PRICE—TWENTY-FIVE CENTS

FM AND TELEVISION

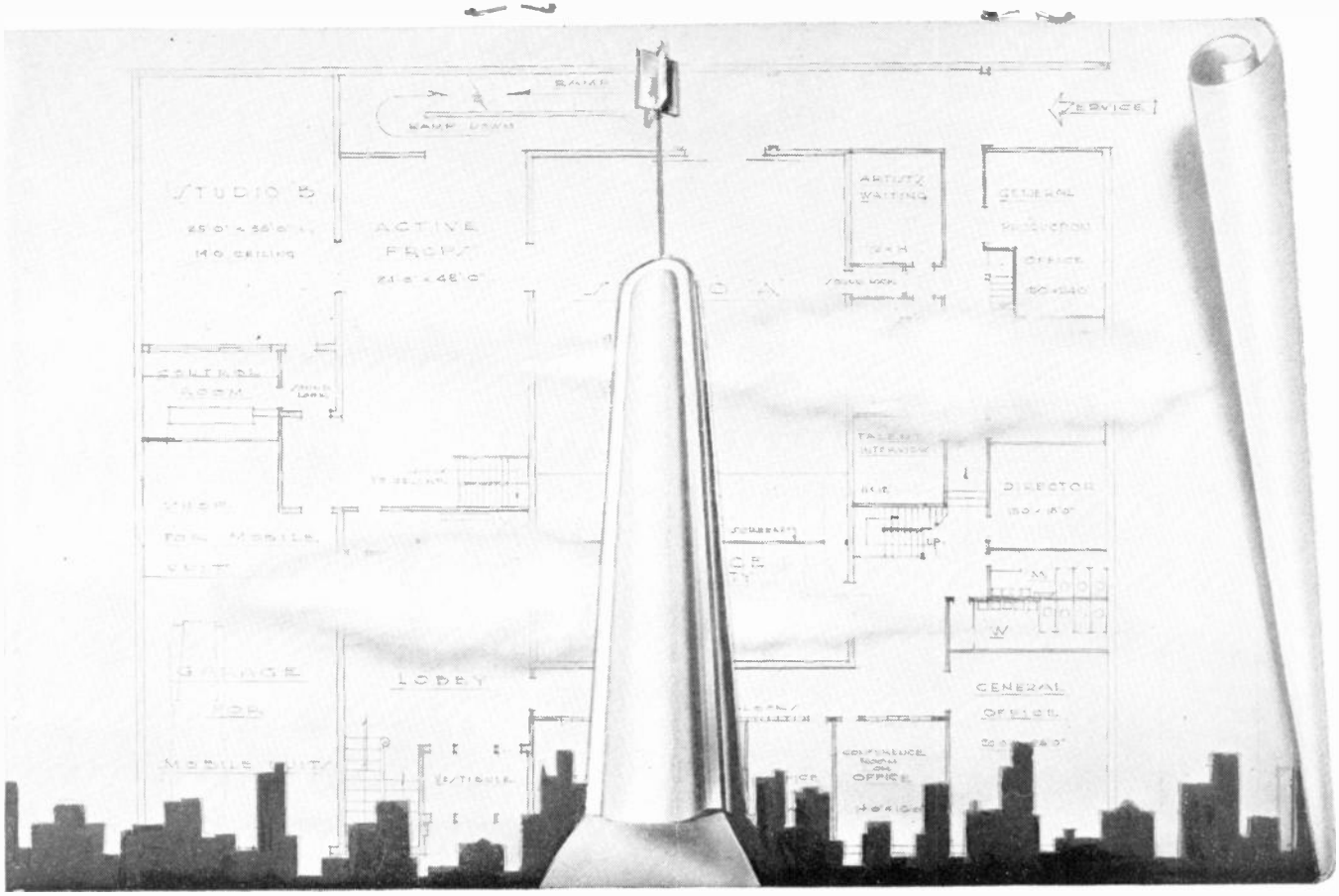
SEPT. 1945

HERE IS FM AT ITS BEST

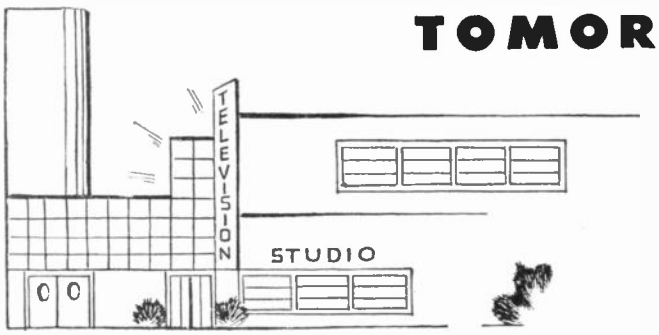
SEE PAGES 3 AND 27

Directory of FM & Television Stations

★ ★ Edited by Milton B. Sleeper ★ ★



DuMONT—FOR THE PATTERN OF TOMORROW'S TELEVISION



TO PROSPECTIVE TELEVISION STATION OWNERS... DuMont has pioneered a pattern for the peacetime commercial operation of a typical television station—a pattern that is yours for study whenever you wish.

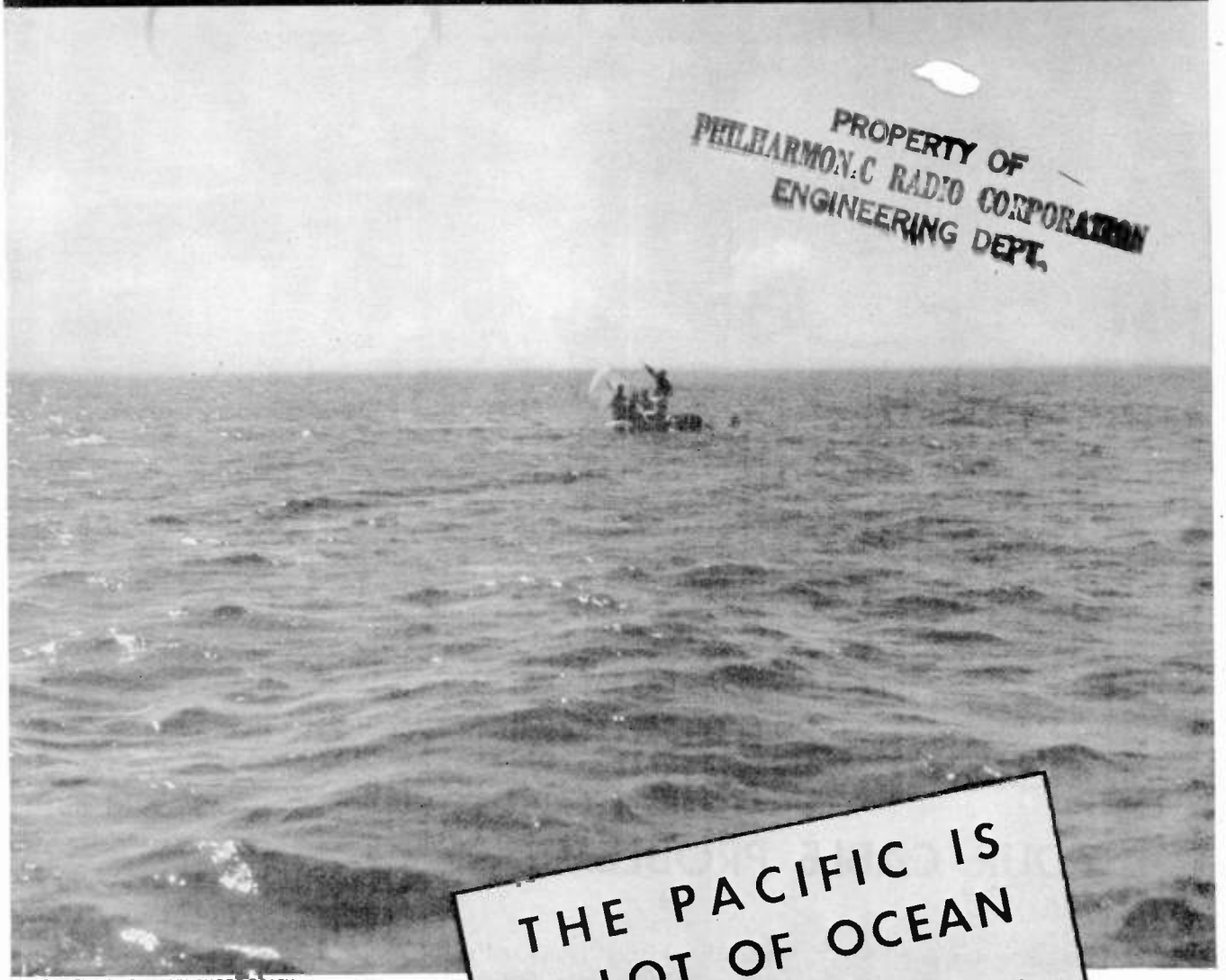
DuMont has designed and built *more* television stations than any other company—stations that, week after week, are demonstrating the simplified precision control of DuMont-engineered equipment, its low operating cost, extreme flexibility, high efficiency and rugged dependability.

DuMont postwar designs incorporate all the flexibility and refinements accruing from more than four years of continuous and increasingly elaborate programming experimentation. Early peacetime delivery is assured through DuMont's Equipment Reservation Plan, plus competent training of your personnel.

Visit DuMont's Station WABD, New York...our Sales Manager will gladly make arrangements.

DUMONT *Precision Electronics and Television*

ALLEN B. DuMONT LABORATORIES, INC., GENERAL OFFICES AND PLANT, 2 MAIN AVENUE, PASSAIC, N. J.
TELEVISION STUDIOS AND STATION WABD, 515 MADISON AVENUE, NEW YORK 22, NEW YORK

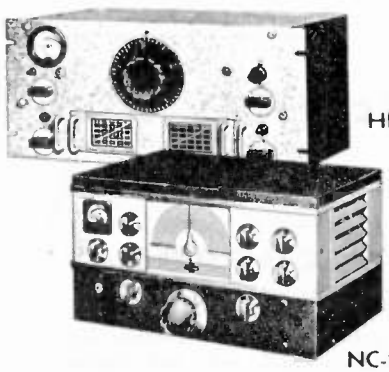


OFFICIAL U. S. NAVY PHOTOGRAPH

THE PACIFIC IS A LOT OF OCEAN

It is a big place to get lost in. The ceaseless search by Navy PBM "Mariners" has saved the lives of many downed fliers. Sometimes the plane can make the rescue; often radio sends help on its way.

The Navy knows how important radio equipment is. 3 out of 4 of the Navy's ships — landing craft and larger — use receivers designed by National.



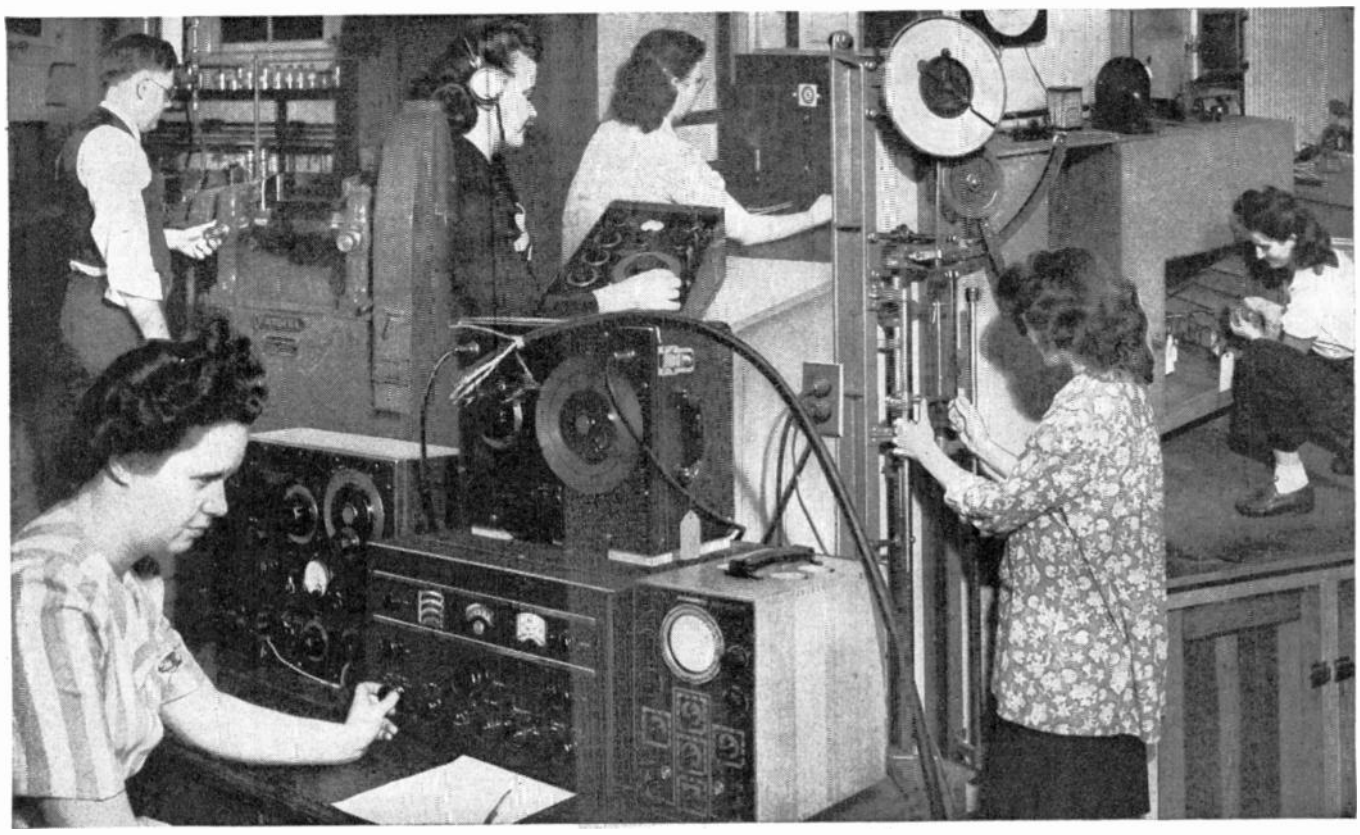
HRO

NC-200

NATIONAL COMPANY

MALDEN MASS, U. S. A.

NATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD



This Laboratory Can Help Solve

YOUR CABLE PROBLEMS

PICTURED above is a composite view of some of the test equipment in daily use at The Ansonia Electrical Company Laboratories.

This equipment and the personnel, both laboratory and engineering, are constantly on the job controlling production quality of our many specialty cables for Government and industry uses.

These facilities have helped get many special Army and Navy multiconductor cables into production. Some of these cables had never been made before. Some were just too tough for many to handle. Some were conventional cables but their performance characteristics using thermoplastic insulation were either unknown or unproved. After extensive research and careful analysis in our laboratories several types of Ankoseal were developed and successfully applied on these various cables.

Today the electrical values and physical characteristics of many types of Ankoseal are known and proved. They are serving over wide temperature ranges and in varied electrical applications all over the world.

The laboratory and engineering personnel, the test equipment, the manufacturing resources of The Ansonia Electrical Company stand ready to help solve your special cable requirements.

Call on us. We'll gladly assist you.

Why ANKOSEAL *solves cable problems*

Ankoseal, a thermoplastic insulation, can help solve many electrical engineering problems, now and in the future. *Polyvinyl* Ankoseal possesses notable flame-retarding and oil resisting characteristics; is highly resistant to acids, alkalies, sunlight, moisture, and most solvents. Polyethylene Ankoseal is outstanding for its low dielectric loss in high-frequency transmission. Both have many uses, particularly in the radio and audio fields. Ankoseal cables are the result of extensive laboratory research at Ansonia—the same laboratories apply engineering technique in the solution of cable problems of all types.

THE ANSONIA ELECTRICAL COMPANY

Specializing in "Ankoseal" a Thermoplastic Insulation

ANSONIA • CONNECTICUT

A Wholly-Owned Subsidiary of

NOMA ELECTRIC CORPORATION

GENERAL OFFICES • NEW YORK, N. Y.

Makers of the famous Noma Lights—the greatest name in decorative lighting. Manufacturers of fixed mica dielectric capacitors and other radio, radar and electronic equipment.

FM AND TELEVISION

FORMERLY: FM RADIO-ELECTRONICS

VOL. 5 SEPTEMBER, 1945 NO. 9

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★ ★ ★ ★ ★ ★

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Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit. Payments are made upon acceptance of final manuscripts.

THIS MONTH'S COVER

THE Radio City building, shown on this month's cover, was completed by *The Milwaukee Journal* just before the wartime restrictions were put into effect. Built to house studios and offices for FM, AM, and television broadcasting, it is probably the finest and most complete installation now in use by any independent operator. It is no exaggeration to say that it is a wonderful source of new ideas for engineers and executives who are planning postwar radio facilities. In case you wonder about the tower shown in this picture, it is not in use now, but it was erected to carry a television antenna.

Entered as second-class matter at Great Barrington, Mass., and Concord, N. H.

WHAT'S NEW THIS MONTH

Emergency Communications

FOLLOWING is the text of a report submitted to the FCC by Eastern States Police Radio League's committee on postwar operations and standards. Chairman of the committee is Frank Bramley, chief radio engineer, Connecticut State Police, Hartford, Conn.

System Standards ★ We favor a strict limitation of power among stations in the emergency services, and are firmly of the opinion that many stations now operating should be required to reduce power.

The problem of deciding how much power should be allowed is so complex and involves so many special cases that there is probably no satisfactory solution except to conduct field strength surveys. While the cost of such a survey would be an intolerable burden on small departments, a rule could be formulated that would require a field survey if a department requests power in excess of some small figure, say 50 watts, or proposes to use antennas of unusual height or power gain. If special conditions are claimed, proof should be required in the form of a field survey.

Stations required to cover large areas, such as county and state systems, would be required by such a rule to conduct a field survey. This would be no hardship since in such cases field tests have been the common practice in recent years.

We are especially concerned by the continued tendency to use excessive power and feel strongly that the FCC should in the future strictly enforce the rule regarding power.

While some overlap into adjacent areas is desirable, the amount of overlap now occurring cannot be justified in the present crowded channels. And while we favor strict limitation of power and antenna efficiency, great care must be taken to provide a safety factor.

No ruling regarding antennas should be made that would prevent the use of aerial systems that increase the field strength within the served area, provided that high angle radiation is restricted and field strength in adjacent areas not increased.

Stations not located in the center of the area served should be required to use antennas having directional radiation patterns so that excessive fields will not be set up in adjacent areas.

Geographical Separation ★ The committee does not feel qualified to set up standards of

(CONTINUED ON PAGE 74)

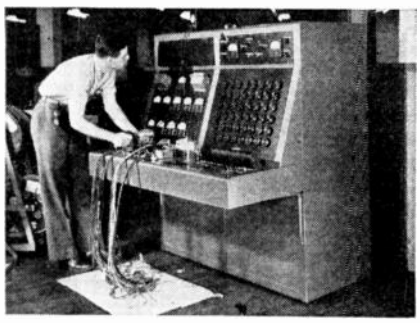
SYLVANIA NEWS

ELECTRONIC EQUIPMENT EDITION

SEPT. *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1945

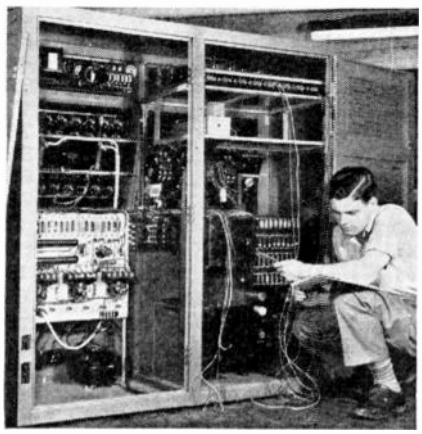
UNIVERSAL TEST UNIT CHECKS RADIO TUBES —ELECTRONIC DEVICES

Another essential electronic apparatus manufactured by the Industrial Apparatus Division of Sylvania Electric at Williamsport, Pa., is shown in accompanying photographs.



Above is the front view of the Universal Test Unit that preheats all tubes except rectifier, short tests all tubes (each element separately), noise tests RF and AF tests, static tests all tubes for all characteristics except plate resistance and amplification factor, dynamic tests mutual conductance, gain and power output at 400 cycles.

In addition, it may be adapted to test many other types of electronic devices by simply changing a small socket adaptor, and can be equipped with automatic tappers for short and noise tests.



Rear view Universal Test Unit

HIGH FREQUENCY TUBE ALSO BEST FOR ALL RADIOS

"Lock-In" Not Only Ideal For FM, Television, But Better For Other Type Sets

An outstanding advantage of Sylvania Electric's advanced type radio tube—the Lock-In—is its perfect suitability for *any* class radio set—portable battery, farm battery, household, automobile, marine or aircraft.

Not Limited In Use

Although the basic electrical and mechanical advantages of the Lock-In construction are right in step with the continuing trend of the industry toward higher frequencies, these exceptional qualities do not limit the tube's applicability.

Set Performance Improved

On the contrary, this superiority is reflected in the better performance attained in all sets employing Sylvania Lock-In Tubes.

Write today for further information. *Sylvania Electric Products Inc., Emporium, Pa.*

REMEMBER THIS EMBLEM

IT STANDS FOR HONORABLE SERVICE TO OUR COUNTRY

9 POINTS OF MERIT

1. Lock-In locating plug . . . also acts as shield between pins.
2. No soldered connections . . . all welded for greater durability.
3. Short, direct connections . . . fewer welded joints — less loss.
4. All-glass header . . . better spacing of lead wires.
5. No glass flare . . . unobstructed space for internal shielding.
6. Improved mount support . . . ruggedly mounted on all sides.
7. Getter located on top . . . shorts eliminated by separation of getter material from leads.
8. No top cap connection . . . overhead wires eliminated.
9. Reduced overall height . . . space saving.

SYLVANIA ELECTRIC

Emporium, Pa.

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

An Unusual Opportunity

One of the most interesting positions in the radio industry, and one affording an unusual opportunity for the development of personal initiative is open to a man who can think clearly and express his thoughts in written words and drawings.

The position is that of assistant editor of *FM* AND TELEVISION. This post calls for a background of electrical engineering and radio theory, and experience in teaching radio or in the preparation of instruction books for military radio equipment.

Knowledge of the accurate use of the English language is a primary requirement. Editorial experience is not essential, nor is it necessary to have specialized knowledge of FM and television. These can be acquired in the course of time by a man well-versed in general radio theory and in the design and operation of radio equipment.

Drafting experience and the ability to produce circuit diagrams and mechanical illustrations such as are used to illustrate this publication are required.

If, in addition to these qualifications, the successful applicant is skilled in the preparation of circulation and advertising material, the salary will be correspondingly higher, but this extra qualification is not a requirement.

The editorial offices of *FM* AND TELEVISION are located at Great Barrington, Mass., in the foothills of the Berkshires, 100 miles from New York City. Healthful climate, beautiful country, fine roads, good schools, and low living costs make this an ideal location.

The post of assistant editor is a permanent position, affording every opportunity for financial advancement in a successful, growing, and harmonious organization, free of politics, where ability is recognized and rewarded promptly.

Please give a simple statement of your experience and interests, together with brief personal details and starting salary you expect. Applicants will be interviewed at our New York City office. Address: *FM* AND TELEVISION Magazine, 309 Main Street, Great Barrington, Mass.

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Magnavox: O. A. Fiebig, for 15 years a member of the Magnavox sales department, has been advanced to the position of assistant sales manager of the radio-phonograph division.

Paul L. Kuch: Former advertising and sales promotion manager for Aerovox has established an advertising, promotion, and publicity organization to serve industrial accounts, with offices at 410 Olympia Building, New Bedford, Mass.

Bendix: Has announced completion of their radio distributing setup, with 62 jobbers in the major trading areas.

Westinghouse: R. H. McMann, former New York City radio distributor, and more recently of Republic Aviation, has been appointed eastern district manager for Westinghouse home radios. He will make his headquarters at 40 Wall Street.

Packard-Bell: Frank E. Ware, acting sales manager during the war, and a former Packard-Bell distributor, has been appointed sales manager under Joe M. Spain, director of sales.

Milwaukee: Electro-Pliance Distributors, Inc., Milwaukee, Motorola distributors, has appointed John F. Mehr sales manager of their major goods division. He was formerly vice president of Roth Appliance.

Concord Radio: Has set up a new industrial department, under the direction of L. R. Browne, to speed handling of telephone and telegraph orders for parts, materials, and equipment carried in the Chicago store, and available from other sources.

Ward-Leonard: Has appointed Wright Engineering Company, 5620 N. Moridian Street, Indianapolis 8, as representatives for southern Indiana, southwestern Ohio, and Kentucky.

Galvin: Export sales in all foreign countries will be handled by Overseas Industries, Inc., 431 S. Dearborn Street, Chicago 5. Company is headed by C. M. Wynne, director of export sales.

Admiral: New distributor of Admiral radios and appliances for Rhode Island is R. U. Lynch, Inc., of Providence.

Electronic Laboratories: Have appointed the following representatives: Harry B. Segar, Ellicott Square Building, Buffalo; Arthur Roche, 133 W. 67th Street, New York City; S. K. McDonald, 1341 Arch St., Philadelphia; J. V. Schoonmaker, 2320 Griffin Street, Dallas.

(CONTINUED ON PAGE 86)

TELEFAX— Printed, Illustrated News by RADIO via FINCH FACSIMILE

TELEFAX is the name of radio-in-writing equipment pioneered years ago by Finch Telecommunications—interrupted by the war—and now being readied for widespread use.

TELEFAX will offer—to urban and rural homes, to ships at sea, planes in the air and cars on land—a means of getting the very latest information and detailed printed news, and other educational and entertainment matter transmitted by the most modern type of facsimile equipment.

TELEFAX offers to broadcasters an opportunity to expand their power, influence, profits and public service.

Inquiries are invited. Finch Telecommunications, Inc., Passaic, N. J.
New York Office, 10 East 40th Street.

THE *AIRPRESS*

FOR SUBURBAN AND RURAL HOMES

FOR SHIPS AT SEA

FOR PLANES IN THE AIR

FOR VEHICLES ON LAND

finch facsimile

Photos courtesy of U. S. Marine Corps.

Marines record Valentine messages for broadcast over U. S. radio stations.

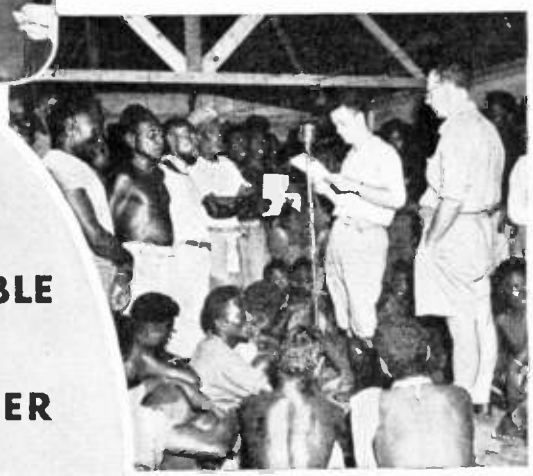
Trailer-studio houses and transports Presto equipment in South Pacific.

Presto microphone picks up on-the-spot interview with fighter pilot.

Presto transcribes battle experiences during Bougainville offensive.

THIS IS WHY YOU HAVEN'T BEEN ABLE TO GET A PRESTO RECORDER

Because Presto equipment has been right there in the front lines with G.I. Joe...to support his strategy with actual combat transcriptions...to support his morale with recorded messages of his voice for the folks back home...and to give America a permanent, unprecedented sound document of a world-at-war.



South Pacific natives serenade U. S. listeners via Presto recordings.

Presto recordings carry Marines' greetings to their families at home.

At the front, Presto is standard equipment with the Armed Services.

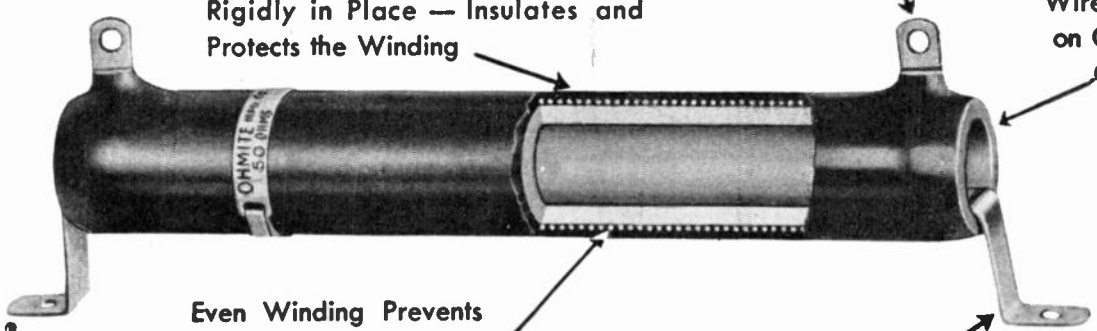
PRESTO
RECORDING CORPORATION

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

Walter P. Downs Ltd., in Canada

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

Why OHMITE Resistors PERFORM SO DEPENDABLY



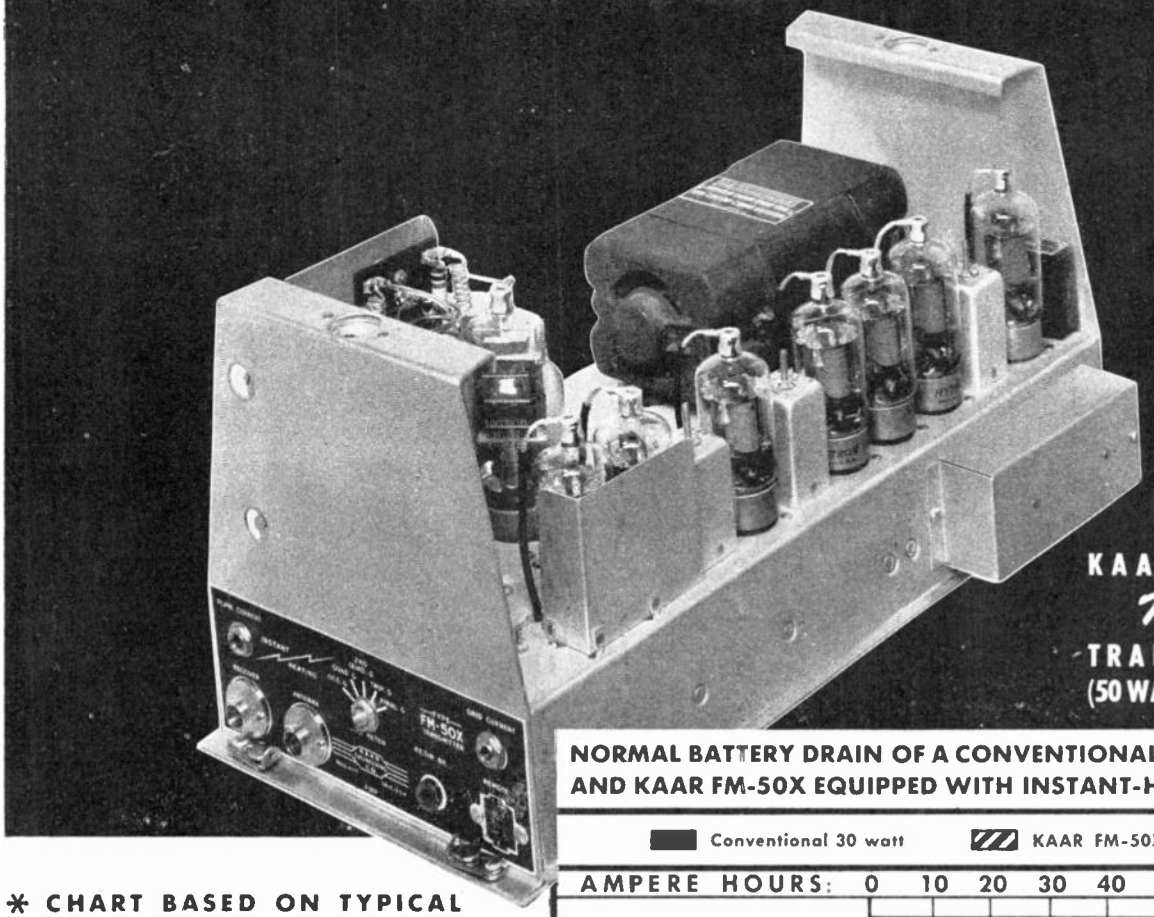
Here you see a few of the important features that insure long life and trouble-free service in every Ohmite Resistor. In the lug type illustrated above, the resistance wire is both mechanically locked and brazed to copper terminal lugs to assure perfect electrical connection. Time-proved Ohmite vitreous enamel construction dissipates heat rapidly . . . withstands humidity. Today, Ohmite Resistors are extensively used in the Armed Forces, Industry, Communications, Research. *Made in a wide range of types and sizes* in stock and special units for every need. Consult Ohmite engineers on your resistor problem.

OHMITE MANUFACTURING COMPANY
4853 FLOURNOY ST., CHICAGO 44, U. S. A.

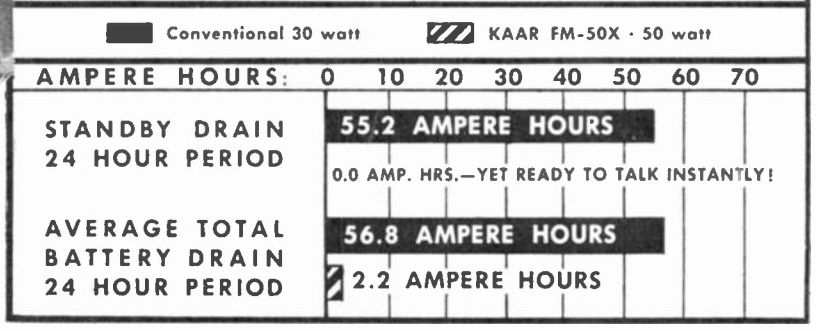
Write on company letterhead for Industrial Catalog and Engineering Manual No. 40. Gives helpful information on resistors, rheostats, chokes, tap switches.

Be Right with OHMITE
RHEOSTATS • RESISTORS • TAP SWITCHES

Compare the actual battery drain!*



NORMAL BATTERY DRAIN OF A CONVENTIONAL TRANSMITTER AND KAAR FM-50X EQUIPPED WITH INSTANT-HEATING TUBES



* **CHART BASED ON TYPICAL METROPOLITAN POLICE USE**

(140 Radiotelephone-equipped cars operating three shifts in city of 600,000 population.)

MESSAGES ORIGINATED BY CARS	904
MESSAGES ACKNOWLEDGED BY CARS	932
TOTAL TRANSMISSIONS PER CAR	13
AVE. LENGTH OF TRANSMISSION	15 sec.
AVE. TRANSMITTING TIME 24 HOURS	3 min. 15 sec.

KAAR mobile FM-50X transmitter gives you 20 watts more output with only 1/25th usual battery drain!

KAAR engineers—who pioneered the instant-heating AM radiotelephone—have now, through the use of instant-heating tubes, made 50 and 100 watt *mobile* FM transmitters practical! Thus you gain greater power and range—along with a tremendous reduction in battery drain!

With instant-heating KAAR equipment standby-current is zero—yet the moment you press the button microphone you are on the air. Contrast this with conventional emergency transmitters, over 90% of which operate with the filaments "hot" during stand-by. Since sturdy instant-heating tubes eliminate this great waste of energy without slowing the handling of messages, KAAR 50 and 100 watt transmitters can be operated from the standard ignition battery!

100 WATT MOBILE FM!

The KAAR FM-100X is identical to the FM-50X, except for the final amplifier. It puts 100 watts into a standard 34 ohm non-inductive load and is ideal for county and state police use. It requires no special batteries, wiring, or generator changes.

ADDITIONAL FEATURES

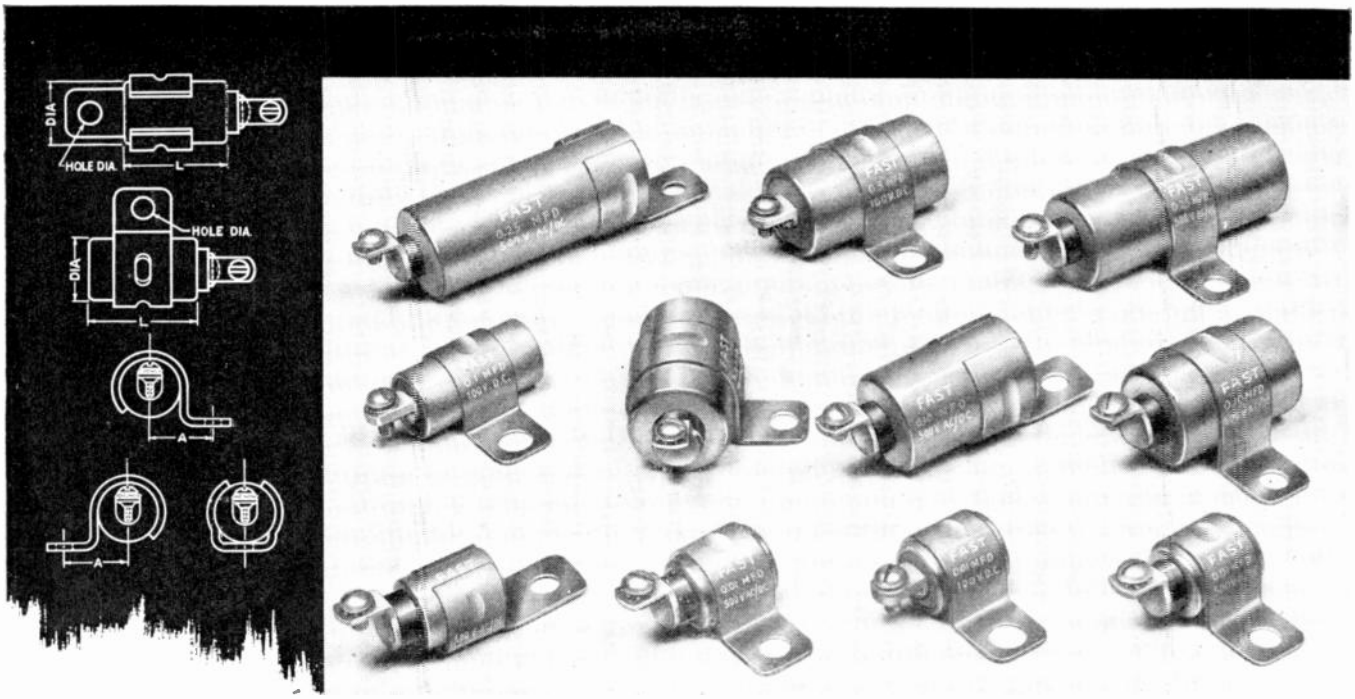
A new system of modulating the phase modulator tubes in KAAR FM transmitters provides excellent voice quality. Note that the equipment is highly accessible, and only two types of tubes are used. Frequency range: 30 to 44 megacycles.

Write today for free bulletin describing KAAR FM transmitters in detail. It's ready now!

KAAR ENGINEERING CO.

PALO ALTO CALIFORNIA

Export Agents: **FRAZAR AND HANSEN · 301 Clay St · San Francisco, Calif.**



FAST
RADIO NOISE-SUPPRESSION *Capacitors*

FAST radio noise-suppression capacitors are of *approved* design and meet the specifications for these types in every respect.

They are particularly efficient in suppressing noise from dynamotors, generators, motors and other motor driven devices which might otherwise impair radio reception.

The illustrations show the rugged construction of the screw-type terminals to safely carry heavy currents. Units are encased in brass containers with a heavy tin dip—oil impregnated, filled, and hermetically sealed to meet the most severe operating conditions.

These capacitors can be supplied in the following capacities and voltage ratings: .01 MFD; .10 MFD; .25 MFD and .50 MFD—100 V. DC. or 500 V. AC/DC. Side or end BRACKETS are available with mounting holes in 3 sizes. Side bracket can be placed in either of two positions depending upon mounting requirements, and can be provided with mounting hole at various distances from center of terminal. Below is a partial list of these types.

Write for prints or any additional data on these or other units—we will be happy to serve you.

Standard or Special Units to Meet Every Need

FAST Capacitors are produced in many types and sizes in standard or special designs. We can supply paper capacitors—oil or wax impregnated—rectangular or tubular—in sizes from the smallest to the largest.

"When You Think of Capacitors . . . Think FAST"

CAP. MFD.	VOLTS	DIMENSIONAL DATA		
		DIA.	LGT.	MOUNTING HOLE DIA.
.01	100 D.C.	11/16	13/16	7/32; 9/32 or 11/32
.10	100 D.C.	11/16	1-3/8	7/32; 9/32 or 11/32
.25	100 D.C.	3/4	1-9/16	7/32; 9/32 or 11/32
.50	100 D.C.	1	1-13/16	7/32; 9/32 or 11/32
.01	500 AC/DC	11/16	27/32	7/32; 9/32 or 11/32
.10	500 AC/DC	1	1-1/2	7/32; 9/32 or 11/32
.25	500 AC/DC	1	2-9/16	7/32; 9/32 or 11/32

JOHN E. FAST & CO.

