PRICE—TWENTY-FIVE CENTS

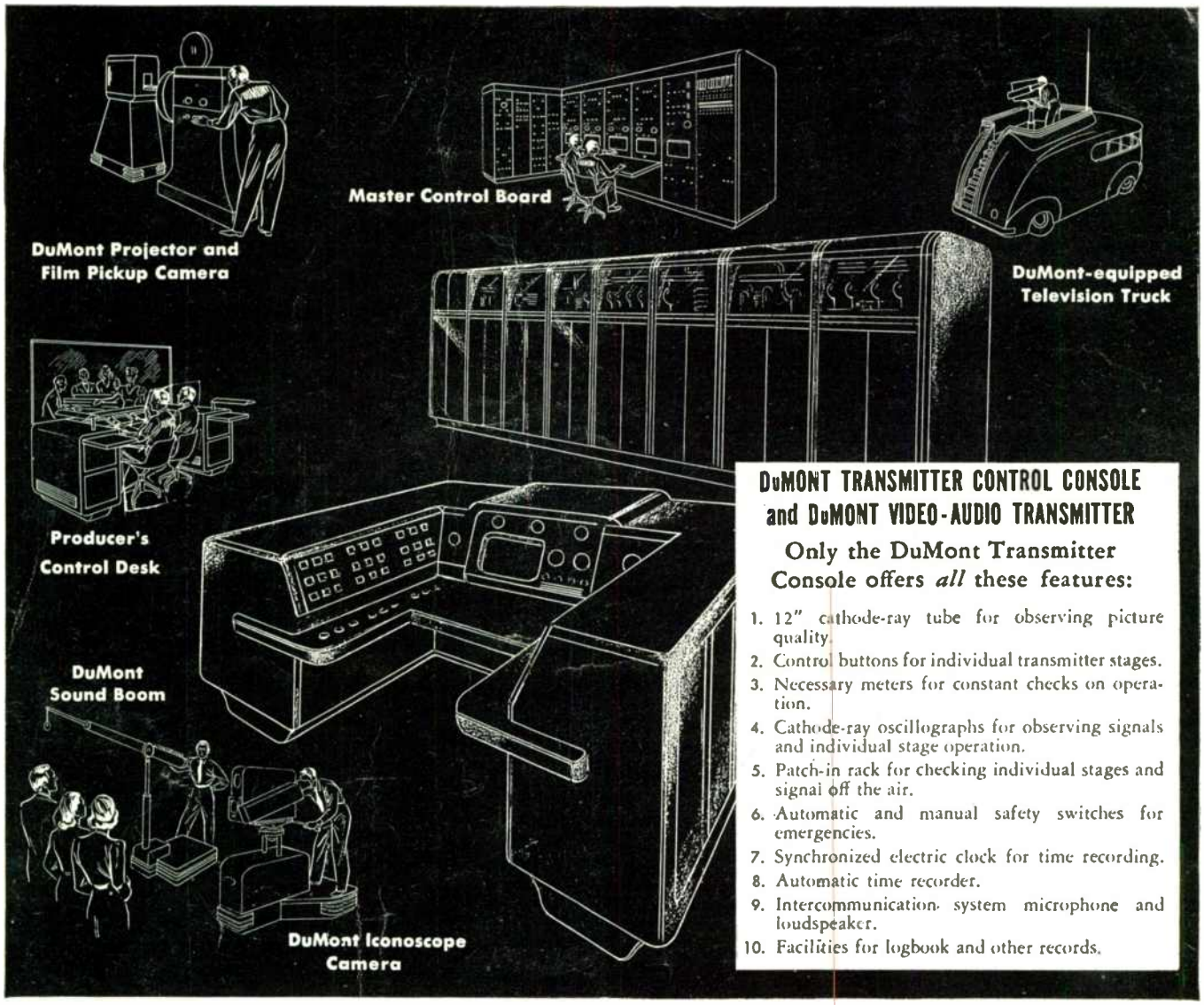
FM AND TELEVISION

JULY 1945

SELF-POWERED FM RELAY

Directory of Emergency Stations

★ ★ Edited by Milton B. Sleeper ★ ★



DuMONT TRANSMITTER CONTROL CONSOLE and DuMONT VIDEO-AUDIO TRANSMITTER

Only the DuMont Transmitter Console offers *all* these features:

1. 12" cathode-ray tube for observing picture quality.
2. Control buttons for individual transmitter stages.
3. Necessary meters for constant checks on operation.
4. Cathode-ray oscillographs for observing signals and individual stage operation.
5. Patch-in rack for checking individual stages and signal off the air.
6. Automatic and manual safety switches for emergencies.
7. Synchronized electric clock for time recording.
8. Automatic time recorder.
9. Intercommunication system microphone and loudspeaker.
10. Facilities for logbook and other records.

DuMONT—FOR THE TOOLS OF TELEVISION

Simplified precision control is the design keynote of all DuMont Television Broadcasting Equipment. Typical of this bull's-eye concentration on basic essentials is the DuMont Transmitter Control Console. All meters and controls of the Video-Audio Transmitter are combined with the station monitor (formerly a separate unit) to achieve a new standard in safety, easy visibility and centralized operation. Operators can be quickly trained to attend it.

DuMont has equipped *more* television stations than any other company. Week-in, week-out, these stations are demonstrating the high pickup and transmitting quality and efficiency, the extreme flexibility, rugged dependability and low operating cost of DuMont-engineered equipment.

DuMont has pioneered the profit pattern for peacetime commercial television... is setting the pace in television broadcasting equipment design. Climb aboard the television bandwagon today by using the DuMont Equipment Reservation Plan to insure early delivery of equipment and training of personnel. *Ride with the leader!*

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

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FM AND TELEVISION

511 Fifth Avenue, New York 17, N. Y.

Please enter my ☐ new ☐ renewal subscription for

☐ 1 year $3.00 ☐ 2 years $5.00 ☐ 3 years $6.00

☐ My remittance is enclosed ☐ Remittance will be sent promptly when bill is received.

Foreign Postage: Add $1.00 per year for foreign postage. For Canada, add 50c per year.

Name.....

Street.....

City & Zone.....State.....

IMPORTANT

The following information is required in order that we can classify your subscription correctly as to your connection with the radio industry:

Company.....

Product or Service.....

Your Title.....

for the m set th the in follows

GROUP SUBSCRIPTIONS

REMITTANCE MUST ACCOMPANY GROUP SUBSCRIPTIONS

Two subscriptions..$5.00 Four subscriptions..$7.00
Three subscriptions..$6.00 Five subscriptions..$8.00

Six or more subscriptions, $1.60 per year each.

☐ New Sub.
☐ Renewal

NAME.....
STREET.....
CITY & ZONE..... STATE.....
Company.....
Product or Service.....
Your Title.....

☐ New Sub.
☐ Renewal

NAME.....
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CITY & ZONE..... STATE.....
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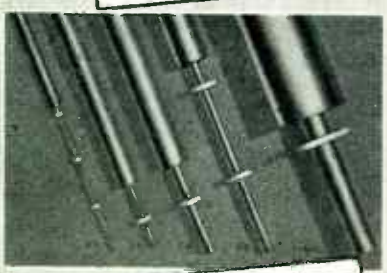
Complete Matched
FM and AM
RADIO COMMUNICATION EQUIPMENT

Engineered and Built by Doolittle

FREQUENCY MONITORS (FM and AM)
Direct reading. No charts or complicated calculations necessary. Models available for 110 Volt A.C. or battery operated portable use. Meet FCC requirements.

MOBILE EQUIPMENT (FM and AM)
Models up to 60 watts output. Crystal controlled. Complete with Transmitter, Receiver, Power Supply and all Accessories.



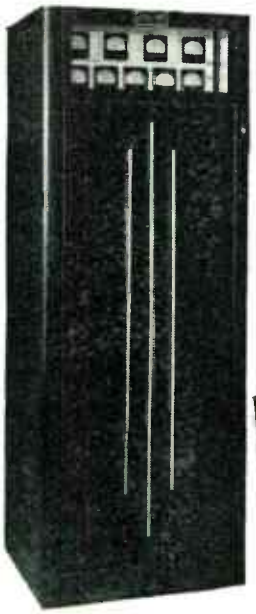
CONCENTRIC TRANSMISSION LINE
Sizes available from 3/8" to 3" diameter. Seamless copper tubing with wide variety of sealed terminals for any application. • STATION ANTENNAE of various types available to suit your requirements.

TIME TELLS. Equipment engineered and built by DOOLITTLE years ago still serves today . . . 24 hours a day . . . without interruption.

That's because DOOLITTLE pioneering work back in the days of emergency radio's infancy was basically sound.

When war came, DOOLITTLE engineering and production facilities were enlisted for the *Naval Aircraft Factory* and the *Bureau of Aeronautics.*

Turn all this experience to your advantage. Build the success of your emergency forces around FM or AM equipment *completely engineered, built and matched by DOOLITTLE.*



With such equipment in your service . . . many benefits are yours today . . . and will still be yours years from now!

A FEW OF THE MANY ADVANTAGES

Low Power Consumption • Maximum Coverage • Latest Electrical and Mechanical Design • Compact Easy to Install • Simple to Service Proved Reliability

STATION TRANSMITTERS (FM and AM)
18 available models. Power output up to 1000 watts. Assure maximum efficiency, absolute reliability and economical maintenance. • Station Receivers, Control Units and Accessories to meet your needs.

Doolittle

RADIO, INC.

7421 S. LOOMIS BLVD., CHICAGO 36, ILL.

Builders of Precision Radio Communication Equipment for Police, Fire, Government, Forestry, Railroad, Public Utility and other emergency services.

FM AND TELEVISION

FORMERLY: FM RADIO-ELECTRONICS

VOL. 5 JULY, 1945 NO. 7

CONTENTS

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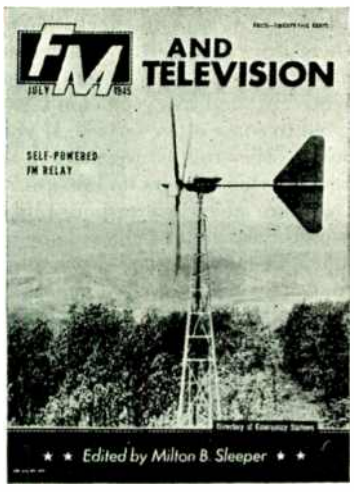


THIS MONTH'S COVER

THERE has been considerable discussion of automatic, unattended radio installations ever since their practicability was demonstrated by the remote transmitters used in the Connecticut State Police FM system.

The first application of such equipment is in the system operated by the Virginia State Police, and described in this issue by William M. Lee. This month's cover shows the wind-driven generator on Poor Mountain, as seen from the radio tower, against the valley and the distant hills. This is only the first of many such installations — some for the police, but a larger number for carrying various kinds of commercial traffic.

WHAT'S NEW THIS MONTH

Police Radio Frequencies

From an address delivered by Milton B. Sleeper before the communications conference of the Eastern States Police Radio League at Nantasket, Mass. on June 19, 1945

I HOPE I didn't show it, but it almost took my breath away when I was so casually asked to discuss the utilization of the new police frequencies before such a group of communications experts as comprise the membership of the Eastern States Police Radio League.

In my capacity as a publisher, I do not originate information. In fact, I do very little writing. My job is to get men who are doing important or original work to do the writing, so that their thinking will be expressed accurately, at first hand, and from their own points of view.

How, then, could I undertake to present the thinking of the Commissioners and engineers of the FCC, particularly right at this time when they are not altogether in agreement among themselves on certain points?

Well, when I want information, I go straight to headquarters for it, so I went right to the FCC and asked questions. I brought back some definite answers, too.

First of all, the FCC is not going to tell you how to plan and operate police communications systems. That would be doing your thinking for you. To use a simile, the FCC has surveyed the ether terrain, and has set up the highways. They have established certain standards for message-laden vehicles so that they can travel the roads without crowding each other. But the FCC is not going to tell how to build the trucks, whether to burn oil or gasoline, or how to load and schedule traffic so that you can attain maximum efficiency.

Instead, the FCC says, in effect, "Gentlemen, here are the highways on which your traffic must travel. You must use them effectively, and any you don't use will be given to some other service. If you need more or other routes, we will try to give you some which others do not use."

Thus, you are given the responsibility for studying the nature and the volume of your traffic. Then you must work out, among yourselves, a coördinated plan that will be adequate for the present and future needs of each town, city, county, and state. When you have done that, in so far as you are able, the engineering department of the FCC will consider your plan and work out with you such modifications

(CONTINUED ON PAGE 72)

SYLVANIA NEWS

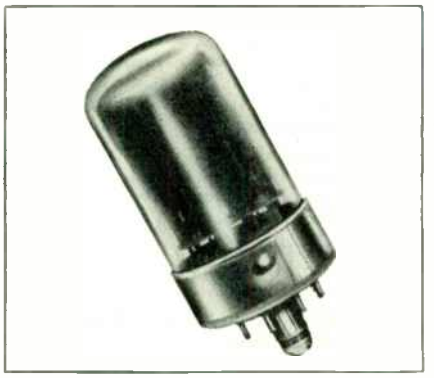
ELECTRONIC EQUIPMENT EDITION

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

NEW TUBE HAS SEPARATE CATHODES

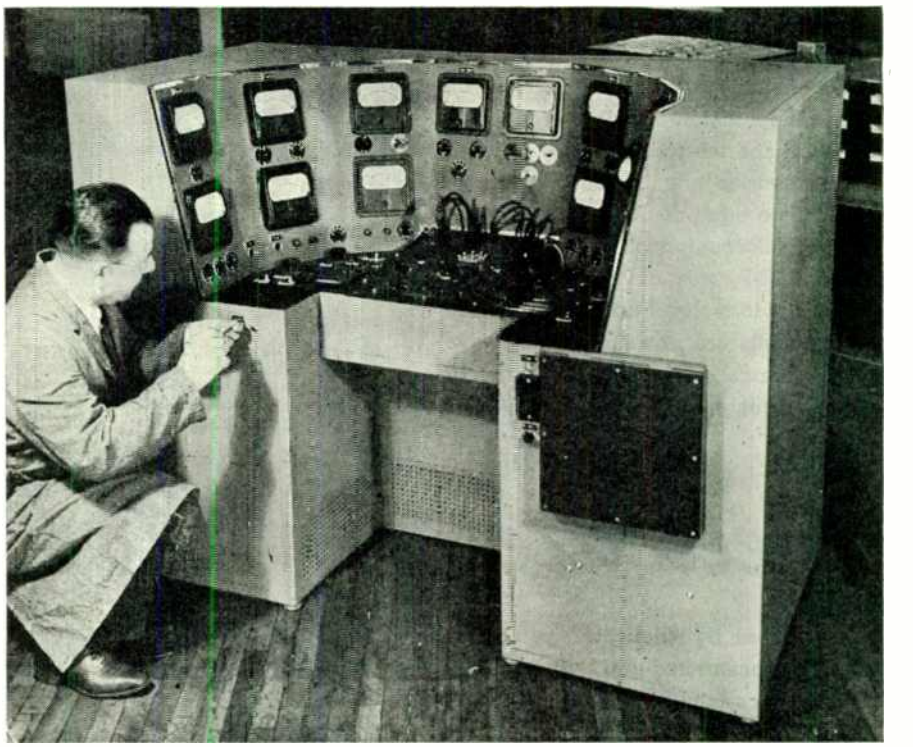
Construction Permits Use As A Discriminator

Sylvania Type 7K7 is a duo-diode high-mu triode differing from the usual diode-triode by having two separate cathodes, one for the triode and the other for the diodes.



This difference permits the tube to be used as a discriminator.

The cut-away view shows that although the construction looks like a duo-triode the second plate is really a shield around the two diodes.



SYLVANIA RADIO TUBE BRIDGE SET INSURES PERFECT PERFORMANCE

Measures Static And Dynamic Characteristics Of Vacuum Tubes

As ultra-high frequencies and a very wide range of intricate electronic applications make strict demands on tube performance and circuit designs, an accurate testing of tube and circuit characteristics becomes of the greatest importance.

One of Sylvania Electric's latest essential radio vacuum tube bridge test sets for precision engineering data is pictured above. Manufactured at Sylvania's plant at Williamsport, Pa., this equipment measures static and dynamic qualities of radio tubes, such as plate current, filament voltage and current, screen current, gas current, plate resistance, power output, mutual conductance, and amplification factor, as well as the characteristics of electronic devices.

The set is compact, fully shielded, with well-filtered, self-contained power supplies, complete with voltage regulators except AC and DC filament voltages.

ADVERTISERS INDEX

ENGINEERING SALES

Hoffman Radio: Has appointed parts jobber E. M. Kemp, 1115 R. Street, Sacramento as distributor of Hoffman home radios for the counties of San Joaquin and Calaveras, the Sacramento valley to the northern California line, and five counties around Reno.

Stromberg-Carlson: Newly created post of eastern district merchandiser has been filled by Charles M. Sherwood, formerly of RCA and Bendix. He will assist S-C distributors in New York City, Philadelphia, Baltimore, and Washington.

Stewart-Warner: Announces the appointment of Cruise Crawford Distributing Company, Birmingham to handle S-W radios in 53 Alabama counties. V. T. Fain and J. D. Kirkpatrick, Jr. will handle radio sales.

Laurence A. King: Secretary-treasurer and general sales manager of Operadio, has resigned after 21 years with that Company. During the war years, he has handled negotiations between Operadio and Army and Navy procurement offices. His future plans have not been announced at this time of writing.

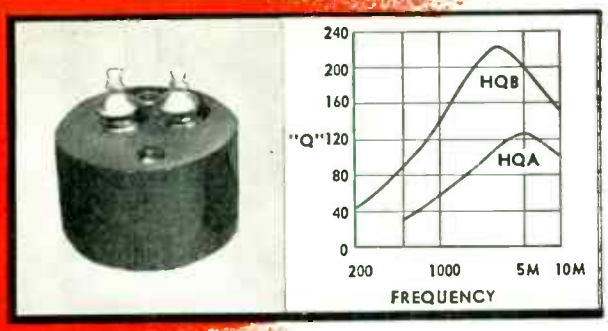
Link: Will be represented in the midwest by Roy E. McConnell, who is setting up headquarters in St. Louis. His address is P.O. Drawer 180. McConnell comes to the Link organization from the A.A.F. Material Command, Wright Field, where he was Chief of the Radio and Electrical Branch. He is an old-timer in the police radio field, and helped to organize the Indiana APCO Chapter, of which he was president in 1940 and '41.

Salesmanship: To attract veterans to selling as a career, the Sales Managers Club, Hartford, Conn. has issued an unusually valuable booklet entitled *An Invitation to Become a Leading Businessman.* Copies can be obtained by writing Charles Brunelle, 15 Lewis Street, Hartford 15, Conn.

Operadio: Has appointed H. H. Van Luven, 307 E. 3rd Street, Los Angeles, as sales representative in southern California and Arizona for their commercial sound division. As soon as restrictions are lifted, he

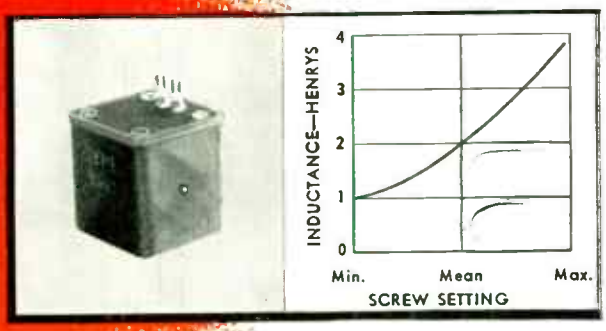
(CONCLUDED ON PAGE 87)

FOR INDUCTORS



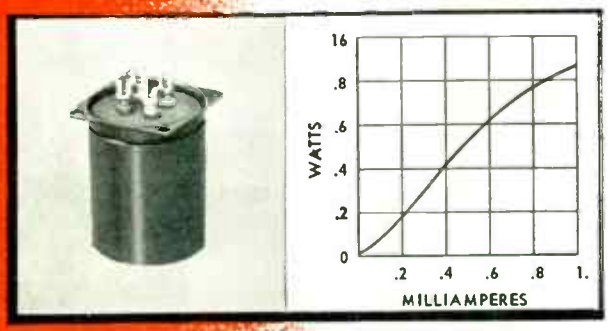
HQA AND HQB HIGH Q INDUCTORS

This series of toroid wound high stability inductors are available from 5 Mhy. to 2 Hys. Voltage stability is excellent, hum pickup is very low. Temperature effects are negligible. HQA units 1-13/16" in diameter by 1-3/16" high



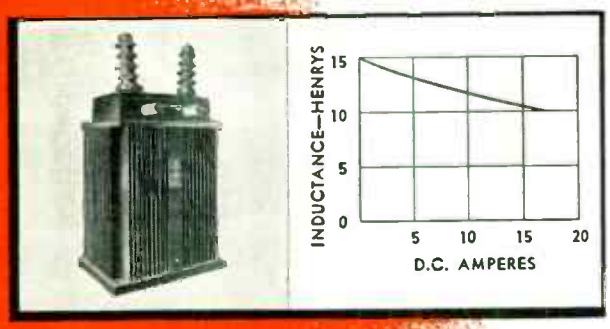
TYPE VI-C VARIABLE INDUCTORS

These inductors are available in optimum values from 10 Mhy. to 10 Hys. They are tunable over a wide range by inserting an Allen Head wrench in the adjusting screw. Units measure 1¼" x 1-7/16" x 1-7/16".



SENSITIVE SATURABLE INDUCTORS

UTC Saturable Inductors cover a wide range of application for magnetic amplification and control. These units are supplied to specific requirements. The curve shown illustrates a high sensitive type, showing DC saturation vs. AC watts into load.



POWER SUPPLY INDUCTORS

UTC supplies power supply components for every type of application, ranging from a one-third ounce reactor, which measures ⅝" x 7/16" x ¾", to the 10,000 pound, broadcast station, plate supply reactor, illustrated.

May we cooperate with you on design savings for your applications...war or postwar?

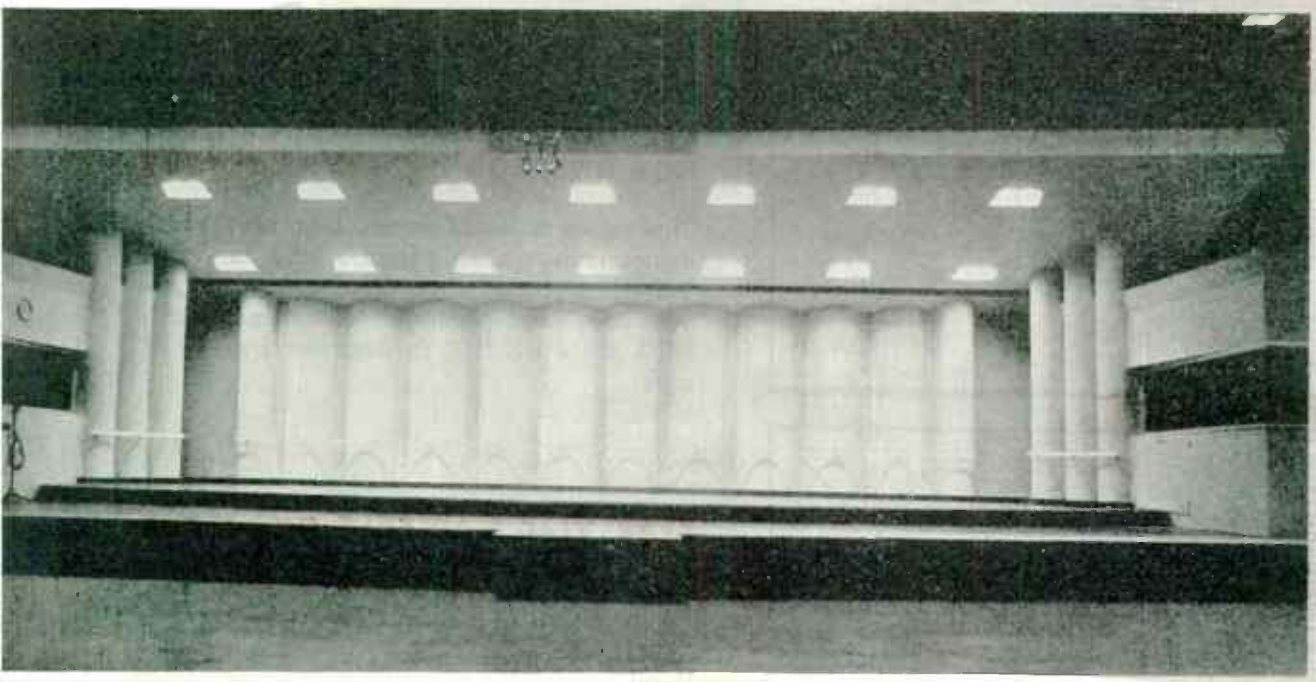
ALL PLANTS ARMY NAVY

United Transformer Corp.

150 VARICK STREET • NEW YORK 13, N. Y.

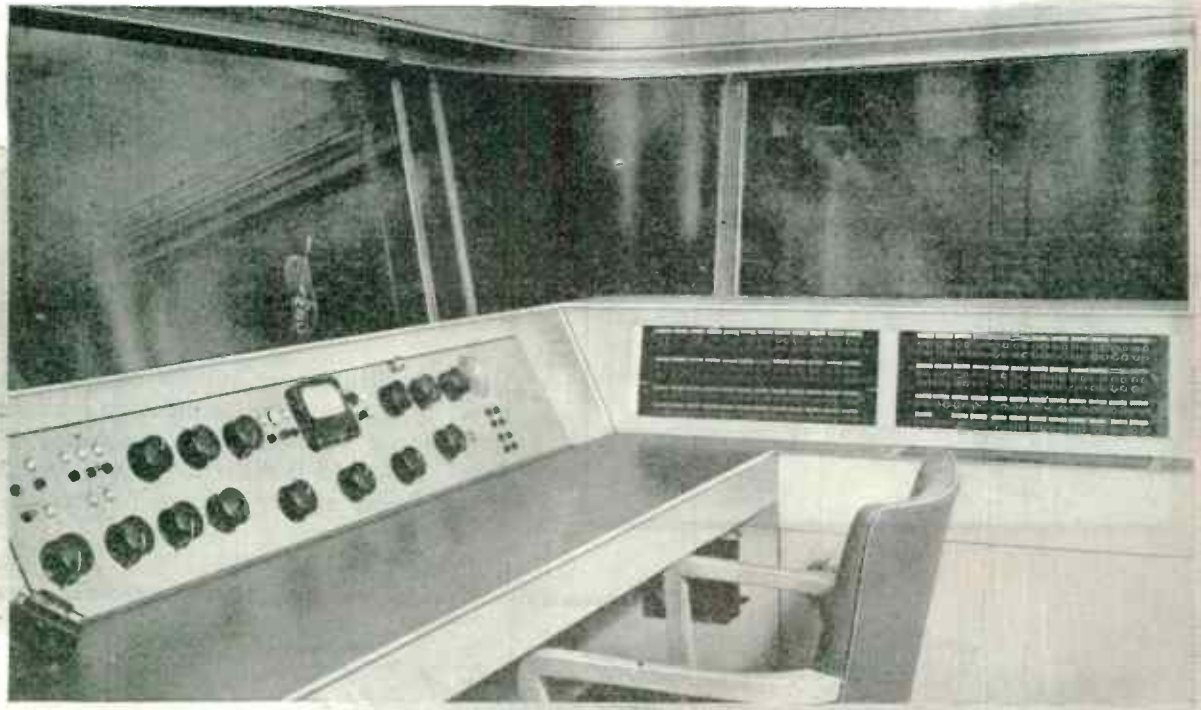
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

FM Station WEAF-FM



Above: *Stage of NBC's studio 8-H. This is one of several studios provided with polycylindrical sound diffusers in order to obtain improved high-frequency response. All of these studios use RCA 44-BX Microphones (on stage), and RCA 77-B Microphones (suspended from ceiling).*

Below: *Control booth of NBC's studio 6-A — another Radio City studio in which many WEAF-FM programs originate. The equipment in this booth is an RCA custom-built control console. Similar RCA consoles are used in all NBC studios, whether for AM or FM.*



uses RCA Equipment from Microphone to Antenna

WEAF-FM, the New York FM station of the National Broadcasting Company, uses RCA equipment "from microphone to antenna." WEAF-FM programs originate in the network's Radio City studios, where RCA 44-BX and 77-B Microphones are used exclusively. They pass through studio control booths equipped with RCA custom-built control consoles, through the big network control panel in the master control room, and through the equipment room with its rows of rack-mounted RCA amplifiers. From the studios, WEAF-FM programs are fed by special high-quality telephone lines to the transmitter room at the Empire State Building. Here, not only the transmitter, but also the audio amplifiers, and the monitoring and test equipment, as well, are standard RCA units. The antenna (highest point in New York) is a specially designed system consisting of four dipoles arranged in a circle. This antenna was developed by RCA engineers in 1939. After the war, it will be replaced by a new multiple-layer type.

That the equipment of WEAF-FM should be all-RCA is, of course, not surprising — for the National Broadcasting Company uses RCA-built equipment in all of its many broadcasting activities — AM, FM, and television. NBC engineers work with RCA engineers in the development of much of this equipment—field-test the models—and otherwise make available their unequaled operating experience. As a result, RCA broadcasting equipment is always up to date; incorporates the features operating engineers want; and, most important of all, is always "top quality."

Operators of both AM and FM stations — and station applicants — can make reservations right now for early delivery of RCA postwar broadcast equipment. For information on our Broadcast Equipment Priority Plan, write Broadcast Equipment Section, Radio Corporation of America, Camden, N. J.

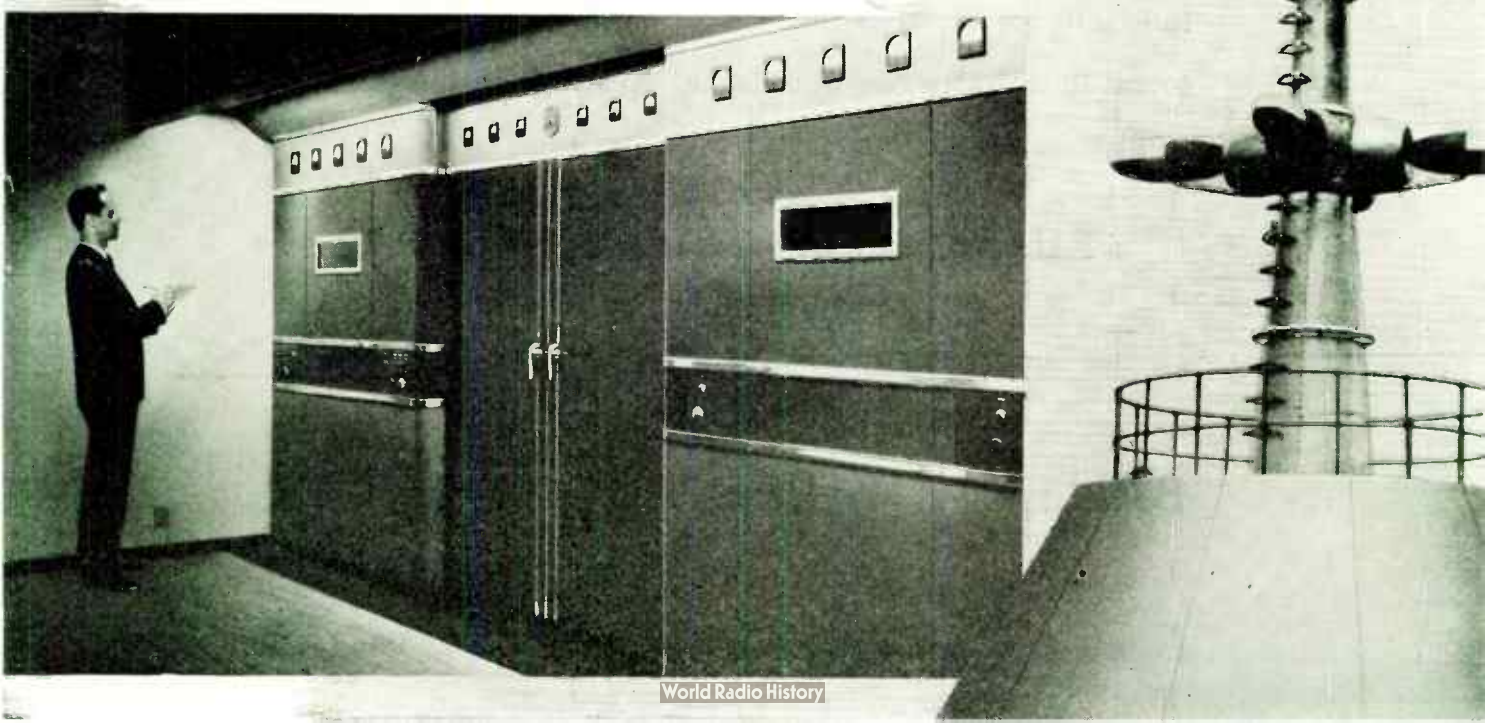
BUY WAR BONDS

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

In Canada, RCA VICTOR COMPANY LIMITED, Montreal

Below: *The RCA FM-10-A Transmitter of WEAF-FM. NBC was the first network to start FM broadcasting in New York City. The installation shown here is in the Empire State Building. Presently operating at reduced power, it will operate on full power as soon as wartime restrictions are lifted.*



Announcing the New

BALLENTINE
RECORD CHANGER

The BALLENTINE Changer is engineered to provide trouble-free, dependable operation, safe from careless or accidental usage. It is the result of exhaustive research, expert technical design and skilled craftsmanship. The BALLENTINE Record Changer assures complete customer satisfaction, free from mechanical annoyances so frequently found in ordinary record changers. Available in three models to fit your requirements.

RUSSELL ELECTRIC COMPANY

362 W. Huron Street, Chicago 10, Illinois

Manufacturers of

BALLENTINE RECORD CHANGER

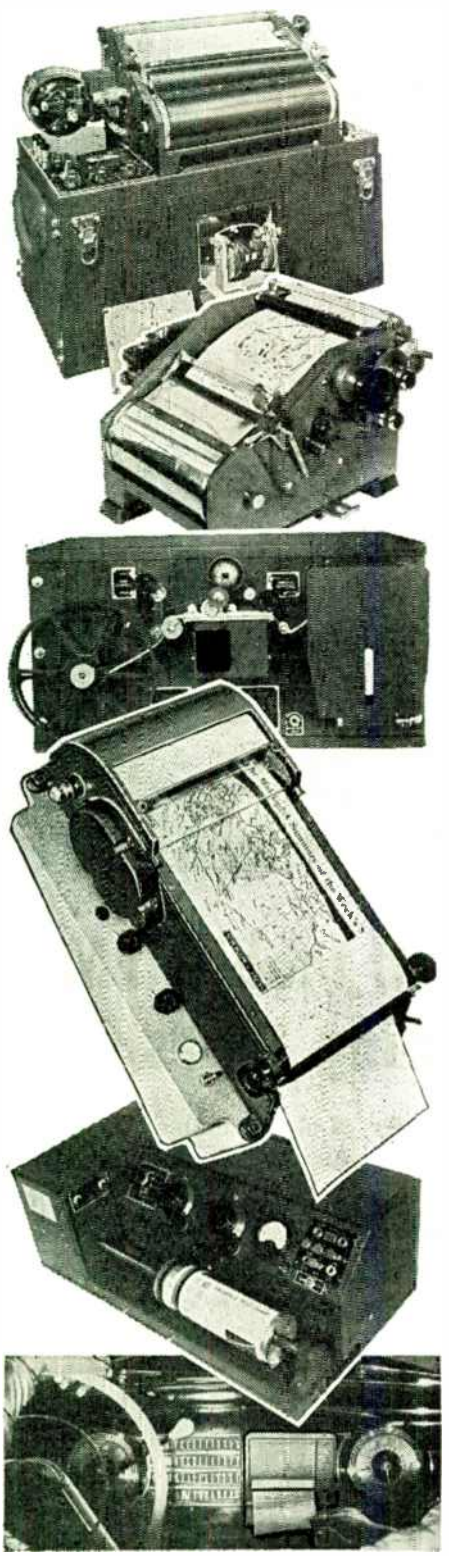
The Ballentine Record Changer Motor is engineered for just one purpose . . . to provide highest efficiency and lowest "rumble" for your changer. This quiet, trouble-free motor is the result of expert technical design, the most modern manufacturing methods and equipment, and skilled craftsmanship . . . You can depend on the Ballentine Changer Motor.

RUSSELL ELECTRIC COMPANY
362 W. HURON STREET • CHICAGO 10, ILLINOIS

Manufacturers of

BALLENTINE CHANGER MOTORS

ALDEN



for Graphic Recording of any kind

OUR YEARS OF EXPERIENCE, and cumulative skills, in the designing and production of RADIO COMPONENTS, are now being used in making equipment which covers ***the entire field of FACSIMILE.***

Actual service, as found in war and communication work under all conditions, has given a PRACTICAL quality to our equipment which, under ordinary conditions, would not have been obtained in years of engineering with limited application.

ALDEN PRODUCTS COMPANY is manufacturing practically ALL TYPES AND SIZES of facsimile and impulse recording equipment—using all the varied recording mediums: Photographic Paper, Film, Electrolytic Paper, Teledeltos, and Ink.

ALFAX IMPULSE RECORDING PAPER

•

By "COVERING THE ENTIRE FIELD," we mean . . .

1 • Some of our equipment has been used for the transmitting and receiving of photographic pictures of reasonably high resolution (such as the war pictures now appearing in the news).

2 • Continuous Recorders—of the type whose value has been proven on National and International news service circuits—are now on their way to the Orient, to be used for the receiving of the so-called "picture" languages. They use ALFAX paper.

3 • Also, through the use of ALFAX (the first high-speed black and white permanent recording paper), HIGH-SPEED Signal Analysis Equipment has been made possible for various laboratories and Government Departments. Other equipments have employed Teledeltos Paper for message work and other purposes.

4 • For outlying posts, where servicing equipment is an impossibility, or, where radio or wire links are of poor quality and power, ALDEN Tape Recorders (recording medium, ink)—have been designed to operate with a minimum of trouble and adjustments, and have PROVED MOST SATISFACTORY.

5 • The ability of ALFAX Paper and ALDEN Machines to record impulses *as they occur*, without the inertia problems of many previous methods, has made possible other recorders at various speeds (including slow). They will record a whole day's history of related phenomena, with time indicated, and often—with self-calibrated linear reference marks for ready interpretation.

ALDEN PRODUCTS COMPANY

117 North Main Street

BROCKTON [64F1], MASSACHUSETTS

. . . . . .

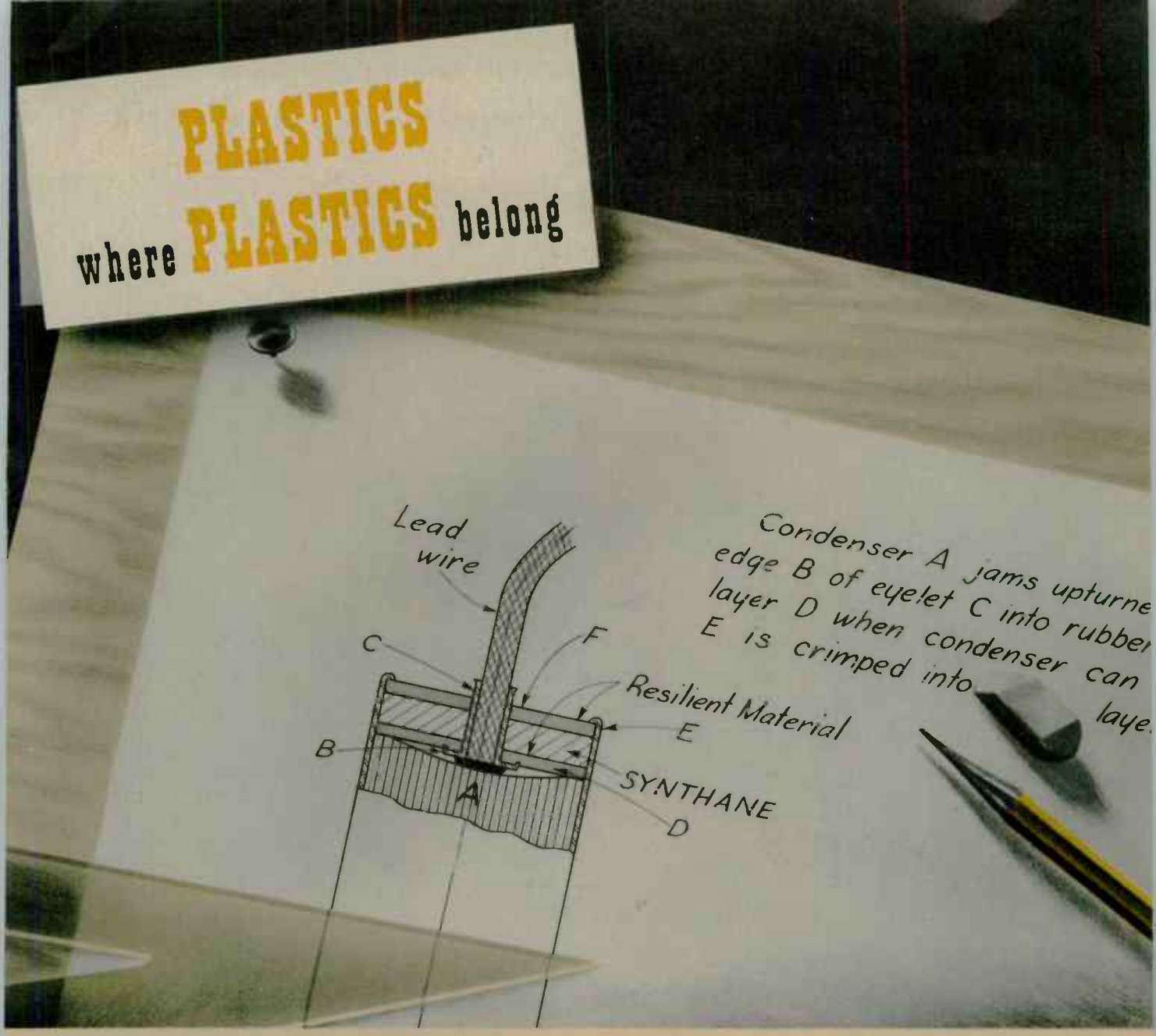
KAAR makes 50 and 100-watt mobile FM practical with instant-heating tubes

Kaar engineers—who pioneered instant-heating AM radiotelephones—have done it again! In presenting the new KAAR FM-50X and FM-100X, they now give you the advantages of FM *plus* instant-heating tubes . . . greater power and range with lower battery drain! Standby current is zero. Yet the instant you press the button microphone, you are on the air with a full 50 or 100 watts output, improved voice quality, and minimum distortion—sending out a strong, clear message that insures excellent reception.

