial if they had been administered impartially on a sound basis. But politics were substituted for economics. There is much hue and cry over the fate of OPA, but its champions were in a large measure responsible for its virtual demise. Administering the economic activities of a nation with a population of 140 million people is too overwhelming a task for any agency or group of agencies no matter how well equipped or intentioned. Competition is a stern but impartial taskmaster that serves consumer interests far better than a bureaucracy where political pressure becomes the dominant interest."

We hope that this comment from the First National Bank of Boston is not an augury of things to come if and when, as is now expected, Paul Porter returns to the FCC.

Many Thanks! In a very informative bulletin entitled *KOZY News*, directed to local radio dealers and servicemen, the Kansas City FM station suggests that they subscribe to *FM* AND TELEVISION because: "To *sell* FM you must *know* FM! And remember, selling FM means greater profits to you." In return, we'd like to tip our editorial hat to *KOZY* for the frank and informative discussion of FM antennas contained in this bulletin. The best way for broadcasters and set manufacturers to insure satisfactory FM reception is to encourage the use of antennas that can deliver strong signals to the receivers.

Woman's Point of View: Katherine Hathaway, writing in *The American Home*, August issue: "Speaking of *fitting in* brings to mind radio cabinets. The expensive ones are lovely, but I mean the average set in the average home. The living room may be very tastefully Federal or provincial with chintz and pine, or bleached oak with shag rugs but there, as much out of place as a bare midriff at a D.A.R. tea, sits the radio, next thing to a juke box, elaborately veneered in curly burl or zebra wood. I'm sure they looked swell and streamlined and modern on the designer's drawing board, but as far as I am concerned, they can just relax and make mine simple."

Chicago Taxi Radio: Veteran's Flash Cabs have installed 2-way FM for dispatching. Using 152.27 mc. at main station and 157.53 in the cabs, practice is to give address or zone of call and wait for nearest driver to answer, or else to call a particular cab, known from its previous assignment, to be headed in that direction. Initial 5-car Motorola installation will be extended to 75 cabs. Plan is to get a cab to any call in the City within 5 minutes.

Engineering Data: A new and greatly enlarged edition of "Reference Data for Radio Engineers" has been announced by Federal Telephone and Radio Corporation, 67 Broad Street, New York 4. Both the number of pages and illustrations have been nearly doubled, to permit the addition of important data compiled by IT&T engineers. Price is $2.00.

Micro-Wave Network: General Electric will take over from Globe Wireless and IBM the permits to construct and operate the projected 5-station micro wave system between Schenectady and New York. Globe has an option to buy the net after it has been proved in. System is intended to handle television and FM programs, facsimile, and business machines.

Chicago Trade Show: Will be held at the Stevens from May 11th to 16th. Jack Berman is new president of Radio Parts and Electronic Equipment Shows, Inc., Charley Golenpaul vice president, Jerry Kahn secretary, and Sam Poncher treasurer. Board members include representatives of AEPEM, Sales Managers Club, RMA, and NEDA.

Moving: Sentinel Radio Corporation has moved to its new brick and stone plant at Evanston, Ill. Space of 125,000 sq. ft. will accommodate 4 assembly lines each 250 ft. long.

FM for Canadian Police: Chief Constable Robert A. Alexander of Toronto now has the services of a complete Motorola system, operated on the 160-mc. band. Installation was made by Rogers Majestic, Ltd., Toronto distributors.

Los Angeles: First General Electric FM transmitter on the west coast has been installed on Mt. Wilson by Earl C. Anthony, Inc., operators of AM station KFI. Initial 250-watt unit, now putting a solid signal into Los Angeles, will be replaced by permanent 3-kw. transmitter.

Noise Conditioner: An effective method of reducing needle scratch has been developed by H. H. Scott of Technology Instrument Corporation, Waltham, Mass. Applicable to studio turntables and to home phonographs as well, the method is described as being effective to the point where the useable frequency range is only limited by the record itself. Licenses are being issued to manufacturers.

West Coast Trade Show: West Coast Electronics Manufacturers are sponsoring a show at the Elks Temple, Los Angeles, October 18th to 20th. Chairman of the show committee is Ed Grigsby.

RI Laboratories
New York
August 8, 1946

To FCC Chairman
Charles R. Denny, Jr.
c/o Raytheon, Waltham, Mass.

May I congratulate you and your fellow Commissioners on your participation in this demonstration! So far as we know, this is the first time that high speed facsimile has been transmitted over a microwave radio relay system from city to city. The equipment in use was designed for military applications and can handle some 500 words per minute on a modulation band of less than 3000 cycles. This is only the beginning of a new era in record communication, for with the 15000 cycle band that Raytheon's microwave system makes available, Faximile Transmission with automatic synchronization at 2000 words per minute becomes a realistic possibility.

John V. L. Hogan

NEWS PICTURE

FACSIMILE, as a commercial service, moved forward another step when, on August 8th, messages were transmitted from New York City to Waltham, Mass., over Raytheon's, 4,000-mc. magnetron-driven relay system. The occasion was a demonstration for the FCC of the system's capabilities. Using Hogan facsimile equipment, the message reproduced full-size here was sent to Chairman Denny.

The Raytheon circuit, now using a 15-kc. band, has terminal facilities atop the Lincoln Building, New York City, and at Raytheon's Waltham plant. Intermediate stations are at Lewisboro, N. Y., Oxford, Bristol, and Tolland, Conn., and at Webster and Waban, Mass. Using high-gain reflector antennas, the relays operate at relatively low power, yet this type of system is virtually free of interference from static, fading, and echoes. It is expected that, on a year-to-year basis, such circuits will have fewer outages than wire lines, and will cost far less for installation and maintenance than underground or overhead cables.

THE W. E. SERIES OF FM TRANSMITTERS

Engineering Information on Western Electric FM Transmitters of 1, 3, and 10 Kw., and Advance Data on Designs for 25 and 50 Kw.—Part 1

BY JOHN H. GANZENHUBER*

THE postwar FM broadcast transmitters recently announced by the Western Electric Company are interesting because of their advanced circuit design, functional cabinet styling, and extremely accessible arrangement of apparatus. This coördinated line of transmitters, providing powers from 1 to 50 kw., was designed by Bell Telephone Laboratories. Later, a 250-watt model will be available.

Features ★ The outstanding features can be divided into several groups, performance, appearance, operation and maintenance, and construction. Dependable, high-quality performance at high efficiency, always the prime consideration of the engineer, is assured by the circuit design and equipment layout. The performance data given in Table 1 indicates the quality and stability that are characteristic of these transmitters. The figures given in this table were compiled by Bell Laboratories from data obtained during many exacting tests and measurements, and represent a conservative appraisal of the transmitter capabilities in practical operation.

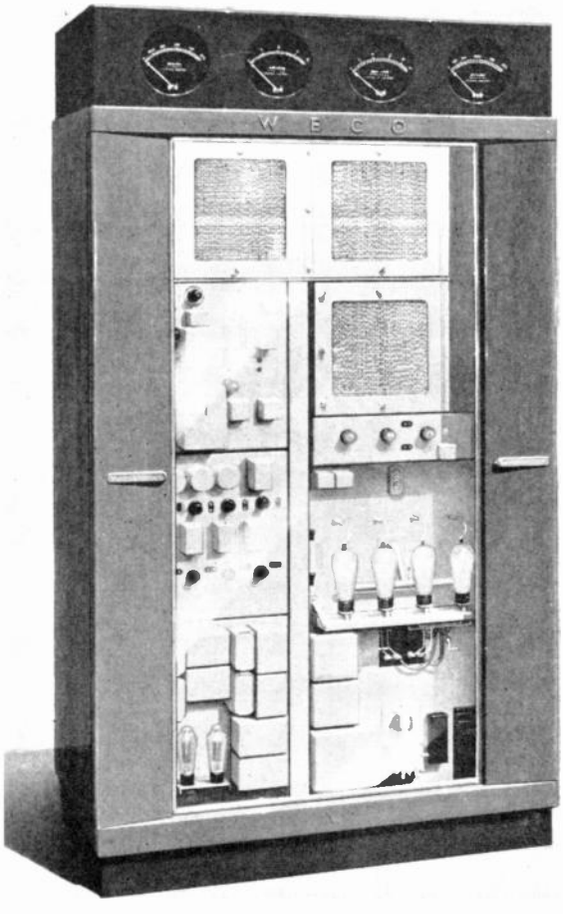
The data on intermodulation is of particular significance. Western Electric frequency-modulated transmitters are practically free of intermodulation products since direct Frequency Modulation is employed, and the frequency modulator is permitted to operate at the optimum point for wide-range linearity.

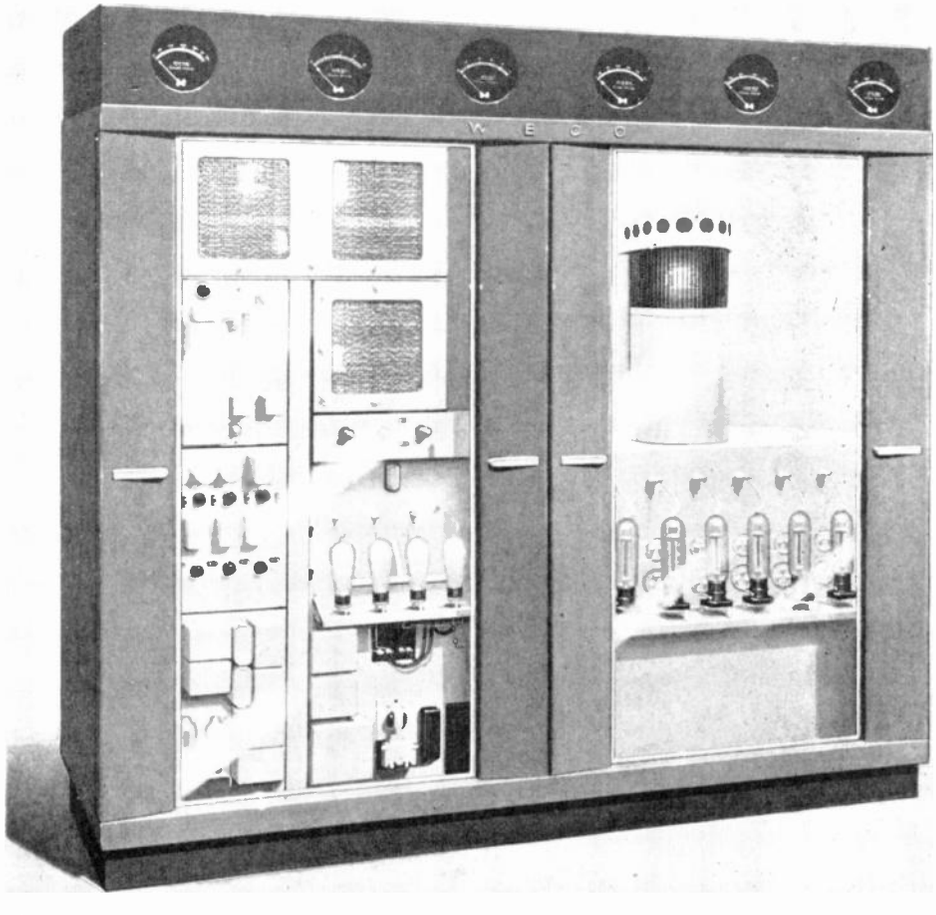
The presence of intermodulation would result in the production of discordant notes not present in the originating program. For instance, if the originating program contains two only tones of 50 and 1,000 cycles, some of the sum and difference frequencies that the listener hears as the result of intermodulation, in addition to the original 50 and 1,000 cycles, are 950 and 1,050 cycles. The additional tones resulting from the inter-action of two or more frequencies in a non-linear circuit are discordantly related to the true tones of the program, and cause what has often been referred to as a muddled form of reproduction.

Intermodulation, a subject long familiar to Western Electric in quality sound recording work, is now being recognized by the broadcasting profession as a measurement of equipment quality. In measuring intermodulation by the method using two tones, the frequencies chosen and the percentage modulation of each tone is important. Experience has shown that, in general, the percentage of intermodulation is largely a function of the harmonic

* Manager, Broadcast Sales, Radio Division, Western Electric Company, 195 Broadway, New York 7, N. Y.

FIG. 1, LEFT. BASIC 1-KW. WESTERN ELECTRIC FM BROADCAST TRANSMITTER. FIG. 2, RIGHT. 3-KW. AMPLIFIER ADDED





distortion of the lower frequency used and that, with 80% modulation of the low frequency and 20% of the high, the intermodulation percentage realized can be about four times the single-frequency harmonic distortion of the lower frequency used for the measurement. The specified high percentage of low frequency modulation is used to simulate the conditions prevailing in most program transmission, since a large per cent of the modulation is caused by the low frequencies. In program transmission, the intermodulation products will be present to distort the quality even though the low-frequency fundamental itself might not be reproduced at the receiver output. For this reason, to be significant, two-tone intermodulation measurements should employ as one of the tones the lowest frequency to be expected at the program source.

In the Western Electric method of direct FM, the single-frequency harmonic distortion is less than 0.5% for all frequencies from 30 to 15,000 cycles. Therefore, the intermodulation distortion is very low regardless of the frequency content of the program material.

This line of transmitters was styled by the prominent industrial designer Henry Dreyfuss. Fig. 1, a picture of the type 503 B-2 1-kw. transmitter, illustrates the basic styling of all the unit cabinets. The 3- and 10-kw. transmitters are shown in Figs. 2 and 3 respectively. Full-length hinged glass doors, a unique departure from conventional broadcast equipment design, facilitate operation and maintenance procedures, and at the same time add a modern touch to the appearance. The two-tone gray and blue finish, the provision of large meters 7 ins. in diameter, roomy design, visibility of all vacuum tubes, provision for station call letters, and numerous other features reflect the results of country-wide surveys to determine the preference of broadcasting people.

It is a matter of experience that designs which are neat and orderly, and hence suitable for viewing through a glass panel, are also easy to maintain. The ability to see all vacuum tubes, rather than a few, without having to open doors and hence remove and reapply power, reduces the time for locating trouble. Also, with the full-length glass door, it is not necessary to penalize the equipment layout to make a few tubes visible through small windows. All operating controls are conveniently located behind the small panels at either side of the main glass doors. Vertical chassis construction, long used in Western Electric equipment, makes all wiring readily accessible.

The new construction carries many important manufacturing features. All cabinets are of standard width and employ the same front and rear door assemblies, and side and top panels. Where two or more units are arranged in a line for the higher-power transmitters, this uniformity, along with the common base and meter panels which are provided, make it possible to tie all units together to give the effect of one transmitter assembly rather than a line-up of discrete units. Thus at any time a broadcaster who looks forward

TABLE 1

PERFORMANCE OF WESTERN ELECTRIC FM TRANSMITTERS

Audio Frequency Response: ± 0.25 db from 30 to 15,000 cycles

Harmonic Distortion for
± 75-kc. swing: Less than 0.5% from 30 to 15,000 cycles
± 100-kc. swing: Less than 0.75% from 30 to 15,000 cycles

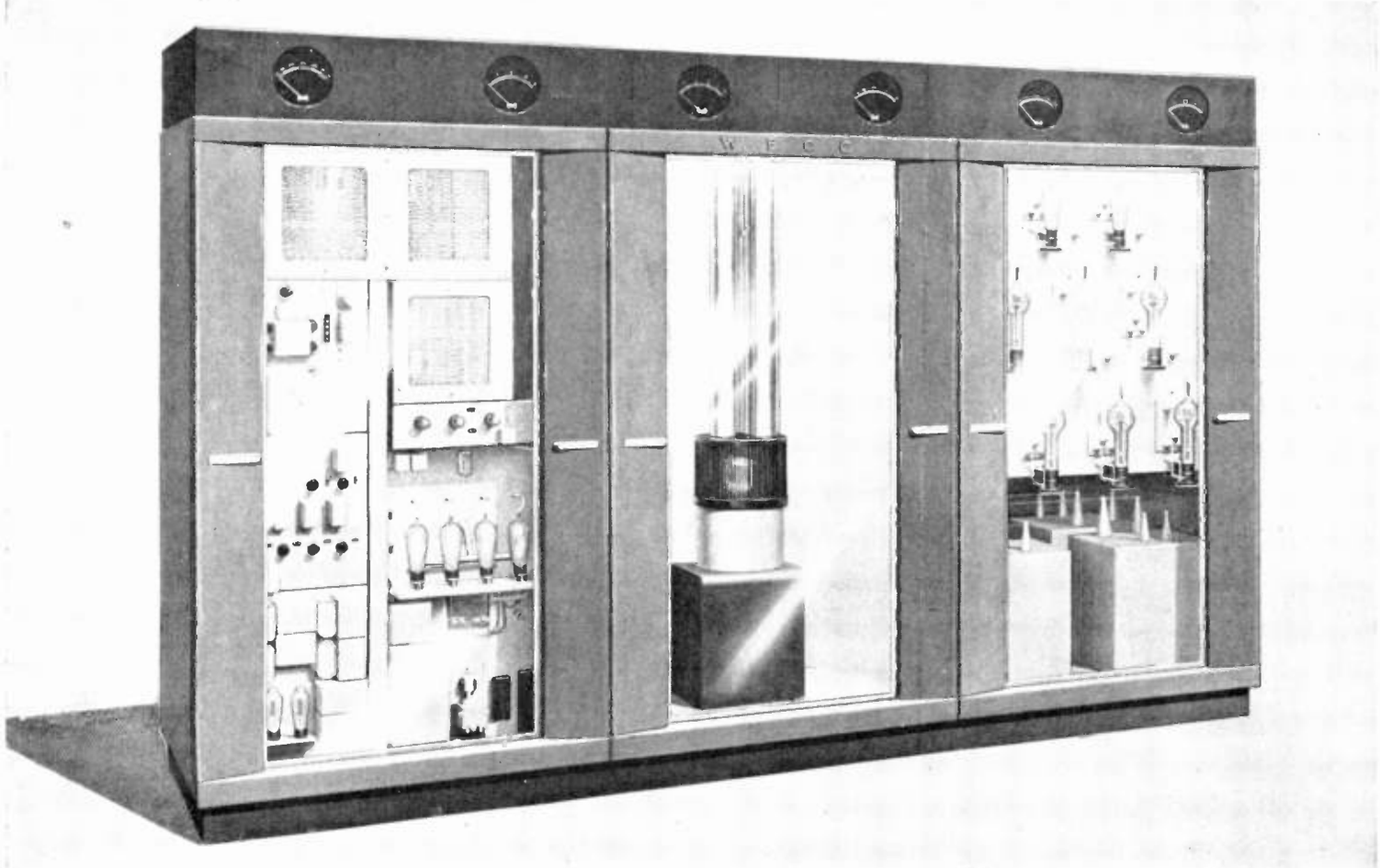
Intermodulation for ± 75-kc. swing: Less than 0.5% for 80% 50 cycles and 20% 1,000 cycles; less than 1.0% for 80% 50 cycles and 20% 7,000 cycles

FM Noise Level: 65 db down at ± 75-kc. swing

AM Noise Level: 50 db down at 100% amplitude modulation

Carrier Frequency Stability: Less than 2,000 cycles deviation (no crystal heater is used)

FIG. 3. COMPLETE 10-KW. FM TRANSMITTER. THIS EQUIPMENT OCCUPIES A SPACE 11 FT. LONG, 82 INS. HIGH, AND 38 INS. DEEP



to authorization of increased power can go to a higher power transmitter by simply adding amplifier units, and still have unity of appearance. All inter-unit wiring can be run in the base. In locations where it is desirable to build the front panels into a wall, the rear door assemblies and side and top panels can be omitted except in areas where excessive dust may be a serious problem.