Capacitor Specialists for Over a Quarter-Century

3109 North Crawford Avenue, Chicago 41

Canadian Representatives: Beaupre Engineering Works, Reg'd. 2101 Bennett Avenue, Montreal, for Power Factor Correction
J. R. Longstaffe, Ltd., 11 King Street, W., Toronto 1, for Special Applications

WHY CHOOSE UTC?

FOR WAR AND POSTWAR COMPONENTS

1 - UTC IS THE LARGEST TRANSFORMER SUPPLIER TO THE COMMUNICATIONS INDUSTRY.

2 - THE SCOPE OF UTC PRODUCTS IS THE WIDEST IN THE INDUSTRY.

3 - UTC ENGINEERING LEADERSHIP IN THE INDUSTRY IS ACCEPTED . . . WE DESIGN TO YOUR NEEDS.

4 - THE QUALITY OF UTC PRODUCTS IS HIGHER THAN EVER.

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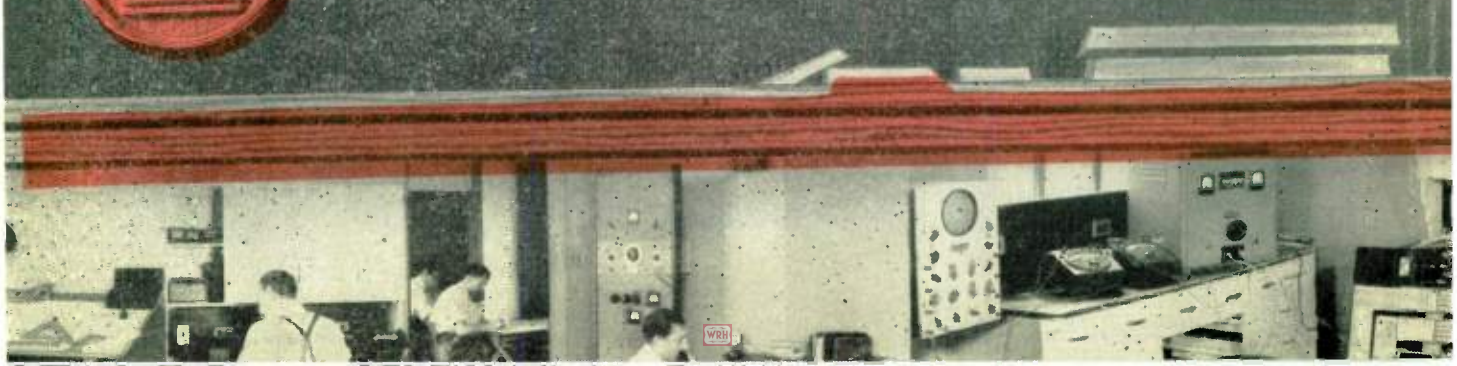

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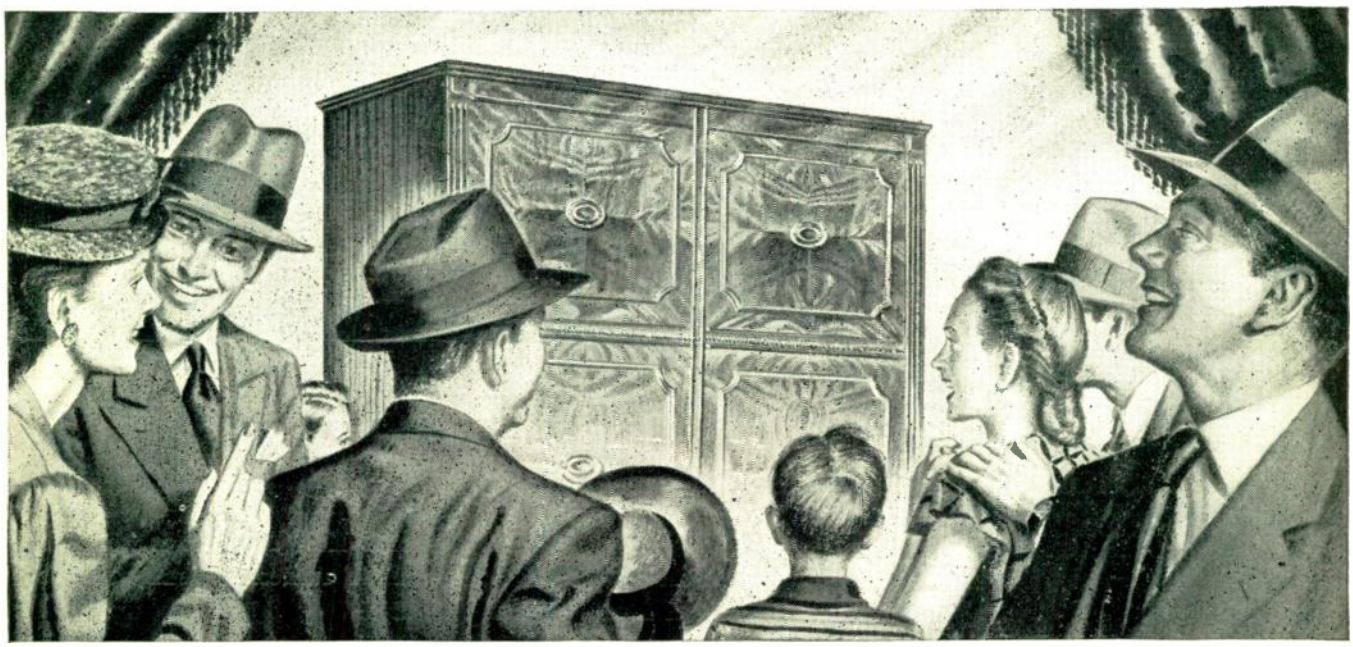

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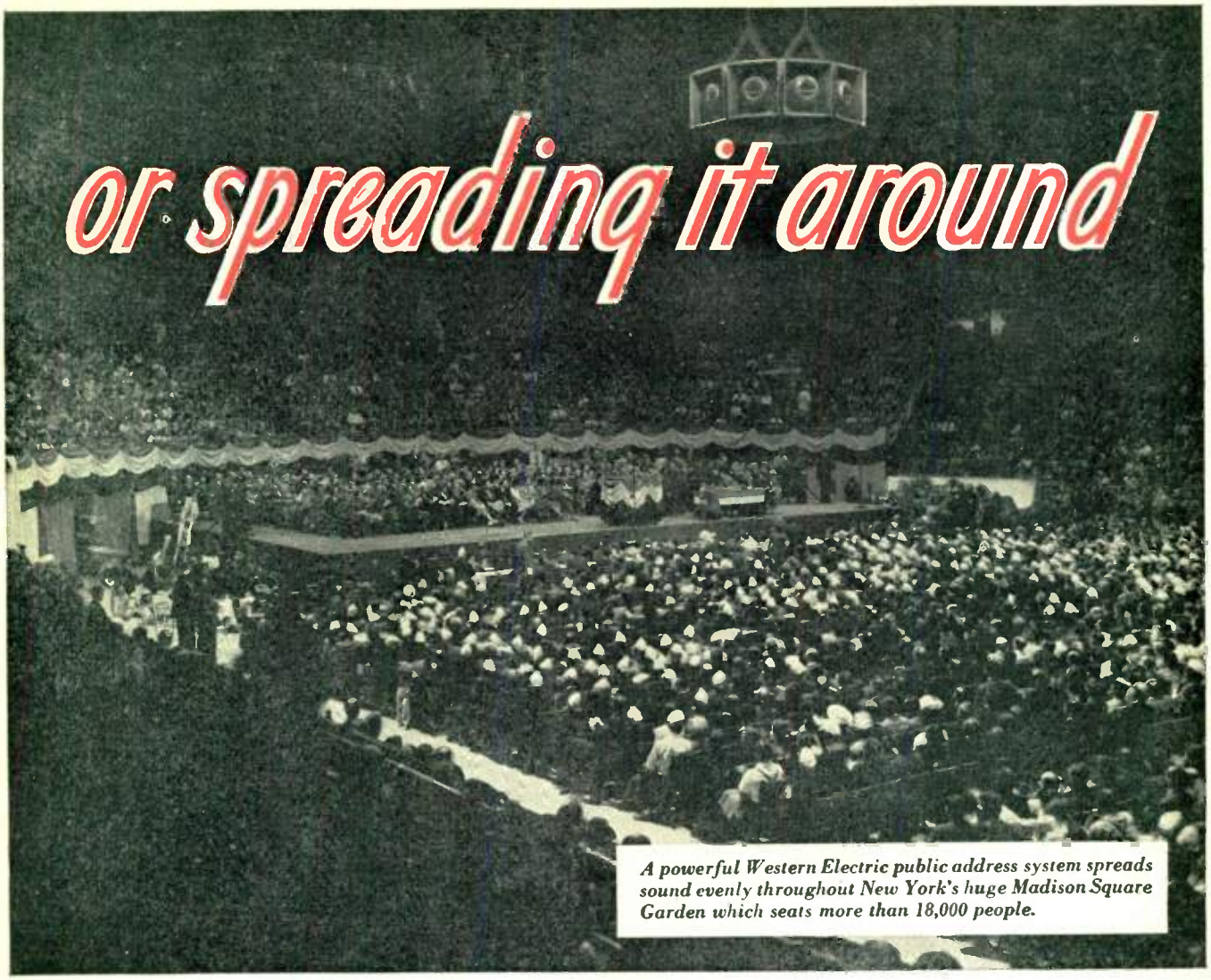

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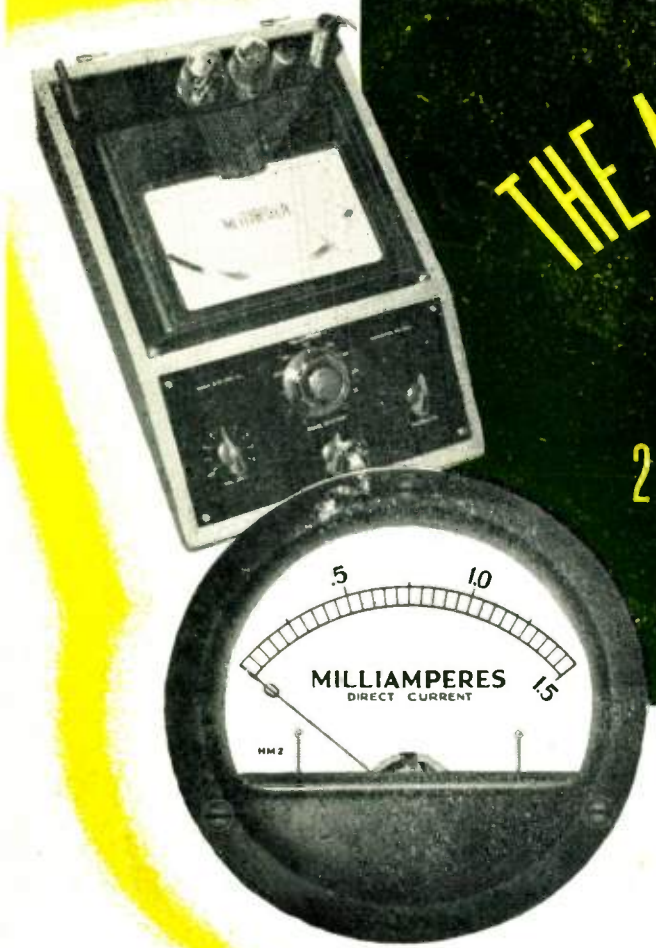

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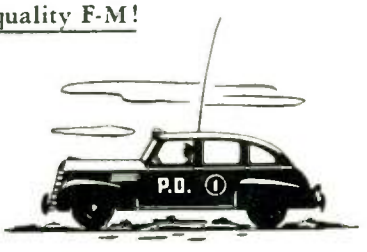

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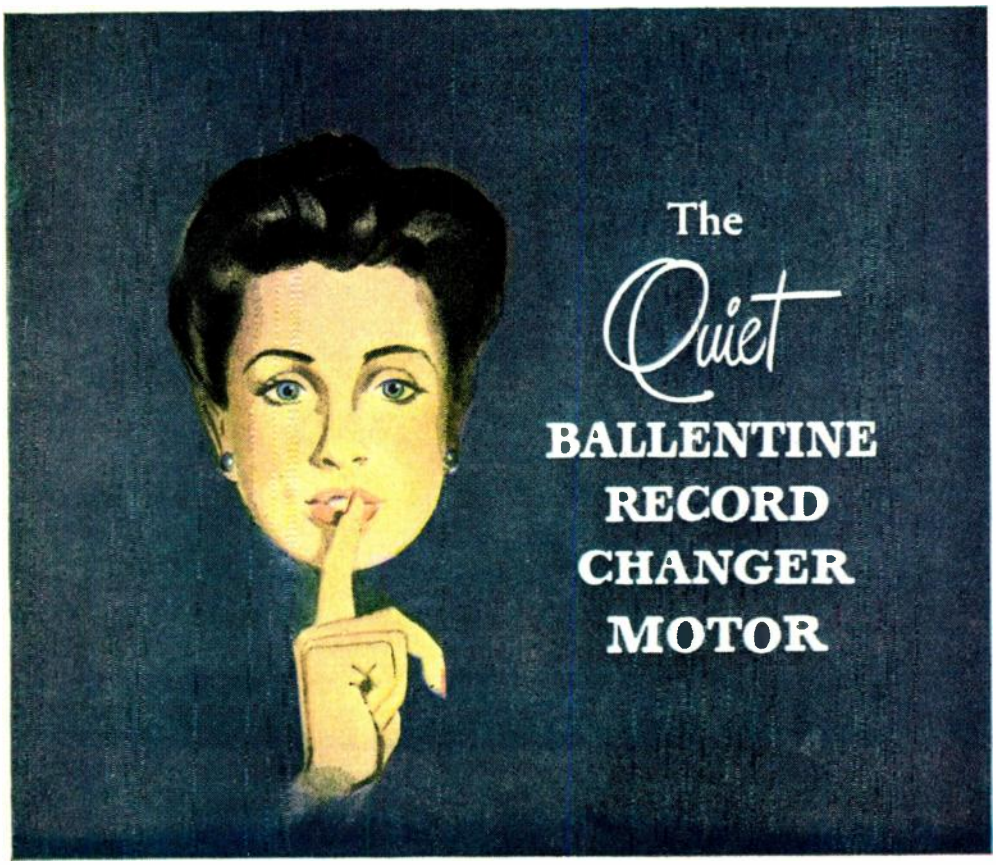

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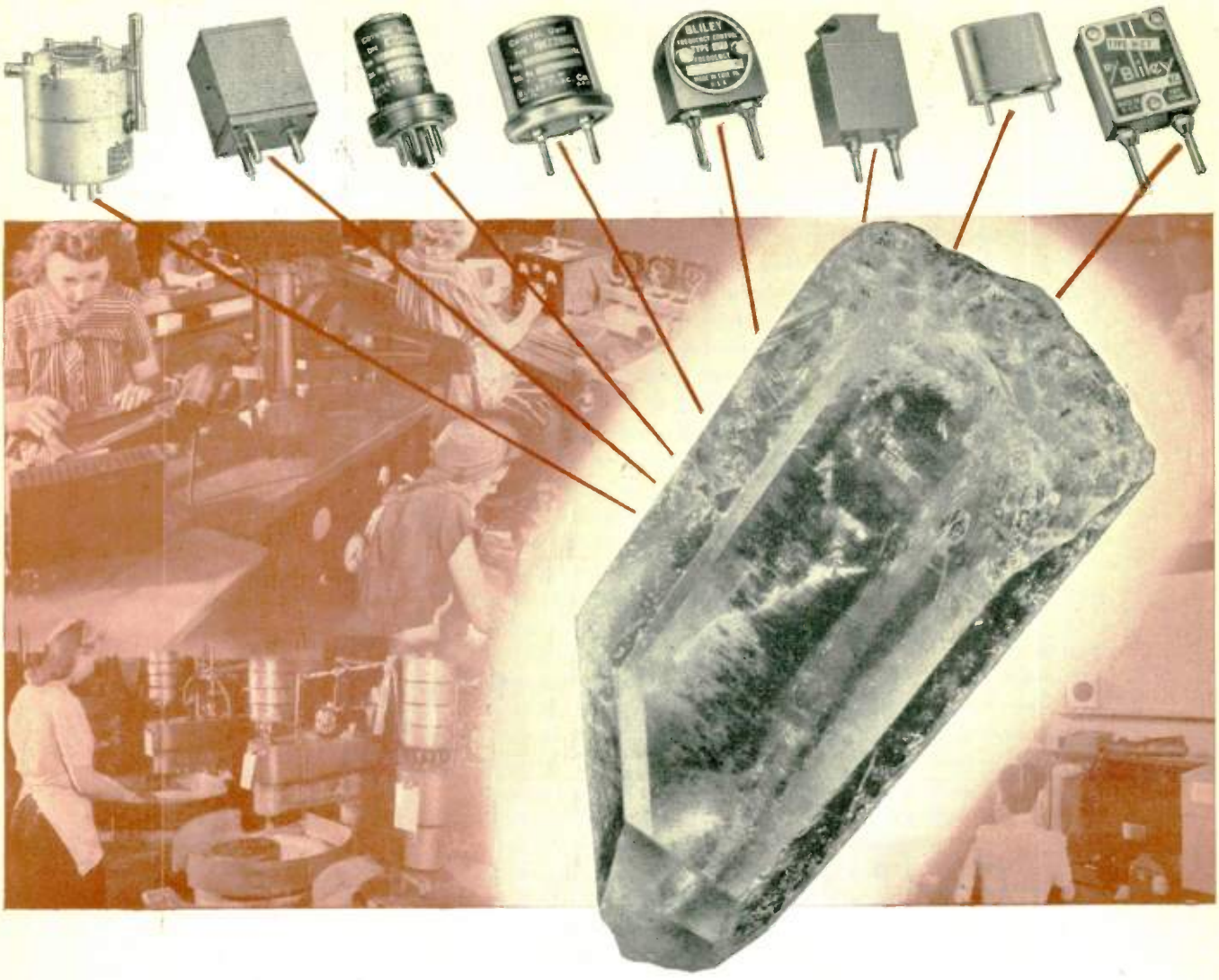

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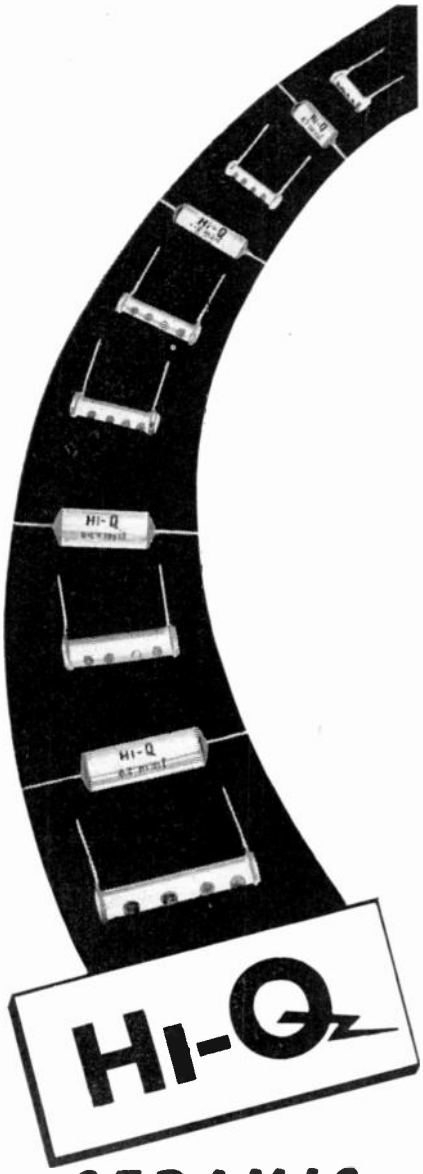

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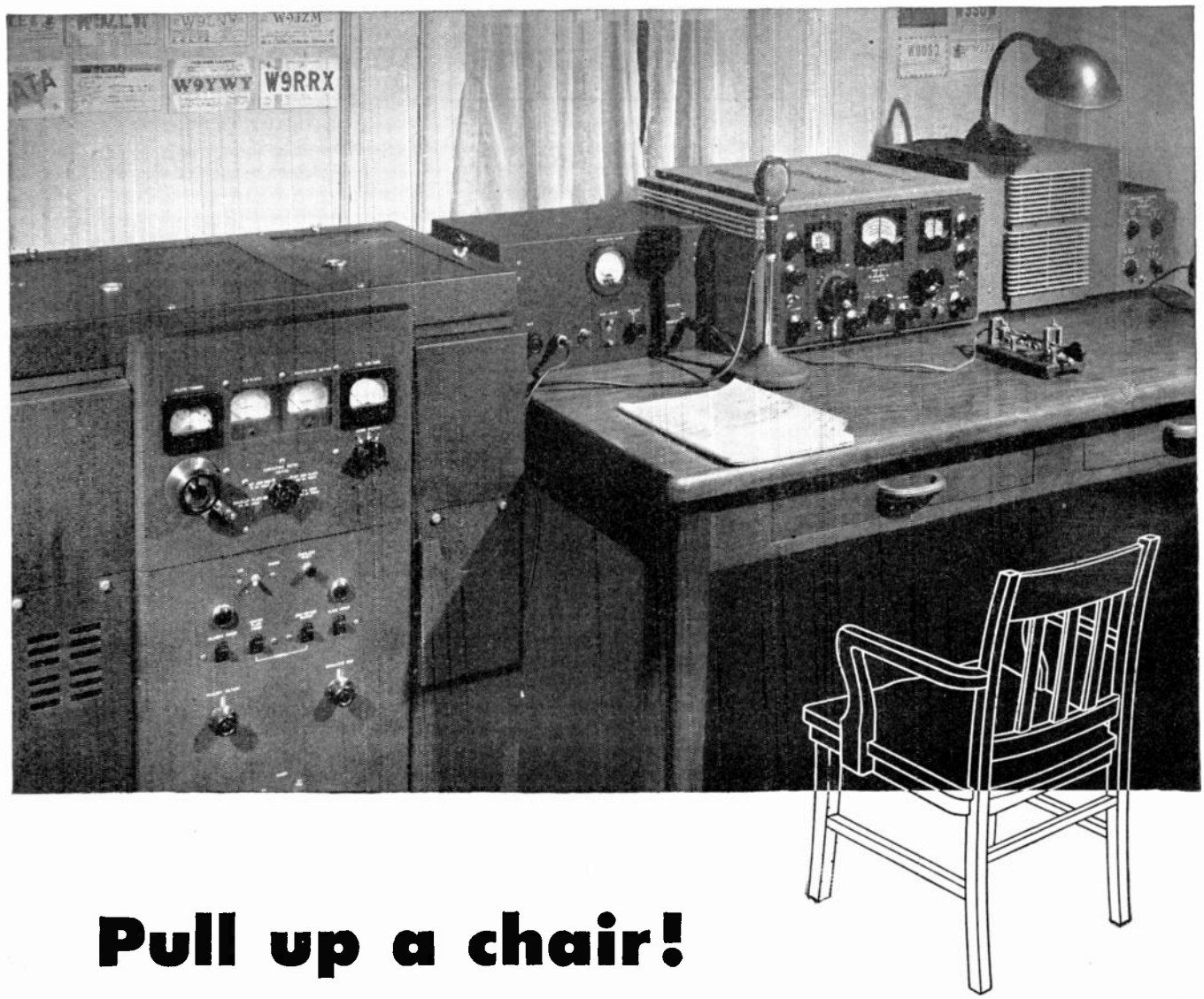

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FIG. 2, RIGHT. THIS CONTROL ROOM SERVES TWO STUDIOS. ANOTHER VIEW OF THIS ROOM IS SHOWN IN FIG. 7

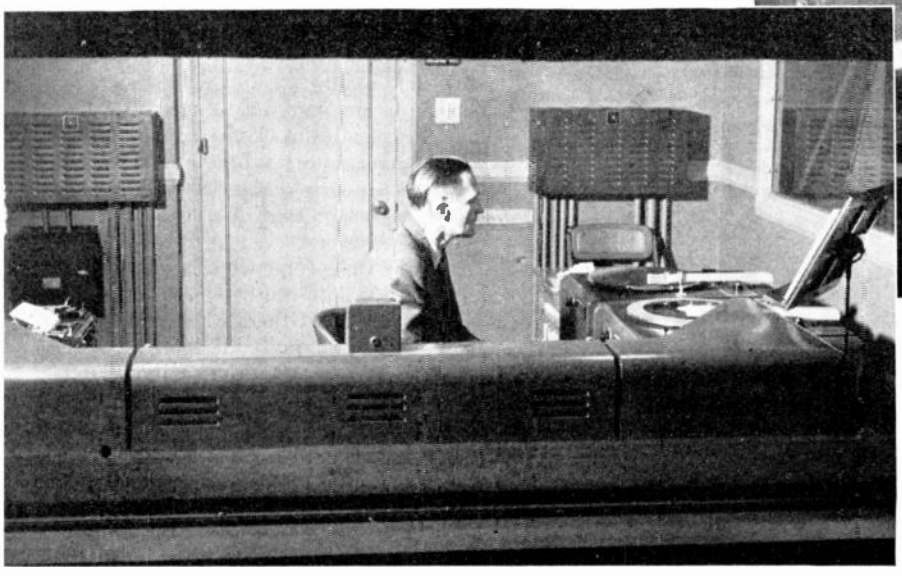


FIG. 1, LEFT. THE SAME CONTROL ROOM, LOOKING IN FROM THE OTHER STUDIO, OVER THE TOP OF THE OPERATOR'S CONSOLE

NOTES ON FM BROADCASTING

Comments and Suggestions Drawn from Experiences at WMFM, Milwaukee

BY D. W. GELLERUP*

LOOKING back over some five years of experience with FM broadcasting, I still maintain that it is a difficult subject to discuss, because FM must be heard to be understood. I know this from having spent half an hour trying to explain effects that can be accomplished on FM programs which are impossible with AM, only to be told: "Well, I listened to FM once, and I couldn't see that it was much different from AM."

That Horse Fly ★ Some time ago, a horse-fly got into one of our studios where we were putting on an FM show and, to the consternation of the control room operator, the buzzing of that fly came over his monitor speaker just as clearly as if it had been making circles around the operator's head. The incident caused such a stir at the station that one of our enterprising publicity writers put out a story about it. Several radio magazines published the story, to my embarrassment, for I am sure that many of the technicians at AM stations read it and said: "Nuts!"

Within the limitations of their AM experience, I can imagine that it did seem absurd. They would have to *hear* the interference that a horse-fly can, and did, make on an FM program to believe it possible.

Back in 1941, W. A. Ready, president of the National Company, while in Rochester, New York, heard that there would be an evening demonstration of FM in one of the rooms at the hotel where the Stromberg-Carlson studios are located. At the time he thought the demonstration was to take place, he went to the room and found the door locked, but he heard workmen sawing and pounding nails. On the assumption that preparations for the show had not been completed, he went away. Returning half an hour later, he found the audience coming out of the room. The show was over. The noise of hammering and sawing that he had heard were coming from the speaker of an FM set!

Yet people have said to me: "I think FM is very much over-rated. A friend of mine has a set that can tune FM, but he never uses the FM band." I haven't anything to say in reply to those who make such remarks, except when I can take them where they can hear genuine FM reception. Five minutes of listening enables them to understand what I couldn't explain if I talked myself blue in the face.

FM Is a System ★ AM broadcasting can be compared to playing catch with a baseball. One man throws the ball as best he can, and the other man tries to catch it. If the throw is good, the catcher will get the ball if he is skillful. However, the ball may go wild, or the catcher may fumble it. There is no certainty, because there are several modifying conditions which affect the operations of throwing and catching, and the flight of the ball through the air, and there is no way to control the conditions in order to obtain consistent results.

In contrast, FM broadcasting provides a complete transmitting and receiving system which is the equivalent of a high-fidelity wire line between the transmitter and each listener's home within the service area. Whatever is transmitted can be heard consistently, and without modification except as reception may be affected by limitations of the receiver, amplifier, or loudspeaker design.

It is both possible and practical, therefore, to deliver the same quality of entertainment in each FM listener's home that

* Broadcast Technical Supervisor, WMTJ and WMFM, Milwaukee, Wis.

FIG. 3. ONE OF A PAIR OF SMALLER STUDIOS SERVED BY ONE CONTROL ROOM

he would hear at the studio provided, of course, that he lives within the station's service area.

However, FM puts new obligations on both the broadcaster and the listener, for poor program material sounds very bad indeed when heard from a high-quality FM receiver, and the best FM program, heard on a poorly designed receiver, may sound no better than AM from a $9.95 midget.

That is why people who have good FM receivers are annoyed by the scratch from worn-out records. Others, who have listened to fine program material received on a makeshift receiver without a limiter circuit, are both honest and accurate when they say that they did not find FM in any way superior to AM, and no amount of explaining or theorizing will change their minds.

Planning for FM ★ In 1941, when *The Milwaukee Journal's* Radio City [1] was designed, it was determined to provide all the facilities required to give full effect to the capabilities of FM programming and transmission. The purpose was to assure our listeners of a quality of entertainment that would be limited only by the performance of the particular receiving sets they purchased.

Our Radio City installation was completed just as all new station construction was stopped. Therefore, it is still the last word in studios planned for FM broadcasting, both as to design and equipment. Experience over a period of nearly four years has confirmed the wisdom of our original planning.

It may be helpful to those who are now preparing to erect FM broadcasting facilities to point out some of the features of our installation, and to present a few notes on FM studio techniques which, although very different from AM practice, are, nevertheless, indicated by our experience in delivering the full capabilities of FM transmission.

Fundamental Microphone Technique ★ First of all, it is necessary to emphasize one fundamental point of difference between AM and FM microphone technique. It is this: Accepted AM practice is to play or speak directly into the microphone. FM practice, on the contrary, calls for locating

[1] See "FM Featured in $500,000 Plant," *FM Magazine*, February, 1941 for plan drawing of the building, and construction details.

FIG. 4, CENTER. MIKE SET UP FOR FM BROADCASTING, IN CONTRAST TO ACCEPTED AM PRACTICE AS ILLUSTRATED IN FIG. 5, BELOW

FIG. 6. IN THIS SETUP FOR FM TRANSMISSION THE MUSICIANS' MICROPHONE IS APPROXIMATELY 15 FT. FROM THEIR INSTRUMENTS, IN WHAT WOULD BE A NORMAL LISTENING POSITION. NOTE HOW THE ANNOUNCER STANDS BACK FROM HIS MIKE

the microphone at a point where speech or music can be heard to best advantage by the human ear.

Moreover, we have found that best results are obtained with a single microphone for FM program pickup. Any advantage that might be gained from two microphones is apt to be offset by phase displacement between them. Under some conditions, this is quite noticeable on high frequencies.

This eliminates one objectionable feature of the multiple-microphone AM practice, particularly in the case of orchestral music. When several mikes are in use simultaneously, the control room operator becomes an associate musical director, and that frequently causes trouble. Besides, there have been occasions when musicians' wives listened to their programs, and complained to their husbands that the placement of the mikes made the woodwinds so loud that they couldn't hear the string section, for example.

If one microphone is located above and behind the director, the responsibility for the performance as it is heard over the air is not shared by the operator or the technicians, and the credit or the blame for the performance is the director's, as it should be.

FIG. 7. THIS CONSOLE IS DESIGNED FOR THE CONTROL OF TWO STUDIOS

Several studio setups are shown in the accompanying illustrations, to make clear the difference between conventional microphone technique and that employed for FM programming.

Figs. 4 and 5 are typical. The usual placement for a microphone to pick up a soloist and piano accompaniment is seen in Fig. 5. The mike stand is directly at the side of the piano, and within easy arm's reach of the singer.

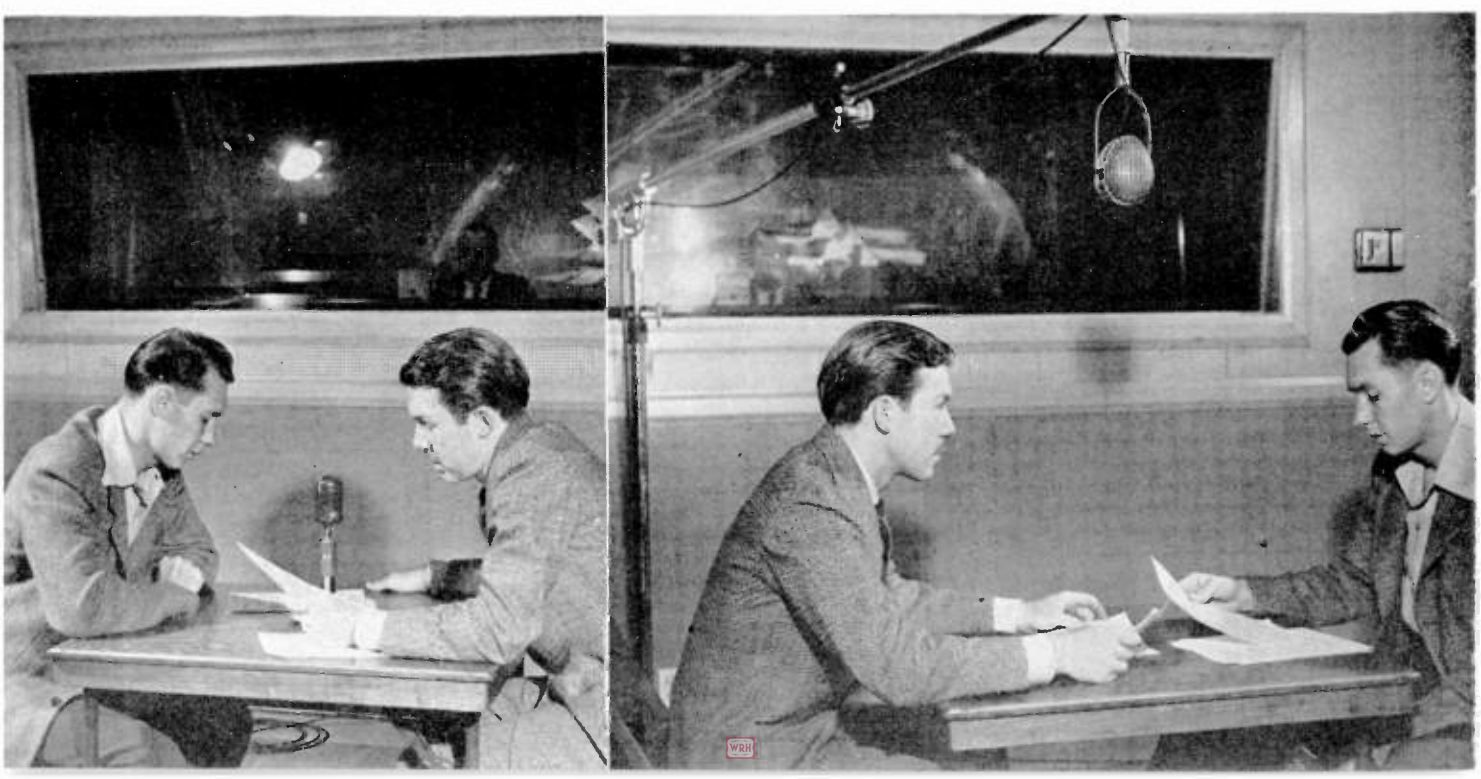
In Fig. 4, the mike is set up for FM broadcasting. It is well spaced from the piano and 6 to 8 ft. from the singer. This arrangement is not set forth as a rule. Modifying factors are the size and acoustics of the studio and the singer's voice. An obvious difference is that the setup in Fig. 4 very nearly corresponds to direct listening, but no one would enjoy the program if he stood where the mike is located in Fig. 5.

The same practice holds good for interviews and newscasting, as indicated in Figs. 8 and 9. Fig. 8 shows the usual AM setup. While it can be used for FM, the arrangement of Fig. 9 gives a great improvement in voice quality. In some cases, speaking voices that have excellent quality and resonance when picked up for FM, as in Fig. 9, sound harsh and unpleasant when directed straight at the mike, as in Fig. 8, and transmitted by AM.

Still another setup is illustrated in Fig. 6. We generally use one of our large studios for such instruments as the harp and violin, or for piano solos, with the mike at a considerable distance from the performers. In this case, the separation is about 15 ft. The announcer stands well back from his microphone, too.

Here is something that may surprise you. We use mikes rated at 8,000 cycles for the high-fidelity transmission of frequencies which approach 15,000 cycles.

FIG. 8, LEFT. CONVENTIONAL ARRANGEMENT FOR AM NEWSCAST. FIG. 9, RIGHT. REARRANGEMENT FOR FM TRANSMISSION



While it is true that a microphone may be limited to 8,000 cycles when it is located immediately adjacent to the sound source, the response range is extended considerably under the conditions illustrated in Figs. 4, 6, and 9. This is another factor that must be studied carefully by AM technicians when they undertake FM transmission.

You will notice that we use boom mike stands extensively. We have found that they reduce the microphone mortality by a considerable factor. Also, they are particularly useful in setting up for FM programs because of the ease with which they can be adjusted to proper microphone height and distance.

FIG. 10. THE AUTHOR WITH THE MONITOR CONTROL IN HIS OFFICE

Studios for FM ★ In order to get the full audio range of voices, music, and sound effects for FM, brilliant acoustic characteristics are required in the studio in order to build up the overtones. We can hear a distinct difference when we use our auditorium, because overtones are absorbed by the audience. It is impossible to offset that effect. Therefore, when musical quality is the only consideration, we prefer not to have an audience.

I hope that, some day, we can have an outdoor band shell, designed for resonance at the high audio frequencies. Then we can obtain the desirable acoustic effects for FM, and have an audience, too.

We have succeeded in getting the noise down 60 db, although we had our troubles doing it. It may seem that we have gone to extremes in reducing the noise level in our studios, but the results justify the effort and expense.

Each studio is completely isolated from the building structure. The walls, ceiling, and floor are built within, and insulated from a steel framework which is suspended from steel beams on insulated hangers. Space between the studio and the building are filled with insulation, so that sound cannot reach the studio by radiation or by conduction.

A 60-db noise level is not easy to attain, even with this elaborate type of construction, and considerable sleuthing was required to discover the causes of noise which showed up in the beginning. We found, for example, that the studio floors were bonded to the corridors of the building by linoleum that extended past the thresholds of the doors. It was necessary to break that connection. Another cause was traced to the construction of the control room windows. The heavy frames were secured by spikes so long that they established a direct connection between the building and the studio walls.

These may seem to be extreme measures. Indeed, they would not show up on the average cheap AM receiver, but the results are made apparent on high-fidelity FM reception.

Control Room Equipment ★ Fig. 14 shows the master controls, and the board which indicates the status of each studio. There are views of one of the control rooms in Figs. 1, 2, and 7.