KAAR FM TRANSMITTER
MODEL FM-50X
50 WATTS OUTPUT

KAAR
ENGINEERING CO.
PALO ALTO • CALIFORNIA
Export Agents: FRAZAR & HANSEN • San Francisco, California

where PLASTICS belong



Using Mechanical and Dielectric Strength

SYNTHANE laminated phenolic, sandwiched between and bonded to layers of a resilient material, is the basis of an interesting plastics application.

The assembly—a condenser—depends upon the resilient material for a perfect seal when the edge of the can is crimped. Synthane backs up the resilient material, provides needed strength and rigidity, and is also an excellent electrical insulator, unaffected by condenser oil.

In an application such as this, as in many others, it is desirable to consult our engineers before you design to see if Synthane can be used, and to decide which grade of Synthane will best meet your individual requirements and can be easily and readily produced. In fact, we will work with you from design, through selection of material, down to the delivery of the finished plastics parts, relieving you completely from worry and responsibility. Synthane Fabricated Parts are produced by men who know how to make plastics and how to machine them, using specialized equipment. Synthane Corporation, Oaks, Pennsylvania.

SYNTHANE TECHNICAL PLASTICS ARMY NAVY **DESIGN • MATERIALS • FABRICATION**

How many of these forms of Synthane do you recognize . . . and use?

1 SYNTHANE SHEETS
Made by curing layers or laminations of impregnated paper or fabric with heat and high pressure.

2 SYNTHANE WRAPPED TUBES
Made by curing impregnated paper or fabric, wound about a mandrel, with heat.

3 SYNTHANE MOLDED TUBES
Same as wrapped tubes except tubes are cured under heat *and* pressure in molds.

4 SYNTHANE RODS
Produced by a method similar to that used in processing molded tubes.

5 SYNTHANE MOLDED-LAMINATED
A means of producing parts in a finished or nearly finished form by curing layers of sheets under heat and pressure in molds. An economical way of making parts in quantity, retaining the desirable strength characteristics of Synthane sheet material.

6 SYNTHANE MOLDED-MACERATED
Flakes of impregnated fabric are cured under heat and pressure in molds. More intricate parts can be formed than are possible by molded-laminated. Strength surpasses ordinary powder molding, does not equal molded-laminated.

7 COMBINATION MOLDED-LAMINATED, MOLDED-MACERATED Some parts requiring strength in certain sections but intricacy in others may be made by a combination of the molded-laminated, molded-macerated methods.

8 COMBINATION MATERIALS
Synthane is sometimes bonded under pressure to other materials to achieve a combination of properties not obtainable any other way. The resiliency of rubber or Neoprene is often teamed with the strength and insulating characteristics of Synthane.

9 SPECIAL MATERIALS
Synthane is available in special forms such as this graphited anti-friction Synthane. The inclusion of graphite is desirable on some applications.

10 FABRICATED PARTS
Synthane produces finished parts by machining sheets, rods, tubes or by molded-laminated or molded-macerated processes or by combining machining and molding operations.

SYNTHANE CORPORATION, OAKS, PENNA.

SYNTHANE

Representatives in All Principal Cities

PLAN YOUR PRESENT AND FUTURE PRODUCTS WITH SYNTHANE TECHNICAL PLASTICS · SHEETS · RODS · TUBES · FABRICATED PARTS · MOLDED-LAMINATED · MOLDED-MACERATED

NO OXIDATION
NO CONTAMINATION
NO MOISTURE . . .

3 MORE REASONS WHY
FEDERAL MAKES
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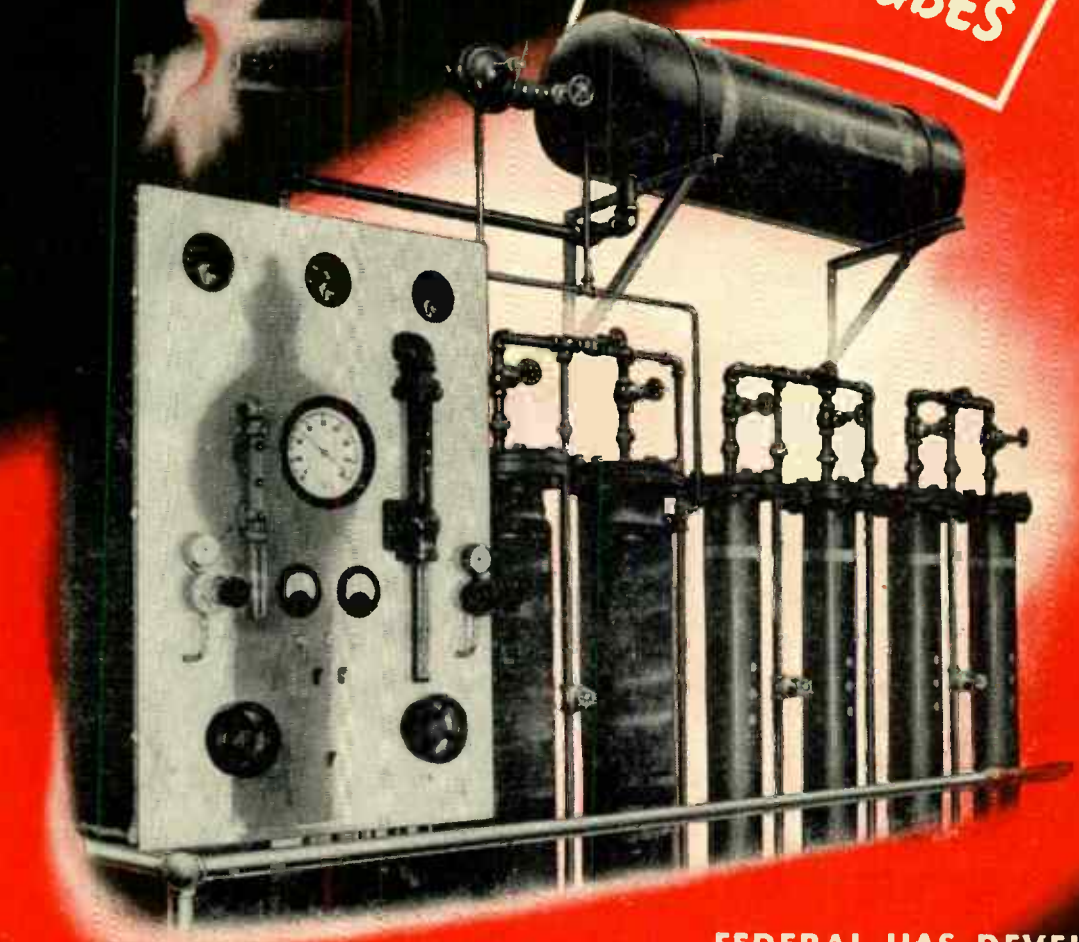

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Intelin Ultra High Frequency Coaxial Cable, developed and manufactured by Federal, has extreme ruggedness and meets all specifications with precision, accuracy, uniformity and dependability.

No oxidation, no contamination, no moisture!

Another Federal First adds extra performance guarantees to FTR vacuum tubes.

In a corner of the new FTR tube plant is this automatic nitrogen purifier. During the process of sealing the anode to the stem, the elements of every FTR tube are now protected from oxidation, contamination and moisture in a scientifically controlled atmosphere of automatically mixed nitrogen and hydrogen.

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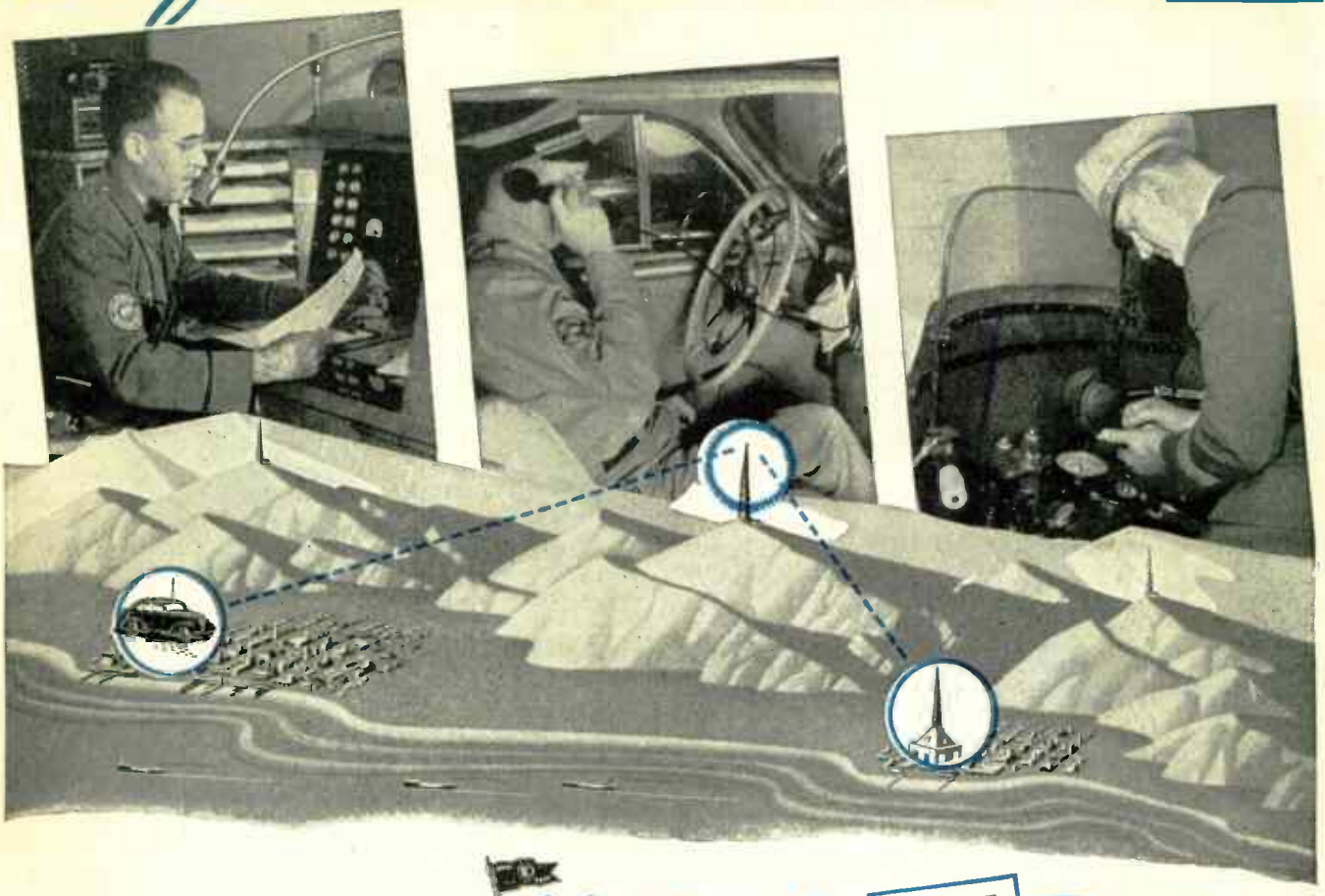
INVEST IN THE FUTURE — BUY WAR BONDS

California's mountains & valleys were TOUGH



. . . but not for Motorola F-M Radio

California's 158,693 square miles and 117,760 miles of roadways—with mountains like Mt. Whitney, 14,498 feet above sea level, and valleys like Death Valley, 300 feet below sea level—presented problems in statewide coverage by radiotelephone that were super-tough.

Nevertheless, by the use of Motorola Radiotelephone F-M units and Motorola Radio automatic relay stations, the California State Highway Patrol has excellent radiotelephone communications with the 485 two-way patrol cars and the 377 one-way motorcycles patroling California's 58 counties.

Your State, County, City or Community should take advantage of the skill and experience that Motorola Radio engineers have displayed in installing F-M 2- and 3-way Radiotelephone systems in 33 States and over 1,000 communities throughout the United States, the Canal Zone and Hawaiian Islands.

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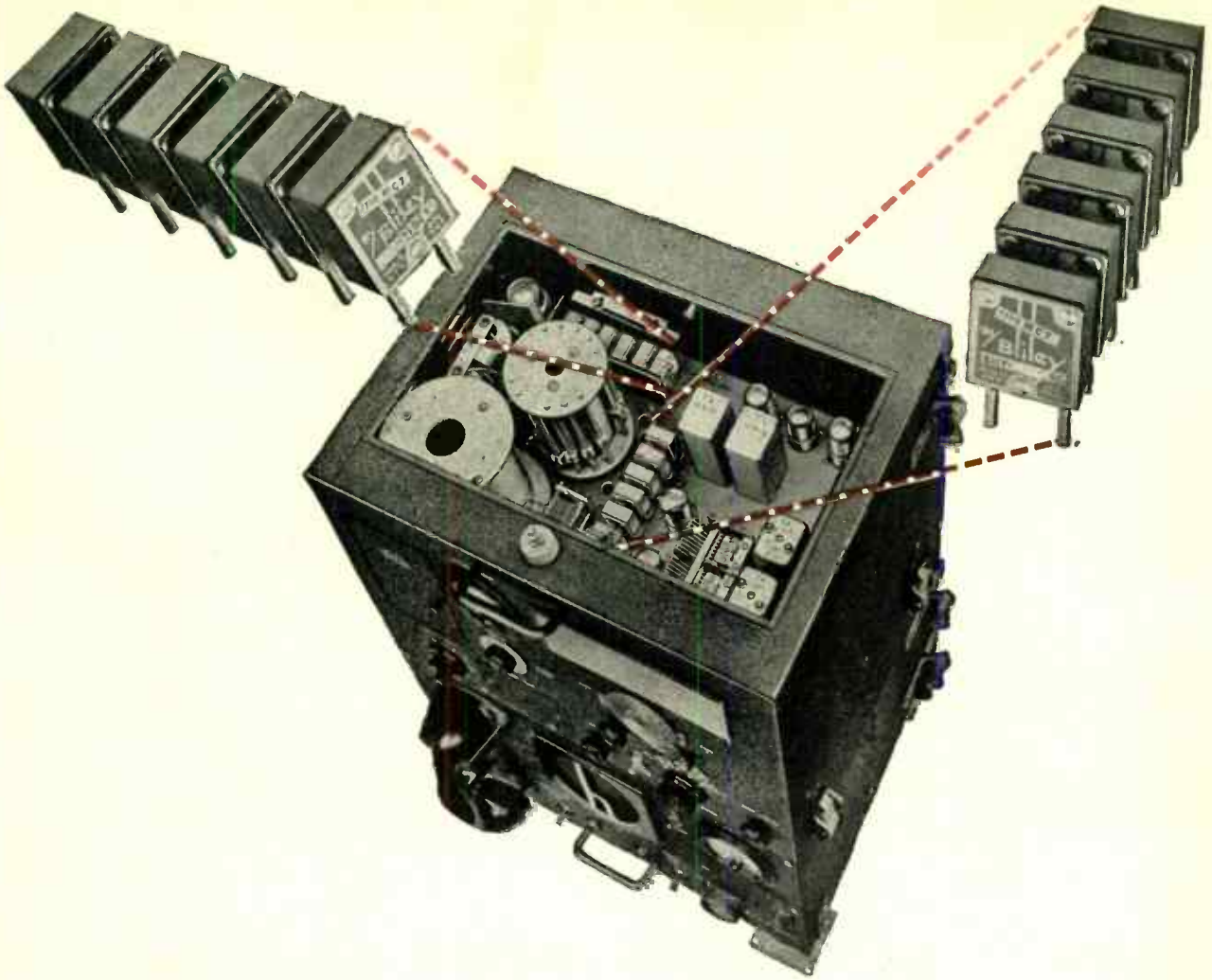
F-M & A-M HOME RADIO • AUTO RADIO • AUTOMATIC PHONOGRAPHS • TELEVISION • F-M POLICE RADIO • RADAR • MILITARY RADIO



The 6 operating frequencies are BLILEY CRYSTAL-controlled

For dependable communications on the high seas here is a battle-tested set incorporating every modern feature that experience has shown to be most desirable for ship-to-shore and ship-to-ship radiotelephone service.

The six Bliley crystal-controlled operating frequencies permit instant and positive channel selection in both transmitter and receiver.

The Bliley *acid etched** Crystals used in this Hallicrafters HT-14 set were designed to meet specific objectives in the operation of two-way radiotelephone communications. They, too, have been battle-tested.

It's a habit with most communications engineers to specify Bliley for all crystal requirements. This is particularly true today when new applications and complex designs require technical excellence in every component. There is no substitute for the 15 years of experience offered by Bliley craftsmen and engineers.

✣ ✣ ✣

**Acid etching quartz crystals to frequency is a patented Bliley process.*

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Bliley CRYSTALS

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buy **extra** War Bonds

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UNION STATION BUILDING · ERIE, PENN.

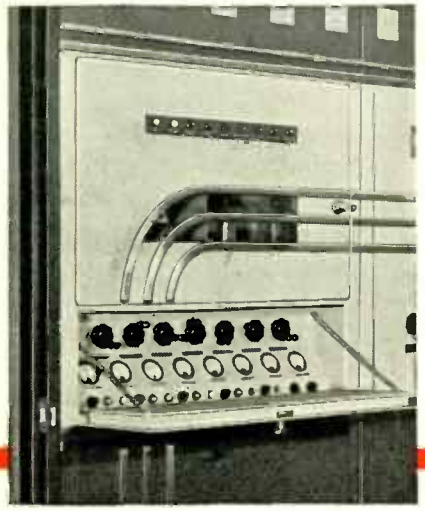
"Supervisory control helps put the finger on trouble" ★

C. W. Burtis, Chief Engineer
WPEN, Philadelphia

This statement by Mr. Burtis, on the value of well-designed supervisory control, brings into sharp focus the extra dependability featured in all Westinghouse transmitters. *For Westinghouse transmitters have more supervisory control than any other type manufactured today.*

Indicator lamps, for example, tell at a glance which circuit has been overloaded, even though the transmitter has returned to the air. "De-ion" circuit breakers supply full overload and undervoltage protection, automatically reduce outage time. Controls reset automatically. Circuit checkup is simplified.

This dependability and efficiency in Westinghouse transmitters are products of on-the-job knowledge gained in 25 years of building and operating radio stations. Your nearest Westinghouse office can give you all the facts on Westinghouse transmitters . . . 5, 10 and 50 kw, AM, and 1, 3, 10 and 50 kw FM. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-08117



★ "Without a doubt, supervisory control is one of the more worth-while additions to the indication devices on a transmitter. It definitely helps put the finger on any trouble that develops by approximating the sphere of that trouble."

(*Signed*) C. W. Burtis

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

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celebrates its 50th Anniversary
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MAGUIRE INDUSTRIES

Throughout the past half century, the name "THORDARSON" has been a synonym for highest quality in transformers and other electrical equipment.

Under the banner of Maguire Industries, this tradition of leadership will be maintained in even fuller measure.

Thordarson's new plans include outstanding improvements in present lines . . . new products and services to meet the expanding needs of the radio and electronic industries . . . vigorous and liberal merchandising policies . . . and a generally forward-looking viewpoint with regard to all of the industries we are privileged to serve.

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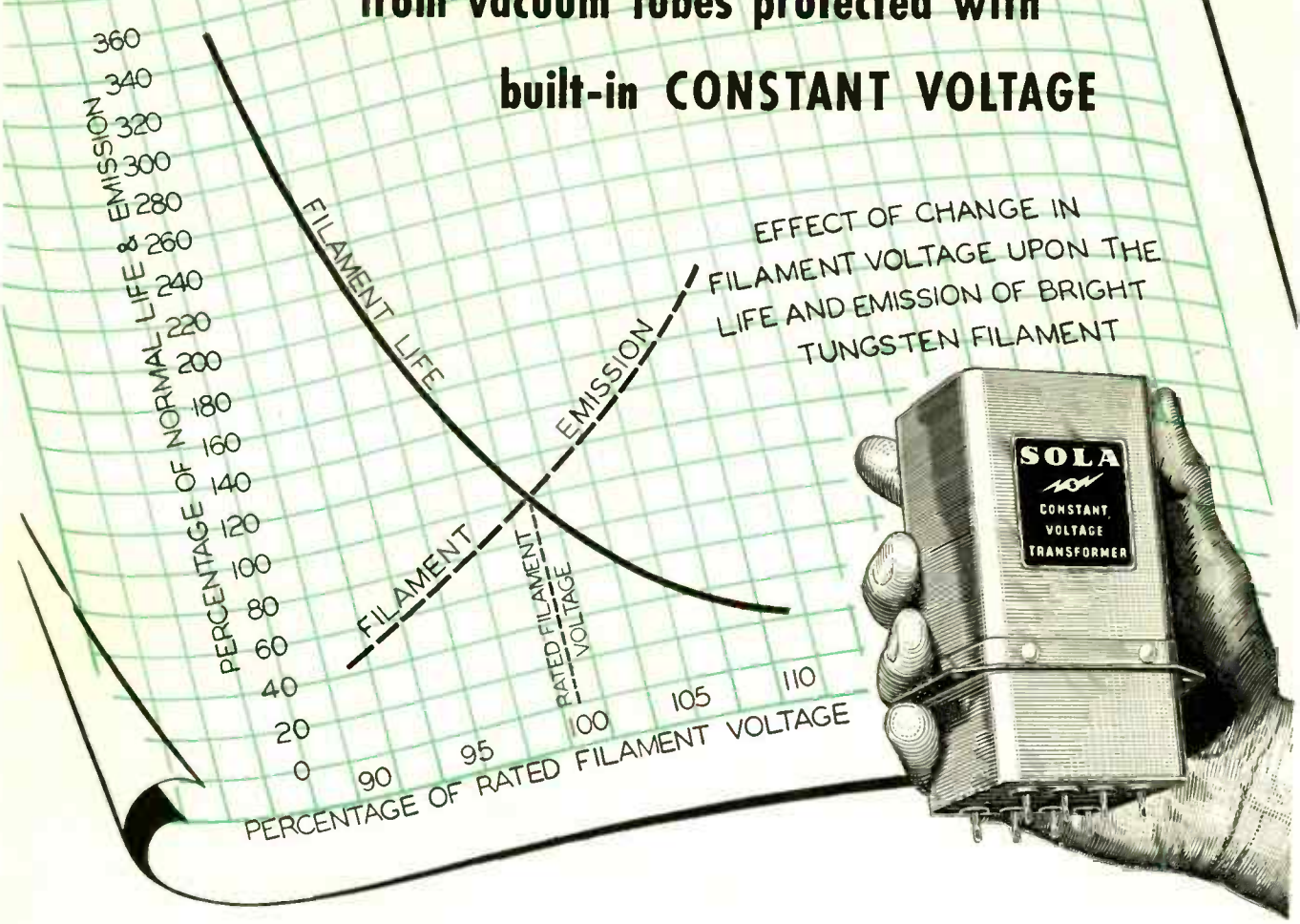
Longer life and better performance from vacuum tubes protected with built-in CONSTANT VOLTAGE



A 5% over-voltage will reduce the life of a tungsten filament by 50%.

A 5% under-voltage will cut filament emission by 33%.

Commercial line voltages today may vary as much as ± 20%.

With a SOLA Constant Voltage Transformer as a built-in component of your equipment, these line voltage variations can be ignored. No need to depend upon operator adjustments. No need to worry about operator forgetfulness. You can depend on it—the right voltage is *always* there.

Vacuum tubes protected by SOLA Constant Voltage Filament Transformers require no starting resistors or high reactance transformers. Filaments are automatically and positively protected against damaging inrush currents. Tube life is noticeably prolonged.

SOLA Constant Voltage Transformers require no supervision, or manual adjustments by the operator. They eliminate the need for voltmeters. They are fully automatic, have no moving parts, tubes or networks, and are self-protecting against short circuit.

Standard units are available in capacities from 10 VA to 15 KVA either for the operation of equipment now in use or as built-in units. Where special problems confront the designer, consultation with SOLA engineers may provide a positive and economical solution.

Constant Voltage Transformers

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 • Door Bells • and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.**

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You'll want to make STROMBERG-CARLSON the Main Radio Line in your showroom!

There's a tremendous pent-up demand for Stromberg-Carlson radios—fine musical instruments for the *main radio* in any home. This is currently being stimulated even farther by vigorous national advertising which carries this *main radio* message to your customers through some 475,000,000 impressions in thirteen leading magazines.

Make this profitable market your own, by becoming an authorized Stromberg-Carlson dealer under the very favorable Franchise Agreement now being offered. Get in touch with your local distributor for details, or write us at once. For Stromberg-Carlson is:

—the important radio unit—the radio unit carrying real profit opportunity —the radio unit with easy-selling public acceptance.

Become an Authorized Dealer now, and organize your postwar business around the Stromberg-Carlson *main radio*—a consistent profit maker whether in an outstanding table model, console, or radio-phonograph combination.

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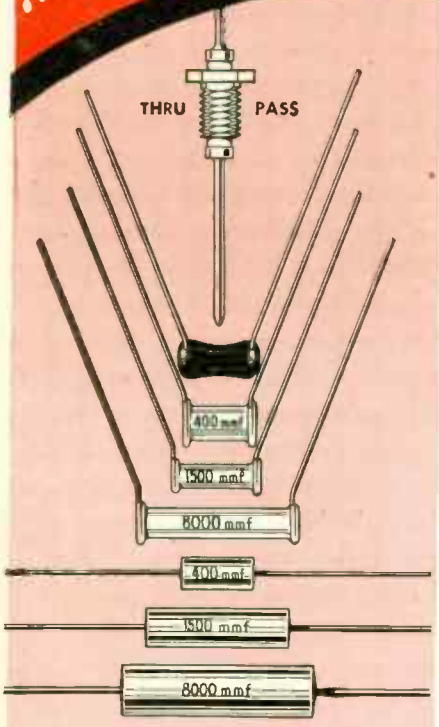
CAPACITORS, RESISTORS, CHOKES ...much Better ... much Smaller

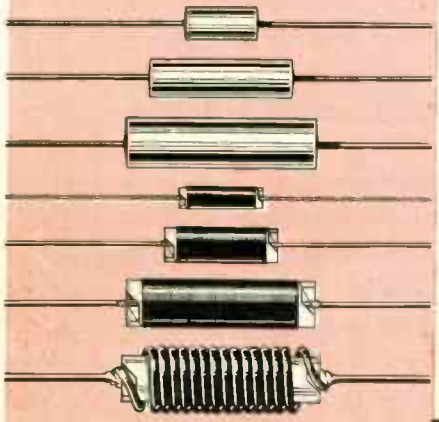


CAPACITORS

Ceramic—Insulated and non-insulated—Yellow for identification—Range from 1 mmf. to 8000 mmf.

RESISTORS

Wire-Wound—Insulated—Red for identification—Ohmage from 1 to 1000.



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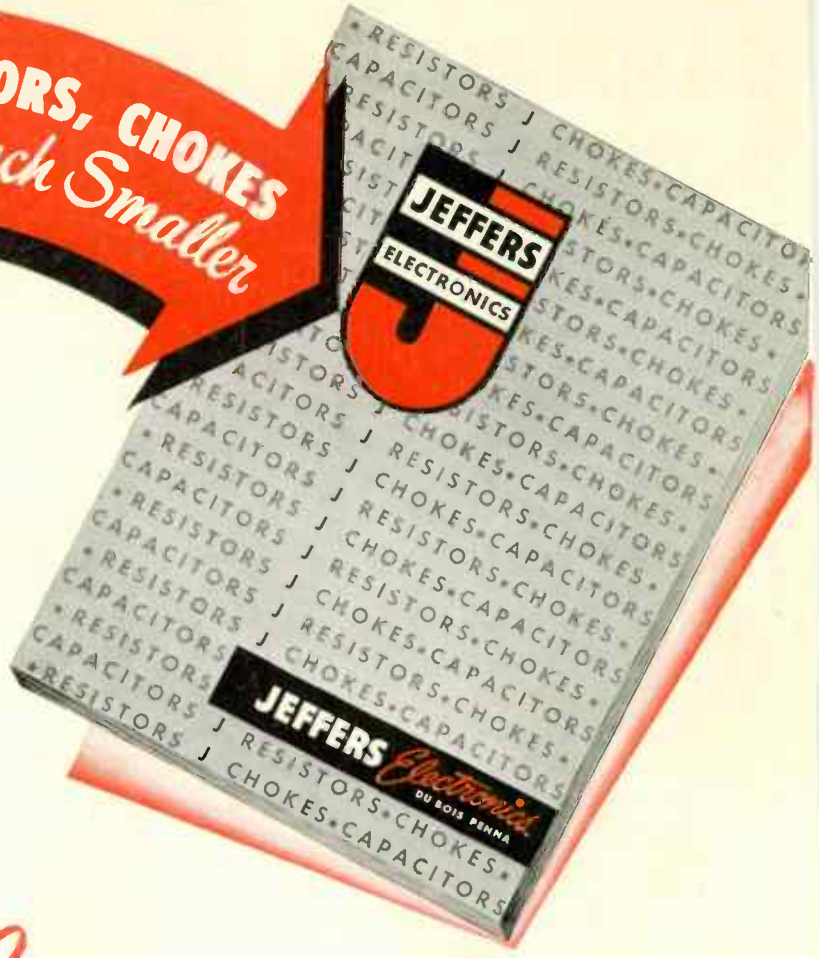
Can be wound on cores of either resin-bonded, high resistance material or resin-bonded iron. Insulated units, green-molded for identification. Non-insulated units protected by baked resin finish.



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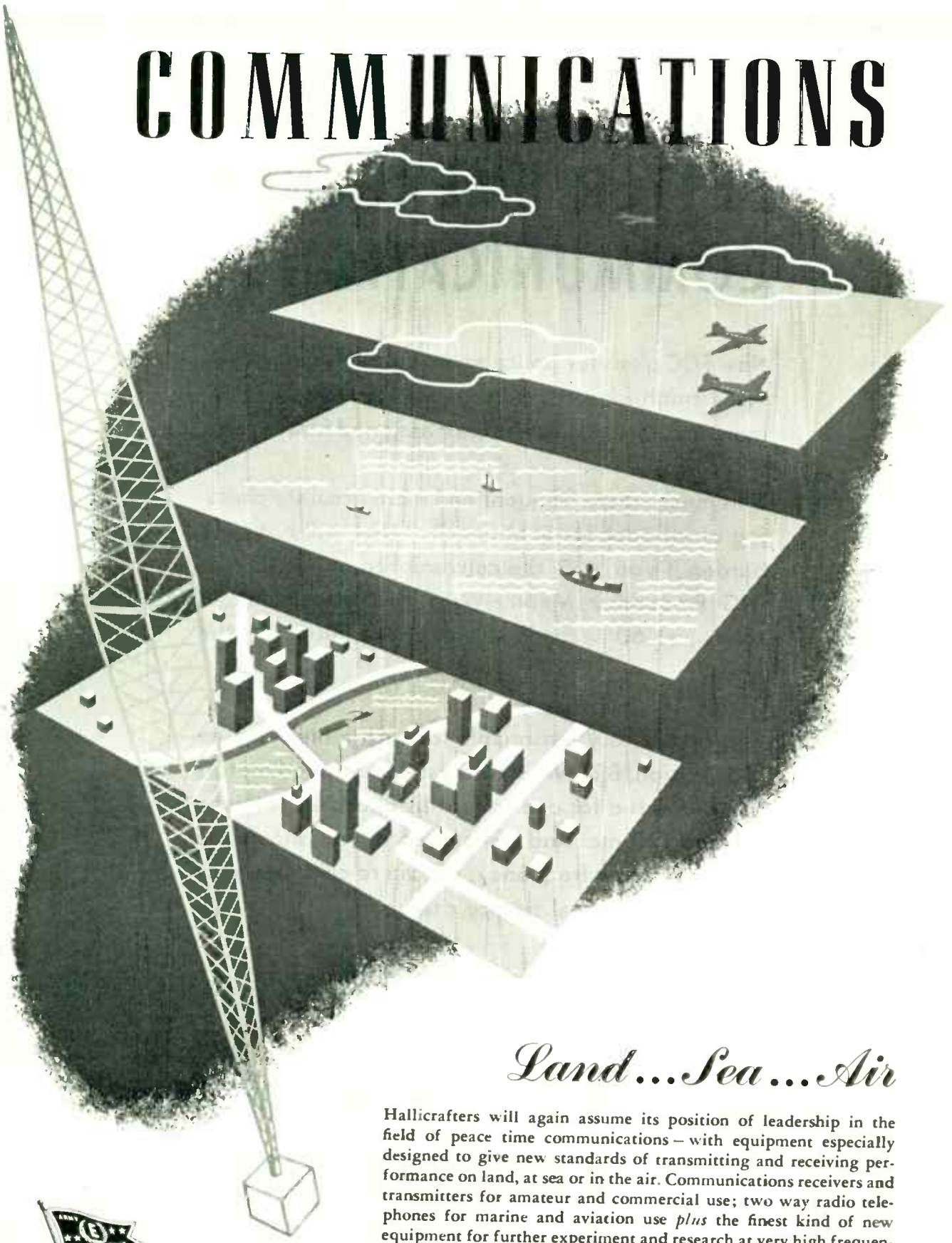
COMMUNICATIONS



Land . . . Sea . . . Air

Hallicrafters will again assume its position of leadership in the field of peace time communications – with equipment especially designed to give new standards of transmitting and receiving performance on land, at sea or in the air. Communications receivers and transmitters for amateur and commercial use; two way radio telephones for marine and aviation use *plus* the finest kind of new equipment for further experiment and research at very high frequencies will all be included in Hallicrafters postwar production plans.

BUY A WAR BOND TODAY!

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THE HALLICRAFTERS CO., WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT, CHICAGO 16, U. S. A.

FM PREPARED FOR NATION-WIDE EXPANSION

Licensees Rushing Equipment for 88–108 Mc.—New Armstrong Invention Announced—Milwaukee Journal Promises Programs Before New Sets Are Ready

BY MILTON B. SLEEPER

A WHOLE train of events was set in motion when, following the FCC's final allocation of frequencies for 44 to 108 mc., on June 27th, leaders in radio manufacturing and broadcasting moved quickly to make their final postwar preparations. Two factors have built up a tremendous force behind FM. One is Major Armstrong's high standing among engineers and the confidence and popularity which he enjoys among executives who are willing to back his judgment. The other is the four-year battle with the FCC which started in 1941 with the investigation of newspaper radio-ownership and concluded with the FCC hearing on June 20th and 21st. This fight has put behind FM a campaign of publicity and promotion unequalled in the history of radio. And now, having proved every claim made for its superiority over AM by service to our Armed Forces in the European and Pacific theatres of war, FM is ready to capitalize on that publicity as it is readied for expansion at home in the fields of communications and broadcasting.

Here is a summary of what has already taken place since the announcement of the allocations listed above:

FM Licensees ★ Accepting the arbitrary attitude of the FCC as a challenge to expand FM quickly on a national scale, licensed manufacturers of receivers and transmitters met in New York City at the Waldorf-Astoria on July 6th to coordinate their engineering plans and thinking, to the end that listeners may enjoy the full benefits of 15,000-cycle programs and FM's noise-reducing capabilities.

Also invited were FM consultants C. M. Jansky of Jansky & Bailey, and Comdr. Paul A. de Mars of Wilmotte Laboratories.

Thus, FM will get under way with transmitters and receivers designed as correlated parts of a single system. This is in sharp contrast to AM practice, under which transmitters and receivers have been designed as if they were unrelated parts of independent services, as a result of which AM reception has been progressively debased.

In other words, the attitude in the past has been that it was the function of AM transmitters to spread signals over the largest areas possible, and the function of AM receivers to make those signals intelligible at the lowest cost possible.

The use of FM introduces a totally new policy. The recognized function of FM transmitters is to transmit, over specific areas, signals which FM receivers within those areas can translate into exact reproductions of the original sounds created in the broadcast studios, without introducing extraneous, interfering noise. For this higher quality of service, the public will pay a little more to have receivers built to higher engineering standards and equipped with adequate reproducing systems.

Behind the plans of the licensed manufacturers there is another purpose of extreme importance. It is to work together to advance the engineering and design of pilot models so that, as military contracts are cancelled, production of FM equipment will afford employment to factory workers and to radio trained veterans when they are released from the Armed Forces.

This employment will extend far beyond the radio factories, for it includes the creation of jobs in the distribution, retail sales, and service of receiving sets, and the erection and operating of new FM broadcast stations.

Major Armstrong's Statement ★ Following the settlement of FM broadcast frequencies, Chairman Porter issued this surprising announcement: "We have received gratifying expressions of satisfaction with this allocation. It is already apparent that the soundness of the allocation is coming to be generally recognized." If there were such expressions, the industry would be greatly interested to know by whom they were issued if, indeed, they were received at all.

In the meantime, Major Armstrong had this to say:

"I have two statements to make regarding the decision of the Federal Communications Commission to move FM to the 100-megacycle band. One of these statements deals with the immediate practical situation facing the broadcasters and the prospective broadcasters. I will make that one now. The other statement will deal with matters of a more fundamental and non-technical nature, and will be made in due course when facts can be assembled and presented in an orderly fashion.

"The case of immediate importance to the broadcaster is whether FM can go ahead on the new band and provide a better service than AM. The answer is, of course, that it can. The original FM work was on 110 and 117 megacycles, and it was on this band that superiority of FM over AM was demonstrated to the men who became FM's pioneer broadcasters.

"FM will start going forward immediately that licenses are issued for the 400 or more applications on file. The Commission can now show its faith in its statement that the same or greater coverage will be obtained in the new band by processing the applications as filed immediately. There is no necessity for further burdening the applicants with useless red tape and re-calculations of meaningless service range figures. If action is taken promptly, then, in spite of the handicap imposed by the shift in the band, FM will be the major factor in postwar employment.

"Anticipating the possibility of this decision by the Federal Communications Commission, there has been designed a device which will enable the stations now on the air to emit simultaneously the old and the new frequencies during the period of interim operation. Details of this will be made available shortly by one of the pioneer FM transmitter manufacturers.

(CONTINUED ON PAGE 89)

ALLOCATION FOR 42 TO 108 MC.

On June 27, 1945, the FCC announced the adoption of Alternative No. 3 with certain modifications. The allocation between 42 and 108 mc. is as follows:

Non-Govt. Fixed and Mobile	42–44 mc.
Television Channel No. 1	44–50
Amateur	50–54
Television Channel No. 2	54–60
Television Channel No. 3	60–66
Television Channel No. 4	66–72
Non-Govt. Fixed and Mobile	72–76
Television No. 5	76–82
Television No. 6	82–88
Non-Commercial Educational FM	88–92
FM Broadcasting	92–106
Facsimile	106–108

FIG. 1. WINCHARGER AND EMERGENCY ENGINE-DRIVEN GENERATOR POWER THIS REMOTE FM RELAY INSTALLATION

UNATTENDED, AUTOMATIC FM RELAYS

Installations Which Fill in Areas Not Covered by Main Stations of the Virginia State Police System

BY WILLIAM M. LEE*

IN THE summer of 1943, the Virginia Department of State Police had 5 fixed AM stations for communication with cars patrolling a total area of 40,000 square miles. Four of these were 1-kw. transmitters, while the fifth had an output of 360 watts. We were trying to cover some 30,000 square miles in the western and south-western portions of the State with 3 of our 1-kw. transmitters, despite the fact that about 17,000 square miles were very mountainous. One of these stations, at Wytheville, near the center of the map in Fig. 2, located in the center of the most mountainous part of the whole territory, was intended to cover 10,000 square miles.

*Radio Engineer, Dept. of State Police, Radio Division, Richmond, Pa.

Experience with AM ★ AM transmission to the patrol cars was on 1,690 kc., with an FM talk-back frequency of 35.78 mc. Each fixed station was equipped with a 310-ft., half-wave, shunt-fed vertical radiator, above which was mounted a half-wave coaxial antenna for picking up 35.78-mc. signals from the cars.

It was intended that the receiving antennas would bring in signals from the cars within each station's service area. However, due to the mountainous terrain, satisfactory reception in many cases was only obtained at a radius of 40 miles, representing an area of less than 5,000 square miles.

The State had been divided into geographical divisions, with the fixed stations near the centers. Since a considerable sum had been spent on these installations, and because of personnel problems, it was not considered practical to put up additional stations to cover areas which had poor coverage or none at all.

Thorough study of topographical maps indicated that the right solution of the conditions would be 2-way unattended, automatic repeater stations to relay transmissions from the fixed stations to the cars, and from the cars to the fixed stations. Accordingly, sites were selected for the proposed repeaters, and actual field tests at these sites were conducted from the fall of 1943 until late spring in 1944.

Commercial power facilities were not available at any of the locations selected.