Housing and Power Requirements ★ Each of the new transmitters is complete with its own self-contained power supplies. Figs. 4 to 8 show plan views of each of the equipments and the necessary space for housing the units.

The power requirements are given in Table II.

TABLE II

POWER CONSUMPTION OF WESTERN ELECTRIC FM TRANSMITTER

Type 503B-2 1 kw. transmitter: 4.2 kw. at 208 to 230 volts, 50 or 60 cycles, single phase

Type 504B-2 3 kw. transmitter: 9.8 kw. at 208 to 230 volts, 50 or 60 cycles, 3 phase

Type 506B-2 10 kw. transmitter: 25 kw. at 208 to 230 volts, 50 or 60 cycles, 3 phase

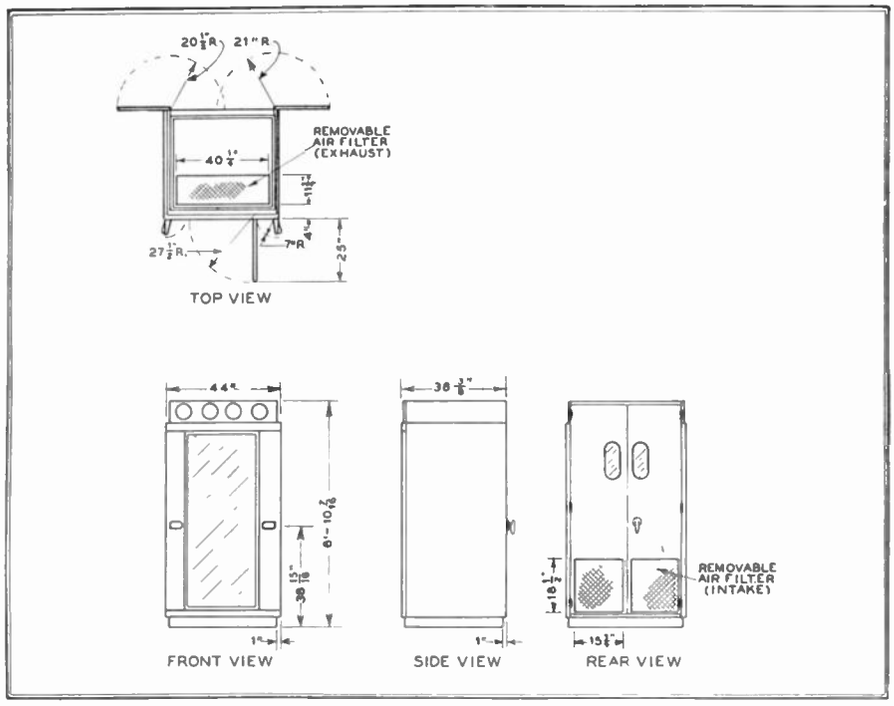


FIG. 4. OVERALL DIMENSIONS AND DOOR SWINGS OF THE 1-KW. TRANSMITTER

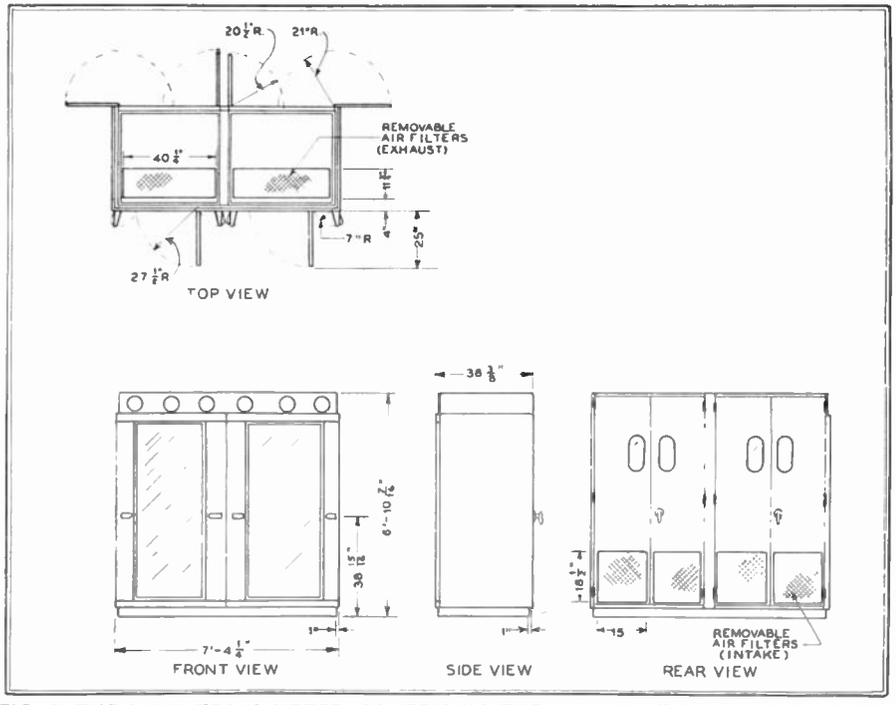


FIG. 5. THE 3-KW. TRANSMITTER, COMPRISING THE 1-KW. UNIT PLUS AN AMPLIFIER

Type 508B-2 25 kw. transmitter: 65 kw. at 460 volts, 50 or 60 cycles, 3 phase

Type 507B-2 50 kw. transmitter: 115 kw. at 460 volts, 50 or 60 cycles, 3 phase

Development of "Synchronized FM" ★ The basic system of these new transmitters was described in an I.R.E. paper by J. F. Morrison,[1] Bell Telephone Laboratories. This paper first reviewed the problem of generating wide-band frequency-modulated waves in order to point out specifically the desired capabilities of a commercial transmitter circuit which would realize the inherent advantages of FM to the fullest extent. The factors which influence or limit these performance capabilities in the two methods available at that time, phase-shift modulation and a system of reactance-tube modulation then in use, were examined and it was found that each method possessed desirable fundamental characteristics not present in the other. However, with the circuits generally employed for either method, the modulation characteristics and carrier frequency control were interrelated so that one had a limiting effect upon the other.

The circuit described by J. F. Morrison was one in which these two important characteristics were independent of each other. Owing to this independence and to other circuit refinements, the modulation capabilities of the new circuit were shown to be unrestricted and to have exceptionally low distortion over an exceedingly wide range of modulating frequencies and levels. This circuit, used in the pre-war Western Electric FM transmitters, has proved so satisfactory over a period of years that the same principles have been retained in the postwar transmitters.

Synchronized FM ★ In the Synchronized Frequency Modulation System employed in all Western Electric FM transmitters, the total number of cycles of the carrier frequency is, in effect, compared with the number of cycles generated by a precise fixed-frequency crystal oscillator, and the tuning of the modulated master oscillator is varied mechanically in a manner to keep the frequencies of the two oscillators always at a fixed relationship. However, instead of making the comparison at the carrier frequency, where the center frequency is of the order of a hundred million cycles per second and the frequency excursions are large, the mean frequency is reduced to a value of the order of 6,000 cycles per second by means of frequency division. This reduced frequency, an exact sub-multiple of the carrier, is then compared with the output of the stable crystal oscillator.

The precise frequency standard needed

[1] "A New Broadcast Circuit Design for Frequency Modulation," delivered at the 15th Annual I.R.E. Convention, Boston, Mass., June 29, 1940. See also "Synchronized FM Transmitter" by W. H. Doherty, *FM* Magazine, Dec. 1940.

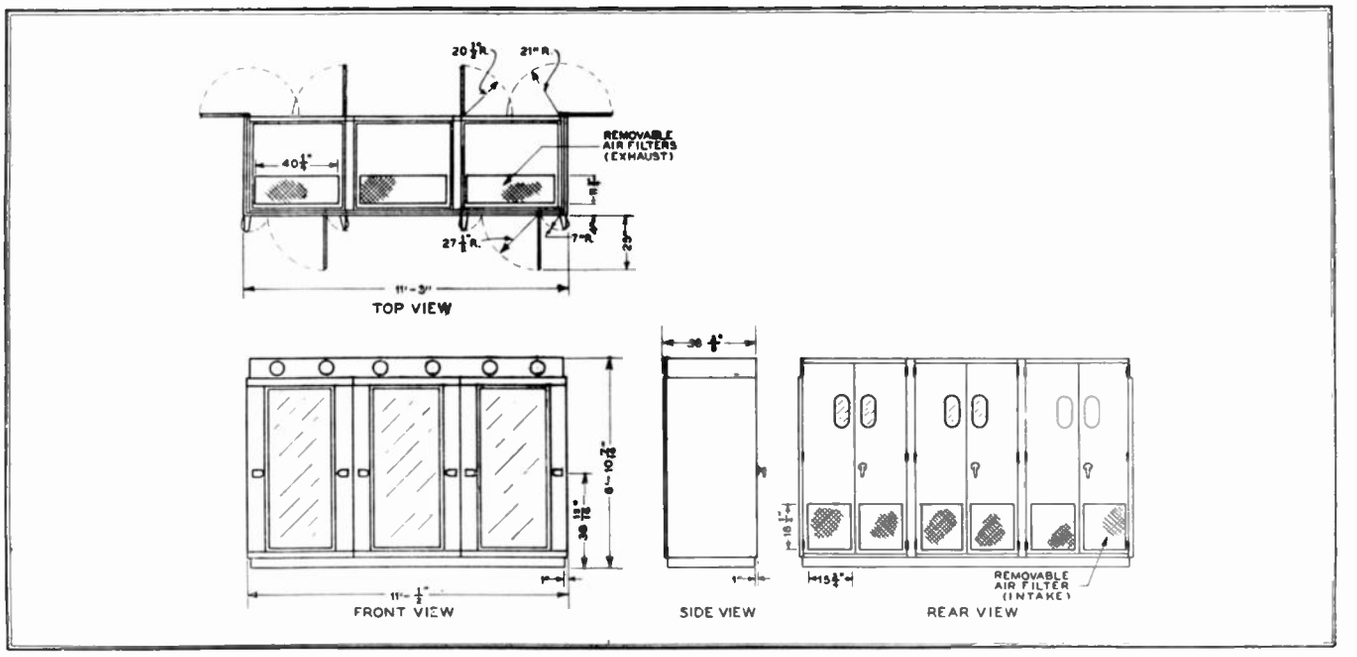


FIG. 6. OVERALL DIMENSIONS OF THE 10-KW. FM TRANSMITTER. ALL THREE SECTIONS ARE IDENTICAL IN SIZE

to meet the center-frequency stability requirements is provided by a crystal oscillator of advanced design. This oscillator employs a crystal unit consisting of two quartz plates bonded together and enclosed in a sealed glass tube. The stability is better than one part in a million per degree centigrade over a wide temperature range. Hence no temperature control is required.

The standard and the sub-multiple frequencies are applied to a modulating circuit and any difference frequency created is applied to the windings of a two-phase reluctance type motor. The motor is mechanically coupled to a variable condenser in the plate circuit of the master oscillator in which frequency modulation is generated. If the standard and sub-multiple frequencies do not have exactly the same value, the difference frequency sets up a rotating field which actuates the motor armature and changes the condenser capacity until the frequency difference becomes zero. When the frequencies are the same, the motor is inactive. The subharmonic of the modulated carrier will, of course, be subject to an alternating phase flutter of about 12° or less at 100% modulation, occurring at the signal frequency rate. Since the flutter is symmetrical around the mean frequency and is of very small amplitude, the inertia of the motor and connecting mechanical parts prevents the flutter from causing the motor to rotate.

So effective is the operation of this control system in correcting changes in the mean frequency that small changes of circuit element values, such as those due to ambient temperature changes and aging of parts, are corrected before they are perceptible. In the other extreme, the control functions effectively to offset frequency errors equivalent to a sudden departure of hundreds of kilocycles at the carrier frequency.

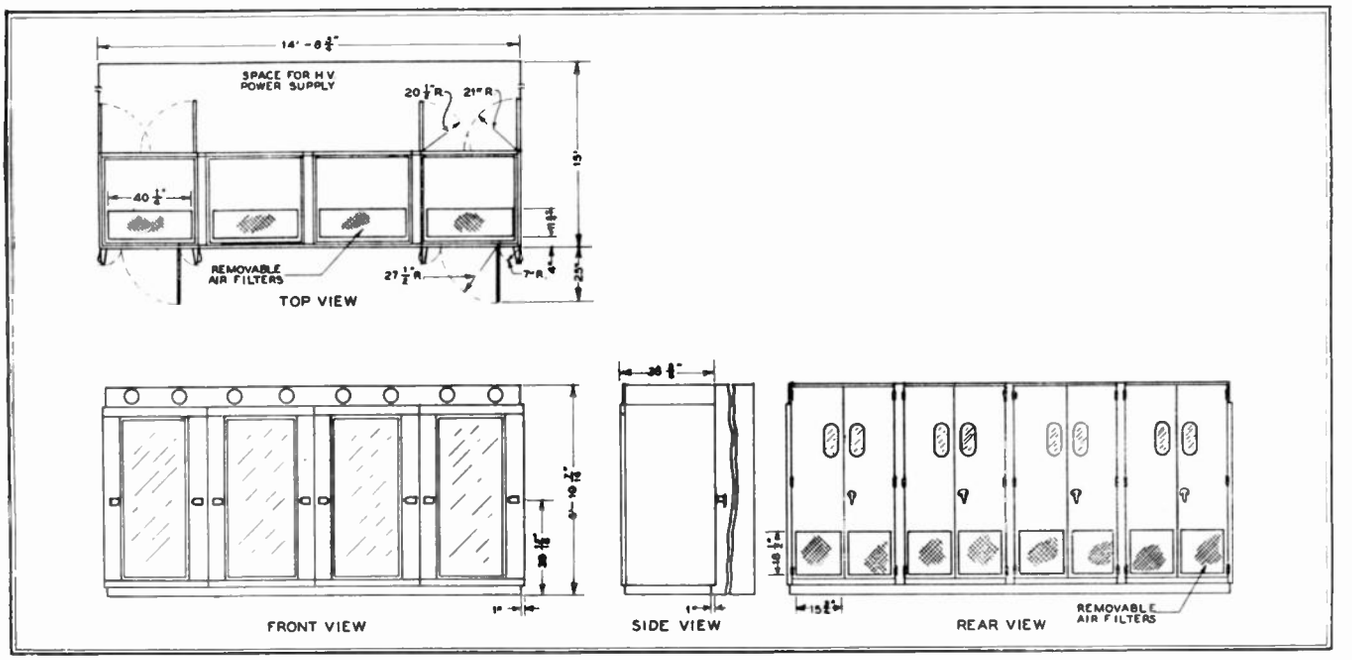


FIG. 7. ARRANGEMENT OF THE 25-KW. FM TRANSMITTER CALLS FOR SPACE AT THE REAR FOR THE HIGH-VOLTAGE SUPPLY

Review of Basic Circuit ★ The operation of the Western Electric FM system can be understood by referring to the block diagram, Fig. 9.

The frequency of the oscillations developed in the 5.3- to 6.6-mc. oscillator is determined by the combination of the

fixed circuit elements and the effective reactance which is injected into the circuit by the reactance modulator. Under the influence of an audio modulating voltage applied to the input of the modulator, the artificial reactance presented to the oscillator circuit undergoes variations, thus causing the frequency of the oscillator to vary symmetrically about its center value, the extent of the deviation being proportional to the amplitude of the modulating audio voltage. By this means the oscillator is *frequency-modulated directly* by the audio signal input.

To develop the carrier frequency, the output of the frequency-modulated oscillator is passed, successively, through a buffer amplifier and four frequency doublers, producing at their output the final mean carrier frequency. This signal is then applied to the subsequent amplifier stages to give the desired output power.