It will be seen that some of our control

FIG. 11. PORTABLE TEST RACK FOR CHECKING AND MEASURING EQUIPMENT CHARACTERISTICS. FIG. 12. SERVICE INSTRUMENTS

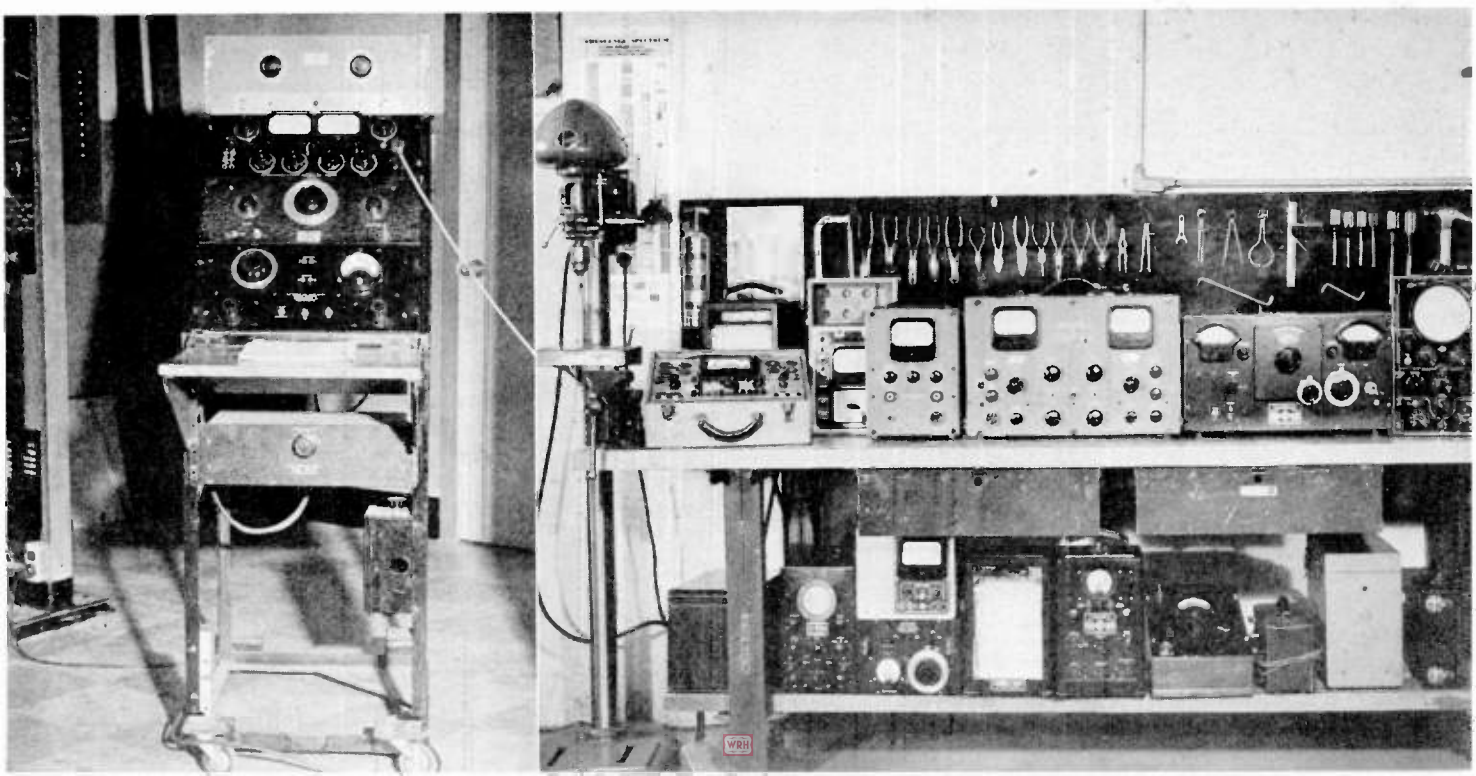
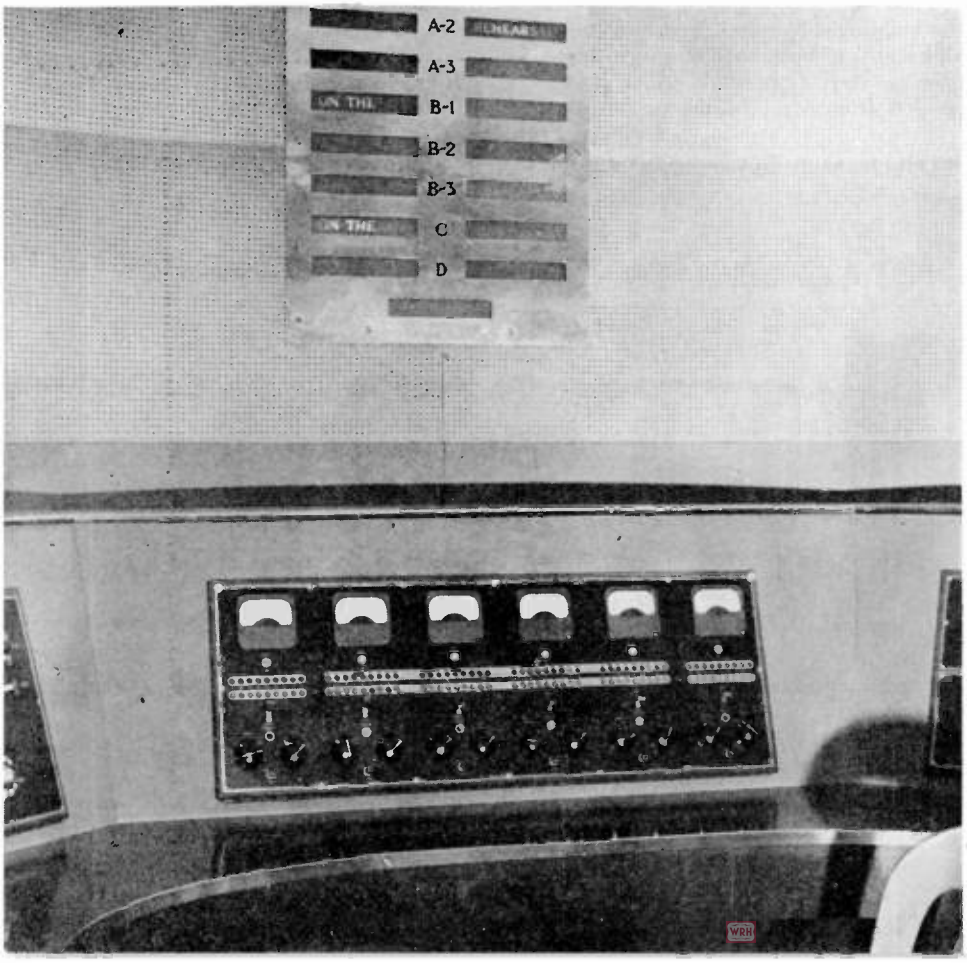


FIG. 13, ABOVE. THE AUDITORIUM AT WTMJ-WMFM SEATS ABOUT 400. A ROOM AT THE REAR, WHICH CAN BE USED FOR RECEPTIONS OR SPONSORS AND THEIR GUESTS, LOOKS DOWN ON THE AUDITORIUM THROUGH A LONG WINDOW

FIG. 14. CONSOLE IN THE MASTER CONTROL ROOM. IF ANY STUDIO IS IN USE, THE ILLUMINATED BOARD ABOVE THE OPERATOR'S POSITION SHOWS WHETHER THE PERFORMANCE IS IN REHEARSAL OR ON THE AIR



rooms are designed to handle two studios. For example, the photographs reproduced in Figs. 1 and 2 are of the same control room, taken through the two studio windows.

In order to prevent the introduction of AC hum, the speech equipment is so arranged that there are no AC power transformers in the console. In fact, the only AC current carried in the console circuits is 6 volts, for the tube filaments.

All relay circuits are in their normal positions when they are set up for a program on the air. That is, there is no voltage on the coils. In case of a power failure, therefore, the program would not be interrupted. The microphones are not controlled by relays, but run to manually-operated keys. Duplicate rectifiers, located on the rear wall, can be seen in Fig. 1.

On the right-hand section of the console there is a switch for cutting in any of the other studios. Thus, a special news flash or an emergency broadcast can be originated in any studio and put on the air without interrupting the program in progress at that moment. This proved to be a great convenience during the war years.

In order to conserve floor space, the monitor speaker is mounted on the ceiling. It can be seen in Fig. 7, above the clock. Controls on the nemo panel, the left hand section of the console, permit the operator to monitor any incoming line, as well as the studio program.

Office Monitors ★ Our engineering offices are equipped with speakers and controls by which any studio or incoming line can be monitored. Fig. 10 shows one of the controls. Program selection is obtained with a conventional telephone dial, operating selector switches. In addition, there are two buttons to operate a volume control, which is driven by a reversible motor mounted in the speaker cabinet.

Test Equipment ★ A brief description of the test equipment most often used at our studios may be helpful to those planning new FM stations. Fig. 11 shows a test rack which we made up from standard instruments. Mounted on rubber-tired wheels, it can be pushed around the building wherever it is needed.

At the top of the rack is a square-wave generator, used in conjunction with the audio oscillator below and a cathode-ray oscilloscope, for studying wave shapes and checking equipment. Next on the rack is a transmission measuring set to check levels on various circuits, and for determining frequency response and maximum gain on various units of our equipment. Next, is an audio oscillator covering

(CONCLUDED ON PAGE 84)

THE FACTS ABOUT 10-KW. FM TRANSMITTERS

Basis of Porter Threat to Shut Down Low-Band FM Is Found To Be Only FCC Doubletalk

BY MILTON B. SLEEPER

ON August 6th, a meeting of the pioneer FM manufacturers was called in New York, to discuss receiver designs which would best meet listeners' requirements under the new FM frequency allocations, and to exchange ideas that would ease the hardships of reconversion. After hearing reports concerning deliveries of new-band transmitters, it was decided that receiver production would start many months before 10-kw. stations could go on the air, and that it would be necessary, in the public interest, to provide FM tuning for the old and new bands. Thus it would be possible for those in areas now served by old-band broadcasting to enjoy FM programs from their new sets until such time as transmitters at 88 to 108 mc. were installed and ready to take over.

Then, on August 17, just three days after World War II came to an end in Japan, FCC Chairman Porter wrote a letter to R. C. Cosgrove, president of RMA, that sent a chill through the radio industry. It came at the very moment when contract terminations were whittling 4 billion dollars of annual production down to the vanishing point, and radio workers by the thousands, suddenly finding themselves unemployed, were wondering if and when they would be called back to their jobs.

Chairman Porter's letter said, in part: "The only reason that has been advanced for the manufacture of receivers covering the old FM band as well as the new is that by building such receivers demonstrations of FM reception to prospective customers will be possible. This does not appear to be a valid reason. We anticipate that very shortly the Commission will announce its standards for FM broadcasting in the higher band. As soon as this is done, FM stations will be required to take steps to begin operation in the new band as soon as possible so that by the time receivers are available all stations will be operating in the new band. Thus it will be possible to demonstrate the operation of the receivers in the band which is to be the permanent home of FM.

"One further point made by the proponents of the two-band receivers should be noted. Namely, that even if stations are operating in the new band by the time receivers are available, high power will not be immediately available in the new band, and that it is important that demonstrations of receivers be conducted with high power. The Commission is informed by transmitter manufacturers that 10-kilowatt transmitters will be immediately available for the new band. The Commission's engineers are of the opinion that this is sufficient power to demonstrate[1] the new receivers and industry representatives appearing at the recent Commission hearing testified that 10 kilowatts would be satisfactory."

Then came the bombshell: "It is the Commission's desire to permit this dual transmitting operation as long as it is necessary. However, if new receivers are manufactured to cover the old band, the Commission might very well take the position that it was necessary to put an end immediately to all FM transmissions in the old band in order to protect the public from an unnecessary expense and to insure that the change-over to FM's new and permanent home should not be delayed."

This pronouncement, coming just when manufacturers were bending every effort to complete new receiver designs and to hasten reëmployment of factory workers, meant revising designs to 1-band FM tuning if it was true that 10-kw. new-band transmitters would be "immediately available." On the other hand, receiver manufacturers had every reason to believe that Chairman Porter's information had come from unreliable sources, or else he had invented it in order to justify a determination to stop low-band broadcasting for some reason of his own.

In either case, this would mean unwarranted interference with receiver manufacturers. Moreover, it would mean cutting off FM service to owners of prewar sets, and postponing indefinitely any service to purchasers of postwar receivers who do not live close to new high-band stations.

Accordingly, *FM* AND TELEVISION Magazine addressed the following letter of protest to Chairman Porter:

Great Barrington, Mass.
August 23, 1945

Paul A. Porter, Chairman
Federal Communications Commission
Washington, D. C.

Dear Mr. Porter:

On behalf of the present FM radio listeners may I add my protest against the threat implied in your letter to Mr. Cosgrove to put an end immediately to broadcasting in the old band if new receivers are designed for two-band coverage.

Surely, Mr. Porter, you do not feel that such an action would be in the public interest. In western Massachusetts, where I live and in many other sections, it would put an end to the only programs which can

(CONTINUED ON PAGE 49)

IN THE AMERICAN TRADITION

LAST July, in his report to the President, Dr. Vannevar Bush, Director of the Office of Scientific Research and Development, wrote: "It has been basic U. S. policy that government should foster the opening of new frontiers. It opened the seas to clipper ships and furnished land for pioneers. Although these frontiers have more or less disappeared, the frontier of science remains. It is in keeping with the American tradition — one which has made the U. S. great — that new frontiers shall be made accessible for development by all American citizens."

The pursuit of any scientific research and development, by which new facilities are made available to industry or the public, is the pursuit of truth, and the establishment of facts. Since its inception five years ago, *FM* and Television Magazine has been dedicated to contributing, however modestly, to opening the two great frontiers of radio science by making factual information available when it is lacking from other sources, and offsetting misinformation, from whatever source, by seeking out and publishing the truth.

It is presumed that these aims are shared by the officials of all Government agencies, and it is not a function of this publication to engage them in any controversy. However, when pronouncements are issued or regulations promulgated that do not reflect true conditions, and which may delay or limit the progress of the art and its service to the public, it is both an obligation and a legitimate function of this publication to present the basic truth.

This, we hold, is in keeping with the highest American tradition of scientific journalism, and this policy we propose to maintain.

[1] If Chairman Porter were thinking in terms of service to radio listeners, he would not have referred repeatedly to "demonstrations." The purpose of the 2-band receivers is to enable people in areas now served by FM stations to enjoy FM reception from the time they buy sets until such times as equivalent service can be given by transmitters in the new band.

SPOT NEWS NOTES

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

More FM Frequencies: First the FCC gave up its plan to reserve FM channels for use by returning veterans. Then it took away the facsimile band of 106 to 108 mc. Yet, according to the Commission's own explanation of its new rules, published on pages 42 to 49 of this issue, there are too few FM broadcast channels even before the new band is put to use.

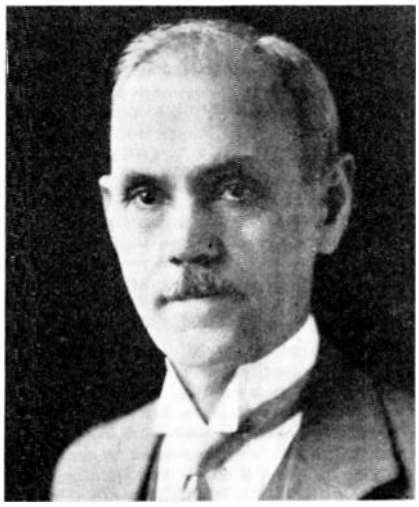
We still maintain that FM should keep the 42- to 50-mc. band. Furthermore, we propose that it be assigned exclusively to non-network Metropolitan stations. Only in this way can new, independent operators obtain sufficient coverage to justify the expense of originating high-quality programs in competition with networks. And why should the enjoyment of such programs be the exclusive privilege of people living within an area equal to the primary coverage of a 50-kw. AM station? The retention of the old FM band for this purpose should be given immediate consideration before other services start to use it!

Philadelphia: Philco Corporation is building a new radio factory of 300,000 square feet, adjoining the main plant. Comprising three floors and a mezzanine, it will contain eight parallel conveyor lines for the assembly of radio sets.

New Television Transmitter: CBS expects to install a new television transmitter operating in the upper band, on the Chrysler Building at the end of this year. A coaxial cable, capable of carrying a 10-mc. band, will be run from the studios in the Grand Central Station building to the transmitter.

Oscar Hammarlund: The founder of the Hammarlund Manufacturing Company, Inc., passed away on August 25th at his Brooklyn home. Born at Stockholm in 1862, he came to the United States at the age of 20, and started in the employ of the Elgin Watch Company. Four years later, he joined Western Electric as superintendent of their Chicago plant. In 1892, at the Gray National Telautograph Company, now Telautograph Corporation, he assisted Elisha Gray in developing the technique of writing over wire lines. He left Prof. Gray in 1910 to found his own company which, during the ensuing years of war and peace, has had a prominent part in the growth of radio communications.

Oscar Hammarlund is remembered by his associates as a master mechanic who had an artist's appreciation of fine design and beautiful workmanship, with a skill of his own that challenged those around him to maintain the high standards which he set.



OSCAR HAMMARLUND

He leaves a son, Lloyd A. Hammarlund, and three grandsons, Lt. L. A. Hammarlund, Jr., Sgt. Frazier S. Hammarlund, and Roger Hammarlund.

I.M.S.A.: Annual meeting of the International Municipal Signal Association will be held at Hotel LaSalle, Chicago, on November 12th to 15th inclusive. Papers will cover fire alarms, police signals, and radio communications for police, fire, and other emergency services. I.M.S.A. secretary is Irvin Shulsinger, 8 E. 41st Street, New York 17; convention chairman is David J. Talbot, 707 City Hall, Chicago.

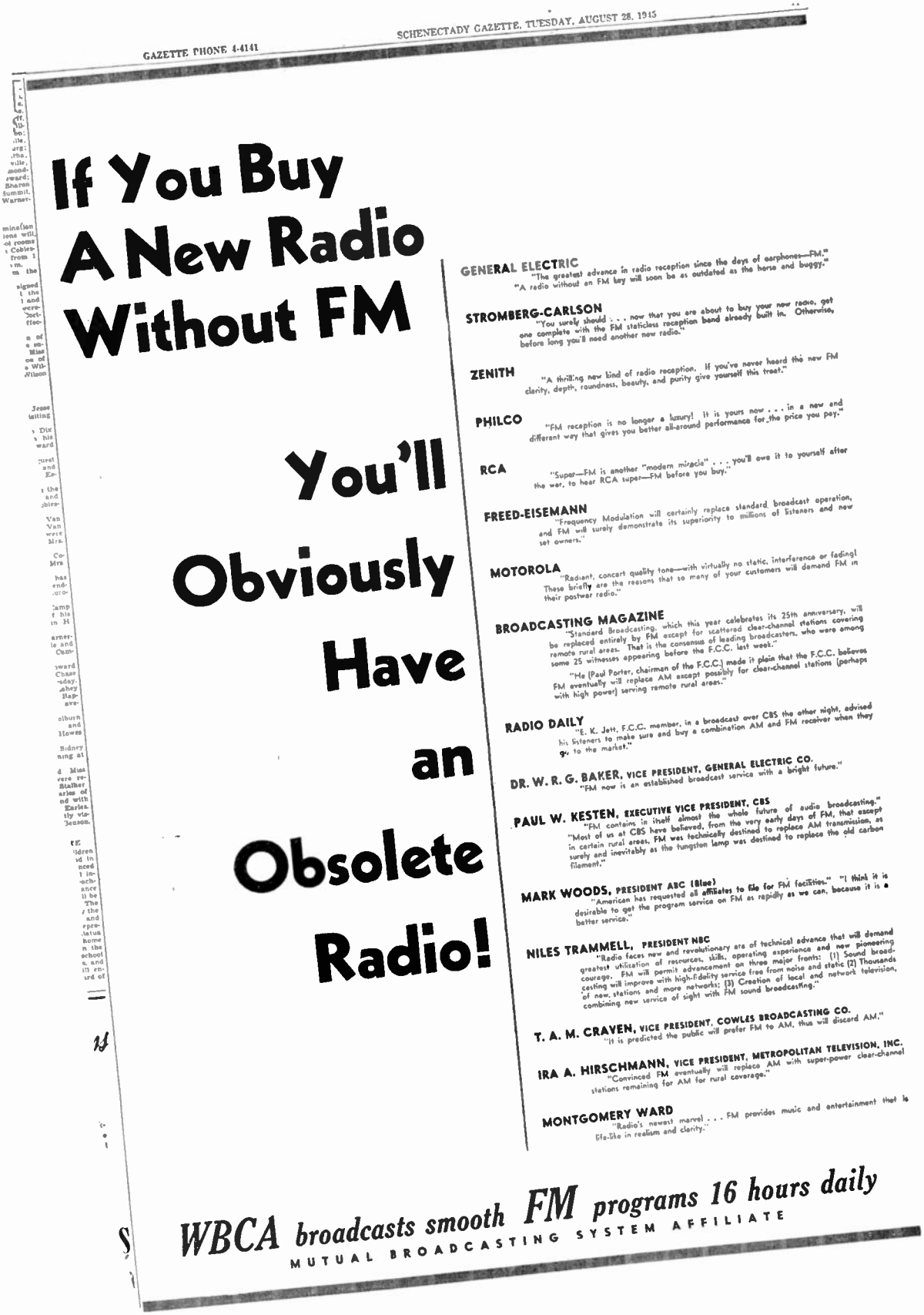
Columbia University: Has applied for an educational FM station, to be operated under the administration of the University Radio Council, subject to the final jurisdiction of the president and trustees. The Council is composed of representatives of various schools and divisions of the University, with Dr. Russell Potter as chairman. Purpose is to make the intellectual, cultural, and scientific resources of Columbia available to the public through forums, recitals, music programs, and lecture courses. In addition, facilities will be used by Teachers College for training teachers in techniques of classroom use of radio. Other institutions which will contribute to programming are Juilliard School of Music, Metropolitan Museum of Art, Jewish Theological Seminary, and Fordham University. Studio will be on Columbia campus, with transmitter at Alpine. Major Armstrong's tower will carry the antenna.

FCC: Schedule of office hours has been changed to 9:15 A.M. to 5:45 P.M., Monday through Friday, except on legal holidays.

Dr. C. B. Jolliffe: Vice president of RCA Laboratories: "It is not fantastic to imagine long telephone and telegraph lines replaced by lines of towers, spaced 25 to 40 miles apart, each equipped with small automatic radio transmitters and receivers carrying coast-to-coast many messages over highly directive radio beams. A single line of radio relays can carry telephone, telegraph, and television or radio programs simultaneously with less maintenance or service than wire lines."

PRODUCTION OF COMMUNICATIONS RECEIVERS FOR AMATEUR AND OTHER CIVILIAN USES HAS STARTED AT HALLICRAFTERS

FM for Buses: Intercity Bus Radio, Inc., a division of National Association of Motor Bus Operators, has applied for CP's to cover a 250-watt central control station in the Chicago Loop, and 2-way 50-watt FM installations on 100 buses for the Pennsylvania, Central, Northland, and Illinois lines running into Chicago. There will also be three relay receiving stations outside the city. Operation will be on two frequencies between 30 and 44 mc. This project is being undertaken by the Greyhound Corporation, under the direction of engineer Frank Walker.



NEWS PICTURE

THIS reproduction of a full-page advertisement in the *Schenectady Gazette* shows what FM station WBCA is telling radio listeners in its area. Those who remember what happened in 1932, when all-wave receivers were introduced, will probably agree with WBCA that, when FM can be heard in dealers' stores on postwar FM-AM models, straight AM sets will be as dead as dodos. Like wartime substitute merchandise still in dealers hands, straight AM receivers priced above $25 will be hard to move when people realize that they offer no improvement in performance over 1940 designs. Exceptions, of course, are people who can only spend a few dollars for cheap AM models.

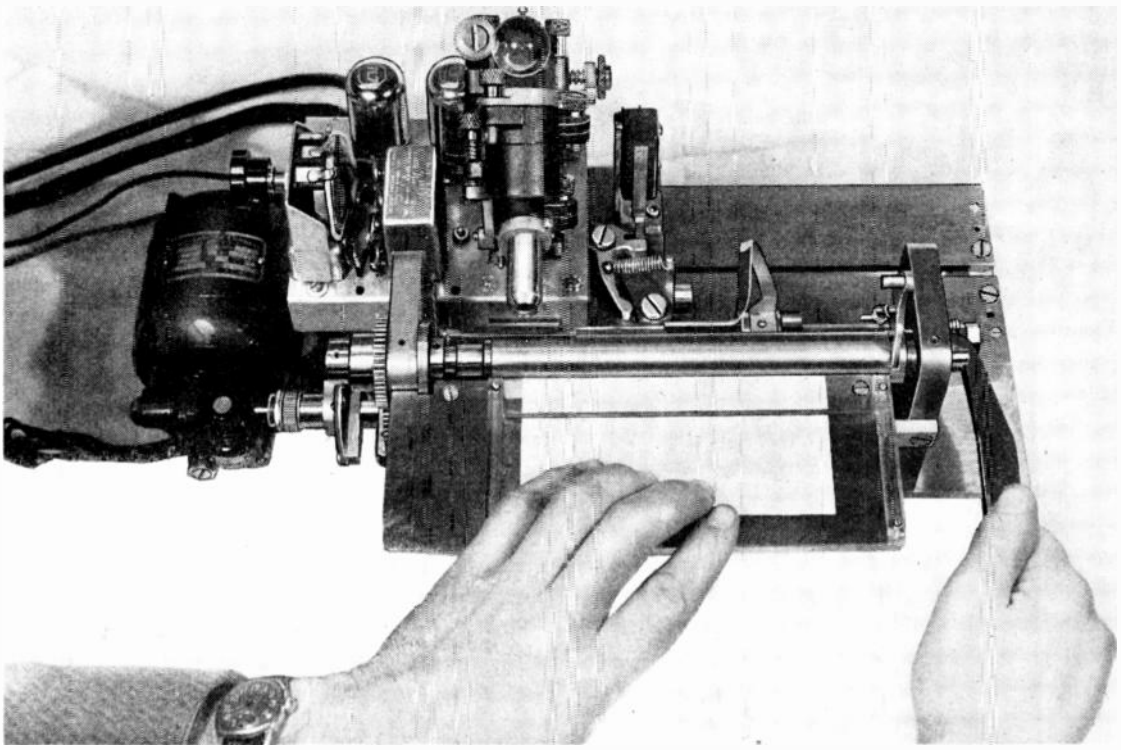


FIG. 13. THE FACSIMILE SCANNING INSTRUMENT WITH COVER REMOVED TO SHOW MECHANISM

A NEW FACSIMILE DISPATCH AND REPORT SYSTEM

Part 2—Mechanical Considerations of Postwar Facsimile Equipment

BY MILTON ALDEN*

THE Alden facsimile equipment, using Alfax paper for recording, is inherently simple. In all our thinking, we have visualized the use of the instruments by the lowest denominator of intelligence in the different fields where they will find use.

An examination of the recorder, shown in Fig. 3 and in other accompanying illustrations, discloses the simplicity of the mechanism and the ease with which wearing parts can be replaced. This is due partly to the fact that the total elements are few in number, and partly to the manner in which the parts are designed into unit groups, any one of which can be removed without disturbing the others. The design is, therefore, in striking contrast to the complex mechanisms of the teletype, electric typewriter, tape recorder, or code recorder.

As a result, this facsimile recorder can be produced in quantity at far lower initial cost, and maintained at minimum expense because so many fewer wearing parts are used, and the few that are required can be replaced easily and quickly.

Details of Scanner ★ Fig. 13 shows the scanning instrument with the cover removed. The diameter of the scanning drum is slightly larger than the width of the paper used for messages, and the side of the paper — not the top — is fed into the scanning instrument. Therefore, the message blank cannot be longer than the scanning drum, in order to fit into the machine. If continuous scanning is required, a different type of instrument must be used.

As the copy revolves on the drum, the optical element moves from left to right, advancing by a screw feed .016 in. per revolution of the drum. This gives 40 scanning lines per inch.

If the recorded message is to appear the same size as the original copy, the width of the recording drum corresponds to the diameter of the scanning drum, and the recorder advances the paper .016 in. for each scanning line. Enlargement is accomplished by using a longer helix and a wider recording drum, so that the linear recording speed is greater than the scanning speed, with the paper feed increased in proportion.

The functions of the scanner are entirely automatic. The only effort required of the operator is to feed the copy and press the lever at the right, as in Fig. 13. In the non-operating position, the copy enters a slot which carries a gripper, as indicated at the top of Fig. 16. This holds the paper on which the message has been written or typed. At the conclusion of transmission, the gripper releases the paper, so that it falls on a plate below.

Since all the functions are performed without vibration, and at relatively low speeds, wear is at a minimum, and all re-

*President, Alden Products Company and Alfax Paper & Engineering Company, Brockton, Mass.

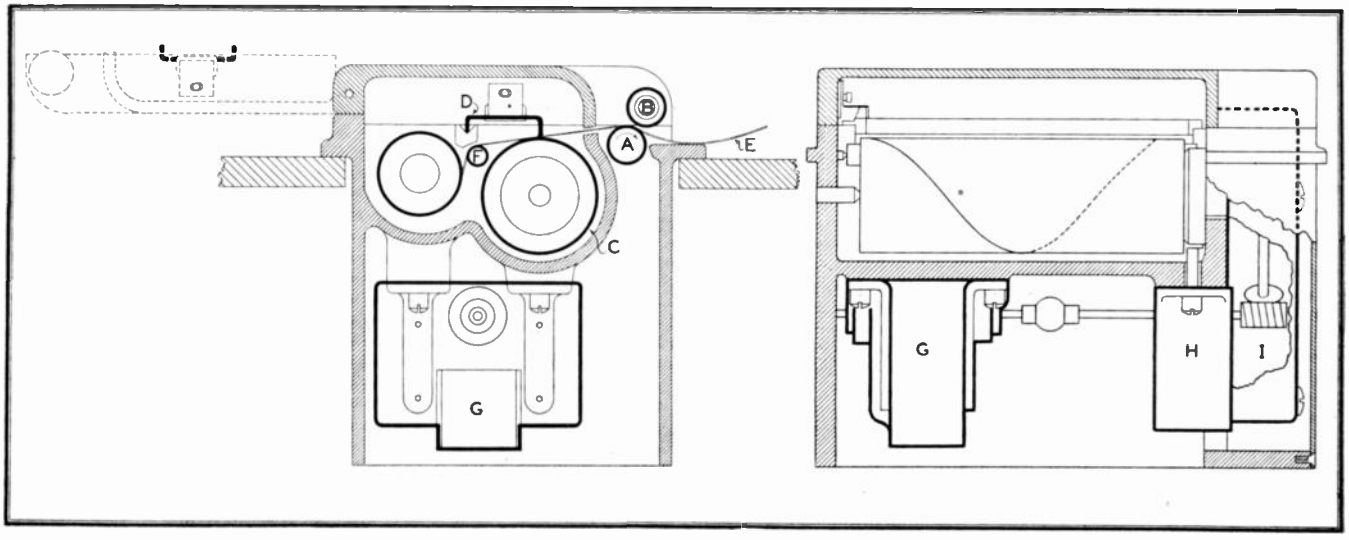


FIG. 14. END AND FRONT VIEWS OF THE RECORDER. HEAVY LINES INDICATE REPLACEABLE ELEMENTS

quirements of service can be met by routine inspection. Service is further simplified by the fact that, in almost every application, only one scanner is required for transmission to a great number of recorders, and the scanners will be located at readily accessible points. For broadcast transmission to home recorders, it would be entirely practical, because of their modest cost, to install a second scanner. In case of emergency, the second instrument could be cut in at the end of any piece of copy, without disrupting the reception.

Details of the Recorder ★ Fig. 14 shows the mechanical construction of the recorder, Fig. 17 the method by which Alfax paper is inserted, while Fig. 15 indicates the removable units of the mechanism.

The only effort required by the operator is to insert a roll of paper when the previous roll has been run off. It is as simple as this: Pressing a button unlatches the cover which, in full-open position, clicks into a stop. The roll of paper is supplied in a quick-opening container. An elongated hub in the recorder, Fig. 17, springs out at a convenient angle to receive the roll. With the roll in position, the cover is closed and the machine is ready to record.

There are no slots through which the paper must be threaded, no paper puller, feed devices, knobs, or other gadgets to manipulate. Anyone familiar with this instrument can insert the paper without fumbling even in the dark, or in a jogging vehicle.

Further details are given in Fig. 14. The paper E is drawn by the driver roll A and the idler rollers B, which can be seen at the top of Fig. 15. In model No. 9010, for example, the rate is 3 ins. per minute. The helix C is a wire wound spirally on an insulated drum. As the drum rotates, the intersecting spot between the helix and recorder bar D travels from left to right. The recorder bar presses lightly on the paper, so that the helix can move under the paper without undue friction, and to permit the driver roll to advance the paper.

The amplified signal current passes from the bar through the paper to the helix wire, making a mark on the paper at the spot where the helix intersects the recorder bar. The density of the spot varies with the signal strength, and that is determined by the intensity of light reflected by the original copy onto a photo-electric cell mounted in the optical system of the scanner. When the facsimile recorder is designed to produce a 50% enlargement of the original copy, the paper feed is geared to advance the paper .025 in., giving 40 lines per inch, while the scanner operates at 60 lines per inch.

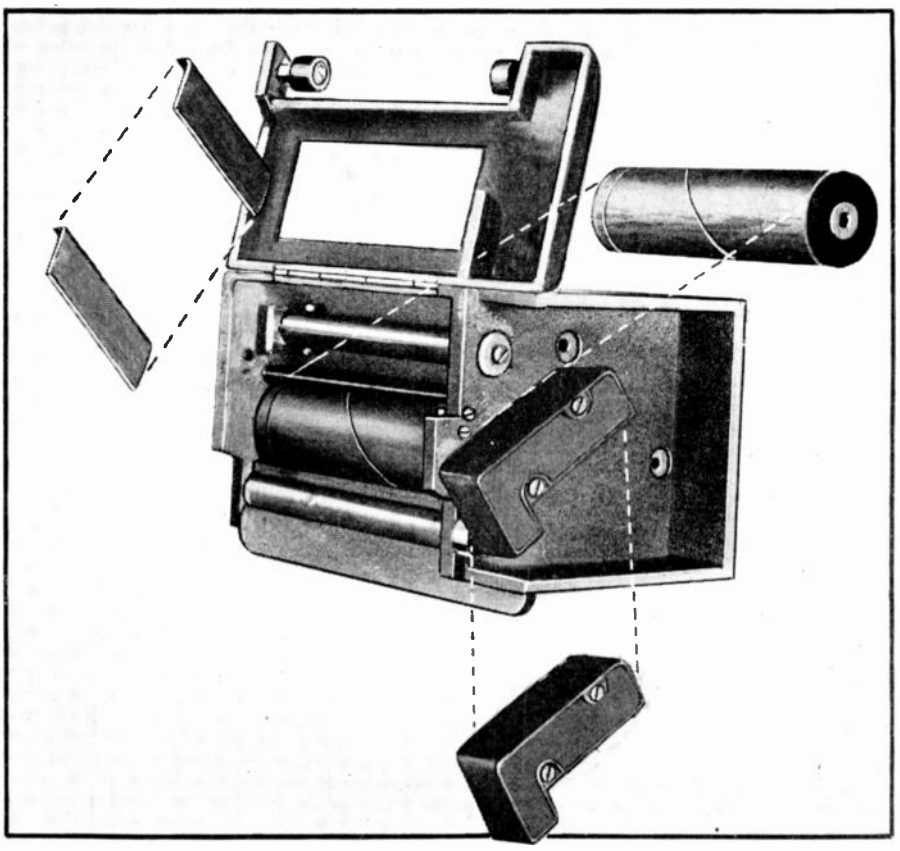


FIG. 15. INTERIOR OF THE RECORDER, SHOWING REPLACEABLE UNITS

Servicing the Recorder ★ Separate elements of the recorder are detailed in Figs. 14 and 15. They are:

1. A synchronous motor G, located positively in position by tapered pilot pins, and secured by two heavy screws.

2. The framing solenoid H, mounted in a similar fashion, and requiring no adjustment as a unit or at any time in use.

3. Paper and helix drive gear train I, with beveled gear completely enclosed in one unit. The drive engages the various elements and is automatically located when the case is slipped over pilot pins and secured by screws.

4. The helix C and intermediate paper roll idler F have special spring-retracting axes. Both can be removed from the top side without tools. Spare helix wires are provided and can be replaced by loosening and tightening one screw.

5. The recorder bar D is a replaceable unit that can be snapped out, and another snapped into position.

Servicing, therefore, is only a matter of having those five basic units on hand for replacements. The only tool required is a screwdriver, since no adjustments are necessary when parts are replaced. It is literally true that any fault that develops in the recorder mechanism can be remedied in a matter of seconds.

There, in a few words, is the complete answer to the question of service and maintenance. To the man who asks, "If we build a system of communications around these radio-operated facsimile recorders, will the whole system be disrupted by delays in case mechanical trouble develops?" the design of the recorder gives its own answer. First, the need for service is reduced to a minimum by the small number of parts and the elimination of wear which would result from vibration or from parts moving at high speeds. Second, all moving parts are divided into independent mechanical elements which can be removed easily and which require no fitting or adjustment.

Thus we can say that the recorders are ideally suited for aircraft, police, and other emergency services, and for home facsimile reception. This applies also to office intercommunications and accounting systems where the recorders are operated by direct connections over wire lines.

It will thus be seen that those who wish to pioneer in proving the practicability of facsimile have, in the prototype equipment described, the means to make use-tests.

For illustration, the scanner and synchronizing oscillator, together with the proper amplifier to modulate the transmitter, is available to operators of police or emergency systems. The scanner will also provide the practical use-tests of the space required in conjunction with headquarters' equipment.

For the receiving end, the recorder is available by itself or complete with amplifier, synchronizing oscillator, multivibrator and time delay circuits which automatically start, frame, record, and reset at the end of each message. The recorder and associated equipment are designed for connection to the 500-ohm output of a regulation police or communications receiver.

Finally, authorization for experimental facsimile transmission can be obtained from the Federal Communications Commission with a minimum amount of formalities and delay.

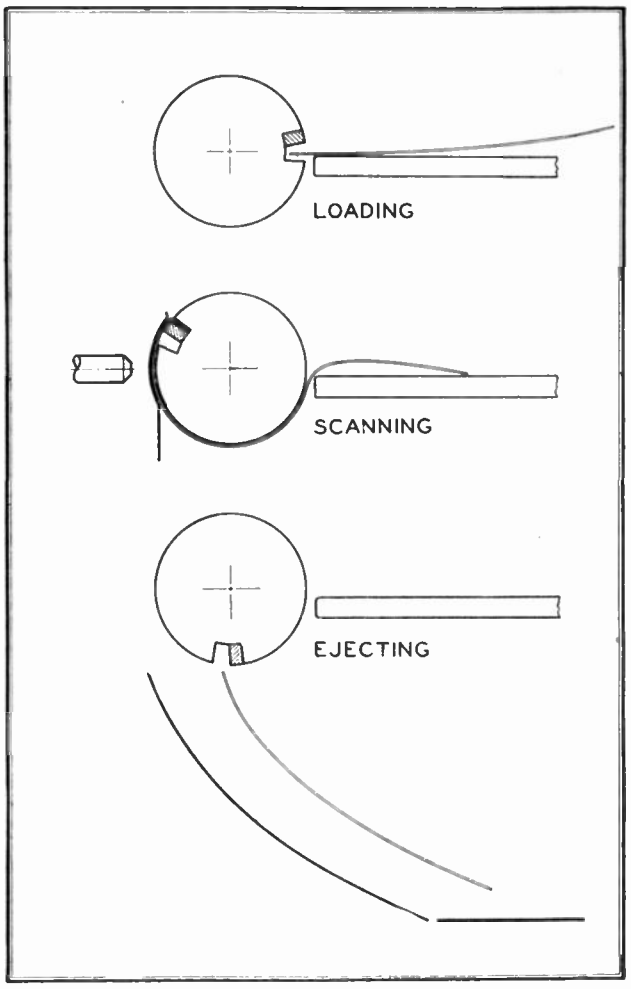


FIG. 16. OPERATION OF THE PAPER-HOLDING CLAMP

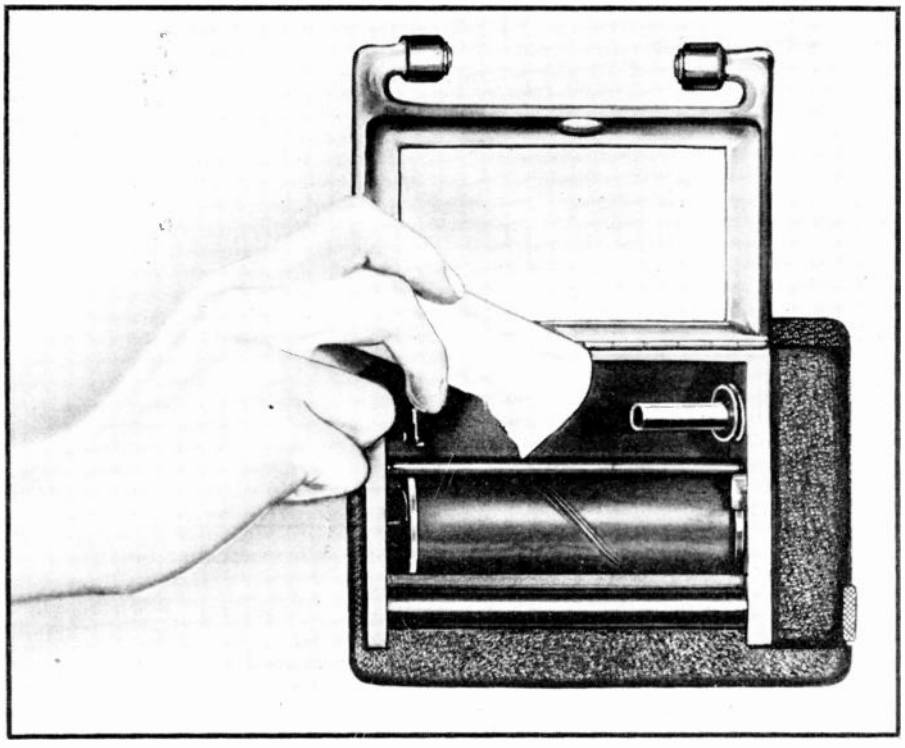


FIG. 17. METHOD OF INSERTING REFILL OF ALFAX RECORDING PAPER

FCC PROPOSAL FOR FM BROADCASTING

Complete Official Text of Proposed Rules and Regulations for Commercial FM Broadcast Service

August 24, 1945

REPORT BY THE COMMISSION

This Report contains the Commission's decision with respect to the 10 suggested rules and regulations concerning FM broadcasting which were set forth in the Commission's order of June 27, 1945 and which were the subject of recent oral argument. The substance of the Rules and Regulations is discussed in this Report which is issued at this time in order that manufacturers, existing and prospective licensees, and applicants may have an immediate opportunity to make specific plans for the postwar development of FM broadcasting. The final draft of regulations and standards based on the allocation plan contained in these proposals will be issued within the immediate future.

PART I

The allocation plan which was set forth as item 10 in the order of June 27 will be discussed first.