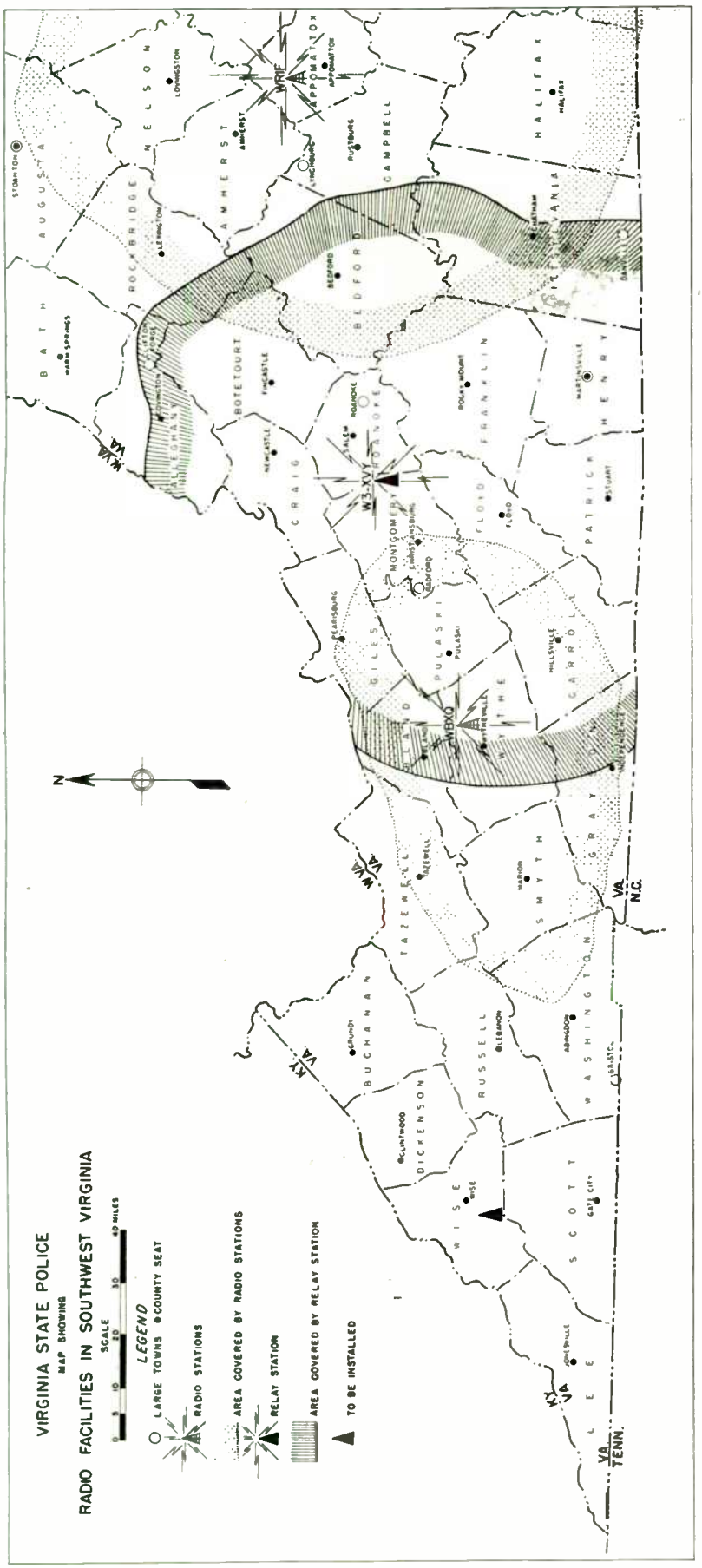


FIG. 2. THIS MAP SHOWS HOW RELAY STATION W3XVY COVERS THE AREA BETWEEN MAIN STATIONS WBXQ AT WYTHEVILLE AND WRIF AT APPOMATTOX

This indicated the use of wind-driven generators for current supply. Inquiries to the U. S. Weather Bureau and the National Park Service brought the information that sufficiently high average wind velocity would be available at each site. By using wind-driven generators, we could eliminate the need for carrying gasoline to these remote locations, as would be necessary if we relied on engine-driven generators.

Preliminary FM Tests ★ In the summer of 1944, a contract was awarded Link Radio Corporation for the installation of 3 automatic relay stations, complete with wind-driven generators and storage batteries. These relays would pick up the car signals on 35.78 mc., and transmit to the corresponding main stations on 116.55 mc. We also decided to plan the relay installations so they could be made to operate 2-way, later, picking up the main stations on a high frequency (it is now expected that we shall use a channel between 152 and 162 mc. or else a channel in one of the shared television bands) and retransmitting to the cars on their frequency of 35.78 mc.

The distances from the relays to their respective main stations were 80, 55, and 20 miles, over paths that did not provide line-of-sight transmission. Therefore, to predetermine the performance of the installations, we decided to run tests at each location. For this purpose, we used a mobile-type transmitter, with an output of 15 watts.

Over the 20-mile path, the 1st limiter of the receiver was completely saturated. Over the 55-mile path, the signals gave a reading of 100 microamperes in the first limiter grid, equivalent to approximately 4 microvolts input to the receiver. Over the 80-mile path, the signals were just strong enough to break the squelch, and were not readable.

We then conducted further tests over the 80-mile path. Best results were obtained by using a reflector and two directors on the coaxial antenna of the test transmitter at the relay site. In addition, we put one director and one reflector on the receiving antenna at the main station. This gave us 80 microamperes in the first limiter, equivalent to approximately 2.5 microvolts input to the receiver. These signals were well above the noise, and gave very good reception.

After these tests were completed, we felt confident that the sites selected would be satisfactory for the relay installations. Contracts were then awarded for buildings to house the equipment at each location. The design of the buildings, as shown in Fig. 1, follows closely that used by the Telephone Company to house their long-lines repeater equipment, except for the special roof construction necessary to support the tower for the wind-driven generator.

FM for Main Stations ★ As a byproduct of these tests, it was decided to install a 250-watt main station at Richmond headquarters. This was completed in the fall of 1944. Then, because of superior coverage obtained from

250 watts on FM as compared with 1,000 watts from our AM transmitter at the same site, we determined to change our entire system from AM to FM!

This change was planned to extend over a period of two years, because our radio department is operated by a staff of only three technicians. They do all the work of maintaining our 5 fixed stations and the 145 2-way FM installations in our cars.

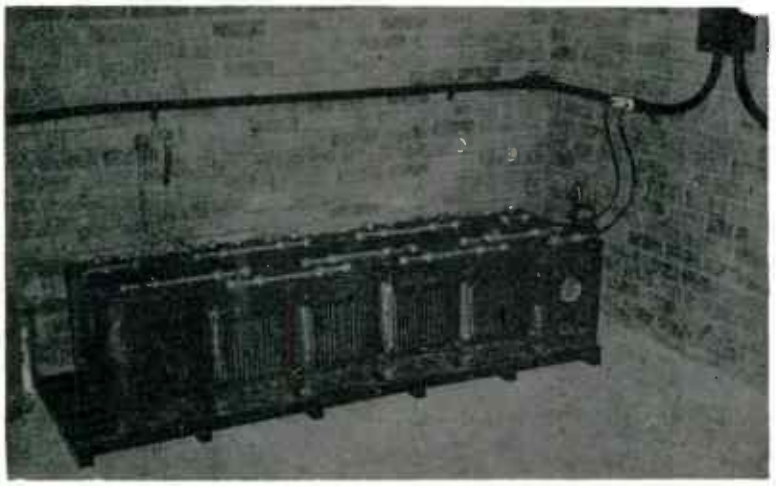


FIG. 3. STORAGE BATTERIES FOR THE 24-VOLT POWER SUPPLY

However, it was apparent that even 250-watt transmitters at our fixed stations could not cover all the mountainous areas. Considering our problems from the point of view of cost and practicability, then, we decided to install 250-watt FM transmitters at our fixed stations to cover the major part of the area to be served, and to increase the power of the projected FM relay transmitters for talking to the cars to 50 watts. Then they would fill in the areas which do not have fixed station coverage.

In a discussion with Fred Budelman, chief engineer of Link Radio Corporation, he suggested designing and wiring the automatic relay transmitters for 2-way operation, but installing only the units needed to pick up car signals and relay them to the corresponding fixed station. Then, when our fixed stations are changed over to FM transmission, it would only be necessary to add receiver and transmitter chassis at the relays in order to handle signals from the cars to the main stations, thus completing the circuit.

This suggestion was acceptable to the Virginia Department of State Police, and the relay installations were so designed.

The First FM Relay ★ The first of our relays,

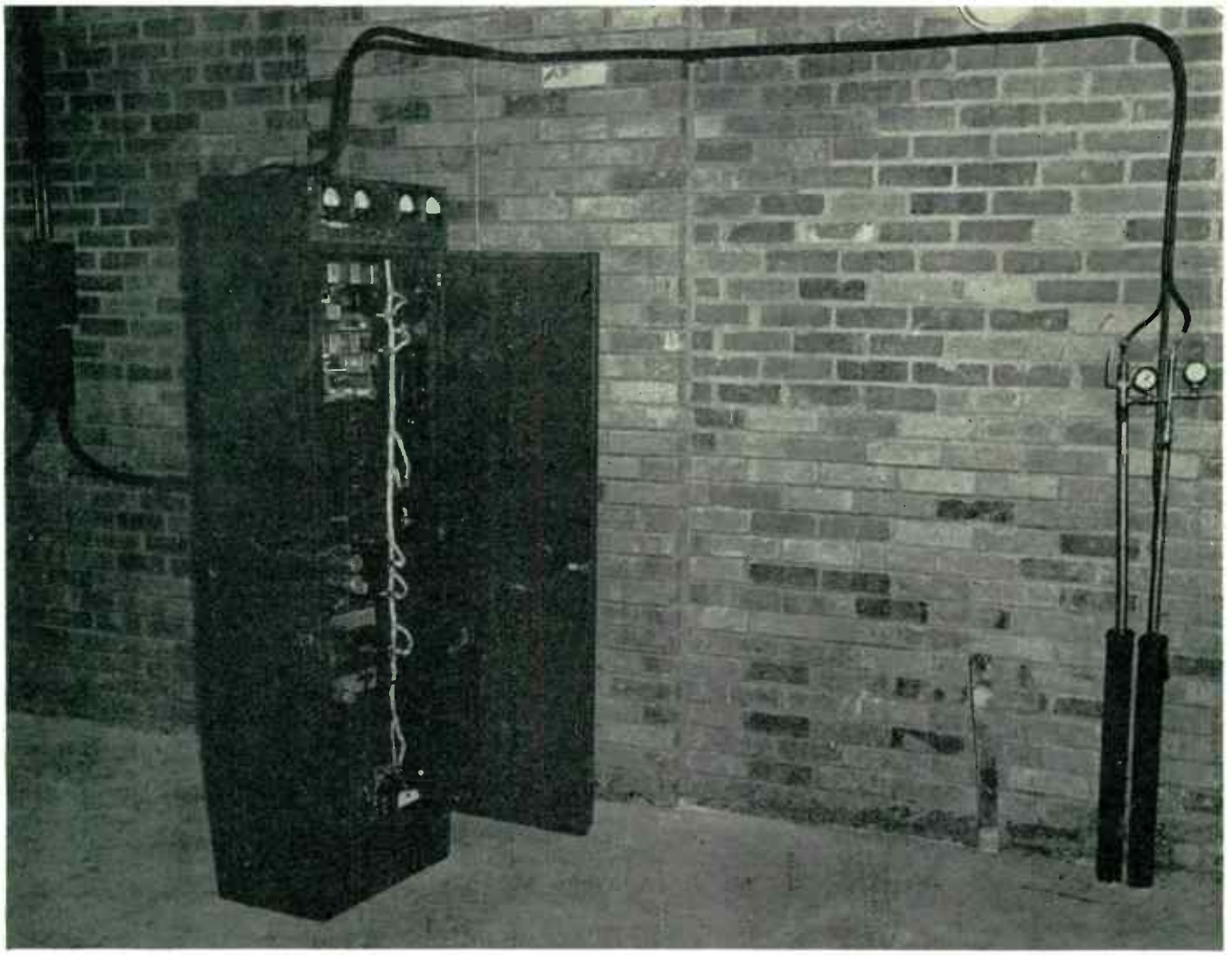


FIG. 4. THE 35.78-MC. FM RECEIVER AND 116.55-MC. TRANSMITTER. THE 2-WAY UNITS WILL FILL CENTER SPACE

the one on Poor Mountain, in Montgomery County, is now in operation, and is illustrated here.

Because of the severe weather at the projected mountain-top locations during the winter months, work could not be started until the spring of this year. At the Poor Mountain site, an elevation of 3,960 ft. approximately 15 miles air-line southwest of the city of Roanoke, antennas were installed by our Tower Superintendent, B. F. Vick. This was done in March. Then, in April, the Wincharger Corporation sent their service engineer, Karl Rahm, to Poor Mountain to assist Mr. Vick with the installation of the wind-driven generator and its supporting tower. These are shown in Figs. 5, 6, and 7.

FIG. 5. TRANSMITTING AND RECEIVING ANTENNAS MOUNTED ON FIRE TOWER

The first FM repeater equipment, ready for 1-way operation from the cars to the main station at Wytheville, was brought down by Link engineer William McFarlin on May 22, 1945. Tests were started on May 25th. The performance came up to our expectations, based on the original survey, in every respect. In all probability, the other relays, at High Knob in Wise County and at Hog Back Mountain in Rappahannock County, will be in operation by the time this account is published. The following data on the relay installations is of special interest because it shows how, after the most careful consideration, means and methods were planned to assure continuous operation under all weather and operating conditions, to cut in emergency devices, and to notify the main station of such a change.

The map in Fig. 2, showing the western part of Virginia where the Poor Mountain relay is located, illustrates the conservative coverage, based on a careful analysis of the field tests. However, in practice, it is commonplace to talk to Wytheville via the relay at a distance 100 miles from the relay.

Relay Power System ★ After it was decided to use battery power, it was necessary to determine the requirements as to battery capacity and voltage, and charging facilities. A 24-volt (nominal) system was chosen for several reasons.

First, it would allow the filament heater power to be taken directly from the battery bank with no conversion loss. This would be possible, of course, with a 6- or 12-volt system, but not with 32 volts. Second, more efficient power conversion could be obtained in the dynamotor and power supplies because of the decreased copper loss. Third, since the same number of batteries would be required in any case, the series connection meant lower currents and lower losses in general.

The steady power drain of the radio repeater is approximately 100 watts for each direction of operation. It was decided to base the power system on a 1-way repeater and then duplicate the power supply when the complete 2-way repeater was put in service. This would provide the maximum factor of safety. A drain of 100 watts represents a monthly power requirement of 72 kilowatt-hours plus the additional load caused by the intermittent operation of the carrier-operated repeater transmitter. To provide this power, a newly-developed Wincharger was selected which has a capability of 100 kilowatt-hours per month under the average wind conditions assured at the locations chosen. The 450-ampere-hour battery bank, Fig. 3, has sufficient storage capacity to run the radio equipment for approximately 5 days in case of a prolonged spell of low wind velocity, although this is not likely.

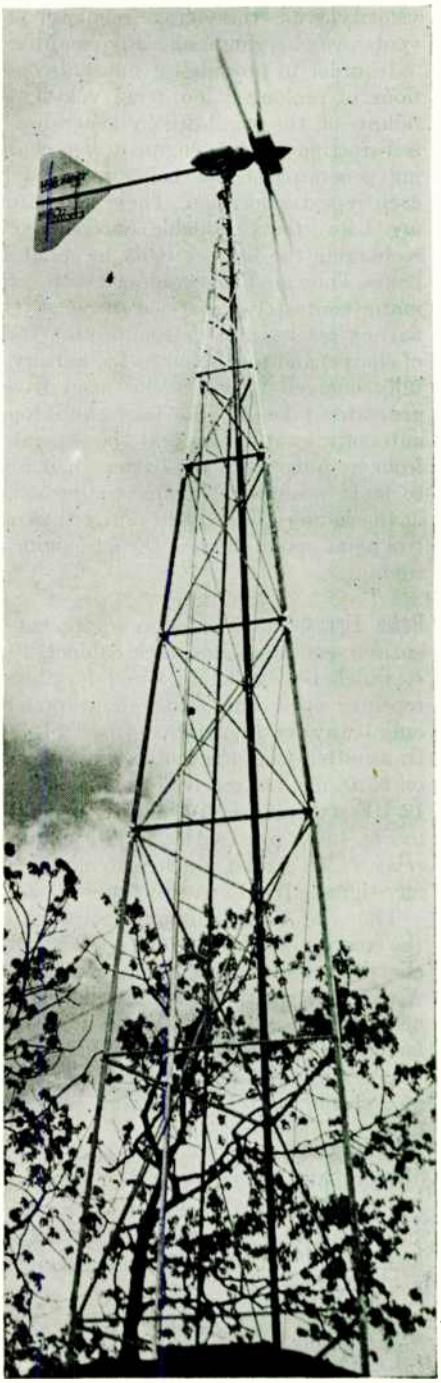


FIG. 6. A SPECIAL TOWER CARRIES THE WIND-DRIVEN GENERATOR

The wind-driven generator, Fig. 6, has a maximum charging rate of 35 amperes. It is prevented from exceeding that value by an automatic speed regulator built into the 12-foot, four-bladed propeller which "feathers" two of the blades to prevent

excessive speed. The output of the generator is voltage-regulated at 28 volts so as to automatically control the charging rate to that required by the batteries. The high maximum charging capability makes it possible to completely charge the battery in less than a day of good wind velocity, while the voltage regulator prevents overcharging under any conditions.

In order to provide for unusual conditions of prolonged low wind velocity or failure of the wind-driven generator, a self-starting gasoline-engine-driven charging generator is also being installed at each repeater location. These generators are 1-kw. units, capable of completely recharging the battery bank in about 12 hours. They are being equipped with automatic controls so as to start when the battery reaches a predetermined low state of charge, and to stop when the battery is fully charged or when the wind-driven generator takes up the load. Additional automatic controls prevent the generator from running down the battery if it fails to start promptly. Means are provided in the radio equipment to notify the control point operator when the gas engine is running.

Radio Equipment ★ The radio equipment is entirely contained in a rack cabinet, Fig. 4, which is completely wired for 2-way repeater operation, although at present only 1-way operation is being used. Signals transmitted from the mobile transmitters on 35.78 mc. are received on a Link type 12-UF receiver, second chassis from top in Fig. 4, equipped with a carrier-operated relay which can be adjusted to operate at any signal strength over 0.2 microvolt.

The vibrator plate-power supply for the receiver is located on the power supply chassis, near the bottom of the cabinet. A vibrator type power supply was chosen because of its efficiency and because similar units have demonstrated reliable continuous life of about 3 months. Servicing is a simple matter of plugging in a new unit, an important factor in a location where servicing facilities are meager.

The Link-type 15-FMR relay transmitter, the top chassis in Fig. 4, operates on 116.55 mc., and has a rated carrier output of 15-watts. It is normally in the standby condition, with the vacuum tube heaters energized but no plate power applied. When an incoming signal is picked up on the 35.58-mc. receiver, the carrier-operated relay starts the dynamotor plate supply for the relay transmitter. The dynamotor can be seen on the lower chassis in Fig. 4. The audio output of the receiver is used to modulate the relay transmitter so as to repeat the car signal to the control point.

The blank spaces in the rack are wired to take a second receiver, transmitter, and power supply. The receiver will be on the relay frequency, probably 156 mc. It will pick up the signals from the operator at the control point, or main station, for rebroadcasting to the mobile units. The output of this receiver is coupled

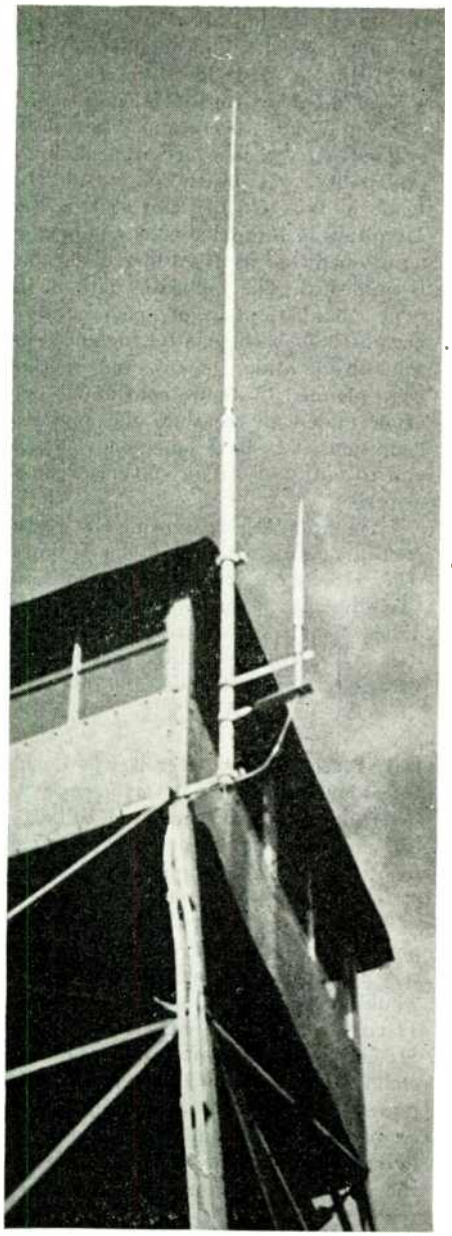


FIG. 7. CLOSE-UP OF THE ANTENNAS AND LEADS FOLLOWING TOWER POST

to a 50-watt transmitter operating on the car frequency of 35.5 mc. The second power supply chassis is identical to the one already installed and shown in Fig. 4.

Carrier-operated control is not used in the case just described, because of the possibility that an unauthorized signal on the relay channel might turn on the 35.5-mc. 50-watt transmitter and block a main police radio channel. Instead, this repeater transmitter can be energized only by the simultaneous transmission, with the voice modulation, of an inaudible, accurately-controlled tone signal over the relay link. In this manner the 35.5-mc. relay transmitter can be controlled by the fixed stations of this system only.

Repeater Control Circuits ★ Beside the transmitter control facilities already described, means are provided to notify the main station operator when the gas-engine generator is running at the relay station so that some record of gasoline consumption can be kept to facilitate servicing operations. This feature consists of a low-level tone which is turned on whenever the gas-engine is running and which is heard in the background of the repeater whenever a car talks to the operator through the repeater station. By making proper notations in his log, the operator can determine the approximate gasoline consumption.

For the convenience of the service personnel, a handset is provided and switching coordinated at the relay so that the servicemen can plug in the handset and talk 2-way with either the mobile units or the main station operator by merely throwing a single selector switch. In addition, a pair of headphones is provided with one earphone bridged across each repeater direction so as to monitor 2-way conversations between the main station operator and a mobile unit without interrupting the circuit.

The complete repeater has been thoroughly tested in 2-way operation, but will be operated as a 1-way unit until the time comes to fit this extra service into the overall program.

Antennas ★ The antennas used in the Poor Mountain installation are shown in Figs. 5 and 7. Two coaxial antennas, one for 35.58 mc. and one for 116.55 mc., are mounted on the fire-control tower. Gas-filled coaxial line is run down the tower leg and underground into the radio building. Fig. 4 shows the two lines entering through the floor. At a convenient point, the lines are terminated in gas tight fitting and coupled to flexible coaxial cable which connects to the radio equipment.

The success of this installation has attracted much attention, and it is undoubtedly the forerunner of a great many more for various communications purposes.

HOW TO TELL WHEN YOUR SUBSCRIPTION EXPIRES

You can always tell when your subscription expires by looking at the mailing wrapper. Adjacent to your address is a number, indicating the expiration date. For example, 7/47 indicates expiration with the August, 1947 issue.

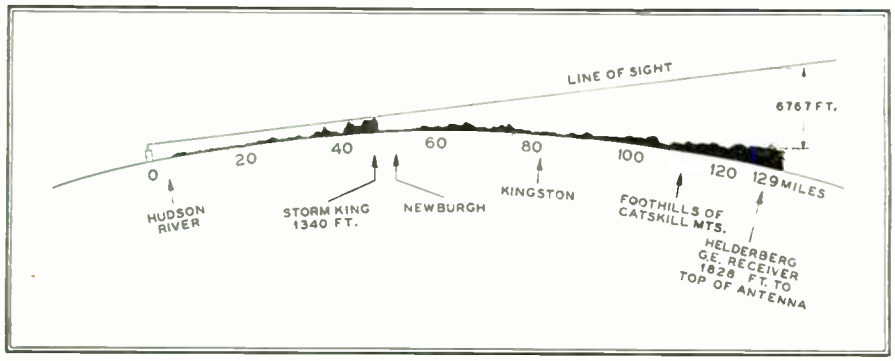


FIG. 36. CONTOUR OVER THE LINE-OF-SIGHT FROM NEW YORK TO THE RELAY RECEIVER

DETAILS OF TELEVISION STATION WRGB

Part 4. Radio Relay Facilities for Direct Pickup of Programs Originating in New York City

BY JAMES D. McLEAN *

DURING the past five years, station WRGB has regularly broadcast television programs originating at WNBT in New York City. Hundreds of air-raid wardens in the Albany-Troy-Schenectady area were trained during the early months of the war by the films and demonstrations broadcast by the New York station and relayed to Schenectady. The Capitol District audience has seen the Easter Parade on Fifth Avenue, the circus, rodeo, hockey games, and wrestling matches televised at Madison Square Garden, the V-E Day celebration in Times Square, as well as many film and live talent programs produced in New York City. All these programs were picked up at our relay station in the Helderberg Mountains for rebroadcasting over WRGB.

* Electronics Department, General Electric Company, Schenectady, N. Y.

Performance ★ General Electric's television relay station is located on a 10-acre plot

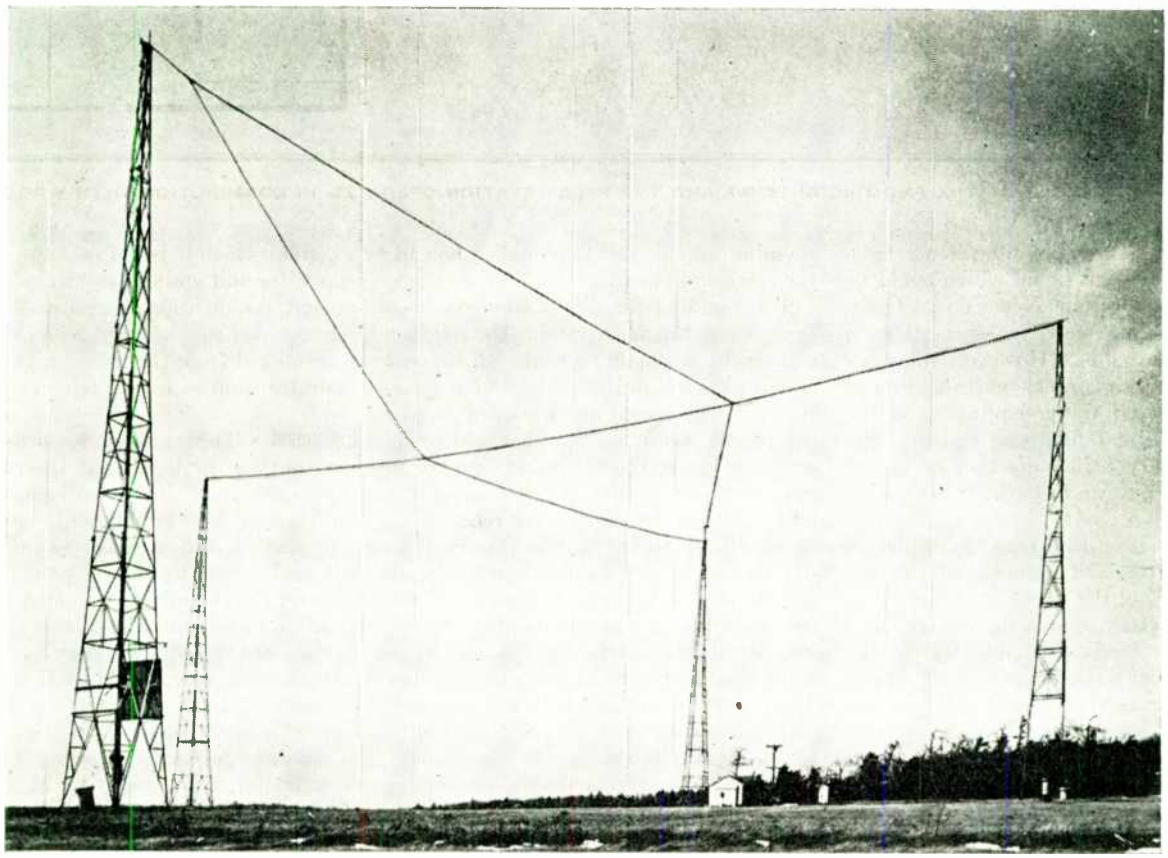


FIG. 37. THE RHOMBIC ANTENNA FOR PICKING UP TELEVISION STATION WNBT, NEW YORK, AT THE RELAY STATION

1½ miles southwest of the main WRGB transmitter in the Helderbergs, outside of Schenectady. Fig. 36 shows the path of the television signal from New York to Schenectady. It will be noted that the relay station picks up the direct transmission from WNBT in New York, 129 miles away, with a receiving antenna located 6767 ft. below the line-of-sight.

Even though the relay station is more than a mile below the line-of-sight, good signal strength is obtained with relatively little interference. The location of the relay station was chosen, after a number of field tests, particularly because of the cause reception difficulty over the network circuit.

Details of the Installation ★ Fig. 37 shows the building and the receiving antenna. The receiving antenna system is a rhombic 180 ft. on each side, and supported by four 128-ft. towers. This antenna is 9 wavelengths long at 58 mc. and shows a gain of 20 db over a standard dipole from 50 to 66 mc. It is used for receiving both picture and sound signals from WNBT in New York.

Fig. 38 shows the plan of the radio relay station which is comprised of the large rhombic antenna and the building housing the relay equipment.

The building for this station contains two rooms. Room 1 contains the relaying equipment A and an oil heater B. Room 2 is a workshop, and provides living quarters for the operators. Included in the equipment room is the video and audio receiving apparatus, operating on 50 to 56 mc., and fed by the large rhombic antenna. Also, a standard or cue receiver for monitoring input signals is provided, as well as a monitor for the outgoing picture signals, and audio amplifiers and controls for transmitting the audio signals which are picked up at the relay station to the main WRGB transmitter over wire lines. A 10-watt video transmitter with automatic frequency control is also located in the equipment room.

As will be seen from the block diagram in Fig. 39, the incoming picture signals from New York are picked up by the receiver and converted, without demodulation, to a carrier frequency of 163.25 mc. This is television channel operating on 162–168 mc. It is amplified in the 10-watt visual transmitter and the signal is then carried to the top of one of the rhombic antenna towers by means of a coaxial transmission line. At the tip of the tower the signal is fed into a small antenna, consisting of a dipole and driven director of large diameter, which beam the picture signal to the main WRGB transmitter, 1½ miles away.

At the main transmitter the picture signal is picked up by a corner reflector antenna similar to the one shown in Fig. 27, from which it is fed into the receiver-converter unit and the 40-kw. video transmitter. As mentioned above, the sound signals, picked up from New York, are transmitted from the relay station to the main transmitter over a telephone line.

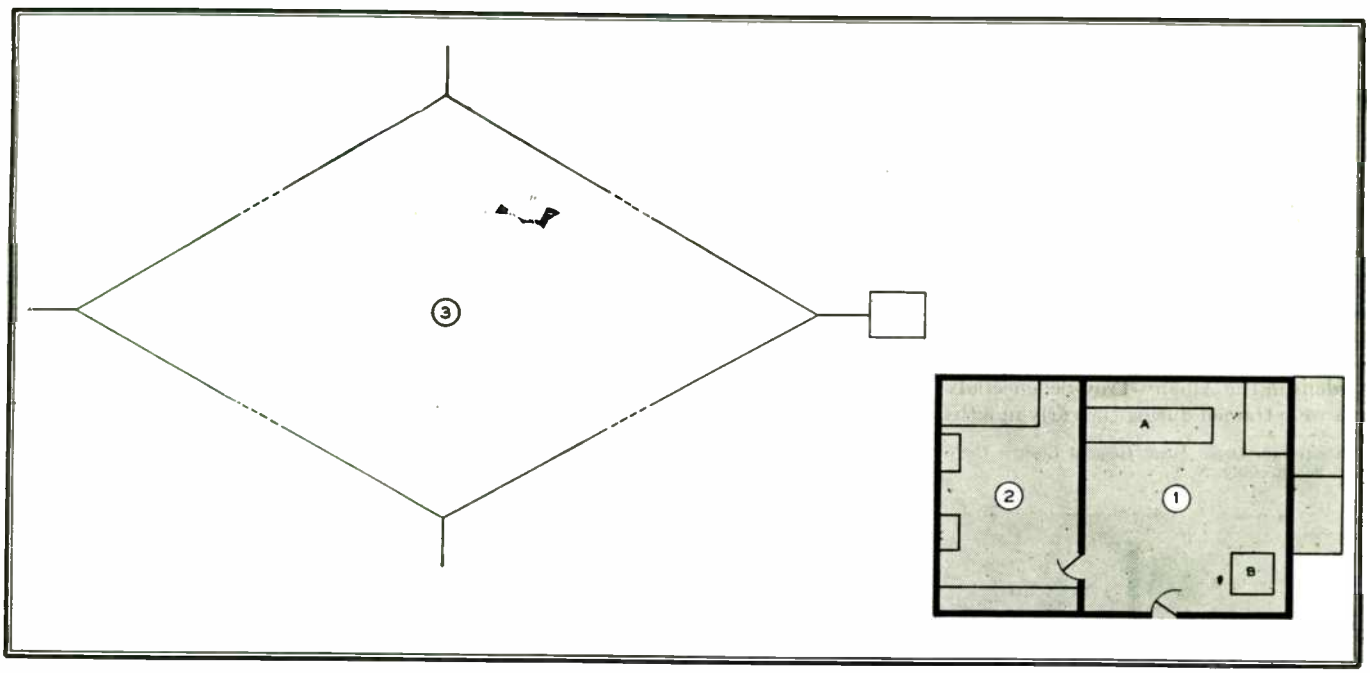


FIG. 38. LAYOUT OF THE RHOMBIC ANTENNA AND THE RELAY STATION OPERATED IN CONJUNCTION WITH WRGB

absence of man-made interference, and the relatively high signal which could be received there from New York. Occasionally interference is experienced from diathermy machines. However, the most serious sources of interference have been static produced by precipitation in the winter time, and lightning static in the summer. Very little reflection or ghosts resulting from multi-path transmission have been observed.

Over a period of a year, good picture signals are received without interference at least 85% of the time.

Unsatisfactory signals, marred by static sources, are received about 10% of the time, and poor reception of picture signals during the remaining 5% of the time is due to fading. During the winter months practically no fading is experienced, and in general the only interference comes from either diathermy machines or precipitation static. In the summer, lightning disturbances and some fading occasionally

Equipment ★ The receiving, monitoring, and transmitting equipment at the relay station are shown in Fig. 40. All equipment is built on standard rack-mounted panels for ease of maintenance and accessibility. The left rack, from top to bottom, carries a receiver for picking up standard FM programs, a three-gang FM-AM receiver, and a standard television on receiver. The second rack carried the FM audio receiver for television sound, the video receiver, master oscillator-multiplier unit, and a group of power supplies. The third rack contains a standard FM receiver, the transmitter power-amplifier unit, converter-amplifier unit, AFC unit, crystal oscillator-multiplier unit and power sup-

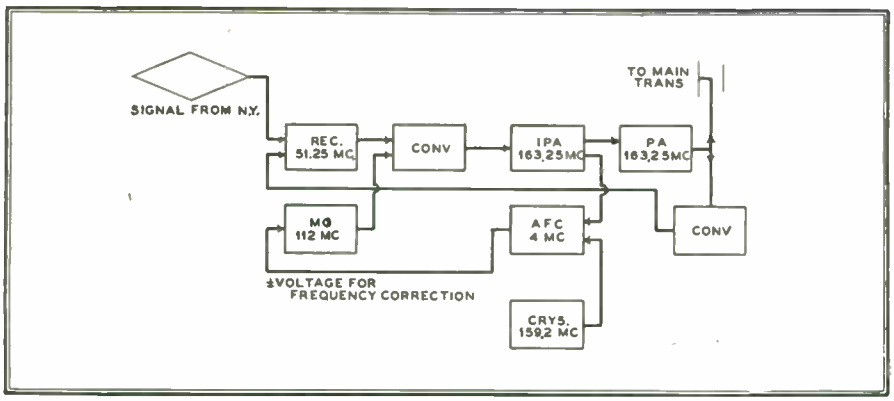


FIG. 39. BLOCK DIAGRAM OF THE VIDEO SIGNAL RELAY INSTALLATION

plies. The fourth rack is for monitoring equipment and contains the frequency monitor, visual picture and wave-form monitors, and switching and power-supply units. The right hand rack contains the audio equipment.

Future Plans ★ Five years of experience at this relay system have proven the feasibility of network television operation. It is recognized that, while this television relay system is reasonably successful, and delivers pictures of good quality to receivers in the surrounding area, it represents only a portion of a complete program of investigation in this field. As is the case with many fields of civilian enterprise, this development project was stopped at the time of Pearl Harbor. It is planned to resume the full investigation of all factors involved when engineering time and equipment become available again. For example, the General Electric Company, in cooperation with the International Business Machines Company, has already received permission from the Federal Communications Commission to install a new microwave radio relay system between New York and Schenectady which will operate in the 2,000-mc. region.

This new network will not only carry television programs simultaneously in both directions, but will also provide channels for high-fidelity sound, for business machine services, and radio-photo or facsimile. Experimental tests of the equipment for this new network are already under way. This and similar microwave radio relay networks will be built just as soon as manpower and materials can be made available. They are planned for the wide distribution of television programs, and will solve one of the problems that has faced prospective television broadcasters.

EDITOR'S NOTE: This series appeared in the issues of November and December, 1944, and January, April, and July, 1945.

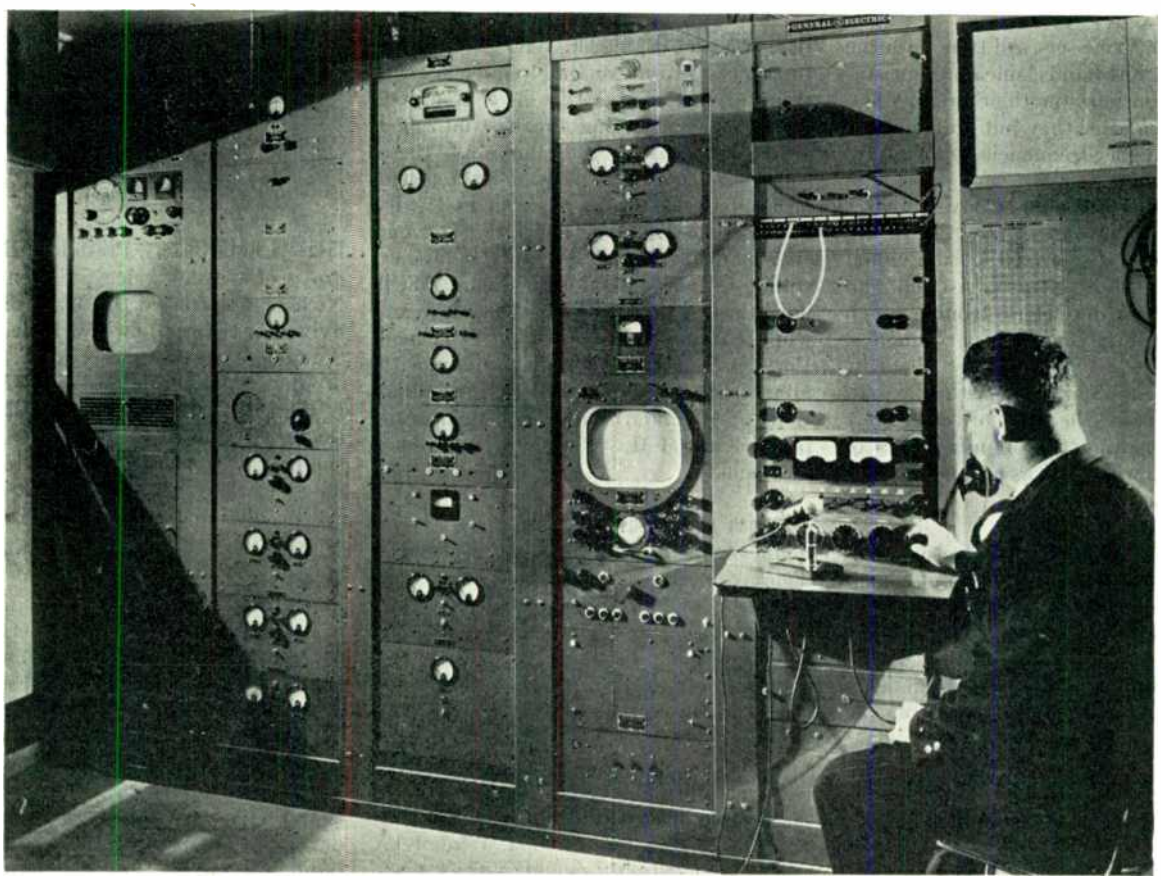


FIG. 40. RECEIVING, MONITORING, AND TRANSMITTING EQUIPMENT THROUGH WHICH WNBT SIGNALS GO TO WRGB

SPOT NEWS NOTES

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

FM Licensees Meet: On July 6th, licensed manufacturers of FM transmitters and receivers met at the Waldorf-Astoria to discuss and exchange views on matters concerned with expediting the expansion of FM broadcasting service. The FCC would have been amazed to see how swiftly it is possible for a group to act when it is composed of men whose common purpose is to arrive at the right answers.