A sample of the output of the buffer amplifier is diverted to the first stage of a group of ten cascaded frequency-dividers employing regenerative modulation. The output frequency of each stage is exactly one-half of its input frequency. A buffer stage amplifies the output of the last frequency-divider circuit where the frequency has been reduced to 1/1024th of the modulated oscillator output frequency.

This reduced frequency is applied as one of two voltages to the inputs of two balanced comparison circuits. The source of the second voltage is the precise crystal-controlled stable oscillator, the output of which is separated into two channels and passed through two phase-shifting networks from which two voltages are obtained. These are identical in value except that the phase of one is shifted 90° with respect to the other. Each of the modulator pairs utilizes one of these quadrature voltages as the second voltage.

The outputs of the two balanced comparison circuits are applied in space quadrature to the field windings of a two-phase motor in which a rotating field is produced whenever there exists a difference between the frequencies of the two sources. When a difference of frequency exists, the rotating field produced causes the armature to move. The armature drives a variable condenser located in the tank circuit of the modulated oscillator. The direction of rotation is such that the capacitance will change the right amount to make the mean frequency of the master oscillator an exact harmonic of the stable crystal oscillator, thus controlling the carrier frequency.

The frequency synchronizer and the frequency modulator are entirely separate circuits. A failure in the frequency synchronizing control cannot in any way affect the quality or continuity of transmission. Another very important feature of this separation is that the modulator, not entering into the control of the mean frequency, can be designed to operate at the optimum point for linear modulation, greatly increasing the linear modulation capabilities. Therefore, harmonic distortion is less than 0.5% for a swing of ± 75 kc. for frequencies from 30 to 15,000 cycles.

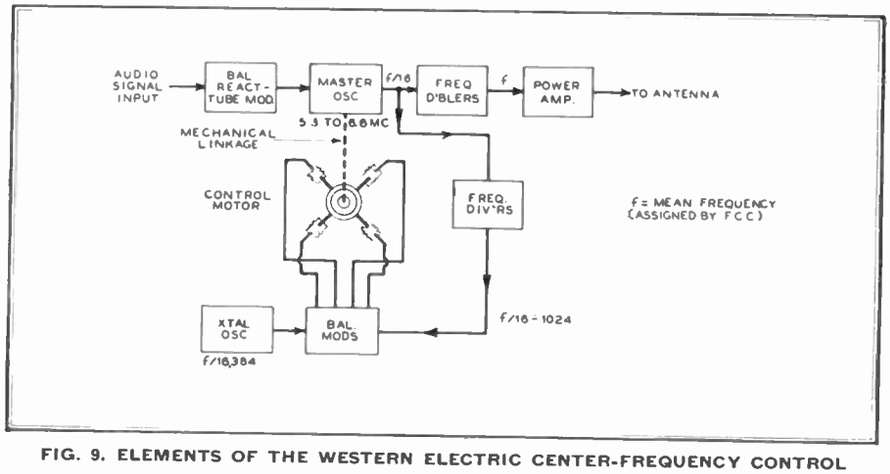


FIG. 9. ELEMENTS OF THE WESTERN ELECTRIC CENTER-FREQUENCY CONTROL

Circuit Description ★ In the new line, the 1-kw. transmitter, Fig. 1, is the basic driving unit for all higher-power transmitting equipments. Thus the detailed description of this circuit will be considered as part of the description of each transmitter. It will be noted that different types of amplifiers are used for the equipments of different power outputs. This results from the fact that the best overall engineering answer was chosen for each power requirement. No one circuit, no matter what its advantages as an individual stage, is necessarily the best when considering the efficient operation of an equipment as a complete unit.

In the 3-kw. transmitter, a single-tube grounded grid amplifier is added to obtain the 3-kw. output. Grounded grid is used

(CONTINUED ON PAGE 57)

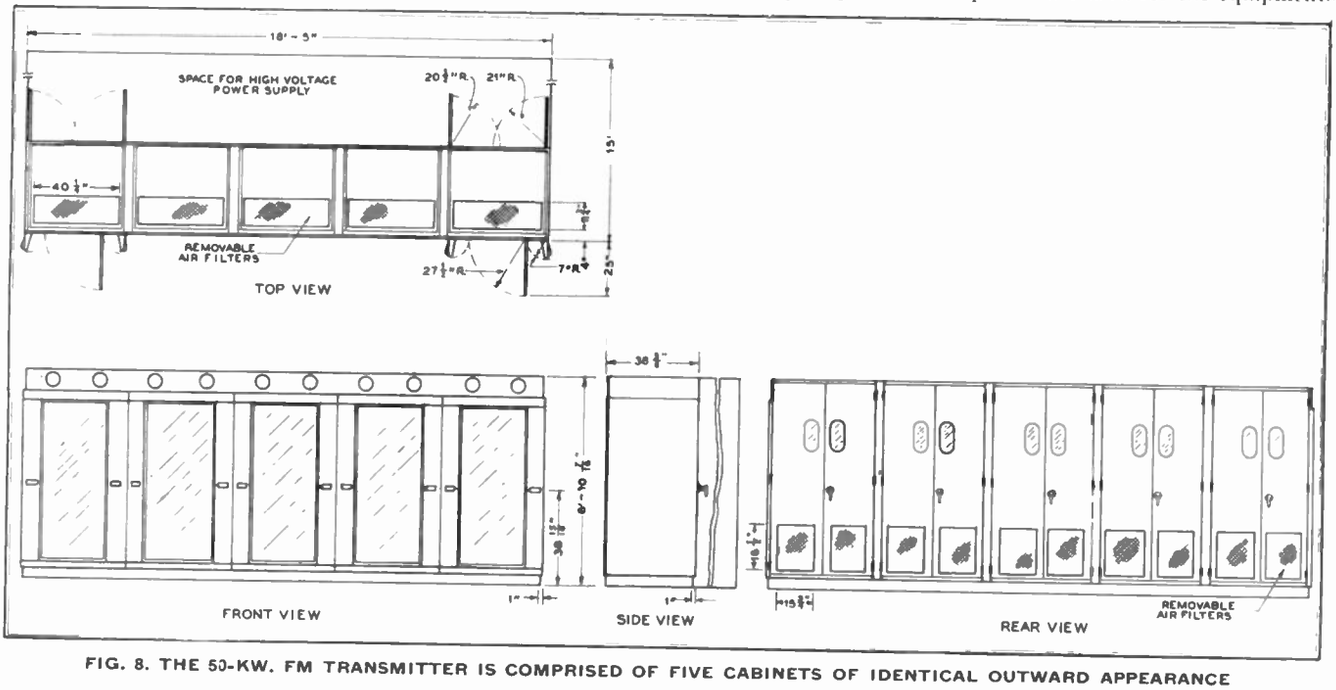


FIG. 8. THE 50-KW. FM TRANSMITTER IS COMPRISED OF FIVE CABINETS OF IDENTICAL OUTWARD APPEARANCE

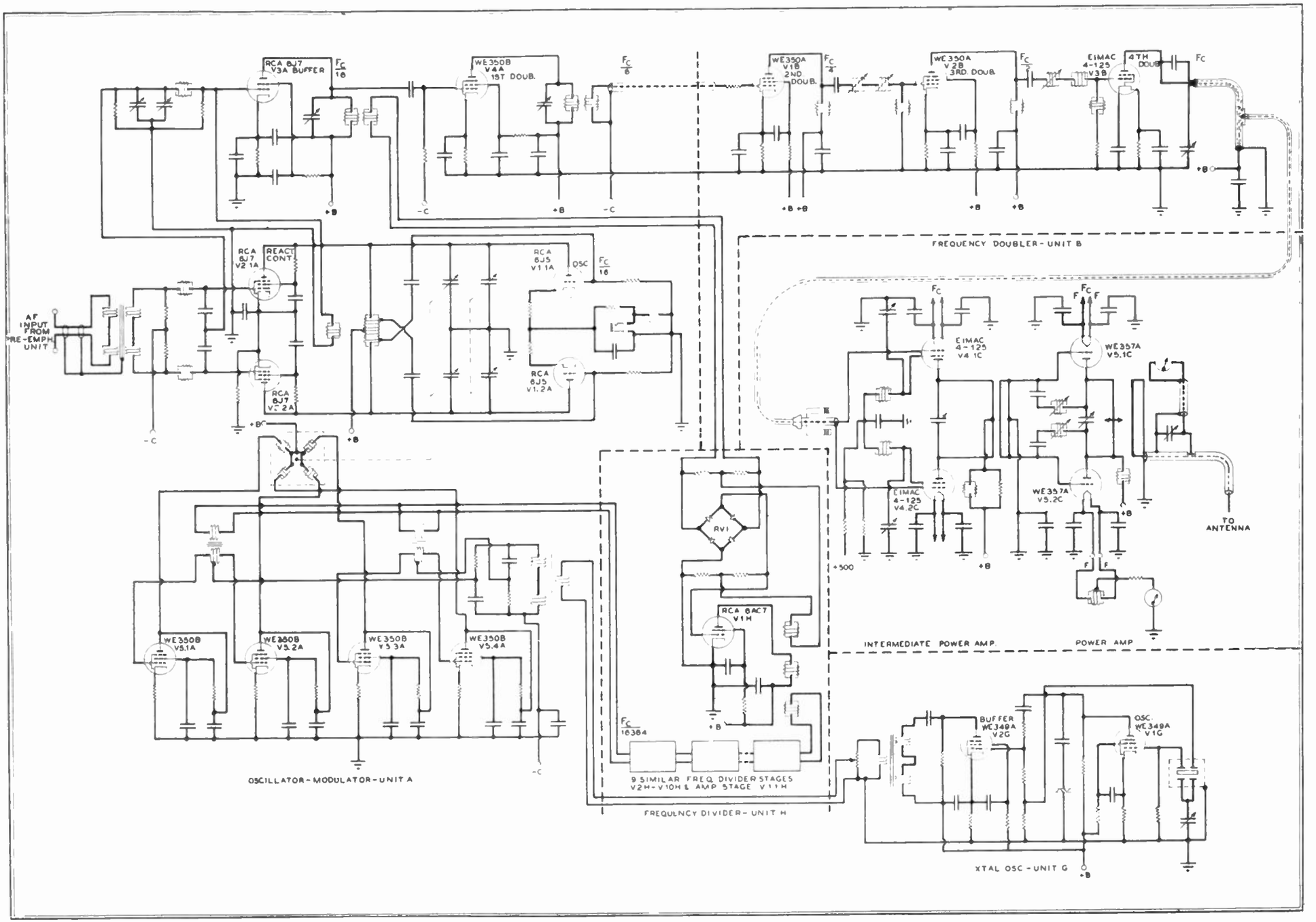


FIG. 10. THE ESSENTIAL CIRCUITS FOR THE 1-KW. WESTERN ELECTRIC FM TRANSMITTER. THIS BASIC UNIT IS USED IN ALL EQUIPMENT OF HIGHER OUTPUT POWER

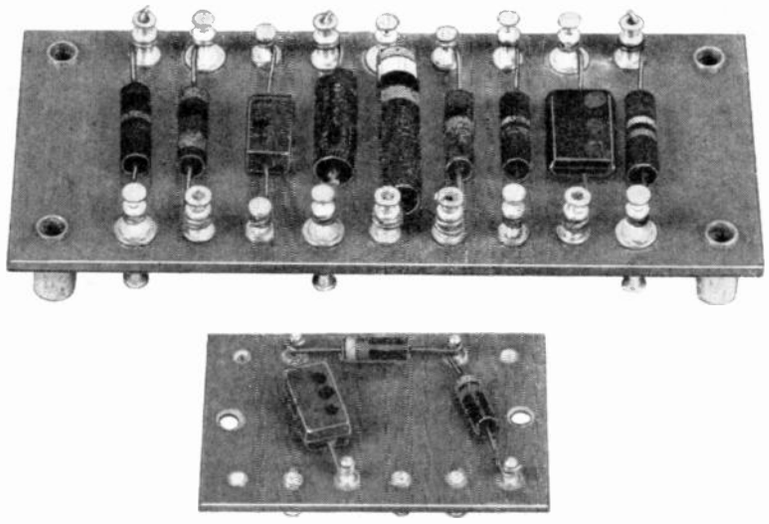


FIG. 1. TOP VIEWS OF TYPICAL TERMINAL BOARDS EQUIPPED WITH SINGLE- AND DOUBLE-ENDED TURRET LUGS. SPECIAL ADVANTAGE OF THESE LUGS IS THAT NO RIVETS ARE USED TO HOLD THEM TO THE TERMINAL STRIP

DATA ON TURRET-TYPE LUGS

The Selection and Use of Turret Lugs as Terminals for Replaceable Components

BY MARY McGILLEN*

TURRET type lugs came into wide use during the war because they offered a simple way to meet Army and Navy specifications on connections to the terminals of circuit components. They have three special advantages: First, since they are designed to be secured to terminal boards by swaging, they do not require screws and nuts or rivets to hold them in place. Second, the single-ended and double-ended turret lugs provide means for securing several wires to any terminal on one or both sides of a board, without having to wrap one wire over another. Third, when any component must be replaced, its leads can be unsoldered without disturbing other wires going to the same terminals.

By means of the standard types illustrated here, it is possible to work out special arrangements which simplify the assembly and wiring of radio equipment, and facilitate production testing as well as subsequent service work. At the same time, the terminal-board method of mounting components not only improves the appearance of the equipment, but gives positive support and protection to the parts which, if strung loosely around a chassis, might come loose under vibration.

Of the many sizes and shapes used in times past, experience has shown that practically every requirement can be met by the 7 types illustrated here. They include 3 sizes of single-ended turrets, 3 double-ended sizes, and a special split lug intended particularly for terminal boards on potted components, such as transformers.

Figs. 1 and 2 show the top and bottom views of two typical boards, but the arrangements that can be worked out are only limited by the ingenuity of the individual designer. A close examination will

*Cambridge Thermionic Corp., 445 Concord Ave., Cambridge, Mass.

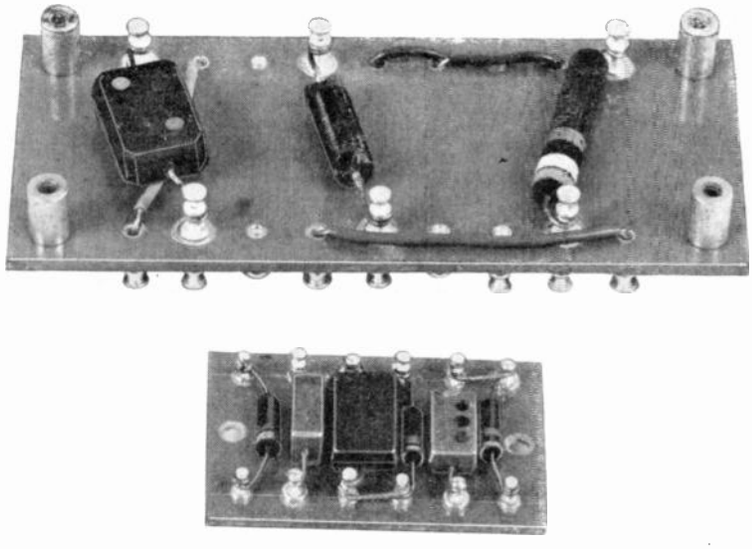


FIG. 2. UNDERSIDES OF THE TERMINAL BOARDS SHOWN IN FIG. 1. NOTE HOW THE DOUBLE-ENDED LUGS ARE USED FOR CONNECTIONS TO COMPONENTS ON BOTH SIDES OF THE BOARDS, AND HOW WIRES ARE SOLDERED AT THE BOTTOM OF SINGLE-ENDED LUGS

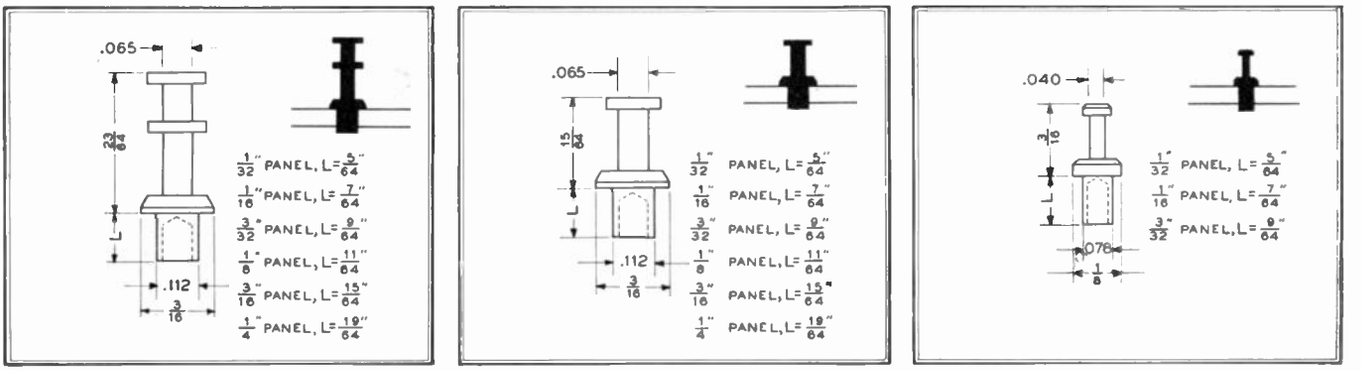


FIG. 3. DIMENSION DRAWINGS AND ACTUAL-SIZE SILHOUETTES OF THREE STANDARD TYPES OF SINGLE-ENDED TURRET LUGS

reveal that some of the turrets are single-ended, while others, requiring connections above and below the board, are double-ended.

Figs. 3 and 4 give the overall dimensions of each type, with a detail silhouette that is actual size.