Plan of Allocations ★ Any allocation plan for FM broadcasting is complicated by the fact that in the eastern part of the United States (hereinafter defined with more particularity as Area I) there is a heavy concentration of population. The demand for frequencies in this portion of the country is far greater than in the remainder of the country and testimony at the hearing clearly indicated that the 70 channels allocated to FM broadcasting would not meet the demands which can reasonably be expected in this part of the country. Accordingly, the Commission has concluded that the two megacycles between 106 and 108 mc., which had been initially reserved for facsimile but which the Commission indicated would eventually be used by FM should be immediately assigned to FM. The Commission is of the opinion that as between facsimile and FM there is much greater *present* need for the use of these frequencies by FM broadcasting than by facsimile.

This does not mean that no provision is being made for facsimile. In the first place the 10 megacycles between 470 and 480 mc. remain available for facsimile broadcasting. Secondly, even as to the 2 megacycles between 106 and 108 mc. the Commission intends for the present to utilize the frequencies in this band for FM broadcasting only in Area I. In the remainder of the country these frequencies will not be assigned to FM at the present time and can be used for facsimile broadcasting. Finally, the rules which the Commission is adopting expressly permit simplex operation of facsimile on any FM channel during hours not required to be devoted to FM aural broadcasting (a minimum of six hours per day) and also permit under certain conditions and on an experimental basis the multiplex transmission of facsimile and aural broadcast programs.

The 80 channels which are available for FM broadcasting in Area I will be apportioned as follows: 20 of them to Community stations and 60 to Metropolitan stations. In the remainder of the country (Area II) 10 frequencies will be available for Community stations and 60 for Metropolitan and Rural stations. A full description of Community, Metropolitan, and Rural stations is contained herein.

Even when the 2 megacycles between 106 and 108 mc. are made available for FM broadcasting in Area I, difficult allocation problems still remain and the Commission must choose between two alternative proposals. Under the first alternative Metropolitan stations would be spaced far enough apart to enable them to serve to their 50 microvolt contour. Under the second alternative, Metropolitan stations would be placed much closer together so that these stations would not be able to serve to their 50 μv/m contour in all directions.

Under the first alternative only a very limited number of Metropolitan stations could be authorized in Area I because the cities are so close together. For example, tentative estimates indicate that if all Metropolitan stations were to be fully protected to their 50 μv/m contour and were authorized to use the equivalent of 20 kw. radiated power with an antenna height of 500 ft., no more than approximately 60 Metropolitan stations could be located in this part of the country. This compares with a total of 125 AM stations which are presently allocated in this part of the country, of which 80 have power of 500 watts or more. Moreover, under such an allocation plan New York would have no more than 10 Metropolitan stations, Boston 6, and Philadelphia, Washington and Baltimore 5 each. Smaller but nevertheless important cities like Hartford, New Haven and Bridgeport would have 2 Metropolitan stations each, while cities like Springfield, Mass. and Scranton would each have but one Metropolitan station. Thus under the first alternative there would be fewer FM stations in the eastern part of the United States than there are AM stations. Moreover, it would be impossible to have even as many nationwide FM networks as there are existing AM networks since some of the important cities which are necessary for a nationwide network would have but one or two stations and hence could not supply outlets for all the existing networks. This alternative would retard the development of FM broadcasting and would automatically deny many AM licensees any opportunity of shifting over to FM broadcasting, no matter how well qualified they might be. Such a situation is clearly not in the public interest.

Under the second alternative, Metropolitan stations would not be able to serve to their 50μv/m contour in all directions. However, as a result these stations would be placed much closer together and hence there would be more stations. Moreover, it should be pointed out that even though these stations will not be able to serve to their 50 μv/m contour in all directions, the primary service area of such stations will in practically all cases be substantially equal to the primary service area of even the clear channel AM stations, and will be much greater than the primary service area of other AM stations. Under this alternative, our studies indicate, it will be possible to allocate in Area I at least as many Metropolitan FM stations as there are existing AM stations (whether high or low power) plus as many as 50% more in most communities.[1] The Commission is of the opinion that it is much more in the public interest to have a large number of stations each with a somewhat smaller service area (although larger than the primary service area of AM stations) than a few stations each with a large service area.[2]

For the purposes of allocation, the United States will be divided into two areas. The first area (Area I) includes southern New Hampshire; all of Massa-

[1] A possible distribution of such stations among the cities in the eastern part of the United States is shown in the table on pages 40 and 42.

[2] Section 307 (b) of the Communications Act provides:

In considering applications for licenses, and modifications and renewals thereof, when and insofar as there is demand for the same, the Commission shall make such distribution of licenses, frequencies, hours of operation, and of power among the several States and communities as to provide a fair, efficient, and equitable distribution of radio service to each of the same.

chusetts, Rhode Island and Connecticut; southeastern New York as far north as Albany-Troy-Schenectady; all of New Jersey, Delaware, and the District of Columbia; parts of Maryland; and eastern Pennsylvania as far west as Harrisburg. In addition the demand for frequencies in some of the territory contiguous to Area I may in the future exceed the supply and when it does this region will be added to Area I. Until this happens this region will not be included in Area I but applications from this region will be given special study and consideration to insure an equitable distribution of facilities throughout the region. This region includes the remainder of Maryland, Pennsylvania and New York (except the northeastern corner) not included in Area I; the northern half of West Virginia; all of Ohio and Indiana; southern Michigan as far north as Saginaw; Eastern Illinois as far west as Rockford-Decatur; and southeastern Wisconsin as far north as Sheboygan.

The second area (Area II) comprehends the remainder of the United States not included in Area I.

The channels available for FM broadcasting will be divided in these two areas as follows:

A. Community Stations ★ Twenty frequencies beginning with 104.1 and ending with 107.9 mc. will be allocated for Community stations in Area I and 10 frequencies beginning with 104.1 and ending with 105.9 mc. will be allocated for Community stations in Area II. The 10 frequencies from 106.1 to 107.9 mc. which are available for Community stations in Area I but not in Area II will be assigned in Area II in the future in accordance with the needs of the area as shown by future developments. In the meantime, they will be available for facsimile.

It will be noted that the Community stations are put at the top of the FM band instead of the bottom as proposed in the Commission's order of June 27. The reason for this is that at the hearing there was some evidence that it might take longer to develop high power on the higher frequencies of the FM band than at the lower portion thereof. Since it is proposed to limit the power of Community stations to 250 watts, these stations should have no difficulty in beginning immediate operation on the higher frequencies.

Community stations will be limited to a maximum effective radiated power of 250 watts and a maximum antenna height of 250 ft. over the average height of the terrain 10 miles from the transmitter. Upon proper showing that an antenna height in excess of 250 ft. is necessary, authorization will be issued for such higher antenna but the Commission may in such cases require a reduction in radiated power. The main

Location of Stations	Population	No. of Existing AM Stations	No. of Possible Metropolitan Stations for the City Where AM Stations Are Located or in Nearby Cities	Channel No.†	1000-μv/m Signal From Metropolitan Stations Located in Other Cities
CONNECTICUT					
Bridgeport	147,121	2	3	50, 52, 54	9
Hartford	166,267	4	6	2, 4, 6, 8, 10, 12	10
New Haven	160,605	2	5	22, 24*, 26*, 28*, 30*	7
New London	30,456	1	2	32, 34	0
Stamford	47,938	1	**		3
Waterbury	99,314	2	4	14, 16, 18, 20	14
DELAWARE					
Wilmington	112,504	2	3	36, 38, 40	13
DISTRICT OF COLUMBIA					
Washington	663,091	6	12	1, 3, 11, 17, 19, 35, 42, 44, 46, 48, 57, 59	0
MARYLAND					
Baltimore	859,100	5	10	5, 7, 9, 21, 23, 25, 27, 29, 31, 33	0
Frederick	15,802	1	**		0
Hagerstown	32,491	1	**		0
Salisbury	13,313	1	**		0
MASSACHUSETTS					
Boston	770,816	7	10	1, 3, 5, 7, 9, 11, 13, 15, 17, 19	4
New Bedford	110,341	2	3	37, 39, 41	6
Fall River	115,428				
Fitchburg	41,824	1	**		8
Greenfield	15,672	1	**		0
Holyoke	53,750	4	6	36, 38, 40, 42, 44, 46	8
Springfield	149,554				
Lawrence	84,323	3	4	33, 35, 43, 45	12
Lowell	101,389				
Haverhill	46,752				
Portsmouth, N. H.	14,821				
Pittsfield	49,684	1	**		12
Salem	41,213	1	**		14
Worcester	193,694	3	4	49, 51, 53, 55	0
W. Yarmouth-Hyannis	3,424	1	**		0
NEW HAMPSHIRE					
Manchester	77,685	2	2	57, 59	4
NEW JERSEY					
Asbury Park	14,617	1	**		20
Atlantic City	64,094	2	**		0
Bridgeton	15,992	1	**		3
Camden	117,536		(See Philadelphia)		19
Jersey City	301,173	1	**		20
Newark	429,760	2	**		20
Paterson	139,656	1	**		20
Trenton	124,697	2	3	49, 51, 53	13
Zaraphath	300	1	**		23
NEW YORK					
Albany	130,577	6	12	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 56, 58	0
Schenectady	87,549				
Troy	70,304				
Brooklyn	2,698,285	3	**		20
Freeport	20,410	1	**		20
Kingston	28,589	1	**		0
Middletown	21,908	1	**		0
Newburgh	27,805	1	**		0
New York City	7,454,995	13	20	3, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45	0
Poughkeepsie	40,478	1	**		0
White Plains	40,327	1	**		23
Woodside		1	**		20

* This channel is also available for assignment in the Mt. Washington area for a wide coverage station.
** This city would be eligible for Community stations.
† For convenience, the 60 FM channels available for Metropolitan stations have been numbered 1 through 60 starting at 92.1 mc.

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Henry Hulick, Chief Engineer, WPTF, Raleigh, N. C.

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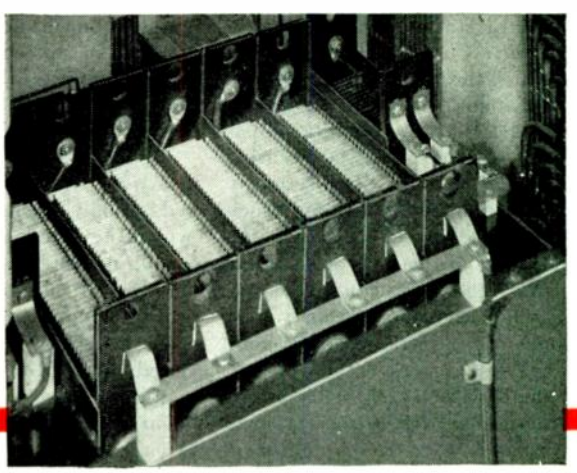

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(Signed) *Henry Hulick*

studio of Community stations shall be located in the city or town served and the transmitter shall be located as near the center of the city as practicable.

All the 20 frequencies allocated to Community stations in Area I will be available in communities which are not the principal city of a metropolitan district. In addition, 10 of these channels will be available for assignment in principal cities of metropolitan districts which have less than 6 Metropolitan stations.[3] In Area II, Community stations will be available for assignment to any community that is not the principal city of a metropolitan district.

A minimum separation of 50 miles will be provided in the case of Community stations on the same channel and a minimum of 35 miles on adjacent channels. Insofar as possible, Community stations will be allocated on the basis of multiples of these distances with the maximum separation possible.

Location of Stations	Population	No. of Existing AM Stations	No. of Possible Metropolitan Stations for the City Where AM Stations Are Located or in Nearby Cities	Channel No.†	1000-μv/m Signal From Metropolitan Stations Located in Other Cities
		PENNSYLVANIA			
Allentown, Bethlehem, Easton	96,904; 58,490; 33,589	2	4	1, 55, 57, 59	3
Harrisburg	93,893	3	6	15, 37, 39, 41, 43, 45	5
Hazelton	38,009	1	**		0
Lancaster	61,345	1	2	56, 58	9
Philadelphia	1,931,334	10	13	4, 6, 8, 10, 12, 14, 16, 18, 20, 24*, 26*, 28*, 30*	6
Reading	110,568	2	4	22, 32, 34, 47	2
Scranton, Wilkes-Barre	140,404; 86,236	5	9	5, 7, 36, 38, 40, 42 44, 46, 48	0
York	56,712	2	5	2, 13, 50, 52, 54	8
		RHODE ISLAND			
Pawtucket, Providence	75,797; 253,504	4	6	21, 23, 25, 27, 29, 31	3

Metropolitan and Rural Stations ★ Sixty frequencies (92.1–103.9 mc.) will be available for Metropolitan stations in Area I. In Area II these 60 frequencies will be available for both Metropolitan and Rural stations. No rural stations will be assigned in Area I.

1. AREA I: At the hearing two different proposals were made to the Commission for the allocation of stations in the eastern part of the United States. Under one proposal stations would be licensed to serve many markets so that the 1000 μv/m contour of such a station would include, for example, Boston, Worcester, Springfield, Providence, New Bedford and Fall River besides many smaller cities. Under the second proposal stations would be permitted to serve a single market only. The allocation which the Commission is adopting does not follow either plan entirely. Due to the fact that Metropolitan areas in Area I are concentrated, the licensing of wide coverage stations would seriously limit the total number of stations which would be included in this area. On the other hand, it is not feasible or desirable to restrict the 1000 μv/m contour of stations to a single metropolitan district or market since in any instances these markets are so close together that an abnormally small service area would result from limiting the service of the station to a single market. What the Commission proposes to do in Area I is to locate Metropolitan stations in such a manner that there will be a maximum number of stations in this region while at the same time ensuring to all listeners in this area the opportunity of having a choice of at least several FM signals. To accomplish this objective, Metropolitan stations will be located much closer to each other in Area I than in Area II. This will mean that Metropolitan stations will not be able to serve to their 50 μv/m contour in all directions. However, as has been pointed out, this service area will be larger than the service areas of AM stations. In general, Metropolitan stations in Area I will be licensed to use the equivalent of 20 kw. radiated power with an antenna height of 500 ft. Where higher antenna heights are available, they should be used but in such cases reductions in power will be required. The Commission may also authorize antenna heights less than 500 ft. where requested, but in such cases the stations will not be permitted to increase radiated power in excess of 20 kilowatts as the evidence shows that increase in power results in more severe tropospheric interference.

Under this plan, Metropolitan stations in Area I will lay down a 1000-μv/m signal not only in the metropolitan district in which they are located, but in some cases also in metropolitan districts that may be adjacent or contiguous thereto. Moreover, since it is not possible to assign Rural stations in Area I, the type of service rendered by the Metropolitan stations will be required to meet the needs and requirements of the rural listeners residing in this Area as well as of the urban listeners.

Preliminary studies by the Commission indicate that under this allocation plan all listeners in Area I, whether urban or rural, will have the opportunity of having a choice of several FM signals. The Commission intends to scrutinize closely the licensing of stations in this area to make sure that this result is achieved. If it should develop that this result is not achieved, the Commission will take appropriate action either by the licensing of Community stations or by adjusting the service areas of Metropolitan stations in an appropriate manner.

For illustrative purposes only and not as a standard of allocation there is set forth here a table showing a possible allocation of Metropolitan stations in Area I. This table shows the number of AM stations in cities in Area I, the number of possible Metropolitan stations that could be located in such cities, and the number of 1000-μv/m signals from Metropolitan stations in other cities which could be received in these cities. It should be pointed out that the mere fact that certain cities are set forth in this table does not in any way indicate that Metropolitan FM stations will be licensed in those particular cities rather than in some neighboring cities. The Commission will consider applications for Metropolitan stations from any communities in Area I whether or not listed in the table, and all such applications will be considered on their individual merits. The purpose of the table is simply to show that under the allocation plan adopted by the Commission it will be possible to have at least as many Metropolitan stations in Area I as there are AM stations and in most cities 50% more. One other point should be mentioned. The table shows only Metropolitan stations. Community stations may be used to supplement the assignment in cities which have less than 6 Metropolitan stations.

2. AREA II METROPOLITAN STATIONS: Metropolitan stations in Area II are designed primarily to render service to a single metropolitan district or a principal city, and to the rural areas surrounding such metropolitan district or principal city. The Commission will designate serv-

[3] For the time being, until more FM stations are authorized, the Commission will not authorize Community stations in principal cities of metropolitan districts having 4 or more AM stations.

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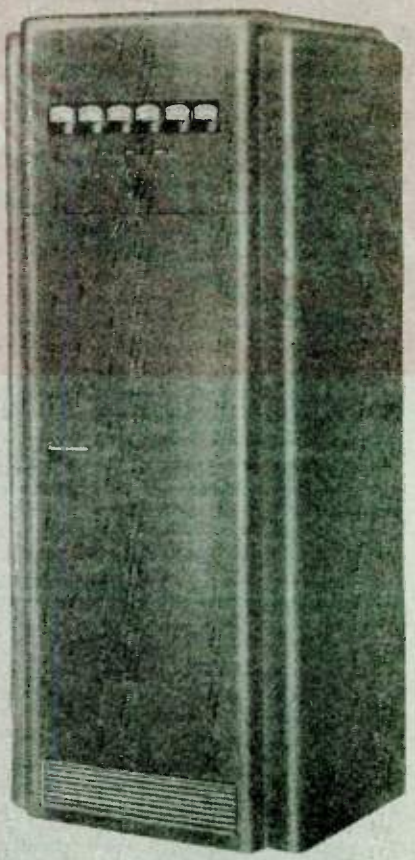
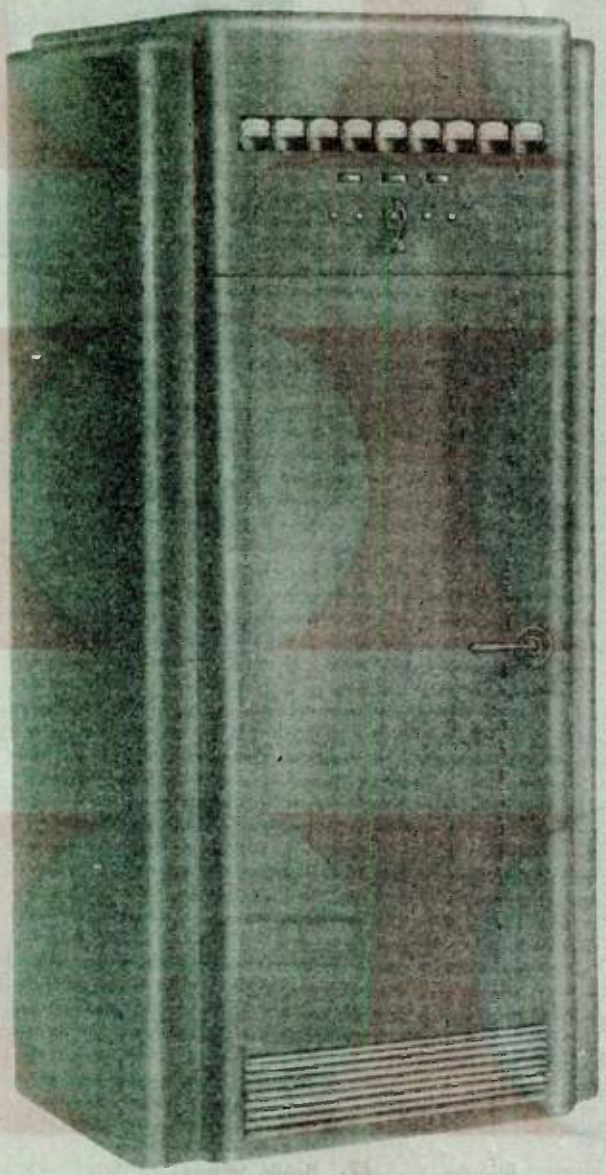


100 watt to 350 watt output ratings.



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2. Motorized Tuning Controls permitting placement of components in chasis positions best suited for maximum circuit efficiency.
3. Eye-Zone Meters and Hand-Level Controls introducing a highly desirable innovation for ease of operation.
4. Temco Power-Flex Multiple Unit Design for expanding power output without making obsolete lower power units and retaining uniform over-all appearance.
5. Dust and Tamper Proof Cabinets.
6. Forced Draft – Filtered Ventilation.
7. Handsome, dignified styling throughout.

Designed and built by Temco Radar specialists, these Transmitters represent a complete embodiment of technically advanced concepts of radio engineering and design, combined with Temco's distinguished *high standard craftsmanship*. Write for specifications stating your power and service requirements. Orders will be filled in rotation as received.

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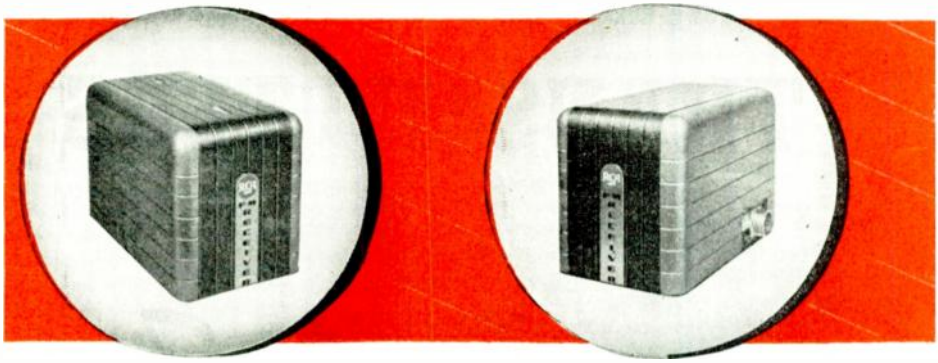
When you see it, operate it, hear it—observe its superior convenience, performance, and facilities for easy, quick servicing—

New RCA 26-42 MC (Mobile or Station) Transmitter Features

1. Superior audio quality sets new standard. Sounds better. Easier on the ear. Easier to get message.
2. Positive modulation threshold limiter. Adjusts automatically to input of low or loud voices. No "blasting."
3. Low spurious emission. Less extraneous noise interfering with other services. Fewer energy leaks to make trouble.
4. Improved phase modulator requires no tuning. No more bother with modulator.
5. Excellent stability over wide temperature range. Temperature change has minimum effect on operation of equipment.
6. Adjustable to exact, specified frequency. Easy, precise tuning in a hurry.
7. All tuning adjustments are from top of transmitter. Easily accessible. (Remember those times you have had to turn the chassis over?)
8. No high voltage exposed above chassis. All dangerous voltage out of reach. (Many times a slip of the hand might have given you a shock.)
9. Provision for two-frequency operation. Useful when you want to switch over from talking between car and station to talking between car and car (and in lots of other ways).
10. Single control cable—also accommodates receiver. One cable, instead of three or four, running from front of car to rear. Simplifies installation and maintenance.
11. Mobile cables equipped with separable connectors. Add flexibility in operating equipment. Equipment removable without using special tools. All cables plug in and lock.
12. Chassis readily detached from base. Easier to inspect and service.
13. Single-unit construction saves space.
14. Easy to install. Mounting hardware supplied. Comes complete, down to bolts and nuts.
15. Start-stop switch on chassis to facilitate adjustment. (Think how much better this is than having to go up front and press a button to turn on the transmitter.)

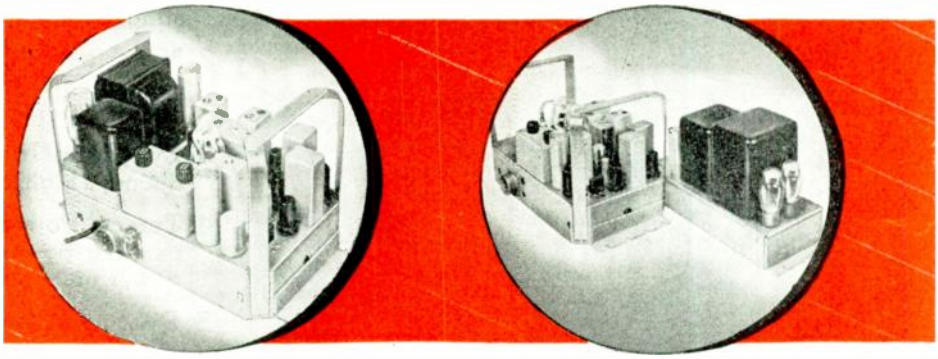
New FM 26-42 MC (Mobile or Station) FM Receiver Features

1. Superior adjacent-channel selectivity. You hear the station you want to hear.
2. Low spurious response. Won't pick up unwanted signals.
3. Excellent stability over wide temperature range. Variations in temperature have minimum effect on operation.
4. Single-unit construction. Fewer interconnecting cables. Easier to service.
5. Easy to install. Mounting hardware supplied. Comes complete, down to last nut and bolt.
6. Chassis readily detachable from base. Easy to remove for inspection and servicing.
7. Mobile cables fitted with separable connectors. Cables plug in and lock. Require no special tools. (Another important point—you can't plug in the wrong cable!)
8. Low battery drain. Less battery servicing.
9. Class B output tube saves power on standby. Output stage takes very little power except when signal is being received.
10. Provision for carrier-operated relay. Can be used to operate other circuits for auxiliary signalling—turn on light, ring bell, etc.—or operate retransmitting equipment.
11. Single crystal. Eliminates potential trouble with matching crystals.
12. Attractively styled. And we mean darned good-looking.



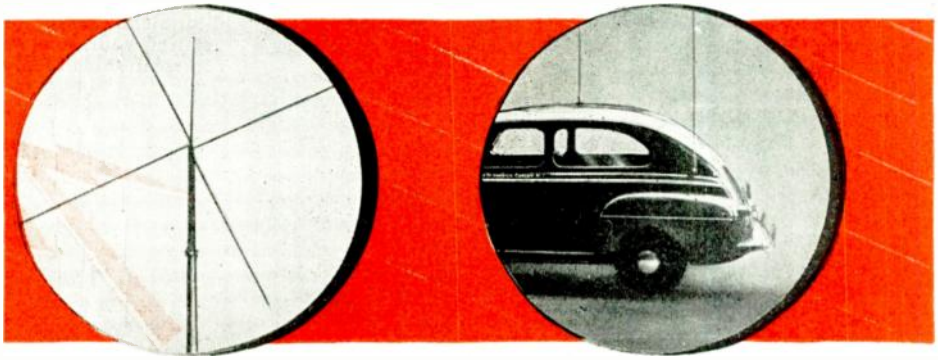
1. **FM Mobile Receiver:** Ultra-modern circuits, construction and styling. Small, compact, rugged. Easily removed from mounting base. Simple to service. Provided with either dynamotor or vibrator type power supply.

2. **FM Station Receiver (for shelf-mounting):** Same chassis unit as #1, but intended for shelf-mounting in headquarters control room. Easily and quickly installed. Attractively styled cover adds to station's appearance.



6. **30-Watt FM Station Transmitter:** Uses same chassis unit as #4. Can be furnished with dust cover (as shown in #4) for shelf-mounting, or with brackets for mounting in standard RCA cabinet-rack, such as shown in #8.

7. **60-Watt FM Station Transmitter:** Uses same chassis as #5, but is furnished with chassis brackets for rack-mounting. A.C. power supply is a separate chassis unit. Not furnished for shelf-mounting.



11. **Station Antenna:** A standard RCA design of proved performance. Consists of vertical radiator plus four "ground" rods. Easy to install, neat appearing, and provides more gain than simple rod type.

12. **Mobile Antenna:** Furnished with FM mobile transmitters shown above. Two models, one for roof-top, the other for fender mounting. Simple one-hole mounting. Supplied complete with connecting coaxial line.

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you will agree that this new RCA equipment sets a new standard of radio usefulness for police- and fire-department requirements. It tunes easier, sounds better, is more stable. It operates simply, smoothly, surely. It is more selective, requires fewer adjustments, and less maintenance, yet can be serviced more quickly, easily, and safely.

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3. FM Station Receiver (for rack-mounting): Also, the same chassis unit as #1, but without cover, and provided with brackets for mounting in a cabinet-style rack. This is the type of mounting used in most larger installations.

4. 30-Watt FM Mobile Transmitter: Mounted in attractively styled housing matching the receiver unit. Makes use of improved phase-modulator circuits providing better quality and better stability. Arranged for two-frequency operation, if desired.

5. 60-Watt FM Mobile Transmitter: Similar to #4 in over-all size and appearance, but provided with additional tube in output stage, in order to obtain full 60-watt carrier. Both transmitters use built-in dynamotor supply.

8. 250-Watt FM Station Transmitter: Consists of the two chassis shown in #7 (as an exciter), plus a 250-watt amplifier, mounted on a similar-type chassis. All assembled in an attractively styled cabinet rack.

9. Station Handset and Control Unit: Furnished with the FM Station Transmitters shown here. The control unit contains a loudspeaker, plus controls for adjustment of "volume" and "squelch." Also, "transmit," "receive," and "stand-by" signal lights.

10. Mobile Handset and Control Unit: Furnished with the FM Mobile transmitters shown above. The two units can be conveniently mounted on the dash in any desired position. Control includes "volume" and "squelch." Signal lights indicate "transmit" and "stand-by."

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ice areas for Metropolitan stations in Area II.[4] At this time, however the Commission will not require Metropolitan stations to serve this entire area, but attention is called to the fact that licensees of Metropolitan stations will at this time be required to serve an area substantially greater than would be served by a Community station, as otherwise there would be a wasteful use of the frequency. In the future, in determining whether the Commission should require all Metropolitan stations to serve the entire area specified by the Commission, the Commission will give consideration to all pertinent factors such as economics, the competitive situation, other services in the area, the demand for frequencies, and the extent to which Metropolitan stations have voluntarily extended their service areas to include substantially the service areas specified by the Commission. Applicants for Metropolitan stations in Area II should keep this in mind when choosing antenna sites and in making long-range plans concerning the operation of their stations.

3. Area II Rural Stations: Licensees of Metropolitan stations or applicants who desire to qualify as Rural stations must make a special showing to the Commission that they propose to serve an area more extensive than that served by a Metropolitan station and that the additional area proposed to be served is predominantly rural in character. As a guide, the Commission will consider that the additional area beyond the service area of a Metropolitan station which is proposed to be served is predominantly rural in character if at least 50 per cent of the population proposed to be added within the 50 μv/m contour live in rural areas or in communities smaller than 10,000. Exceptions to this rule will be made where a showing is made to the Commission that due to conditions of terrain or local factors, more extended service to unserved rural areas is possible by licensing Rural stations to serve an area which does not meet the above test than would otherwise be possible.

PART II

Other Regulations ★ With respect to the other suggested rules and regulations which were set forth in the Commission's order of June 27, 1945, the Commission took the following action:

1. Minimum Operating Schedules: All FM stations will be licensed for unlimited time operation and initially will be required to operate a minimum of six hours per day for aural broadcasting. Simplex facsimile transmission will be permitted during hours not required to be devoted to aural broadcasting.

2. Program Duplication: No rules or regulations are being adopted at the present time concerning program duplication.

3. Multiple Ownership: The rule on multiple ownership is the same as the existing Rule 3.230. This is the rule that was set forth in the Commission's order of June 27, 1945. It reads as follows:

> Multiple Ownership: (a) No person (including all persons under common control) [5] shall, directly or indirectly, own, operate, or control more than one FM broadcast station that would serve substantially the same service area as another broadcast station owned, operated, or controlled by such person.
>
> (b) No person (including all persons under common control) shall, directly or indirectly, own, operate, or control more than one FM broadcast station, except upon a showing (1) that such ownership, operation, or control would foster competition among FM broadcast stations or provide an FM broadcasting service distinct and separate from existing services, and (2) that such ownership, operation, or control would not result in the concentration of control of FM broadcasting facilities in a manner inconsistent with public interest, convenience, or necessity; *provided, however*, that the Commission will consider the ownership, operation, or control of more than six FM broadcast stations to constitute the concentration of control of FM broadcasting facilities in a manner inconsistent with public interest, convenience, or necessity.

4. Ownership of FM Stations by Licensees of AM Stations: The Commission does not believe it is necessary to promulgate any rule on this subject at the present time.

5. Network Regulations: The chain broadcasting regulations (Sec. 3.101–3.108) are being made applicable to all types of broadcasting stations.

6. Use of Common Antenna Site: The Commission is adopting a rule which provides that no FM license or renewal of an FM license will be granted to any person who (1) owns, leases, or controls a particular site which is peculiarly suitable for FM broadcasting in a particular area and which is not available for use by other FM licensees; and (2) no other comparable site is available in the area; and (3) where the exclusive use of such site by the applicant or licensee would unduly limit the number of FM stations that can be authorized in a particular area or would unduly restrain competition among FM stations.

7. Booster Stations: No regulation with respect to booster stations is being promulgated at the present time. However, applications for booster stations will be considered on their individual merits.

8. Reservation on 20 Channels: The Commission does not propose to reserve any FM channels from assignment at the present time.

9. Facsimile Broadcasting and Multiplex Transmission: This rule is being adopted in the form contained in the Commission's order of June 27, 1945. It reads as follows:

> Facsimile Broadcasting and Multiplex Transmission: Transmission of simplex facsimile on FM channels in accordance with the Commission's Standards of Good Engineering Practice on Facsimile may be permitted, upon application to the Commission, during hours not required to be devoted to FM aural broadcasting. The Commission may grant experimental authority to an FM station for the multiplex transmission of facsimile and aural broadcast programs, provided that the facsimile transmission is incidental to the aural broadcast, does not reduce the quality of the aural program, and that a filter or other additional equipment is not required for receivers not equipped for facsimile service.

Separate Views of Commissioner Clifford J. Durr

In its order of hearing issued in these proceedings, the Commission suggested two proposed rules which, it seemed to me, were of great importance to the early development of FM broadcasting in the public interest. The first would have provided for at least two hours of independent programming of every FM station operated by an AM licensee, one hour during the morning and one hour during the evening. The second would have reserved twenty FM channels from present assignment in the interests of encouraging the entry of newcomers into the field of FM broadcasting. The Commission has now rejected both of these suggestions, and to that extent I am unable to agree with the report.

The value of Frequency Modulation broadcasting does not lie solely in its superior fidelity and greater freedom from static and interference. Of equal, if not

[4] In determining service areas for particular communities, the Commission will give consideration to population distribution, terrain, trade areas, economics and other pertinent factors. There are several current and recognized authorities on retail trading areas or consumer trading areas from which the applicant may prepare its showing and to which the Commission will give consideration in making its determination. Among these recognized authorities are the following: J. Walter Thompson (Retail Shopping Areas), Hearst Magazines, Inc. (Consumer Trading Areas), Rand McNally Map Co. (Trading Areas), and Hagstrom Map Co.'s Four Color Retail Trading Area Map.

[5] The word "control" as used herein is not limited to majority stock ownership, but includes actual working control in whatever manner exercised.

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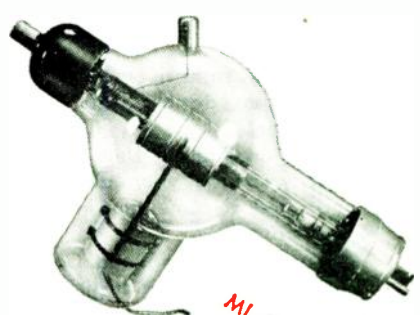

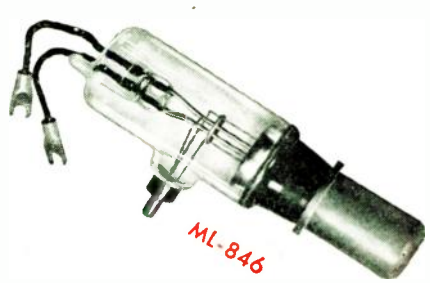

WHEN first announced, in 1938, the Machlett Dynamax represented the solution of the most difficult problems ever encountered in electron tube manufacture — paralleled only by the Machlett VM-1, the first precision, sealed-off, 2,000,000-volt dc tube.

The Dynamax was designed to meet the demand for a dependable, high-capacity X-ray tube that would give much sharper definition under the most adverse conditions. The desired results could be obtained only by using a very small focal spot, and an electron beam of high energy, 100 KV, .5 amp. Concentrating so much energy on a small spot meant destruction of target and tube unless the heat could be dissipated. Rotating the target was found to be the most effective means of protection, but this produced a much greater problem, that of lubricating the motor bearings inside the envelope without impairing the vacuum through distillation of the lubricant. A novel method of coating the bearings with a film of pure metallic silver was developed by Machlett engineers, with the result that the weakest spot became the strongest.

Today, Machlett rotating-anode tubes give over 200,000 exposures, over ten times the normal life expectancy of X-ray tubes of only a few years ago, and *more than twice that of present-day conventional stationary-anode tubes!* This is the preferred type for use in mass health surveys and busy institutions where the load is too great and too constant for any other tube. You will be interested in the full story of the Dynamax — write for your copy today; it will be sent with our compliments.

True enough, the Dynamax is an X-ray tube — but all electron tubes are brothers under the skin. The engineering talent, the techniques and the manufacturing skill which produced the first really successful rotating-anode tube are the same that now guarantee the performance and advanced features of all Machlett electron tubes, for all purposes, whether in the fields of radio or industry. It will pay you to use this background of electron tube engineering and production skill by choosing a Machlett when you need an oscillator, amplifier, modulator or rectifier. Machlett Laboratories, Inc., Springdale, Connecticut.

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APPLIES TO RADIO AND INDUSTRIAL USES ITS 48 YEARS OF ELECTRON-TUBE EXPERIENCE

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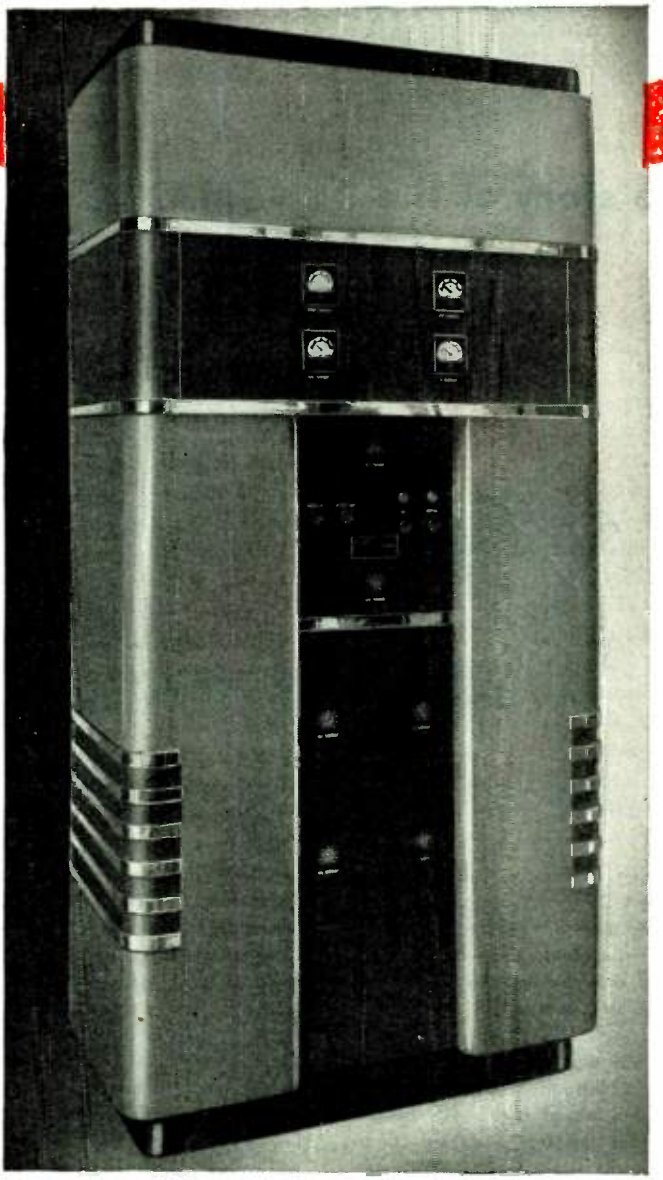

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Phasing equipment by Johnson can be found successfully operating in more than 50 broadcast stations and is backed by over 20 years experience in the manufacture of radio transmitting equipment. All major components used in Johnson Phasing and Antenna coupling equipment are designed and manufactured by Johnson, assuring the best material and workmanship. The quality of the equipment is under control of Johnson engineers at all times.

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greater importance are the new spaces which it opens up in the broadcasting spectrum and the opportunities thereby afforded of providing the public with a wider range of program choice. Because of the failure of the Commission to require any independent programming of FM stations, I am very much afraid that many FM licensees who are now operating AM stations will be inclined to regard their FM licenses primarily as insurance policies protecting their AM operations against the risks of technological development, with the result that, for several years at least, the listening public will receive little more than the same program traffic carried over improved highways. It seems to me that the use of two radio channels for only one program service is not only a waste of frequencies but will retard the development of FM broadcasting. FM will develop at the speed of the increase of listening sets in the hands of the public and, in my opinion, listeners will not be encouraged to buy FM receivers if their investment means only that they can hear a little more clearly the same programs which they now receive.

It is true that some new programs will be offered by newcomers into the broadcasting field, such as educational institutions and the comparatively few commercial newcomers having the financial means to absorb the operating losses which are to be expected until FM broadcasting becomes established, but still the AM operators should be expected to carry their full share of the burden of FM development. Their profits now are at an all-time peak, and it is not unreasonable to expect them, in the interests of the public they have undertaken to serve, to devote at least a part of these profits to the production of new programs, particularly suited to the greater fidelity of FM broadcasting.

I cannot go along with the Commission's abandonment of the requirement of separate programming which has been its established policy since June 21, 1940 (Rule 3.261).