Those attending were: Arthur Freed, Freed Radio, chairman; Bell Laboratories, W. H. Dougherty; Fada, D. P. Brand and Leo Galanek; Freed Radio, Murray Weinstein and Paul Nachemson; Garod, B. S. Trott; General Electric, W. R. David and I. J. Karr; Hallicrafters, C. T. Read; Link Radio, William Fingerle; Meissner, Lawrence Carver; Pilot, L. C. Shapiro; REL, Frank Gunther; Stewart-Warner, E. R. Rutledge; Stromberg, B. P. Shiro, H. C. Sager, and Ben Gross; Templetone, Dale Pollack; Western Electric, L. F. Bockoven. Guests were Major Armstrong, Comdr. deMars, C. M. Jansky, Jr., Myles Loucks, I. B. Robinson, and Milton B. Sleeper.

Following are the highlights of the all-day conference:

Two FM Bands: New sets will tune both the new and old FM bands, since present stations will continue on their present frequencies even after they put on transmission at the higher frequencies.

Thumbs Down on Converters: Converters are not recommended unless they are of designs specifically approved by individual set manufacturers. Reason is that an added oscillator may cause trouble which would give unsatisfactory performance, and prejudice listeners against the new frequencies, as compared with the old. (FCC proposed the use of converters without consulting the manufacturers of the sets with which it was proposed to use these interim devices.)

New Bands for Old Sets: No decision was reached concerning the problem of changing present sets so that they can tune the new frequencies.

New FM Transmitters: There will be no delay in delivering FM transmitters of 250 watts, 1 kw., 3 kw., and 10 kw., since suitable tubes are in production. However, the output stage at 10 kw. will be of "interim" design because it will be advisable to replace the output tubes now available with improved types which are under development. It may be two years before tubes will be ready for 50-kw. transmitters. Meanwhile, applicants for such stations can start at lower power, and add a high-power stage when the equipment is ready.

Cost of transmitters for 88 to 108 mc. will be slightly higher than for 42 to 50 mc., but the antennas may be a little cheaper.

Transmitter Drift: Experience with phase shift FM transmitters on 42 to 50 mc. showed that drift could be held to 200 cycles. It is expected that drift at 88 to 108 mc. will not exceed 400 cycles.

FM Signal Generators: There is an urgent need for FM signal generators calibrated down to 1 microvolt at 100 mc.

Receiving Antennas: Finally — the only point on which there was definite disagreement was on receiving antennas, some holding that the higher frequencies favor the use of built-in antennas, while others insisted that, since dipoles of conveniently small size can be used, every set should be sold with an outside antenna to assure maximum signal pickup and best performance.

Head-Scratching Department: Who gave orders to the FCC to move FM frequencies upstairs? Surprisingly, this is a complete mystery, even among the best-informed grapevine sources. But none of these sources think that the decision was reached on the basis of testimony from FCC witnesses. Some opinion holds that former chairman Fly resigned because he wasn't willing to take orders on this point. We'll have the answer one of these days. Meanwhile, attention is focused on Chairman Porter's June 29th promise to move with all possible speed to revise present regulations and standards of good engineering practice for FM, television, and home facsimile.

Television Applications: According to an announcement from the FCC on June 29th: Television applications for particular channels should be prepared in accordance with the new method now prescribed in the television standards, providing for an interpolation by using the several charts incorporated therein. A chart for 300 mc. is now available from the Commission upon request. Applications now pending for Commercial television stations may be modified for particular channels in accordance with this method. While television applications should specify particular channels and coverage, the Commission in passing on applications may not be able to assign the channel requested.

Wanted: Copies of *FM* Magazine for November and December 1940, and February 1941, or the first bound volume containing issues from November, 1940 through April, 1941, by Miss Alice Clasen, Librarian, J. P. Seeburg Corporation, 1500 Dayton Street, Chicago 22.

Not So Good: It was bad enough when the chief engineer of one of the net works, testifying that his company agreed with the Norton theory of intolerable interference on the lower FM frequencies, stated that he was in the best position to give an unbiased opinion because his company did not operate any FM transmitters (and therefore had no experience with FM propagation). However, it was surprising that the No. 1 man of the ARRL would be so unsportsmanlike as to testify that the amateurs' experience proved the band from 56 to 60 mc. to be so erratic that it was an experimenter's paradise, and therefore unsuited for commercial broadcasting, without explaining to the Commissioners, who wouldn't know otherwise, that this statement was based on the use of AM flea-power equipment, the performance of which could not be compared with FM broadcast transmitters. That kind of smoke-screen testimony isn't in keeping with amateur ethics.

1945—46 RMA Officers: President, R. C. Cosgrove of Crosley; vice presidents, E. A. Nichols of Farnsworth; M. F. Balcom of Sylvania; George Lewis of Federal; R. C. Sprague of Sprague Electric; T. A. White of Jensen; Treasurer, Leslie Muter of L. F. Muter. After the election, RMA gave the smaller member companies a kick in the pants by passing a resolution recommending that WPB should not authorize any production of home radios in the third quarter.

Railroad Radio: The electronics division of Maguire Industries, Inc. has been authorized by the FCC and WPB to install radio equipment for experimental tests on the Reading Railroad. The tests will cover operation in the 152– to 162– mc. band for freight yard, terminal, and end-to-end communications. Maguire officials say that this Company will specialize in the development and installation of railroad radio systems.

(CONCLUDED ON PAGE 71)

The FCC Hearing on FM Frequencies

June 22nd and 23rd, 1945

"We've called you here," the Chairman said,
"To help choose Number Three.
We've reached this point by Multipath
(Astrophysicalee).

"We want no economic facts
The records to encumber.
This hearing is a high-low game.
Just pick a sunspot number."

Then K. A. Norton took the stand
And, frigid like an iceberg,
Declared, "I've heard from Istanbul,
A wire signed *Doctor Gleissberg.*

"Herr Doctor Gleissberg wires: *I guess*
My guess two years ago
Is just as good a guess today
As any guess I know.

"I cite the ancient records of
The Zurich registrars
And, if that fails, add ten percent
And turn to Page on stars.

"Page says, when Neptune's half-way round,
Uranus sets the pace —
That's V-Day (V Sporadic E)
If Saturn stays in place."

The Chairman said, "We do commend
Your astro-engineering.
Should these exhibits go to the
Museum or this hearing?"

Full many witnesses were heard,
And each a silly fool,
For none refuted Page on stars,
Or the Doc from Istanbul.

The Chairman said, "The polls are closed.
'Tis a famous victoree;
For the hottest sunspot cycle yet,
We now choose Number Three.

"We'll keep FM on Layer F
Till 'Gene stops sending wires[1],
Till the Major's patience disappears,
And his patent right expires.

"Until the sun shall lose its spots
In the music of the spheres —
Till then this hearing stands adjourned
For another eighty years[2]."

---

[1] Chairman Porter had previously reproved Comdr. E. F. McDonald, Jr., president of Zenith Radio, for sending telegrams to members of Congress, and complained that any comments about FM frequencies should have been expressed in person at the previous hearing. However, at the hearing on June 20 and 21, executives who attempted to discuss significant economic factors or the views of their engineering departments which favored Alternative No. 1 were promptly asked to qualify themselves as propagation experts, and were told by the Commissioners that any opinion opposing Alternative No. 3 must be supported by propagation data.

[2] K. A. Norton prophesied that there will be an extreme sunspot condition in 80 years which would practically wipe out FM broadcast service on 50 to 60 mc.

WORD PICTURE

THE final allocation for FM broadcasting was based on the testimony of K. A. Norton, the FCC's so-called expert witness whose errors the Commissioners have consistently concealed or refused to consider, although his conclusions were at variance with those of propagation experts who are qualified by scientific knowledge and years of practical experience. However, the Commissioners readily accepted testimony from witnesses who agreed with Norton's conclusions, without asking them to qualify as propagation experts, even though their statements obviously reflected personal bias.

In this connection, it is interesting to recall that, in November, 1935, newspapers quoted the FCC's assistant chief engineer at that time as saying: "Major Armstrong's new system (FM) is utterly impractical, and the quest for static elimination must go on."

Of such opinions, and they were shared by others who offered mathematical theories to support them, Major Armstrong wrote (*FM & T*, Aug. 1944): "Anyone who has had actual contact with the making of inventions that built the radio art knows that these inventions have been the product of experiment and work based on physical reasoning, rather than on mathematicians' calculations and formulae."

Thus, to the men who made "the inventions that built the radio art," the FCC's June hearing on FM frequencies appeared to be the farce depicted in the jingle above. We regret that the contributor failed to sign his name.

NEW FM EMERGENCY EQUIPMENT

Describing RCA Postwar Designs for Fixed and Mobile Units

BY H. F. MICKEL*

HEADQUARTERS CONTROL & HANDSET

THE new line of RCA emergency radio equipment for 30 to 40 mc. has been designed to meet the requirements of varying coverage areas, topography, noise levels, and operating conditions. It includes transmitters of different powers but, in the interests of economy and interchangeability, they are of the same basic design. Also, the receivers provided for mobile operation and for fixed stations use are essentially the same in either table mounted or rack mounted form. In this way it is possible to increase production runs, reduce costs, and provide interchangeable units, all of which work out to the advantage of police and other emergency services.

Thus the new RCA line is made up of 30- and 60-watt mobile transmitters; 30-, 60-, and 250-watt fixed station transmitters; and mobile and fixed station receivers, together with the necessary appurtenances to provide complete operating units and systems.

Many new developments have been incorporated in the equipment designs. In the transmitters, a positive modulation threshold limiter compensates for variations in the voice levels of different operators and insures 100% modulation at all times.

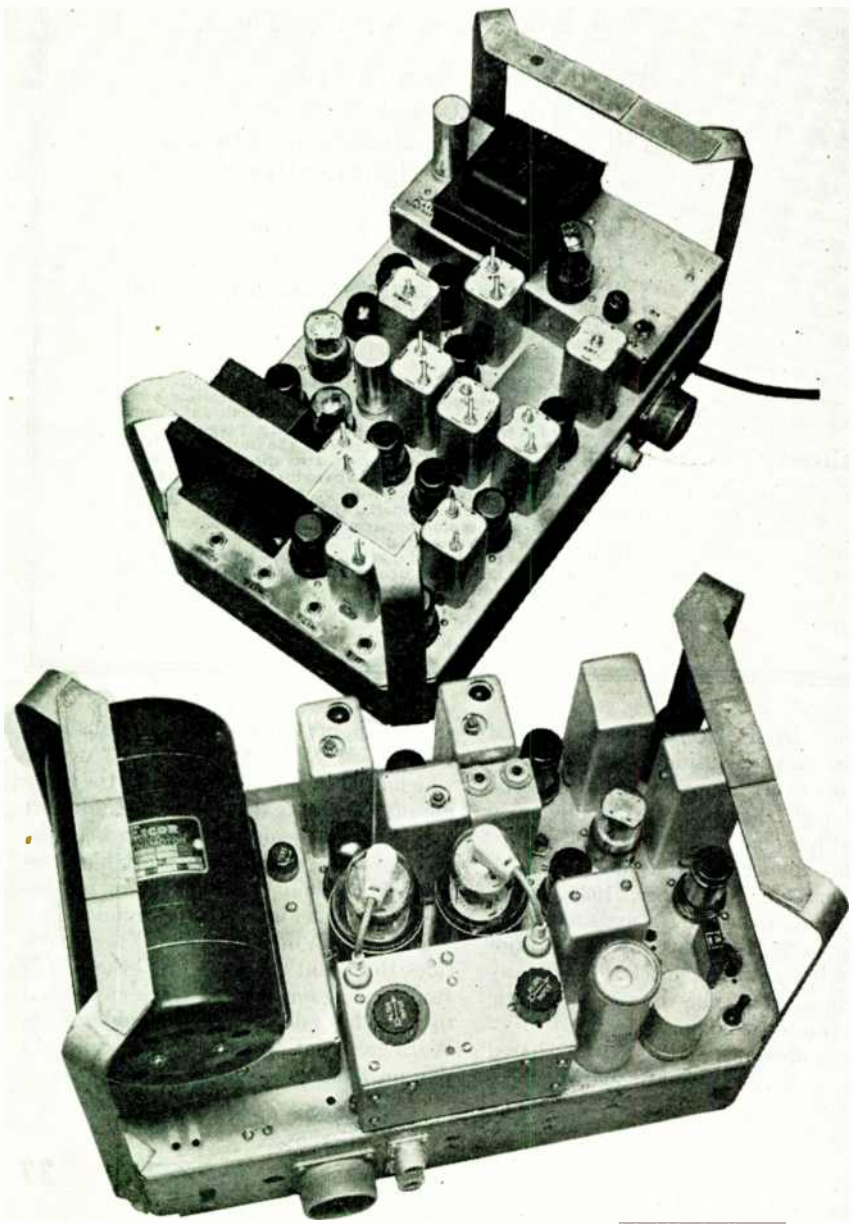
The modulation circuit is of an improved phase type which requires no tuning over the entire range of the equipment. This makes for improved quality, and is particularly valuable when 2-frequency operation is employed. In the ordinary phase modulation circuit, a shift in oscillator frequency results in impaired quality if the modulator is not retuned. The fixed-tuned modulator in the new RCA apparatus removes this objectionable feature.

Another feature of the new RCA transmitters is the fact that the ratio of carrier frequency to crystal frequency represents a multiplication factor of only 18 times. This results in low spurious emission, with all harmonic radiation at least 60 db down over the entire frequency range. With this equipment there are no more worries about interference on nearby channels due to spurious emission.

Although FM equipment has many advantages for the emergency services, the actual quality of reproduction of such systems has, in the past, resulted in considerable justified criticism. Much consideration has been given to this factor in the design of this equipment. Proper compensation to give true phase modulation response with an overall transmitter distortion of less than 10% at 500 cycles with ±15-kc. swing results in crisp, intelligible, lifelike quality. You don't need to guess who is on the mike — you can recognize his voice as soon as he comes on the air.

Furthermore, you can be sure that all transmitters are operating at maximum efficiency because they are all "on frequency". A simple adjustment tunes each transmitter to the exact, specified frequency. This is done without manipulating the crystal or crystal holder.

Provision is made in all transmitters for the addition of a second crystal and frequency transfer relay. This permits 3-way operation when the main station and the mobile units are on different channels.



ABOVE: FM RECEIVER HAS 3 WATTS OUTPUT, USES ONLY 4 TUBE TYPES
BELOW: 60-WATT MOBILE FM TRANSMITTER. NOTE EASE OF ADJUSTMENT

*Manager, Emergency Communications Section, RCA Victor Division, Camden, N. J.

The mobile transmitters are of compact, single unit design, ruggedly constructed to withstand the rigorous service they encounter, as evidenced by the fact that they pass the exacting humidity and temperature tests, ordinarily reserved for military units, with flying colors.

The family of receivers includes mobile units with either vibrator or dynamotor power supply, and rack-mounted or table type 115-volt AC station receivers.

Here again, particular attention has been given to quality of reproduction. Less than 10% distortion with 3 watts output in mobile units, and higher power in fixed station receivers, combined with correct audio response, result in faithful, lifelike reproduction. And 3 watts audio output with low distortion in mobile units is worthy of mention. High speed traffic noises are easily overridden. This is accomplished with low power drain through the use of a Class "B" output stage.

Spurious and image response reach a new low in this receiver, being an average of 60 db down over the entire range. Superior adjacent channel selectivity is a feature of genuine importance.

Only one crystal is used in the new RCA receiver, resulting in economy and reduced service worries. Furthermore, any change in frequency assignment means only one new crystal per receiver.

In the operation of any emergency radio system, efficient receiver squelch action is an absolute requisite. Each receiver must remain mute when no signal is on the air but must be ready to accept a transmitted message. Under varying noise conditions this becomes a real problem. If the ordinary squelch adjustment is set to accept weak signals it may be opened by bursts of noise. Conversely a tightly set squelch may exclude weak but useable signals. The answer, therefore, lies in a squelch circuit which will automatically adjust itself for varying noise levels. In the new RCA receivers the squelch action is regulated by rectifying the noise and using it as a control medium. Accordingly, the squelch setting automatically varies with the noise and the receiver becomes operative on any useable signal.

For maximum flexibility and applicability to various systems requirements, these receivers are provided with three output connections. Two high-level outputs of 500 ohms and 4 ohms are furnished, together with a low-level, 500-ohm, center-tapped output. The latter is primarily intended for remote receiver installations where telephone lines are used to carry the receiver output to the main station. The low-level output eliminates the necessity for padding, and minimizes trouble due to hum.

Only 4 different types of tubes are used in mobile receivers, with one additional for station units. This reduces to a minimum the number of types which must be carried as maintenance stock.

In the design and construction of this new line of equipment particular attention has been paid to the problems of installation and service. The efficiency of a radio communication system depends to a large extent on the ability of maintenance personnel to render prompt service. This means that equipment must be designed for maximum accessability, ease of removal and replacement and with a minimum number of adjustments. Equipment must be easy to install and readily transferable from one unit to another.

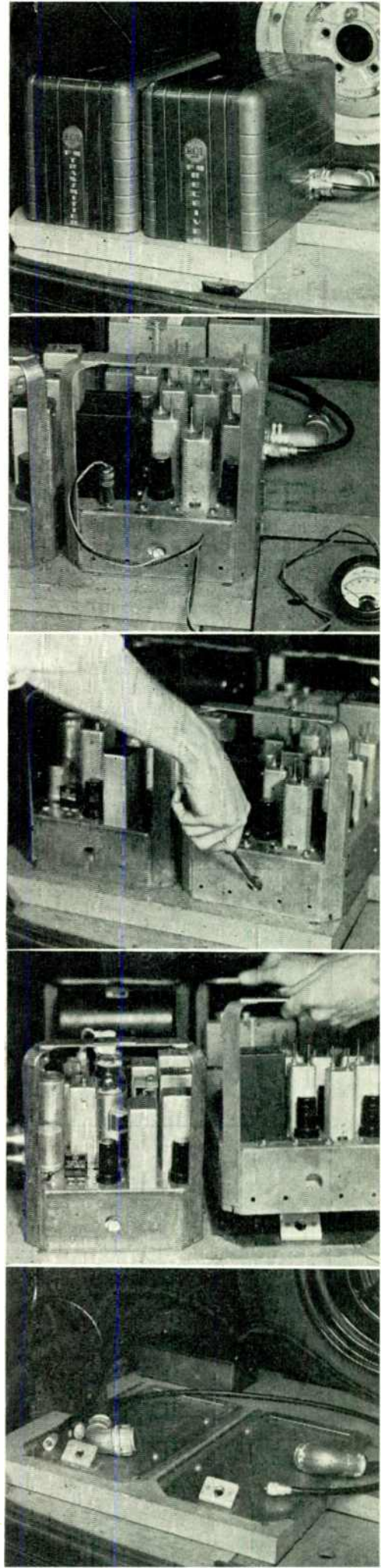
All these factors have been given careful consideration in the new RCA line of equipment. All adjustments of both transmitters and receivers are from the top of the chassis. This permits tuning of equipment without removal from its normal operating position. Metering jacks are provided on transmitter and receiver units to permit simultaneous checking and adjustment of all necessary circuits.

The installation of equipment in mobile vehicles is extremely easy and straightforward, as shown in the accompanying illustrations. Each unit is supplied with a separate base plate, bolted to the deck of the car or truck. The chassis then slides into position and is locked in place by means of a single fastener. One control cable and junction box are used for both transmitter and receiver. All cables connecting to the transmitter and receiver chassis are equipped with positive, A-N screw type connectors. This feature alone eliminates many maintenance headaches and service interruptions.

Each mobile transmitter and receiver is equipped with an attractive cover, with key lock, but with no handles projecting beyond the surface of the cover. This minimizes the danger of equipment damage when spare tires, stretchers, fire fighting tools, or similar equipment are carried in the same compartment with the radio apparatus.

Fixed station equipment is also designed for convenience of installation, adjustment and maintenance. Attractively styled cabinets and cabinet racks are available to house single units or combinations of equipment.

In short, RCA engineers have applied all their vast wartime experience into these units, so that they are truly postwar designs in every respect.



RIGHT, TOP TO BOTTOM: COMPLETE CAR INSTALLATION — TEST JACKS ON CHASSIS — SINGLE FASTENER RELEASES CHASSIS FOR EXAMINATION OR REPLACEMENT — CHASSIS MOUNTING IS BOLTED TO DECK OF CAR

FM BROADCASTING & COMMUNICATIONS HANDBOOK

Chapter 6: Introduction to FM Receivers and Discussion of FM Signal Amplifiers and Limiters

BY RENÉ T. HEMMES

IN THE preceding chapters it has been emphasized that the *amplitude* of an FM signal remains constant during modulation, while the *frequency* is alternately increased and decreased in accordance with the variation of the audio modulating voltage at the transmitter.

It follows that the first requirement to be met in the design of FM receivers is that the detector be capable of giving a change in its output voltage proportional to a change in the *frequency* of the input signal. When an FM signal is applied to a detector that meets this specification, the detector yields an audio output voltage having the same wave form and frequency as the audio modulating voltage at the transmitter.

Elementary FM Receiver ★ An FM receiver, in its simplest form, could consist of such a detector alone, as shown in Fig. 49. Here the input signal causes a voltage to be induced in coil L that sets up a radio frequency current in the tuned circuit LC. The current flowing in the tuning condenser C establishes an RF voltage across this condenser that is applied to the grid-leak and grid-condenser combination R_1C_1 by way of the grid and cathode of the tube. The grid and cathode operate as a diode rectifier and cause a DC voltage to be established in grid condenser C_1 very nearly equal to the amplitude of the RF voltage across tuning condenser C. The

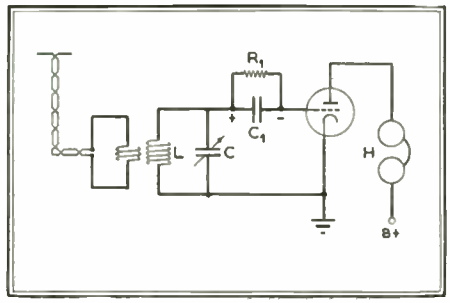


FIG. 49. ELEMENTARY TYPE OF FM RECEIVING CIRCUIT

DC voltage established in grid condenser C_1 acts as a negative bias on the grid of the tube and limits the flow of plate current.

If the amplitude of the RF voltage across tuning condenser C is increased, the negative bias developed across C_1 is increased and the plate current of the tube is reduced. Conversely, if the RF voltage across C is decreased, the bias across C_1 is decreased, and the plate current is increased. Now, if the amplitude of the RF voltage across C increases and decreases at an audio rate, then the bias established in C_1 will vary in like manner. The resulting audio variation of the plate current will cause the diaphragms of the headphones H to vibrate.

In fact, old timers will recognize the FM detector circuit of Fig. 49 as being exactly like that of a non-regenerative grid-leak detector for receiving AM signals. In the case of AM reception, the circuit LC is tuned exactly to the carrier frequency of the AM signal. This insures the maximum RF current flow in the tuned circuit LC and the maximum RF voltage across tuning condenser C. During modulation, the amplitude of the voltage across tuning condenser C is varied because the amplitude of the voltage *induced* in coil L by the AM signal is varied. The detector translates the amplitude variations of the voltage across C into variations of plate current, as previously explained.

For the reception of FM signals, however, the circuit LC is not tuned to exact resonance with the carrier or center frequency of the FM signal. In fact, the circuit LC is detuned until the amplitude of the voltage across C, produced by an unmodulated signal, falls off to about one-half that at resonance. A typical adjustment for the reception of FM signals is indicated at point A on the selectivity curve of the tuned circuit, at the upper left in Fig. 50. In this case, the resonant frequency F_R of the tuned circuit is higher than the center frequency F_C of the signal. It would also be possible to obtain FM detection by tuning LC to a frequency somewhat lower than the center frequency of the signal.

The waveform of the incoming FM signal is shown at the lower center in Fig. 50. Since the detector is responsive to a change in *frequency* of the signal, the frequency of the signal is plotted to the same scale of time, at the lower left in Fig. 50. The curve of the signal frequency variation is then projected upward against the selectivity curve of the tuned circuit, the area of impingement being centered

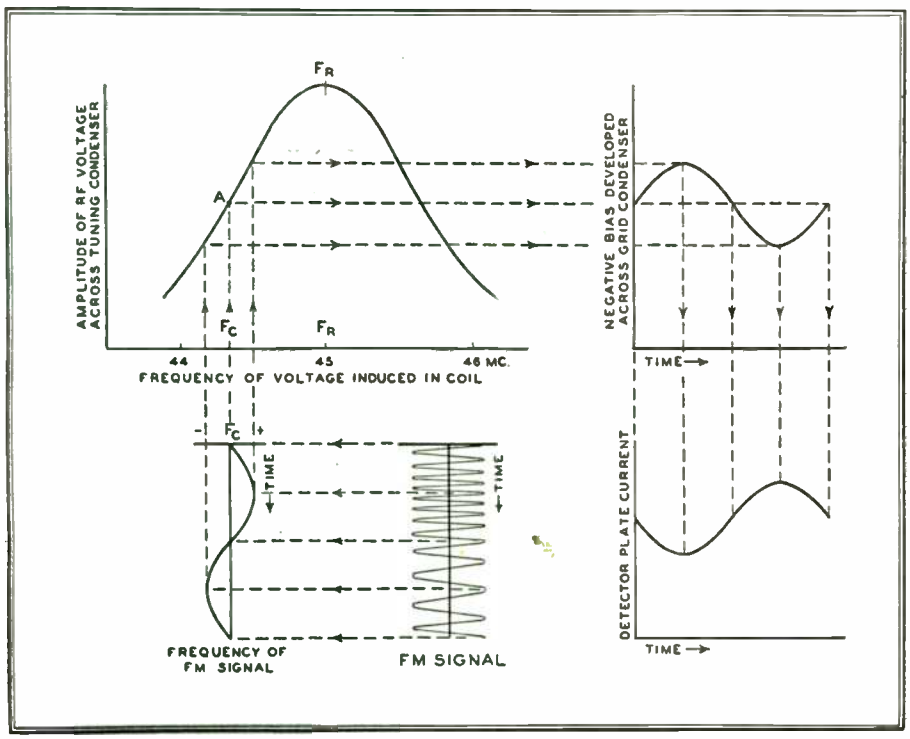


FIG. 50. TUNED-CIRCUIT DETECTION FROM ELEMENTARY RECEIVER, FIG. 49

about point A on the curve in Fig. 50.

It is noted that in the immediate vicinity of point A, the selectivity curve in Fig. 50 is steep and nearly straight. This means that when an FM signal is inducing voltage of constant amplitude but varying frequency in coil L, Fig. 49, the *amplitude* of the voltage built up across tuning condenser C will vary over a wide range, and the change in the amplitude of the voltage across C will be practically proportional to the change in the frequency of the voltage induced in L.

Thus a tuned circuit adjusted to a frequency somewhat higher or lower than the center frequency of an FM signal has the property of translating the frequency variations of the signal voltage *induced* in the coil into amplitude variations of voltage across the tuning condenser. As the frequency of the signal swings toward the resonant frequency of the tuned circuit, the voltage across the tuning condenser increases. As the frequency of the signal swings away from the resonant frequency of the tuned circuit, the voltage across the tuning condenser decreases. By careful adjustments, the amplitude variations of the voltage across the tuning condenser can be made nearly proportional to the variations of the signal frequency. The grid-leak detector converts the changes in amplitude of the voltage across the tuning condenser to corresponding changes in grid-condenser bias, as shown at the upper right in Fig. 50. The changes in grid-condenser bias, in turn, cause proportionate changes in plate current, as shown at the lower right in Fig. 50. Thus a voltage is built up across the load in the plate circuit having nearly the same wave form as the audio modulating voltage at the FM transmitter.

While an FM receiver can thus be constructed with a minimum of parts, it can hardly be claimed that such a single-tube detector would give satisfactory reception. The operation of this simple receiver has been described in order to illustrate the principle of an FM detector in terms familiar to all. It also explains why AM communications receivers, covering frequencies above 40 mc., can, with careful tuning, achieve poor but intelligible reception of FM signals. Finally, a consideration of the shortcomings of the simple circuit described will point out the characteristics required of a genuine FM receiver, capable of delivering the type of performance that distinguishes FM from AM.

FM Receiver Design Considerations ★ In the first place, the receiver of Fig. 49 would be very insensitive. The FCC considers the service area of usable signal of an FM station to extend to the 50-microvolt contour. Therefore, the receiver should incorporate sufficient RF gain to give satisfactory operation at input voltages in the order of 5 to 40 microvolts. This calls for high RF amplification before the detector, a requirement that can be met most satisfactorily by the use of the superheterodyne circuit, indicated in Fig. 51. The reduction of adjacent-channel interference (interference from FM stations operating on channels adjacent to the channel of the desired station) is made more effective by the use of the superheterodyne circuit.

Secondly, while the detector shown in Fig. 49, can be made to give an output nearly proportional to the change in *frequency* of the applied FM signal, it would still be responsive to changes in *amplitude* of the detector input voltage. Thus noise and other interference would not be eliminated nor reduced in the circuit of Fig. 49. In the superheterodyne, changes in amplitude due to interference and noise pass through the IF amplifier. In order to prevent these amplitude variations from being impressed on the second detector, it is necessary to employ an effective amplitude limiter, as indicated in Fig. 51. The use of the limiter is required to reduce noise and interference, regardless of the type of detector employed. Sufficient gain must be provided in the receiver to insure that the weakest signal it is desired to receive without interference noises is amplified to a level sufficient to cause amplitude limiting action in the limiter.

A third deficiency of the detector shown in Fig. 49 is that in order to obtain reasonably linear conversion of input signal *frequency* variations into output voltage *amplitude* variations, the tuned circuit LC must be very carefully adjusted to the frequency at the mid-point of the straight portion of the selectivity curve, indicated by point A in Fig. 50. Even so, if the swing of the transmitter frequency is too great, operation in the curved portions of the curve will result, causing distortion of the detector output waveform. Also, since the detector plate current decreases as the voltage across the tuning condenser increases, excessive input voltage may drive the plate current beyond cutoff, with resulting harmonic distortion. Genuine FM receivers have special FM detector circuits called *discriminators*, designed to handle large input voltage and to give essentially linear response over a wide frequency range.

It will also be noted that the circuit in Fig. 49 contains no de-emphasis to compensate for the pre-emphasis characteristic introduced at FM transmitters. Thus a de-emphasis network is inserted immediately after the discriminator, as indicated in Fig. 51.

Finally, if the full advantages inherent in FM broadcasting are to be realized, it is especially important to employ an audio amplifier having a wide frequency range and minimum harmonic and cross-modulation distortion. The noise and hum level of the audio amplifier should be very low. A high quality speaker system is also necessary, to obtain realistic reproduction.

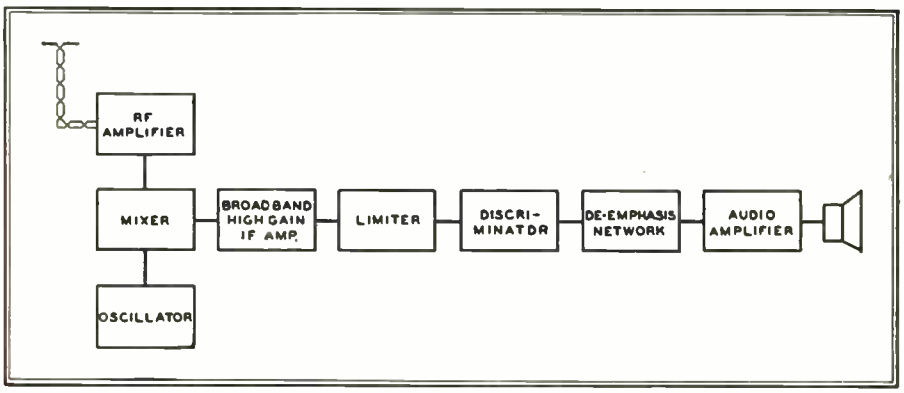


FIG. 51. BLOCK DIAGRAM SHOWING ELEMENTS OF A GENUINE FM RECEIVER

In this Chapter, it is proposed to discuss only the circuits of the conventional superheterodyne that amplify and limit FM signals. The following Chapter will take up discriminators, de-emphasis networks, audio systems and special FM circuit arrangements.

Superheterodyne FM Receiver ★ It will be observed in Fig. 51 that the arrangement of the superheterodyne FM receiver, from the antenna to the input of the limiter, resembles that of a conventional AM receiver. However, even in this area, there are certain important differences between FM and AM circuits.

For example, an automatic volume control acting upon all the RF and IF amplifier stages, as commonly employed in AM receivers, is neither necessary nor desirable in FM circuits. It is unnecessary because the FM limiter maintains the amplitude of the signals applied to the discriminator at a fixed level. It is undesirable because, in general, any system which

reduces the RF gain preceding the limiter tends to lower the signal-to-noise ratio at the limiter. However, a few receivers have been designed in which a limited amount of automatic or manually adjustable volume control is incorporated in order to prevent the signal amplifier grids from being driven positive on very strong signals.

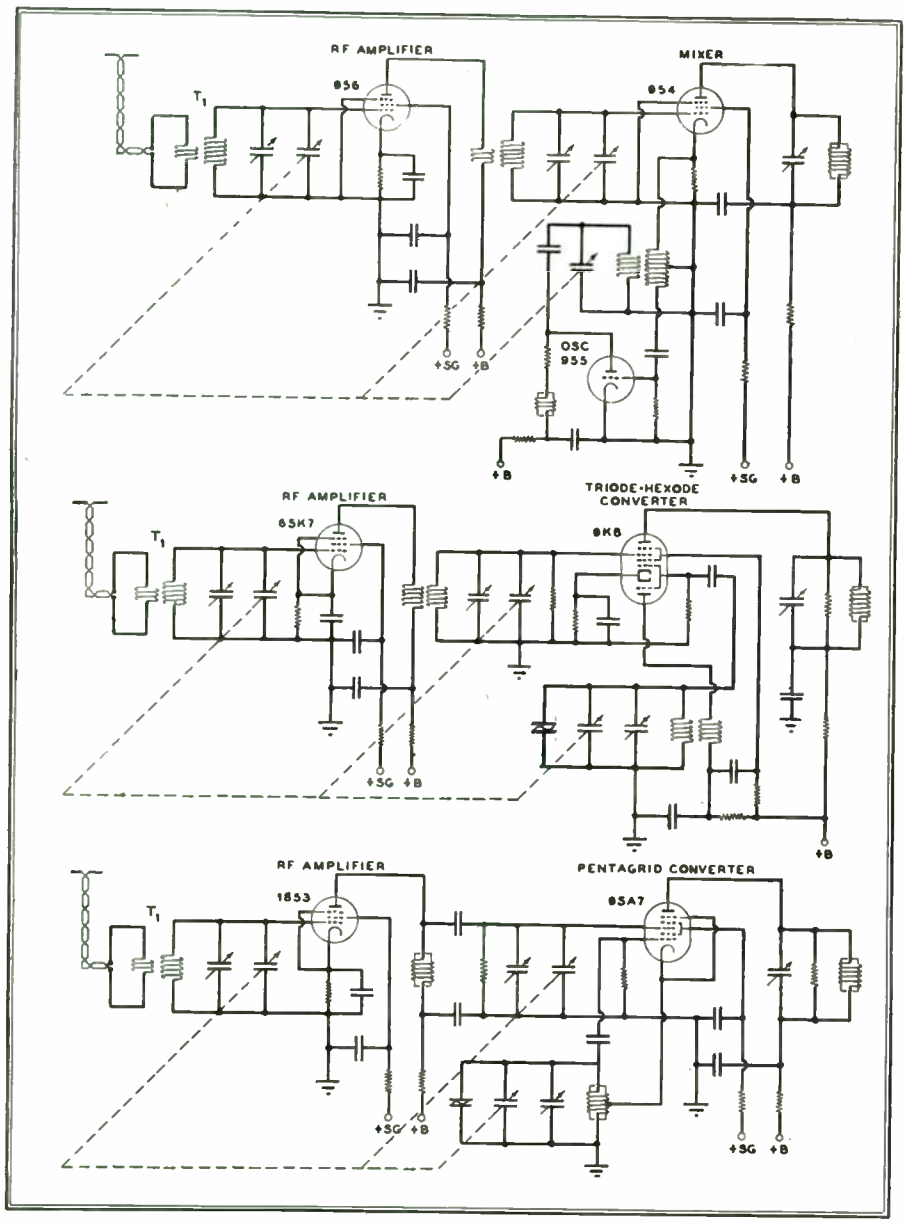


FIG. 52. THREE DIFFERENT TYPES OF MIXER CIRCUITS FOR FM RECEIVERS

Another difference between FM and AM superheterodyne receivers lies in the comparative band width of the IF amplifier system. In AM, at any one modulating frequency, there is but one pair of sideband components, having frequencies respectively higher and lower than the carrier by the amount of the modulating frequency. If the highest modulating frequency is 10 kc., a band width of 20 kc., centered at the intermediate frequency, will be adequate. On the other hand, in the case of FM signals, a large number of pairs of sideband components of appreciable amplitude may be present along with the center frequency component. As was noted in Chapter 1, the maximum band width is required when the FM signal is fully modulated at the highest modulating frequency. For example, in FM broadcasting, if the frequency is varying over the full range of plus or minus 75 kc., at 15 kc. per second, it was shown that eight important pairs of sidebands are present, requiring a theoretical band width of 16 x 15 or 240 kc., centered at the intermediate frequency. Actually, the band width is not made as wide as theoretically required, because 1) sideband components at frequencies near the limits of the theoretical band are of rather small amplitude and appear only when the transmitter is strongly modulated at the higher audio frequencies, 2) a worthwhile increase in RF gain per amplifier stage is obtained as the band width is decreased, and 3) with a somewhat narrower band, adjacent-channel interference is reduced.

The selectivity curves of IF amplifiers commonly employed in prewar FM broadcast receivers are down about 6 db at 75 kc. above and below the intermediate frequency. This represents a compromise between the opposing aims of obtaining maximum gain per stage and excellent suppression of adjacent-channel interference on the one hand, and of having uniform amplification of all sideband components on the other. As will be explained later, this comparatively narrow IF band width can cause appreciable distortion when the incoming FM signal is strongly modulated at high audio frequencies. Thus post-war receivers will probably have IF band widths somewhat greater than those of pre-war receivers, in order to realize the full advantages of FM.

In general, FM receivers should have a higher overall RF gain than AM receivers. This is necessary in order that the weakest signal from which satisfactory reception is desired will be amplified sufficiently to permit amplitude-limiting at the limiter. For example, if the receiver is to operate satisfactorily on a signal voltage of, say, 10 microvolts (.00001 volt) at the antenna terminals, and if 4 volts are necessary at the limiter to obtain amplitude-limiting action, then the overall RF gain in the RF amplifier, mixer, and IF amplifier should amount to at least 4/.00001 or 400,000. Such a gain at the high order of RF and IF frequencies involved, together with greater band width in the IF stages, makes the design of the signal amplification section of the FM superheterodyne considerably more difficult than that of AM receivers.

The RF Amplifier ★ All FM receivers should incorporate a radio frequency amplifier preceding the mixer or converter stage. The advantages gained more than justify the extra expense involved.

In the first place, the RF amplifier supplies additional RF gain. With a well-designed coil, the voltage step-up in the coil at resonance is in the order of 3 to 5. By careful circuit design and choice of the RF tube, the tube gain may be in the order of 6 to 10, thus giving an overall gain in the RF amplifier of about 20 to 50. While a really large gain is not obtainable in the RF amplifier at frequencies in excess of 40 mc., the gain of the RF amplifier does serve to reduce materially the amount of gain required of the mixer

and IF amplifier stages.

The introduction of gain *before* the mixer stage is especially desirable because it serves to improve the signal-to-noise ratio of the receiver. Most of the noise due to tube hiss is introduced by the mixer. Thus if the amplitude of the signal can be raised before reaching the mixer grid, the usable sensitivity of the receiver can be improved.

As in the AM superheterodyne, the tuned input circuit of the RF amplifier also serves to reject signals on the image frequency which might otherwise cause serious interference. The image frequency is that frequency which differs from the signal frequency by twice the intermediate frequency and which lies on the same side of the signal frequency as the oscillator frequency.

For example, suppose that the intermediate frequency of the receiver is 4 mc., and that the desired signal has a frequency of 48 mc. If the receiver is one in which the oscillator frequency is higher than the signal frequency, the oscillator frequency would be 48 + 4 or 52 mc., and the image frequency would be 48 + 8 or 56 mc. If the receiver is one in which the oscillator operates at a frequency lower than the intermediate frequency, the oscillator frequency would be 48 − 4 or 44 mc., and the image frequency would be 48 − 8 or 40 mc. If the image frequency reaches the grid of the mixer tube, the mixer responds as readily to image frequency interference as to the desired frequency.

In receivers which do not have RF amplification before the mixer stage, signals at the image frequency are attenuated only in the one input tuned circuit of the mixer. If they are of sufficient strength at the mixer grid, they create a component at the intermediate frequency in the mixer output which interferes seriously with, or even over-rides, the component created by the desired signal.

On the other hand, if a tuned radio frequency amplifier precedes the mixer, signals at the desired frequency and the image frequency are passed through two independent tuned circuits and the rejection of the image frequency is more pronounced. For example, if one tuned circuit, resonant at the desired signal frequency, is capable of reducing the strength of signals at the image frequency by a ratio of 50 to 1, then two independent tuned circuits of the same characteristics will reduce the image frequency signal by the ratio of 2,500 to 1.

Similarly, the use of a tuned RF amplifier stage gives valuable additional protection against interference from strong signals at the intermediate frequency, which might otherwise reach the mixer grid in sufficient strength to cause serious interference at the mixer output.