The first turret in Fig. 3 provides 2 separate sections for soldering wires. Usually, the lower section is used for the lead to a condenser or resistor, while the upper one takes a wire running off to some other part of the circuit. Two smaller turrets are also shown in Fig. 3. It should be noted that hook-up wires can be soldered into the hole at the bottom of any one of these lugs. If a hot iron is applied quickly, a wire can be soldered in place or removed at one end without affecting the connection at the other end. Such connections can be seen on the smaller board in Fig. 1, and on the larger board in Fig. 2.

Tables in Fig. 3 show the standard shank lengths for terminal boards of various thicknesses.

When components are mounted above and below a terminal board, as in the case of the assemblies illustrated here, double-ended turrets are required. Fig. 4 shows the 3 standard designs, of which one has two sections on each end.

The special design, Fig. 5, is used for terminal boards on various components which are mounted in cans, and are potted. Lead wires are brought through the lugs when the cover is fastened in place. Then each lead is wrapped around one leg of its respective lug, and soldered. The other legs are used for circuit connections.

Each type is made with a counter-bored extension on the shank which passes through the terminal board. This is provided for swaging, an operation which secures the turret firmly in place. Unless the tool used for this purpose has exactly the right shape, the edge will not be turned over property. This is extremely important, for upon the success of this operation depends the security of the turrets.

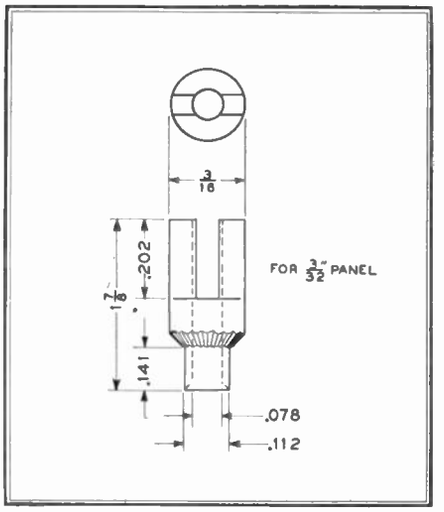


FIG. 5. SPECIAL LUG FOR TERMINAL BOARDS ON POTTED COMPONENTS

Standard swaging tools are available for each type. The base is recessed to hold the turret in place while it is being put into the board, thus speeding up assembly. For model shop use, the base can be put in a vise, and the upper part, or rolling tool, struck with a hammer. However, the tools are designed for use in a kick-press, and should be used in that manner for production work.

All the different types of turrets are silver-plated. This is an advantage in soldering when rosin flux is used. Dip-tinning offers no advantage over the silver, and cannot be cleaned off properly from the shank where it passes through the terminal board. Silver plating does not introduce any variation in the shank diameter.

On communications and broadcast equipment, where the ease of replacing components is an important sales factor, terminal boards with turret lugs for mounting components are now used almost universally. And this type of design on any radio equipment is certain to win the hearts of all service and maintenance men.

In the case of mobile radio equipment, the use of turret lugs and terminal boards has proved to be the most effective way to protect condenser and resistor leads from failing under vibration. Even after several years of continuous road duty, components mounted in this manner show virtually 100% perfect records.

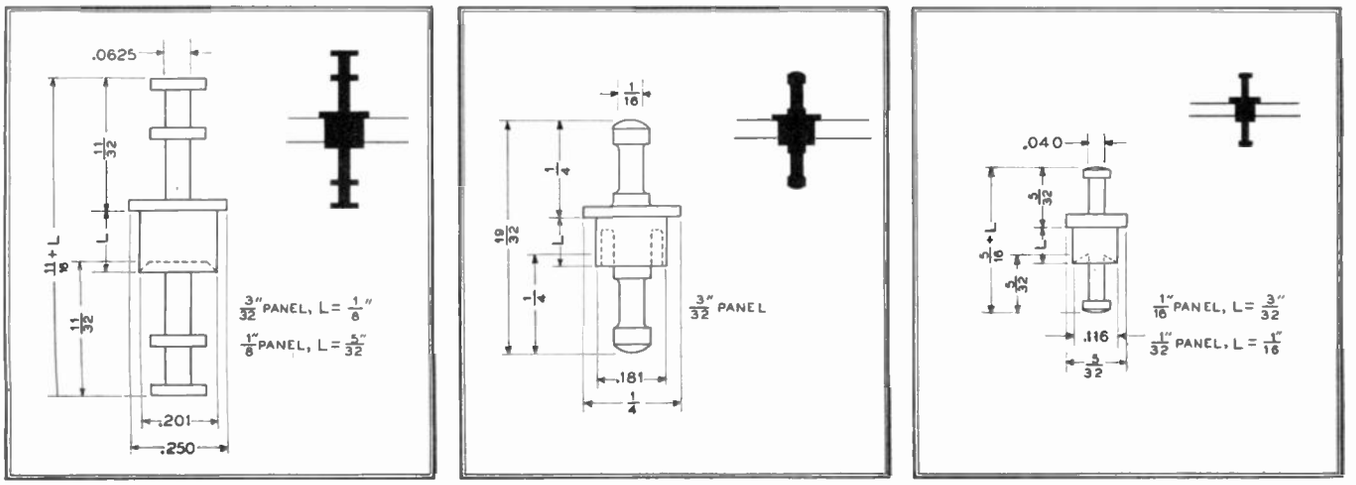


FIG. 4. DIMENSION DRAWINGS AND ACTUAL-SIZE SILHOUETTES OF THREE STANDARD TYPES OF DOUBLE-ENDED TURRET LUGS

U. OF K. LOOKS FORWARD

University of Kentucky Now Serves Listeners by Training Students at Its Own FM Station

BY ELMER G. SULZER*

SPEAKING at the Public Service Radio Institute, University of Wisconsin, on August 5th, C. M. Jansky, Jr., Washington radio consultant, referred to a letter he had received from a university to which he had suggested the installation of FM. The letter stated, in part:

"The desirability of applying for an FM assignment has been considered, but it is recognized that FM is not at the present time the radio system in general use, and the time when it will become so appears to be uncertain and may possibly be distant. Therefore, it has been decided that an application will be made for an FM channel with the expectation that it may possibly be several years before the FM situation will have crystallized to the point where we will be called upon to erect an FM station."

Commented D. M. Jansky: "This philosophy is so much at variance with that upon which those of us in educational broadcasting embarked in the early days of AM that I began to wonder what has happened during the past 26 years to stultify the spirit of research and exploration of which our schools and colleges so proudly boast. . . . Today, because of the forward march of science, broadcasting is face to face with a revolution which is going to so change the art that the future will bear little resemblance to the past. . . . In the face of what is ahead, I cannot but deplore the attitude of commercial broadcasters and educators alike who believe that it will be several years before they are 'called upon' presumably by competitive conditions, to erect FM stations. It is unfortunate that so many insist on keeping their eyes on the past, refusing to grasp or even recognize the opportunities of the future."

In the light of these remarks, the purpose behind the University of Kentucky's FM station, and the results already obtained, are of great interest to schools now engaged in broadcasting, and to those planning to enter this field.—Editor

ABOUT two years ago, the University of Kentucky decided to enter the FM field. Kentucky's State University was not without a wealth of radio tradition, however. As far back as April 1, 1929, the University of Kentucky made the first of a series of daily broadcasts over WHAS, Louisville, a precedent which has been maintained to the present day. Later when WLAP came to Lexington, regular programs over that station were scheduled from the U.K. studios. For a period of more than a year immediately preceding the World War II, the Mutual Broadcasting System's *School of the Air* originated in the U.K. studios 5 days a week.

A high quality of public service, coupled with a sense of commercial-station showmanship and mass audience appeal, has dominated all of these presentations. In 1942, the University of Kentucky Studios was awarded a George Foster Peabody medal for its series of talks on venereal disease, the first radio programs to crack the shell of secrecy on the details of this social problem.

Meanwhile, we developed elaborate studios on the U.K. campus, maintaining in all respects standards equal to and often exceeding those of commercial stations. In 1933, a system of radio listening centers, located in remote parts of the Kentucky mountains, was established, a system which has been continued to the present day, and which has been emulated to a certain extent in many parts of the world.

It was only natural, therefore, that the University would look with interest on the new art of Frequency Modulation with a firm desire to enter the field. This came about in the summer of 1944 when the nation was at war. Radio parts were scarce, and when available at all they were obtainable only by a high priority. Thus, at first glance, the plan did not seem practicable.

A little searching of the field, though, indicated that perhaps we could get on the air with a low-power FM station. D. C. Summerford, then acting head engineer of WHAS, had been constructing an FM transmitter of his own which, with small modifications, would fill the bill at U.K. McVey Hall is the campus building where our radio studios occupy the top floor. Fortunately, it is located on the highest point of the campus which, in turn, is perched on the highest point of Lexington. In fact, from the roof of McVey Hall one can see out a distance of more than 6 miles over the gently rolling Bluegrass.

It was decided, therefore, to go ahead with the proposition on a sort of trial and error basis. The 500-watt FM transmitter, occupying a single cabinet rack, was properly modified and installed in the master control room. Since all necessary studio input equipment was already in use, that was no extra problem. The University studios owned an RCA 303A frequency monitor which had been used with an experimental AM station on the old educational band, and this monitor was called into service for the new FM station.

Because of the height of the McVey Hall studio building, and since the University was embarking on FM in a more or less experimental capacity, it was decided to have the University's own Maintenance and Operations Department erect a 4-in. pipe mast on top of the building immediately over the master control room where the transmitter was set up. A few lengths of suitable pipe were readily available.

JOAN TALLEY, U. OF K. STUDENT SOLOIST AT THE WBKY MICROPHONE

Luck was with us on the antenna, too. We learned that Motorola had a surplus coaxial antenna stored in Louisville. This was promptly purchased and cut to the proper frequency.

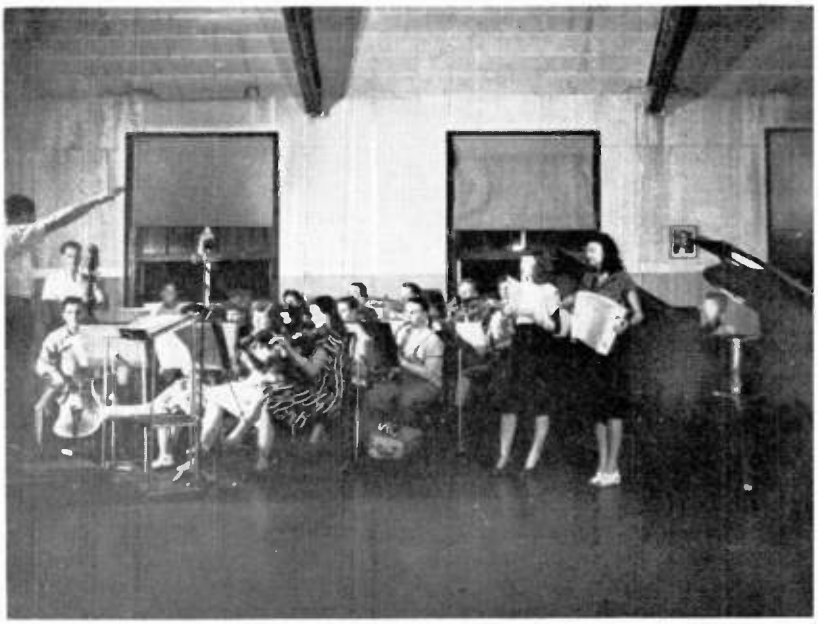
The coaxial transmission line posed a problem for a time, since it was not too easy to procure with a nation at war. However, we learned of a Lexington firm that had a stock of ⅞-in. copper pipe and a number of coils of ¼-in. copper tubing. We also found out where we could secure the required lava insulators with a low priority. As you may guess, we fabricated our own transmission line.

In the meantime we made application to the Federal Communications Commission for a construction permit and were fortunate in being allotted space in the 42- to 50-mc. band.

Starting operations in March, 1945, the results of our setup far exceeded our most enthusiastic preliminary hopes. Although there are only approximately 300 FM receivers in our listening area, according to pre-war dealers' sales records, the listeners we have are most enthusiastic and, it might be added, communicative. We find that we are laying down a serviceable signal over a radius of 22 miles, this figure being based upon both field strength measurements and reports from listeners. This coverage seems rather surprising when you consider that our FM power is only 500 watts, and that we are using a vertical coaxial antenna 103 ft. above the ground. However, we are favored by being

*Director, Radio Station and Department of Radio Arts, University of Kentucky, Lexington, Ky.

DRAMATIZATION OF "CASEY JONES" ON THE AIR FROM WBKY



STAFF ORCHESTRA EARNS SCHOLARSHIPS BY RADIO WORK

situated on the exact hump of the Bluegrass.

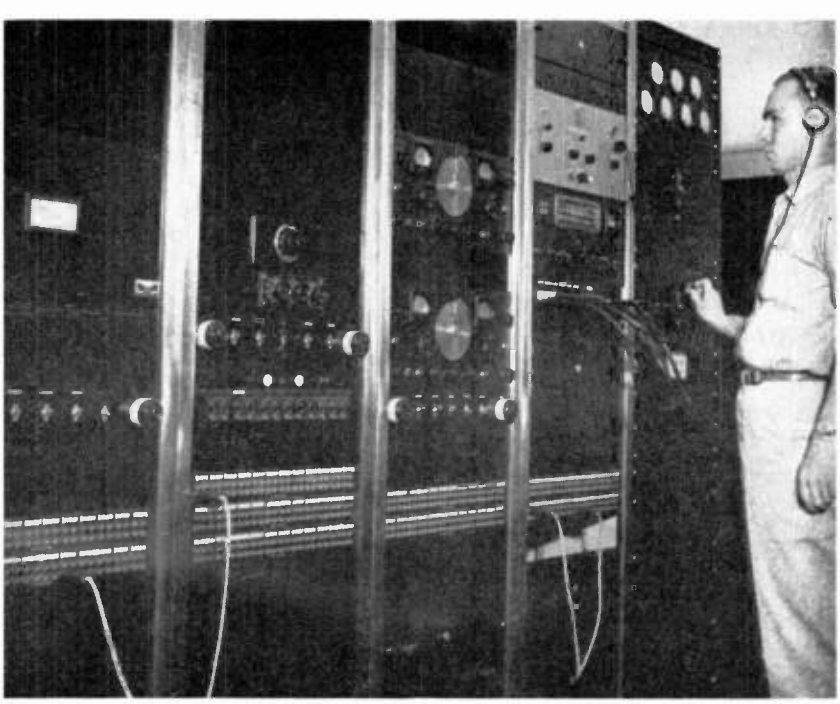
Now, the chief interest of the University of radio studios is being directed towards the completion of our new transmitter. James Hisle, head engineer of the U.K. studios, is constructing a 1-kw. unit which will operate on the new band. The FCC has allocated the University the frequency of 91.3 mc. A 102-ft. self-supporting Blaw-Knox tower, a gift of the Lexington Police Department, is being erected at the side of McVey Hall. The new tower will carry a 40-ft. steel pole with a 4-element turnstile antenna. This will be fabricated by our own engineering staff. We shall also add a standard frequency and modulation monitor. Based upon a combination of theory and horse sense, our prediction is that the new setup will cover a radius of 35 to 40 miles, or an area of 4,000 to 5,000 square miles.

Programming of our FM station is carried on by the writer and one full-time program supervisor. All other participants, including engineers, announcers, musicians, actors, sound effects people, script writers, and producers, are students. A small salary is paid the transmitter engineer, the head studio engineer, and the head announcer. Members of the 16-piece staff orchestra receive scholarships. All other students perform without pay. At the present time, the operating hours of WBKY (We Broadcast Kentucky) are somewhat restricted because of the paucity of FM receivers in our area, but our plans to expand the programming run hand-in-hand with the increase in the number of sets.

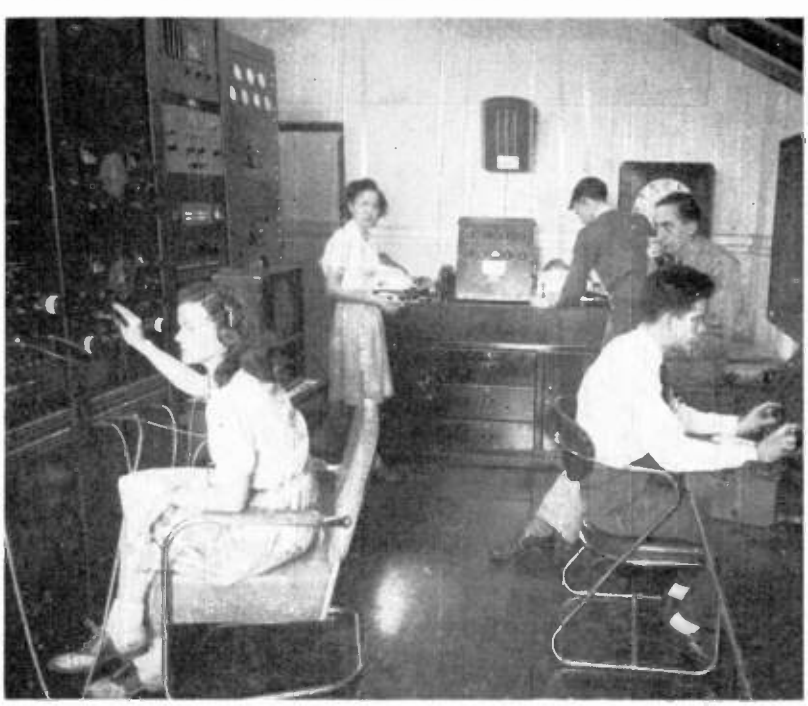
When the new 1-kw. transmitter is in operation, probably late in the fall, we plan on dual operation of our two transmitters until we are required to vacate our 42.9-mc. channel.