In its Allocation Report of May 25, 1945, the Commission stated:

"Since the radio spectrum is public domain, the granting of a license to operate a station is a valuable public privilege. The Commission, in carrying out its responsibilities under the Communications Act, has frequently emphasized the statutory mandate that broadcasting shall be conducted on a competitive basis, and has sought to maintain a fair and even-handed treatment of competitors. It is economically and socially unwise to concentrate the control of broadcast facilities in the hands of a select few, and it is economically and socially essential to keep the door open to the fullest extent possible for newcomers.

"However, as indicated above, the large percentage of AM licensees among the present FM applicants and the economic advantage which AM licensees have in building and operating FM stations more cheaply raise serious questions as to whether, unless some special measures are taken to that end, this objective will be accomplished. The Commission recognizes that until a substantial number of receivers are in the hands of the public, FM broadcasting will not be a self-supporting operation.

"To keep the door open for later applicants, the Commission is considering the adoption of the following plan: 50 FM commercial channels will be available for assignment both to present licensees and to newcomers in the radio field. This policy will afford existing AM licensees an opportunity to enter FM if they so desire, and in addition will enable some new persons to participate in FM's early development. The remaining 20 FM commercial channels will be reserved from assignment at the present time to be licensed in the future in accordance with rules and regulations subsequently to be promulgated."

The favored position of the AM operator has been further enhanced by the Commission's abandonment of the requirement of independent programming. The newcomer must bear the expense of completely programming his FM station while the AM operator can program his FM station without any additional cost whatsoever.

The need of reserving twenty channels for newcomers is as great today as it was at the time the Commission's Allocation Report was issued, and the arguments in favor of such reservation are even more equally compelling. Section I of the instant Report now makes it clear in portions of the country the immediate demand for FM frequencies may well exceed the supply. Moreover, there are undoubtedly many men and women still in the armed services who would like to apply for broadcasting licenses and who could bring to broadcasting the imagination, energy, and freshness of approach which it so urgently needs. Upon their discharge from the service, they may find that in their communities the best channels, if not all of them, have already been fully occupied.

Except as above stated, I concur in the Report.

Editor's Note: The final text of the Rules and Regulations for FM broadcasting, issued just prior to our closing, confirms the text given here in every detail.

10-KW. FM TRANSMITTERS

(CONTINUED FROM PAGE 33)

be received with enjoyable quality and freedom from interference.

Even when new transmitters go on the air in the new band, they will not replace the present transmitters, since they will have to operate at low power for a considerable period of time, so that listeners will have to depend, to a large extent, on the present transmitters which are operating at full power.

Your implied threat to discipline manufacturers at the expense of FM listeners is without precedence, and it has no justification under your obligation to serve public interest, convenience, and necessity. I speak for both listeners and manufacturers when I beg to remind you that manufacturers are only obligated to conform to the requirements of their customers, the radio listeners.

If the decision to risk listeners' best interests by shifting FM broadcasting to a new band has placed the Commission in some difficult situation, the situation should be remedied by the Commission. I hope sincerely that you will not make a bad situation still worse by interfering with radio manufacturers for, in the end, the listeners will be the ones who will really suffer.

Our view of the present situation, as it appears from up here, is expressed in the enclosed proofs ("What's Behind the AM vs. FM Battle?") from our August issue.

Cordially,
MILTON B. SLEEPER

The following undated letter refers to both our letter and the article:

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D. C.

Mr. Milton B. Sleeper
FM AND TELEVISION
511 Fifth Avenue
New York 17, New York

Dear Mr. Sleeper:

I have no desire to engage in controversy with respect to my letter to Mr. Cosgrove which as you have correctly interpreted was purposely designed to discourage manufacturers from building receivers for two-band FM coverage. The purpose of this unanimous opinion of the Commission appears obvious on its face and while the Commission has no authority over the manufacturers, and desires none, it does have a duty to allocate radio frequencies and a definite responsibility to inform the public and its licensees of the bases for such decisions. This it has done and will continue to do.

It does appear to me, however, that

(CONTINUED ON PAGE 56)

FREQUENCY AND PHASE MODULATION

Explaining Similarities and Differences Between Amplitude, Frequency, and Phase Modulation

BY RALPH S. HAWKINS*

IN THIS discussion of fundamental relations between frequency modulation and phase modulation, it will be assumed that the modulating audio frequencies and the modulated radio frequencies are sine waves, in order to avoid unnecessary complications.

It is fundamental that frequency modulation produces an equivalent phase modulation, and that phase modulation produces an equivalent frequency modulation. This should be kept in mind so as to understand that either may be the cause, and the other is always the effect. Furthermore, the deviation cycle of the equivalent modulation is also sinusoidal, but 90° out of phase with the deviation cycle of the direct modulation.

A clearer picture of the situation is given by showing how a phase modulator can be employed in place of a frequency modulator, by making use of the equivalent frequency modulation produced by the phase modulator. If a phase modulator is to be used as a frequency modulator, it is obvious that the equivalent frequency modulation deviation must be directly proportional to the amplitude of the modulating wave and independent of its frequency, as is required for frequency modulation. However, in a phase modulator, the phase deviation is directly proportional to the modulating wave amplitude and the equivalent frequency deviation is related to the phase deviation as follows:

$$\Delta F = f\Delta\Theta$$

This equation indicates that the above requirement is not fulfilled in that the equivalent frequency deviation depends directly on the modulating frequency. This situation can be remedied by passing the audio modulating wave through a de-emphasis circuit before application to the phase modulator so that the amplitude of the wave actually applied to the modulator is inversely proportional to frequency. This combination still produces a phase-modulated wave, but the amplitude of deviation of the equivalent frequency modulation is independent of the modulating frequency, and directly dependent on the modulating wave amplitude, as is required for frequency modulation. Also, for these conditions, the amplitude of the phase deviation produced is inversely proportional to the modulating frequency and directly proportional to modulating wave amplitude, which is characteristic of the equivalent phase modulation of a frequency modulator. These statements are based on the relation between maximum phase or frequency deviation and the equivalent frequency or phase deviation which, for sinusoidal modulating and modulated waves, is:

$$\Delta\Theta = \frac{\Delta F}{f} \text{ or } \Delta F = f\Delta\Theta$$

It should not be forgotten, however, that the modulator in this example is fundamentally a phase modulator and, therefore, the cycle of phase deviation is in phase with voltage applied to modulator, and that the cycle of frequency deviation is not in phase with the voltage applied to the modulator, as would be the case if a frequency modulator were actually used. This phase difference is, of course, 90°. If a particular modulating wave shape can be represented by a sinusoidal wave and its harmonics then, for the fundamental and each of the harmonics the same 90° (relative to the frequency of the harmonic involved) phase difference between the frequency and phase deviation cycles exists. And if in the de-emphasis circuit the phase shift caused in the modulating wave is directly proportional to frequency, then the shape of the deviation cycle of the equivalent frequency modulation produced by the phase modulator with de-emphasis is therefore exactly the same as the shape of a cycle of the particular modulating wave involved.

The phase modulator with de-emphasis is, therefore, able to produce a frequency-modulated wave which, even for a complex modulating wave, is the same as would be produced by a frequency modulator except for the phase shift due to both the de-emphasis circuit and the 90° phase difference between the direct and equivalent modulation.

In a similar manner a frequency modulation discriminator can be used as a phase modulation detector because the discriminator will respond to the equivalent frequency modulation of the phase-modulated wave. The amplitude of the equivalent frequency modulation deviation cycle is given by the expression:

$$\Delta F = f\Delta\Theta$$

Thus the amplitude of the equivalent frequency deviation depends directly on the modulating frequency as well as the amplitude of the modulating wave. This fact indicates that the amplitude of the recovered audio wave will also depend directly on the modulating frequency as well as the amplitude of the modulated wave. This situation can be corrected by a de-emphasis circuit in which the response is *inversely* proportional to frequency, and the phase shift is *directly* proportional to frequency. The amplitude of the audio wave, recovered from the discriminator and de-emphasis circuit combination, will be independent of the modulating frequency and will depend directly on the modulating wave amplitude. Such an arrangement is, therefore, capable of demodulating a phase-modulated wave, even when a complex modulating wave is employed. It should be remembered that the recovered audio will not be in phase with the audio frequency modulating wave due to both the 90° relation between direct and equivalent modulation and due to the phase shift in the de-emphasis circuit.

In the preceding discussion, it was of course assumed that the linear operation capabilities of the modulator or discriminator were not exceeded.

In circuits linking the modulator and demodulator, the carrier and side bands, which must be considered, are exactly the same for either frequency or phase modulation. The number of side bands and their

IN THIS article, Ralph Hawkins has cleared up a point which has caused much confusion, sometimes further confounded by the use of "PM" to identify equipment which might better be described by what has become the generic term: "FM."

The explanation here shows that both frequency and phase modulation are present in any "FM" transmitter, and that which ever is used as the cause, the other is the effect.

Incidentally, it should be pointed out that Major Armstrong did not intend that his invention should be called "FM." But that name stuck in the beginning, and it is too firmly established to change it now.

*Engineering Department, National Company, Inc., Malden, Mass.

amplitude and the carrier amplitude depend only on the value of modulation index β. The frequency of the side bands for either type of modulation related to the carrier frequency is the same and depends only on the modulating frequency. The resultant sum of the carrier wave and all the side bands is, of course, equal to the frequency- or phase-modulated wave, as the case may be. The phase deviation cycle of this resultant wave is in phase with modulating wave for phase modulation and the frequency deviation cycle of the resultant wave is in phase with modulating wave for frequency modulation.

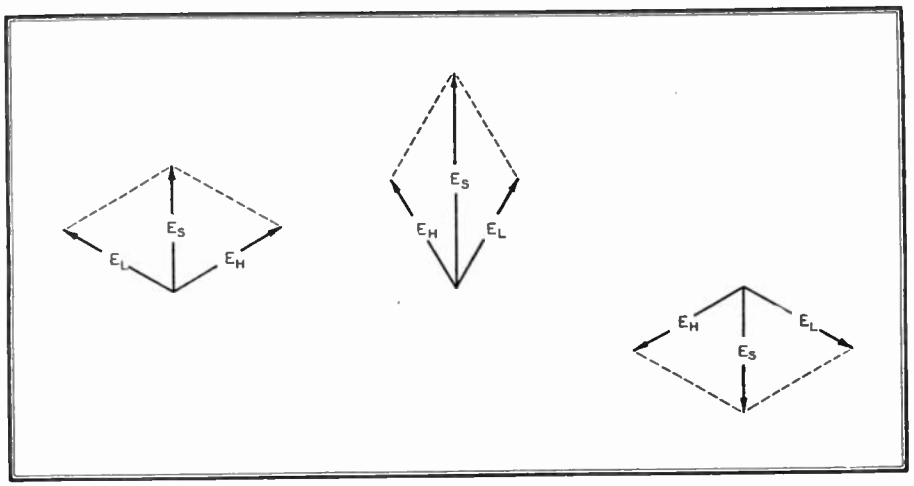


FIG. 1. PAIR OF AM SIDE BANDS AT THREE SUCCESSIVE INSTANTS DURING ANGULAR ROTATION

In reviewing the fundamental relations for amplitude modulation with sinusoidal modulating and modulated waves, it will be remembered that the amplitude-modulated wave can be considered as composed of a sinusoidal carrier wave and a pair of sinusoidal side bands. The carrier wave is of constant frequency and amplitude. The side bands are of equal amplitude, and the amplitude is directly proportional to the amplitude of the modulating wave. It will also be remembered that for amplitude modulation the frequency of the higher-frequency side band is equal to the carrier frequency plus the modulating frequency, and that the frequency of the lower-frequency side band is equal to the carrier frequency minus the modulating frequency.

Inasmuch as somewhat similar relations also hold true for frequency and phase modulation, some of the features of AM, FM, and PM are readily illustrated by means of vector diagrams when sinusoidal waves are involved. In the cases to be considered, the maximum amplitude of the radio-frequency waves considered will be of a greater interest than the instantaneous amplitude, which makes it expedient to use vector diagrams in which the carrier wave is represented by a stationary (i.e. not rotating) vector.

The reader can, if he chooses, think of the paper on which the vectors are drawn as rotating in a clockwise direction with an angular velocity in radians per second of 2π times the carrier frequency in cycles per second. In this type of diagram, therefore, the higher-frequency side band is represented by a vector which rotates in a counter clockwise direction with an angular velocity of 2π times the modulating frequency, which corresponds to the difference in frequency between the side band and carrier frequency. Similarly the lower-frequency side band is represented by a vector which rotates in a clockwise direction with an angular velocity equal to 2π times the modulating frequency.

For ease of reference to the vector diagrams to be considered, the following notation will be employed:

E_C = Vector representing the carrier
E_H = Vector representing the higher-frequency side band
E_L = Vector representing the lower-frequency side band
E_S = Vector representing the sum of the higher- and lower-frequency side band pair
E = Vector representing the amplitude-, or frequency-, or phase-modulated wave as the case may be, which in any case is equal to the sum of the carrier and all of the side band pairs involved.

The vectors shown in Fig. 1 represent a pair of AM side bands and their sum at three successive instants during their cycle of angular rotation.

These vector diagrams indicate that the sum of the side band waves E_H and E_L is a wave, E_S, which is of constant frequency, equal to the carrier frequency involved, as the vector E_S does not rotate. It should be noted, however, that the maximum amplitude of E_S changes and that each time the maximum amplitude passes through zero, the relative phase changes by π radians (i.e. 180 degrees). These vector diagrams also illustrate the well-known fact that, for AM, the maximum amplitude of E_S varies in a sinusoidal manner. It is also true for AM that the instantaneous maximum amplitude and relative phase of E_S depends directly on the instantaneous amplitude and polarity of the modulating wave. These facts are not, however, shown directly by the vector diagram.

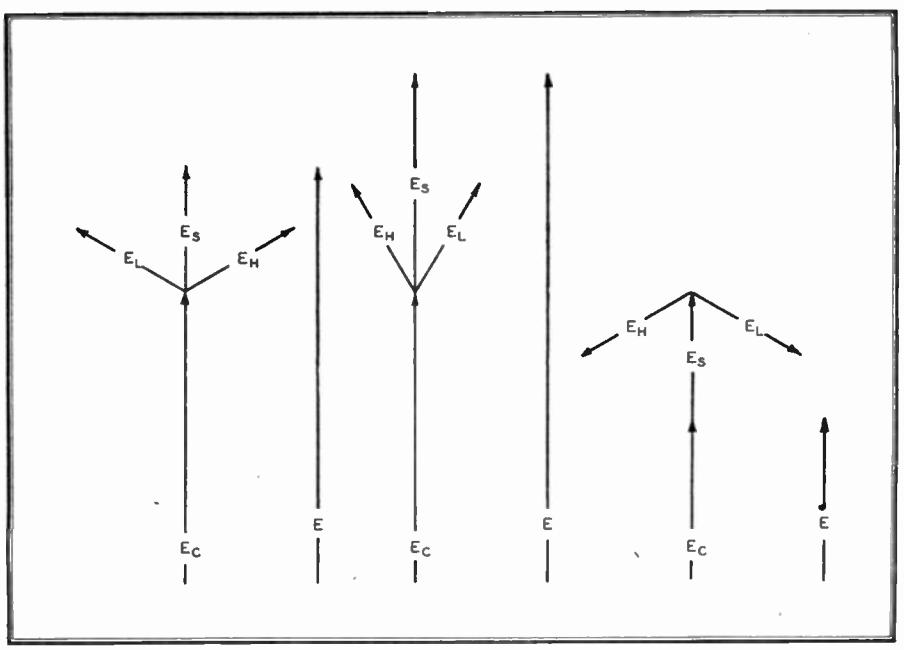


FIG. 2. HERE AN AM CARRIER PLUS THE SIDE BAND SUM IS REPRESENTED BY "E"

The vector diagrams shown in Fig. 2 illustrate the carrier and side band relations for AM if a carrier represented by a

vector E_C is added to the side band sum E_S with a relative phase such that E_S either adds directly to or subtracts directly from E_C depending on the relative phase of E_S. These conditions are illustrated in Fig. 2 which also shows the resultant amplitude-modulated wave E, which is the sum of the carrier and side bands.

In Fig. 2 it should be noted that the frequency and relative phase of the resultant amplitude-modulated wave E are constant as the vector E does not rotate, and also that the maximum amplitude of the amplitude-modulated wave E varies in a sinusoidal manner relative to the maximum amplitude of the carrier E_C.

If the carrier E_C had been added to the side band sum E_S so that E_S is at right angles to E_C then the vector diagrams would illustrate a combination of amplitude and phase modulation. Fig. 3 illustrates these conditions.

It should be noted that both the maximum amplitude and relative phase of the resultant wave E change, which indicates that both amplitude and phase modulation respectively occur in this case.

For AM to be eliminated, the amplitude of the resultant wave E should not change. That is, the tip of the vector E should follow the circumference of a circle (shown dotted in Fig. 3) with radius equal in this case to E_C. Also, for pure phase modulation to be obtained, the relative phase angle θ between E and E_C must be directly proportional to the instantaneous amplitude and polarity of the modulating wave. From Fig. 3 it can be observed that the relative phase angle θ between E and E_C is dependent on the maximum amplitude and relative phase of E_S which, in turn, is directly proportional to the instantaneous amplitude and polarity of the modulating wave, because the side bands being considered are produced by an amplitude modulator. It can be observed also that the change in maximum amplitude of E is dependent on E_S.

If the ratio of E_S to E_C is restricted to values of 0.2 or less, the amplitude modulation is essentially eliminated. Also essentially pure phase modulation is obtained for these restricted conditions, because the phase angle, in radians between E and E_C, which is the phase deviation, is equal to the tangent of the angle θ which, in turn, depends directly on the instantaneous maximum amplitude and relative phase of E_S, and this, in turn, depends directly on the instantaneous amplitude and polarity of the modulating wave.

This basic method for the production of a phase-modulated wave has been used in practical transmitters. The relatively small phase deviations produced under these conditions can, of course, be increased by the use of frequency multipliers. The phase modulator can be used as a frequency modulator by making use of the equivalent frequency modulation as previously described.

When modulation index β is equal to .2 or less, only one important side band pair is produced, and this agrees with the foregoing discussion. If, however, a phase modulator is employed which is capable of producing phase deviations of greater than 0.2 radian without distortion, then other side band pairs become involved. The wave which is the sum of the second side band pair produced also has a frequency equal to the carrier frequency and a relative phase such that the wave either adds directly to or subtracts directly from the carrier, E_C.

As the deviation is increased, more and more side band pairs are produced and the wave which is the sum of any side band pair has a frequency equal to the carrier frequency, and the relative phase is such that the sum of each pair adds to the carrier alternately at right angles and directly as in the cases of the first and second side band pairs. Also for pure phase modulation, the maximum amplitude and relative phase of the side band pairs and even of the carrier are dependent on the maximum deviation. The sum of the carrier and all the side band pairs must, of course, add together in such a manner as to result in the phase-modulated wave. It has been shown by well-known investigators in the field that the amplitude of the carrier and also of the side bands can be calculated by means of Bessel functions [1] from a knowledge of the maximum deviation.

The relations between the carrier and side bands involved for phase modulation are readily seen by means of vector diagrams which show the sum of each important side band pair added to the carrier, and also the resultant phase-modulated wave. The vector diagram in Fig. 4 show this addition for a phase-modulated wave of unit amplitude at 0°, 30°, 90°, 150°, 180°, 210° and 330° during a *sinusoidal* audio modulating cycle. Vectors E_{S1}, E_{S2} and E_{S3} represent respectively the sum of the first, second and third side band pairs. A maximum phase deviation of 1 radian was chosen as this deviation results essentially in only three important side band pairs. The magnitudes of the carrier and side band sums were calculated by means of Bessel functions.

In Fig. 4 it should be noted that at 0°, 180°, and also at 360° during the sinusoidal audio modulating cycle, the amplitudes of E_{S1} and E_{S3} are equal to zero. It should also be noted that at similar deviations throughout the audio cycle the same vector diagrams apply, as might be expected.

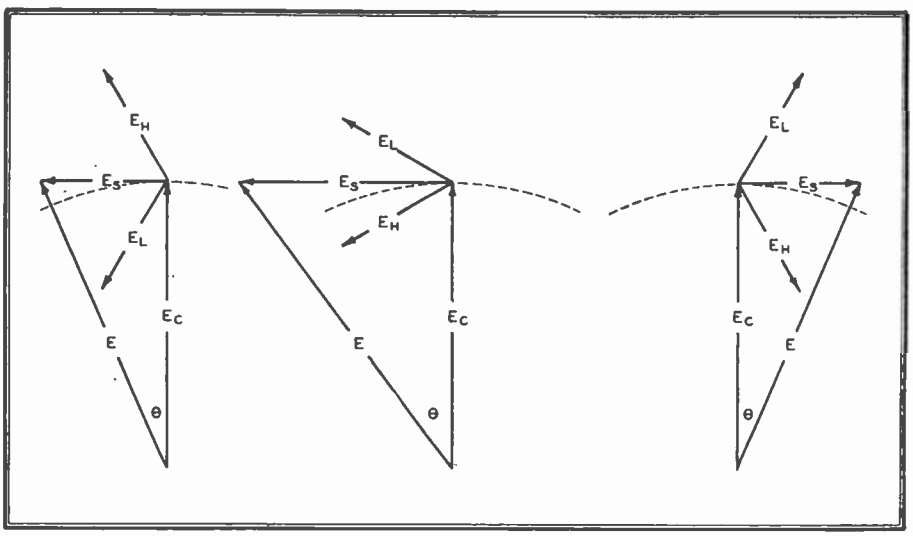


FIG. 3. DIAGRAMS SHOWING A COMBINATION OF AMPLITUDE AND PHASE MODULATION

For example, at 30° and 150° during the audio cycle the same phase deviation is obtained and the same diagram applies, as the Sin of 30° and also of 150° is equal to + 0.5. The deviation is equal to .5 times the maximum deviation or $0.5 \times 57.3 = 28.65°$. Also for 30° and 210° the same deviation is obtained except for the sign, as the Sin of 30° is + 0.5 and the Sin of 210° is − 0.5. Vectors E_{S1} and E_{S3} for 210° are both drawn in the opposite direction from E_{S1} and E_{S3} for 30°, thereby producing a negative deviation of $-.5 \times 57.3°$ or $-28.65°$.

The type of diagram shown in Fig. 4 illustrates directly the relative phase at any instant for a phase- or frequency-modulated wave, but does not show directly the frequencies at corresponding instants. This limitation does not detract from the usefulness of the diagram if it is remembered that a sinusoidal direct phase

[1] See "FM Broadcast and Communications Handbook" Chapter 1, *FM* AND TELEVISION, February, 1945.

modulation causes an equivalent frequency modulation which is also sinusoidal but 90 degrees or $\frac{\pi}{2}$ radians out of phase with the phase deviation cycle. To be more specific concerning this 90-degree phase difference, it should be noted that *sinusoidal* direct phase modulation causes *cosinusoidal* equivalent frequency modulation and similarly *cosinusoidal* direct frequency modulation causes *sinusoidal* equivalent phase modulation.

which results from the physical fact that in order to change the relative phase of a wave the frequency must be changed also. More specifically, for either phase or frequency modulation the phase deviation cycle lags the frequency deviation cycle by 90 degrees.

It may seem to the reader at first glance that it is somewhat round about to compare amplitude and frequency modulation by comparing each to phase modulation,

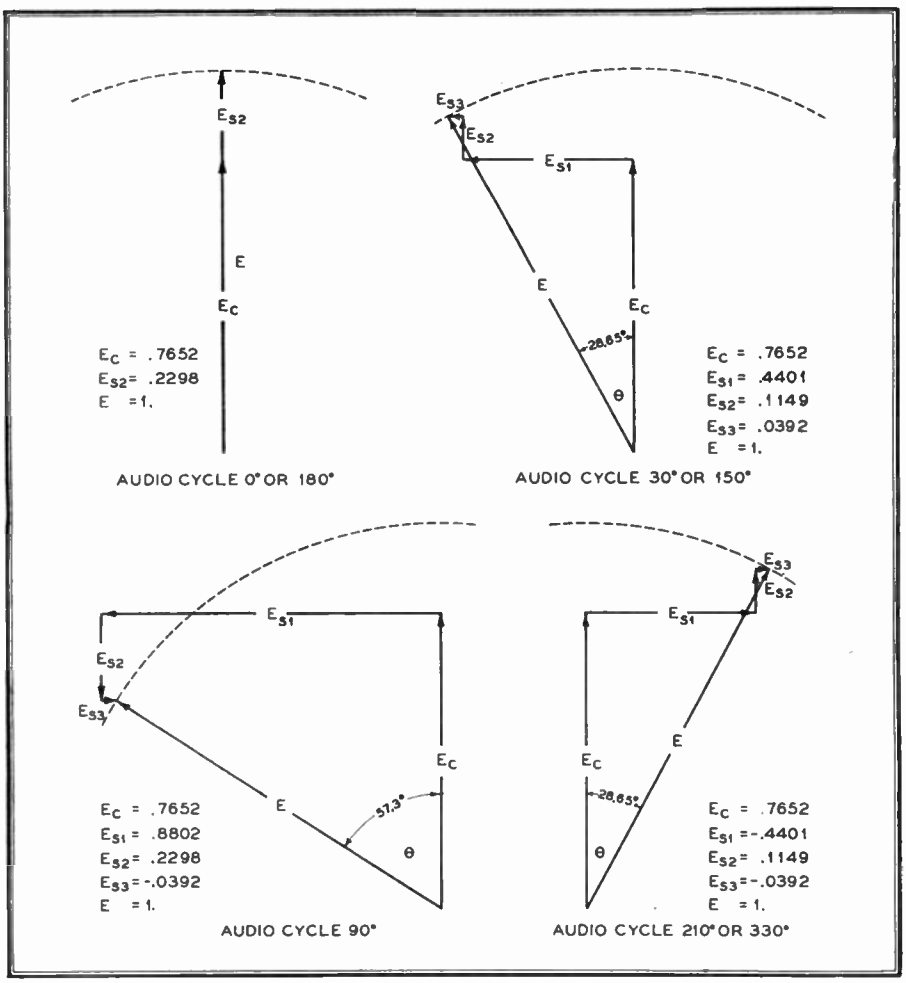


FIG. 4. RELATIVE PHASE FOR A PHASE- OR FREQUENCY-MODULATED WAVE

The diagrams shown in Fig. 4, therefore, also illustrate a particular case of frequency modulation. Inasmuch as Fig. 4 shows the position of the vector representing a *phase*-modulated wave at 0°, 30°, 90°, 150°, 180°, 210°, 330°, and 360° during the cycle for a *sinusoidal* modulating wave, it also shows the position of the vector representing a *frequency*-modulated wave at 0°, 30°, 90°, 150°, 180°, 210°, 330° and 360° during the cycle for a *cosinusoidal* modulating wave. The modulation index β for the frequency modulation case illustrated in Fig. 4 is also equal to 1, as for the phase modulation case.

These relations clearly indicate the similarity of phase and frequency modulation but a closer view of the situation will show that this method actually gives a clear picture of the relations involved. With the relations shown in Fig. 4 in mind, a better understanding of some of the preceding paragraphs can be obtained.

COMMUNICATIONS FOR N. E.

THERE will be a new communications service along the New England coast if applications filed by the Raytheon Manufacturing Company with the Federal Communications Commission are granted for construction permits to install five coastal harbor radiotelephone stations at Eastport, Rockland, and Portland, Maine; and Gloucester and New Bedford, Mass.

Included with the applications were statements from eighty-nine important potential users testifying to the vital need for the proposed service. At present only one coastal harbor radiotelephone station is in operation in this part of the country. This is the Boston station operated by the New England Telephone and Telegraph Company.

One of the most important users of the proposed service would be the fishing industry. The New England catch represents 16.2% of the total yearly volume in pounds of the United States, and 19.7% in dollar value, amounting to 626 million pounds, or 20 millions dollars.

Raytheon proposes to introduce for the first time in coastal harbor service frequencies in the newly-allocated 152-to 162-mc. FM band. The engineering report discloses that an average satisfactory service range of some 45 miles is estimated for 160-mc. operation at each of the five points.

In addition, Raytheon has requested the assignment of channels at 2, 4, 6, and 8 mc. for servicing vessels at greater distances. The application points out that the most efficient operation would be obtained by the assignment of exclusive frequencies for the five stations, but in the event the Commission finds it impossible to make such assignments, the application requests the shared use of 2550, 4282.5, 6470, and 8585 kc. now allocated to the Great Lakes Coastal Harbor stations.

A survey made by Raytheon disclosed that fishing vessels require communications service at distances as great as 800 miles from the New England coast.

The proposed radiotelephone rates employ a basis quite different from those offered by existing coastal harbor stations. A rate of $1.00 for 3 minutes is offered when the 160-mc. frequencies are employed, and a rate of $1.50 for 3 minutes when the frequencies in the 2- to 8-mc. band are employed, with an additional per minute charge of 35¢ and 50¢ respectively.

In its application, Raytheon specified a power of 2 kw. for operation in the 2- to 8-mc. band, and 50 watts on 160-mc. operation. Three frequencies were requested in the 152- to 162-mc. band, with one channel for calling purposes and the other two for traffic operations. Two traffic frequencies will meet peak loads and avoid interference between stations when a vessel is in a position within the over-lapping service areas of any two land stations.

The Raytheon application also stated that service would be offered to land mobile units, such as trucks and buses, when within the 160-mc. service area, if such services are requested.

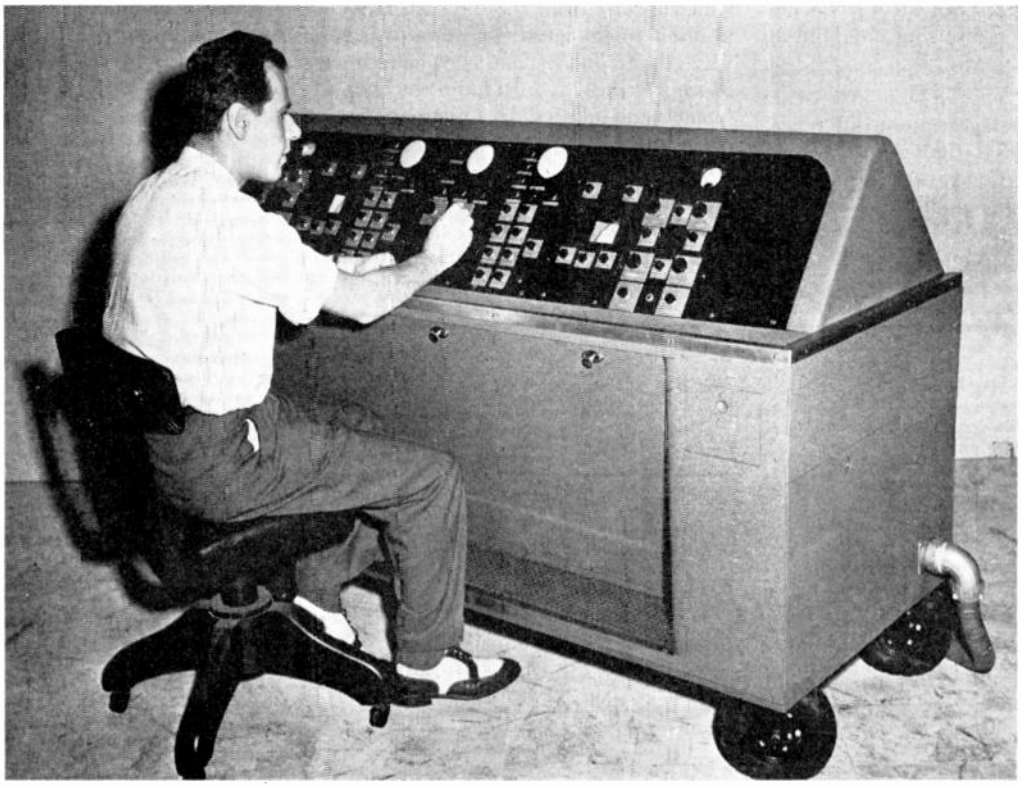


FIG. 1. THE TELEMOBILE IS A SELF-CONTAINED, MOBILE CONTROL CONSOLE FOR TWO CAMERAS

TELEVISION CONTROL ROOM ON WHEELS

This Equipment Takes the Control Room to the Television Stage

BY KLAUS LANDSBERG *

THE television control unit shown in the accompanying illustrations has been named the Telemobile because it combines, in mobile form, all the control equipment necessary for the operation of two television cameras. These controls include the synchronizing pulse generator, sweep signal generator, power supplies, and monitors.

We are very proud of the design and performance of the Telemobile because its highly functional construction was not an effort to *anticipate* operating requirements in our studios, but the *product of experience* evolved from the use of Du Mont "suitcase" equipment.

One of its most important advantages is that it eliminates the duplication of television control consoles in each of several studios, since the Telemobile can be pushed around wherever it is needed. When the action takes place in a very large studio, the unit can be moved behind whatever window in the studio wall is nearest the scene. In addition, it is small enough and light enough to be carried to field pick-ups, and operated right in a station wagon.

Setting it up at any point is only a matter of a minute's time. No cabling of the units is required, and the outside connections are only to 110 volts 60 cycles and to the two camera cables.

When more than two cameras are to be used, any number of Telemobiles can be combined. These added units are smaller in size, because they do not have to include synchronizing and sweep generators, or line amplifiers. Also, the same equipment can be used for any type of television camera, whether for studio, field, or motion picture pick-up.

The extremely small size of the assembly is made possible by built-in air cooling. With more than 200 tubes in operation, the equipment is maintained well below temperatures which would be injurious to the circuit components. Fans at the bottom circulate the air around the separate instruments upward and out through louvers at the top, behind the control panel, as shown in Figs. 2 and 3.

Great care was taken to determine the correct height and angle for the panel. As can be seen in Fig. 1, the controls are at right angles to the operator's natural line of sight when he is sitting high enough to look over the top. Another design feature which, we found, called for serious consideration was shock-mounting, not only to protect the apparatus from physical damage but to prevent microphonics. This was accomplished by using rubber mounts plus pneumatic tires on the wheels.

Figs. 2, 3, and 4 show how easy access to the equipment was provided, both for the controls and the power supplies. This was made possible by the vertical chassis on each unit, as a result of which this equipment is easier to service than many rack assemblies. Test meters and cathode-ray oscillographs needed for testing are built in, and can be switched to any circuit.

* Director of Television, Paramount Station W6XYZ, Television Productions, Inc., 5451 Marathon Street, Hollywood, Calif.

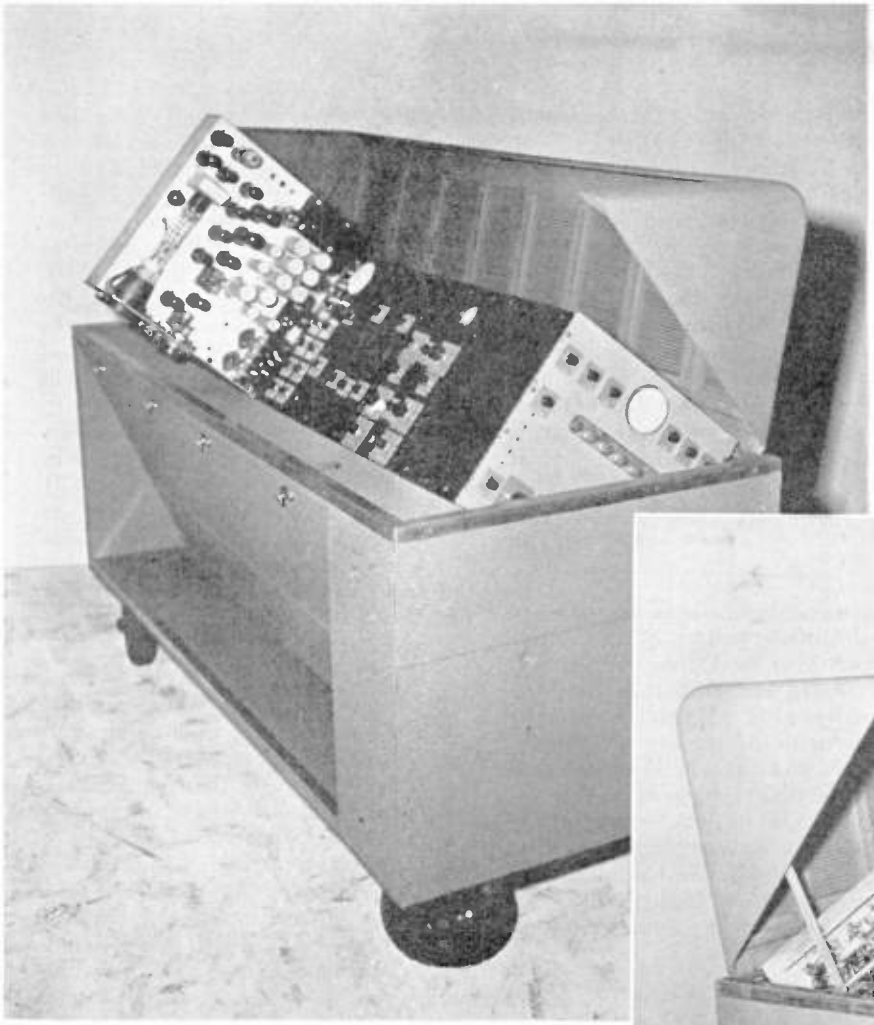


FIG. 2, LEFT. EACH OF THE CONTROL UNITS IS HINGED AT THE BOTTOM AND CAN BE SWUNG FORWARD FOR SERVICING. THE USE OF VERTICAL CHASSIS GIVES EASY ACCESS TO THE COMPONENTS

FIG. 3, RIGHT. LOUVERS IN THE COVER, BEHIND THE CONTROL PANEL, PROVIDE AN OUTLET FOR AIR FORCED UPWARD BY FANS AT THE BOTTOM

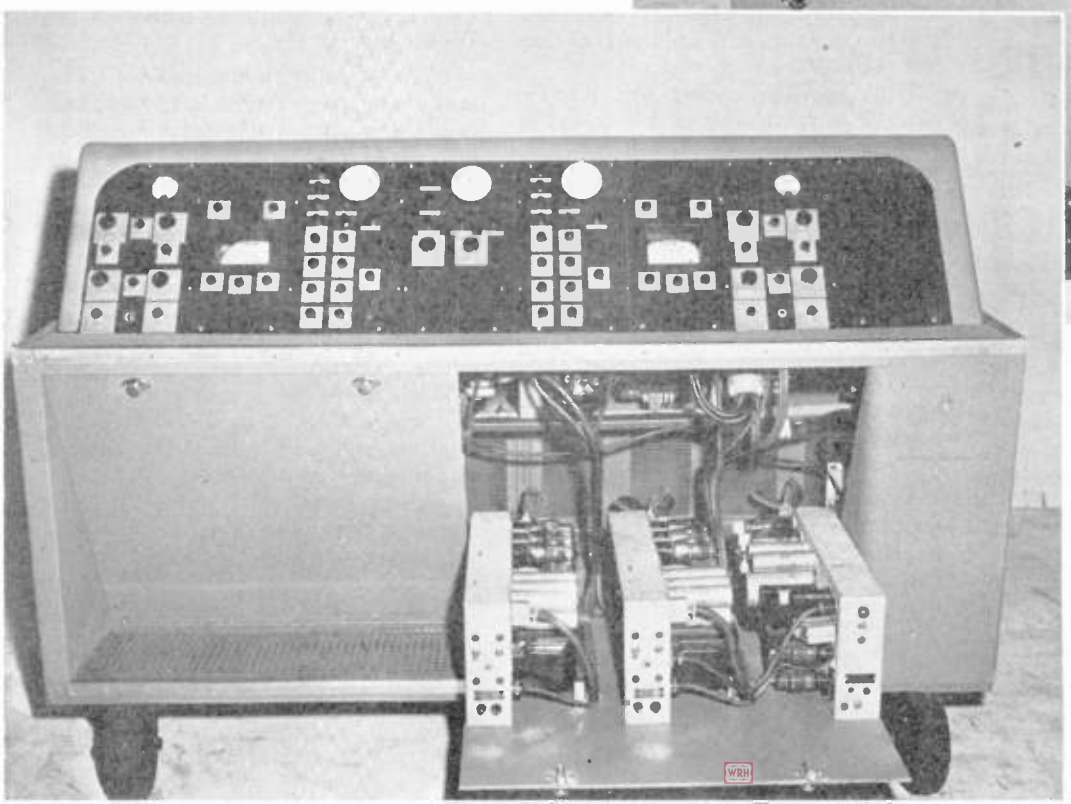


FIG. 4, LEFT. POWER SUPPLIES ARE MOUNTED BELOW ON DOORS WHICH SWING DOWN. HERE, ALSO, THE CHASSIS ARE MOUNTED VERTICALLY

10-KW. FM TRANSMITTERS

(CONTINUED FROM PAGE 49)

your position represents the short range, and to some extent, the selfish interests of a relatively small group of manufacturers who apparently desire to skim the cream off the market fast in spite of the fact that purchasers of two-band receivers would ultimately be disadvantaged by having paid unnecessary costs for useless components. As to the present owners of FM sets, you are aware of the opportunity for the use of converters to maintain these sets.