Typical RF amplifier circuits are shown at the left of the circuit diagrams of Fig. 52. The input transformer T_1 in each case is designed to permit the use of a dipole antenna for picking up signals. The low impedance input winding matches the

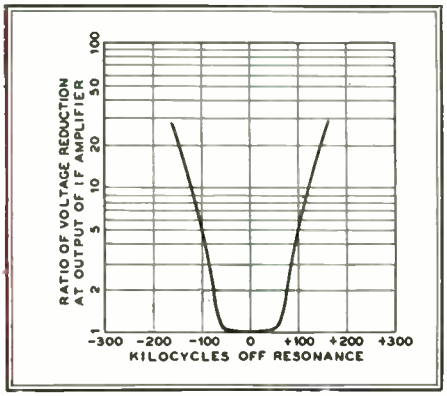


FIG. 53. TYPICAL CHARACTERISTIC OF IF CIRCUIT IN FM RECEIVER

low impedance line from the dipole, so that efficient transfer of signal energy to the tuned input circuit will be obtained.

A low-loss coil is employed in the tuned circuit and in view of the high frequencies involved, it is especially important to use short leads between the coil, condenser and tube. The tuned input circuit should be carefully shielded from the remainder of the receiver. A direct lead should be employed between the low-potential terminals of the coil and condenser, instead of grounding both terminals to the chassis to complete the circuit. It is best to make all grounds in the RF amplifier stage at a common point on the chassis. This minimizes stray inter-stage coupling, and helps to avoid regeneration or degeneration in the RF amplifier stage. Degeneration would result in loss of gain, while regeneration may lead to oscillation in the amplifier.

The tube employed in the RF amplifier should be one which will give high gain at high frequencies. RF pentodes are usually employed for their high mutual conductance and low grid-to plate capacity. The tube chosen should be one which has low input capacity and high RF resistance between the grid and cathode. Acorn and button type pentodes are especially suitable because of their high gain, low input capacity and short leads to the tube electrodes, but the less expensive conventional types of pentodes have often been used.

The Oscillator and Mixer ★ In accordance with the superheterodyne principle, signal voltage from the RF amplifier and constant-amplitude RF voltage from a local oscillator are applied to separate control elements of the mixer tube. The component of plate current at the difference frequency is utilized to excite the high gain IF amplifier which follows the mixer stage.

Three types of circuit arrangements for mixer and oscillator are shown in Fig. 52. The circuit at the top employs acorn tubes throughout, with a separate tube for the oscillator. This arrangement permits each tube to be operated with maximum efficiency and good stability, and relatively high gain is obtained in the RF amplifier and mixer. The expense of this arrangement is high, however, because three special types of tubes are employed.

The circuit shown at the center of Fig. 52 is an alternate arrangement in which a triode-hexode converter tube is used. Hexode is the name applied to a six-electrode tube containing a plate, a cathode, and four grids, grid No. 1 being nearest the cathode and grid No. 4 nearest the plate. The triode-hexode tube contains the elements of a triode in addition to those of the hexode, within the same tube envelope. In the triode-hexode converter, the plate currents of the hexode and triode are taken from opposite sides of the flat rectangular cathode. Only one grid encircles the cathode, and this grid serves both as the control grid of the triode and as grid No. 1 of the hexode.

The constant-amplitude RF voltage is generated by the triode elements in a simple feed-back oscillator circuit. The RF

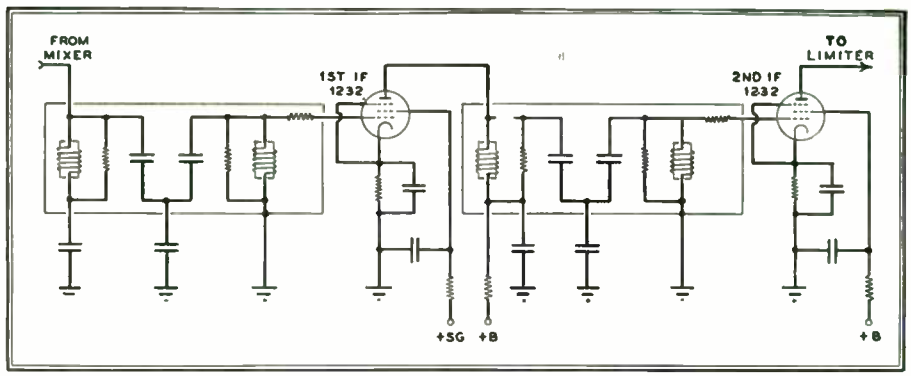


FIG. 54. CIRCUIT FOR TYPICAL TWO-STAGE IF AMPLIFIER FOR FM SET

voltage on the grid of the oscillator is likewise on grid No. 1 of the hexode, because mechanically one grid is the extension of the other to the opposite side of the flat cathode, as previously explained. The FM signal voltage is applied to grid No. 3 of the hexode, which is shielded from the plate and from grid No. 1 by grids Nos. 2 and 4, both of which are held at ground RF potential by means of a bypass condenser. Thus both the oscillator and the signal voltages modulate the electron stream, while there is a minimum of electrostatic coupling between the oscillator, the signal input, and the mixer output circuits.

The third circuit arrangement, shown at the bottom of Fig. 52, employs a pentagrid converter tube, type 6SA7. This tube functions as both oscillator and mixer. Grid No. 1 serves as the grid for the oscillator while grid No. 2 serves simultaneously as the oscillator anode and as a shield between oscillator grid No. 1 and signal grid No. 3. For efficient shielding, grid No. 2 must be at ground RF potential, which requires that the oscillator cathode be operated at a RF difference of potential with respect to ground, as shown.

The 6SA7 is constructed with two deflecting plates connected to grid No. 2, so arranged that they collect most of the electrons which are repelled by voltage on the signal grid, No. 3, and which would otherwise fall back toward the cathode and affect the cathode current. The plates also serve to improve the shielding effect of grid No. 2 between the signal and oscillator circuits. These improvements of the 6SA7 over earlier pentagrid converters have made it possible to employ this simple, less expensive tube and circuit arrangement with reasonably satisfactory results at the FM frequencies.

Whatever tube and circuit arrangement is employed, it is important that the mixer tube furnish as much signal gain as possible and that there be a minimum of interaction between the oscillator and signal circuits. For example, adjustment of the trimmer condenser in the tuned signal input circuit should not affect the oscillator frequency.

The output voltage of the oscillator should be as large as possible without overloading the mixer and should be fairly constant over the frequency range. In the design of the receiver, the frequency of the oscillator may be made either higher or lower than the signal frequency. Both arrangements were used in pre-war receivers.

With the oscillator frequency higher than the signal frequency, it is easier to obtain good tracking over the tuning range. In other words, it becomes possible to select coil and condenser values for the oscillator and signal circuits such that at all settings of the tuning dial the difference between the oscillator frequency and the resonant frequency of the signal circuits is equal to, or very closely approximates, the intermediate frequency of the receiver. When the oscillator frequency is lower than the signal frequency, deviation from perfect tracking is likely to be somewhat greater in a practical receiver design.

On the other hand, with the oscillator frequency lower than the signal frequency, it is easier to obtain good frequency stability from the oscillator. In broadcast reception, where the maximum transmitter deviation is 75 kc., it is found that the maximum permissible receiver oscillator drift, after the oscillator has completed its warm-up, is 10 kc. For an oscillator at a frequency of 45 mc., this represents a maximum percentage drift of .022%, whereas for an oscillator at 55 mc., 10 kc. represents a maximum drift of .018%. While the difference in these percentages appears small, it was found difficult to obtain a frequency stability in broadcast receivers greater than .02%, even with temperature-compensated oscillators for home use. The majority of receivers were built with oscillators operating at the lower frequency for this reason.

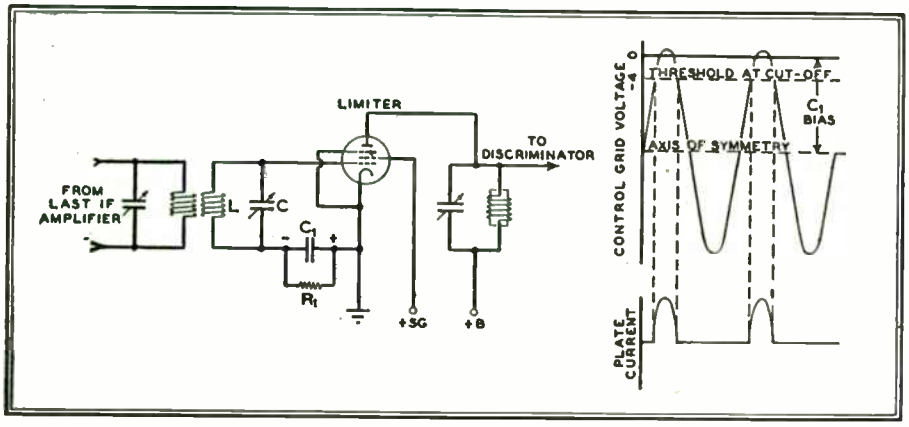


FIG. 55. ONE-STAGE AMPLITUDE LIMITER CIRCUIT, SHOWING HOW GRID LEAK BIAS ALLOWS GRID TO SWING TO ONLY A SLIGHTLY POSITIVE VALUE

A third factor which affects the choice between oscillator frequencies higher or lower than the signal frequency is the matter of image frequencies. The image frequency lies on the same side of the signal frequency as the oscillator frequency. Thus, if the factors of good tracking and high oscillator frequency stability are discounted against each other, the choice between a higher or lower oscillator frequency would be strongly influenced by the presence of interfering signals, immediately above or below the FM band.

The IF Amplifier ★ The intermediate frequency amplifier in an FM receiver, as in an AM receiver, contributes the major part of the RF gain and provides the selectivity necessary to avoid adjacent-channel interference.

From the standpoint of obtaining good selectivity and high gain per stage, a low intermediate frequency would be desirable. It would also give a more sensitive discriminator, since any given frequency deviation, such as 75 kc., becomes a comparatively large percentage of the IF frequency at the discriminator.

However, consideration of interference from signals at the image frequency demands that a fairly high intermediate frequency be employed. The image frequency, which differs from the desired signal by twice the amount of the intermediate frequency, will then be effectively suppressed in the tuned RF amplifier and mixer circuits. The intermediate frequency should preferably be equal to at least one-half of the width of the FM receiver tuning band, so that all the image frequencies will lie outside the FM band. However, the intermediate frequency should not itself be a frequency on which strong signals are encountered.

In prewar broadcast receivers, the intermediate frequency most often employed was 4.3 mc. The width of the FM broadcast band, extending from 42 to 50 mc., was 8 mc., indicating that an intermediate frequency of 4 mc. would place all image frequencies outside the 42- to 50-mc. range. However, a frequency of 4 mc. was undesirable because of the possibility of interference from strong signals in the 80-meter phone band. The somewhat higher frequency of 4.3 mc. was, therefore, generally used.

Some receiver engineers have advocated the use of a still higher intermediate frequency in order to avoid any interference between two FM stations separated by the amount of the intermediate frequency. In such a case, each station may act as an oscillator for the other, and the two stations may be heard over the entire tuning range of the receiver. This condition has not been encountered frequently in the past, but may become more serious as

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additional stations are put into operation. While the use of a tuned RF amplifier and the choice of an intermediate frequency having an odd number of tenths of a megacycle will tend to minimize this type of interference, the more effective solution would lie in having the intermediate frequency equal to at least the entire width of the FM band, assuming that excessively strong signals are not present in the spectrum area adjacent to the band. For the 42- to 50-mc. band, an intermediate frequency of at least 8 mc. would be required to avoid this type of spurious response. With the wider band assigned to postwar FM broadcasting, an intermediate frequency of 18 mc. or more would be required to obviate all possibility of experiencing this type of interference!

Whether or not such high intermediate frequencies will be employed eventually, the fact remains that the trend in receiver design is toward the use of higher intermediate frequencies.

IF Amplifier Characteristics ★ As previously explained in this Chapter, the band width required by FM signals is greater than that for AM signals. Fig. 53 shows a typical selectivity curve for the IF amplifier of an FM broadcast receiver. It is observed that at frequencies 75 kc. above and below resonance, the voltage reduction ratio is 2 to 1, equivalent to 6 db down. At frequencies 100 kc. removed from resonance, the ratio is 5 to 1 or about 14 db down.

This represents a considerable narrowing of the band width over the theoretical ideal of a band flat to 120 kc. above and below resonance. As previously explained, the narrowed band represents a design compromise in favor of greater gain per stage and improved adjacent-channel selectivity.

The argument in favor of such a compromise is that although the amplitude of a fully modulated FM broadcast signal will be cut down to one-half as the frequency of the signal swings toward the limit of plus or minus 75 kc., as long as the *least* amplitude of the signal is sufficient to saturate the limiter, the amplitude variations will be removed by the limiter.

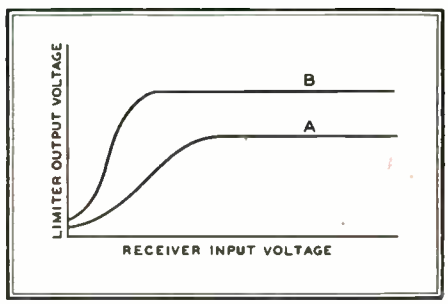

FIG. 56. CHARACTERISTICS OF ONE- AND TWO-STAGE LIMITERS

A point not so frequently considered is the fact that as the frequency swings into the curved regions of the IF amplifier selectivity curve, the currents and voltages in the band pass circuits undergo a shift of phase as well as a variation of amplitude. For a given deviation of the signal frequency during modulation, the *rate of change of phase* in the band pass circuits is proportional to the modulating frequency. In other words, the band pass circuits introduce a variation in the frequency of the signal currents, in addition to the frequency variation due to modulation, that is proportional to the modulating frequency.

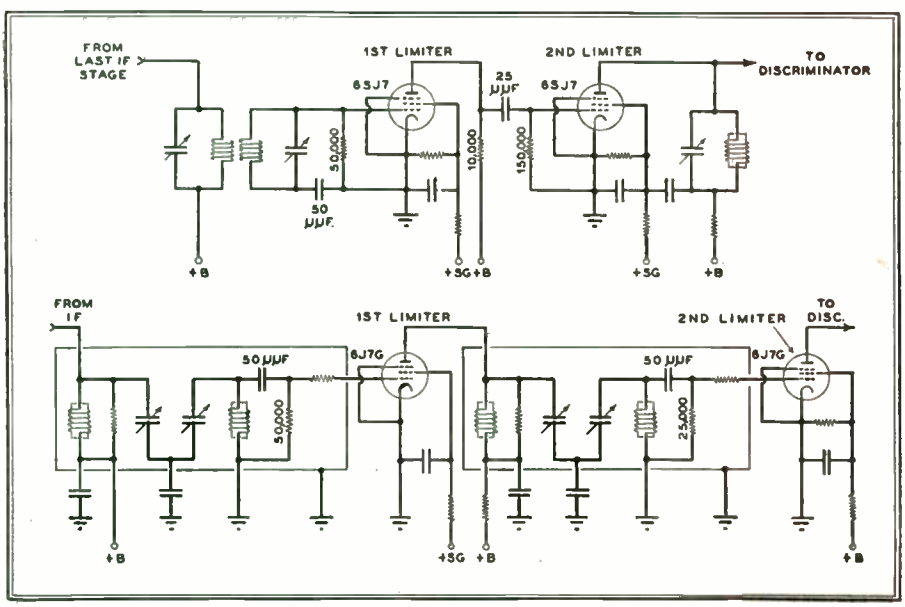

FIG. 57. CIRCUITS OF TWO TYPICAL TYPES OF DUAL LIMITERS

This frequency variation is too small to be of consequence at low modulating frequencies, but as the modulating frequency is increased, the time rate of phase change in the tuned circuits is increased, meaning that the frequency variation superimposed on the FM signal by the tuned circuits is increased. These frequency variations produce amplitude distortion at the receiver output. For example, when the signal is fully modulated at 5,000 cycles, distortion in excess of 2% will be caused by phase shifts in an IF amplifier having a characteristic that is down 6 db at frequencies 75 kc. above or below resonance.

Set designers particularly interested in obtaining the highest degree of fidelity over the entire audio range are inclined to favor an IF characteristic in which the signal is down only 1 or 2 db at 75 kc. deviation, although it is more difficult to obtain adequate RF gain with the broader band. The broader selectivity curve also allows signals whose level is somewhat below limiting to be received without distortion, thus increasing the usable sensitivity of the set in locations where the noise level is very low.

As shown in Fig. 54, the wiring diagram of the IF amplifier of an FM superheterodyne is fairly conventional. It will be noted that loading resistors may be used across the coils to broaden the characteristics of the band pass circuits. These resistors may range in value from 10,000 to 100,000 ohms. Decoupling circuits are employed in both the screen and plate circuits to improve the stability of the high gain amplifier.

Two stages of IF amplification are all that can be used at these frequencies without encountering instability. Experience indicates that, from the production standpoint, the maximum gain that can be safely obtained in the mixer and IF amplifier is about 15,000. The RF amplifier is required to furnish the remainder of the RF gain necessary to bring the weakest signal it is desired to receive up to a level that will saturate the limiter.

The Limiter ★ From the standpoint of the reduction of noise and interference, the limiter stage is the most important component of the FM receiver, because all types of FM detector circuits are responsive to amplitude as well as frequency variations of the detector input voltage, during the reception of FM signals.

With a really effective limiter located immediately ahead of the detector, and with sufficient RF amplification in the receiver to raise the signal level up to that necessary to obtain limiting action, amplitude variations due to noise and interference will be removed, and the detector output voltage will vary only in proportion

to the *frequency* variation of the signal at the output of the IF amplifier.

Fig. 55 shows a simple one-stage limiter of the grid leak type, employing a 6SJ7 or similar tube. The tube is operated with low plate and screen grid voltages so that cut-off occurs with relatively small grid bias, such as −4 volts.

The control grid and cathode of the limiter tube act as a diode rectifier, so that with the grid driven only slightly positive with respect to the cathode, a charge is stored in the grid condenser C_1, Fig. 55, such that the DC voltage across C_1 is very nearly equal to the amplitude of the IF voltage across the tuning condenser C. Thus the voltage set up by the charge in C_1 increases and decreases with the amplitude of the input voltage across tuning condenser C, thereby biasing the grid negatively to the amount necessary to prevent the grid from swinging more than slightly positive, regardless of how the amplitude of the input voltage varies.

The result, as shown at the right in Fig. 55, is that the plate current varies between two fixed levels, namely, that corresponding to a slightly positive grid voltage and that of cut-off, regardless of variations in excitation voltage across tuning condenser C, assuming only that its peak amplitude is in excess of the 4 volts necessary to give cut-off.

The characteristic curve of a single-stage limiter is shown at A in Fig. 56. It is essential that the horizontal portion of the input characteristic be flat, and it is desirable that the horizontal portion extend to a low value of input voltage, so that a more definite limiting action will set in at low signal levels. Curve B of Fig. 56 shows the improvement obtained by the use of a two-stage limiter, also known as the dual or cascade limiter.

The circuits of two types of two-stage limiters are shown in Fig. 57. Both stages in each of these limiters are of the grid-leak type, the grid leaks being shunted from grid to ground rather than across the grid condenser as in Fig. 55. The operation of each of the limiter stages is like that of the single-stage limiter, the second stage simply serving to remove any small residual amplitude variations remaining in the output of the first limiter, thus flattening the characteristic and extending it down to lower input voltages. The lower circuit differs from the upper by having a tuned circuit for coupling between the limiters rather than a resistor. This is a more expensive arrangement but gives somewhat improved performance.

The time constants of the grid-condenser and grid-leak combinations in the limiter are of considerable importance in the suppression of impulse noise. The time constant is a means of stating the rate at which a condenser will discharge through a resistance. Theoretically such a discharge continues indefinitely because as the discharge takes place the condenser voltage falls off, reducing the discharge current and prolonging the discharge period. Practically, in most RC circuits, the discharge current falls to a less than measurable value in a short period of time, the discharge time being greater when the condenser capacity is large or the resistance of the discharge path is high or both.

The time constant is defined as the amount of time required for the voltage of a condenser discharging through a resistance to fall off to 36.8% of its initial value. The time constant in seconds is equal to the product of the condenser capacity in farads and the grid leak resistance in ohms. The time constants in the limiter circuits should not exceed 10 microseconds, shorter time constants being indicated when automobile ignition interference is anticipated. The time constants of the grid-leak and grid-condenser combinations of the circuits in Fig. 57 range from 1.25 to 4 microseconds.

Short time constants make it possible for the grid bias to follow, almost instantaneously, an impulse so phased as to remove the signal voltage from the grid. Thus the time required to recover normal bias is less than the time of one cycle at the highest audio frequency, and the grid leak bias system does not increase the amplitude nor prolong the effect of an individual impulse. However, since the grid-leak limiter operates from an artificial threshold that is near the positive peak of the input signal, as shown in Fig. 55, it is sensitive to more and smaller impulses than would affect an ideal limiter whose threshold corresponds to the axis of symmetry of the signal voltage.

When two tubes are used in cascade, it becomes possible to rearrange the limiter circuit so that the condition of such an ideal limiter is approached. In Fig. 58, there is no self bias on the first 7C7, and the plate and screen voltages are so chosen that the plate current drops to cut-off when the instantaneous value of the input signal is more than 1 volt negative. The positive peak of signal voltage is reproduced without limiting in the first tube, but by means of resistance coupling, it is reversed in phase and applied as a negative voltage to the second tube. Thus both peaks are limited while the threshold is maintained near the axis of symmetry of the input signal, so that this limiter is responsive to but few small impulse peaks.

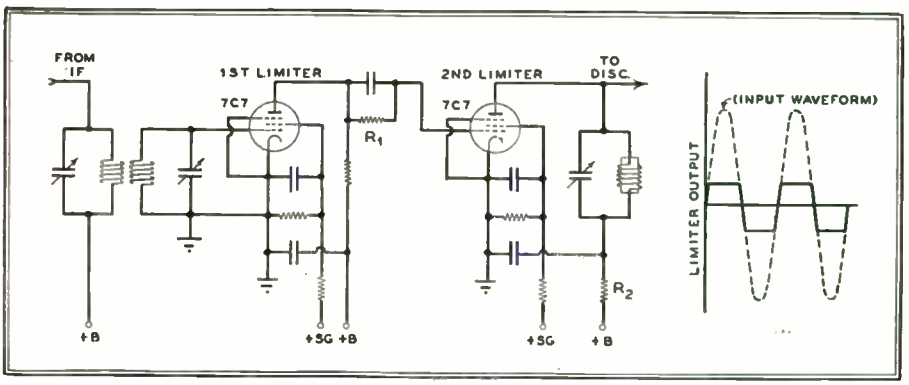

FIG. 58. CIRCUIT NOT EMPLOYING GRID LEAK IN THE FIRST STAGE. RIGHT, CURVE SHOWING THE INPUT WAVE FORM AND RESULTING OUTPUT

By a proper choice of the resistors R_1 and R_2, it is also possible in this limiter circuit to obtain some decrease in the output sensitivity when there are no input signals strong enough to suppress the noise, so that a partial squelch is obtained while tuning from one station to another.

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1. Superior audio quality sets new standard. Sounds better. Easier on the ear. Easier to get message.
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6. Adjustable to exact, specified frequency. Easy, precise tuning in a hurry.
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11. Mobile cables equipped with separable connectors. Add flexibility in operating equipment. Equipment removable without using special tools. All cables plug in and lock.
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13. Single-unit construction saves space.
14. Easy to install. Mounting hardware supplied. Comes complete, down to bolts and nuts.
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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.
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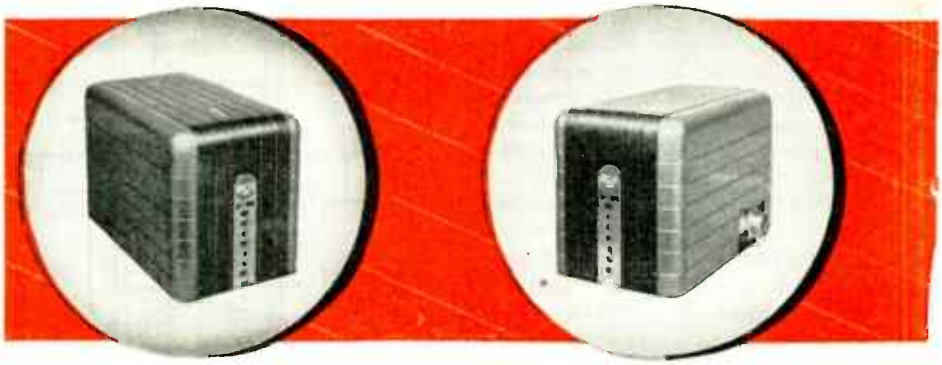
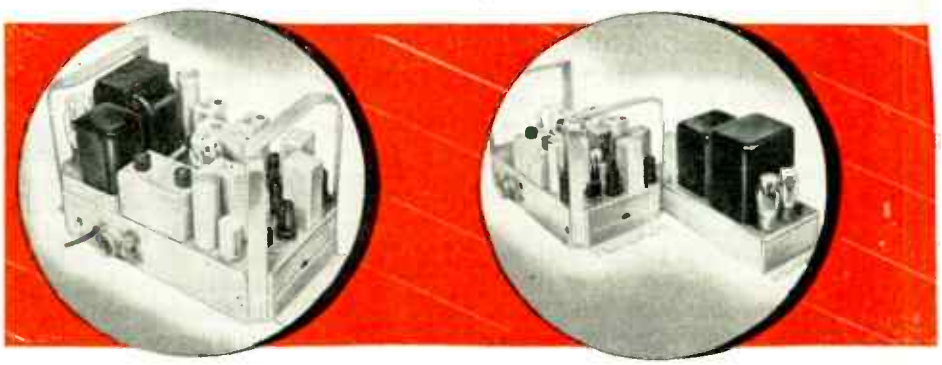


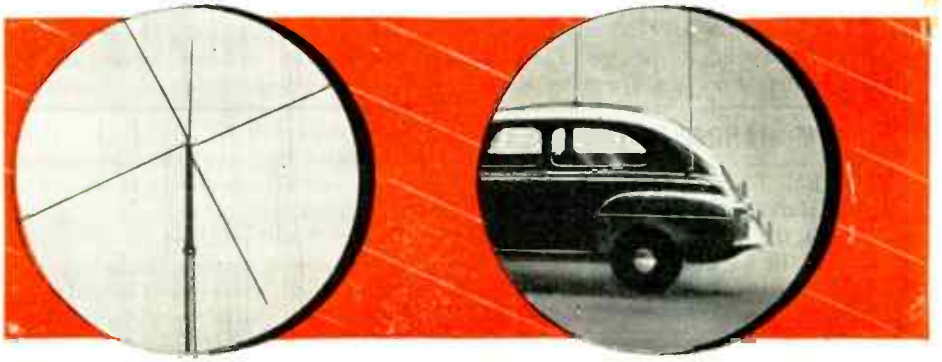
1. FM Mobile Receiver: Ultra-modern circuits, construction and styling. Small, compact, rugged. Easily removed from mounting base. Simple to service. Provided with either dynamotor or vibrator type power supply.

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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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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WMUJ New Haven JC Burlan

DISTRICT OF COLUMBIA

Fire Dept 4th & Douglas NW HA Friede
WDCS Washington

LOUISIANA

City of New Orleans
WSKW New Orleans 2 Canal St
WSKX New Orleans Fireboat "Deluge"
WSKY New Orleans Fireboat "Samson"

MAINE

City of Portland Fire Dept 380 Congress Portland Me
WDBE Portland OT Sanborn

MASSACHUSETTS

City of Boston Fire Dept 59 Fenway Boston Mass
WEY Boston JA McCarron

MICHIGAN

City of Detroit Fire Dept 697 Macomb Detroit Mich
WKDT Detroit AJ Van Damme

NEW YORK

City of New York Fire Dept Municipal Bldg Chambers & Centre Sts New York NY V Fendrick
WNYQ Brooklyn
WNYF New York City
WHGH Staten Island
W2XYT (P)

WASHINGTON

City of Seattle Fire Dept 301 2nd Ave Seattle
KRMO Seattle

FORESTRY STATIONS

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State of Ala Div of Forestry Dept of Cons 5 N Bainbridge St Montgomery Ala GM Goodson
WRBG Chapman Ala

ARKANSAS

State of Ark Forestry Commission Little Rock Ark
No fixed stations WJ Henry

CALIFORNIA

County of Kern Bakersfield Calif WE Whiting
KRBJ Bakersfield Calif
W6XAF Grapevine "
Los Angeles Co Calif Dept of Forester & Fire Warden 524 N Spring St Los Angeles Calif CW Black
KFRW La Canada Calif
KQXB Agoura "
KRJO Newhall
KRNL (P)
Salinas Rural Monterey Co Fire Protection Dist Salinas Calif
No fixed stations
San Bernardino Co Calif Dept of Forester & Fire Warden 3870 Sierra Way San Bernardino Calif H Gillette
KQRW San Bernardino
W6XEK Strawberry Peak
KQRX Yucaipa
KBIA Twenty-Nine Palms
State of Calif Dept of Natural Resources Div of Forestry 312 State Bldg Sacramento Calif WF Koch
KFQO Alma
W6XGK Box Spgs Mountain
W6XBT Calistoga
KSFX Carmel
KEUL Felton
KEVA Fortuna
KQWH Fresno
KFQP Hollister
KGSC La Mesa
KGMI Madera
KQUB Mt Danaher
KEUN Napa
KEUZ Nevada City
KEUC Oakridge
KEUS Oroville
KAIV Perris
KEUX Red Bluff
KALJ Sacramento
KRDT San Francisco
KEUW St Helena
KBZC Redding
KFSC San Luis Obispo
KBXR Santa Rosa
W6XJG Stephenson's Peak
KQWH Susanville
KRDS Visalia
KBIA Twenty-Nine Palms
KEUJ Willits

CONNECTICUT

State of Conn Park & Forestry Commission Forestry Dept 165 Capital Ave Hartford Conn Lieut Boas
WSPQ Glastonbury
WBSO Meriden
WROY Sterling
WROZ Storrs

In most cases, mobile and portable-mobile transmitters are not listed here because they operate under the same call letters as their main stations. However, if portable or portable-mobile transmitters have call letters of their own, they are listed. Where names of radio supervisors do not appear, it is because no replies have been received to our repeated requests for this information.

DELAWARE

State of Delaware Forestry Dept Legislative Hall Dover Del
No fixed stations

FLORIDA

State of Fla Bd of Forestry & Parks PO Box 1200 Tallahassee Fla RL Atkinson
WAGU Lake City
WBWY Munson
WSTD Panama City
WSRM Port St Joe
WAGI Shamrock
WRQO Vairico
WAGZ De Leon Spgs
WANB Dinsmore

National Turpentine & Pulpwood Corp Jacksonville
No fixed stations WW Miller

GEORGIA

State of Georgia Dept of Forestry Atlanta Ga
WGSF Brunswick Ga

Union Bag & Paper Corp South Newport Townsend Ga
WEGK Pine Harbor Townsend Ga

MARYLAND

State of Maryland Dept of Forests & Parks State Office Bldg Annapolis Md DM Parr
WMBK Avalon DM Parr
WMBU Brandywine "
WMEQ Burtonsville "
WQWF Church Creek "
WMAY Cub Hill "
WMES Great Mills "
WQVY Green Hill "
WMDK Hollofield "
WMSY High Knob "
WMCR Hillmeade "
WMBX Long Hill "
WMCL Laurel "
WMBE Madonna "
WQWB Nassawango "
WQWE Powellville "
WQWC Quantico "
WQWD Salisbury "
WRLF Shiloh "
WMAI Stoney Forest "
WMBQ Welcome "
WMBJ Woodlawn "

MASSACHUSETTS

Town of Easton Fire Dept 5 Sullivan Ave North Easton Mass GR Wood
WLDK North Easton Mass
Commonwealth of Massachusetts Dept of Cons Div of Forestry 20 Somerset St Boston Mass
WBMR Andover
WRML "
WQYW Barnstable
WBIO Billerica
WRNB Boston
WQWJ Bourne
WQWL "
WRKT Brimfield
WCAW Burlington
WAJP Carlisle
WQYR Carver
W8VG Duxbury
WRKQ Fall River
WQYV Falmouth
WQYX "
WBQY Foxboro
WQYU Hanson
WQWG Harvard
WQYA Harwich
WBKX Haverhill
WRKP Mendon
WQYQ Middleboro
WCAS Monument Beach
WMNR North Reading
WRKW Osterville
WRKU Oxford
WRKR Petersham
WQYS Plymouth
WRGE "
WQWH Princeton
WRKO Sharon
WBPP Sterling
WBKW Stoughton
WBGD Stow
WRKV Wareham
WQWI Westboro

MICHIGAN

State of Mich Dept of Cons Lansing Mich
WBRD Atlanta E Cornett
WDAI Baldwin "
WBQR Baraga "
WDAQ Boyne City "
WSWK Crystal Falls "
WRRC Escanaba "
WDSO Ewen "
WBXA Gladwin "
WBRF Marquette "
WBKZ Mio "
WBQP Newberry "
WIVA Roscommon "
WMIC Sault Ste Marie "
WKJK Traverse City "
WBYK Muskegon "

MINNESOTA

Minnesota Forest Service 338 State Office Bldg St Paul Minn W Olson
No fixed locations

MISSOURI

Missouri Cons Commission c/o State Forester Jefferson City Mo
KQGH (P) JH White
KAUM (P) "
KAUH (P) "
KQXP (PM) "

NEW HAMPSHIRE

State of New Hampshire Forestry & Recreation Dept State Office Bldg Concord NH
WKJY Concord B Cutting
WSRF Franklin "
WLOM Loudon "
WAYI Manchester C Klaubert
WKRH Northwood B Cutting
WFZW Wolfeboro "

NEW JERSEY

State of New Jersey Dept of Cons 1206 Broad Trenton NJ PW Crozer
WQVN Bass River
WQVR Batsto
WQVI Bearfort
WQVS Belle Plain
WQVC Blue Anchor
WQVE Budd Lake
WQVB Butler
WQVG Catfish
WQVP Cedar Bridge
WGVF Culver Lake
WQVM Farmingdale
WQVQ Lakewood
WBPN Lebanon State Forest
WQVU McKeetown
WRHU Port Republic
WQVL May's Landing
WQVT Milliville
WQVJ Milton
WQVM Mispah
WQVO Retreat
WQVK Toms River
WQVA Trenton
WQVD Union Hill
WQVH Windbeam

NEW YORK

State of New York Cons Dept Albany NY No fixed locations SJ Hyde

NORTH CAROLINA

State of North Carolina Dept of Cons & Dev State Office Bldg Raleigh NC
WLSE Hertford
WLSK South Mills

OKLAHOMA

State of Oklahoma Div of Forestry Oklahoma Planning & Resources Bd Capitol Bldg Oklahoma City
No fixed locations

OREGON

State of Oregon Dept of Forestry 2600 State St Salem Ore WF Sanders
KQGO Brookings
KQSD Dallas
KQJS Eugene
KRNI Forest Grove
KQHN Gold Beach
KQSC Grants Pass
KRNJ Jewell
KAMV Kinzua
KOIB Klamath Falls
KRDQ LaGrande
KQLM Marshfield
KRDP Medford
KGLK North Fork
KQFP Prineville
KGLP Roseburg
KQHQ Salem
KHWI Sexton Mt
KGLS Sisters
KOIA Tillamook
KRLY Toledo
KQSE Veneta
KOFD Wallowa
KHWR Wards Butte

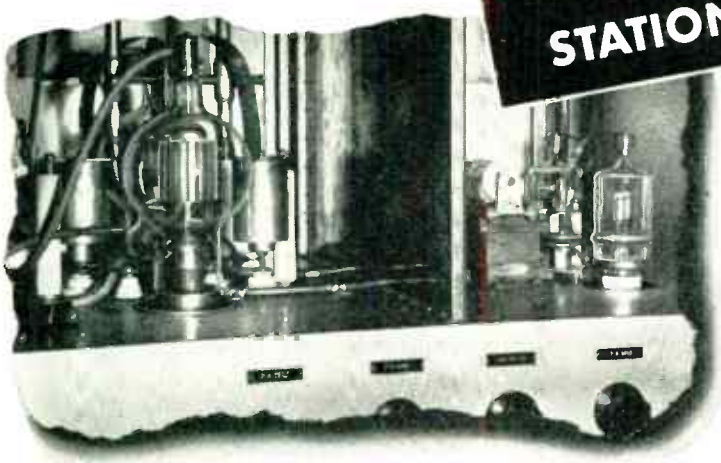
PENNSYLVANIA

Commonwealth of Pennsylvania Dept of Forest & Waters Harrisburg Pa

IT'S EIMAC AGAIN! FIRST CHOICE FOR THE KEY SOCKETS AT TELEVISION STATION WBKB

A. H. Brolly . . . Chief Engineer of Television Station WBKB, Chicago, adjusts the grid circuit of the Eimac 304-TL's in the Class B linear stage of the video transmitter.

Mr. Brolly calls attention to the Eimac 1000-T's in the final stage of the Audio FM Transmitter which operates at 65.75 megacycles. It is a very stable amplifier of good efficiency.



The video transmitter operates at 61.25 megacycles; peak power output is 4 KW which provides a television service throughout metropolitan Chicago and reaches suburbs out to 35 miles or more.

Eimac 152-T's are used in the modulated stage and 304-T's in the first Class B linear amplifier of the video transmitter.

E. F. Cawthon and W. R. Brock are operating the station which has been broadcasting television programs with the present equipment since 1942 and began operation on a commercial schedule in October, 1943.

Grid modulation is employed at WBKB and a broad band of frequencies must be passed in all stages following the modulated amplifier. Multiple-tuned resistance loaded coupling circuits are used between stages.

Performance, stability, dependability are good reasons why Eimac tubes are to be found in the key sockets of the outstanding new developments in Electronics. Balaban & Katz, owners of television station WBKB of Chicago, offer potent confirmation of the fact that Eimac tubes are first choice of leading Electronic Engineers the world over.