The experience of the University of Kentucky indicates that the installation and operation of college-owned FM stations is well within the financial and artistic scope of most institutions of higher education, and that such institutions are passing by the opportunity of a lifetime in not getting their frequencies while the getting is still good. This opinion is based on the value to our students of the first-hand experience they have had from programming and operating our FM station,

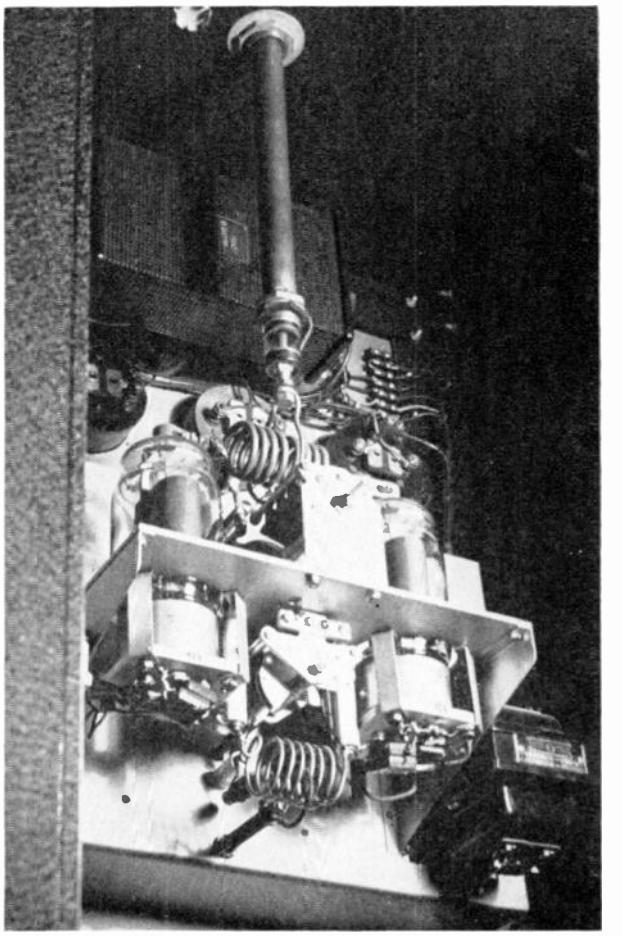
MASTER CONTROL ROOM. FM TRANSMITTER AT EXTREME RIGHT



ON VJ-DAY STUDENTS MADE RECORDINGS OF HISTORIC EVENT



PENDING ERECTION OF NEW TURNSTILE, WBKY IS GETTING EXCELLENT RESULTS WITH POLICE TYPE COAXIAL ANTENNA



FINAL STAGE OF THE LOW-BAND TRANSMITTER BUILT BY D. C. SUMMERFORD, ACTING HEAD ENGINEER AT WHAS

and the services we have been able to render the public in our part of the State, despite the limited number of FM receivers in use at the present time.

Our future plans call for close coöperation with the radio dealers and our listeners, to the end that they will have the full advantages that FM broadcasting can provide, through furnishing high-fidelity reception, free from static and background noise. We feel that FM stations must share this responsibility.

PHASE-SHIFT TRANSMITTERS

(CONTINUED FROM PAGE 27)

driver, providing automatic sequence-starting under the control of a single pair of switches which, if desired, can be located remotely.

The output of the transmitter, or amplifier, is monitored by an integral demodulator-amplifier unit designed to feed a 600-ohm audio line at + 12/VU level. The internal hum and noise of this device are more than 70 db below maximum output, and the distortion is held to a negligible value. A standard 75-microsecond de-emphasis network is included, thus permitting measurements of overall transmitter performance with a minimum of accessory apparatus.

Many design features intended to provide a high degree of trouble-free and efficient operation have been included. The equipment is completely enclosed to prevent the accumulation of dust. Forced ventilation is provided by blowers. Both the air intake and exhaust are covered by glass-wool filters, and rate-of-flow interlocks are provided on each blower. The use of complicated circuits and mechanisms has been held to a minimum without impairment of performance.

Styling of the 1-, 3- and 10-kw. transmitters is highly flexible, and allows considerable latitude of selection on the part of the purchaser. The basic 1-kw. unit and the power amplifiers are available in the individual, enclosed design illustrated at Fig. 5. They can also be supplied with built-in enclosure construction carried out to the walls and ceiling of the room in which the equipment is installed. This provides sufficient flexibility to meet any reasonable custom-built requirements.

The following table gives the basic performance characteristics for all three power ratings:

Carrier Frequency Range: 88 to 108 mc.

Audio Frequency Response: ± 5db from 50 to 15,000 cycles.

Harmonic Distortion: less than 0.9% from 100 to 10,000 cycles; less than 1.5% from 50 to 100 cycles, for ± 75 kc. swing.

FM Noise Level: 65db below ±75 kc. swing.

AM Noise Level: 50db below 100% amplitude modulation.

FM DEMONSTRATION STUNT

When radio programs were transmitted simultaneously on AM and FM, listeners could shift from one to the other and get a direct comparison of reception quality. If the original program material was good, the difference between the two methods of transmission was striking. Now that this is no longer possible, FM stations have hit upon an equivalent plan which is just as effective. Here is the method:

The announcer explains that listeners will have a chance to test the performance of their FM sets by listening first to high-fidelity FM transmission, and then to the same music transmitted with the quality limited so as to sound like reception on an average AM table model.

Using full-range pickup, two or three voices and a musical selection are broadcast. Then the same performance is repeated, but with the frequencies below 200 and above 4,000 cycles cut off with filters. In this way, listeners can check the degree of improvement of their receivers over the average AM sets. "If," the announcer explains, "you do not hear a vast improvement, your set isn't working right."

CHARACTERISTICS OF THE PYLON FM ANTENNA

In This RCA Design, Each "Bay" Is Simply a Slotted Cylindrical Section

BY ROBERT F. HOLZ*

THE latest addition to what has become a large family of FM antennas is the RCA pylon design. In the development of the pylon antenna, all previous concepts of high-frequency radiators were abandoned. The result is an out-of-this-world design which, for simplicity and ease of erection, can hardly be equalled.

General Description ★ Structurally, mechanically, and electrically this new antenna has been reduced to strictly functional elements. Each pylon section, Fig. 1, is a metal cylinder approximately 13 ft. high and 19 ins. in diameter. It carries no dipoles, no loops, no appendages of any kind. The radiator is the cylindrical structure itself. A single transmission line, running up the inside of the cylinder, along the slot to the mid-point, is the feed line.

The cylinder is rolled from a single aluminum sheet, bolted at the top and bottom to cast rings which give it great mechanical strength and provide means for securing the pylon section to the supporting tower or to additional stacked sections.

As many as four, and perhaps more of these basic cylindrical sections can be stacked to provide a high-gain antenna of remarkably single design. Such an assembly is shown in Fig. 2. It should be noted that the bottom section is mounted directly on the building roof, without the use of a supporting tower.

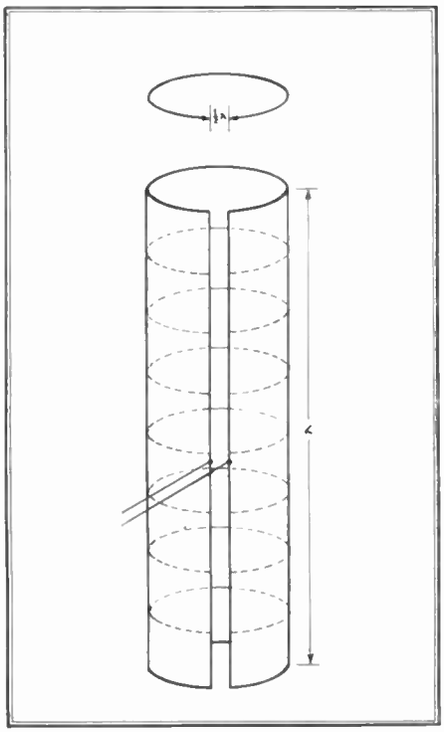


FIG. 3. EACH SECTION SERVES AS A NUMBER OF CIRCULAR ELEMENTS

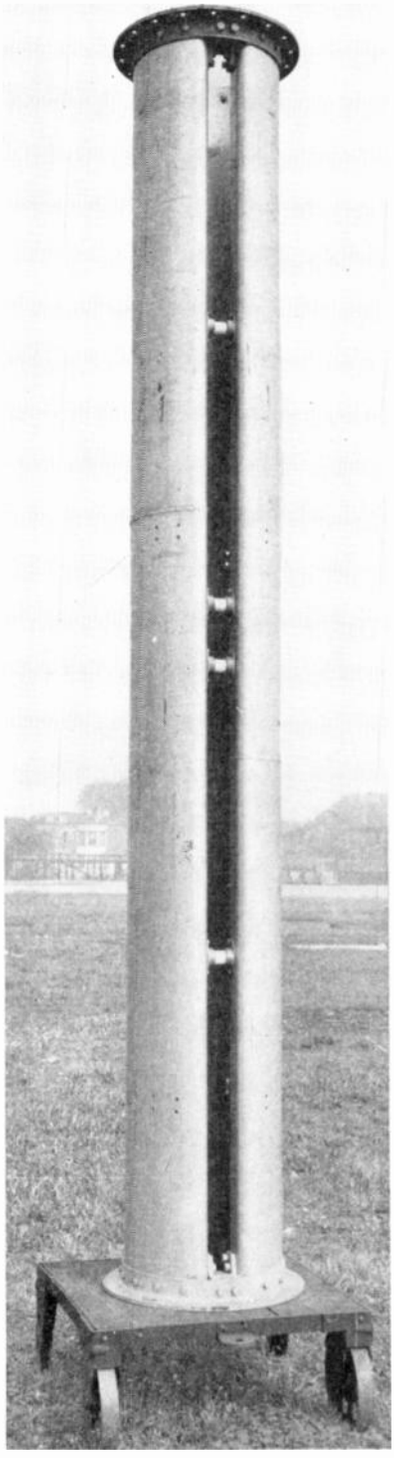


FIG. 1. SINGLE PYLON ANTENNA SECTION

Origin of the Design ★ The cylindrical pylon antenna has been undergoing development since early in 1944 at RCA in Camden. The principle of the so-called slot antenna has been employed in a number of applications where existing plane metal surfaces had to be adapted to radiating high-frequency energy.

When it was recognized that these radiating surfaces could be rolled into a cylinder and used for the radiation of omnidirectional, horizontally-polarized waves, steps were taken to explore the further possibilities of such a design. As Fig. 3 shows, the pylon antenna is, in effect, made up of a large number of circular elements, each one of which is a radiating member. When power is fed to the slot, Fig. 4, the slot functions as a transmission line, and currents flow around the circular paths shown by the dotted line.

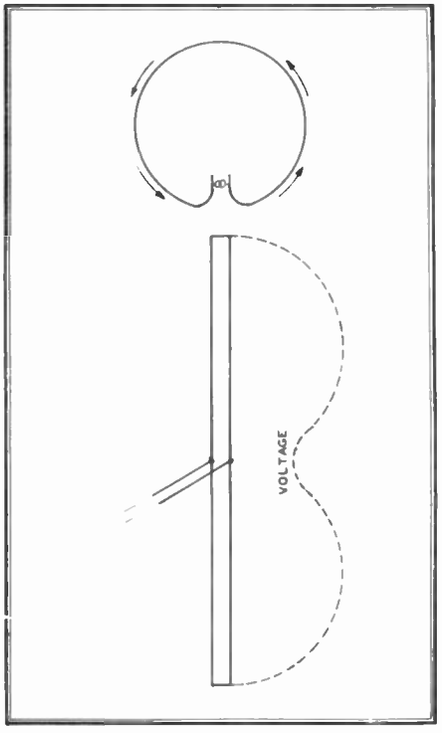


FIG. 4. THE SLOT FUNCTIONS AS A TRANSMISSION LINE WHEN FED WITH POWER

Early tests were conducted on 200-mc. models, fabricated of light wire screen. Although it may appear that the choice of a radiator ½ wavelength in circumference and 1 wavelength long was an obvious one for such an antenna, this is by no means true. A given set of dimen-

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

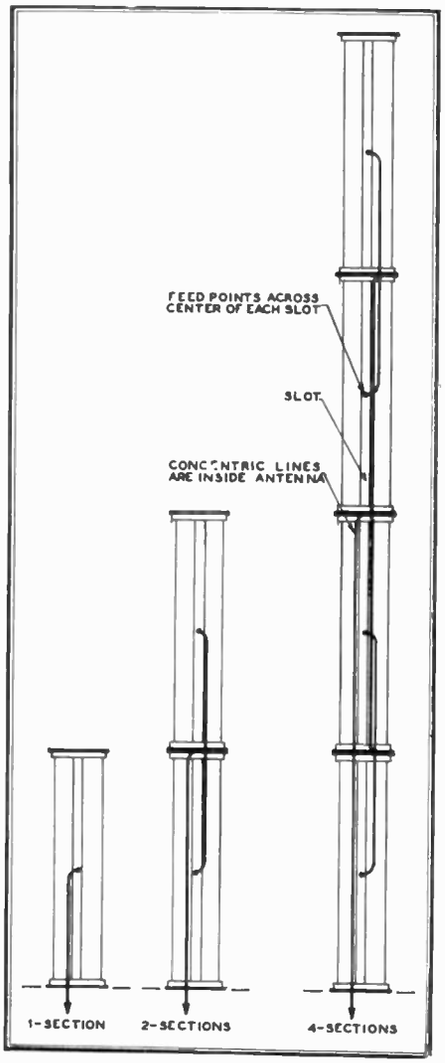


FIG. 5. FEEDER SYSTEM USED FOR 1, 2, AND 4 SECTIONS IS EXCEEDINGLY SIMPLE

sions for a cylinder yields a radiator which can be operated at any one of a number of nodes. The cylinder diameter is intimately associated with the horizontal

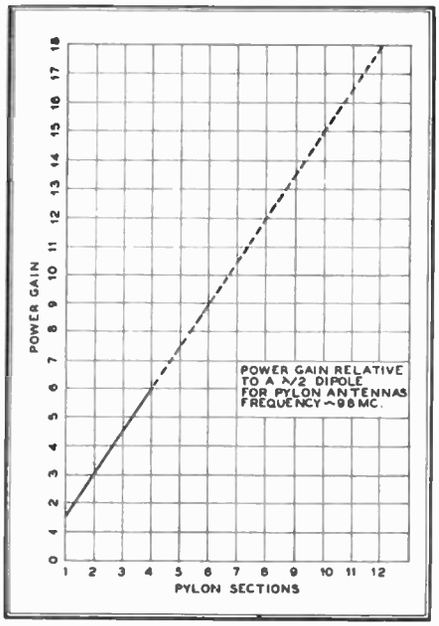


FIG. 6. POWER GAIN OF PYLON, RELATIVE TO STANDARD HALF-WAVE DIPOLE

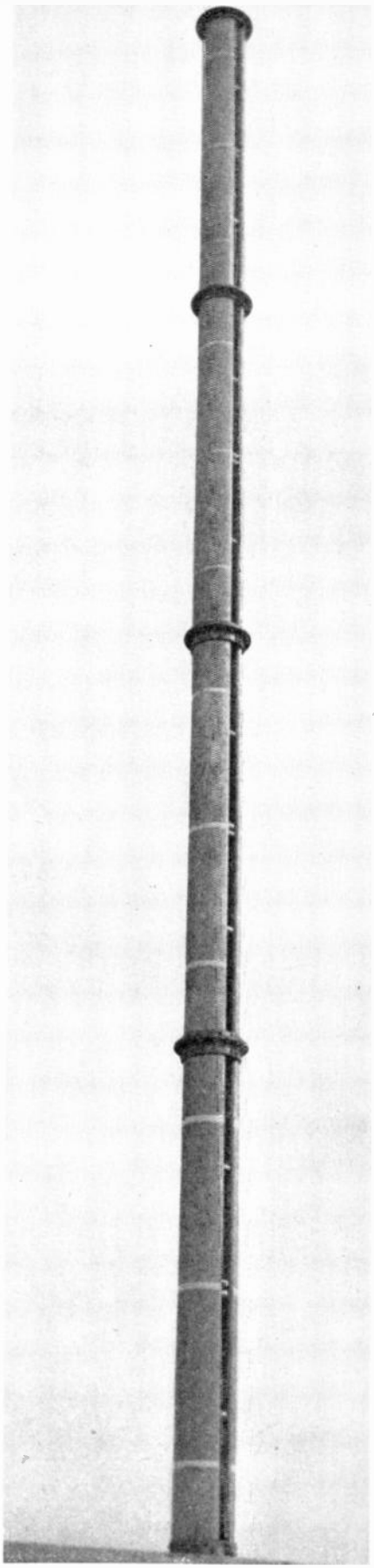


FIG. 2. A 4-SECTION PYLON ANTENNA, MOUNTED ON THE ROOF OF A BUILDING

pattern. On the other hand, the diameter is also a controlling factor in the length of cylinder for resonance.