Your suggestion that my letter contained a "threat to discipline manufacturers" is wholly without justification. Certainly we have no basis for interfering with manufacturing activities nor any intention to do so. However, we do propose to execute our responsibilities in connection with allocations and should it develop that receiver manufacturers or anyone else are distributing sets to the public designed to make more difficult the acceptance of the decision which the Commission has heretofore rendered, then we would take steps to protect not only the public but the other services which have been assigned the present FM band.

I thank you for having sent me an advance page proof of your article entitled, "What's Behind the FM Versus AM Battle?" I consider it misleading, distorted and based upon unfounded suspicion instead of fact. I have always suspected that there was a sleeper in the proposal to manufacture two-band FM receivers. The third from last paragraph of your article tips the hand of the two-band advocates — apparently they are plotting to keep their foot in the door of the old 42–50 megacycle band in an effort to swipe it from the safety services and television. Your article states: "Second, if new sets can tune both FM bands, the FCC will have no excuse for not giving the 44–50 megacycle band back to FM for rural or multi-market stations or for other needs which cannot be met in the upper band."

I believe that the Commission would do FM a disservice if it gave any encouragement to the possibility that FM might get both the old and the new band. Ample provision was made for FM when the Commission assigned it 20 megacycles between 88 and 108 — which was 4 megacycles more than the industry requested for FM. Having thus liberally provided for FM I do not see how we can countenance a suggestion that FM be given in addition a band which has been assigned to and is needed by the safety services and television.

Finally, you seem to think that members of the Commission and its staff are either knaves or fools. I can assure you that there is no foundation for the gigantic conspiracy you envision and that the Commission will continue in the future as it has in the past to give every possible encouragement to the development of FM even though it may in the process step upon the toes of a few who would like to have everything their own way. Some time, somewhere, a trade publication may discover the fact that most persons in positions of public responsibility are motivated only by the desire to do the job which they took an oath they would perform; however, it seems that the millennium is not yet at hand.

Sincerely yours,
PAUL A. PORTER,
Chairman

There was no reference in this letter to the real subject matter of the article "What's Behind the AM vs. FM Battle?" which pointed out that the CBS-FCC single-market plan, as it now stands, limits FM stations to playing the low-powered pauper rôle, and leaves multi-market coverage an exclusive privilege of the princely high-power AM stations. More specifically, no light was thrown on the mysterious sources of 10-kw. new-band transmitters which would be "immediately available." Accordingly, the following telegram was dispatched:

Great Barrington, Mass.
August 24, 1945

Paul A. Porter, Chairman
Federal Communications Commission
Washington, D. C.

In response to inquiries inspired by your statement regarding FM transmitters, I have personally canvassed manufacturers and find the most optimistic estimate of shipment is six months for one kilowatt and ten to twelve months for ten kilowatts, plus two to six months additional to complete installation.

Will appreciate collect wire advising name of company able to deliver and install ten kilowatt FM transmitters within the next six months, at which time leading manufacturers definitely promise FM-AM sets will be available in substantial quantities at retail stores.

FM — MILTON B. SLEEPER

In reply, Chairman Porter wired:

Washington, D. C.
August 29, 1945

Milton B. Sleeper
FM AND TELEVISION Magazine
511 Fifth Avenue, New York City

Your inquiry to manufacturers regarding FM transmitters creates misleading impression. Suggest you would perform a useful service to the industry and the public if you would ask manufacturers whether they could deliver and install FM transmitters in volume in old band sooner than transmitters for new band. We are advised by leading manufacturers that shift in frequencies makes absolutely no difference and that transmitters in volume for new band will be available just as quickly as they would have been for the old band. Materials not design is the bottleneck. We have been advised that production one to ten kilowatt transmitters will be undertaken promptly and rate of deliveries will depend upon ability of manufacturers to obtain components. Further advised shift in frequencies is not a retarding factor in production of one to ten kilowatt FM transmitters. This fact should be made clear in justice to the Commission's allocation decision and in order not to deceive those who plan to install and operate FM stations.

PAUL A. PORTER,
Chairman

There was no apparent connection between the comparative time required to deliver old-band and new-band transmitters and the source of the Commission's information that "10-kilowatt transmitters will be immediately available for the new band." However, the manufacturers were queried again. All those who had built FM equipment before the war said that they could make much more prompt deliveries on old-band designs. Those without previous experience said it would make no difference. Officials of both groups repeated that they were making no promises of delivery on 10-kw. transmitters, and that delivery early in 1946 was impossible. This information was forwarded in the following telegram:

Great Barrington, Mass.
September 3, 1945

Paul A. Porter, Chairman
Federal Communications Commission
Washington, D. C.

You have failed to give name of transmitter manufacturer who has 10 kw. new band transmitters available for immediate delivery or who can even install them by the end of this year when you propose to shut down old band FM. Since this uncertainty threatens to disrupt industry conversion, I respectfully insist that you give the name of the manufacturer so informing you for the benefit of our readers, the industry in general, and the listening public whose interests are involved.

Reference to the new issue you raised that transmitters up to and including 10 kw. can be supplied as quickly as old band transmitters: I have followed your request to interrogate manufacturers on this new question. Those who have prewar experience advise me they could have been delivered promptly as proven transmitter designs are ready and suitable tubes of

(CONTINUED ON PAGE 85)

FIG. 1. A NEW TYPE OF UHF RECEIVER PRODUCED BY NATIONAL FOR THE NAVY

RADIO DESIGNERS' ITEMS

Notes on New Products and Methods of Interest to Design Engineers

Communications Receiver: Fig. 1 shows the exterior of a UHF receiver developed by the National Company, Inc., Malden, Mass., in collaboration with the U. S. Naval Research Laboratory. This new model will be installed on fleet units and at shore stations. Details have not been released, but the designers emphasize the features of simplified construction and ease of servicing. When the handles at the sides are released, the interior assembly can be pulled out on a drawer slide. In this position, the chassis can be tilted into three different positions, providing access to all components.

Electronic Galvanometer: Aural methods or the use of conventional galvanometers are replaced by a 6E5 tuning eye for null detection in 1,000 cycle AC bridge circuits. This unit, Fig. 2, was designed by Henry D. Hall, senior engineer at Harvey Radio Laboratories, Inc., Cambridge, Mass. Circuit of the instrument comprises an AC amplifier, signal rectifier, indicator tube, and power supply.

FIG. 2. HARVEY RADIO'S GALVASCOPE

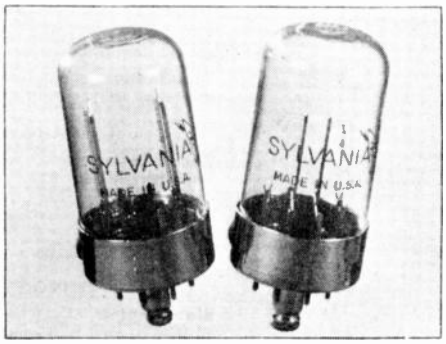


FIG. 3. SYLVANIA RF TEST LAMPS

In the absence of an applied signal, the eye of the indicator tube is closed or overlapped, depending upon the setting of the indicator bias control. When a signal voltage is applied, the eye opens. As the associated bridge circuit is brought into balance, the signal decreases, and the eye begins to close. By proper manipulation of the sensitivity and bias controls, the eye can be set to close, without overlapping, at balance. Bridge measurements can be made with great accuracy by the use of this instrument, without interference from ambient noise, and readings can be taken quickly, without waiting for a pointer to come to rest.

Power Measurement Lamps: By comparing the brightness of two separate filaments in a tube of the types shown in Fig. 3, direct power output measurements can be made at frequencies up to 900 mc. Manufactured by Sylvania Electric Products, Inc., Emporium, Pa., these tubes are available in six capacities, for measurements ranging from .05 to 25 watts at an accuracy within 5% or less, depending upon the method of reading.

Power measurements are made by connecting one filament to the high-frequency output, and the other to an AC or DC source, the voltage of which is regulated until the two filaments are equally bright. Greater accuracy can be obtained by reversing the filaments and averaging the results. Useful range can be extended by the use of dark filter for visual observation, or by photo-electric measurements.

Hermetic Seals: Four types of leaders carrying from 2 to 8 hermetically sealed leads, and 16 different standard sealed terminals are shown by dimension drawings in a pamphlet issued by Electrical Industries, 42 Summer Avenue, Newark 5, N. J. Complete data is given for each type, including peak voltage rating at 30% and 90% humidity, and continuous current capacity at 40° C. temperature rise.

Test Instrument: The test instrument shown in Fig. 4 is the model 195 A voltohmyst, recently introduced by RCA, Camden, N. J. It provides the means for measuring DC or AC voltage, resistance, audio level, and FM discriminator balance. There are 6 ranges of AC and DC voltage, an ohmmeter reading from .1 ohm to 1,000 megohms, a linear AF voltmeter, and an audio level meter calibrated in VU's on 600-ohm lines. Furnished with the instrument is a shielded AC cable and probe.

Leathercloth: An interesting wartime product which may find favor as a covering material for portable radio cases is Tolex, manufactured by Textileather Corp., Toledo, Ohio. It is a plastic leathercloth of such wear-resisting qualities that it was used for upholstery in tanks, trucks, and naval warecraft.

FIG. 4. RCA MULTIPLE TEST INSTRUMENT

FM AND TELEVISION STATION DIRECTORY

Listing All Stations Now in Operation, and Those for Which Applications Have Been Filed

In this first complete Directory of FM and Television Stations we have included only such information as was furnished in response to questionnaires sent to stations and applicants. FM or television station calls, if assigned, appear at the extreme right. Manager's name is indicated by (M); chief engineer, (E); engineering consultant, (C). Final data, as far as it was furnished, indicates estimated cost of station, make of transmitter, AM affiliate, and network affiliation.

FM STATIONS

ALABAMA

Birmingham
Binghamton B/C Co. N. 2nd Ave.
Birmingham News Co. Dixie Carlton Hotel
Voice of Ala., Inc. Prot. Life Bldg. W4XFM
(M) T Holt (E) N Hurley (C) P Godley
$78,000 WE WAPI CBS

Mobile
Mobile Daily Nsp., Inc. 304 Gov. St.
(M) W Hearin (C) Jansky & Bailey
$75,000
Pape B/C Co. AT & NRR Bldg.

Montgomery
Covington, G. W. 2 Montgomery St.
Montgomery B/C Co. Montgomery & Catoma

Tuscaloosa
Doss, Jas. R. P.O. Box 4

ARKANSAS

Fort Smith
Reynolds D. W. 505 Rogers Ave.

CALIFORNIA

Alameda
Times-Star Pub. Co. 1511 Park St.
(C) J Barron
$30,000

Alhambra
S. Cal. News Ass'n 11-13 S. Stoneham Ave.

Avalon
Santa Catalina Island Co. 615 Crescent Ave.

Fresno
J. E. Rodman Radio Station KRFE
(M) P Bartlett (E) H Brown (C) G T Wrathall
$64,975 GE KFRE Mutual

Glendale
S. Cal. News Ass'n 333 N. Brand

Hollywood
Don Lee B/C System 5515 Melrose Ave. KHJ-FM
(M) L Weiss (E) F M Kennedy
$175,000 WE KHJ Mutual
Warner Bros. B/C Co. 5833 Fernwood

Long Beach
Consolidated B/C Corp. 435 Pine Ave.

Los Angeles
E. C. Anthony, Inc. 141 N. Vermont Ave.
(M) W Ryan (E's) Blatterman & Mason
GE KFI NBC
Don Lee B/C System 5515 Melrose Ave.
Los Angeles Times
Standard B/C Co. 338 S. Western Ave.
The Times Mirror 202 W. 1st St.

Marysville
Sacramento Valley B/C 424 Fourth St.

Oakland
S. W. & E. N. Warner Bros. 327 21st St.
(M) S W Warner
Tribune Bldg. Co. Tribune Tower

Ontario
The Daily Report
(M) A Miller (C) M Woodward
$50,000 GE

Richmond
Contra Costa B/C Co. 202 Tenth St.
(C) J Barron
$100,000 GE

Riverside
B/C Corp. of America KPOR
(M) W Gleeson (C) Andrew King
$35,000 GE KPRO

Sacramento
McClatchy B/C Co. 911 7th St.
Royal Miller Radio 10th and K

San Bernardino
S. C. Lee Bros. B/C Co. 512 4th St.
The Sun Co. of San Bernardino 446 Court St.

San Diego
Airfan Radio Corp. 326 Broadway
Union-Tribune Pub. Co. 941 Second Ave.

San Francisco
Associated B/C, Inc. Pine & Mason Sts.

San Jose
Pacific Ag. Foundation. 87 E. San Antonio

San Pedro
San Pedro Print. & Pub. Co. 356 W. 7th St.

Santa Barbara
News Press Pub. Co. Dela Guerra Pl.

Stockton
Peffer, E. F. 40 S. California St.

COLORADO

Colorado Springs
Out West B/C Co. Antlers Hotel

Denver
K.L.Z. B/C Co. Shirley Savoy Hotel

CONNECTICUT

Hartford
Hartford Times, Inc. 10 Prospect St.
Travelers B/C Service Corp. 26 Grove St.
(M) P Morency (E) H D Taylor
$141,500 RCA WTIC NBC

New London
The Thames B/C Corp. 281 State St.
(M) G Morey (E) G Morey
$25,000 GE WNLC Mutual

Putnam
Colonial B/C Co. 66 Main St.
(E) A Wilson (C) G Gilette
$73,895 GE

Waterbury
Travelers B/C Ser. Corp. 71 Grand St.

DELAWARE

Wilmington
WDEL, Inc. 10th and King Sts.

DISTRICT OF COLUMBIA

Washington
Bingham, N. M. 921 Tower Bldg.
Capital B/C Co. 1000 Conn. Ave. N.W.
(M) B Strouse (E) R Beville (C) McNary and Wrathall
$24,110 GE WWDC
Evening Star B/C Co. Evening Star Bldg.
Jansky & Bailey 970 Nat'l Press Bldg. W3XO
Mid Coastal B/C Co. 815 15th St. N.W.
National B/C Co. Translux Bldg.
(M) C Smith (E) A Johnson
RCA WRC NBC
The Times Herald 1317 H St. N.W.

FLORIDA

Daytona Beach
News-Journal Corp.
$120,000 GE

Fort Lauderdale
Gore Pub. Co. 231 S.E. 1st Ave

Jacksonville
Florida B/C Co. 118 W. Adams St.
(M) F King (E) E Vorderulard (C) Ring & Clark
$100,000 WE EMBR CBS
The Metropolis Co. 500 Laura St.
Radio Station WJHP 500 Laura St.
(M) F Chaplan (E) B Hayford
$60,000 RCA WJHP Mutual

Miami
WQAM
(M) F Barton (E) Earl Lewis
WQAM CBS
Isle of Dreams B/C Co. 600 Biscayne

Miami Beach
Katzenstine, A. F. 1759 N. Bay Rd.

Orlando
Orlando Daily Nsprs. 238 So. Orange St.

St. Petersburg
Pinellas B/C Co.

Tampa
Tampa Times Co. 114 No. Franklin St.
The Tribune Co. 504 Lafayette St.

GEORGIA

Atlanta
Constitution Pub. Co. 148 Alabama S.W.
Liberty B/C Corp. Fort Industry Co.
(M) C Smithgall (E) A Jones (C) C M Jansky WAGA

Augusta
Ringson, W. R. 8th and Broad St.

Columbus
Columbia B/C Co., Inc. 1420 2nd Ave.
Ga.-Ala. B/C Corp. 17 West 12th St.

Macon
Macon Tel. Pub. Co. 450 Cherry St.
Middle Ga. B/C Co. 601 Cherry St.
Southeastern B/C Co. 666 Cherry St.

Moultrie
Pidcock, F R 606 Fifth Ave. S.E.

IDAHO

Pocatello
Radio Service Corp
(M) H H Fletcher (E) H H Fletcher
$15,575 RCA KSEI NBC

Twin Falls
Radio Broadcasting Corp. 241 Main St.

ILLINOIS

Bloomington
WJBC Co. 209 E. Washington St.

Champaign
The Champaign News Gaz. 4850 Main St.
(M) J McDermott (E) J Baum (C) P Godley WDWS CBS

Chicago
Agricultural B/C Co. 1230 W. Washington Blvd.
Board of Education 228 N. LaSalle St. WBEX
(M) G Jennings (E) E H Andresen
GE
Chicago Fed. of Labor 666 Lake Shore Dr.
Columbia B/C System 410 N. Michigan Ave. WBBM-FM
(M) H L Atlass (E) J J Belovngy
GE WBBM CBS
Drovers Jrnl. Pub Co. 836 Exchange St.
Midwest FM Network Inc. 435 N. Michigan
Nat'l B/C Co. 222 N. Bank Dr.
(M) H C Kopf (E) H C Luttgens
WMAQ NBC
Zenith Radio Corp. 6001 Dickens Ave. WWZR
(M) E H Herrmann (E) Ross Utter
Zenith

Decatur
Commodore B/C Co. 367 N. Main St.

East St. Louis
Miss. Valley B/C Co. Broadway & 5th

Herrin
Orville W. Lyerla Box 179
(M) C R Cook (C) John Barron
$14,700 RCA WJPF

Mt. Vernon
Midwest Broadcasting Co.
(M) T N Jordan (C) Lohnes & Culver

Peoria
Peoria B/C Co. 200 Alliance Life Bldg.
(M) E L Bill (E) T Giles (C) Jansky & Bailey

Rock Island
Rock Island B/C Co. Safety Bldg.
(M) L Johnson (E) R Sinnet (C) G. Davis
$150,000 WHBF Mutual

Quincy
Ill. Broadcasting Co. 570 Main St.
Quincy Newspaper, Inc. 130-138 S. 5th St.

Springfield
WCBS, Inc. 523 E. Capital Ave.

Urbana
Univ. of Ill. 1010 S. Wright WIVC
(M) J F Wright (E) A J Ebel
$2,000 WILL

Waukegan
Keptone Printing Service, Inc.
(M) F W Just

INDIANA

Connersville
News-Examiner Co. 406 Central Ave.
(C) McNary & Wrathall

Elkhart
Truth Pub. Co. Hotel Elkhart
(M) R R Baker (E) L W Zellmer
$150,000 GE WTRC NBC

Evansville
Evansville on the Air 519 Vine St. WMLL
(M) C Leich (E) Schoeny (C) F B Cardway
$30,000 Eng. Staff WGBF—NBC WEDA—CBS

Fort Wayne
Farnsworth Tel. & Radio Co. 3700 E. Pontiac
West'house Radio Sta. 925 S. Harrison WOWO-FM
(M) P E Mills (E) B H Ratts
Westinghouse WOWO ABC

Hammond
Radio Station WJOB 449 State St.
(M) O Richardson (E) S Strasburg (C) Jansky & Bailey
$30,000 WE
WFAM, Inc. 449½ State St.

Indianapolis
Black, Amelia M. 50 N. Illinois St.
Capital B/C Co. Board of Trade Bldg.
Indianapolis B/C Inc. Claypool Hotel
(M) E C Pulliam (E) E E Alden
WIRE NBC
WFBM, Inc. 48 Monument Circle
(M) F O Sharp (E) H S Holland
$85,000 RCA WFBM CBS
The Wm. F. Block Co. 50 N. Ill. St.
(M) C W Spiess
$50,000 RCA

Muncie
Burton, D. A. 42 Allen Rd.

Shelbyville
Shelbyville Radio Inc.
(M) Marion T Auers (C) McNary & Wrathall
$35,000 GE

South Bend
S. Bend Tribune 225 W. Colfax Ave. WSBF
(M) F D Schurz (E) H G Cole (C) J Barron
$40,000 RCA WSBT CBS

Terre Haute
Banks of Wabash, Inc. 303 S. 6th St.
(M) D Aldrich (C) J Caraway

IOWA

Cedar Rapids
The Gazette Co. 500 3rd Ave. S.E.

Davenport
Central Bestg. Co. 1002 Brady St.
Tri City B/C Co. 1000 Brady St.
(M) B Lottridge (E) P Arvidson (C) P Loyet
$75,000 American

Dubuque
Dubuque Broadcasting Co.
(M) J Carpenter (E) L Carlson (C) Comm. Rad. Equip.
$25,000 RCA WJBB American
Telegraph-Herald 8th & Bluff Sts.

Iowa City
State University of Iowa KSUI
(M) C Menzer

Waterloo
Josh. Higgins B/C Co. 500 E. 4th St.

KANSAS

Hutchinson
Hutchinson Pub. Co. 28 E. 2nd St.

3 OUTSTANDING FEATURES OF THE NEW EIMAC 4-125A TETRODE

1 LOW DRIVING POWER

With but 2.5 watts driving power, the 4-125A will deliver 375 watts output at frequencies as high as 120 Mc. The low driving power requirement has been achieved without the use of excessive secondary emission. The control grid is specially processed to reduce both primary and secondary emission.

2 HIGH FREQUENCY PERFORMANCE

The Eimac 4-125A will deliver 200 watts output at 250 Mc. The performance curves below show the relationship between driving power and power output at frequencies up to 250 Mc.

3 LOW GRID-PLATE CAPACITANCE

The grid-plate capacitance of the 4-125A is only *0.03 uufd.* This low value allows operation up to 100 Mc. without neutralization. Stability is further assured by the special grid processing which reduces secondary emission.

A technical bulletin on Eimac 4-125A Power Tetrode contains full specifications and detailed discussion of the tube's characteristics, circuit diagrams and constant current curves. Write for your copy today.

The Eimac 4-125A is the first of many new Eimac tubes that are on the way. Watch for future announcements.

ELECTRICAL CHARACTERISTICS

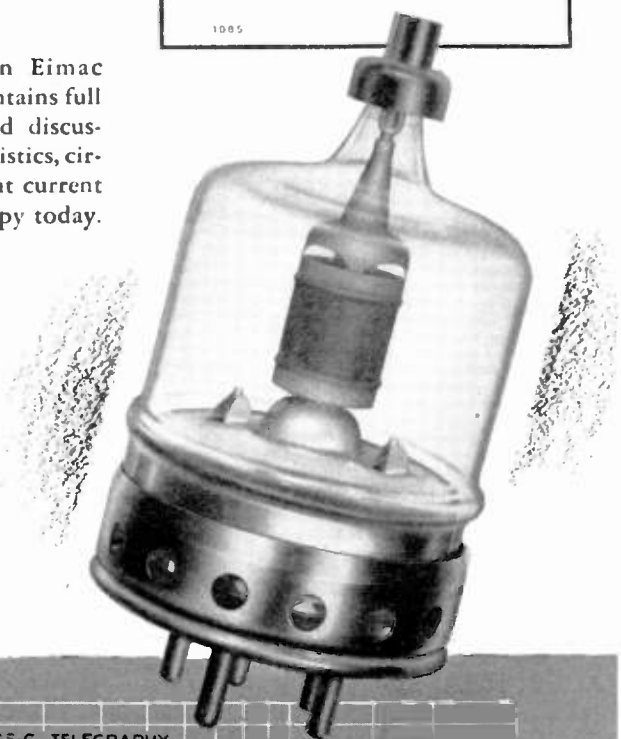
Filament: Thoriated Tungsten
- Voltage . . . . . 5.0 volts
- Current . . . . . 6.2 amperes

Plate Djssipation (Maximum) 125 watts

Direct Interelectrode Capacitances (Average)
- Grid-Plate (Without shielding, base grounded) . . . . 0.03 *uufd.*
- Input . . . . . 10.3 *uufd.*
- Output . . . . . 3.0 *uufd.*

Transconductance (i_B = 50 ma., E_B = 2500 v., E_{C2} = 400 v.) . 2450 *umhos*

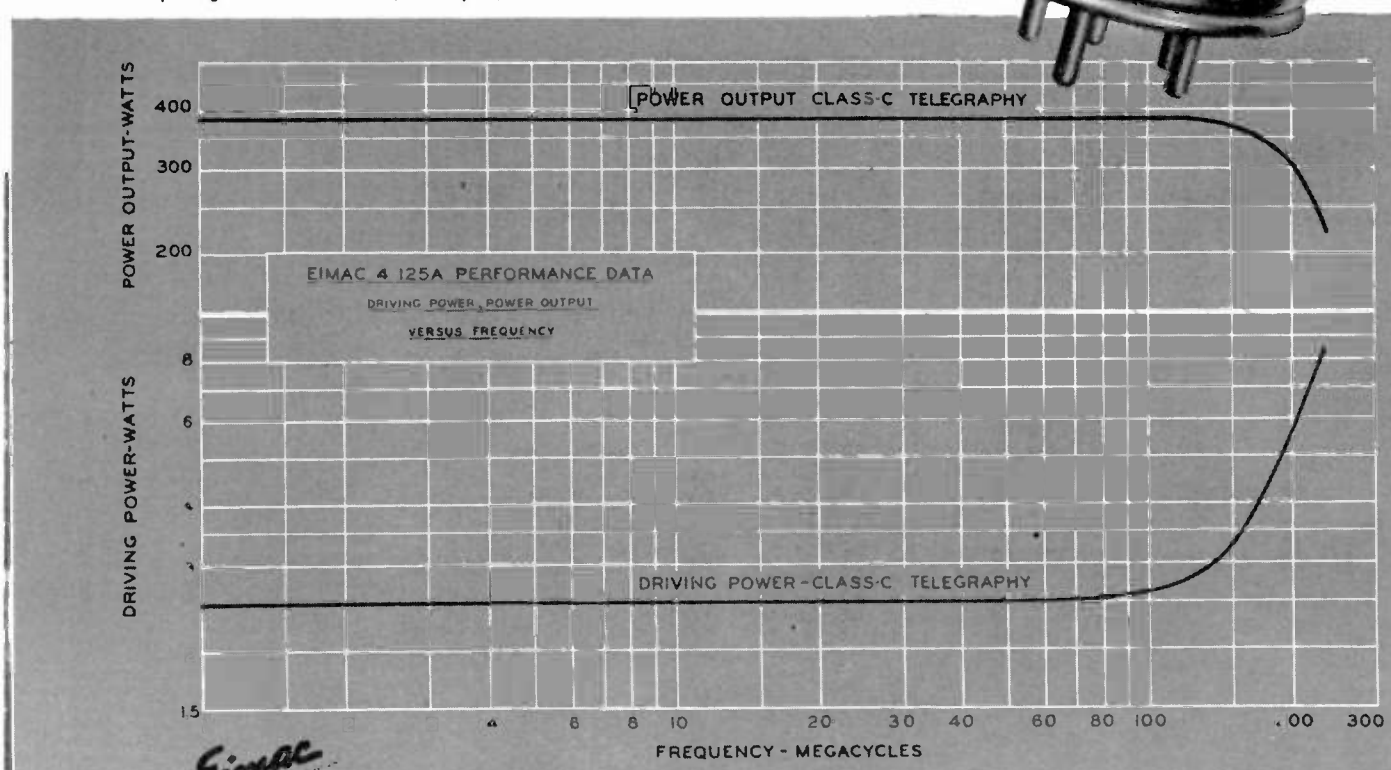
1085



FOLLOW THE LEADERS TO

Eimac TUBES REG. U. S. PAT. OFF.

EITEL-McCULLOUGH, Inc., 1085 San Mateo Avenue, San Bruno, Calif.
Plants located at: San Bruno, California and Salt Lake City, Utah
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco 11, Calif., U. S. A.



Eimac TUBES **THE COUNTERSIGN OF DEPENDABILITY IN ANY ELECTRONIC EQUIPMENT**

FM STATIONS, Continued

Lawrence
The World Co.
(M) D Simons (C) Comm. Radio Equip.
$28,522 GE

Topeka
Stauffer, O. S. Cappen Bldg.
Topeka B/C Assn., Inc., 1035 Topeka Blvd.
(M) B Ludy (E) K G Marguardt
RCA

Wichita
Farmers & Bankers B/C Corp. 1st & Market
Station KFH Co. York Rite Temp. Bldg.

KENTUCKY

Ashland
Ashland B/C Co. 20th & Greenup
(M) J Mathews (E) C Weaver (C) McNary & Wrathall
$15,000 WE WCMI CBS

Lexington
American B/C Co. Radio Bldg. W5ISL
(M) J E Willa (E) S Helt (C) McNary & Wrathall
$16,000 WLAP American
University of Ky. WBKY
(M) E G Sulzer (E) H C Locklar
$20,000 American

Louisville
Courier Journal-Louisville Times Co. W9XEK
(M) W Coulson (E) D Summerford (C) O Towner
WE WHAS CBS
Northside B/C Co. 5th & Jefferson Sts.
WAVE Inc. 334 E. Broadway

Owensboro
Owensboro B/C Co., Inc.
(M) H O Potter (E) L Goodaker (C) Ring & Clark
$40,000 GE WOMI Mutual
Owensboro B/C Co., Inc. Lovermore Rd.

Paducah
Hopkinsville B/C Co., Inc. Box 1020
Paducah B/C Co., Inc. Taylor Bldg.
(M) P Lackey (E) V Morris (C) McNary & Wrathall
$25,000 WPAD CBS

Winchester
Win. Sun Co., Inc. Wall & Cleveland Sts.
(C) G Wrathall

LOUISIANA

Alexandria
Alexandria B/C Co., Inc. 505 Johnston St.
(M) E Cappellini (E) J Sexton (C) O S Drake
$15,000 RCA American
Walter H Allen 5th & Johnston Sts.

New Orleans
Times Picayune Pub. Co. Lafayette Sq.
(M) A H Talbot, Jr. (E) H F Wehrmann (C) J Barron

MAINE

Portland
Gannett Pub. Co. 119 Exchange St.
Portland B/C Sys. Inc. 645A Congress St.

MARYLAND

Baltimore
Md. B/C Co. 7 E. Lexington St. WX3MB
(M) T Tinsley (E) J Duff (C) Jansky & Bailey
WE WITH
A. S. Abell Co. 219 Northway Guilford
Balt. Rad. Show, Inc. 10 E. North Ave.
(M) H H Barroll, Jr. (E) W Ranft
$126,000 RCA WFBR American
Balt. B/C Co. North at Hartford
Monument Rad. Co. 811 W. Lanvale St.

Hagerstown
Hagerstown B/C Co. 33 West Franklin St.

Salesbury
Peninsular B/C Co. Radio Park

MASSACHUSETTS

Boston
Fidelity B/C Co. 80 Mason St.
Filene's Tel. Inc. 426 Washington St.
Matheson Radio Co. 66 Boylston St.
Yankee Network 21 Brookline Ave. WGTR
(M) J Shepard (E) T B Robinson
REL Yankee—Mutual

Fall River
Fall River B/C Co. 120 S. Main St.

Greenfield
Hargis, J. W. 354 Main St.
Recorder Pub. Corp. 397 Main St.
(M) H I Jenks (C) Jansky & Bailey
$43,000 GE

Haverhill
The Haverhill Gazette Co.
(C) F McIntosh
$40,000 WE

Holyoke
Hampden Hampshire Corp. 180 High St.
(M) P J Montague (E) T Humphrey WHYN Mutual

Lawrence
Hildreth & Rogers Co. 283 Essex St.

New Bedford
E. Anthony & Sons, Inc. 575 Pleasant St.

North Adams
James A. Hardman The Transcript
$4,300 GE

Pittsfield
Eagle Pub. Co. Berkshire Evening Eagle
(C) P F Godley
Trans. Equip. Mfg. Co.
England & Co. 8 Bank Row

Waltham
Raytheon Mfg. Co. Foundry Ave.

Worcester
Worcester Tlg. Pub. Co. 18 Franklin St. WTAG-FM
(M) E E Hill (E) E A Browning
WTAG CBS

MICHIGAN

Ann Arbor
Washtenaw B/C Co., Inc. Hutzel Bldg.
(M) E F Baughn (E) G D Stearns
REL WPAG

Battle Creek
Federated Pub., Inc. 38 W. State St.

Bay City
Bay Bestg. Co., Inc. 100 Center Ave.

Benton Harbor
The Palladium Pub. Co. 61065 Wall St.

Detroit
The Fort Indus. Co. 506 New Center Bldg.
Jos. F. Hopkins, Inc. 6559 Hamilton Ave.
King Trendle Bestg. Co. 1700 Stroh Bldg.
Kokomo B/C Corp. 914 Lafayette Bldg.
(C) J Barron
$25,000 WKMO
Radner, Herman 17330 Wildemere Ave.
Stoner, Geo. B. 506 New Center Bldg.
Thomas, R. J. 411 Milwaukee Ave.
UAW-CIO 411 W. Milwaukee Ave.
The Detroit News 4500 Penobscot Bldg. WENA
(M) K Wheeler (E) C H Wesser
REL WWJ NBC

Escanaba
J. P. Norton 520 Third Ave.

Grand Rapids
Grand Rapids B/C Co. 1325 Underwood Ave.
Versulis, Leonard A. 6 Fountain St. N.E.

Jackson
WJBM, Inc. Hotel Hayes

Kalamazoo
Fetzer Broadcasting Co.
(M) J E Fetzer (E) C E Lee
$93,000 GE WKZO-WJEF CBS

Lansing
WJJM, Inc. 100 N. Washington Ave.

Muskegon
Ashbacker Radio Corp.
(M) F Ashbacker (E) G Krivitzky
$30,000 GE WKBZ American

Port Huron
The Times Herald Co. 907 6th St.

Saginaw
Saginaw B/C Co. 610 Eddy Bldg.

Washtenaw
Washtenaw B/C Co. 576 E. Liberty St.

Wyandotte
Wyandotte News Co. 3042 First Ave. WJJW
(M) S Grantz (C) C Wesser
$40,000 REL

MINNESOTA

Minneapolis
Minnesota B/C Co. 115 E. Grant St.

Rochester
So. Minnesota B/C Co. 100 First Ave. Bldg.

St. Paul
KSTP, Inc. 363 St. Peter St.
(M) K Hance (E) J Fricker
$225,000 RCA KSTP NBC

MISSOURI

Kansas City
The Kansas City Star 1729 Grand Ave.
Midland Bestg. Co. 10th & McGee Sts.
WHB Bestg. Co. Box 389

Monkato
F. B. Clements & Co.
(M) F Meagher (E) J Houts (C) GC Davis
DYSM NBC

St. Joseph
KFEQ, Inc. Schneider Bldg.

St. Louis
Columbia B/C Sys. Inc. 401 So. 12th St.
(M) B Falknor (E) HC Harvey
KMOX CBS
Globe Democrat Pub. Co. 1133 Franklin Ave.
Mo. Bestg. Co. Hotel Melbourne
Thos. Patrick Inc. Hotel Chase
(M) R Dady (E) N J Zehr (C) J Barron
Pulitzer Pub. Co. 12th & Olive Sts.
Star-Times Pub. Co. 12th & Delmar Blvds.
(M) C L Thomas (E) A Reckart
$75,000 GE KNOK American
WMIX 1287 St. Anthony Ave.
(M) Eater & Hoffman (E) W Fritze (C) A Wilson

NEBRASKA

Lincoln
Central St. B/C Co. 1st Nat'l Bank
Cornbelt B/C Co. Stuart Bldg.

Omaha
Inland B/C Co. 2027 Dodge St.
(M) P R Fry (E) P Zeigler
World Pub. Co. 15th & Farnam St.

NEVADA

Las Vegas
Nev. B/C Co. P.O. Box 1310
(M) M Kelch
$10,000 KENO American

Reno
Speidel Newspapers

NEW HAMPSHIRE

Manchester
Radio Voice of N. H. 1819 Elm St.
(M) H Carter (E) H Chandler (C) Jansky & Bailey
$90,000 American

Mt. Washington
Yankee Network. Boston, Mass. WMTW
(M) J Shepard (E) T B Robinson
REL Yankee—Mutual

NEW JERSEY

Asbury Park
Asbury Park Press
(M) W D McMurray
RCA

Bridgeton
E. States B/C Co. Bridgeton WSNJ

Jersey City
Fidelity Media B/C Co. 222 Lonnele Ave.
(M) A L King (C) Paul Godley
$50,000 GE

Newark
Bremer B/C Co. 11 Hill St.
(M) I Resenhaus (E) F Bremer (C) G Gillette
$65,000 GE WAAT
Evening News Pub. Co. 215 Market St.

New Brunswick
Home News Pub. Co.
(C) W C Lent
$46,000 GE

Passaic
Passaic Daily News 140 Prospect St.

Patterson
N. Jersey B/C Co. 115 Ellison St.

Trenton
Mercer B/C Co. 10 S. Stockton St.

NEW YORK

Albany
WOKO, Inc. Radio Centre
(M) Harold E. Smith
GE WOKO CBS

Binghamton
Wylie B. Jones Adv. Agcy. Capitol Theatre Bldg.

Brooklyn
Frequency B/C Corp 800 St. Mark's Ave.
Elias I. Godofsky 26 Court St.
(M) Elias I. Godofsky
$50,000
WLIB, Inc. 846 Flatbush Ave.
(C) Lohnes & Culver
WLIB

Buffalo
Buffalo B/C Corp. Rand Bldg.
WBEN, Inc. Hotel Statler
(M) A Kirchhofer (E) R Kingsley (C) P Godley
$200,000 RCA WBEN
WEBR, Inc. 23 North St
(M) Cy King (C) Frank McIntosh
MBS

Corning
W. W. Underhill 170 Delaware Ave.

Dunkirk
Dunkirk Printing Co. 8 E. 2nd St

Elmira
Elmira Star-Gazette 201 Baldwin St.

Hastings
Bernard Feln Box 145
$25,000

Howell
W. H. Greenhow Co. 85 Conistro St

Ithaca
Cornell University
(M) M R Hanna (E) True McLean
$75,000 WHCK CBS

Jackson Heights
Geo. Mayaral & Wm. Cartada 3721 85th St.
(M) Ramon Cartada (C) George Mayaral
$150,000 GE

Jamaica
Jamaica Radio Tel. Mfg. Co. 143-18 Jamaica
(M) Ruth Vorbach (C) Wm. B. Still
$30,000 Jamaica Radio & Tel. Co.

Jamestown
James B/C Co., Inc. Hotel Jamestown Bldg.
(M) S Goldman (E) H Kratzert
GE WJTN AM B/C Co.

New York City
Armstrong, Edwin H. 435 E. 52nd St. W2XMN
Atlantic B/C Co., Inc. 29 W. 57th St.
Blue Network Co. 30 Rockefeller Plaza
City of New York Municipal Bldg. WNYC-FM
(M) M S Nevik (C) B B Arnew
$15,000 WE WNYC
Columbia B/C Sys., Inc. 485 Madison Ave. WABC-FM
(M) A H Hayes (E) H Grossman
$40,000 GE
Debs Mem. Radio Fund 117 W. 46th St
Hudson B/C Sys., Inc. 1775 Broadway
(M) Bert Harmon
$25,000 GE
Interstate B/C Co. 730 Fifth Ave. WQXQ
(M) E M Sanger (E) D Valentine
$13,360 REL WQXR
Marcus Loew Bkg. Agency 1504 Broadway
Nat. B/C Co., Inc. 30 Rockefeller Plaza WEAF-FM
(M) F E Mullen (E) O B Hanson
RCA WEAF NBC
News Syndicate Co., Inc. 220 E. 42nd St.
Peoples Radio Found., Inc. 100 5th Ave.
Raytheon Mfg. Co. 60 E. 42nd St. W2XRA
(M) J Pierson (E) W Phillips (C) D Deneulf
$300,000 Raytheon Mfg. Co.
WBNX B/C Co. 260 East 161 St.
WMCA, Inc. 1657 Broadway

Ogdensburg
St. Lawrence B/C Corp.
(M) J Brandy (E) C Moore (C) John Keel
RCA or GE MBS

Ossining
Schecter, A. A. R.F.D. No. 2 Shingle-house Rd.

Oswego
Palladium-Times, Inc.
(M) E M Waterbury (C) E L Dillard

Poughkeepsie
Poughkeepsie Newspapers, Inc. 65 New Market
(M) H W Cassill (E) M Selmes
$48,000 GE WKIP American

Rochester
Stromberg-Carlson Co. 100 Carlson Rd. WHFM
(M) W Fay (E) K J Gardner
REL WHAM NBC
WHEC, Inc. 40 Franklin St. WHEC
(M) G Wrig (E) B O'Brien (C) Ring & Clark
REL WHEL CBS

Schenectady
Capitol Broadcasting Corp.
GE Mutual
General Electric 1 River Rd. WGFM
(M) G. Emerson Markham (E) W J Purcell
GE WGY

Syracuse
Central N. Y. B/C Corp. Kemper Bldg.
(M) H Wilder (E) A G Bell Isle (C) J Barron
$35,000 WSYR NBC
Onondaga Radio B/C Corp. WFBL
WAGE, Inc. 108 Jefferson St.

Troy
Troy B/C Co., Inc. 92 Fourth St.
(M) W Ripple (E) S Stanley (C) Lohnes & Culver
GE WTRY American

FM STATIONS, Continued

Utica
WIBX, Inc. 187 Genesee St.

Watertown
The Brockway Corp. 120 Arcade St.

White Plains
Westchester B/C Corp. Roger Smith Hotel
(M) F Seltz (E) Seltz (C) McNary & Wrathall
WE WFAS

NORTH CAROLINA

Burlington
Alamance B/C Co., Inc.
(M) E Jones (C) G C Davis
$25,000 GE WHBB Mutual

Dublea
Radio Station WMFD P.O. Box 696
(M) R Dunlea (E) E Herring (C) Ring & Clark
$30,000 RCA WMFD American

Durham
Durham Radio Corp.