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WRMV Clearfield
WRMT Emporium
WIRT Harrisburg
WJAB Harrisburg
W8XVE Kellogg Mt Fire Tower
W8XVF Knobs Fire Tower
W8XUT Lee Fire Tower
W8XVL Loop Fire Tower
WROE Milroy
WRKM Mifflinburg
WROF Petersburg
W3XPT Peters Mt
WRMQ Renova
WIYA Scranton
W8XUN Shaffers Path Fire Tower
WRIA Stroudsburg
WRIB Williamsport

RHODE ISLAND

State of Rhode Island Dept of Agriculture & Cons Office ... of Forests & Parks 18 State House Providence
WAWR Scituate RI LC Leighton

SOUTH DAKOTA

South Dakota Park Bd Custer State Pk Hermosa SD
KAFQ Hermosa EL Burns
KAFP Hermosa "

TEXAS

State of Texas Texas Forest Service Div of Forest Protection Lufkin Texas LJ Beard
KBWP Cushing
KBWR Hyatt
KBWO Jefferson
KHJF Lufkin
KBWK Newton

VIRGINIA

Commonwealth of Virginia Cons Commission Forest Service University Station Charlottesville Va
WETN Deep Creek
WETV Suffolk

WASHINGTON

State of Washington Div of Forestry Olympia Wash
KGMD Olympia RM Fuller

WISCONSIN

State of Wisconsin Cons Commission State Office Bldg Madison Wis
No fixed locations

MUNICIPAL POLICE

ALABAMA

WRBD Anniston City Hall J Hudson
WPFM Birmingham City Hall L Kron
WJZG " (P) " "
WADN Decatur
WKAD Dothan 113 S St Andrews J Smith
WKUH Florence Police Hdqtrs
WQIG Gadsden City Hall HD Williams
WMHA Huntsville Madison St NH McKay
WPGW Mobile 59 St Emanuel HP Black
WMPM Montgomery N Perry & Madison FP Stephens
WDBZ Northport (PM) City Hall J Arendale
WASP Selma Municipal Bldg RB Sommerville
WBVS Sylacauga Police Hdqtrs JS Towers
WQLH Tuscaloosa 2524 7th St HD Billingsley

ARIZONA

KFPX Flagstaff (PM)
KRIZ Mesa R LaRue
KGZJ Phoenix 17 S 2nd Ave
KNHG Prescott (PM) 117 W Goodwin R LaRue
KEYZ South Tucson
KEYU Tempe 31 E 5th St R LaRue
KQEP Tucson OC Mitchell
KQPW "
KRDW Winslow City Hall R Murdock

ARKANSAS

KEZH Benton City (PM)
KPBA Blytheville
KRNQ Fayetteville PO Box 42 JD Fields Jr
KNHA Fort Smith City Hall EH Eudy
KGHZ Little Rock B'dway & Markham EF Henning
KPDM Monticello Police Hdqtrs DF Polk
KRAE North Little Rock 300 Main St RL Stinnett
KTAP Texarkana Municipal Bldg EV Henderson

CALIFORNIA

KQBR Alameda City Hall R Burton
KGWC Albany (PM) 805 San Pablo Ave
KQAH Alhambra 7 N Second St L Cowley
KRBQ " " " "
KQCL Anaheim (PM)
KQAP Arcadia 50 Wheeler St A Locher Jr
KQXC Atherton (PM)
K1BR Azusa City Hall H Ziegler
KGPS Bakersfield (PM) City Hall RH Fox
KQLY Banning (PM) 4000 Orange St HO Platt
KQJH Beaumont (PM) HO Platt
KPBC Bell 6326 Pine Ave A Rizzo
KQSN Benicia City Hall W Davena
KGFM Berkeley (P) 2171 McKinley LF McKinney
KGIH " " " "
KGNL " " " "
KSW " " " "
KQAI Beverly Hills 450 N Crescent Dr FR Gonsett
KBMP Brawley
KADQ Brea 403 S Pomona Ave G Ellis
KQBE Burbank 2715 E Olive ES Barber
KQCM Burlingame JJ Hartnett
KQFI Carmel-by-the-Sea City Hall C Simpson
KQEO Chico Police Hdqtrs EP Milburn
KQKN Chino (PM) City Hall RC Anderson
KQJG Chula Vista (PM) 294 3rd Ave GN Lewis
KWRY Claremont (PM) 221 W 2nd H Ziegler
W6XHU Coalinga (Fresno)
W6XHV " "
KQVO Colton (PM) Sheriff's Office RC Anderson
KQAQ Compton WW Hurst
KBIV Corona Police Hdqtrs Capt H Platt
KQKV Coronado (PM) 1011 6th G Lewis
KPCM Corte Madera (PM)
KIQH Covina (PM)
KPDC Culver City 4010 Duquesne St HC Dunn
KEYG Delano 1111 Jefferson WE Whiting
KNGJ El Centro 793 Main St
KQVN " (P) "
KAMM El Cerrito (PM)
KROR El Monte H Greenwood
KQJL El Segundo 209 W Franklin FE Dine
KGTS Elsinore (PM)
KQHX Escondido 100 Valley Blvd VW Thompson
KQRM Eureka City Hall JR McKenzie
KDIC Fairfax (PM)
KGZA Fresno PO Box 828 RM Schuler
KRDY " "
KQBN Fullerton (PM) Police Hdqtrs B Whiteman
KQEG Gardena C Grove
KTOB Gilroy
KQZL Glendale 111 N Howard K Furry
KQCI " " " "
KGVC Grass Valley (PM) 127 E Main St B Jenkin
KBJT Hemet (PM) 135 N Carmalita AJ Berg
KRMZ Hermosa Beach City Hall FE Dine Co
KANQ Hillsborough (P) Police Hdqtrs WH Harrington
KHBP Hillsborough (P) "
KSPH Hillsborough (P) "
KQAL Huntington Beach (PM) Sheriff's Office Santa Ana Calif
KHPM Huntington Park 6400 Pacific Blvd W Hoyt
KQHJ Indio (PM)
KQXL Inglewood O Wick
KKFD Kensington Park
KQEN Laguna Beach (PM)
KEZT La Mesa (PM) V Thompson
KDII Larkspur (PM)
KQPZ La Verne (PM) City Hall HM Case
KRIM Lindsay
KNGY Lodi Police Hdqtrs PT Nesbit
KBQW Long Beach (P) City Hall F Strong
KQAO " " " "
KQST " (P) " "
KQXI " " " "
KGPL Los Angeles 401 N Ave 19 F Crowder
KNGX " (P) " "
KQJN " " " "
KQEF " " " "
KQJO " " " "
KQJP " " " "
KERL Los Banos Police Hdqtrs
W6XHA Lyons Peak (San Diego)
KQHK Lynwood City Hall G Martin
KRIB Manhattan Beach 1400 H'land Av MI Ravich
KQKA Martinez (PM) City Hall
KADS Marysville Police Hdqtrs M LeBoeuf
KHNJ Maywood (PM)
KQXV Menlo Park (PM) 1098 El Camino Real W Harrington
KQDP Merced T Margaretic
KDIO Mill Valley (PM) Police Hdqtrs M Lewis
KQDQ Modesto 614 10th St R Gada
KQAG Monrovia 140 E Lime Ave A Locher Jr
KQFE Montebello
KRLF Monterey Colton Hall CE Simpson
KGKR Monterey Park JW Tufts
W6XGQ Mt St Helena
KPNC Napa
KQBF National City 1241 National Ave K Curtis
KQRN Nevada City (PM) 317 Broad St CE Holdstead
KQAF Newport Beach (PM) 2011 Court
KQRV North Sacramento (PM) 1501 Del Paso Blvd EW Lindfelt
KALT Oakland (PM) AJ Morganthal
KADI Oceanside 305 N Nevada TH Berg
KQKT Ontario (PM) 225 S Euclid RC Anderson
KQBI Orange (PM) City Hall Mr Whiteman
KOXC Oxnard 617 A St CD Smith
KAZI Pacific Grove City Hall C Simpson
KQAS Palm Springs HO Platt
KQHK Palo Alto 450 Bryant E Amsler
KGJX Pasadena 142 Arroyo N Pkwy HB Calvert
KIDW Perris (PM) HO Platt
KQCY Petaluma Police Dept JA Sykes
KQCP Piedmont 120 Vista Ave I Hudson
KQDV " (P) " "
KQBT Pittsburg
KALM Pomona
KNFJ " "
KQAU Porterville
KQFT Redlands (PM) 215 N 5th AO Peterson
KRAZ Redwood City Police Hdqtrs W Harrington
KRCP Reedley 1752 10th St
KEYZ Richmond 145 Park Pl HM Watson
KRLW " "
KQJE Riverside (PM) 4089 Orange St R Slaughter
KRPD Roseville
KRPC Ross (PM) Police Hdqtrs JM Lewis
KESJ Ross (P) " "
KNGF Sacramento 6th & H Sts EW Lindfeldt
KHSC " (P) " "
KSPD " " " "
KQHY Salinas (PM) Police Hdqtrs GC Weight
KQBP San Anselmo Tunstead & San Anselmo JM Lewis
KQAC San Bernardino (PM) 416 3rd St RC Anderson
KACN San Buenaventura
KRGK San Carlos (PM)
KFWL San Diego 801 W Market GE Lewis
KGZD San Diego 801 W Market GE Lewis
KRMQ San Fernando JL Gorin
KGPD San Francisco Hall of Justice H Bogardus
KQBL San Gabriel 532 W Mission Dr JW Tufts
KQHV San Jacinto (PM)
W6XHW San Jose City Hall H Kirby
KGPM " "
KRAW San Luis Obispo (PM) 865 Higuera BJ Epperly
KQDW San Marino
KQDA San Mateo 215 B St M Trinta
KRGX San Mateo (P) 215 B St M Trinta
KSRP San Rafael (PM)
KQAK Santa Ana (PM) WE Whitman
KGZO Santa Barbara City Hall HW Brittain
KSBP " " "
KGZT Santa Cruz City Hall WR Keller
KSMP Santa Maria City Hall HW Brittain
KQDF Santa Monica 1685 Main E Cavaness
KRMG Santa Monica (P & PM) 1685 Main E Cavaness
KQDG Santa Rosa City Hall ML Bruner
KPSC Sausalito (PM) Bridgeway Blvd M Lewis
KQGX Seal Beach (PM)
KQFU Signal Hill (PM) 2175 Cherry Ave W Farrell
KQPY South Gate 8437 Victoria Ave GL Martin
KBSP S Pasadena (PM) 1422 Mission H Calvert
KGIA S San Francisco City Hall W Harrington
KQCR Stockton City Hall Moreing Radio Service
KRMF Torrance 1511 Cravens Ave C Long
KACO Tracy
WPDA Tulare City Hall O Woods
KQCG Turlock Police Dept R Gada
KQJA Tustin (PM)
KQKU Upland (PM) Police Hdqtrs C Anderson
KGPG Vallejo
KQBQ Visalia O Wood
KWCP Watsonville 231 Union St H Harrison
KREQ West Covina (PM) 361 W State H'way HW Zeigler
KGHY Whittier 112 W Bailey RL Amsbury
KAGD Woodland 300 1st St CD Bouton
KQGZ Yreka City (PM) City Hall EW Macavoy
KBQY Yuba City (PM) 441 Sumner St M LeBoeuf

COLORADO

KQGA Boulder 1921 14th St KH Cooper
KPCS Colorado Springs City Hall JD Boatright
KQHI Denver JR Derby
KGPX " "
KIUE Englewood (PM)
KQFV Fort Collins City Hall KH Cooper
KQXT Grand Junction 214 S 6th RL Dexter
KPDG Greeley CC Hunter
KPLJ La Junta 13 E 3rd St
KPDL Longmont 4th & Kimbark K Cooper
KQCX Pueblo City Hall RE Barraclough
KRHY " "
KE8Y Sterling 214 Poplar St EG Beehler
KHRI Trinidad (PM) Police Hdqtrs JP Shew

CONNECTICUT

WHNK Bethel (PM) Police Hdqtrs
WLST Bloomfield (PM) J Sipple
WPFW Bridgeport 398 Fairfield Ave
WKEQ " Police Hdqtrs C Frazer
WJVO Bristol 17 N Main CD Muckel
W8RE Danbury 174 Main St S Oliva
WQYB Darien Hecker Ave R Brown
WBXC East Hartford 740 Main St W Clancy
WBMW Enfield
WKGF Fairfield 100 Reef Rd C Fraser
WKVQ Glastonbury (PM) 2367 Main St GC Hall
WQLE Greenwich HJ Robinson
WIZY Groton (PM) 359 Thames St BC Chapman

SCHEDULE OF DIRECTORIES IN *FM* AND TELEVISION

JANUARY	FEBRUARY	MARCH	APRIL
All Police and Emergency Stations in the U. S. A.—includes names of the Radio Supervisors. CLOSING DATE JAN. 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE FEB. 5	FM, AM, and Television Stations in the U. S. A. and Canada—includes general managers, chief engineers. CLOSING DATE MAR. 5	Set and Parts Jobbers, listing general managers & service managers; and Factory Representatives CLOSING DATE APR. 5
MAY	**JUNE**	**JULY**	**AUGUST**
Radio Manufacturers in the U. S. A.—includes the names of general managers and chief engineers. CLOSING DATE MAY 5	Railway Signal Engineers on all roads in the United States, Canada and Mexico. CLOSING DATE JUNE 5	All Police and Emergency Stations in the U. S. A.—includes names of the Radio Supervisors. CLOSING DATE JULY 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE AUG. 5
SEPTEMBER	**OCTOBER**	**NOVEMBER**	**DECEMBER**
FM, AM, and Television Stations in the U. S. A. and Canada—includes general managers, chief engineers. CLOSING DATE SEPT. 5	Set and Parts Jobbers, listing general managers & service managers; and Factory Representatives CLOSING DATE OCT. 5	Radio Manufacturers in the U. S. A.—includes the names of general managers and chief engineers. CLOSING DATE NOV. 5	Railway Signal Engineers on all roads in the United States, Canada and Mexico. CLOSING DATE DEC. 5

MUNICIPAL POLICE, Continued

WHPD Hamden Memorial Town Hall TH Brown
WCZJ Hartford 85 Market St HD Taylo
WQRC " " "
WRZP Manchester 66 Center St F Barlow
WKSM Meriden Police Hdqtrs CD Muckel
WSKV Middletown 225 Main
WBLD Milford W River St T Parkinson

WRAF New Britain 42 Commercial St Univ. Radio Co., Inc.
WBKA New Haven (P) 165 Court St TH Brown
WQFA " " " "
WAKB New London 57 N Bank St GJ Morey
WEIS Norwalk City Hall JF Dorney
WBXY Norwich City Hall TH Brown
WIHL Plymouth (PM)
WPHH Stamford
WSVL "
WCBH Stratford 2725 Main St C Frazer

WKSC Stratford 2725 Main St C Frazer
WCSM Suffield Town Hall JR Gould
WCSO " " "
WKPJ Torrington 106 State St New Haven TH Brown
WJUY Trumbull (PM)
WMIR Wallingford R Tuttle
WJYX Watertown (PM) WA Parker
WMPW Waterbury 235 Grand St E Sullivan
WABT Weathersfield (PM)
WQJI West Hartford 28 S Main St HQ Starkell

WBLB West Haven Town Hall FH Brill
WBLT Westport Town Hall W Whitbeck
WEGJ Willimantic EP Balcom
WLSY Windsor (PM) Town Hall JH Sipple
WHUO Winsted WS Heath

DELAWARE

WAZO Dover
WMDM Milford City Hall H Silverrisen
WRPF Wilmington Police Bureau 10th & King ML Dull
WWPD Wilmington " " "

DISTRICT OF COLUMBIA

WPDW District of Columbia 750 Park Rd FM Beall
WLOV See Lorton Va

FLORIDA

WAJT Belleair (PM) Police Hdqtrs EE Heerdt
WRMO Bradenton
WQOI Clearwater (PM) 100 N Garden HR Weaver
WRHQ Daytona Beach Marion & Magnolia Ave WH Grogan
WBLE Dunedin (PM) R Weaver
WAKO Fort Lauderdale "
WFMF Fort Myers Police Hdqtrs
WPPF Fort Pierce " "
WQFC Gainesville City Hall OR Gano
WSVE Hallandale (PM) L Person

WBJE Holly Hill (PM) 1061 Ridgewood WR Billingsley
WQNL Hollywood L Person
WPFG Jacksonville E Connell
WJBH Jacksonville Beach 316 S 1st EW Connell
WPFT Lakeland 121 N Mass Av BE Atwood
WLWP Lake Worth Heglund & Curl
W4XJY Miami (P) Lieut Ben Demby
W4XKJ " " "
W4XKK " "
WIDHI "

WPFZ Miami
WRLU " (P)
WQMA Miami Beach 100 Meridian Ave GC Bate
WBTW Ocala FJ Cipray
WPHM Orlando FJ Sachse
WMJI Ormond Mr Grogan
WPFX Palm Beach Town Hall Curl & Hegland
WAZU Panama City Luverne Ave & 4th CH Beach
WRGP Pensacola Main & Jefferson B Mead
WQSU St Augustine

WQMZ St Petersburg 333 1st Ave S HD Hirshberg
WQRA Sanford 300 N Park Ave RG Williams
WEAG Sarasota JE Grant
WQSX Tallahassee
WFPT Tampa Florida Ave & Jackson DC Bailey
WPHN " "
WRZY West Palm Beach City Hall ME Curl
WQFN Winter Haven City Hall M Rowe

GEORGIA

WGYI Albany (PM) CM Kinnett
WRJW Americus 101 Lee St JN Worthy
WPDY Atlanta 175 Decatur SE JC Fleming
WQFV Augusta 104 9th St SL Price
WQTC Brunswick
WBLV Columbus
WPFI "
WHNX Gainesville Police Hdqtrs CM Callicott
WQTZ LaGrange Police Hdqtrs JM McKay
WQFB Macon

WQNQ Rome 601 Broad St
WQTR Savannah Police Hdqtrs
WROTH Thomasville J Poole
WBYB Valdosta JW Stewart
WMPF Waycross

TERRITORY OF HAWAII

KFAV Honolulu
KFJC "
KFJD "
KFJJ "
KFJO "
KFJP "
KFJR "
KFJY "
KGPQ "
KFIV " (P)

KFKF Honolulu (P)
KFKK " "
KFLS " "
KRHZ " "

IDAHO

KQBD Boise 118 N 8th St E French
KNFB Idaho Falls Police Dept CN Lane
KRNO Lewiston (PM) City Hall HE Steiner

KQZS Nampa Police Hdqtrs FE Hurt
KRBL Pocatello 239 E Lewis JE Mitchell
KRDZ Twin Falls

ILLINOIS

WQSR Alton 101 E 3rd St B Ruyle
WBNQ Arlington Heights (PM) E Meika
WQRM Aurora 15 Fox St F Schuster
WBOF Bartonville (PM)
WKDV Batavia (PM) W Hampson
WJVI Bedford Park
WQTG Belleville 103 S Illinois LE Dechant
WSVH Berwin 6700 W 26th St W Ponshe
WQRI Bloomington JW Farnsworth
WDBL Broadview (PM) 16th Ave & Rooseveit L Dutton

WIPC Cairo Police Hdqtrs RM Montgomery
WKJN Calumet City 204 Pulaski Rd
WBWG Calumet Park (PM) 12409 S Throop J Pizza
WHNB Canton A Carnahan
WSKZ Centralia E Vaughn
WQIB Champaign 102 N Neil St J Wainscott
WPCB Chicago 1121 S State St FW McLaughlin
WPDC " " "
WPDD " " "
WQJF " 425 E 14th St "

WPDB Chicago 4800 Wabash
WQXZ Chicago Heights 1600 Halsted St G Hahn
WRHC Cicero 4932 W 25th Pl J Spevacek
WBEP Collinsville 100 W Church St L DeChant
WRGQ Danville
WQTF Decatur
WRIJ Des Plaines
WBVY Dolton (PM) G Giess
WRIW Downers Grove GA Ralston
WJVM East Peoria (PM)

WSTX East St Louis 111 N Main St B Ruyle
WJYL Elgin AC Kadow
WQNO "
WQJX Elmhurst 118 Schiller O Johns
WIEG Elmwood Park 11 Elmwood P'way JH Dodman
WQLO Evanston Police Hdqtrs
WBKL Evergreen Park (PM) 9400 S Kedzie Ave
WEKB Flossmore (PM)
WBXG Forest Park 517 Desplaines Ave AR Hess
WJWT Franklin Park (PM) 3113 Atlantic St JH Dodman

WBYF Galesburg 155 S Cherry St WC Day
WQLN Glenece 675 Vernon Ave AC Kadow
WAEX Glen Ellyn (PM) 498 Penn Av CP Fettweis
WGLI Glenview 965 Pine St E Meika
WQYG Granite City
WALG Harrisburg J Tate
WSOK Harvey 156 E 154 St CV Cortiss
WQRE Highland Park 131 S St Johns Ave R Rolf
WROG Hinsdale 23 E 1st St OG Johns
WSKD Homewood 6700 S Archer Argo Ill N Biorn

WBHY Homewood (P) " "
WQLW Joliet 76 N Joliet St W Bowdre
WKPD Kenilworth
WAFC La Grange 27 W Calendar Ave RV Dondanville
WMHZ LaGrange Park RU Dondanville
WQLK Lake Forest 665 Forest Ave R Rolf
WBMG Lansing (PM) 3404 Lake E VanLaningham
WQKR LaSalle City Bldg
WQGV Lawrenceville 601 11th St
WSYW Libertyville (PM) 116 W Cook Ave HF Quandt

WDBT Lincoln City Hall JD Farnsworth
WSKR Lincolnwood (PM) 6918 N Keeler Ave EG Meika
WDCV Lyons (PM) 7801 W Ogden Av L Dutton
WMQK Madison 1529 3rd St WF Guennewig
WQHX Marion 100 Public Sq EW Baumeyer
WBZB Marwood A Rizzio
WJXF Midlothian (PM) 3822 W 147th St FC Fuller
WAON Moline Police Hdqtrs R Anderson
WMHI Monmouth A Carnahan
WSKJ Morton Grove (PM) 8531 Callie Ave EG Meika

WMTV Mt. Vernon 1100 Main St AH Featherstun
WAJS Mundelein (PM) Hawley St JJ Shields
WMKU Nameoki W Guennewig
WROA Naperville
WQJR Normal 128 E Beaufort St JD Farnsworth
WRLN N Chicago (PM) 1815 Sheridan Rd HF Quandt
WIWZ Oak Lawn (PM)
WQLF Oak Park Euclid & Lake St VL Watson
WSRZ Oglesby (PM) 128 W Walnut St
WQKN Ottawa 105 Lincoln Pl RM Nicholson

WBZD Park Ridge
WSTO Pekin 400 Margaret St K Patterson
WQOP Peoria
WRIM " (P)
WMWZ Peoria Hgts (PM)
WQKM Peru 1530 4th St
WBHZ Quincy 301 Hampshire St W Lindsay
WBMQ Riverdale (PM) Police Hdqtrs CF Fuller
WQIN River Forest 7810 Central Ave WK Ingle
WRIX " (P) " "

WJWS River Grove (PM) J Dodman
WCEV Riverside LE Dutton
WPGD Rockford 410 Walnut St LS Ward
WBDI Rock Island 316 16th St R Anderson
WQXL Skokie 5127 Oakton St E Meika
WBNP South Beloit (PM)
WQXJ Springfield 617 E Jefferson VO Lehman
WQKE Streator Police Hdqtrs RM Nicholson
WSTY St Charles (PM)
WAGR Urbana J Wainscott

WBLS Villa Park 20 S Ardmore Ave O Johns
WJEC Waukegan 111 Madison D Duncan
WQLM " (PM) " "
WDCR W Chicago (PM) 132 Main C Fettweis
WKYZ Western Springs 914 Hilgrove Ave RV Dondanville
WQJV Wheaton 300 W Wesley St CP Fettweis
WDEY Wilmette Village Hall J Dodman
WQTO Winnetka 510 Green Bay Rd EG Meika

INDIANA

WEDX Alexandria 123 N Wayne A Titus
WMPI Anderson
WACT Auburn City Hall MJ Hull
WBIP Bedford J Nolon
WBPD Bloomington
WAMI Bluffton 128 E Market H Noonan

WGHQ Columbia City (PM) MJ Hull
WRJF Columbus
WAMB Connersville Police Hdqtrs WS Moore
WCIP Crawfordsville City Hall F Burkhardt

WRQT E Chicago 4525 Indianapolis Blvd JL Stull
WSGP East Chicago (P) " "
WBVH Elkhart 133 E Franklin St WW Wiegner
WASF Elwood 1600 Main St J Lowder
WQKB Evansville 200 SE 2nd St ND Covert
WETS " " "
WBST Fort Wayne (P) CN Hoemig
WPDZ " " "
WAKK Frankfort 16 N Main St HR Evans
WAEE Gary Police Dept V Christman

WSKI Goshen (PM)
WQKY Hammond City Hall G Maynard
WRGW " " "
WAKA Huntington
WMDZ Indianapolis RL Batts
WLSM Indianapolis (P) RL Batts
WJAI Jasper (PM) City Hall HC Nolan
WPDT Kokomo Police Hdqtrs
WQFQ Lafayette 6th & Columbia HC Garba
WMPL La Porte 803 Indiana Ave R Wuletich

WMPQ Logansport City Bldg R Barnes
WRAY Marion B Welcht
WSVF Michigan City Police Hdqtrs V Christman
WSKP Mishawaka 204 E 1st St LH Wert
WBTY Mt Vernon 530 Main St NG Covert
WPGP Muncie RO Smith
WBWX New Albany J Pritchard
WBNC New Castle Police Hdqtrs W Reynolds
WKUO Noblesville 838 Maple Ave
WASC Peru J Hull

WPDH Richmond 5 N 5th St R McDonald
WKRI Richmond (P) " "
WDPS Shelbyville 44 W Washington M Fisher
WPGN South Bend 222 N Main St L Wert
WQOF Terre Haute 17 Harding Ave FS Casteel
WMPV Valparaiso City Hall L Lohr
WQKT Vincennes 21 S 4th St E Robb
WBIE Wabash Police Dept LW Keller
WJKM Warsaw (PM)
WRMW W Lafayette (PM) N W & North H Garba

WQKD Whiting 1600 Fischruff Ave W Wehmeyer

IOWA

KQFW Ames City Hall
KQAR Burlington AG Kline
KFLZ Cedar Rapids (Portable)
KGOZ Cedar Rapids
KRIX Clinton City Hall R Johnson
KPCB Council Bluffs (PM) Police Dept C Gaines
KGPN Davenport 216-230 W Fourth R Phillips
KGZG Des Moines E 1st & Court Ave LE Olney
KQDT Dubuque Police Dept JI Osterhoff
KQZF Fort Dodge 813 1st Ave S DG Sinclair

KBYS Fort Madison
KAWP Iowa City 25 S Linn St SJ Ebert
KRHL Marshalltown Police Dept GR Sutton
KQAE Mason City RE Sawyer
KQJI Oskaloosa M McGlothlin
KPDO Ottumwa M McGlothlin
KGPK Sioux City 116 6th St RL Beck
KRMJ Waterloo 619 Lafayette St

KANSAS

KACA Atchison 515 Kansas Ave CH Lyman
KGZF Chanute Police Dept
KGZP Coffeyville City Hall M Hawkins
KNGH Dodge City Fourth & Spruce R Hickman
KAPD Eldorado 101 N Vine I Graham
KQUJ Emporia 103 E 5th St HR Kinkaid
KNFH Garden City Police Dept RW Snyder
KBQN Great Bend
KGHN Hutchinson 18 B East DG Baumhart
KAPG Iola 119½ W Madison H Gardner

KQBH Kansas City City Hall J Wilt
KROK " D Humarks
KQBM Lawrence 745 Vermont St C Bliesne
KNFF Leavenworth
KRJC Manhattan 112 N 3rd St
KGKD Parsons 1819½ Washington St L Stafford
KPGK Pittsburg 4th & Pine Sts LS Stafford
KNGV Salina 5th & Ash TL Bayne
KGZC Topeka 204 W 5th St EN Johnston
KGPZ Wichita 115 E Williams HO Byers

KENTUCKY

WMHD Anchorage (PM)
WSAG Ashland City Bldg VN Reese
WRNM Bowling Green Police Dept J Gerard
WKXC Covington 3rd & Court J Dickerson
WMHK Hazard
WQTT Henderson 238 1st St R Davidson
WRPE Hopkinsville 500 S Main St W Roper
WPET Lexington
WPDE Louisville W Lane
WMKY Madisonville ND Covert

WRPG Maysville 223 Court St H Stone
WRPJ Owensboro 325 St Ann L Goodaker
WQNP Paducah 4th & Kentucky TW Clark
WSYK Shively (PM)

LOUISIANA

KHML Alexandria (Parish) Sheriff's Dept MN Sandefur
KPAL Alexandria 518 Lee St MN Sandefur
WBRP Baton Rouge Police Dept F Bowers
WFKK Bogalusa Arkansas & Memphis A Gatlin
WAME E Baton Rouge Parish (PM)
KANX Houma (Parish) Wood & Russell Sts
KRKP Lake Charles City Hall AP Kay
KLFN Lafayette Court House
KPML Monroe City Hall HE Griffith
KRAV New Iberia 110 W Main St

WPEK New Orleans 2700 Tulane Ave MB O'Neil
KNGP Shreveport 801 Crockett St AF Wingate
KNGO Shreveport (P) " "
KHBM St. Martinville City Hall TJ Lovas

MAINE

WSAH Auburn 45 Spring St F Perkins
WALR Augusta 1 Cony St
WJTM Bangor Police Dept JH Wibby
WLBM Bath Police Dept C Shaw
WLDU Houlton Water St E Trumpfeller
WRQH Lewiston City Bldg FM Perkins
WPFU Portland 132 Federal St TJ Barry
WPIN Presque Isle 5 Church St LE Hughes

ENGINEERED INSULATORS

Johnson Radio Engineers have been specialists in insulator design for radio frequencies for almost a quarter of a century. Shapes to provide strength for strains and stresses — reinforced mounting holes and carefully designed mountings — high internal resistance to radio frequency voltage — long leakage path — careful treatment to present a surface that will not collect dirt and foreign matter — quality hardware, not punched nuts and poorly formed parts — materials selected for their radio frequency characteristics, not the ordinary variety of ceramics. To Johnson Engineers an insulator is a piece of radio apparatus and given the same careful attention in design and production. As a result you can't buy a better insulator than Johnson. Your radio-electronics parts jobber stocks Johnson insulators.

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MUNICIPAL POLICE, Continued

WMQT Saco TJ Perry
WMHB Sanford 213 Main St T Barry

WCAD South Portland 25 Cottage St K Woodbury
WJYE Waterville Police Dept R Parker

MARYLAND

WAMD Annapolis Gloucester St GW Rawlings
WPFH Baltimore
WMEY Cumberland Public Safety Bldg AE Burke
WAUM Frederick City Hall IL Hankey
WABV Greenbelt (PM) L Mackall
WHMD Hagerstown City Hall GW McIntire
WAOL Hyattsville (PM)
WBVQ Salisbury City Hall MT Bohler

MASSACHUSETTS

WITY Acton (PM)
WMKZ Agawam (PM)
WBRJ Andover G Hinkley
WPED Arlington 7 Central St C Scannell
WBJA Athol 206 Exchange St WJ Callahan
WBVC Attleboro Wall St L Jaquilla
WBHC Auburn (PM)
WAMQ Barre Police Dept JH Higgins
WRJZ Belmont Concord Ave R Anderson
WBMP Beverly 191 Cabot St RF Anderson

WQIP Boston 154 Berkeley Lt AH Vickerson
WRAS " " "
WAGJ Boston (P) "
W1XWE " " "
W1XWF " " "
WQRF " (MDC) (P) 20 Somerset DJ McFarlane
WQRG " " (P) "
WQRH " " (P) "
WBUA Braintree Police Dept ER Myrbeck
WMPB Brockton 30 E Elm St CO Nowell

WQKK Brookline 339 Washington St A Charlton
WQLF Cambridge 7 Western Ave EF Tierney
WKWU " " "
WSTI Chelmsford (PM) Police Dept RJ Huislander
WAFL Chelsea 19 Park St JF Porter
WBMT Chicopee Police Dept WG Patterson
WBGV Clinton
WPGU Cohasset 8 Main St EA Edwards
WRAC Concord R Anderson
WRAU Danvers 7 School St FA Stacey

WRJT Dartmouth Police Dept J Medeiros
WRNU Dedham MB Rowe
WDBI Duxbury (PM)
WAKF Everett J Porter
WFMP Fairhaven 31 William St ET Parker
WAKV Fall River 158 Bedford St WS Giblin
WPHA Fitchburg 20 Elm St CR Rawson
WKMF Foxboro Rockhill St G Brown
WBWZ Gardner 115 Pleasant St MW Preston
WGMP Gloucester 10 Duncan St G Keefe

WKQT Greenfield Police Dept L Wheeler
WHAV Haverhill Court St DP Mahoney
WQTI Hingham Lincoln St A Sylvester
WQIF Holyoke 206 Maple St A Senay
WEHB Hudson Main St JT Connington
WQYD Hull Police Dept A Sylvester
WQYE " " JP Duffy
WMJQ Ipswich Elm St FA Stacey
WKDX Kingston (PM)
WBLC Lawrence 18 Lawrence St R Anderson

WBND Leominster West St CW Hardy
WBTZ Lexington 1625 Mass Ave RF Anderson
WBOQ Lincoln (PM) 20 Williams St AD King
WBUI Longmeadow AD King
WQNR Lowell Market St HA Morrison
WKLM Lynn 18 Sutton St ED Callahan
WLDP Lynnfield Summer St RF Anderson
WSVC Malden 15 Middlesex St JF Porter
WBRT Manchester RF Anderson
WAQO Mansfield Police Dept AJ Nielsen

WBVZ Marblehead RF Anderson
WJHJ Marshfield (PM)
WPHG Medford 80 Main St JA MacInnis
WMEJ Melrose 562 Main
WBGA Methuen H Fieldhouse
WQRT Milton (MDC) DJ McFarlane
WRBA " 36 Central Ave M Welch
WQJH Natick 2 Park St
WMPN Needham 99 School St M Rowe
WPFN New Bedford 25 Spring St W Soboski

WBMF Newburyport 4 Green St PD Tribou
WBSW Newton (P) 1321 Washington WW Hartford
WPFA Newton (P) 1321 Washington WW Hartford
WQOV North Adams State St L Lavendol
WEIL North Andover Police Dept
WBMB Northampton Police Dept AC Egan
WCET Norwood Nahatan St WH Sullivan
WAVN Pembroke (PM)
WEIW Phillipston J Harrington
WJKH Pittsfield 39 Allen St RF Coakley

WQYJ Plymouth Police Dept E Grady
WQRP Quincy 442 Southern Artery JP Duffy
WQID Reading Pleasant St RF Anderson
WMPR Revere Police Dept T Tranfaglia
WQYI Rockport 37 Broadway W Mills
WRCG Salem 17 Central St FA Stacey
WHNS Salisbury Police Dept
WAYU Saugus 7 Taylor St RF Anderson
WQOJ Scituate First Parish Rd AF Sylvester
WQSO Sharon GC Wright

WBOG Shrewsbury 12 Church Rd
WPEH Somerville 67 Union Sq JA MacInnis
WAMX Southborough U Brault
WBTV Southbridge Police Dept
WQMD Springfield
WRHB Stoneham R Anderson
WKTB Taunton 16 Court St JW Flood
WQTY Tewksbury (PM) Police Dept CL Barker
WKWM Wakefield Police Dept
WHNQ Walpole Police Dept

WRNA Waltham Town Hall RF Anderson
WAGL Ware H Richard
WSTW Wareham Town Hall TW Coakley
WBNE Watertown 38 Cross St MT Rowe
WMKW Webster 39 High St
WQJG Wellesley 49 Church St MT Rowe
WWBM West Bridgewater (PM)
WAKW Westfield J Davick
WBVI Westford (PM)
WHTE Weston Police Dept JS Viles

WMWP Westport Main Rd JE Harrington
WFLL West Springfield (PM) G Dorsam
WKYA Westwood (PM)
WBVN Weymouth 1393 Pleasant St
WJHQ Winchendon MW Preston
WJYI Wilmington (PM)
WQSV Winchester
WAKZ Woburn 10 Common St A Stockelburg
WPGX Worcester Police Dept F Driscoll

MICHIGAN

WSKH Allen Park (PM) W Runkle
WQKV Alpena City Hall LA Pusel
WQRK Ann Arbor Huron & Fifth CR Nevins
WRLM Battle Creek
WQRK " (PM)
WRLM " (PM)
WPGA " (PM)
WPGA Bay City City Hall FE Simons
WSVO Benton Harbor (PM) City Hall E Ziek
WRIZ Berkley (PM)

WRIY Birmingham City Hall HH Rash
WQOG Bloomfield Hills E Long Lake Rd E Gocha
WBNR Center Line (Warren Twp) 22901 Memphis St Van Dyke D Morrison
WGBX Center Line (PM) 7550 10 Mi Rd D Morrison
WRJA Clawson (PM) 35 W Clawson Rd EC Gocha
WQND Dearborn
WCK Detroit 1300 Beaubien EC Denstaedt
WFGF " " " "
WPDX " " " "
WAEZ East Detroit (PM) 16083 Nine Mile Rd D Morrison

WQMH Ecorse Police Hdqtrs A Gillman
WAYA Escanaba 115 S 11th St G Brosick
WRJB Ferndale (PM) E Gocha
WPDF Flint 615 Beach St G Jewett
WSOJ Grand Haven Police Dept H VanderWal
WPEB Grand Rapids 35 Crescent St NR Sellon
WCPX " (P) " "
WQMT Grosse Pointe L Carrier
WRDR "
WQMT Grosse Pointe

WQTD Hamtramck 8521 Jos Campau Ave SA Jerzykowski
WJUG Hazel Park (PM)
WMO Highland Park 23 Gerald Av DF Weston
WHBM Holland 63 West 8th H Vander Wall
WRJC Huntington Woods (PM) 12775 W 11 Mi Rd E Gocha
WPHP Jackson
WAMG Kalamazoo 146 E Water St JA MacGregor
WKWQ Lansing City Hall C Wolfe
WPDL " " " "
WQLL Lincoln Park Police Dept

WSLJ Marquette 210 Washington St G Brozek
WDBM Marysville (PM) 29 Huron Blvd L Conant
WMLF Mason (Lansing) C Wolfe
WRZQ Menominee 715 Sheridan Rd M Lund
WBLA Midland 202 Ashman LW Burd
WQTB Monroe
WSRQ Mount Clemens (PM) DO Morrison
WPFC Muskegon Walton & Jefferson FE Castenholz
WBKD Muskegon Heights (PM) FE Castenholz
WBHW New Haven (PM) 2900 Main St HR Shampine

WRQF Niles Police Dept
WDBK Oak Park (PM)
WQFL "
WDDI Owosso Municipal Bldg K Fortman
WBXO Parchment (PM) 146 E Water JA MacGregor
WRJD Pleasant Ridge (PM) 23646 Woodward E Bocha
WQMG Pontiac 8 N Perry E Gocha
WPGB Port Huron City Hall L Conant
WROQ River Rouge R Howe
WRIR Roseville 27700 Gratiot D Morrison

WQMB Royal Oak 205 Williams St GF Blount
WBWM " (P) " "
WQVX Royal Oak Twp (PM) "
WPES Saginaw 1315 S Washington R Manchester
WAGP St. Clair Shores (PM)
WSQM St. Joseph (PM) Police Dept E Zick
WCBQ Sault Ste. Marie City Hall E Kaari
WRMB Traverse City 118 Cass St JV Ealy
WRHV Wyandotte 3505 Biddle Ave C Wesser
WQOK Ypsilanti

MINNESOTA

KQBG Austin Maple & Chatham H Ferris
WRJP Brainerd City Hall T Templeton
WFJC Cloquet City Hall RO Elmgren
KNFE Duluth City Hall AA Jarvi
KQRK " (P) " "
KQED Faribault M Washa & J Houts
WJUI Hibbing H Schroeder & H Jackson
KQAA Mankato J Houts
KGPB Minneapolis
KGPR "

KQDB Red Wing City Hall LL Dosdall
KQAM Rochester City Hall B Hagaman
KQFY St. Cloud Police Dept R Mitschen
WPDS St. Paul 235 Grand Ave L Ginther
KQGR South St. Paul (PM)
WDCX Virginia City Hall E Begley
KBZB Winona WA Haeussinger

MISSISSIPPI

WJJN Biloxi Police Dept AH Ryan
WMPG Greenville 222 Main St AN Rankin
WSRW Greenwood R Soward
WQPP Gulfport 1510 24 Ave D Murphy
WBJC Hattiesburg
WAMK Jackson WM Ellington
WLCP Laurel
WAMJ Natchez Police Dept WT Golson
WRNC Vicksburg City Hall FL Ford

MISSOURI

KQBS Cape Girardeau 538 Independence FL Schneider
KQDE Columbia Seventh & Walnut HW Duncan
KWRU Hannibal 201 S 4th St B Schenke
KRLK Independence ME Hall
KQAJ Joplin City Hall RP Meek
KGPE Kansas City 1125 Locust St R DeShaffon
KQOU Ladue 9345 Clayton Rd P Kilby
KQCD St. Charles 101 S Main P Kilby

KQBW St. Joseph 710 S Ninth St
KGPC St. Louis 12 & Clark JH Teeter

KAME Sedalia 2nd & Osage St G Curnutt
KQBO Springfield 214 S Market E Maxey

MONTANA

KQHU Anaconda 401 E Comm W Derzay
KQIZ Billings 224 N 27th St - LE Grube
KBSO Bozeman 326 E Main St E Neath
KBPD Butte 24 E B'dway WI Whipple
KPGF Great Falls 425 2nd Ave VA Dolva
KHMP Helena Civic Center GF Pfeiffer
KGKC Kalispell City Hall D Gorman
KFMW Miles City 19 S 8th St I Elliot

NEBRASKA

KQAV Grand Island City Hall WA Barrett
KRLX Hastings 104 N Burlington C Peterson
KGZU Lincoln 323 N 10 St JT Carroll
KNGN Norfolk 127 N 4th St F Weidenbach
KRGW North Platte 420 E 8 St L Mills
KGPI Omaha 105 S 11th St CC Gaines
KRKV Scottsbluff EA Guilliams

KQWD South Sioux City (PM)

NEVADA

KGHG Las Vegas 120 N2 St RO Dow
KGHM Reno 41 E 1st St NA Sowle
KGHC Sparks Police Hdqtrs NA Sowle

NEW HAMPSHIRE

WKTX Claremont Court House B Cutting
WRJV Concord 3 Warren St H Bean
WMYQ Dover B Cutting
WJLR Keene 11 Washington St JL Regan
WCOT Laconia 68 Pleasant St B Cutting
WQLQ Manchester 351 Chestnut St JA Wheeler
WPHB Nashua 229 Main St J Wheeler
WKSA Portsmouth
WGAZ Rochester Wakefield St B Cutting

NEW JERSEY

WQRO Alpine (PM) Police Hqts P Welland
WSOE " Interstate Park Police
WABM Asbury Park 646 MattisonAve CW Rogers
WLDN Atlantic City D. Homarks
WQIY "
WJZB Atlantic Highlands (PM) 106 First Ave R Johnson
WETQ Audubon Oak & Atlantic Ave E Schneider
WQXN Bayonne 26 St & Ave C VJ Doyle
WBQX Belleville
WQNT Belmar 8th Ave & E St R Johnson

WRJU Bergenfield 198 N Washington JS O'Neil
WAKH Bloomfield
WAKD Bloomingdale (PM)
WIUA Bogota 375 Larch Ave JS O'Neill
WFUA Boonton 713 Main St HM Warner
WQKA Bound Brook 226 Hamilton St TJ Cain
WQHW Bradley Beach 701 Main
W8KA Bridgeton
WDBX Brielle (PM) Boro Hall R Johnson
WJVN Brigantine

WQNA Budd Lake (Mt. Olive) Rte 6 HM Warner
WB8X Burlington
WANZ Butler (PM) Belleview Ave HM Warner
WQNI Camden City Hall JA Howell
WFZG Camden (PM) " "
WKUZ Carlstadt (PM)
WAWX Cedar Grove Police Dept S O'Neill
WBCX Cliffside Park
WSQO Clifton
WRLZ Closter Boro Hall

WQNG Collingswood 26 W Collings Ave E Schneider
WQMC Cranford 114 No Union F Linder
WRPR Cresskill (PM)
WQOQ Deal Durant Sq J Wallace
WDHM Dover 37 N Sussex St WW Knapp
WBNW Dumont 42 Park Ave JW Middleton
WETX East Hanover (PM) R Hunt
WQKI East Orange 61 N Munn Ave TO Laird
WPJV Eatontown (PM)
WBOO Edgewater 916 River Rd S O'Neill

WRAD Elizabeth 35-39 Morrell St F Weck
WHBA Emerson (PM) Linwood Ave S O'Neill
WQIK Englewood Police Dept JH Bellingham
WBMC Englewood Cliffs (PM)
WJJE Englishtown (PM) RJ Johnson
WRKY Ewing (PM)
WCAK Fair Lawn 10-01 Gardner Rd JS O'Neill
WQYZ Fanwood (PM) 131 Watson Rd F Linder
WSRL Florham Park (PM) Ridgedale Ave WW Knapp
WBYC Fords

WBKN Fort Lee J Midleton
WAII Freehold (PM) P Coyne
WRQE Garfield
WGIP Garwood (PM) F Linder
WQIJ Hackensack 24 Mercer St JS O'Neill
WBKH Haddon (PM) Police Dept E Schneider
WRBJ Haddonfield Boro Hall C Brokaw
WRAN Haddon Heights 608 Station Ave RCA Camden
WBTK Haledon (PM)
WQJM Hamilton Twp (PM) Harrison Av CL Allen