A compromise was struck at this stage of the development. Investigations revealed that the slot width could be used to control the absolute value of the im-

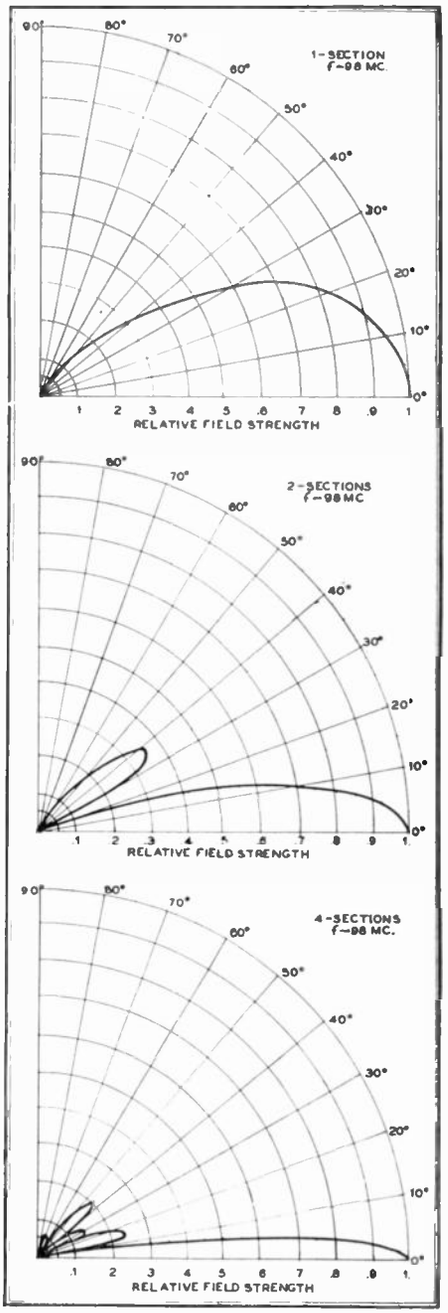


FIG. 7. HORIZONTAL RADIATION PATTERN FOR ANTENNAS OF 1, 2, AND 4 SECTIONS

pedance level at the feed point. This characteristic was explored carefully, in order to arrive at an optimum design. Careful tests were carried out to make certain that a round cylinder would yield the optimum characteristics. It was found that no reasonable degree of ovality improved the performance in any way. Multiple-slot cylinders, with more than one slot on the periphery, were considered and rejected because the structural and electrical simplicity were lost.

Characteristics ★ Pylon sections can be stacked to provide higher gain. Fig. 2 shows a 4-section assembly which has a power gain of 6. As many as 8 sections can be stacked in the same manner to give a power gain of 12.

Fig. 5 illustrates the very simple feeder system required for 1, 2, and 4 sections. The lines are actually run inside the pylon sections, so that they are protected from exposure. The feed system has an advantage when the antenna is being erected. That is, each pair of sections can be joined on the ground, and the interconnecting line put in place. Then it is only necessary to make 2 or 3 connections "in the air".

Successive sections are joined by bolting the end flanges together. All construction work involving arms or loops is eliminated, and no supporting mast is required since the pylon sections are at once mast and radiators.

The power gain is indicated in Fig. 6, and the horizontal radiation in Fig. 8. While the pattern is not exactly circular, this is generally an advantage since, in any area, there is always one direction in which it is desirable to direct extra power to overcome topographical conditions, or to obtain a little extra distance. The vertical field patterns are plotted in Fig. 7.

One size of radiator, or pylon section, and two sizes of transmission line lengths cover the whole FM broadcast band. No tuning or adjusting is required either on the ground or in the air. The wide bandwidth is obtained by the use of line elements, Fig. 9.

A single section, Fig. 1, weighs only 350 lbs., or 700 lbs. for two sections, while a 4-section assembly, made of heavier material, comes to 2,000 lbs. These weights include the radiators, transmission line, beacon, steps, and hardware.

The ice problem is negligible because the transmission lines are inside the cylinders, where ice formation is unlikely. Any formation on the outside will add little to the weight and loading. Maintenance is made easy by the simple feed-line arrangement, the small number of end seals, and by the fact that the lines are enclosed within the antenna sections.

A standard 300-mm. code beacon can be mounted on the plate which covers the top section of the antenna. When it is necessary to replace the beacon lights or the lines, they can be reached by climbing the steps on the cylinders. The slot is wide enough to give access to the feeder lines.

When an antenna of this type is carried at the top of a supporting tower, the load is made light by the smooth and unbroken exterior of the pylon sections. This can be seen from the relatively low value of R_1, Fig. 10 shown in the table of specifications. Furthermore no unbalanced load is present in this design. Accordingly, there is a saving in the cost of tower construction, if required, particularly in areas where icing and its attendant top-loading must be taken into consideration.

The wind load at the center of the radiator sections is based on 20 lbs. per square foot of the projected area and assumes a circular cross-section. The value of R_1 includes the 300-mm. beacon.

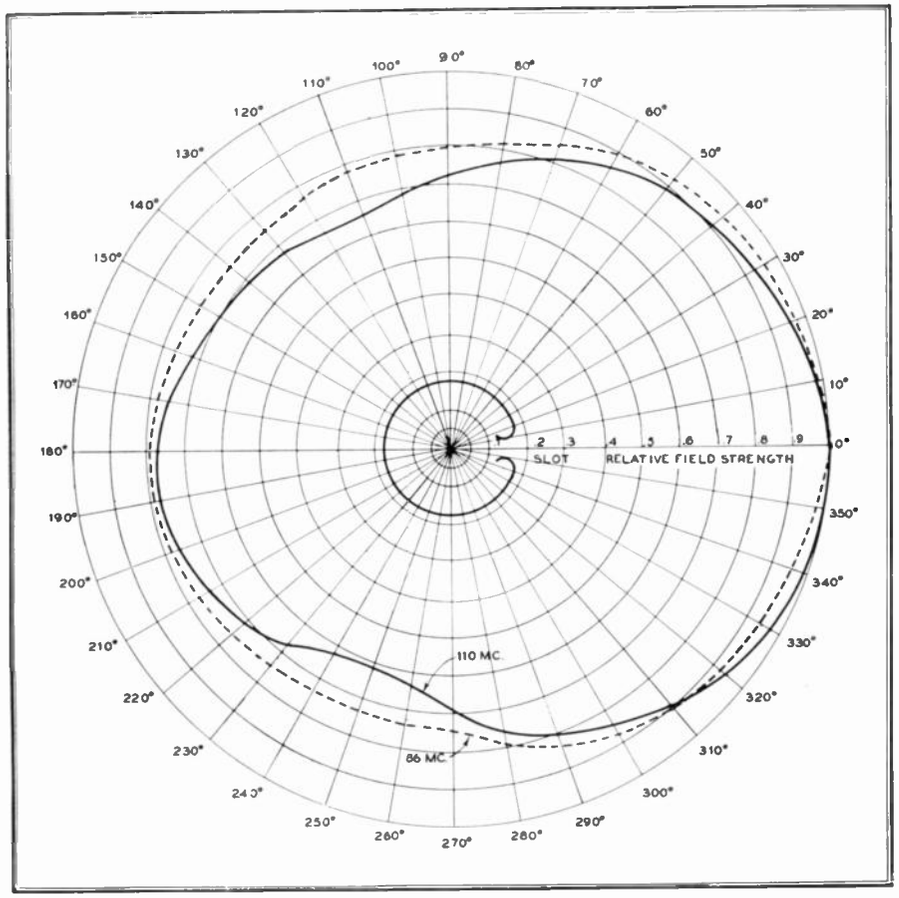


FIG. 8. PLOT OF THE HORIZONTAL RADIATION, AT FREQUENCIES OF 86 AND 110 MC.

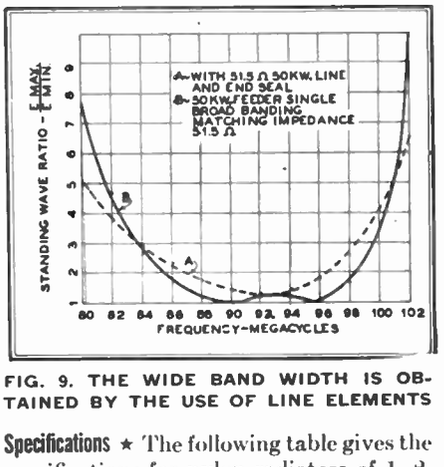


FIG. 9. THE WIDE BAND WIDTH IS OBTAINED BY THE USE OF LINE ELEMENTS

Specifications ★ The following table gives the specifications for pylon radiators of 1, 2, and 4 sections:

	1 Sec.	2 Sec.	4 Sec.
Power Gain, nominal	1.5	3	6
Field Gain, nominal	1.23	1.73	2.45

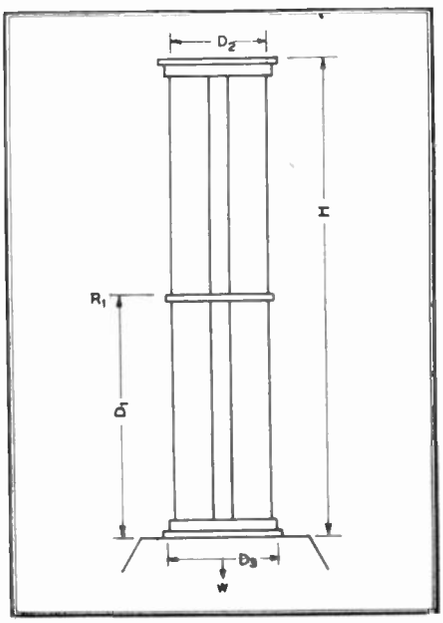


FIG. 10. VALUES FOR THESE DESIGN FACTORS ARE GIVEN IN THE TABLE HERE

Weight, lbs.[1]	350	700	2000
Height, ft.	13.5	27	54
R_1, lbs.[2]	501	950	1868
D_1, ft.	7½	14	27 ⅛
D_2, ins.	19½	19½	19 ½
D_3, ins. bolt circle[3]	22⅝	22⅝	22 ⅝

[1] Total weight including radiator, transmission lines, beacon, steps, and hardware.

[2] Total wind load on radiator, including beacon. Based on 20 lbs. per sq. ft. of projected area, all sections assumed rounds.

[3] Mounting is by means of eighteen ¾-in. bolts on 22⅝-in. circle.

FM AND TELEVISION PROGRESS REPORT

Construction Permits Issued by the FCC in August 1946

TELEVISION STATIONS

MASSACHUSETTS

Boston: Westinghouse Radio Stations, Inc.
Commercial No. 4 66–72 mc. 10 kw. Video 500 ft.

FM BROADCAST STATIONS

ARKANSAS

Fort Smith: Southwestern Hotel Co. (KFPW)
Class B No. 239 95.7 mc. 9 kw. 160 ft.

CALIFORNIA

Oakland: Warner Bros. (KWBR)
Class B No. 247 97.3 mc. 10 kw. 680 ft.
Richmond: Contra Costa Bcstg. Co.
Class A No. 284 104.7 mc. 500 watts 340 ft.
San Jose: Valley Bcstg. Co. (AM Grantee)
Class B No. 263 100.5 mc. 10 kw. 2,530 ft.
San Luis Obispo: Valley Electric Co. (KVEC)
Class B No. 222 92.3 mc. 11 kw. 690 ft.

DISTRICT OF COLUMBIA

Washington: Commercial Radio Equip. Co. (W3XL)
No. 267 101.3 mc. 20 kw. 500 ft.
Washington: Cowles Bcstg. Co. (WOL)
No. 263 100.5 mc. 20 kw. 350 ft.
Washington: National Bcstg. Co. (WRC)
No. 233 94.5 mc. 20 kw. 490 ft.
Washington: Metropolitan Bcstg. Co. (WASH)
No. 269 101.7 mc. 20 kw. 500 ft.
Washington: Potomac Bcstg. Cooperative, Inc.
No. 227 93.3 mc. 20 kw. 490 ft.
Washington: Evening Star Bcstg. Co. (WMAL)
No. 231 94.1 mc. 20 kw. 500 ft.
Washington: WINX Bcstg. Co. (WINX)
No. 225 92.9 mc. 20 kw. 500 ft
Washington: Theodore Granik
No. 229 93.7 mc. 20 kw. 500 ft.
Washington: Capital Bcstg. Co. (WWDC)
No. 265 100.9 mc. 20 kw. 500 ft.

FLORIDA

Daytona Beach: News-Journal Corp.
Class B No. 233 94.5 mc. 8.5 kw. 330 ft.
Jacksonville: City of Jacksonville (WJAX)
Class B No. 242 96.3 mc. 159 kw. 564 ft.
Jacksonville: The Metropolis Co. (WJHP)
Class B No. 244 96.7 mc. 34 kw. 350 ft.
Palm Beach: Palm Beach Bcstg. Corp. (WWPG)
Class B No. 256 97.9 mc. 7.2 kw. 310 ft.

ILLINOIS

Brookfield: George M. Ives
Class A No. 284 104.7 mc. 250 watts 168 ft.
Champaign: Champaign News-Gazette (WDWS)
Class B No. 258 99.5 mc. 20 kw. 500 ft.
Freeport: Freeport Journal-Standard Pub. Co.
Class B No. 271 102.1 mc. 9 kw. 235 ft.
Kankakee: Kankakee Daily Journal Co. (WKAN)
Class B No. 243 96.5 mc. 60 kw. 275 ft.
Springfield: WTAX, Inc. (WTAX)
Class B No. 267 101.3 mc. 3 kw. 510 ft.

INDIANA

New Castle: Courier-Times
Class A No. 284 104.7 mc. 340 watts 250 ft.

IOWA

Cedar Rapids: The Gazette Co.
Class B No. 241 96.1 mc. 11 kw. 550 ft.
Des Moines: Cowles Bcstg. Co. (KRNT)
Class B No. 269 101.7 mc. 158 kw. 745 ft.
Des Moines: Kingsley H. Murphy (KSO)
Class B No. 267 101.3 mc. 154 kw. 505 ft.

KANSAS

Topeka: Topeka Bcstg. Association (WIBW)
Class B No. 273 102.5 mc. 2.9 kw. 336 ft.

KENTUCKY

Lexington: American Bcstg. Corp. (WLAP)
Class B No. 272 102.3 mc. 3 kw. 320 ft.
Louisville: WAVE, Inc. (WAVE)
Class B No. 260 99.9 mc. 33 kw. 490 ft.
Owensboro: Owensboro Bcstg. Co. (WOMI)
Class B No. 222 92.3 mc. 20 kw. 500 ft.

LOUISIANA

Alexandria: Alexandria Bcstg. Co. (KALB)
Class B No. 261 100.1 mc. 3 kw. 380 ft.

MARYLAND

Silver Spring: Tri-State Suburban Bcstg. Co.
Class A No. 282 104.3 mc. 440 watts 360 ft.

MASSACHUSETTS

North Adams: James A. Hardman
Class B No. 268 101.5 mc. 1 kw. 649 ft.

MICHIGAN

Benton Harbor: Palladium Publishing Co.
Class B No. 280 103.9 mc. 9.2 kw. 230 ft.
Detroit: James F. Hopkins, Inc. (WJBK)
Class B No. 233 94.5 mc. 33 kw. 410 ft.
Jackson: WIBM, Inc. (WIBM)
Class A No. 290 105.9 mc. 500 watts 305 ft.
Mt. Clemens: Macomb Publishing Co.
Class A No. 286 105.1 mc. 340 watts 153 ft.
Saginaw: Saginaw Broadcasting Co. (WSAM)
Class B No. 252 98.3 mc. 15 kw. 410 ft.

MINNESOTA

St. Paul: KSTP, Inc. (KSTP)
Class B No. 271 102.1 mc. 320 kw. 620 ft.

MISSISSIPPI

Jackson: Lamar Life Insurance Co. (WJDX)
Class B No. 268 101.5 mc. 69 kw. 580 ft.

MISSOURI

St. Louis: Thomas Patrick, Inc. (KWK)
Class B No. 237 95.3 mc. 360 kw. 545 ft.

NEBRASKA

Omaha: Inland Broadcasting Co. (KBON)
Class B No. 221 92.1 mc. 330 kw. 700 ft.

NEVADA

Las Vegas: Nevada Bcstg. Co. (KENO)
Class A No. 282 104.3 mc. 330 watts 125 ft.
Reno: Saviers Electrical Products
Class A No. 282 104.3 mc. 530 watts 970 ft.

NEW HAMPSHIRE

Claremont: Claremont Eagle
Class B No. 271 102.1 mc. 1.5 kw. 930 ft.

NEW YORK

Ithaca: Cornell University (WHCU)
Class B No. 267 101.3 mc. 30 kw. 650 ft.
Syracuse: Civic Bcstg. Corp. (WOLF)
Class B No. 234 94.7 mc. 1.5 kw. 725 ft.
Syracuse: WAGE, Inc. (WAGE)
Class B No. 230 93.3 mc. 1.6 kw. 610 ft.
Utica: Rome Sentinel Co.
Class B No. 252 98.3 mc. 4.3 kw. 490 ft.

NORTH CAROLINA

Burlington: Alamance Bcstg. Co. (WBBB)
Class B No. 267 101.3 mc. 34 kw. 410 ft.
High Point: Radio Station WMFR (WMFR)
Class B No. 249 97.7 mc. 3.3. kw. 310 ft.
Raleigh: Capitol Bcstg. Co. (WRAL)
Class B No. 237 95.3 mc. 12 kw. 615 ft.

OHIO

Columbus: United Bcstg. Co. (WHKC)
Class B No. 235 94.9 mc. 26 kw. 450 ft.

OKLAHOMA

Ardmore: John F. Easley (KVSO)
Class B No. 246 97.1 mc. 8.2 kw. 690 ft.
Oklahoma City: KOMA, Inc. (KOMA)
Class B No. 261 100.1 mc. 190 kw. 500 ft.

OREGON

Albany: Central Willamette Bcstg. Co. (KWIL)
Class A No. 282 104.3 mc. 250 watts 125 ft.
Portland: KOIN, Inc. (KOIN)
Class B No. 233 94.5 mc. 50 kw. 1350 ft.

PENNSYLVANIA

Pottsville: Miners Bcstg. Service
Class B No. 252 98.3 mc. 5.8 kw. 790 ft.