Greensboro
Greensboro B/C Co., Inc. Ashe St.
(M) R Lambeth (C) John Barron
WGBG ABC
Greensboro News Co. 200 N. Davie St. WTHS
(M) P Hines (C) Lohnes & Culver
$34,800 GE
N. C. B/C Co., Inc. O'Henry Hotel

High Point
Radio Station WMFR 164 S. Main St. WMFR
(M) H Lambeth (E) G Davis
WMFR ABC

Raleigh
WPTF Radio Co. Insurance Bldg.

Roanoke Rapids
Tellecast Inc. Peoples Theatre

Rocky Mount
Josh L. Horne 150 Howard St.

Salisbury
Piedmont B/C Co. Yadkin Hotel

Wilmington
Dunlea, R. A. 116 Kenwood Ave.
Wilmington Star News Murchison Bldg.

Winston-Salem
C. G. Hill Wachovia B & T Co.
Gordon Gray Winston-Salem 1 WMIT
(M) H Essex (E) P Dillon (C) Lohnes & Culver
GE WSJS NBC
Piedmont Pub. Co. 419 21 N. Spruce St.
(M) H Essex (E) P Hedrick (C) Lohnes & Culver
WSJS
Piedmont Pub. Co. 416 N. Marshall St.

OHIO

Akron
Akron Radio Corp. 2200 First Central Tower
F. T. Neid & P. H. Stevens 1st Central Tower
Simmons, A. T. Box 830
Summit Radio Corp. 106 S. Main St.
United B/C Co. Cleveland, Ohio

Alliance
Review Pub. Co. 28 S. Linden Ave.

Ashland
Beer and Koehl Times-Gazette WATG
(M) R Beer (C) R Fox
GE

Ashtabula
WICA, Inc. 221 Center St.

Athens
Messenger Pub. Co. 9 S. College St.

Cincinnati
Cincinnati B/C Co. 1616 Union Central Bldg.
The Cincinnati Times Star 800 Broadway
The Crosley Corp. Crosley Square W8XFM
(M) J D Shouse (E) R J Rockwell
WLW NBC
Scripps Howard Radio 3800 Carew Tower
L. B. Wilson, Inc. Hotel Gibson

Cleveland
Acme Newspictures, Inc. 1200 West 3rd St.
(M) H Walker (E) L Thompson
$5,000 Composite
Cleveland Board of Ed. 1380 E. 6th St. WBOE
(M) W Levenson (E) N Neal
$15,000 REL
Nat'l B/C Co., Inc. 815 Superior St.
(M) V Pribbles (E) S Leonard (C) NBC
RCA NBC
United B/C Co. 1311 Terminal Tower
WGAR Statler Hotel
(M) J Patt (E) R M Pierce
$75,000 GE or RCA WGAR CBS

Columbus
Central Ohio B/C Co. 21 E. State St.
Pexley, L. A. 33 North High St.
RadiOhio, Inc. 33 No. High St. WELD
(M) L Nafzger (E) L Nafzger
REL WBNS CBS
United B/C Co. Cleveland, Ohio

Dayton
Miami Valley B/C Co. 455 Ludlow St. W8XMV
(M) R Moody (E) E Adams (C) F McIntosh
WE WHIO CBS

Findlay
Fred R. Hover 500½ S. Main St.
(M) F Hover (E) E Smith
$20,000 GE

Fostoria
Hanny, L. W. 920 N. County Line St.

Fremont
Robert F. Wolfe Co. 907 W. State St.
(M) R Wolfe (E) G Swartztander
$35,000 GE

Glendale
Great Trails B/C Corp. 835 Woodbine Ave.

Hamilton
The Ft. Hamilton B/C Co. 2nd Nat'l Bank
(M) D Ioset (E) A Bruck
WMOH Mutual

Liverpool
Ohio B/C Co. 517 Broadway

Marion
The Marion B/C Co. North Main St.

Newark
The Advocate Print. Co. 25 West Main St.

Toledo
The Fort Industry Co. 506 New Center Bldg.
(M) E Flannigan (E) F Hilbert (C) CM Jansky
The Toledo Blade Co.
(M) W Courtney
Unity Corp., Inc. 1014 Edison Bldg.
(M) E Lamb (E) A Bitter

Steubenville
The Valley B/C Co. 708 Sinclair Bldg.

Youngstown
WKBN B/C Corp. 17 N. Champions St.
(M) W Williamson (E) W Williamson, Jr. (C) McNary & Wrathall
RCA WKBN CBS
WFMJ B/C Corp. 101 West Boardman St.

Wooster
Wooster Rep. Printing Co.

OKLAHOMA

Lawton
Shepler, Ned

Muskogee
KOMA, Inc. 111 So. Cherokee St.

Oklahoma City
Plaza Court B/C Co. Plaza Court
(M) M Bonebrake (E) G Brock (C) Comm. Radio Equip. Co.
KOCY Mutual
WKY Radiophone Co.
(M) E Bell (E) J Lovell (C) D McKey
$150,000 WE WKY NBC

Tulsa
Fred Jones B/C Co. 1201 S. Boston St.
Tulsa B/C Co.
(M) J Esau (E) R Snider
$106,600 to $118,600 KTUL CBS
World Pub. Co. 317 South Boulder

OREGON

Medford
Vergin, Mrs. W. J. Box 1306

Portland
Broadcasters Oregon Ltd. 411 S.W. Salmon St
KOIN, Inc. P.O. Box 1031
(M) C W Meyers (E) L Bookwalter
KXL Broadcasting Co. Orpheim Bldg.
Oregonian Pub. Co. 537 S.W. 6th Ave.
Pacific Rad. Adv. Ser. 506 Oreg. Bldg.

PENNSYLVANIA

Allentown
Lehigh Valley B/C Co. 39-41 No. 10th St.
(M) B B Musselman (E) R H Musselman
$100,000 WE WSAN NBC

Bradford
Bradford Pub Co. 43 Main St.

Easton
Associated B/C 516 Northampton St.

FM STATIONS, Continued

Harrisburg
Keptone B/C Corp. 31 N 2nd St.
The Patriot Co. 105 N. Front St.

Lancaster
WGAL, Inc. 8 West King St.

Johnstown
WJAC, Inc. Tribune Annex.

Philadelphia
Gibralter Serv. Corp. The Even. Bulletin
Pennsy. B/C Co. 35 S. 9th St. WIP-FM
(M) B. Gimbel, Jr. (E) C Harris
WE WIP Mutual
The Phila. Inq. 400 N. Broad St.
Philco Rad. & Tel. Corp. Phila. W3XWQ
(M) W Merkle (E) P M Craig
Philco
WCAU B/C Co. 1622 Chestnut St. WCAU-FM
(M) Lion Levy (E) G Lewis
RCA WCAU CBS
WDAS B/C Stat., Inc. 1211 Chestnut St.
(M) P J Stanton (E) F Unterberger (C) Jansky & Bailey
$150,000 WDAS
West'house Radio Sta., Inc. 1619 Walnut St. KYW-FM
(M) L W Joy (E) I N Eney (C) Ring & Clark
$36,000 RCA KYW NBC
WFIL B/C Co. Widener Bldg. WFIL-FM
(M) R W Clipp (E) L E Littlejohn
REL WFIL ABC
WM Penn B/C Co. 1528 Walnut St. WPEN-FM
(M) G E Larson (E) C W Burtis (C) G C Davis
$18,000 GE WPEN

Pittsburgh
Stehlman H. H. 411 7th Ave.
Pitts. Rad. Sup. House 1406 Chamber of Comm.
(M) H Brennen (E) W McCoy (C) W McCoy

Reading
Hawley B/C Co. 30 N. 4th St.
$35,000
Reading B/C Co. 533 Penn St.

Scranton
Scranton B/C Co. 1000 Wyoming Ave.

Sharon
Sharon Herald B/C Co. Box 541

Uniontown
Fayette B/C Corp. 3 W. Main St.

Wilkes Barre
Baltimore, L. G. Wilkes Barre

Williamsport
WRAK, Inc. 244 W. 4th St.

York
Susquehanna B/C Co. 47 Market St
York Broadcasting Co. 13 S. Beaver St.

RHODE ISLAND

Pawtucket
Pawtucket B/C Co. 450 Main St.

Providence
Cherry & Webb B/C Co. 15 Chestnut St.
The Outlet Co. 176 Wabosset St.
Providence Journal 25 Fountain St.

SOUTH CAROLINA

Charlestown
Atlantic Coast B/C Co.
(M) R Bradham (E) D Bradham (C) E Dillard

Columbia
Radio Station WIS 1811 Main St.
(M) G Richard (E) W E Benns (C) Jansky & Bailey
$125,000 GE WIS NBC

Greenville
The Greenville News 305 S. Main St.
Textile B/C Co. Nehi Bldg. Co.

Greenwood
Greenco, Inc. Box 868 Greenco, Inc.

Spartanburg
Spartanburg Adv. Co. 224 E. Main St.

TENNESSEE

Chattanooga
Mark K. Wilson 406 Lovewan Bldg.
$51,300 GE
Winger, C. W. Ham Nat. Bank Bldg.

Clarksville
Leaf Chronicle Co. 112 S. 2nd St.
(M) D E Charlet (C) G Reynolds
$25,000

Jackson
The Sun Pub. Co. 104 Baltimore St.
(M) A Stone (E) B C Brummel (C) G Davis
$50,000 RCA WTJS American

Johnson City
WJHL, Inc. WJHL-FM
(M) W H Lancaster (E) O K Garland
$37,750 WJHL American

Knoxville
Knoxville Pub. Co. Knoxville
Radio Sta. WBIR 406 W. Church St.
(M) J Hart (E) J Horton (C) McNary & Wrathall
$16,000 WE WBIR ABC Blue
Stewart B/C Co. 531 S. Gay St.

Memphis
Herff. H. 295 Union Ave.
Radio Sta. WMC P.O. Box 311
(M) H W Slavick (E) E C Frase (C) G C Davis
$150,000 RCA NBC

Nashville
Nashville Radio Corp. 1100 Broad St.
WSIX B/C Station Nashville Trust Bldg.

TEXAS

Abilene
The Report B/C Co. P.O. Box 30

Amarillo
Amarillo B/C Corp. Nunn Bldg.
(M) H Roberson (E) J Thomas (C) McNary & Wrathall
$15,000 KFDA American
Planes Radio B/C Co. 8th & Harrison St.

Beaumont
KRIC, Inc. 380 Walnut St.
(M) J Nell (E) B Hughes
KRIC

Brownsville
Brownsville Herald Brownsville

Dallas
A. H. Belo Corp. 801 Commerce St.
(M) M Campbell (E) R Collins (C) E Cullum
WFAA NBC
KRLD Radio Corp. Dallas

Fort Worth
Frontier B/C Co., Inc. 1201 W. Lanchester

Galveston
KLUF B/C Co., Inc. P.O. Box 562

Harlinger
Harbenito B/C Co.
(M) A McDaniel (E) S L Spencer
GE CHS
Valley Pub. Co.

Houston
Houston Print Corp. 2318 Polk Ave.
KTRH B/C Co. Main & Texas

San Angelo
KGKL San Angelo

San Antonio
Southland Industries WOAI Bldg.
The Walmac Co. Nat. B. of Commerce

Texarkana
KCMC, Inc. 317 Pine St.

Wichita Falls
Rhea Howard P.O. Box 120
(M) R Howard (C) Ring & Clark
$75,000 GE

UTAH

Salt Lake City
Intermountain B/C Corp. 143 S. Main St.
Utah B/C & Tel. Co. 29 S. State St.
(M) F C Carmen (C) McNary & Wrathall
$50,000 RCA KUTA American

VIRGINIA

Norfolk
Hampton Rds. B/C Corp. 500 Portlock Bldg.
(M) E Bishop (E) W Grether (C) G Davis
WE American
WTAR Radio Corp. 1304 Nat'l Bk. of Com. Bldg.

Portsmouth
Portsmouth Radio Corp.

Richmond
Havens & Martin, Inc. 3301 W. Broad St.
Richmond Rad. Corp. 323 E. Grace St.
(M) E S Whitlock (E) W Selden (C) Jansky & Bailey
$40,000 WE American
Larus & Bros. Co. 22nd & Cary Sts.

Roanoke
Times-World Corp. P.O. Box 150

WEST VIRGINIA

Beckley
Beckley Newspaper Corp. 341 W. Prince St.
(M) C Hodel (C) Jansky & Bailey
GE
Joe L Smith, Jr.
(M) J L Smith (E) A Ginkle (C) McNary & Wrathall
$75,000 WJLS CBS

Charleston
Charleston B/C Co. 1016 Lee St.

Morgantown
W. Va. Radio Sta. 440 Spruce St.

Wheeling
W. Va. B/C Corp. Fort Industry Co.
(M) G W Smith (E) E L Kelm (C) C M Jansky
WWVA

Seattle
Evergreen B/C Corp. Smith Lawer
(M) B Sims (E) A A Schultz (C) R Hilgers
$40,000 GE KEVR
Fisher Blend Stat. Inc. 1326 Fifth Ave.
Queen City B/C Co. 66 Cobb Bldg.
Radio Sales Corp. 2939 4th Ave. S.

Spokane
Louis Wasmer, Inc. Radio Central Bldg.

WISCONSIN

Green Bay
Green Bay Newspaper Co. Walnut & Madison

Madison
Banger B/C Co. 110 E. Main St.

Milwaukee
The Journal Co. 333 West State St. WMFM
(M) W J Damm (E) P B Laesser
REL WTMJ
Milwaukee B/C Co. 711 Empire Bldg.
Myles H. Johns 231 W. Wisconsin Ave.
$160,000 RCA

Oshkosh
Oshkosh B/C Co. 151½ Main St.
Racine B/C Corp. 441 Main St.
(M) H LePoidevin (C) George Davis
$29,500 RCA WRJN American

Sheboygan
Press Pub. Co. 636 Center Ave.

Stoddard
WKBH, Inc. 409 Main St.
(M) H Dahl (E) A Leeman
$59,300 RCA WKBH NBC

Wausau
Record Herald Co. 316 Scott St.

TELEVISION STATIONS

CALIFORNIA

Hollywood
Don Lee 3800 Mt. Lee Dr. W6XAO, KTSI, W6XDU
(M) L A Weis (E) H R Lubcke
$1,000,000 GE KHJ Mutual

Fresno
J. E. Rodman Station KFRE
(M) P R Bartlett (E) H R Brown (C) G Wrathall
$169,250 GE KFRE Mutual

Los Angeles
Earle C. Anthony, Inc. 141 N. Vermont Ave. KSEE
(M) W B Ryan (E) Blatterman & Mason
RCA KFI NBC
Blue Network Co., Inc.
Hughes Productions W6XHH
Metro-Goldwyn Mayer Studios
National Bestg. Co.
Tele. Productions, Inc. W6XY2, W6XLA
Times Mirror Co.

San Francisco
Assoc. Broadcasters, Inc.
Hughes Productions W6XHT
Don Lee Bestg. System
National Bestg. Co.

Pasadena
Columbia Bestg. System

Stockton
E. F. Pfeffer

Riverside
Bestg. Corp. of America 3401 Russell St.
(M) W L Gleeson (C) Andrew Ring
$150,000 GE KPRO American

COLORADO

Denver
National Bestg. Co.
KLZ Bestg. Co.

CONNECTICUT

Bristol
Raytheon Mfg. Co. Newton, Mass.

Greenfield Hill
Conn. Tel. Co. Meriden, Conn.

Hartford
Travelers Bestg. Service Corp. 26 Grove St.
(M) P W Morency (E) E D Taylor
$209,400 RCA WTIC NBC
Yankee Network, Inc.

New London
The Thames Bestg. Co. 281 State St.
(M) G J Morey (E) G J Morey
$25,000 GE WNLC Mutual

Tolland
Raytheon Mfg. Co. Newton, Mass.

WASHINGTON, D. C.

Bamberger Bestg. Service 1440 B'way, New York
Capitol Bestg. Co. 1000 Conn. Ave. N.W.
(M) B Strouse (E) R Beville (C) McNary & Wrathall
$144,000 RCA WNDC
Allen B. DuMont Labs., Inc. Passaic, N. J. W3XWT
Marcus Loew Bkg. Agency
Nat'l Bestg. Co. Translux Bldg.
(M) C D Smith (E) A E Johnson
RCA WRC NBC
Philco Radio & Tel. Corp. Philadelphia, Pa.
Scripps-Howard Radio, Inc.
The Times Herald

DELAWARE

Wilmington
WDEL, Inc.

FLORIDA

Miami Beach
A. Frank Katzentine

Jacksonville
Jacksonville Bestg. Corp.

ILLINOIS

Chicago
Balaban & Katz Corp. 190 N. State St. W9XBT
(M) E C Upton (E) A H Brolly
DuMont
Blue Network Co., Inc.
Columbia Bestg. System
Johnson Kennedy Radio Corp.
Nat'l Bestg. Co. 222 North Bank Dr.
(M) H C Koff (E) H C Luttgens
RCA WMAQ NBC
Raytheon Mfg. Co. Newton, Mass.
Television Prod., Inc. Los Angeles, Calif.
WGN, Inc.
Zenith Radio Corp. 6001 Dickens Ave. W9XZV
(M) J E Brown

INDIANA

Fort Wayne
Farnsworth Tele. & Radio Corp.

Indianapolis
Capitol Bestg. Corp.
Ind. Bestrs., Inc. Clay Pool Hotel
(M) E C Pulliam (E) E E Alden
WIRE NBC
P. R. Mallory & Co., Inc.
Wm. H. Block Co. 50 N. Illinois St.
(M) C W Spiess
$200,000 RCA
WFBM, Inc. 48 Monument Circle
(M) F O Sharp (E) H S Holland
$100,000 RCA WFBM CBS

West Lafayette
Purdue University W. Lafayette W9XG
(M) Dr. D D Ewing

IOWA

Ames
Iowa State Coll. of Agriculture

Des Moines
Tel. Produc., Inc.

Iowa City
State University of Iowa W9XUI
Composite

KENTUCKY

Louisville
WAVE, Inc.

LOUISIANA

New Orleans
Loyola University
Maison Blande Co.

MARYLAND

Baltimore
Hearst Radio, Inc.
Maryland Bestg. Co.
The Tower Realty Co.
J. M. Zamoiski Co.

Havre de Grace
Philco Radio & Tel. Corp. Philadelphia

TELEVISION STATIONS, Continued

Sappington
Philco Radio & Tel. Corp. Philadelphia

MASSACHUSETTS

Boston
E. Anthony & Sons, Inc.
Columbia Bestg. System
Allen B. DuMont Labs., Inc. Passaic, N. J.
Filene's Tel., Inc.
Gen. Tel. Corp. W1XG
Francis Taylor
Twentieth Century Fox Film Co.
Westinghouse Radio Sta., Inc.
The Yankee Network, Inc.

Lexington
Raytheon Mfg. Co. Newton, Mass.

Waltham
Raytheon Mfg. Co. Newton, Mass.

Webster
Raytheon Mfg. Co. Newton, Mass.

MICHIGAN

Detroit
Evening News Assn. Penobscot Bldg.
(M) H Bannister (C) Ring & Clark
WWJ NBC
Inter. Detrola Co.
Jam Handy Org., Inc.
King Trendle Bestg. Co.
Tel. Prod., Inc. Los Angeles, Calif.
United Detroit Theatre Corp.
WJR, The Goodwill Station

MINNESOTA

Minneapolis
Ind. Tool & Die Works

MISSOURI

Kansas City
Kansas City Star Co.

St. Louis
Alfco Co.
Columbia Bestg. System
Globe Dem. Pub. Co.
Pulitzer Pub. Co.
Star Times Pub. Co. 12th & Delmar Blvds.
(M) C L Thomas (E) A Rekart
$200,000 GE KXOK American
Thomas Patrick, Inc. Hotel Chase
(M) R Dady (E) N J Zehr (C) J Barron
RCA KWK Mutual

NEBRASKA

Omaha
Radio Sta. WOW 17th & Farnam
(M) J Gillin (E) J Herold (C) Ring & Clark
$220,000 RCA WOW NBC
World Pub. Co.

NEW JERSEY

Camden
Radio Corp. of America W3XEP, W3XAD

Clifton
North Jersey Bestg. Co., Inc.

Newark
Bremer Bestg. Co. 11 Hill St.
(M) J Rosenhaus (E) F Bremer (C) G Gillette
$250,000 DuMont WAAT

Passaic
A. B. DuMont Labs., Inc. 2 Main St. W2XWT
(M) J Armstrong (E) M Barton
A. B. DuMont Labs. Inc. 2 Main St. W2XVT
(M) J Armstrong (E) J J Goldsmith, Jr.
$250,000 DuMont Labs.

NEW MEXICO

Alberquerque
Alberquerque Broadcasting Co.

NEW YORK

Brooklyn
Sherron Electrics Co. 1201 Flushing Ave. W2XDK
(M) P J Gollhofer (E) M V Barasch
Sherron

Buffalo
Tel. Productions, Inc. Los Angeles, Calif.
WBEN, Inc. Hotel Statler
(M) A A Kirchhofer (E) R J Kingsley (C) P Godley
$150,000 GE WBEN
WEBR, Inc. 23 North St.
(M)C King (C) F McIntosh

Jamaica
Jam. Radio & Tel. Co. 143-18 Jamaica Ave. W2XJT
(M) R Verbach (C) W B Still
$20,000 Staff construction

New York
Bamberger Bestg. Service W2XBB
Blue Network Co., Inc.
Col. Bestg. System 485 Madison Avenue WXBW, W2XCB
(M) M Miner (E) P C Goldmark RCA
Dels. Memorial Radio Fund, Inc.
A. B. DuMont Labs., Inc. 515 Madison Ave. WABD
(M) S H Cuff (E) S R Patremio DuMont
P. K. & L. Leberman
Marcus Loew Bkg. Agency
Metropolitan Tel., Inc. W2XMT
(M) L L Thompson (E) T B Grenier
Nat'l Bestg. Co. Empire State Bldg. WNBT, W2XBT, W2XBU
(M) J F Royal (E) C B Hanson RCA NBC
News Syndicate, Inc.
Philco Radio & Tel. Corp. Philadelphia, Pa.
Raytheon Mfg. Co., C. D. 60 E. 42nd St.
(M) J Pierson (E) T Gottler (C) D K de Neuf
$1,200,000 Raytheon
WQIB, Inc.

Rochester
Stromberg-Carlson Co. Carlson Rd.
(M) W Fay (E) K J Gardner
RCA WHAM

Schenectady
Gen. Electric Co. 1 River Rd. WRGB, W2XGE, W2XI
(M) G Markham (E) W Purcell
GE WGY

White Plains
Westchester Bestg. Co. Roger Smith Hotel
(M) F A Seltz (C) McNary & Wrathall
WFAS

OHIO

Akron
United Broadcasting Co. Cleveland, O.

Cincinnati
Crosley Corp. Crosley Sq. W8XCT
(M) J D Shouse (E) R J Rockwell Crosley WLW NBC

Cleveland
Nat'l Bestg. Co. 815 Superior Ave.
(M) V H Pribble (E) S E Leonard (C) NBC
RCA NBC
Scripps Howard Radio, Inc.
United Bestg. Co. 1311 Terminal Tower
WGAR Bestg. Co. Statler Hotel
(M) J F Patt (E) R M Pierce
WGAR CBS

Columbus
Central Ohio Broadcasting Co.
The Crosley Corp. Cincinnati
United Broadcasting Co. Cleveland, O.

Dayton
The Crosley Corp. Cincinnati

OKLAHOMA

Oklahoma City
WKY Radiophone Co. WKY
(M) E T Bell (E) J Lovell (C) D B McKey
$300,000 RCA WKY

OREGON

Portland
Oregonian Publishing Co.

PENNSYLVANIA

Honey Brook
Philco Radio & Tel. Corp. Philadelphia, Pa.

Johnstown
WJAC, Inc.

Philadelphia
Penn Bestg. Co. 35 S. 9th St.
(M) B Gimbel (E) C G Harris
$300,000 WIP Mutual
Philadelphia Daily News
(M) J E Lit (C) P Godley
$325,000 DuMont
Philadelphia Inquirer
Philco Radio & Tel. Corp. W3XE, W10XPC, W10XP, W10XPR, W10XPA, WPTZ
(M) W W Merkle (E) F J Bingley Philco
Seaboard Radio & Bestg. Co.
WCAU Bestg. Co. 1622 Chestnut St. W3XAU
WDAS Bestg. St., Inc. 1211 Chestnut St.
(M) P J Stanton
$200,000 DuMont WDAS
Westinghouse Radio Stations, Inc.
WFIL Bestg. Co. Widener Bldg.
(M) R W Clipp (E) L E Littlejohn WFIL American

Pittsburgh
Scripps Howard Radio, Inc.
Westhinghouse Radio Station, Inc.

Springfield Township
Philco Radio & Tel. Co. Philadelphia, Pa.

RHODE ISLAND

Providence
E. Anthony & Sons
The Outlet Co.
The Yankee Network Boston, Mass.

TENNESSEE

Nashville
J. W. Birdwell

TEXAS

Dallas
A. H. Belo Corp. 801 Commerce St.
(M) M Campbell (E) R Collins (C) A C Cullum
WFAA NBC
Interstate Circuit, Inc.

El Paso
Tel. Products, Inc.

UTAH

Salt Lake City
Intermountain Bestg. Co.
Utah Bestg. & Tel. Co. 29 S. State St.
(M) F C Carmen (C) McNary & Wrathall
$108,000 RCA KUTA American

VERMONT

Peru Mt.
Television Productions, Inc.

VIRGINIA

Arlington
Philco Radio & Tel. Corp. Philadelphia, Pa.

Richmond
Havens & Martin, Inc.

WASHINGTON

Seattle
Radio Sales Corp.

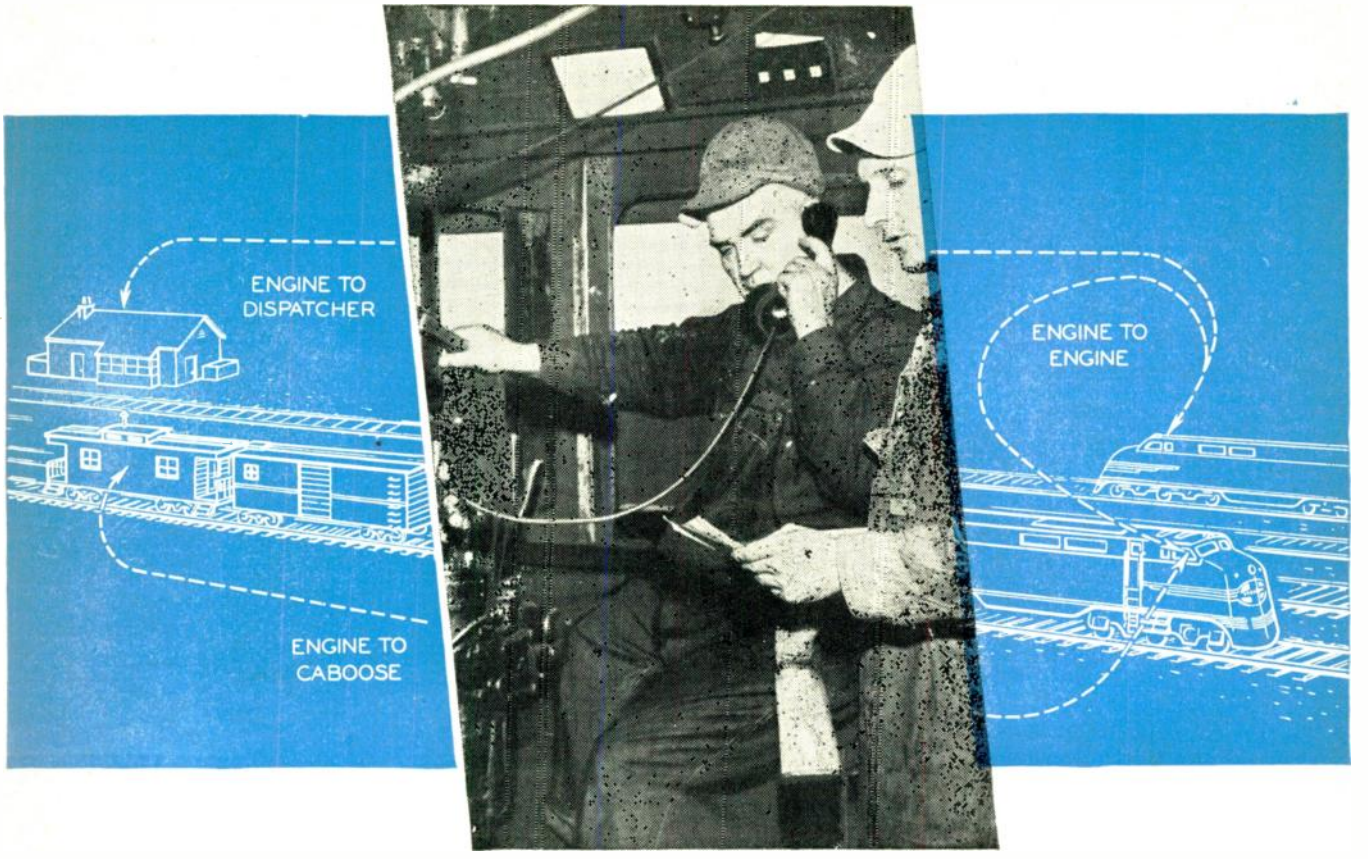
Spokane
Louis Wasmer, Inc.

WEST VIRGINIA

South Charleston
Gus Zaharis

WISCONSIN

Milwaukee
Hearst Radio, Inc.
Journal Co. 333 W. State St. WMJT, W9XCV
(M) W J Damm (E) P B Laeser
WTMJ



The basic starting point in designing transportation communications equipment is CONSTANT VOLTAGE

With a calculated operating voltage, communications equipment can be designed to operate superbly in the laboratory.

But what happens when this equipment gets into the field where voltages may vary as much as 30% from the laboratory standard? Signals become indistinct and garbled and the life of costly tubes may be prematurely shortened.

The communications equipment now being designed to provide greater safety, greater efficiency in the operation of our rail, sea, air, bus and truck transportation cannot fulfill this function if it is to rely on uncertain supply voltages. Constant voltage here is a "must".

SOLA Constant Voltage Transformers specially designed for communications equipment have been widely and successfully used before and during this war. They are the starting point in the basic design of much of the equipment now being planned for the major developments that are coming. Have you planned them into your equipment?

Consultation *now* with SOLA engineers means better communications for the future. SOLA Constant Voltage Transformers are available in standard designs in capacities from 10VA to 15KVA. Or special units can be designed to meet any requirements. SOLA Constant Voltage Transformers require no supervision or manual adjustments. No networks or moving parts to get out of order. They protect both themselves and the equipment against short circuit. They are a practical and economical solution to ever present voltage problems.

Constant Voltage Transformers

SOLA

To Manufacturers:

Built-in voltage control guarantees the voltage called for on your label. Consult our engineers on details of design specifications.

Ask for Bulletin 5CV-102

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • etc. **SOLA ELECTRIC COMPANY, 2525 Clybourn Avenue, Chicago 14, Illinois**

WHEN THE INSULATION GOES—

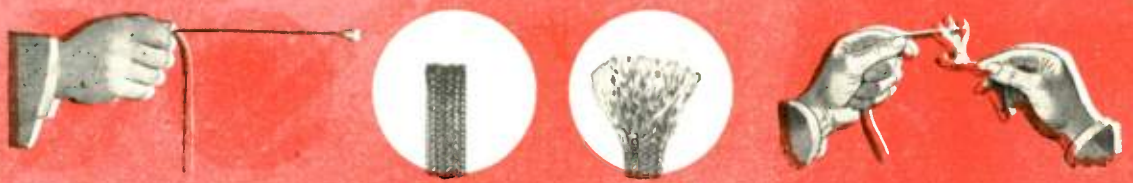
YOUR TROUBLE STARTS!

WHAT does it mean to *you* when Mrs. Smith's electric iron goes *phht?* If electrical insulation is a part of *your* product, whether it's appliance, radio or electrical equipment, you, like the iron manufacturer, run this *risk*. The risk of insulation failure—of inconveniencing customers, jeopardizing good will, and possibly losing sales.

Since your product's performance may depend on a few cents worth of insulation, be sure to use the best. Assure trouble-free service with BH Fiberglas Sleeving, the *original* non-fraying, non-stiffening, non-burning Fiberglas sleeving. An exclusive BH process combines *permanent* freedom from hardening, cracking or rotting with the many advantages of Fiberglas — including high dielectric and tensile strength, resistance to moisture, oil, grease and most chemicals.

Severest wartime uses prove beyond question the superior qualities of all three BH Fiberglas Sleevings in electrical applications for home and industry. One of them may fit your needs to a "T"—*plus!* Write for free BH samples today and put them to the toughest tests your product can dish out!

3 GREAT BH FIBERGLAS SLEEVINGS— EACH 3 WAYS BETTER!



NON-STIFFENING* **NON-FRAYING*** **NON-BURNING***

BH EXTRA FLEXIBLE FIBERGLAS SLEEVING • BH SPECIAL TREATED FIBERGLAS SLEEVING

BEN-HAR COATED FIBERGLAS SLEEVING

*Ask for sample folder giving degree above characteristics are combined in these three sleevings.
All standard sizes and colors—available in standard 36-in. lengths and 500-ft. coils.

BH PRODUCTS

ALSO SLOW-BURNING IMPREGNATED MAGNETO TUBING • SLOW-BURNING FLEXIBLE VARNISHED TUBING • SATURATED SLEEVING • A. S. T. M. SPECIFICATIONS

BENTLEY, HARRIS MANUFACTURING CO.

Dept. B Conshohocken, Penna.

A POSTWAR PROJECT FOR YOU...

SUPERSTANDARD RECEIVING TUBES

SUPERSTANDARD—above standard; a term coined by Hytron for a standard receiving tube completely redesigned to give improved performance in special electronic applications

Receiving tube design is often a compromise. Ruggedness, dependability, long life—the very qualities most desirable in industrial electronics and aviation—have often been sacrificed for reduced cost and power consumption in broadcast receivers. Low filament current may be poor economy in an industrial tube. A standard 6SJ7GT may be objectionably microphonic in sound equipment. Vibration, jars, shocks, and inadequate maintenance in the factory may play hob with a standard receiving tube.

STANDARD—SPECIALLY SELECTED—NOW HYTRON PROPOSES SUPERSTANDARD

HYTRON IS CONVINCED: Standard receiving tubes are not right for special electronic applications. Special selection of standard tubes leads to embarrassing replacement problems—does not guarantee permanence of characteristics specially tested, long life, or suitability for operation at not-too-conservative maximum ratings. Hytron prewar ceramic-based low-loss GTX tubes were but a step in the right direction. The Navy "ruggedized" tube program points the way. Complete redesign of many receiving tubes is mandatory. A tube listing at a dollar in electronic equipment costing thousands and controlling huge production lines is false economy which has already dealt industrial electronics many an unnecessary black eye.

MAY WE HAVE YOUR OPINION?

1 Do you agree that special selection merely results in replacement problems?

2 How many thousands of hours of life should *SUPERSTANDARD* tubes have?

3 What degree of vibration and shock should *SUPERSTANDARD* tubes be capable of withstanding?

4 For what characteristics not now tested should *SUPERSTANDARD* tubes be production tested?

5 Would you be willing to pay a premium price for *SUPERSTANDARD* tubes to attain trouble-free operation?

6 Should Hytron concentrate on developing *SUPERSTANDARD* tubes usable for many special purposes, and avoid trick and highly specialized tubes?

7 How closely should a *SUPERSTANDARD* tube adhere to fundamental characteristics of a standard receiving tube it supersedes?

8 Do you believe *SUPERSTANDARD* tubes should have special bases to avoid replacement by inferior standard receiving tubes?

9 Should *SUPERSTANDARD* tubes have new type numbers, or the old standard type numbers with a special suffix (e.g., 6SJ7GTS)?*

10 Have we omitted pertinent questions you believe important?

*NEMA and RMA are now working on type designation systems

The Hytron SUPERSTANDARD tube is as yet an idea—a postwar project for YOU. You who use the tubes can spark the program—can make it come to life. Hytron will put its postwar engineering drive behind the SUPERSTANDARD tube, if you will help. Let us know the improvements of specific characteristics your experience has proved desirable. Drop a line today to our Commercial Engineering Department.

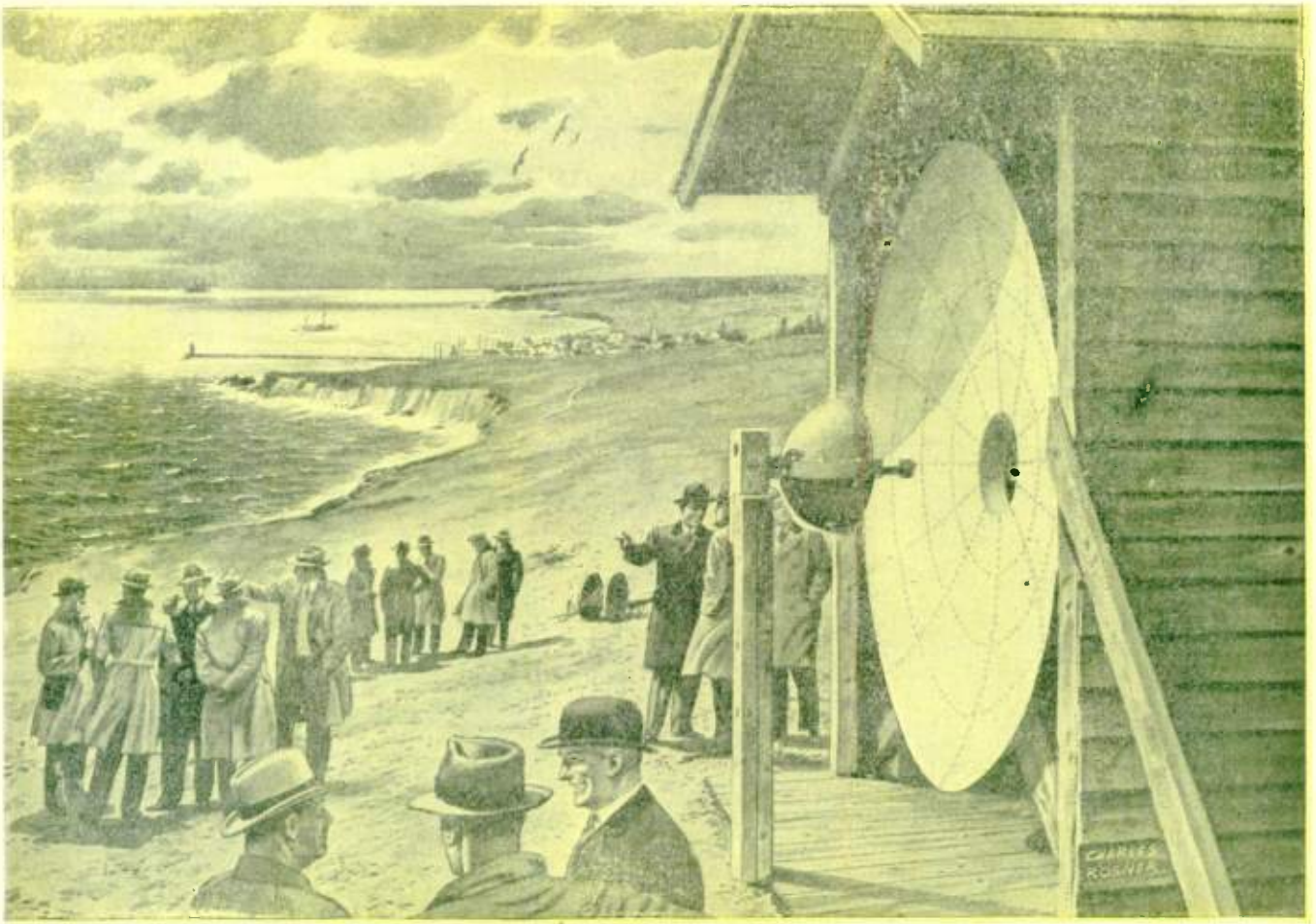
OLDEST MANUFACTURER SPECIALIZING IN RADIO RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

PLANTS: SALEM, NEWBURYPORT, BEVERLY & LAWRENCE



Federal's men know Microwave

On a gusty March day in 1931 . . . when man's voice was beamed across the English Channel from an antenna less than an inch long and powered by a mere half-watt . . . Microwave was born.

This was the inauguration of a new technique in the art of communication . . . blazing the trail for modern, high fidelity television, FM transmission, pulse time modulation, plurality of currents on a common carrier, and certain other commercial applications for this technique.

Many of the scientists now at work in Federal laboratories participated in that triumph and helped in its developement through the years. Now they are engaged in extending its application, opening vast and striking possibilities for the future of communications.

Pioneer in the field of microwave . . . a contributor to radio progress for more than 35 years . . . Federal stands for leadership in research, development and manufacture of equipment and components for every segment of the communications industry.