WLSH Hanover Twp (PM) Whippany NJ H'way 10 R Hunt
WBYX Hasbrouck Heights 248 Hamilton Ave JS O'Neill
WRGN Hawthorne R Vandervalk
WBXL Highland Park Police Dept JL Potter
WSYZ Hillside
WMFH Hoboken Police Dept G Baumann
W8RP Hohokus (PM)
WLSN Irvington 22 Washington Ave
WQRS Jersey City 769 Montgomery E Arnold
WRMJ " (P) " "

WRPH Kearny 404 Kearny Ave W Green
WDCM Keyport
WRBT Lakewood Police Dept E Theibault
WQJN Lawrence (PM)
WSTB Leonia JS O'Neil
WAJQ Linden Police Dept W Green
WJKI Little Falls Stevens Ave H Warner
WFAB Little Silver (PM) Boro Hall RS Johnson
WQMK Livingston 62 S Livingston Ave RH Hunt
WQNF Long Branch 344 Broadway R Johnson

MUNICIPAL POLICE, Continued

WQMP Longport
WBTT Lower Penns Neck (PM)
WSOM Lyndhurst Municipal Bldg JS O'Neill
WQJU Madison
WCBB Mahwah Twp
WMNJ Manasquan (PM)
WBYR Manville JJ Jasinski
WRLY Margate City City Hall F Kearns
WCBL Matawan (PM)
WKZB Mataway Twp (PM)

WQMX Maywood 14 Park Ave JS O'Neill
WQLT Metuchen Main & Middlesex Av F Linder
WFZD Middlesex (PM) Garden Pl & Bound Brook T Cain
WBXZ Middletown (PM) Police Dept RJ Johnson
WQKJ Millburn 375 Millburn Ave AW Currey
WRHR Millville S High St
WQMO Montclair (PM) 51 Valley Rd HM Warner
WKPM Montville (PM) Police Hqtrs HM Warner
WGNQ Moorestown 40 E Main St R Barrington
WQXR Morristown 110 South St T Laird

WBXE Mountainside (PM) F Linder
WBOD Mount Holly 21 Washington St Barrington Radio Serv
WBYD Neptune 137 S Main St RJ Reynolds
WKKG Neptune City (PM)
WQIE Newark JM McGowan
WQRV New Brunswick Rear 78 Bayard St FA Higgins
WGCS New Milford 249 Center St HL Jordon
WBRZ North Arlington
WAHG North Bergen
WBVF North Haledon (PM) S O'Neil

WQJS North Plainfield 255 Somerset St MJ Kane
WRHG Nutley
WBGU Oakland (PM)
WRMG Oakiyn (PM) Police Dept RCA
WHTV Ocean City 9th St & Asbury Ave F Kearns
WCBU Oceanport (PM) Main St R Johnson
WGMU Oradell
WQTS Orange (PM) City Hall T Laird
WPPP Palisades Park (PM) Broad Av J Middleton
WBKE Paramus (PM) S O'Neil

WQKH Passaic
WRGO Paterson 111 Washington St S O'Neill
WSPT Pennsauken 6512 Wyndam Rd R Barrington
WBSL Penns Grove State & W Main WH Atkinson
WANX Pequannock (PM) Pompton Tpk Pompton Plains HM Warner
WFTK Perth Amboy 56 Fayette St WW Knapp
WENX Phillipsburg
WQJY Piscataway
WAOW Pitman S N B'dway W Atkinson
WQKG Plainfield Cleveland Ave F Linder

WQMQ Pleasantville 14 N 1st WH Atkinson
WAXV Point Pleasant (PM)
WSWI Pompton Lakes 25 Lenox Ave Chief WF Charles
WQTA Princeton 50 Stockton St R Applegate
WRBI Princeton Twp (PM)
WBTL Prospect Park (PM)
WQYG Rahway 1470 Campbell St F Knapp
WQJC Raritan
WIEJ Red Bank 51 Monmouth St RS Johnson
WBKP Ridgefield

WSKM Ridgefield Park 232 Main St JS O'Neill
WQYF Ridgewood Police Dept S O'Neill
WAKJ Ringwood (PM)
WDYY River Edge (PM) 705 Kinderkamack Rd S O'Neil
WQMY Roselle
WQJQ Roselle Park 139 Chestnut St WW Knapp
WQKQ Rumson R Johnson & JE Ward
WBMJ Rutherford S O'Neil
WMHT Saddle River (PM)
WSQK Salem Market St R Rosen Co Philadelphia

WSPP Scotch Plains F Linder
WFUO Sea Girt (PM)
WQIL Secacus Paterson Plank Rd A Temple
WRSO Somerville 41 N Bridge St J McCoo
WBJD South Belmar (PM) F St & Redmond Ave R Johnson
WBXJ Boro of S Bound Brook (PM)
WABU South Plainfield
WSLG Sparta Twp
WBHG Springfield Police Dept WW Knapp
WRAZ Spring Lake 311 Wash Ave RS Johnson

WQRX Summit Police Dept F Linder
WQJO Teaneck
WGVZ Teaneck (P)
WRGI Tenafly 42 Washington St S O'Neill
WJKC Totowa (PM) Police Hdqtrs S O'Neill
WQIZ Trenton Chancery Lane LF Neese
WRPI " (P) " "
WQJB Union 981 Caldwell Ave WW Knapp
WQNY Union City H Kane
WAYE Upper-Penn's-Neck (PM) Carney's Pt NJ TL Smith

WQKX Ventnor City Cambridge & Atlantic W Atkinson
WBWH Ventnor City (P) "
WLDR Ventnor City "
WQYH Verona 600 Bloomfield Ave HM Warner
WAKM Wanaque (PM) Ringwood Ave
WSPE Watchung (PM)
WSLC Wayne
WKGL Weehawken 400 Park Ave J Middleton
WSQN West Caldwell (PM) 3 Fairfield Ave R Hunt
WQOM Westfield 121 Prospect St Sgt Wragg

WFOV West Long Branch (PM)
WBNG West Milford (PM)
WQRN West New York
WSKN West Orange (PM) Police Dept AA Christiano
WSKN West Orange (PM) Police Dept
WIUO West Paterson (PM)
WRMZ Westwood
WBOJ Wildwood F Kearns
WQJE Woodbridge
WRLV Woodbury 33 Delaware St R Rosen Co Phila

NEW MEXICO

KGZX Albuquerque
KNFA Clovis
KRNM Roswell Police Dept
KGPF Santa Fe T Gonsales

NEW YORK

WPGH Albany
WHDI Amityville Police Dept
WKNI Amsterdam 292 Locust Ave GH Wells
WMLG Arcade (PM)
WPDN Auburn Market St HJ House
WROI Babylon " "
WROP " (PM)
WRJS Batavia
WJXL Bear Mountain Police Hdqtrs S O'Neill
WPGL Binghampton 18 Hawley St HW Squires
WHTZ " " "

WBDN Briarcliff Manor (PM)
WQOY Bronxville 200 Pondfield Rd
WMJ Buffalo Church & Franklin Sts J Buchanan
WKQO Buffalo City Hall
WEKU Chappaqua (New Castle)
WBLF Clarkstown (PM) Nanuet NY W McDermott
WKPI Corning Police Dept J Mulligan
WBID Cortland 23 Court St J Frye
WQLC Eastchester Police Dept W Robinson
WKVI East Hampton (PM)

WBLL Elmira J Mulligan
WIKE Endicott Police Dept CJ Yeager
WBDO Floral Park 9 Floral Blvd S Fleming
WAFR Freeport 40 N Ocean Ave P Elar
WBIC Fulton 67 S First F Maude
WQKO Garden City 110 7th St E Ruth
WQOU Geneva Police Dept AC Hausmann
WRJG Glen Cove
WBVK Grand View on Hudson (PM) 118 River Rd GP Cline
WQKZ Greenburgh

WQLX Harrison
WBLG Haverstraw (PM)
WQTK "
WQKP Hempstead 10 N Franklin St E Ruth
WAKN Herkimer
WBOY Hilliburn (PM) Police Dept H Wanamaker
WRAP Hornell 10 B'dway F Clark
WPGO Huntington 219 Main St AW Biggs
WQNS Ithaca WC Simmers
WJNY Jamestown 210 E 3rd St RN Johnson

WMOJ Johnson City (PM)
WQXP Kingston Police Dept
WMOQ Lake Success
WQJT Larchmont Municipal Bldg WT Keresey
WRIO " (Mamaroneck) 11 Edgewood Ave LV Boivin
WROJ Lindenhurst (PM) Babylon Town Hall
WKAF Lockport (P) 36 Pine St HP Sy
WKAG " (P) " "
WKAH " (P) " "
WLOC " " "

WLOD " (P) " "
WQEZ Mahopac (Carmel)
WSNK Mamaroneck 169 Mt. Pleasant Ave J Porkorny
WMJX Massena Police Dept CF Reed
WSRN Middletown Police Dept EH Warnock
WQLV Mount Vernon Police Dept MI Silverstein
WEUA Newburgh 81 B'dway TH Brown
WQKC New Rochelle 23 Lawton St JP Doege
WBIS NewYork (P) 240 Center St FA Burns
WBIT " (P) "

WBKF " (P) "
WNYM " (P) "
WPEE " "
WPEF " "
WPEG " "
WRGS " (P) "
WRQC " "
WRQD " "
KHCWX " "
KHCWW " "

WNFP Niagara Falls
WBAH " (P)
WBAT " (P)
WBAW " (P)
WBBJ " (P)
WBBP " (P)
WBBQ " (P)
WBBS " (P)
WBBT " (P)
WBBU " (P)

WBBV Niagara Falls (P)
WBBY " (P)
WBCB " (P)
WBCN " (P)
WBCX " (P)
WBCY " (P)
WETY Nissequogue (PM)
WQLD North Pelham Bodner Radio Inc Tuckahoe
WBXN N Tarrytown 28 Beekman Av J Livingston
WBTI North Tonawanda Police Dept J Hewitt

WRGM Nyack
WQMV Olean
WJAM Oneida 169 Phelps St R Reynolds
WQFJ Oneonta 238-242 Main St WR Bates
WSWJ Orangetown (PM)
WQNH Ossining Municipal Bldg Jasper Livingston
WJXL Palisades Park (PM)
WRNE Patchogue (Brookhaven)
WBZW Peekskill 926 Central Ave J Doherty
WDAG Pelham (P & PM) 195 Sparks Ave CJ Bodnar Co

WQOT Pelham (PM) 195 Sparks Ave CJ Bodnar Co
WJFU Pelham Manor 4 Penfield Pl JW Lyon
WQOS " (PM) " "
WRHE Piermont Police Dept
WDGS Plattsburgh City Hall J Vrindten
WRSY Port Chester 346-350 N Main HR Stevenson
WRND Port Jefferson
WQXY Port Jervis 21 Sussex St LC Kadel
WABN Port Washington Police Dept
WRCV Poughkeepsie Little Washington St E Prichard

WBLH Ramapo (PM) Police Dept WR McDermott
WPDR Rochester
WKHZ Rome City Hall G Evans
WQKU Rye 25 Third St V Burke
WBSB Salamanca
WQHZ Sands Point
WQKL Scarsdale JJ Shwedo
WQRB Schenectady 301 Clinton St GH Wells
WBWN Sloatsburg (PM)
WAFV Smithtown Branch Police Dept

WBVR South Nyack (PM)
WBLI Spring Valley (PM) Police Dept W McDermott
WBLM Suffern (PM) W McDermott
WPEA Syracuse 2306 Grant Blvd R Wood
WBLN Tarrytown 54 Main St
WRCD Troy
WQJD Tuckahoe
WBLO Upper Nyack (PM)
WPGJ Utica 315 Oriskany St W FL Peterson
WMLJ Warsaw (PM)

WCDX Watertown City Hall J Lewis
WMJN Watervliet
WQKS White Plains 255 Main St E Cunningham
WRNJ Williamsville (Amherst)
WPFY Yonkers Wells & Woodworth Av PF Dankovic

NORTH CAROLINA

WQMJ Asheville (PM) City Plaza AZ Bridgewater
WRJE Burlington Front & Worth St B Tysor
WPDV Charlotte 625 E 4 St WF Anderson
WRPL " H Palmer
WSLF " HC Severs
WQNE Concord
WDMP Durham Police Dept AL de Bruyne
WBIV Elizabeth City 100 S Martin St
WROS Fayetteville Police Dept WC Finch
WQNZ Gastonia City Hall J Abernathy

WABQ Goldsboro City Hall D Trueblood
WQMR Greensboro 200 N Greene St RL Byrum
WRGY Hickory ES Long
WHPP High Point 200 E Commerce RL Byrum
WIUD Kings Mountain G Patterson
WQLR Kinston 110 W King HB Civils
WBNL Lenoir Box 736 AY Cottrell
WRNT Lexington Police Dept WC Harris
WKZM Monroe Police Dept TP Brandon
WADX New Bern

WQLY Raleigh Police Dept
WRPW Reidsville 110 Morehead St RL Byrum
WQLI Rocky Mount Municipal Bldg WW Prim
WQLU Salisbury 115 W Fisher HA Kanoy
WANY Shelby
WDBS Statesville 120 N Center St HA Kanoy
WETO Thomasville EL Sherman
WDPW Wilmington SH Jones
WQNU Wilson Municipal Bldg W Wooten
WQMS Winston-Salem 1st & Main Sts RG Simpson

NORTH DAKOTA

KQRL Bismarck 515 Thayer Ave W Beeler
KNHM Fargo 639 N Pacific Ave G Trautman
KQSO Grand Forks 402 2nd Ave N A Petrick

OHIO

WPDO Akron RJ Myers
WJUK Alliance City Hall JK Young
WBIU Amberly C Conrad
WAXC Ashland 16 W 2nd St F Atterholt
WSTK Ashtabula Police Dept H Johnson
WJGD Barberton 585 W Tuscarawas AW Bock
WBQF Bedford JF Gresham
WQTQ Bucyrus 116 E Rensselaer St E Gearhart
WQKW Canton 201 2nd St SW NS Walker
WRIC Chillicothe City Hall ER McCoppin

WKDU Cincinnati PO Box 183 Station D JL Hearn
WRBH Cleveland
WENB "
WRPD "
WLDO Clyde (PM) 131 S Main St GW Swartzlander
WPDI Columbus Gay St & Marconi Blvd R Simpson
WBUJ Cuyahoga Falls 2006 Front St AW Bock
WPDM Dayton 15 E Monument Ave PE Benton
WHIV Delaware 1 S Sandusky AB Shirk
WMLC East Liverpool GT Kelly

WRNS Elyria City Hall I Finegold
WLSD Euclid 585 E 222 St H Fitzgerald
WMHX Fairfield Dayton Sig Repair
WMPK Fremont City Hall GW Swartzlander
WRQM Galion 301 Harding Way E WE Morrison
WQOX Hamilton Police Hdqtrs T Norton
WRSI Hills and Dales (PM)
WQST Indian Hill (Ranges) Box 284 Rte 1 Cincinnati O C Conrad
WBVL Ironton City Hall O Helm
WKMP Kenton

WHTL Lakewood CR Henderson
WQFC Lancaster Main & Broad St T Schneider
WAFU Lima 215 E High St RO Albridge
WBOH Logan Police Dept RR Loomis
WLOP Lorain Central Police Station HC Kaufman
WQRL Lorain
WQFY Mansfield 2nd & Walnut Sts LW Campbell
WMVH Maple Heights LJ Hradek
WRGL Marietta
WJJI Marion 283 W Center St WE Marks

WBGT Massillon City Hall L Burkhart
WMOP Mentor 1373 Mentor Ave J Bay
WAIS Mentor-on-the-Lake (PM) Sheriff's Office JD Bay
WBVB Middletown 1425 Central R Bookwalter
WQRW Newark 16 N 4th St JV Clark
WRQL Niles Police Station JK Young
WJUM Norwalk 37 N Linwood Ave WB Sanger
WBYG Norwood C Wright
WBKC Oakwood
WMVD Orange (PM)

WQOL Ottawa Hills Richards Rd M Maseker
WKHL Painesville G Spaulding
WKYF Perrysburg 111 W Second St JF Drake
WQTP Piqua 219-221 W Water St D Davis
WSTM Port Clinton 130 Adams GW Swartzlander
WPGI Portsmouth City Bldg WC Gammon
WCDE Reading C Conrad
WAFX Rocky River 19120 Detroit Rd A Taylor
WJSB St Bernard 4701 Vine St C Conrad
WBGW Salem

WAKI Sandusky Police Dept GW Swartzlander
WAMH Shelby 16 W Main LW Campbell
WSGO Sidney City Bldg
WQMI Springfield City Bldg RJ Free
WPHD Steubenville
WKTP Tiffin Police Dept GW Swartzlander
WRDQ Toledo
WBIZ Toledo (Portable)
WRIL Toronto
WQTX Troy City Bldg ER Beach

WJVQ Urbana 207 S Main St HW Sprague

MUNICIPAL POLICE, Continued

WCBK Warren Police Station JK Young
WMPO Wellsville 5th & Main R Villers
WKMZ Westlake
WJZV Wickliffe (PM) Euclid Ave J Bay
WQWO Will-O-Wick JD Bay
WBYA Wyoming 500 Grove Ave E Laakko
WPDG Youngstown 2107 Market St Jazetts
WPHO Zanesville RD Combs

OKLAHOMA

KNHC Ada
KACL Altus
KARD Ardmore
KQFM Bartlesville
KEZY Blackwell 224 W Blackwell Ave R Frampton
KOKB Bristow
KACF Chickasha 113 N 6th St OL Jenkins
KAPB Cushing
KNGK Ducan 714 Main St DR Gray
KRBK Durant Police Dept

KRHT Edmond (PM) 29 E First WR Green
KQAB El Reno D Eagle
KAPK Enid
KGOP Guthrie City Hall JM Patterson
KGHP Lawton
KNGT Muskogee 230 Court St SE Bernard
KWDI Nichols Hills (PM) 6407 Avondale Dr LM Corbett
KAPE Norman (PM) 122 N Peters E Corbin C Blackert
KQDS Oklahoma City (PM) JJ Hill
KAPF Okmulgee City Hall WC Wynn

KOPM Pawhuska JR Hicks
KQFL Pawnee Police Dept
KACP Ponca City 500 E Grand Ave JE McFadden
KPDS Sapulpa 123 E Hobson JO Edwards
KACR Seminole
KWCM Shawnee City Hall EM Moore
KSWP Stillwater
KQEI Tulsa R Hicks
KWMP Wewoka 112 S Wewoka Ave JC Howe

OREGON

KIAO Albany
KWKX Astoria 15th & Duane J Titus
KQIN Bend 142 Louisiana St RC Stennett
KFZO Corvallis Police Hdqtrs GS Felkert
KAIV Eugene City Hall S Miller
KGZH Klamath Falls City Hall K Cramer
KRLA McMinnville Police Hdqtrs
KRIQ Medford
KGOQ Oregon City Police Dept C Newman
KGPP Portland 2nd & Oak St CL Austin

KPFD Portland 2nd & Oak St CL Austin
KQEJ " (P) " "
KGZR Salem 295 N High St J Pincus
KHNX The Dalles City Hall
KHWL West Linn (PM) W Ellis

PENNSYLVANIA

WQNW Ablington Police Hdqtrs JJ Guinan
WRIK Aliquippa
WQJZ Allentown 626 Linden St R King
WSRD Altoona Police Dept G Hayes
WRHZ Ambridge
WQNX Ardmore 75 E Lancaster Ave L Marion Twp L Hatton
WQQB Beaver 468 Third St RJ Villers
WRHA Beaver Falls Police Dept
WKJH Berwick
WQJJ Bethlehem 100 E Third St

WBRA Bradford City Hall BA Franklin
WHRL Bristol Pond & Mulberry Sts
WQOR Brookline (Haverford) Darby & Manoa Upper Darby Pa
WMBT Butler 130 W North St
WMCB Chambersburg GW McIntire
WKWY Charleroi
WKLC Chester 4th & Market St JH Cullis
WQRD Clairton St Clair & Miller B Busch
WBRS Clifton Heights (PM) S Springfield Ave
WBRV Coatesville 208 Harmony St M Godschal

WBEV Collingdale (PM)
WBRC Coraopolis
WQON Elkins Park (Cheltenham) H Krause
WKMG Ellwood City 525 Lawrence Av RR McClain
WBHV Ephrata 21 E Locust St L Daniels
WQLS Erie City Hall LA Raub
WKKX Folcroft (PM)
WRJX Glenolden (PM)
WQHP Hanover 9 York St
WQOD Harrisburg Walnut & Aberdeen RW Delmotte

WRMA Jeanette 2nd & Clay CE Walter
WBKO Jenkintown (PM) Leeden & West Aves FA Sweeney
WRHW Kingston 166 S Sprague Ave M Krupa
WQTW Lancaster 27 E Grant St L Daniels
WANG Lansdale
WQNB Lansdowne Boro Bldg PL Richards
WRLH Latrobe 316 Main St W Harbeck
WBMV Lebanon 9th & Scull Sts EA Weimer
WBXR Lewistown Police Dept
WBSN Lock Haven City Hall LN Persio

WBWA Lower Moreland (PM)
WQIC McKeesport 323 Market St B Busch
WBRH Marple (PM)
WRGZ Meadville 156 Chestnut BC French
WRKX Media (PM) Police Dept
WDBF Milton 28 N Front St MC Budd
WQFF Monessen 3rd St & Donner Ave W Horlbeck
WIEQ Monongahela W Gamble
WRMC Morrisville (PM)
WANE Nether Providence (PM)

WPGT New Castles City Bldg WU Sines
WLDI New Kensington 1050 4th Ave WW Neely
WQMU Norristown City Hall
WRHY Norwood (PM)
WPHZ Oil City 248 Seneca St H Wagner
WBJI Parkside (PM)
WBQW Philadelphia City Hall H Simon & TP Burns
WPDP " " " "
WQNJ Phoenixville 140 Church St R Rosen
WPDU Pittsburgh Bedford Ave & Francis WM Gamble

WPIM Pittsburgh "
WJPP Pottsville City Hall C Moyer

WSTQ Prospect Park (PM)
WPFE Reading City Hall GR Hartman
WBKV Ridley (PM)
WABH Ridley Park (PM)
WBHE Rose Valley (PM) Moylan-Rose Valley R Timmons
WQTV Scranton
WBXP Sewickley Thorn St A Pierce
WQIA Sewickley Heights Club Road P Gramba

WQFU Sharon Police Dept Hugis Elec Co
WQOC Sharon Hill Sharon Ave & Spring St
WFUQ Spring City (PM) 307 S Main J Hanebury
WKVS Spring Garden Twp (PM)
WJZD State College 118 S Frazier St JR Juba
WPFQ Swarthmore 105 Park Ave RE Timons
WBOI Tinicum (PM)
WQTN Uniontown
WSVN Upper Dublin (PM) Ambler Pa J Guinan
WSVB Upper Moreland Willow Grove Pa (PM)

WBLP Upper Providence (PM)
WRMU Upper Southampton Twp
WENZ Warren
WKYR Washington
WIUY Waynesboro 57 E Main St
WQNV West Chester
WQFM Wilkes-Barre Police Dept J Alles
WQOH Williamsport 454 Pine St L Persio
WRLO Yeadon (PM)
WAKX York W Weaver

RHODE ISLAND

WBRI Bristol
WKAA Central Falls (PM)
WPGK Cranston Police Hdqtrs SW Atkinson
WPEI East Providence Police Station
WMPH Newport Police Dept EW Graffam
WPFV Pawtucket Roosevelt Ave EB Petit
WPGF Providence 209 Fountain St J Lawless
W1XVI " " "
WJAF Wakefield
WPIA Warren JF Byrne

WJWR Warwick Police Dept
WSYV " " "
WRPS Westerly
WPEM Woonsocket 139 Front St CG Hoyt

SOUTH CAROLINA

WRJQ Anderson 401 S Main WR Davidson
WCPD Charleston Police Dept DM Bradham
WJHR " 4 mi No Hwy 52
WCMP Columbia 1415 Lincoln St JP Davenport
WQLG Greenville
WSVQ Greenwood Box 208 HC Spangler
WPRH Rock Hill 128 E White St JW Beaty
WSSC Spartanburg 146 Broad St AM Miles

SOUTH DAKOTA

KAWC Aberdeen Police Dept DT Hunt
KVPB Huron 453 3rd St SE EW Smith
KQSP Mitchell Police Dept
KNGM Rapid City
KBTY Sioux Falls 9th & Dakota FJ Searls
KQJM Watertown 24 W Kemp F Alwin
KQXR Yankton City Hall

TENNESSEE

WRCK Chattanooga 10th & Linday OJ Davis
WBSV Dyersburg Police Dept E Jones
WRSJ Jackson Police Dept BC Brummell
WPGZ Johnson City 218 W King St EB Jones
WQTJ Kingsport 232 Shelby St MG Boatright
WPFO Knoxville P Mayes
WPEC Memphis K Young
WBYH Nashville
WBTB Paris
WRLX Union City Church & 2nd BC Brummell

TEXAS

KADR Abilene 1209 N 2nd St LD Irvine
KAER " " "
KQZW Alamo Heights (PM) 6116 B'dway
KQDH Amarillo 120 W 4th St MH Clack
KGHU Austin 124 W Eighth St LB Kreuz
KGPJ Beaumont
KACM Big Spring City Hall RC LeFevre
KGCV Borger 111 E 6th St J Bonnett
KNGW Brownwood City Hall AW Stewart
KGHT Brownsville RW DuBose

KPBR Bryan Police Dept FJ Sosolik
KMGE Cleburne
KGHV Corpus Christi
KRGA Corsicana Municipal Bldg CS Cooper
KVP Dallas c/o Station WRR DJ Tucker
KVPA " " "
KQAT Denison 108 W Main PS Borum
KHNF Denton City Hall C Phillips
KPDE Electra OE Moates
KGZM El Paso 219 S Campbell CG Bakofsky

KQAN Fort Worth 1000 Throckmorton DL Bunday
KRLJ Fort Worth 1000 Throckmorton DL Bunday
KADM Gainesville 200 E Elm St C Phillips
KRPW Galveston HF Weinzel
KHGC Goose Creek (PM) 209 S Goose Creek FA Royder
KHAR Harlingen
KQGS Highland Park 4710 Drexel Dr BD Meredith

KHPR Houston 401 Carolina St PE Franklin
KHTP " "
KKPD Kilgore City Hall EM Moore
KGZW Lubbock R Portwood
KQDN Lufkin
KTWP McKinney 112 S Kentucky J Floyd
KADT Marshall
KQXW Mexia
KRLE Midland J Cecil
KRAN Nacogdoches

KEZU Orange 803 A Green Ave JR Scroggs
KOTP Olmos Park (PM)
KPAM Pampa City Hall J Bonnett
KQKM Paris CL Thompson
KPPD Pasadena (PM) Police Hdqtrs
KRKQ Plainview
KPAT Port Arthur
KASD San Angelo City Hall WL Anderson
KGZE San Antonio Market & St Mary's V Gallagher

KQIS Sherman

KAPJ Sweetwater 203 E 4th St G Dotson
KRKW Temple Police Dept M Edison
KQJB Terrell Hills (PM) Rte 3 Box 74-A San Antonio
RTWL Texas City 519 6th St N PE Franklin
KQCF Tyler
KQZI Univ Pk 3800 Univ Blvd Dallas Tex DMJ Cooper
KEPL Victoria 210 W Constitution RL McCown

KGZQ Waco City Hall AD Mitchell
KRIW Westover Hills (PM)
KGZI Wichita Falls 900 Ohio Ave CW Payne

UTAH

KHQW Logan GW Peterson
KQCH Ogden 2545 Wash Blvd FD Thompson
KPMU Provo 21 S University Av G Wing
KGPW Salt Lake City 1324 S 3rd West St EH Morgan

VERMONT

WBQG Brattleboro 120 Maple St BF Cutting
WRCW Burlington Police Dept
WIUF Springfield 96 Main St DG Sinon

VIRGINIA

WAVA Alexandria 126 N Fairfax
WPHV Bristol 123 Water St HG Cross
WROM " (PM) " "
WQTE Charlottesville MF Greaver
WRGU Danville 1. Motley
WHCN Falls Church (PM) 119 S Washington GE Simpson
WRQG Fredericksburg 809 Princess Anne St
WELH Hampton City Hall N King St Arnold Co Richmond Va

WBXS Harrisonburg Police Dept
WQOZ Hopewell 404 E Poythress St JE Martin
WLOV Lorton (D.C.)
WQFH Lynchburg City Hall
WRIV Newport News 229 25th RJ Booker
WQNK Norfolk Police Dept
WQFI Petersburg 11 W Bank RN Biggs
WPVL Portsmouth Police Dept GF Matthews
WPHV Richmond FG Allen

WSYC Richmond " "
WQFG Roanoke JT Aldhizer
WRID Staunton 15 N New St Arnold Co
WRGV Suffolk City Hall Arnold Co
WADB Virginia Beach 20th & Arctic Ave
WIGV Waynesboro 126 Wayne Av LL Kennedy
WKYT Williamsburg 400 N Boundry St L Arnold
WSKQ Winchester 5 N Cameron R Campbell

WASHINGTON

KGZV Aberdeen P True
KACK Bellingham 210 Lottle St BT Olson
KASF Bremerton Police Dept L E Gruber
KREB Camas (PM)
KGHW Centralia
KABX Clarkston (PM)
KWKC Colfax (PM) HE Steiner Lewiston Idaho
KNFP Everett Central Fire Station LH Machin
KFQB " " " "
KAPL Hoquiam

KATH Nr. Issaquah (Seattle)
KQEQ Kelso LV Hott
KNFI Mt Vernon
KACE Olympia
KIBS Pasco City Hall
KPAP Port Angeles 3rd & Lincoln LE Geisler
KQVP Pullman (PM)
KPWP Puyallup Police Station EC Dahl
KGLB Renton 207 Wells CS Williams
KAFO Seattle 416 Yesler Way N Sandstedt

KATH " " "
KGPA " " "
KHLD Shelton (PM) City Hall W Gebenini
KRLI Spokane (P) City Hall CL Brown
KGHS " " "
7XHC (P) " "
KGZN Tacoma 415 S Tacoma Av DM McDonough
KRDM Vancouver (PM) 710 Washington
KACV Walla Walla
KHGW Wenatchee City Hall RB Sutton

KNGU Yakima 10 E Walnut St CA Cole

WEST VIRGINIA

WKHK Beckley JF Bucy
WBWV Bluefield PT Flanagan
WPHI Charleston City Bldg WD Stone
WPFP Clarksburg
WPHJ Fairmont Police Dept MA Morgan
WSLE Follansbee
WRHF Hollidays Cove Ferry Rd GR Smith
WQOW Huntington 802 5th Ave RW Nixon
WAEF Keyser Davis St JG Freeland
WCHD Martinsburg JG Freeland

WJWZ Morgantown 389 Spruce St RC Spence
WPHQ Parkersburg Police Hdqtrs CR Knowles
WSTH Princeton 1016 Mercer St
WBUB South Charleston
WRIN Wellsburg City Hall R Villers
WQTU Wheeling City Bldg EL Kelm

WISCONSIN

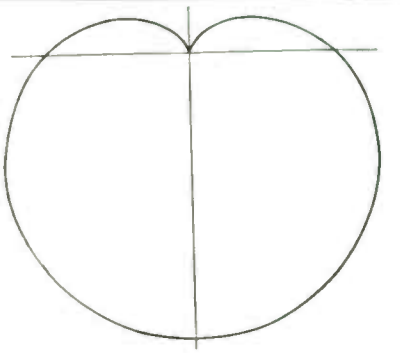
WKLG Baraboo (PM) City Hall R Hoffman
WSTG Beaver Dam N Spring St LW Zwieg
WRNI Beloit 430 State St K Crittenden
WBVE Blooming Grove (PM)
WGUX Chenequa
WHNP Depere (PM) Police Hdqtrs WJ Stangel
WBHT Eau Claire 414 E Grand Ave TO Jorgenson
EFXQ Edgerton (PM) FA Stone
WRLP Fort Atkinson Police Dept L Skalitzky
KNHB Green Bay City Hall P Kehl

WRNQ Janesville (PM) Rock Co Sheriff's Bldg
WPEP Kenosha F Christopherson
WQTH La Crosse City Hall L Jenks
WQRJ Lake Geneva (PM)
WASD Madison 14 S Webster St RS Groenier
WSVY " (PM) " "
WRNF Maple Bluff (PM)
WALF Marinette Police Dept AL Stewart
WPDK Milwaukee 4715 W Vliet St HF Wareing
WSWH Monona (PM)

WRJM Monroe (PM) 1114 16th Ave FJ Saries
WFUD Neenah 208 S Commercial IH Stilp
WCJR Oshkosh (PM) City Hall H Davis

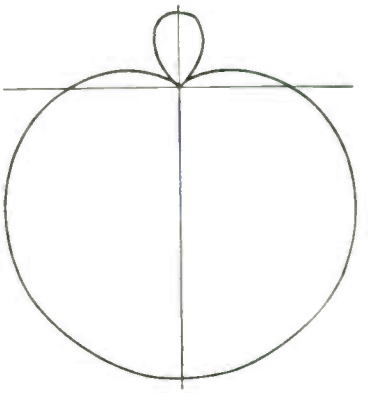
. . This is Cardioid

"Cardioid" means heart-shaped. It describes the pickup pattern of a microphone as illustrated in this diagram. Unwanted sounds approaching from the rear are cancelled out and the pickup of random noise energy is reduced by 66%. The actual front to back ratio of reproduction of random sound energy is 7 to 1.



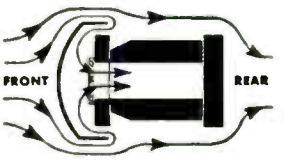
. . This is Super-Cardioid

"Super-Cardioid" also describes a pickup pattern and is a further improvement in directional microphones. The Super-Cardioid has a wide front-side pickup angle with greater exclusion of sounds arriving from the sides and the rear. The front to back random sound ratio is 14 to 1 which makes it twice as unidirectional as the "Cardioid." A 73% decrease in the pickup of random noise energy is accomplished.

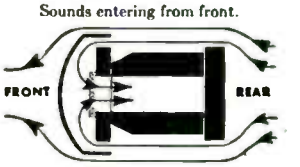


. . This is Uniphase

"Uniphase" describes the principle by which directional pickup is accomplished in a single Microphone unit. This is a patented Shure development and makes possible a single unit "Super-Cardioid" Directional Microphone eliminating the necessity of employing two microphone units in one case—it gives greater uniformity in production, greater ruggedness, lower cost for comparable quality and more uniform vertical pickup pattern.



Sounds entering from front.



Sounds entering from rear.

. . This is the result

The SHURE Super-Cardioid

A decrease in the pickup of random sound energy by 73%—reduction of feedback and background noise—simplification of sound pickup are among the many advantages offered by the Shure "Super-Cardioid" Dynamic. These, plus faithful reproduction, are the reasons why Shure "Super-Cardioid" Microphones are used by more than 750 Broadcast Stations in the United States alone, by our Armed Forces throughout the world, and on thousands of Public Address Systems everywhere.

SHURE BROTHERS

Designers and Manufacturers of Microphones and Acoustic Devices

225 West Huron Street **Chicago 10, Illinois**

SHURE MICROPHONES

MUNICIPAL POLICE, Continued

WKOL Plymouth (PM) City Hall G Zimmermann
WRJL Port Washington Lake & Jackson Sts J Miller
WOLJ Racine 103 3rd St RT Beck
WQMW Sheboygan W Wagner
WRNG Stevens Point 612 Clark St VW Nickel
WSWE Superior (PM) Police Dept AA Jarvi

WDCJ Two Rivers Police Dept EW Frank
WRHX Watertown 110 N 1st St EC Knight
WQML Waukesha (PM) 130 Delafield St Lathrop

WYOMING

KEYD Casper (PM) City & Co Bldg
KQOI Cheyenne Police Dept CA Houge
KRTQ Laramie (PM)
KEYH Rawlins (PM) Houge Elec Shop Cheyenne
KEYI Rock Springs (PM)
EKYJ Sheridan (PM) CA Houge

COUNTY SYSTEMS

ARIZONA

KHRS Bisbee
KQOJ Flagstaff Sheriff's Office R LaRue
KRAC Florence
KQXU Maricopa Co (PM) Sheriff's Office R LaRue
KQHM Prescott Sheriff's Office R LaRue
KRJA Safford
W6XEJ Tempe
W6XEH Tucson
KQEX Yavapai Co (P) Sheriff's Office R LaRue
KADF Yuma 256 2nd Ave TH Kelling

ARKANSAS

KSDC Arkansas City Sheriff's Office JE Bailey
KSDD Dumas Sheriff's Office Arkansas City JE Bailey
KQMC Garland Co (P) Sheriff's Office RE Ermey
KQEH Hot Springs Sheriff's Office RE Ermey
KRGI Little Rock Sheriffs Office EF Henning
KSDE McGehee
KPMA Mississippi Co (PM)
KQGT Pine Bluff Sheriff's Office AK Kesterson

CALIFORNIA

KPDA Alameda 1225 Fallon St Oakland CB McMurphy
KPDB Alameda (P) " "
KRGE Alameda (P) " "
KACS Bakersfield Sheriff's Dept WE Whiting
KQHL Banning 4000 Orange Riverside HO Platt
KBYQ Butte (PM)
KQRO Colusa Sheriff's Office
KHNI Contra Costa (P)
KHCP Eureka

6XGL Grapevine
KEWB Hanford Court St O Wood
KDHB Hollister Sheriff's Office MJ Barlich
KEZQ Imperial Co (PM) RM Belwood
KQAD Indio 4000 Orange St Riverside HO Platt
W6XIA Kings Co Point LaCima Hanford Calif O Wood
KAVL Lake Port Sheriff's Office LM Reese CW Ellison
KQDD Lancaster 1021 Cedor St
KQBV Los Angeles 271 Hall of Justice CW Ellison
KQDD " " "

KRGU " " "
KFWH Madera Sheriff's Office RS Schuler
KEZB Marin Co (P)
KRBS Martinez Sheriff's Office GK Burton
KQCE " " "
KHNI " (P) "
KSOM Merced Sheriff's Office T Margaretic
KASE Modesto
W6XIJ Modjeska Peak
W6XCD Mt Diablo Sheriff's Office Martinez GK Burton

W6XGQ Mt St Helena JK Maybee
W6XGX Mt Tamalpais
W6XHG Mt Toro
KOCM Orange Co (P) WE Whitman
W6XHO Pine Hill
KBSV Quincy NA Saule
KRGX Redwood City 715 Middlefield Rd WH Harrington
KERC Riverside 4000 Orange St HO Platt
KQSG " " "
W6XEI " " "

KEZE " Co (P) " "
W6XHD Rocky Hill
KFPN Sacramento (PM) 620 H St EW Lindfelt
KQCO Salinas Monterey Co Sheriff's Office MJ Barlich
KSBC San Bernardino 351 Arrowhead RC Andersen
KQOV San Diego Co (PM)
KSRC San Rafael
KGHX Santa Ana Sheriff's Office WE Whiteman
KQIR Santa Barbara (PM) Co Court House HW Brittain
KSRM Santa Rosa 200 Hinton JK Maybee

KBRV Solano Co (PM)
W6XJB South Mountain
KAPH Stockton Court House Bldg
W6XAB Strawberry Peak
KAEX Susanville Sheriff's Office NA Soule
KBQF Sutter Court House M LeBoeuf
KFOJ Ventura Co (PM) Court House CD Smith
KAZF Visalia
KBQZ Yuba Co (PM)

COLORADO

KAEU Larimer Co (PM) Ft Collins KW Cooper
KEHM Trinidad Sheriff's Office HL Corley

FLORIDA

WBSM Alachua (PM)
WAKG Clearwater 100 N Garden Av HR Weaver
WMUW Fernandina
WKWP Marion Co (PM) Ocala Fla FJ Sachse
WKRE Panama City
WBSR Pensacola
WMQP St Lucie Co

WBUW St Petersburg (PM) 123 3rd St T Tucker
WBYI Sarasota Court House DC Bailey

TERRITORY OF HAWAII

KENU Hana
KADK Hilo
KAPR Honokaa
KGPQ Honolulu
KHAB Kaneohe
KRLB Kaunakakai Molaka
KIRU Kealakekua Kona
KENW Lahaina
KBSN Lanai City
KQXY Pala

KHAC Pearl City
KHAA Wahiawa
KAPM Walluku

IDAHO

KAHP Ada (PM)
KEHK Caldwell Sheriff's Office
KQCE Coeur d'Alene Sheriff's Office C Brown
KRLG Lewiston Court House HE Steiner
KQJF Moscow Sheriff's Office M Hart

ILLINOIS

WSKE Bedford Pk 6700 S Archer Argo Ill N Biorn
WSKO WA Wallingford
WAZV Bloomingdale Twp
WMPJ Clinton JD Farnsworth
WASB Decatur 235 E Wood
WQRY Edwardsville
WKGI Freeport 7 N Walnut CW Price
WDAA Geneva 3rd & James Sts AC Kadow
WMQD Henderson Co (PM) JA Carnahan
WSTU Kankakee 441 E Court St E Chinski

WLIS Lewiston FA Carnahan
WDBU Lincoln Logan Co Jail JD Farnsworth
WSCI Maine Twp
WABV Marion
WSGQ McLean Co 310 N Madison St Bloomington Ill
WMHI Monmouth
WLEB Mt Vernon Court House AE Featherstun
WQFZ Ottawa RM Nicholson
WANU Pekin 360 Court St K Patterson
WRNK Peoria (PM)

WKPS Princeton Sheriff's Office G Billeaux
WBXM Salem
WMQM Saline Co
WRSC Sangamon Co (PM) Sheriff's Office
WJYF Taylorville Court House HA Trapp
WBQY Vandalia Fayette Co
WBWJ Vermillion (PM) J Moyer
WQFX Waukegan
WQJW Wheaton
WKJO Will Co (PM) 4 N Chicago St