SOUTH CAROLINA

Anderson: Wilton E. Hall (WAIM)
Class B No. 278 103.5 mc. 29 kw. 400 ft.
Greenville: Greenville News-Piedmont Co. (WFBC)
Class B No. 225 92.9 mc. 160 kw. 1120 ft.

TENNESSEE

Bristol: Radiophone Bcstg. Station WOPI WOPI)
Class B No. 245 96.9 mc. 10.4 kw. 2210 ft.
Jackson: Sun Publishing Co. (WTJS)
Class B No. 236 95.1 mc. 30 kw. 420 ft.
Kingsport: Kingsport Bcstg. Co. (WKPT)
Class B No. 277 103.3 mc. 32 kw. 970 ft.
Knoxville: Knoxville Publishing Co.
Class B No. 222 92.3 mc. 20 kw. 500 ft.

TEXAS

Amarillo: Plains Radio Bcstg. Co. (KGNC)
Class B No. 269 101.7 mc. 36 kw. 400 ft.
Denton: Harwell V. Shepard (KDNT)
Class B No. 269 101.7 mc. 3.1 kw. 290 ft.
Houston: Houston Printing Corp. (KPRC)
Class B No. 259 99.7 mc. 39.2 kw. 497 ft.
Houston: KTRH Broadcasting Co. (KTRH)
Class B No. 257 99.3 mc. 290 kw. 500 ft.
San Antonio: Express Publishing Co.
Class B No. 268 101.5 mc. 330 kw. 845 ft.
Temple: Bell Bcstg. Co. (KTEM)
Class A No. 282 104.3 mc. 210 watts 505 ft.

VIRGINIA

Portsmouth: Portsmouth Radio Corp. (WSAP)
Class B No. 234 94.7 mc. 29.6 kw. 350 ft.

WASHINGTON

Seattle: Radio Sales Corp. (KRSC)
Class B No. 228 93.5 mc. 15 kw. 410 ft.

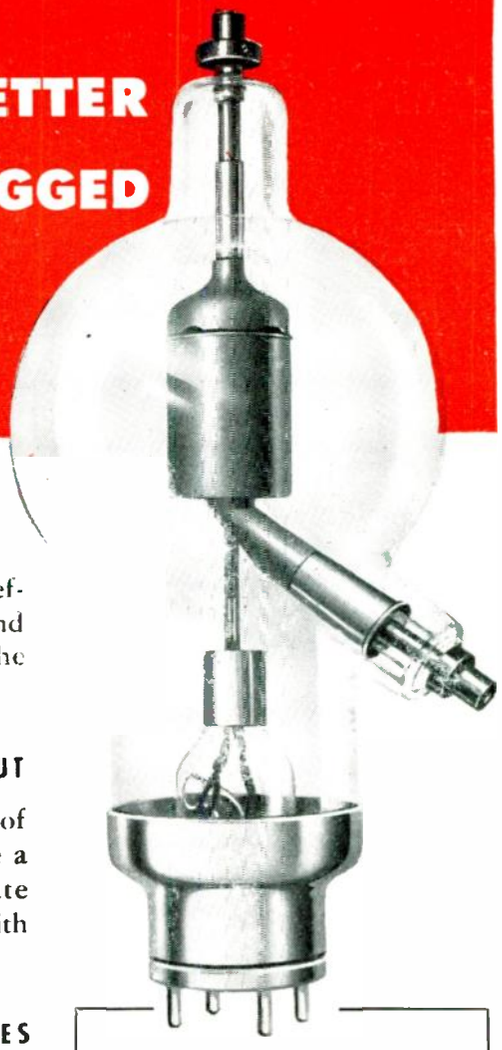
WEST VIRGINIA

Huntington: Huntington Bcstg. Corp. (WPLH)
Class B No. 258 99.5 mc. 38 kw. 570 ft.

WISCONSIN

Milwaukee: The Journal Company (WTMJ)
Class B No. 222 92.3 mc. – kw. 645 ft.
Wisconsin Rapids: Wm. F. Huffman (WFHR)
Class A No. 284 104.7 mc. 290 watts 350 ft.

IT'S TOUGH TO FIND A BETTER TRIODE THAN THE BIG, RUGGED EIMAC 750TL



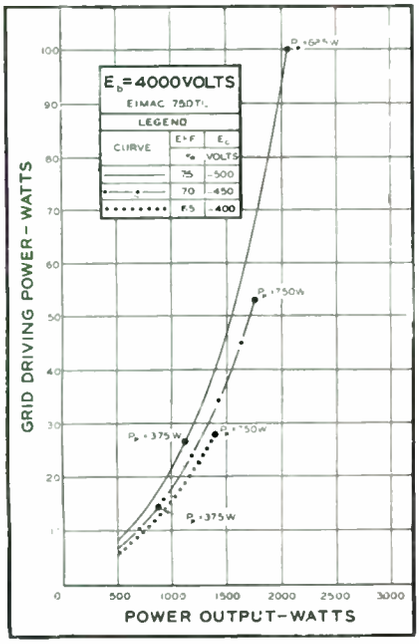
VERSATILE MEDIUM-MU TRIODE

The Eimac 750TL is a medium-mu triode designed for high efficiency operation whether used as a modulator, oscillator or amplifier. This is an unusually versatile tube capable of many kilowatts of output.

Successful high frequency operation of this triode is assured by unusually low interelectrode capacitances, heavy leads, and a big tough cathode.

The chart below shows power-gain characteristics of the 750TL.

As a Class-C amplifier, the Eimac 750TL will provide plate power output of 1750 watts with 4000 volts on the plate and only 53 watts driving power.



At frequencies below 40 mc, or as a Class-B modulator, the 750TL operates at high plate efficiencies, thus permitting r-f and a-f outputs of many times the plate dissipation rating.

3½ KILOWATT AUDIO OUTPUT

As Class-B modulators, a pair of Eimac 750TL's will produce a typical maximum-signal plate power output of 3500 watts, with only 30 watts grid drive.

THESE ARE RUGGED TUBES

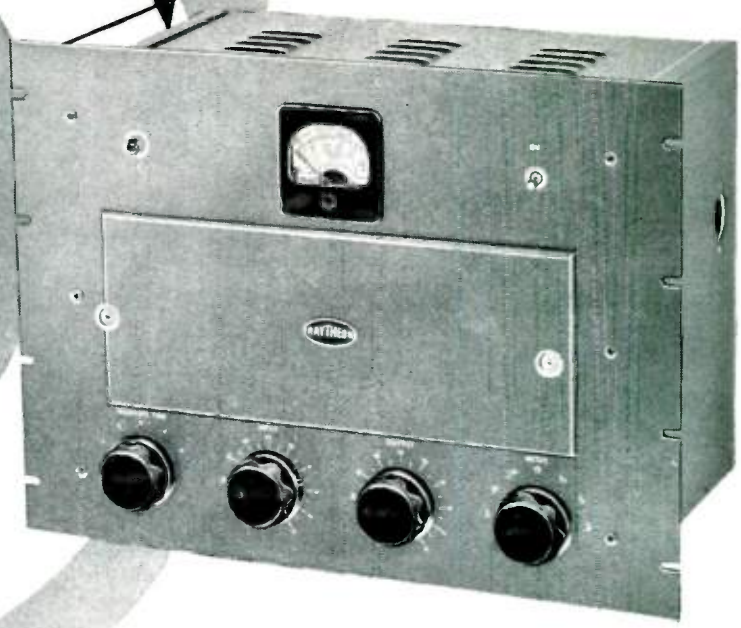
These big, powerful 750TL's are built for long, trouble-free service for a wide variety of uses. Many Eimac 750TL's installed months and years ago are still going quietly and efficiently about their business. Why not ask Eimac today for a price and data sheet giving full details of this versatile triode. Naturally, there is no obligation. Eitel-McCullough, Inc., 1298I. San Mateo Ave., San Bruno, Calif. Export Agents: Frazar and Hansen, 301 Clay St.,

GENERAL CHARACTERISTICS

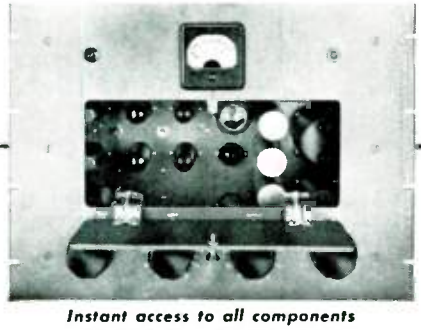
Eimac 750TL

Filament: Thoriated tungsten	
Voltage	7.5 volts
Current	21.0 amperes
Amplification Factor (Average)	15
Direct Interelectrode Capacitances (Average)	
Grid-Plate	5.8 *uufd*
Grid-Filament	8.5 *uufd*
Plate-Filament	1.2 *uufd*
Transconductance (I_B=1.0 amp., E_B=5000, E_C=—100)	3500 *umhos*
Frequency for Maximum Ratings	40 Mc
Base	Special 4 Pin No. 5003B
Basing	RMA type 4BD
Maximum Overall Dimensions:	
Length	17.0 inches
Diameter	7.125 inches
Net Weight	2.75 pounds
Shipping Weight (Average)	8.0 pounds

Push out the USEFUL range of your signal!



Get ALL your effective transmitter power with Raytheon's VOLUME LIMITER



Instant access to all components through hinged front panel.

STUDY THESE QUICK FACTS

Meets or exceeds all FCC requirements for FM transmission • Flat frequency response from 30 to 15,000 cycles • Separate input and output controls • Attenuators easily handle input variation from —40db to 20db • Meter, with rotary selector switch, checks plate current of critical tubes and shows exact amount of compression • Compression ratio 10 to 1 • Distortion less than 1% • Noise level 60db or better • Maximum output 23db • Mounts in standard relay rack or cabinet, front panel 19" x 14" • Rear dust cover slides off to expose all wiring on vertical chassis.

YES—you *can* increase the radius of your primary area with Raytheon's new Volume Limiter. This carefully-engineered equipment will raise your average percentage modulation *without* any audible increase in harmonic distortion. Thus it makes the most effective use of your transmitter power and greatly improves reception throughout your area.

Already, Raytheon's Volume Limiter is increasing coverage for many stations in many localities. Everywhere it is winning the acclaim of operating personnel . . . for its ease of handling and ease of servicing. Like all Raytheon designs, its handsome modern styling adds distinction to a station . . . beautifully finished in medium metallic tan.

This Limiter is engineered for use in high fidelity AM or FM speech input systems. Variable recovery time, controlled by the operator, assures proper recovery for all types of programs. The limiting action, which is independent of frequency response, prevents distortion and over-modulation.

Write for price and illustrated folder giving complete specifications. Deliveries can now be made within ten days.

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RAYTHEON MANUFACTURING COMPANY

Broadcast Equipment Division, 7517 North Clark St., Chicago, Ill.

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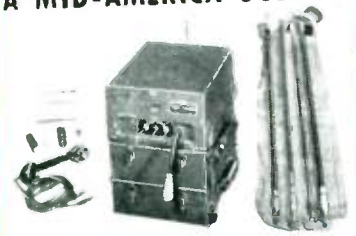
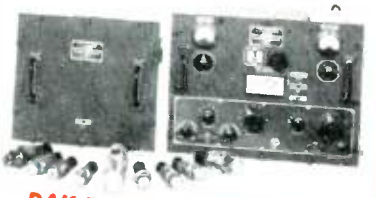


Portable and Mobile FM Transmitter and Receiver, SCR-510

FM transmitter and receiver for short range communication. Lightweight. Operate from 6 or 12 volt DC source. Freq. range 20 to 27.9 mc, crystal controlled for operation on any two of 80 channels. Either of two pre-set frequencies can be chosen by the channel switch. Change from receive to transmit by switch-on telephone hand set. Tubes: one 1LH4, one 1LC6, four 1LN5, two 1291, one 1294, four 1299. Complete with 80 crystals, tubes, telephone hand set, instructions, accessories, ready to operate, less batteries.

SPECIAL, **$79.50 ea.**
$59.50 in lots of 50

SPECIAL!



RAK-7 Long Wave Receiver

A real commercial receiver for experimenters, marine, aviation, hams, etc. 110 volt AC operated, regulated power supply. Frequency range, 15-600 kc. Two tuned RF stages. Panel has band switching, DB meter, AVC level control, Antenna, and RF controls, audio tuning control, sensitivity controls, including an AC-DC Filament Voltmeter with a range of 10 volts. Tubes: four 6D6, two 41, one 5Z3, one 874, one 876. Comes complete with *extra* set of tubes and parts. MA #RAK-7.

SPECIAL, **$64.50 ea.**
$55.00 in lots of 50

INTERPHONE SET

Sensational buy! Look at these parts:
125 feet—3 conductor cable
75 feet—#72 Seine Twine
1 roll—6 ft. red acetate tape
1 roll—6 ft. white acetate tape
2 —Cable clamps
1 —4 prong Jones plug in aluminum jacket
1 —4 contact Jones socket in aluminum jacket
2 —Pull chain assemblies
MA #Tow-3 SPECIAL, **98c per kit**
75c per kit in lots of 50

WHILE THEY LAST!

ALNICO 5" SPEAKERS

5" Alnico PM Speaker with 4 ohm voice coil, less output transformer. Limited supply—order at once! MA #7580.

$1.70 ea.
$1.45 in 50 lots

A TERRIFIC VALUE!

T-17-B 200 Ohm Carbon Mike

Lightweight, with press-to-talk button. Built-in filter to suppress carbon hiss. 5 ft. rubber covered cable and PL-68 three-circuit plug supplied.
MA #17-B. SPECIAL PRICE, **$1.75 ea.**
$1.50 each in lots of 100

UNIVERSAL OUTPUT TRANSFORMER

Will match voice coil to any tube, single or push-pull. Strap mounting, on 2¾" centers. Size 2¼" high, 2" wide, 2" deep. MA #UOT-15. SPECIAL, **$1.20 ea.**
95c each in lots of 50

Telephone Handset TS-13

With listen and talk switch. Incorporates 200 ohm carbon mike and 2000 ohm ear phone. Supplied with 6 ft. cord and one each PL-55 and PL-68 plugs. SPECIAL, **$2.95 ea.**
$2.50 each in lots of 50

Here Are More Typical MID AMERICA VALUES

POTENTIOMETERS:	
50000 ohm W.W. with switch 3" shaft	34¢
400 ohm W.W. 3" shaft	24¢
750 ohm W.W. 2" shaft	24¢
50000 ohm carbon 3" shaft	24¢
Dual carbon 20000 ohm frt 40000 ohm rear	32¢
Socket std acorn for 954,955 tubes, etc.	$9.50/C
Socket octal ceramic 1½" mtg ctrs	4.50/C
MILLIAMMETERS:	**EACH**
GE, West'hs 0-20 DC, 2⅝" dia. flange	$2.49
GE, 0-300 DC 2⅝" dia. flange	2.49
Simpson 127, 0-5 DC	2.49
POWER RHEOSTATS:	
H.H.F.—500 watt, 10 ohms, 7 amps	$3.95
Ward Leon. 500 watt, 12.5 ohms, 10 amps	3.95
West'hs 800 watt, 175 ohms, 3.7 amps	4.95
ELECTROLYTIC CONDENSERS:	
30 mfd, 15 mfd, 10 mfd, at 250 VDCW	75¢
80 mfd, 40 mfd, 40 mfd, at 250 VDCW	75¢
1 mfd, 500 vdcw, GE #26F466 pyranol	39¢
1 mfd, 600 vdcw, GE #22F281 pyranol	49¢
.25 mfd, 1000 vdcw, GE #26F467 pyranol	39¢
18 mfd, 1000 vdcw, GE #23F17G2 pyranol	$2.95
3 mfd, 4000 vdcw, pop. makes, oil filled	4.50
MISCELLANEOUS PARTS:	
Headphone 8000 ohm HS23	$1.50
Bliley crystal holder FT-171-B	30¢
DPDT high volt. antenna knife switch	39¢
Circuit breaker .5 amps at 1000 volts	4.50
Circuit breaker 220 milliamps at 115 v.	2.40

TUBES On hand for immediate shipment. Write for low prices in lots of 100.

RECEIVING TUBES: 1R5 1S5 1T4 3Q4 3S4 6B8 6AC7 6AG5 6AL5 6H6 6J6 6K7 6SL7GT 12D8 6SN7GT 12SH7 12SR7GT VR-90 14AF7 VR-150

TRANSMITTING TUBES: 2X2/879 2C26A 211 3D21A HY114B HY615 RK34 801A 803 803B 954 955 957 958A 9002 9003 9004 1201 1203A 1613 1624 1625 1632 1633 1634 1635 1644 3BP1 5CP1

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80 Meter Transmitter BC-223-A

80 meter transmitter, phone, CW, or ICW, 25 watt output. Use as regular transmitter or as exciter: 2000 kc to 5250 kc. Requires external power supply (not supplied) that can deliver 500 plate voltage. Tubes: 801 osc, 801 PA, 46 speech amp, and two 46 class B modulation. Panel switch selects M.O.P.A. or any of four crystal frequencies. Unit supplied less tubes. MA #3233-A. SPECIAL, **$22.50 ea.**
$17.50 in lots of 50

UNBEATABLE PRICES ON ANTENNAS

(A) TEN METER COLLAPSIBLE, SPRING-ACTION VERTICAL ANTENNA—8 sections totaling 120 inches. ⅜" threaded base shank.
(B) VERTICAL ANTENNA, 32½ in. long. Flexible spring base with threaded stud. Top section pulls out for storage. ¾" threaded base shank.
(C) ANTENNA ELEMENTS—set of six. Screw in antenna section approximately 38" long, totaling 18', tapering from 9/16" base to ⅜" tip.
(D) 12½ FOOT TELESCOPIC ANTENNA—pulls out to 12½ feet and telescopes down to 12 inches. Base is ⅝" diameter with ⅜" threaded base shank.