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

— and Prove Them Over Our Own Experimental Station W2XDK

All the requisites that add up to perfect performance are brought to bear in our manufacture of FM and television transmitters and studio controls. That includes our recognized work in the field of electronics, as well as a long experience in fine metal fabrication. PLUS...our own experimental television station! Checked every step of the way, Sherron models get a final and infallible check — under actual telecasting conditions . . . As manufacturers of custom-built electronic equipment for manufacturers exclusively, we can serve you in the building of the following to your specifications:

- **TELEVISION TRANSMITTING . . . both video and audio models.**
- **STUDIO CONTROL DESKS . . . providing exclusive control for technical director.**
- **MASTER CONTROL BOARD . . . five available video channels used for monitoring program.**
- **TRANSMITTING CONTROLS DESKS . . . for operational control for both video and audio.**

SHERRON ELECTRONICS CO.

Division of Sherron Metallic Corporation

1201 FLUSHING AVENUE, BROOKLYN 6, N. Y.

"Where The Ideal Is The Standard, Sherron Units Are Standard Equipment"

EMERGENCY COMMUNICATIONS

(CONTINUED FROM PAGE 4)

this nature but offers the following suggestions:

The present separation of co-channel stations has become altogether too small because of insufficient channels. As soon as convenient, reassignments should be made, where necessary, especially when equipment changes are contemplated.

In the final analysis the decision for minimum channel assignments depends upon the ability of the manufacturers to improve the design of transmitters and receivers, and upon the ability of the users to pay for such equipment if and when it is built.

Present equipment could not tolerate even alternate channel assignments in the same area.

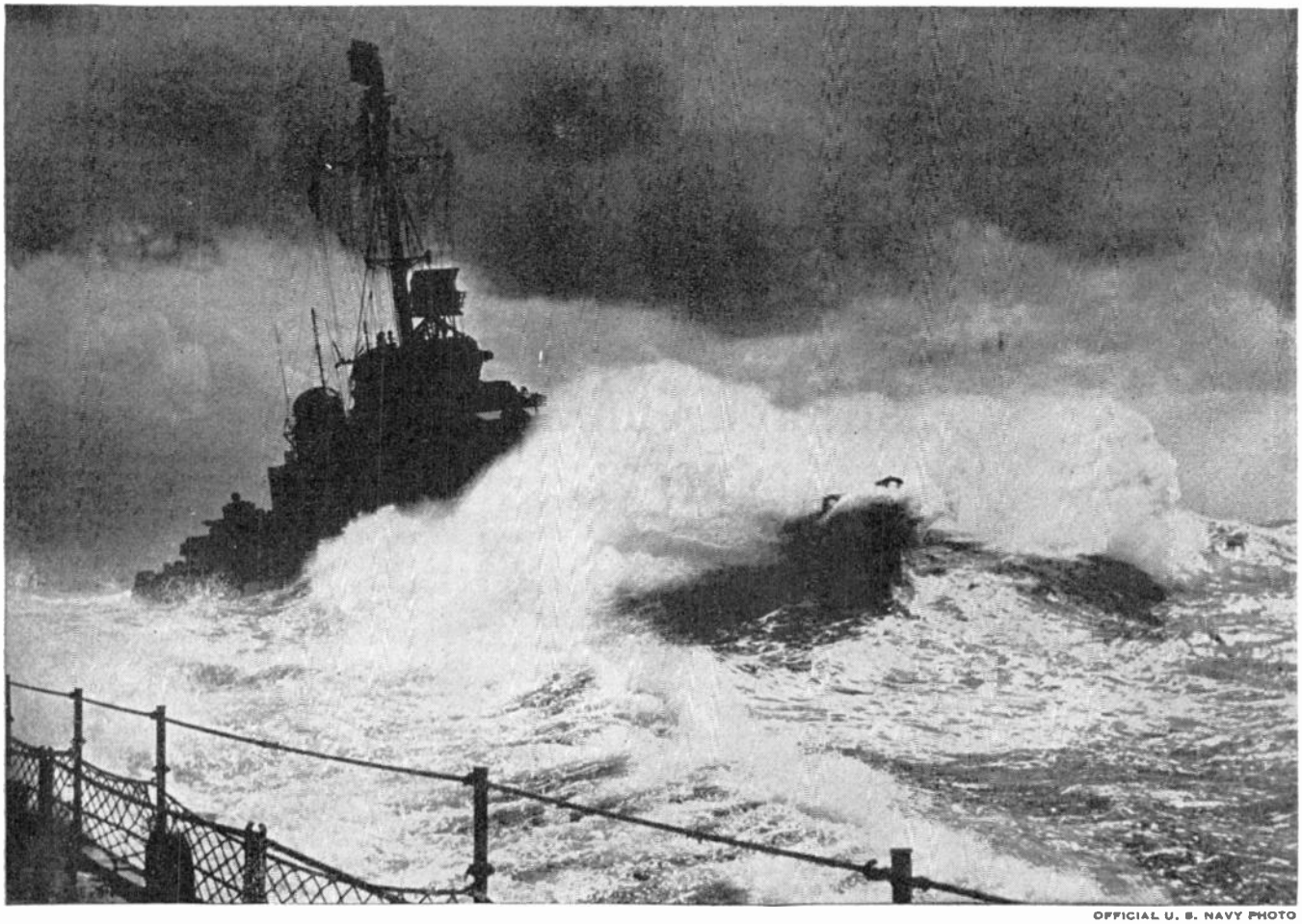
Selectivity ★ Present FM receivers are very unsatisfactory in regard to interference from adjacent channels. Stations operating one or two channels removed from the receiver design center sound no different from stations on the correct frequency. Stations as many as ten channels removed sometimes open the squelch on receivers for many miles around. Present FM receivers appear to need more adjacent-channel selectivity.

Spurious Responses ★ Present FM receivers have many spurious response points. Since effective limiting plus automatic volume control tends to make all signals that open the squelch sound about alike, spurious responses may be as much as 10,000 times down and still appear serious. Ways must be found to reduce this.

Selective Squelch ★ Engineers in the emergency service seldom have the time or equipment to make measurements of a quantitative nature on receiver characteristics. It is frequently very difficult to determine whether a case of interference is due to lack of selectivity, spurious response, or spurious radiation. In any case the development of simple, effective, selective squelch circuits would greatly reduce the requirements placed upon equipment design. If by some selective response arrangement the squelch circuit could be prevented from opening unless operated by a special signal from the proper station, interfering stations, and probably noise as well, could be locked out.

Sensitivity ★ The sensitivity of present receivers is sufficient for most needs except as noted below. In fact, it is believed that for the mobile services receiver sensitivities have nearly reached both the theoretical and practical limits. It is not desirable that technical requirements be placed upon mobile equipment that will materially raise the price or increase the maintenance problems of such equipment.

(CONTINUED ON PAGE 76)



OFFICIAL U. S. NAVY PHOTO

Any port in a storm ... but there are no ports

More than one sailor has said, "It's a helluva place to fight a war!"

That's a miracle of understatement when you know the Pacific as well as the U. S. Navy knows it.

They know how many thousands of miles you have to go before you reach the fighting fronts.

They know there's almost continual rain and bad weather to hamper operations after you get there.

And they know there are no good ports!

Think of the thousands of ships, and the millions of tons of supplies it takes to keep our fighting forces moving toward Japan.

Imagine, if you can, the problem of handling those ships and supplies with no port facilities.

There are no giant cargo cranes... no miles of docks and warehouses...nothing but beaches, and human backs, and a refusal to call any job impossible.

Remember, too:

It takes 3 ships to do the supply job in the Pacific that 1 ship can do in the Atlantic.

It takes 6 to 11 tons of supplies to put a man on the Pacific battleline, and another ton per month to keep him supplied.

It takes a supply vessel, under ideal conditions, half a year to make one round trip.

Add up those facts, multiply by the number of sailors, soldiers, and marines for whom the Navy is responsible.

Maybe you'll begin to realize what "no ports" can mean in the rough, tough waters of the Pacific.

Maybe you'll see that we have *two* reasons to be proud of the U. S. Navy. *First,* the way they've sunk the enemy's ships.

Second, the way they sail *your* ships ... taking the worst the Pacific can hand them... but keeping the supply lines open ...keeping the attack *on schedule!*

SPERRY GYROSCOPE COMPANY, INC. GREAT NECK, N. Y.

★

Division of the Sperry Corporation

LOS ANGELES • SAN FRANCISCO • SEATTLE • NEW ORLEANS
CLEVELAND • BROOKLYN • HONOLULU

MAKERS OF PRECISION INSTRUMENTS FOR THE ARMED FORCES

EMERGENCY COMMUNICATIONS

(CONTINUED FROM PAGE 74)

Wavetraps ★ It may be economically more practical for manufacturers to build one or more high Q wavetraps into their receivers than to eliminate all spurious responses by other means. Wavetraps can be made for high frequencies, as elsewhere, that will provide a high degree of attenuation for the unwanted signal and, at the same time, increase the response to the wanted signal.

Receiver Audio Response ★ It is difficult to consider the audio response of the receiver alone, because the response of the whole system is the only thing that counts.

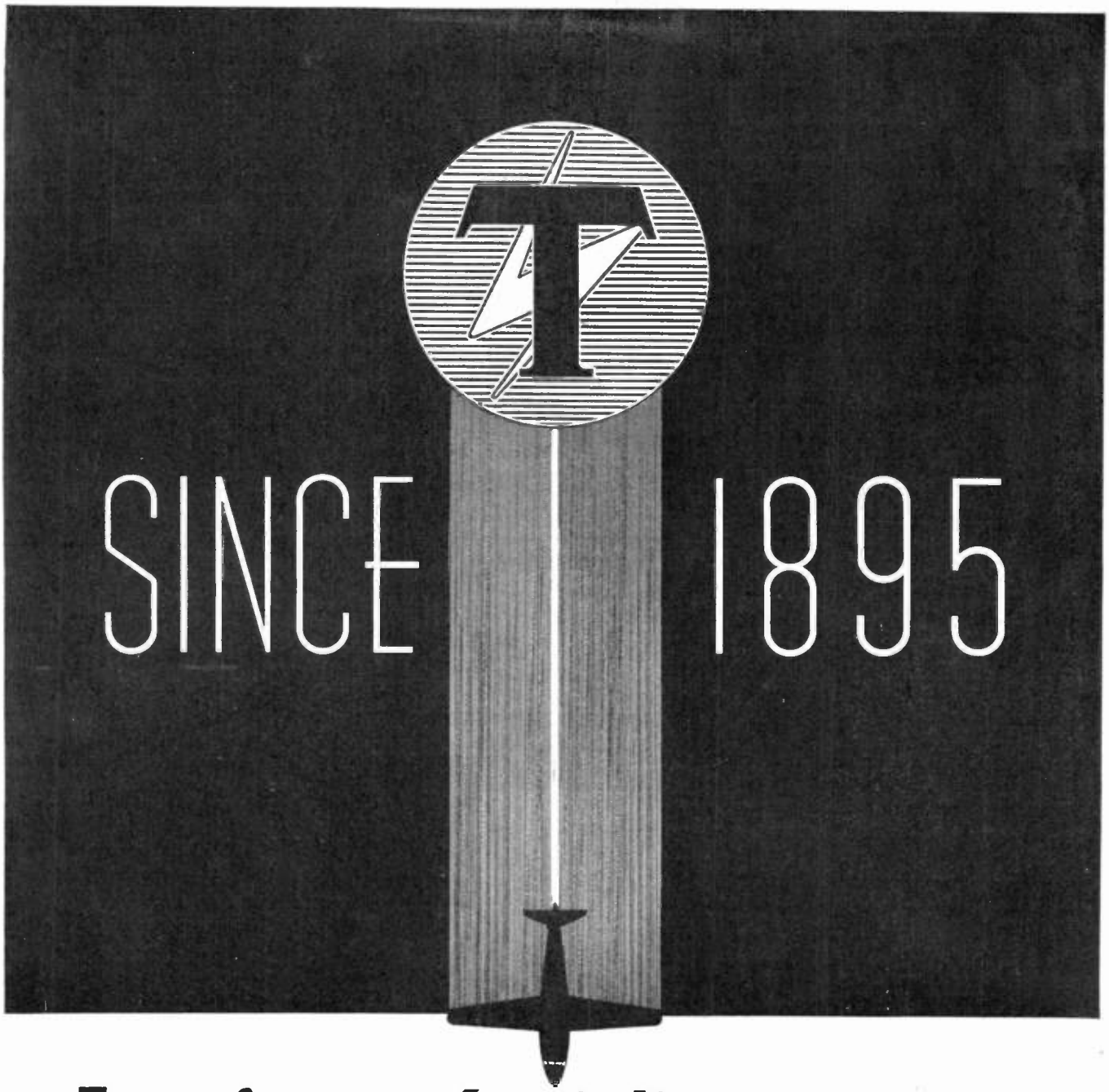
It is definitely felt that the over-all response of both AM and FM systems could and should be improved. Recent improvements in the sensitivity of FM receivers have further reduced the intelligibility of FM systems. Refer to the Eastern States Police Radio League testimony before the FCC, pages C-3 through C-8, and A-1 through A-8, entitled "Apparatus Limitations" and "The Need for Low Noise Levels and High Intelligibility."

Present practice is to limit the audio response of emergency communications systems to 3,000 cycles per second by means of sharply tuned audio filters. Contrast this with present practice on AM broadcasting stations where limiting sometimes begins to occur at 5,000 cycles.

We allow better response for entertainment systems than we do for emergency communications. We are presently proposing to extend FM broadcasting to 15,000 cycles per second. If there is reason for and justification of this extension for purely entertainment purposes, there is certainly room for emergency communication channels that will allow modulation up to at least 3,000 cycles per second. We view with great alarm any proposal further to restrict channels already too narrow. The FCC states (page 16 of the May 25, 1945 Report) "For voice transmission (or facsimile transmission at a reasonably satisfactory speed) 2,500 cycles is considered adequate." As has already been pointed out (See ESPRL Report to the FCC, page A-8) "If police radio receiver band widths are further narrowed, further audio compensation will be necessary, and to our already great difficulties will be added the psychological irritation factor caused by harsh, unnatural voices.

"Since the purpose of police radio is to convey information rapidly, accurately, and reliably, everything that will achieve that end must be explored and if possible attained. It may be added that the more distinctly the message comes through, the lower the volume control may be set, the fewer repetitions that will be necessary, and the more room there will be on the air for everybody."

(CONTINUED ON PAGE 78)



Transformer Specialists . . .

Thordarson's tradition of quality provides the underlying reason for its past half-century of progressive leadership in the specialized manufacture of dependable transformers, components and other electronic devices. This same tradition, upheld through every phase of *Thordarson* design, engineering and manufacturing is your guarantee of the finest transformers for requirements of Tomorrow . . . and years to come. With confidence . . . gained by this ability to produce quality merchandise and coupled with novel sales policies . . . *Thordarson* looks forward to supplying the expanding demands of the radio and electronic industries.

500 WEST HURON ST., CHICAGO, ILL.

ARMY (E) NAVY

ORIGINATORS OF TRUE-FIDELITY AMPLIFIERS

THORDARSON

ELECTRIC MANUFACTURING DIVISION

MAGUIRE INDUSTRIES, INCORPORATED

EMERGENCY COMMUNICATIONS

(CONTINUED FROM PAGE 76)

High grade service to mobile units can best be furnished by communications systems allowed to respond accurately to high pitched sounds.

While it is true that telephone practice indicates that 2,500 cycles is sufficient for telephone purposes, there is nowhere any indication that 2,500 cycles is sufficient for reproduction by loudspeaker, especially under the high ambient noise conditions encountered in emergency service.

A. B. Bailey of the Bell Telephone Laboratories believes that for mobile equipment the range should extend to at least 6,000 cycles.

The Jensen Technical Monograph No. 4, entitled "The Effective Reproduction of Speech," Figure 1, shows a chart after Gannet and Kerney indicating that if high frequencies are progressively attenuated in steps, the effect can be noticed only in degrees called liminal units. Thus the range from 2,400 and 15,000 cycles per second is divided into seven steps or liminal units, each of which represents a just-noticeable reduction of intelligibility. These steps occur at 2,400, 2,700, 3,000, 3,600, 4,400, 5,300, 7,600 and 15,000 cycles per second. Tests were not made below 2,400 cps. It can be seen that for speech the reduction of the audio passband from 15,000 to 7,600 is just noticeable, or 1 lim. Reducing the passband from 7,600 to 3,000, however, is equivalent to four liminal units, a serious reduction, while going from 7,600 to 2,400 cps in six steps. "At an upper frequency limit of say 3,000 cycles, a change of one lim is produced by a reduction of only 300 cycles, indicating that appreciable speech energy is present and that it is highly important to the speech characteristics as appraised by the ear." It is unquestionably true that for speech the last two steps are most important, especially when speech is reproduced by a loudspeaker into a medium already saturated with low frequency noise.

Finally, we see no reason why it should be necessary to restrict the upper modulation limits of a communication system, provided carrier swing does not exceed the channel width. Many emergency communication systems plan to use selective signalling devices which may involve modulation frequencies as high as 20,000 cycles per second. Other departments would like to use multiplexed facsimile. These facts plus the demonstrated need for high frequency modulation in mobile units make it absolutely essential that there be no limitation of peak modulation frequencies in the emergency services.

We recommend that for purposes of standardization, present rulings be continued. A deviation ratio of 5 to 1 and cutoff at 3,000 cycles per second is now standard and satisfactory to a degree. However, those services that have need of or use of

(CONTINUED ON PAGE 80)

Answers to your Questions about the SHURE "556" *Super-Cardioid Broadcast Dynamic*

Q. *What is meant by Super-Cardioid?*

Answer: Super-Cardioid is an improvement on the cardioid (heart-shaped) pickup pattern, which makes it even more unidirectional. "Super-Cardioid" reduces pickup of random noises by 73% as compared to 67% for the Cardioid, and yet has a wide pickup angle across the front.

Q. *To accomplish this, is it necessary to have two Microphones in a single case?*

Answer: No. The Shure "556" is designed according to the "Uniphase" principle, a patented Shure development which makes it possible to obtain the "Super-Cardioid" pattern in a single compact, rugged unit.

Q. *Over what range does the Shure "556" give quality reproduction?*

Answer: The Shure "556" provides a high degree of directivity, both horizontally and vertically over a wide frequency range from 40 to 10,000 cycles.

Q. *Does the Shure "556" reduce feedback?*

Answer: Yes! Reflected sounds and "spill-over" from loud speakers entering from the rear are cancelled out within the Microphone.

Q. *Can the Shure "556" be used outdoors?*

Answer: Yes. It is insensitive to wind and will withstand heat and humidity. The low impedance models may be used at practically unlimited distances from the amplifier.

Q. *Can the Shure "556" be used for Studio Broadcasting?*

Answer: More than 750 Radio Broadcast Stations in the United States and Canada use the Shure "556" in their studios. Because it can be placed with its back to the wall without picking up reflected sounds or echoes, it facilitates Microphone placement.

Model 556A for 35-50 Ohm circuits—
LIST PRICE $75

Model 556B for 200-600 Ohm circuits—
LIST PRICE $75

SHURE BROTHERS

Designers and Manufacturers of Microphones and Acoustic Devices

225 West Huron Street, Chicago 10, Illinois

CABLE ADDRESS: SHURE MICRO

SHURE MICROPHONES

EMERGENCY COMMUNICATIONS

(CONTINUED FROM PAGE 78)

higher modulation frequencies should be allowed to use them provided they are willing to accept lower deviation ratios so that carrier swing will not exceed the bandwidth.

Spurious Radiations ★ It is essential that transmitters be designed so as to minimize spurious radiations.

It is also probable that the present practice of building transmitters for two-frequency operation with adjustments made for only one will have to be discontinued. This is so-called three-way operation. Spurious radiation from equipment operating on the 3-way or secondary frequency, to which the equipment is not accurately tuned, may become a serious matter. However, the cost of building transmitters for operation in the normal manner on two frequencies would be much greater than the present method. This problem needs further study.

Use of Higher Frequencies ★ It is recommended that all new installations involving small areas be required to use the new 72–76 or the 152–162 megacycle bands so that the 30–44 megacycle band may be retained for large area service.

Transmitter Audio Response ★ The audio response of transmitting equipment should be only part of an integrated overall response. Provided the deviation is kept within prescribed limits, there appears to be no reason why frequency response should be limited (except the maintenance of a fixed deviation ratio). If the user wishes to utilize full audio response it should be available. Contrary to certain opinions, the use of high quality audio equipment for emergency communication is thoroughly justified, especially for fixed stations. Even though only a small portion of the available passband is utilized, the reduction in distortion and increased intelligibility is more than worthwhile. Use of high quality microphones at fixed stations is particularly desirable.

Use of low grade, open wire, telephone lines in the remote control link of present systems is a serious limiting factor that cannot be eliminated until equipment and frequencies are available for reliable radio relay and transmitter control systems. A rapid changeover to radio relay and control circuits is desirable.

Compression Amplifiers ★ Opinion seems practically unanimous that high grade compression amplifiers should be required on all fixed stations.

Police service, of necessity, must use men picked for their ability as law enforcement officers, rather than the quality of their voices or suitability as radio announcers. In many departments each and

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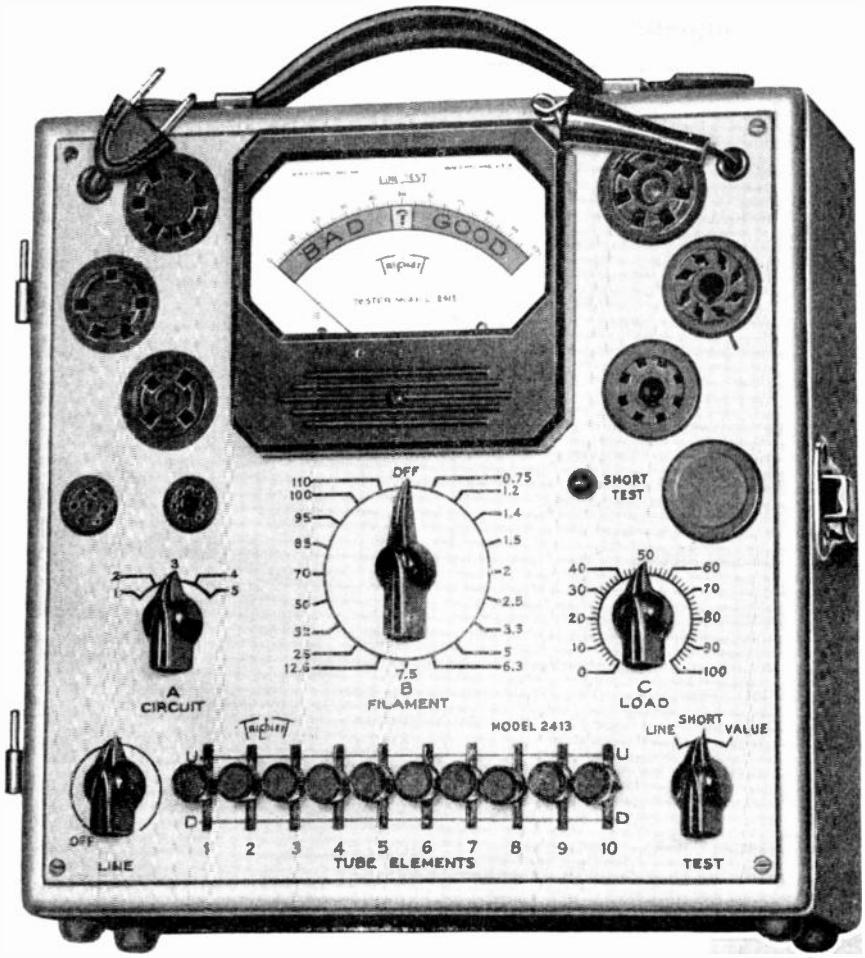

MODEL 2413 is another member of the NEW TRIPLETT Square Line

The New Speed-Chek Tube Tester

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Three-position lever switching makes this sensational new model one of the most flexible and speediest of all tube testers. Its multi-purpose test circuit provides for standardized VALUE test; SHORT AND OPEN element test and TRANSCONDUCTANCE comparison test. Large 4" square RED•DOT life-time guaranteed meter.

Simplicity of operation provides for the fastest settings ever developed for practical tube testing. Gives individual control of each tube element.

New SQUARE LINE series metal case 10" x 10" x 5½", striking two-tone hammered baked-on enamel finish. Detachable cover. Tube chart 8" x 9" with the simple settings marked in large easy to read type. Attractively priced. Write for details.

Additional Features

- Authoritative tests for tube value; shorts, open elements, and transconductance (mutual conductance) comparison for matching tubes.
- Flexible lever-switching gives individual control for each tube element; provides for roaming elements, dual cathode structures, multi-purpose tubes, etc.
- Line voltage adjustment control.
- Filament Voltages, 0.75 to 110 volts, through 19 steps.
- Sockets: One only each kind required socket plus one spare.
- Distinctive appearance with 4" meter makes impressive counter tester — also suitable for portable use.

STANDARDS ARE SET BY TRIPLETT

Precision first ...to last

Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

EMERGENCY COMMUNICATIONS

(CONTINUED FROM PAGE 80)

every man may, at times, be called upon to be a radio dispatcher. It is quite impossible to preset the gain of speech amplifiers high enough to give satisfactory modulation levels for some voices without having excessive modulation levels for others. This fact is just as true of FM as it is of AM. Experiments have shown that compression amplifiers are badly needed on FM police systems.

The same experiments showed that, as the carrier level becomes lower, the need for full carrier swing becomes greater. In fact, it seems apparent that the reliable service area can be increased by using high degrees of compression.

Economic Problem ★ Most recommendations which tend to improve the technical operation of radio equipment also tend to increase the price and probably the complexity of the equipment. There is obviously no point in manufacturing apparatus so expensive that departments cannot afford to buy it nor in making equipment so complex that the average technician cannot easily maintain it.

Proposed 20-Kc. Channels ★ It is entirely probable that manufacturers can produce workable equipment for 20-kc. channels in the 30–40 megacycle band, but it cannot be denied that the cost of such equipment would be greater. In addition, the maintenance problems would be still more difficult. To mention just one problem, it is believed that crystal tolerances would be of the order of .001%. This means that for transmitters multiplying 32 times, at the fundamental frequency the crystal would be allowed a variation of only about plus or minus 10 cycles. This is a crystal of broadcast station quality and not cheap.

If channels of such width are used, the maintenance problems will be tremendous. Receiver and transmitter tune-up requirements would probably be increased by a factor of ten, which would mean that equipment might be expected to be out of adjustment and thus giving less than optimum results for as much as 10% of the time instead of about 1% of the time.

Relay and Transmitter Control Frequencies ★ The Commission has indicated that they expect the emergency services to use the 940–960 megacycle band for relay and transmitter control. A canvass of manufacturers indicates that no one has apparatus for such use in production at the present time. Furthermore, they point out that the apparatus in production for the Armed Services on these frequencies is far from reliable. To be useful to the emergency service, relay equipment would necessarily have to be more reliable than the presently used telephone circuits. Time outages due to equipment and tube

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EMERGENCY COMMUNICATIONS

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failure should be less than .1% on a 24-hour day, 365-day basis. Present equipment for the 1,000-megacycle region does not approach such a figure and there is no way of telling when the degree of reliability required by the emergency service could be developed or when equipment of this type will be available at all. Transmitting equipment of small power does not seem to be a problem, but most manufacturers admit that receivers having appreciable sensitivity are still an unsolved problem.

Many proposed relay and control paths are far from line of sight and there is no available information to indicate that the proposed 940–960 megacycle waves would be satisfactory — and no equipment available to prove that they would be.

For these reasons we suggest that a portion of the 152–162 megacycle band be set aside for permanent use by relay and transmitter control service. There is immediate need to standardize the construction of such equipment.

NOTES ON FM BROADCASTING

(CONTINUED FROM PAGE 32)

30 to 20,000 cycles, and a distortion and noise measuring set. Below the shelf there is a set of filters for the distortion meter, so that we can get an accurate check on distortion at 50, 100, 400, 1,000, 5,000, and 7,500 cycles. The unit strapped to the leg of the supporting framework is merely a voltage control by which we can get exactly 110 volts AC.

The equipment on the test bench illustrated in Fig. 12 includes, at the top, from left to right: tube checker, logarithmic vacuum-tube voltmeter, and 5-in. oscilloscope. On the lower shelf are: a 3-in. oscilloscope, microvolter, ohmmeter, Esterlino-Angus recording meter, vacuum-tube voltmeter, and multimeter test kit.

Conclusion ★ There is one suggestion I would like to offer those who are now making plans and preparations for new FM stations. It is perfectly natural for engineers of long AM experience to proceed along the lines of established practices, making only limited concessions to the special requirements of FM.

Such methods, however, will not produce the best end results in FM broadcasting. A much more effective method, and I say this because of our experience of *The Milwaukee Journal* station, is to study the special requirements of FM broadcasting, and base all plans for facilities and equipment on those considerations, without regard to AM practice.

Only in this way is it possible to anticipate the increasingly critical judgment of radio listeners which will result from widespread use of high-fidelity FM receivers.

10-KW. FM TRANSMITTERS

(CONTINUED FROM PAGE 56)

known performance, the only real bottleneck, have been in production for years.

Your response to my request for the name of manufacturer who has 10 kw. new band transmitters immediately available, as stated in your letter to RMA president Cosgrove under date of Aug. 17 is now awaited by entire industry. Any corrected statement by that manufacturer as to when he will really have 10 kw. new band transmitters available will be likewise of much interest.

If those who plan to install and operate FM stations have been misinformed or misled by any statement published in *FM* AND TELEVISION Magazine, I am as anxious as I know you are to correct any error and to present facts as to the true conditions for the benefit of all concerned. Please wire me collect your earliest convenience. Between us we will find out who is misleading the industry and the public.

FM — MILTON B. SLEEPER

After a week's time, another request was sent:

Great Barrington, Mass.
September 11, 1945

Paul A. Porter, Chairman
Federal Communications Commission
Washington, D. C.

Respectfully request collect reply my telegram one week ago as new issue is closing and want to give our readers full story on transmitters for new band. Would appreciate answer your earliest convenience for my guidance in editorial comment.

FM — MILTON B. SLEEPER

Since this brought no reply, arrangements were made to keep open a form of *FM* AND TELEVISION until the last minute, and a final attempt was made to get the information which, if forthcoming, would have a profound effect upon the plans of set manufacturers. This wire was sent:

Great Barrington, Mass.
September 13, 1945

Paul A. Porter, Chairman
Federal Communications Commission
Washington, D. C.

No answer received from my two telegraph requests for information as to the basis for your statement regarding availability of new band transmitters. May I add that in requesting a reply by wire collect, I am asking for an answer to a question in the minds of thousands of our readers. Public interest demands the facts about this situation. Our last form for September issue closes Friday night. If reply is not received then, I must assume for purpose of editorial comment that you are unable to furnish information requested.

FM — MILTON B. SLEEPER

(CONCLUDED ON PAGE 86)

10-KW. FM TRANSMITTERS

(CONTINUED FROM PAGE 85)

There was no reply. Meanwhile, however, it had been established that there was no foundation in fact for the statement that "10-kilowatt transmitters will be immediately available for the new band."

The truth about this situation was presented to the FCC in the form of a report from the RMA transmitter committee. Official statements from the manufacturers showed that one company, with no prewar experience with FM broadcast equipment, promised 10-kw. new band units in 6 months. *The earliest promise from a concern that had built FM equipment before the war was 1 year!*

No one would deny the Commission the privilege of making its inevitable share of honest mistakes. But it is hard to believe that the FCC would offer the "immediate" availability of 10-kw. new band transmitters as a justification for stopping old-band transmission without determining the true conditions.

This incident, rather, gives weight to opinions expressed during the FM hearings that the Commission first determines on a line of action, and then seeks testimony to support its decision. In this instance, the Commission's action gave support to the belief that some unofficial statement was accepted to justify closing down old-band transmitters. Then, when 10-kw. new-band transmitters were not found to be "immediately available," the FCC could blame the manufacturers.

Up to now, we can only ask: When will the Commission start to make good on its promises that it will "give every possible encouragement to the development of FM"? So far, the industry can only consider such words as insincere double-talk.

ENGINEERING SALES

(CONTINUED FROM PAGE 8)

Amertran: George G. Felt, formerly of Wright Aeronautical, has joined American Transformer Company, Newark, N. J., as advertising and sales promotion manager.

Stromberg-Carlson: New representatives at S-C sales office in San Francisco is William C. Miles, formerly Seattle sales promotion manager for Westinghouse.

New York: D. W. May Corp., 1 E. 42nd Street, distributors for Farnsworth, Wilcox-Gay, and Ken-Rad, has issued a 10-point policy statement promising vigorous dealer protection under Fair Trade Laws, and pledging that discount houses will not be sold directly or indirectly.

Boston: Theodore R. McElroy, president of McElroy Mfg. Company, 82 Brookline Avenue, has set up a distributing division to handle Hallicrafters line.

Hollywood: Norman B. Neely Enterprises, factory representative for Hewlett-Pack-

(CONCLUDED ON PAGE 87)

ENGINEERING SALES

(CONTINUED FROM PAGE 86)

ard, Kaar Engineering, Presto Recording REL, Sensitive Research, and Webster Electric, has purchased and now occupies a new building at 7422 Melrose Avenue.

Magnavox: Capt. Jerre Neislar has been released from active duty in the AAF, and has rejoined the Magnavox organization as southwestern sales representative. He was commanding officer of an airbase squadron in the South Pacific. Later he attended the Command and General Staff School at Ft. Leavenworth, and then served in the ATS Command at Wright Field.

Marion: Has appointed Morhan Exporting Company, 458 Broadway, New York, as export agents to sell their line of instruments in all foreign countries except Canada.

Philadelphia: Goldner Bros., 1223 N. Broad Street, Philadelphia, distributors of Motorola radios, have changed their company name and address to Goldner Distributing Co., 46 N. 5th Street. Samuel Goldner will continue as the head of the firm, and there have been no personnel changes.

Hoffman Radio: Export sales will be handled by Exportadora, Inc., Los Angeles, under the direction of Donald M. Palmer, president, who will leave shortly on an eight months trip through Central and South America.

Echophone: Is preparing to deliver a postwar line to their established distributors, comprising five or six table model radios and phono combinations, to be followed by FM-AM console combinations.

Rogers Majestic: Of Toronto has appointed S. G. Patterson, formerly of Electrical Supplies, Ltd. and Canadian Marconi, as manager of the telecommunications division. This division has been established to handle the sale of emergency and point-to-point communications equipment, and Amperex tubes.

New York: Lieut. Robert Coventhal, superfortress pilot who won a chest-full of medals before his bomber was shot down over Austria, is back on his old job as sales and advertising manager at Terminal Radio Corp., 85 Cortland Street, New York City.

Aireon: Has opened an office in the Kohl Building, San Francisco, with sales engineer Jack Kaufman in charge.

Detrola: After 25 years with Tung-Sol, George A. Bodem resigned as general sales manager to join International Detrola as vice president in charge of radio sales.

Admiral: Has appointed Sun City Distributors, El Paso, to handle Admiral radios and appliances in the El Paso and Albuquerque areas.

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"HQ-129-X"

$129.00* AMATEUR NET

LESS SPEAKER

*PRICES SUBJECT TO CHANGE WITHOUT NOTICE

WRITE TODAY

A postcard will bring description of this outstanding new receiver.

FINEST LOW COST RECEIVER

By all measurement this is unquestionably one of the greatest values ever offered to amateurs . . . Here is "ham" communication at its best, streamlined for highest performance at a modest cost . . . WRITE TODAY. Send card for descriptive folder.

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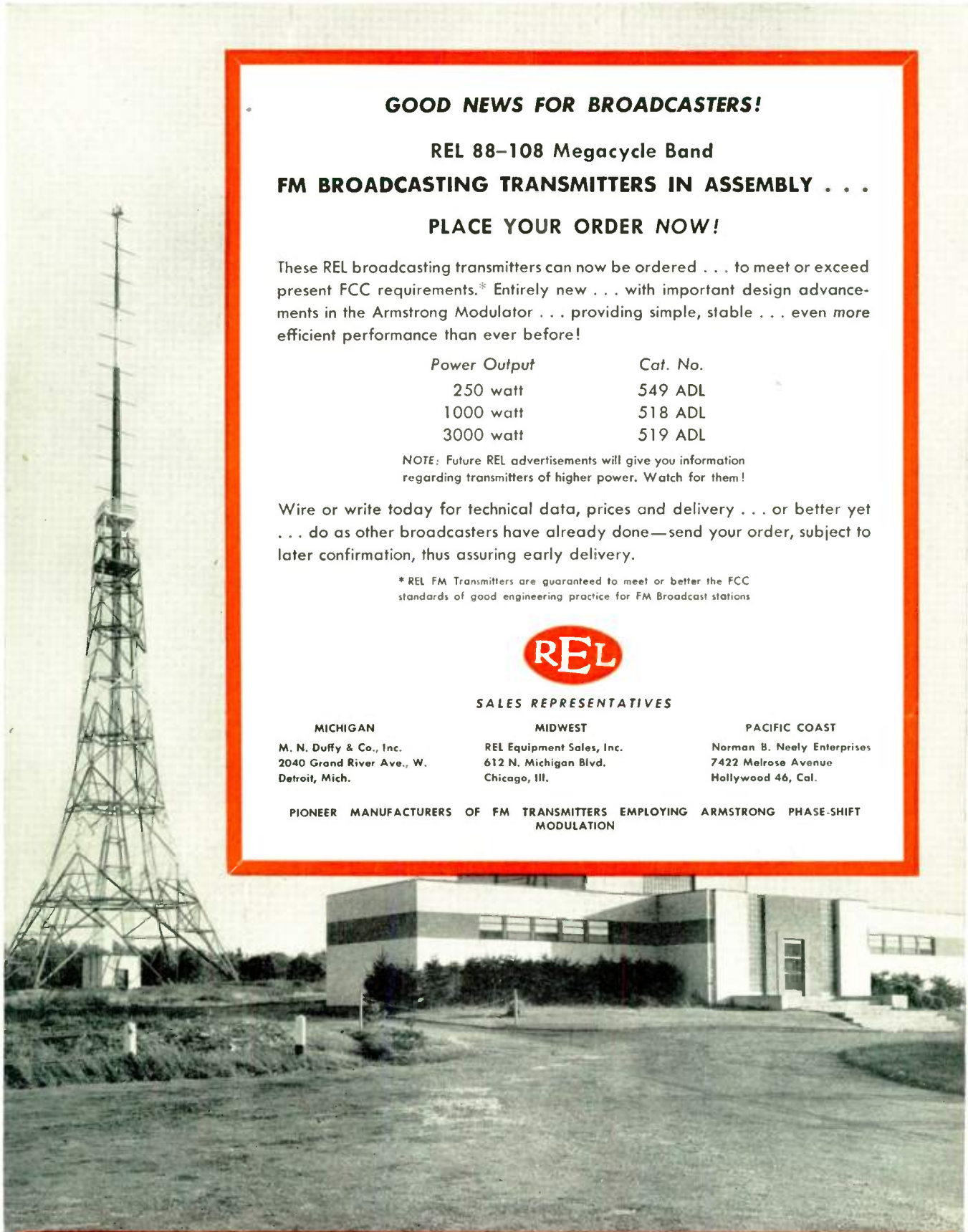

GOOD NEWS FOR BROADCASTERS!

REL 88–108 Megacycle Band

FM BROADCASTING TRANSMITTERS IN ASSEMBLY . . .

PLACE YOUR ORDER *NOW!*

These REL broadcasting transmitters can now be ordered . . . to meet or exceed present FCC requirements.* Entirely new . . . with important design advancements in the Armstrong Modulator . . . providing simple, stable . . . even *more* efficient performance than ever before!

Power Output	*Cat. No.*
250 watt	549 ADL
1000 watt	518 ADL
3000 watt	519 ADL

NOTE: Future REL advertisements will give you information regarding transmitters of higher power. Watch for them!

Wire or write today for technical data, prices and delivery . . . or better yet . . . do as other broadcasters have already done—send your order, subject to later confirmation, thus assuring early delivery.

* REL FM Transmitters are guaranteed to meet or better the FCC standards of good engineering practice for FM Broadcast stations

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MIDWEST
REL Equipment Sales, Inc.
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PACIFIC COAST
Norman B. Neely Enterprises
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PIONEER MANUFACTURERS OF FM TRANSMITTERS EMPLOYING ARMSTRONG PHASE-SHIFT MODULATION

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FM *and* AM
MAIN STATION *and*
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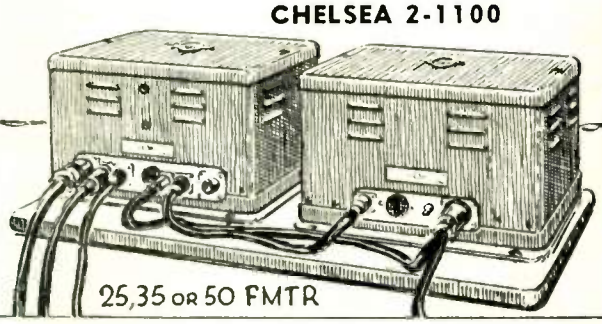

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