SPECIAL PRICES	EACH	Lots of 50
A—MA No. CVA-1	$1.49	$1.19
B—MA No. AN-130	.49	.39
C—MA No. AE-6	3.45	2.90
D—MA No. TE-12	1.95	1.40

IMPORTANT!

To assure yourself of fastest possible service and delivery, please send 25% deposit with your order. Address all your orders to MID-AMERICA'S store address.

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Send me at once—ABSOLUTELY FREE—your brand-new catalog listing hundreds of "hard-to-get" radio parts, transmitters, and electrical equipment, ALL AT MONEY-SAVING PRICES.

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FEDERAL'S BALANCED HF CABLE KT-51

HAS THE RIGHT TWIST

for Peak Performance of FM and Television Receivers

HERE'S A NEW HF cable that will keep your FM and Television receivers working at peak performance—free from locally-induced interference, even in the most adverse locations. Where the performance of such costly equipment is at stake, it will pay you to specify Federal's KT 51—the finest high frequency lead-in cable available. More costly—but *worth* more!

The *twisted,* dual-conductor cable cancels any noise or signals not stopped by the double *braided shields* . . . because it's electrically balanced and stays that way in service, in any position. It's a rugged cable, too—remarkably resistant to abrasion, acids, alkalies, oils and greases, as well as smoky atmospheres and weather.

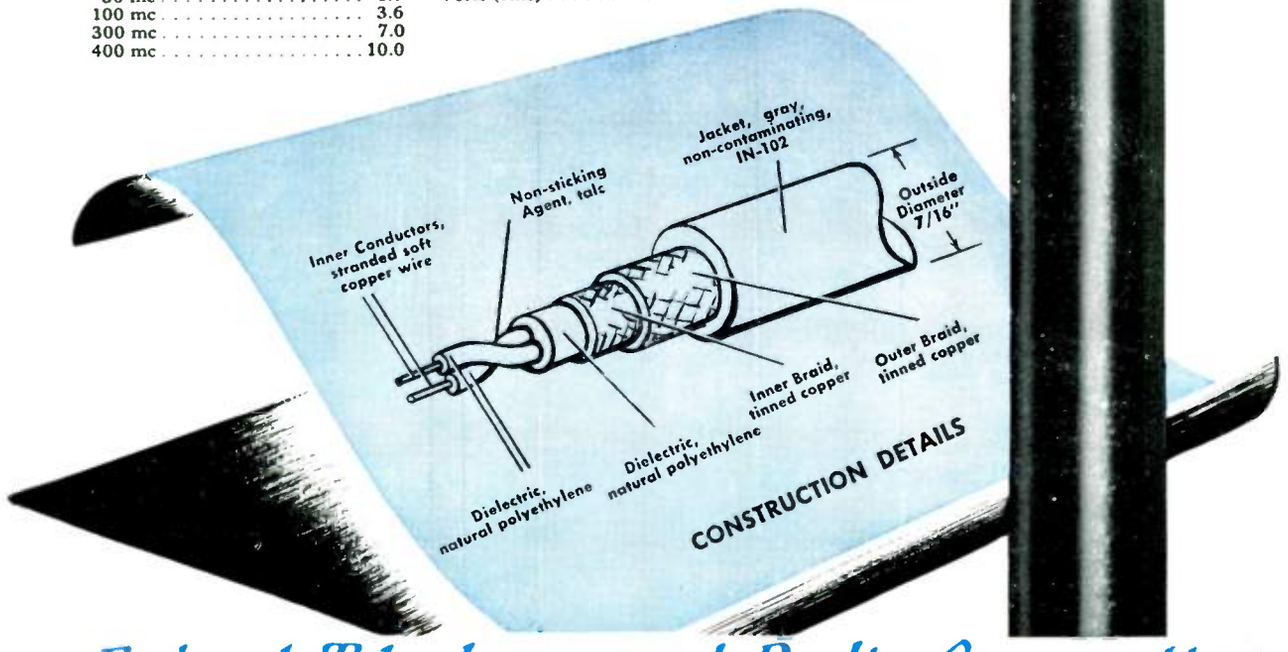
Don't let the lead-in wire be the "weak link" in otherwise perfect equipment. Be sure it's KT 51—the HF cable with the "right twist" to assure interference-free operation. For complete details, write to Dept. D610.

ELECTRICAL CHARACTERISTICS

Nominal Attenuation (db/100 ft.)

Frequency	*Attenuation*
10 mc	0.9
30 mc	1.7
100 mc	3.6
300 mc	7.0
400 mc	10.0

Maximum Capacity Unbalance	1%
Nominal Characteristic Impedance (ohms)	95
Nominal Capacitance per ft. (uuf)	16
Volts (rms)	2000



Federal Telephone and Radio Corporation

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

An IT&T Associate — FTR Federal Telephone & Radio

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It's Precision Plus

IN ARC MICROWAVE ACCESSORIES

The **PLUS-VALUE** in all A.R.C. equipment is the know-how, the background of knowledge and experience, that makes this equipment outstanding.

A. R. C. 24,000 megacycle Attenuator, showing "Split-Plate" construction.

A.R.C. "Magic Tee"—a specialized item of Microwave Plumbing designed and manufactured to the highest standards of precision.

A.R.C. Directional Coupler—another product reflecting in the accuracy of its construction the precision methods employed by A.R.C.

The ever-increasing importance of microwave transmission in the field of electronic navigation, communication, and industrial controls turns the spotlight on the A.R.C. line of equipment and accessories to serve this field.

The A.R.C. 24,000 megacycle attenuator with its unique "split-plate" construction typifies the quality of A.R.C. design and manufacture. This design (patent pending) permits the machining of the wave-channel to an accuracy impossible to achieve through other methods of construction, while the jointure of the plates themselves is so precise as to leave no possibility of leakage and loss.

A complete line of A.R.C. Microwave Accessories is available. For full details on these and other A.R.C. Radio and Electronic Component Parts, write:

NOW AVAILABLE: free, illustrated catalog of A.R.C. Radio and Electronic Component Parts and Accessories.

AIRCRAFT RADIO CORPORATION

BOX 150 BOONTON, NEW JERSEY

Model 315 Signal Generator. Designed down to the most minute detail for highest accuracy, greatest stability, minimum leakage, and good wave form $67.35

Model 305 Tube Tester. Tests all tubes. Provides for filament voltages from .5 volts to and including 120 volts. Spare sockets for future tube developments....$46.25

Model 260 High Sensitivity Set Tester. 20,000 ohms per volt. D.C. Voltage ranges to 5,000 volts A.C. and D.C. Resistance ranges to 20 megohms. Current ranges to 500 milliamperes.....$38.95

This Simpson "Big 3"

. . . gives servicemen a real profit-making set-up

● The successful radio serviceman today must have the finest in test instruments for a very practical reason—that's his only hope of present and continued profits. To meet the tremendous volume of business available he must be able to "trouble-shoot" fast and *accurately* every time. Only thus can he correct trouble speedily, with satisfaction to the customers.

Simpson offers you, in three basic test instruments, the accuracy and advanced electronic engineering which have given Simpson the proudest name in the industry. They are tried-and-tested examples of the kind of instruments Simpson has always built. Their use will demonstrate that from Simpson alone can you expect "instruments that stay accurate" with construction and design that lead the field.

To dealer and to serviceman alike, Simpson offers today the assurance of continued profits that only quality can give. No Simpson instrument is ever marketed, or ever will be, unless its makers feel that, of its kind, nothing finer can be produced.

Simpson

INSTRUMENTS THAT STAY ACCURATE

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

W. E. FM TRANSMITTERS

(CONTINUED FROM PAGE 38)

here because of the relatively large amount of driving power available from the 1-kw. driver, which then appears in the output of the amplifier.

To minimize the number of units required to obtain the maximum overall efficiency, and to make full use of the driving power available, the 10-kw. transmitter uses a grounded plate amplifier. This circuit has a power gain of better than 10 to 1. Approximately 700 watts drive is required from the 1-kw. unit to produce the full 10-kw. output.

This output was measured with a precise, water-cooled dummy antenna built by Bell Laboratories to obtain accurate power readings by measuring the rate of flow and temperature rise of a stream of water circulated over a pure resistive load. The grounded plate circuit is outstanding for its simplicity and stability. In Bell Laboratories tests, outputs considerably in excess of 10-kw. have been obtained without exceeding the rated output of the driver, thus comfortably assuring the rated 10-kw. output in practice.

The 10-kw. transmitter will be used in the driving line-up of the 25- and 50-kw. equipments. The final stage of each of these transmitters will use a single water-cooled tube. The complement of expensive, high-power amplifier tubes is therefore kept at a minimum. There are numerous advantages for the broadcaster in a single water-cooled tube. The circuit is simpler, fewer spare tubes are required, tube life is greater, the tube is smaller and lighter in weight, and with grounded-plate circuit there is no RF loss in the water because the anode is at RF ground potential.

Part 2 of this paper will appear in the October issue. Detailed circuit diagrams will be given for the various units of the basic transmitter, and mechanical and electrical features will be explained.

NEW FM RECEIVERS

New York City dealers are complaining bitterly because so few FM sets are being shipped into that area. They reason that, since New York is considered the No. 1 radio market, the dearth of sets there indicates that something is wrong.

Most manufacturers, however, are following a new policy in the case of FM receivers. With the demand spreading to all parts of the U. S., they are planning their shipments in close coöperation with new FM stations now going on the air. These stations are doing an excellent job of promoting the advantages of FM, using large newspaper space to tell the public that straight AM sets are now obsolete. And they are building audiences by helping dealers to sell FM receivers.

FM has been kicked around so badly by AM broadcasters in New York that it now looks as if that city will wind up at the end of the FM parade.

ENGINEERING SALES

(CONTINUED FROM PAGE 8)

factory sales engineer in 1936, spent two years in the European Theatre as Captain in the 9th Air Force.

Ward Leonard: Resistor manufacturers of Mt. Vernon have opened a district office in Boston at 38 Newbury Street. Kasson Howe is in charge. Newly appointed representatives are L. F. Church Company, 750 Natoma Street, San Francisco 3, and Marvin H. Kirkeby, 237 Sheridan Avenue, South, Minneapolis 5, Minn.

RCA: Theodore A. Smith has been advanced to the position of general sales manager of RCA's engineering products division, Camden, N. J. He has been with the Corporation since he joined the Van Cortlandt Park laboratories in 1925.

Daven: L. B. Keim, formerly chief engineer of New York FM station WGYN, is now field electronics engineer for the Daven Company.

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

just gave it a spot check. However, we did read "The Hucksters" very thoughtfully, page by page, and with much enjoyment.

That's why we think that Mr. Wakeman should be retained to get out a revised edition of the Blue Book. As Evan Evans would have said, the original text needs a goosing — but thoroughly!

As a castigation of those responsible for the kind of radio programs that are turning listeners from AM sets to phonographs, and that have now built record sales up to the 1946 level of 200,000,000 (yes, two hundred million), "The Hucksters" is far more effective than the FCC's very dry, statistical complaint.

Incidentally, we must confess that Mr. Wakeman brought out more clearly than we have been able to do in *FM* AND TELEVISION the fact that the one thing sponsors and advertising agencies *never* do is to survey the quality of program reception in listeners' homes.

For example, it was weeks before we found out what connection there was between LFMFT and Lucky Strikes. The trouble was not, of course, with the announcer's annunciation, but with the inability of ordinary AM receivers to reproduce the letter S, or any of the other sibilants. For the benefit of those who write commercials, the sibilants are: *z*, *sh*, *zh*, *ch*, and *j*.

3. In the footnote which appeared in "Railroad Radio Specifications" on page 39 of our June issue, we meant to make it clear that those specifications had not been adopted by the Association of American Railroads. Our purpose in

(CONCLUDED ON PAGE 60)

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 59)

publishing these specifications was to answer requests for any available information that would be helpful to engineers working on railroad radio equipment.

However, J. L. Niesse, Chairman of Committee No. 4, Radio and Allied Communications, American Association of Railroads, felt that there might be a misunderstanding on the part of our readers concerning the status of those specifications. Accordingly, we present Mr. Niesse's comments:

In view of the fact that our railroad radio specifications have been discussed with and are fairly well known to various manufacturers and railroad personnel, it occurs to me that the publication may lead to some misunderstanding and I thought it would be advisable to write to you in order to clarify the matter.

The preparation of the railroad radio specifications was assigned to a subcommittee of Committee No. 4 — Radio and Allied Communications — of the Communications Section, Association of American Railroads. This Subcommittee consists of the following: Mr. L. E. Kearney, communications engineer, Association of American Railroads, chairman; Mr. G. M. Brown, electronics engineer, New York Central; Mr. E. A. Dahl, electronics engineer, Rock Island; Mr. L. R. Thomas, electronics engineer, Santa Fe; and Mr. J. H. Wallis, communications engineer, Baltimore and Ohio. The Subcommittee reports its findings to Committee 4. The latter considers the subject matter and may make revisions on its own account or returns it to the Subcommittee for further consideration, and finally reports the specifications to the Section at an annual meeting. After discussion and consideration at the annual meeting, it may be adopted or returned to the committee for further revision.

In this particular case, the specification you have printed was the first Subcommittee revision of the draft prepared by Mr. Kearney. It has been revised a second time by the Subcommittee and then forwarded to Committee 4. There was considerable adverse comment given by Committee 4 and the specification was referred back to the Subcommittee for further revision. It has been revised twice since and the final revision will be submitted to the Section for discussion in November. You can readily appreciate, therefore, that the Railroad Radio Specifications, as printed, were practically as initial draft, are now obsolete, and so far as the Association of American Railroads is concerned, have no authorization or standing whatsoever.

In view of the above, perhaps you may wish to include an explanatory article in the next issue of *FM* AND TELEVISION so that no incorrect implications may be obtained.

WE NEED YOUR COOPERATION

When you change your address, your copies of *FM* AND TELEVISION will not reach you unless you do two things:

1. You must give us 30 days notice of your change of address, because work on our wrappers is started 20 days in advance of mailing.

2. You must leave your new address at your postoffice before you move.

If you fail to do these two things, you may miss one or more copies of *FM* AND TELEVISION.

A flood of new subscriptions is cleaning out each issue soon after publication, so that very few back numbers are left to replace copies that go astray when our subscribers delay in giving us their new addresses.

Maintain High Fidelity of FM with Collins Speech Equipment

You can maintain the high quality of your programs through successive amplifiers by using Collins speech equipment. The fine overtones, the magnificent bass—every detail of your well-balanced program is protected.

The 6P and 6X, shown below, embody typical Collins high engineering standards. Their frequency response of 30-15,000 cps, −65 db noise level, and 1% distortion reflect special attention to high fidelity requirements and thorough engineering of circuits.

Dependability of operation is assured by the use of correctly designed components of select quality. Conservatively designed operating levels further contribute to continuous operation free from troublesome outages.

These equipments are used with standard commercial microphones and program lines, fit standard 19-inch racks, and are available in metallic crystalline gray or black wrinkle finishes. Send today for an illustrated bulletin.

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The 6P preamplifier

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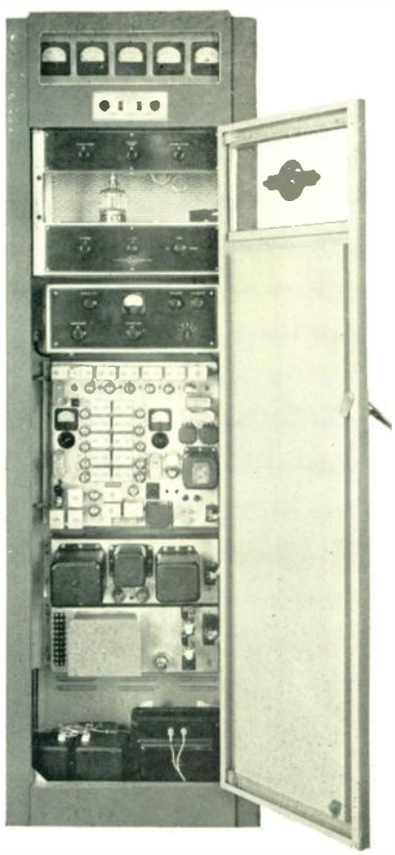
250 WATT • ONE KW • THREE KW

WITH THE SAME HIGH STANDARDS THAT HAVE MADE *Link* THE RECOGNIZED LEADER IN EMERGENCY RADIO COMMUNICATIONS EQUIPMENT



TYPE 250 FMB

Specifications

Frequency Range: 88 to 108 mc.

Center Frequency Stability: Within ± 2000 cycles of assigned frequency.

Modulation: Phase modulation (Armstrong system).

Audio Input: Standard 600/150 ohm line.

Deviation: Standard ± 75 KC.

Frequency Response: Within ± 1 DB of standard 75 microsecond pre-emphasis curve from 50 cycles to 15,000 cycles.

Distortion: Less than 1.0% rms from 100 to 7500 cycles; less than 1.5% rms from 50 to 100 and 7500 to 15,000 cycles at ± 75 KC swing.

FM Noise Level: At least 65 DB below ± 75 KC swing within the band of 50 to 15,000 cycles when measured in conjunction with a demodulator of standard 75 microsecond de-emphasis characteristic.

AM Noise on Carrier: At least 50 DB below the equivalent of 100% AM modulation level within the band of 50 to 15,000 cycles.

RF Harmonics: At least 60 DB below fundamental frequency output level.

Audio Monitor: Built-in.

External Monitoring: Jacks are provided for operating external carrier and frequency swing monitors.

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