WPWC Winnebago Co Sheriff's Office Rockford Ill WA Wallingford

INDIANA

WSKG Allen Co (PM) C Hoemig
WIUM Angola
WSLH Cass Co (PM)
WBTJ Clinton Co (PM) H Evans
WAGT Crown Point J Dodman
WAXU DeKalb Co (PM)
WSVP Hamilton Co (PM)
WSRY Goshen Sheriff's Office R Hawk
WBXD Howard Co (PM)
WSTA Huntington Co (PM) Nelson W Stern

WMBR LaPorte Co (PM)
WBMK Madison Co (PM)
WSIF Marion Co (PM) RL Batts
WBTY Mt Vernon 530 Main ND Covert
WBVG Montgomery Co (PM) F Burkhartd
WBVT Porter Co (PM) JW Alinsky
WHHB Putnam Co (PM) P Grimes
WSTL Shelby (PM)
WBXF Vandeburgh Co (PM)
WBIH Wabash (PM)

WHCR Warsaw (PM) F R Lucas
WRIP Wayne Co (PM) R McDonald
WBJH Whitney Co (PM)

IOWA

KHQD Cass Co (PM) H Jordan
KBGX Des Moines Co (PM)
KIGR Polk Co (PM)
KAEQ Douglas Co (PM)

KANSAS

KRHU Crawford Co (PM)
KANH Labette (PM) Sheriff's Office Oswego LS Stafford
KQJK Wyandotte Co (PM)

KENTUCKY

WKKZ Henderson Co (PM)
WKYP Hopkins Co (PM)
WKJC Jefferson Co (P) Court House Louisville Ky
WQOB Lexington Court House S Helt
WRGJ Mitchell Hill

LOUISIANA

WKKO Franklinton Court House A Gatlin
KANX Houma Court House RA Lirette

MARYLAND

WMHF Bel Air RA Fulker
WJYO Brooklyn Fire House
WMPY Catonsville
WMQG Dundalk Balto Co Police Dept Towson Md Lt W Taylor
WMHE Edgemere Police Hdqtrs Towson Md W Taylor
WHRP Eastport Police Hdqtrs
WMPT Essex
WJHS Ferndale Police Hdqtrs
WMPU Fullerton
WHRO Galesville Police Hdqtrs

WMQE Halethorpe Balto Co Police Dept Towson Md C Purcell
WJLW Hyattsville
WMPP Pikesville

WKYX Rockville
WMQA Reisterstown
WHMM Silver Spring Court House L Rice
WPFL Towson
WJLU Upper Marlboro
WMPX Woodlawn
WQUA Washington Co (PM)

MASSACHUSETTS

WRAQ Barnstable Box 175 C C Dimond
WRAG Bourne "
WEWE Chatham "
WQTL Falmouth "
WQTM Harwich "
WRJH Hyannis "
WBYJ Nantucket "
WPBM Wellfleet "
WGBU West Yarmouth "
WRLQ " " "

WRAR Hyannis

MICHIGAN

WQGS Bad Axe
WEKA Bay Co (PM) 500 Center Ave F Simons
WHNA Charlotte Sheriff's Dept 126 N Bostwick
WAYG Flint 917 Beach St
WOMN Grand Haven
WAUK Jackson (PM) Sheriff's Dept 110 S Jackson
WBVU Kalamazoo Co (PM) 146 E Water JA MacGregor
WBPK Marshall Sheriff's Dept WW Wellever
WRPB Mt Clemens
WBSU Muskegon (PM) F Castenholtz

WQRZ Oakland (PM)
WRNH Saginaw (PM) Police Dept R Manchester
WSPV St Clair (PM)
WSTJ St Joseph 919 Port St EJ Zick
WBJG Washtenaw (PM) 119 W Ann St CR Nevins
WQMF Wayne 33809 Michigan Ave WR Watson

MINNESOTA

KPDW Hastings (PM) Sheriff's Dept
KANN Minneapolis Court House J J Sentyrz
KQKW Ramsey Co (PM)
KRIN Willmar

MISSISSIPPI

WJYG Harrison Co (PM)
WJEU Hinds Co (PM)

MISSOURI

KRHW Jackson Co (PM) 415 E 12th St
KBMB St Charles Co (PM) Court House L Plackmeyer

MONTANA

KGRC Custer Co (PM) Sheriff's Office I Elliott
KROI Gallatin Co (PM)
KQKD Missoula City Hall

NEBRASKA

KRAF Falls City 1700 Stone St KF Gates
KRNY Omaha Court House PR Zeigler AG Bates
KRNX " " "

NEVADA

KKWC Washoe Co (PM) Sheriff's Office Reno NA Sowle

NEW HAMPSHIRE

WKUY Cheshire Co (PM) B Cutting

NEW JERSEY

WAKC Freehold Court House RS Johnson
WPFK Hackensack F Levin

NEW MEXICO

KRHQ Chaves Co (PM) Sheriff's Office

NEW YORK

WEJZ Bath Sheriff's Dept
WCAV Canandaigua Sheriff's Dept WA Elling
WKJX Canton Sheriff's Dept C Moore
WAXK Ellicott Sheriff's Dept
WHOH Fonda Sheriff's Dept GK Nellis
WAZS Geneseo Sheriff's Dept DS Beam
WKHR Lockport
WBIF Mayville Sheriff's Dept VD Chipman
WITV Mineola (P)
WITX " "

WPGS " 15th St
WQLV Napoli Twp
WITV Nassau Co (P) 15th St Mineola WK Allen
WITX Nassau Co (P) 15th St Mineola WK Allen
WPGS Nassau Co 15th St Mineola WK Allen
WANG Nassau Co (PM) 15th St Mineola WK Allen
WBPJ Nassau Co (P) 15th St Mineola WK Allen
WRMF Nassau Co (P) 15th St Mineola WK Allen
WQIM New City Sheriff's Office W McDermott
WKHR Niagara Co (PM) Sheriff's Office N Best

WBVJ Onondaga Co (PM) 2306 Grant Blvd Syracuse RJ Wood
WJZX Oswego Co Jail JM Bartlett
WJPV Riverhead Court House RC Tillot
WBGJ Schenectady
WQJK Viola
WBPE Warsaw Twp Sheriff's Office G Kinney
WJKS White Plains City Hall

NORTH CAROLINA

WPFS Asheville
WSLF Charlotte 2401 Statesville Ave
WRPU Forsyth Co (PM)
WJDZ Goldsboro (PM) Court House DB Trueblood
WLSG Guilford Co (PM)
WDBR Iredell Co (PM)

. . . Here's what Simpson has ready and waiting for your postwar needs

Sensational? Yes . . .

1. This new Simpson Mutual Conductance Tube Tester tests tubes with greater accuracy than any commercial tube tester ever designed.
2. Provides greater flexibility for future tubes than any other tester.
3. Tests tubes with voltage applied automatically over the entire operating range.
4. Simplifies as never before the interpretation of tube condition from mutual conductance readings.

SIMPSON ELECTRIC COMPANY
5200-18 Kinzie Street, Chicago 44, Ill.

Simpson

INSTRUMENTS THAT STAY ACCURATE

COUNTY SYSTEMS, Continued

WBJF Leakesville Sheriff's Office RL Bynum
WSLF Mecklenburg Co (PM)
WBXT Morganton
WBTX Newton

WATU Rutherfordton 217 N Washington GB Patterson
WJDZ Wayne Co (PM)
WRPU Winston Salem (PM) City Hall

OHIO

WCAY Akron 212 S B'dway LP Hennigan
WAAL Allen Co RG Albridge
Canton 1727 Mahoning Rd NE NS Walker
WJWO Champaign Co (PM)
WJJO Chardon 219 Main St J Spaulding
WJKB Columbus County Jail 36 E Fulton St AB Shirk
WLOZ Colerain Twp
WSRS Cross Creek
WHNL Delaware Co (PM) A Shirk
WBYO Elyria Co Jail H Kauffman

WALU Erie Co GW Swartzlander
WSPX Jackson
WSIG Jefferson Court House H Johnson
WHHA Licking Co (PM) J Clark
WRMY Mahoning Co (PM)
WBAV Montgomery Co (PM) 2107 Market St J Haines
WBOK Painesville 74 E Erie St
WFRK Ravenna FR Reed
WMGW Richland Co (PM) WE Morrison
WAKL St Clairsville 1 E Main St W McGlumphy

WBTU Sandusky (PM) Court House GW Swartzlander
WBNA Seneca Co (PM) Sheriff's Office Tiffin O
WMFO Toledo Arlington Ave C Beck
WAFE Trumbull Co (PM) Police Dept JK Young
WEMX Wayne Twp

OKLAHOMA

KACF Chickasha Sheriff's Office OL Jenkins
KQTV Kay Co (PM)
KAPE Norman (PM) 200 S Peters Ave C Blackard
KETG Oklahoma City 301 NW 1st St AJ Spooner
KGPH " " "
KOMU Osage Co (PM) JR Hicks

OREGON

KBSX Clackamas Co (PM) Fleming & Co Portland
KQJR Multnomah Co (PM) Fleming & Co
KORM Salem (PM) Sheriff's Office O Scott
KRJB Washington Co (PM) JW Connell

PENNSYLVANIA

WJVY Beaver
WPEZ Bethlehem Bethlehem Steel Co LF Gares
WMCN Norristown JJ Guinan
WSRT Springfield (PM)

SOUTH CAROLINA

WMGU Richland Co (PM)
WJKE York Co (PM) JS Beaty

TENNESSEE

WPHY Elizabethton
WFJN Hamilton Co (PM)
WRHT Nashville

TEXAS

KFTX Anahuac
KETB Beeville RV Ennis
KBPT Bexar Co (PM)
KNGW Brownwood Court House AW Stewart
KRMB Dallas Co (PM)
KRHV El Paso Co (PM)
KGCT Galveston Co (PM) Court House H Weinzel
KFXL Grayson Co (PM)
KFEA Howard Co (PM) RL Wolf
KACU Longview Court House EM Moore

KFWT Newgulf Sheriff's Office WB Preston
KWSF Newgulf Sheriff's Office WB Preston
KFQV Swisher Co (PM)
KBLB Vernon County Jail O Key
KEPL Victoria 210 W Constitution RL McCown
KRKC Waxahachie 200 E Franklin J Cariker
KWSO Wharton County Jail B McLean
KRGC Wilson Co (PM)

VIRGINIA

WPAV Arlington Court House JJ Greene
WMFC Fairfax Police Dept C McIntosh
WTPH Hampton 22 Court St
WEUG Henrico Co (PM)
WAQJ James City Co (PM)
WMVP Nr. Radford MC Helton
WADB Princess Anne Co (PM) The Arnold Co Richmond
WHNJ Stafford Co (PM)

WASHINGTON

KBSM Asotin HE Steiner Lewiston Idaho
KQWA Chehalis Court House FW McCorkle
KRDL Clark Co (PM) County Court House Vancouver RE Brady
KQDM Colfax Sheriff's Office H Steiner
KQHW Coupeville
KABI Ephrata H Hansen
KBJA Kelso Court House CH Pritchard
KAEV Lincoln Co (PM)
KQBA Pierce Co (PM) Court House Tacoma EC Dahl
KADL Port Orchard Sheriff's Office JW Clanton

KQEC Port Townsend
KRAU Ritzville J Schafer
KHKE Shelton Sheriff's Office EF Martin
KBRW Spokane Co (PM)
KRHM Thurston Co (PM) Court House Olympia FC Tamblyn
KACJ Wenatchee

WEST VIRGINIA

8XZK Grant District

WEIR Weirton
WRGH Wellsburg

WISCONSIN

WBIQ Appleton S Walnut St G Merkl
WJZH Arpin VW Nickel
WHNO Brown Co (PM) WJ Stangel
WKLU Chilton Sheriff's Office
WHIX Columbia Co (P & PM) OL Jones
WTNR Dane Co (PM)
WBHU Eau Claire Co (PM) 305 W Grand Ave T Jogenson
WMPE Elkhorn EC Knight
WFDW Fond Du Lac 226 Linden St RS Matteson
WBUV Jackson Co (PM)

WRIT Janesville 102 Water St
WRAJ Jefferson 608 Main St LA Skalitzky
WQXO Juneau 30 N Main St E Beneditz
WPEP Kenosha FB Christopherson
WCCP La Crosse Court House S Mattison
WSTF " " "
WBSY Manitowoc Sheriff's Office EW Frank
WRJK Monroe RFD 4 FJ Sarles
WAKE Oshkosh Court House H Davis
WBIQ Outagamie Co (PM) G Merkl

WSOR Portage Court House OL Jones
WRNP Racine (PM)
WJUP Sauk Co (PM) R Hoffman
WBOA Sheboygan Court House R Endlich
WBMY Richland Co (PM)
WMRQ Sparta Co S Mattison
WKZQ Sturgeon Bay RB Bleri
WBWL Viroqua Court & Dunlop Sts H Benson
WMPD Waukesha Sheriff's Office R Lathrop
WBDX Wausau

WRPQ West Bend 340 5th Ave R Koth
WJZH Wisconsin Rapids 431 Baker St VW Nickel

WYOMING

KQRZ Laramie Co (PM)

STATE POLICE

ALABAMA

WKVG	Anniston	Police Barracks	LJ Smyth
WLBA	Birmingham	"	"
WKSD	Decatur	"	"
WESK	Demopolis	"	"
WKXR	Dotan	"	"
WQXE	Evergreen	"	"
WKSG	Gadsden	"	"
WKSP	Huntsville	"	"
WKSQ	Mobile	"	"
WRBU	Montgomery*	Dept Public Safety	LJ Smyth
WQXG	Opelika	Police Barracks	LJ Smyth
WKSJ	Selma	Police Barracks	LJ Smyth
WRBU	Snowdoun	"	"
WKRY	" (P)	"	"
WKSF	" (P)	"	"
WQXA	" (P)	"	"
WQXB	" (P)	"	"
WQXC	" (P)	"	"
WQXD	" (P)	"	"
WHTX	Tuscaloosa	"	"
WQXF	Tuscumbia	"	"

* Headquarters Station

ARIZONA

W6XEF Crown King Ariz H'way Patrol R LaRue
KNGG Phoenix Ariz H'way Patrol R LaRue
WJXEJ " Maricopa Co Sheriff's Office

ARKANSAS

KFDL	Clarksville	Police Barracks	P Todd
KQSR	El Dorado	"	"
KFDK	Forrest City	"	"
KEZX	Hope	"	"
KASP	Little Rock *	"	"
KBSL	Newport	"	"
KFDO	Warren	"	"
KHAD	" (P)	"	"

* Headquarters Station

CALIFORNIA

W6XH	Blue Canyon	Police Barracks	Sgt EH McKee
W6XIE	Grapevine Summit	"	"
KAPI	Grass Valley	"	"
KAWF	Los Angeles	"	"
KGNW	(PM) 66	"	"
W6XHL	Lyons Peak	"	"
W6XHJ	Mt Diablo	"	"
W6XFY	Mt Hamilton	"	"
KQUI	Newhall	"	"
KFPE	Ridge Route	"	"
KRBU	Oakland	"	"
KSCO	Oroville	"	"
KQUG	Pomona	"	"
KSPR	Redding	"	"
KFPH	Ridge Rte Station	"	"
KAAS	Sacramento	"	"
KADS	Sacramento	"	"
W6XIK	Sacred Oak Peak	"	"
KAPA	(PM) Sacramento		"
KQDO	San Luis Obispo	"	"
W6XIC	San Luis Obispo Co		"
W6XHM	San Marcos Pass	"	"
W6XAR	Santa Ana	"	"
W6XHI	South Mountain	"	"
W6XHK	Strawberry Peak	"	"
KIUF	Ventura	"	"
KSCY	Yreka	"	"

* Headquarters Station

COLORADO

KQKY Denver (PM) 1308 Lincoln St EB Nicholas

CONNECTICUT

WJTH	Hartford *	100 Washington	WJ Boas
WJTI	Bethany	Police Barracks	"
WJTA	Ridgefield	"	"
WJTD	Danielson	"	"
WJTK	Colchester	"	"
WJTF	Westbrook	"	"
WJTE	Groton	"	"
WJTJ	Litchfield	"	"
WJTB	Canaan	"	"
WJTC	Stafford	"	"
WJTG	Westport	"	"
WJAN	(P)		"

* Headquarters Station

DELAWARE

WAFF	Bellefonte	Police Barracks	M Dull
WAYZ	Bridgeville	"	"
WJRF	Dover	"	"
WAYY	Georgetown	"	"
WDSP	State Road*	"	"

* Headquarters Station

FLORIDA

WLIU	Chipley	Police Barracks	FJ Cipray
WJJX	Deland	"	"
WRSF	West Palm Beach	"	"
WSPF	Ft Myers	"	"
WKSO	Bartow	"	"
WKDR	Lake City	"	"
WJXI	Ocala	"	"
WJXJ	Camp Blanding	"	"
WKTF	Tallahassee *	"	"
WSWR	Pensacola	"	"
WKQZ	Tampa	"	"
WSTZ	Jacksonville	"	"
WSYP	Miami	"	"
WSYU	Belle Glade	"	"
WSWX	Ft Lauderdale	"	"
WSWY	(P)		"
WKGJ	(P)		"
WBMX	(PM)		"
WJXD	(PM)		"

* Headquarters Station

GEORGIA

WQSP	Atlanta *	Police Barracks	CL Mattson
WSIJ	Reidsville	"	"
WSIK	Albany	"	"
WSIN	Griffin	"	"
WSIO	Washington	"	"
WGRN	Gainesville	"	"

* Headquarters Station

ILLINOIS

WQPB	Blue Island	Police Barracks	CH Nicholson
WQPC	Chicago	"	"
WQPD	DuQuoin	"	"
WQPF	Effingham	"	"
WQPE	Elgin	"	"
WQPJ	E St Louis	"	"
WQPO	Joliet	"	"
WQPM	Macomb	"	"
WQPL	Peoria	"	"
WQPP	Pontiac	"	"
WQPR	Rock Island	Police Barracks	CH Nicholson
WQPS	Springfield *	"	"
WQPG	Sterling	"	"
WQPH	Urbana	"	"
WQPX	(P)		"
WQPY	(P)		"
WQPZ	(P)		"
WSTE	(PM)		"
WQPI	(P & PM)		"

* Headquarters Station

INDIANA

WBMO	Charlestown	Police Post	Capt H Sutherlin
WPHS	Chesterton	"	"
W9XGX	Columbia City	"	"
WBII	Connersville	"	"
WPHE	Indianapolis *	126 State House	"
WPHU	Jasper	Police Post	"
WQFW	Ligonier	"	"
WRNR	Pendleton	"	"
WQGB	Putnamville	"	"
W9XGC	Rochester	"	"
WQFE	Seymour	Police Post	"
WROR	West Lafayette	"	"
WAHO	(PM)		"
WAHP	(PM)		"
WAHQ	(PM)		"
WAHR	(PM)		"
WISP	(PM)		"
WRSH	(PM)		"
WSPC	(PM)		"
WSPI	(PM)		"

* Headquarters Station

IOWA

KACD	Atlantic	Police Barracks	CJ Nord
KNFN	Cedar Falls	"	"
KGHO	Des Moines *	State House	"
KACC	Fairfield	Police Barracks	"
KNFO	Storm Lake	"	"
KADW	(PM)		"

* Headquarters Station

KANSAS

KAQB	Chanute	Police Barracks	HB Miller
KBMO	Norton	"	"
KAZZ	Topeka *	State House	"

* Headquarters Station

KENTUCKY

WQWY Frankfort T Thompsou
WMLI (PM)

LOUISIANA

KRAD	Alexandria	Police Barracks	WT Golson
WLSP	Baton Rouge *	State House	"
KSPB	E Lake Charles	US Hy 90	"
KSPF	Franklin	Police Barracks	"
KSPL	Leesville	"	"
KSPC	Monroe	"	"
KSPE	(P)		"
KSPA	(P & PM)		"
KSPG	(P & PM)		"
KHQS	Lafayette	Police Barracks	"

* Headquarters Station

STATE POLICE, Continued

MAINE

WBNV	Augusta *	66 Hospital St	RH Parker
WKQP	Bangor	629 Main St	"
WSYX	Boothbay Harbor	Oak St	"
WLDQ	Houlton	North Rd US 1	"
WSTR	Thomaston	US Route 1	"
WSWD	Wells	US Route 1	"
WBVW	West Scarboro	US Route 1	"
WSYD	Patrol Boat "Maine"		"

* Headquarters Station

MARYLAND

WEVN	Belair	Police Barracks	WH Weber
WMSH	Conowingo	"	"
WMSC	Cumberland	"	"
WMEV	Dan's Rock	"	"
WMSE	Easton	"	"
WMSF	Frederick	"	"
WMHN	Hagerstown	"	"
WMQU	"	"	"
WMSR	Randallstown	"	"
WWSG	Salisbury	"	"
WMSW	Waldorf	"	"
WHWN	Waterloo	"	"
WAKY	(PM)		"

MASSACHUSETTS

WKFI	Adams	Police Barracks	WT Armstrong
WKFA	Andover	"	"
WBKU	Bridgewater	"	"
WBVP	Brookline	"	"
WKGC	Fall River	"	"
WBQN	Framingham	"	"
WPEW	Hadley	"	"
WMP	Milton	"	"
WSPN	Nantucket	"	"
WPYM	Northampton	"	"
WSPO	Oak Bluffs	Police Barracks	WT Armstrong
WPEL	Plymouth	"	"
WSQL	Princeton	"	"
WBQE	(P)		"
WBQH	(P)		"

MICHIGAN

WBQI	Alpena	Police Barracks	FW Walker
WBRD	Atlanta	Dept Cons	E Cornett
WBQT	Bad Axe	Police Barracks	FW Walker
WDAI	Baldwin	Dept Cons	E Cornett
WIWG	Battle Creek	Police Barracks	FW Walker
WITR	Bay City	"	"
WJBS	Blissfield	"	"
WDAQ	Boyne City	Dept Cons	E Cornett
WAOD	Brighton	Police Barracks	FW Walker
WBQS	Cadillac	"	"
WBTO	Center Line	Police Barracks	FW Walker
WKJU	Cheboygan	"	"
WJBR	Clinton	"	"
WSWK	Crystal Falls	Dept Cons	E Cornett
WAPU	Detroit	Police Barracks	FW Walker
WRDS	East Lansing *	"	"
WBQL	East Tawas	"	"
WJBP	Erie	"	"
WRRC	Escanaba City	Dept Cons	E Cornett
WDSO	Ewen	"	"
WAPW	Flatrock	Police Barracks	FW Walker
WITQ	Flint	"	"
WKJR	Gaylord	"	"
WBQU	Gladstone	"	"
WBXA	Gladwin	Dept Cons	E Cornett
WRLS	Grand Haven	Police Barracks	FW Walker
WRDH	Houghton Lake	"	"
WBSI	Iron Mountain	"	"
WBNF	Jonesville	"	"
WITN	Jackson	"	"
WITP	Keego Harbor	Police Barracks	FW Walker
WBQR	L'anse	"	"
WBQK	Manistee	"	"
WBTP	Manistique	"	"
WBKZ	Mio	Dept Cons	E Cornett
WKJM	Mt Pleasant	Police Barracks	FW Walker
WBYK	Muskegon	Dept Cons	E Cornett
WBQP	Newberry	Police Barracks	FW Walker
WBQJ	New Buffalo	"	"
WSWF	Niles	"	"
WBRF	Palmer	Police Barracks	FW Walker
WRDP	Paw Paw	"	"
WRLE	Reed City	"	"
WMSP	Rockford	"	"
WJBL	Romeo	"	"
WIVA	Roscommon	Dept Cons	E Cornett
WJBI	St Clair	Police Barracks	FW Walker
WQSY	St Ignace	"	"
WJAT	Sandusky	"	"
WMIC	Sault Ste Marie	Dept Cons	E Cornett
WJBT	South Haven	Police Barracks	FW Walker
WKJK	Traverse City	"	"
WBQV	Wakevield	"	"
WBQQ	West Branch	"	"
WJAW	White Pigeon	"	"
WAOG	Ypsilanti	"	"
WBMU	(P)		"
WBLU	Patrol Boat No 1	Dept Cons	E Cornett

* Headquarters Station

MINNESOTA

KNHD	Redwood Falls	Police Barracks	HC Olson
WAMV	St Paul	1279 Univ Ave	State Hy Patrol E Larimer

MISSISSIPPI

WJGW	Brookhaven	Justice & Fore Sts	RC Coker
WJKZ	Grenada	Police Barracks	"
WMHP	Hattiesburg	"	"
WRJI	Jackson*	2550 N State	"

* Headquarters Station

MISSOURI

W9XGL	Carthage	(Automatic Relay)	JM Wherritt
W9XGD	Ft Leonard Wood	Police Barracks	"
KHPF	Jefferson City *	"	"
KHPC	Kirkwood	"	"
KHPA	Lee's Summit	"	"
KHPB	Macon	"	"
W9XGF	Osborn	"	"
KHPE	Poplar Bluff	"	"
W9XGE	Potosi	"	"
KHPD	Springfield	"	"
W9XGG	Winona	(Automatic Relay)	"

* Headquarters Station

MONTANA

KRNW	Helena	(PM)	Civic Center	GF Pfeiffer

NEVADA

KRNP	Reno	Police Hdqtrs	NA Sowle	
KRGL	Carson City	"	"	

NEW HAMPSHIRE

WRPT	Concord*	Police Barracks	BF Cutting	
W1XUD	Warner		"	

* Headquarters Station

NEW JERSEY

W3XTI	Absecon	Police Barracks	FA Kelly
W3STK	Berlin	"	"
W3XTG	Cape May	"	"
W3XTS	Flemington	"	"
W3XTJ	Hammonton	"	"
W3XTO	Netcong	"	"
W2XZS	Howell	"	"
W3XTH	Port Norris	"	"
W3XTT	Hightstown*	"	"
	Penns Neck*	"	"
W2XZU	Keyport	"	"
W3XTL	Malaga	"	"
W3XTX	New Brunswick	"	"
W3XTN	Newton	"	"
W3XTQ	Morristown	"	"
W2XZQ	Ramsey	"	"
W3XTW	Riverton	"	"
W2XZR	Scotch Plains	"	"
W3XTM	Woodstown	"	"
W3XTR	Somerville	"	"
W2XZT	Toms River	"	"
W2XZP	Tuckerton	"	"
W3XTP	Washington	"	"
W3XTV	West Trenton*	"	"
	Trenton*†	"	"
W3XTU	Wrightstown*	"	"
	Columbus*	"	"
W8PZ	Boat Anne E	"	"
WRSN	" Director	"	"
WPIF	" Elisabeth	"	"
WR8L	" Navigator	"	"
WR8M	" Polaris	"	"
W1OXQR	(P & PM)		"
W1OXQS	(P & PM)		"
W1OXQT	(P & PM)		"
W1OXRT	(PM)		"
W1OXRU	(PM)		"
WBPR	(PM)		"
WCAG	(PM)		"
WJZP	(PM)		"
WSYN	(PM)		"
WSYO	(PM)		"

* Station operated from both points
† Headquarters Station

NEW YORK

WKVA	Altamont	Police Barracks
WJKW	Babylon	"
WBTC	Batavia	"
WIZP	Bay Shore	"
WIZO	Bethpage State Pk	"
WLSA	Commack	"
WKVC	Fishkill	"
WIZL	Jones Beach	"
WIZG	Kings Park	"
WIZC	Lake Success	"
WJKR	Montauk	"
WPJK	Oneida	"
WJGA	Riverhead	"
WPGC	South Schenectady	"
WAKP	Sidney	"
WIZA	Valley Stream	"
WSYQ	(P)	

NORTH CAROLINA

WANL	Elizabethtown	Police Barracks	CD Farmer
WANH	Raleigh*	State House	"
WANK	Salisbury	Police Barracks	"
WANJ	Swannanoa	"	"
WANI	Williamston	"	

* Headquarters Station

NORTH DAKOTA

KAZB	Bismark	O Orson

OHIO

WOZV	Athens	Police Barracks
WOHO	Bellevue	"
WLSZ	Bridgeport	"
WPHT	Cambridge	"
WPGQ	Columbus	"
WODH	Dayton	"
WPGG	Findlay	"
WLSW	Geneva	"
WOUG	Lorain	"
WLSV	Mansfield	
WOGN	Marion	
WPHC	Massillon	
WOUB	Middletown	"
WODX	Perrysburg	"
WHNT	Portsmouth	"
WOEX	Salem	"
WTOH	Troy	"
WBGQ	Warren	"
WPHK	Wilmington	"

OKLAHOMA

KOSC	Ardmore	Police Barracks	HL Kimsey
KOSU	Claremore	"	"
KOSX	Clinton	"	"
KOSY	Lawton	"	"
KOSW	McAlester	"	"
KOSO	Oklahoma City*	State House	"
KOSP	Perry	Police Barracks	"
KOSR	Enid	"	"

* Headquarters Station

OREGON

KOHA	Astoria	Police Barracks	CD Cannon
KOHB	Baker	"	"
KOHN	Bend	"	"
KOHU	Burns	"	"
KOHC	Coquille	"	"
KOHD	The Dales	"	"
KOHE	Eugene	"	"
KOHI	Gov Camp	"	"
KOHG	Grant Pass	"	"
KOHO	John Day	"	"
KOHK	Klamath Falls	"	"
KOHL	LaGrande*	"	"
KOHQ	Medford	"	"
KOHY	Odell Lake	"	"
KOHP	Pendleton	"	"
KOHM	Portland	"	CF Cross
KQZH	(PM) Portland	"	"
KOHR	Roseburg	"	CD Cannon
KOHS	Salem	"	"
KOHJ	Santiam Junction	"	"
KOHF	(P)		
KOHT	(P)		
KOHH	(PM)		
KOHV	(PM)		
KOHW	(PM)		
KOHX	(PM)		
KQZH	(PM)		

* Headquarters Station

PENNSYLVANIA

W8XXF	Allegheny Mt	Po. Barracks	Lt DE Wagner
W8XXI	Allegheny Mt	"	"
W8XXL	Bedford	"	"
WBJU	Bedford	"	"
W3XRC	Blue Mt	"	"
W3XRD	"	"	"
WBJY	Blue Mt	"	"
WBJV	Breezewood	"	"
WBJZ	Carlisle	"	"
WBJO	Donegal	"	"
WBJS	Everett Maint Shed	"	"
WBJX	Ft Littleton	"	"
WPSP	Harrisburg*	Capitol Bldg	"
WBJM	Irwin	Po. Barracks	"
WBJR	Kegg Maint Shed	"	"
W8XXD	Laurel Hill	"	"
W8XXH	"	"	"
WBJN	New Stanton	"	"
WBJT	Newville Maint Shed		"
W8XXJ	Rays Hill	"	"
W8XXE	Sideling Hill	"	"
W8XXK	Sideling Hill	"	"
WBJP	Somerset	"	"
WBJQ	Somerset Maint Shed		"
W8XXG	Tuscarora Mt	"	"
WBJL	Willow Hill	"	"
WAMF	(P)	"	"
WSVR	(P)	"	"
WRSQ	(PM)	"	"
WJAK	(PM)	"	

* Headquarters Station

RHODE ISLAND

WRSA	Scituate	Rte 6	N Scituate	EC Godwin
WRSW	"	(P)	"	"

TENNESSEE

WJBV	Chattanooga	110 E 9th St	PE Griffith
WBVM	Nashville*	State Bldg	"
WKVT	Knoxville	Blount & Henley	"
WDBW	Memphis	232 Front St	"
WAMW	(PM)		

* Headquarters Station

TEXAS

KTXA	Austin*	State House	WH Broman
KTXH	Dallas	Police Barracks	"
KTXF	Ft Worth	"	"
KTXU	Houston	"	"
KTXB	(P)		
KTXR	(P)		

* Headquarters Station

UTAH

KUSH	Ogden	Police Barracks	JB Littlejohn
KPRV	Provo	"	"
KUHP	Salt Lake City*	Capitol Bldg	JB Littlejohn
KBTS	(P)		"

* Headquarters Station

VIRGINIA

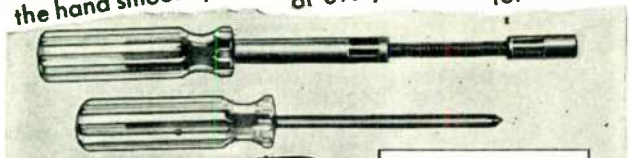
WRIF	Appomattox	Police Barracks	WM Lee
WSPH	Chesterfield Co	"	"
WRIG	Culpepper Co	"	"
WSNL	(P)	"	
WAEY	Princess Anne Co	"	"
WRXQ	Wytheville	"	"
W3XVY	Montgomery Co	"	"

WASHINGTON

KNFK	Bellingham	Police Barracks
KQZT	Bremerton	"
KNFS	Chehalis	"
KGHQ	Chinook Pass	"
KQCS	Colfax	"
KAXV	Colville	"
KWSF	Davenport	"
KNFX	Ellensburg	"
KNGZ	Ephrata	"
KFDG	Everett	"
KRHX	Fort Lewis	"
KNGA	Goldendale	"
KBPW	Hoquiam	"
KBKK	Kelso	"
KQGF	K-M Hill	"
KNFZ	Lodge Pole Camp	"
KQDY	Mason City	"
KFHP	Mt Vernon	"
KACB	Okanogan	"
KFPM	Olympia*	Legislative Bldg
KNFG	Olympia*	"
KQEK	Pasoc	Police Barracks
KRGS	Port Angeles	"

PICKING THE RIGHT SCREW DRIVER

. . . to perform some particular job easier and more efficiently is a simple matter when you choose a Vaco. Vaco Amberyl shock-proof and break-proof plastic handle drivers are made in 173 types. Handles fit the palm of the hand smoothly, yet permit a firm grip. Bits take care of every possible need. Write for catalog.

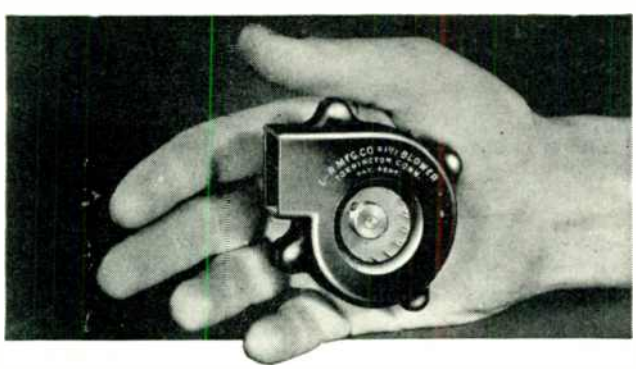


PATENTS MAKE JOBS

VACO PRODUCTS CO.

335 E. ONTARIO ST. • CHICAGO 11, ILL.

Canadian Warehouse: 560 KING STREET, WEST • TORONTO 2, ONTARIO



MOVING AIR --

15 CUBIC FEET A MINUTE ONLY 2½" OF SPACE NEEDED

The blower illustrated, No. 1½*, is one of many blower models manufactured by the L-R Mfg. Div. with C.F.M.'s at 8000 R.P.M. ranging from 15 to 270. These blowers will outperform many larger and heavier types formerly in use and where size and weight are factors, they are the answer to cooling problems presented by electronic tubes or circuit components in airborne communication units as well as in many industrial applications.

*WEIGHT: 2 oz.; CAPACITY: 15 C. F. M. at 8000 R. P. M.; CONSTRUCTION: Housing of high impact phenolic plastic. Wheel is turbo-type cadmium-plated steel; SIZE: 2⅝" long x 61/64" wide x 2½" high.

L-R MANUFACTURING DIVISION OF

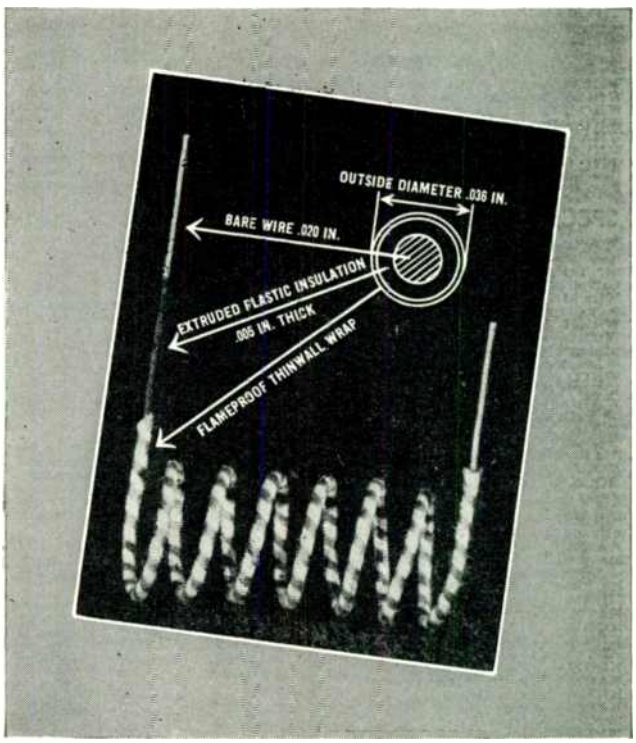
The RIPLEY Company

2. NEW LITCHFIELD STREET
TORRINGTON, CONNECTICUT

THE WESTERN UNION TELEGRAPH CO.

installs SURCO THINWALL WRAP *after Rigid Testing*

. . . . . the first uniformly high quality fine wire, plastic insulated with flame proofed yarn serving.



This photo of typical construction is absolutely unretouched

Voltage Breakdown — 7000 Volts
(For spiraled section shown in photograph after 5 minutes in water)
Insulation Resistance—30 Megs. Per 1000 Ft. at 60°F. (After 72 hrs. in water)

Here are Thinwall's Characteristics:

High dielectric properties, Maximum saving in space and weight, Unlimited coding and identification, High temperature operation, Excellent abrasion resistance and toughness, Maximum protection against damage by soldering iron, Unusual flexibility at below freezing temperatures, Flameproof qualities, Good end and spot-stripping characteristics, Low cost.

Surco-American Thinwall Wrap is available in a wide variety of formulations finer sizes of wire and thinner insulations than shown above, for use where maximum performance under specific operating conditions is required.

SURCO PRODUCTS

Surprenant

ELECTRICAL INSULATION CO.
Dept. R **84 Purchase St., Boston 10, Mass.**

STATE POLICE, Continued

KWSE Raymond "
KGHD Seattle "
KNFL Shukson "
KGHE Snoqualmie Pass "
KNGR Spokane "
KQJY Tacoma "
KNGC Vancouver "

KNGD Walla Walla "
KNGQ Wenatchee "
KNGB Yakima "
KQAW (P)
KQFS (P)
KQMA (P)
KQZY (P)
KRBV (P)
KQBX (PM & P)
KRAH (PM & P)

KRAI (PM & P)
KRAM (PM & P)
KWSA (PM & P)

* Headquarters Station

WEST VIRGINIA

WBSP Beckley Police Barracks CA Marshall
WSUA Chapmanville " "
WSPL Elkins " "
WMWV Moundsville " "
WSJA Parkersburg " "
WRMP Romney " "
WSWV Shinnston " "
WPWV South Charleston " "
WSLT Stollings " "
WRPC (P)
WBSQ (PM)

WISCONSIN

W1ZR Madison State Traffic Control
WAQZ (PM)
WKWS (PM)

WYOMING

KWHF Casper Police Barracks CA Houge
KWHC Cheyenne 1500 E 5th St "
KWHG Cody Sheriff's Office "
KWHD Rawlins Sheriff's Office "
KWHA Rock Springs City Hall "
KWHE Sheridan Police Dept "
KWHQ Laramie (P) "

SPECIAL EMERGENCY STATIONS

ALABAMA

Amer Tel & Tel Co 100 N Franklin St Mobile JC Carroll
Wire Mobile
Birmingham Gas Co 1200 6th Ave N Birmingham
WBXH Birmingham Ala TG Humphreys Jr
WBXI " "
Southern Natural Gas Co Box 2563 Birmingham LC Bomar
WBVO Wetumpka Ala
WKHT Tarrant "
WKHU Atlanta Ga

ARKANSAS

Little Rock Municipal Waterworks Little Rock
KQCJ Reservoir of Little Rock Ark EF Henning
KQCK Mun Filter Plant " " "

CALIFORNIA

Ambrose G 810 Mills Bldg San Francisco
KAMA Santa Cruz Island Santa Barbara Calif
State of Calif Dept of Pub Wks Div of H'ways 12th & N Sts Sacramento Calif
KATW Alturas
KQGM Bishop
KATX Burney
KQGI Burnt Mill
KQGJ Cajon Pass
KBTC Conway Summit
KQGK Crestview
KAON Donner Summit
KRMA Echo Summit
KFPE Grapevine
KQGC Marysville
KATU Mineral
KATR Mt Shasta City
KFPE Oak Glen
KATV Pulga
KATQ Quincy
KASN Redding
KFPH Ridge Route
KQGN San Bernadino
KBTD Sonora Junction
KATS Susanville
KQGD Truckee
KATT Yreka
KQGB Yuba Gap
KASO Test Car (PM)
KQGL (PM)
California Elec Power Co 3771 8th St Riverside JK Reaves
KGJF Blythe Calif
KGJD Calipatria "
KGYF Bishop
KGYB Tonopah Nevada
City of Long Beach Long Beach Calif
KQXI Long Beach Calif FG Strong
City of Los Angeles Dept of Water & Power Box 3669 Terminal Annex Los Angeles Calif WW Matney
KQS Independence Calif
KQT Los Angeles "
KFMQ " "
KIIE Victorville "
KIIG Silver Lake Camp Calif
KIKH Boulder City Nevada
KADN (P)
KADP (P)
Hayside Co 40 Spear St San Francisco
No fixed stations
Los Angeles Co Calif Flood Control Dist 751 S Figueroa St Los Angeles Calif ME Kennedy
KAOS N Hollywood
KAOP Puddingston Dam San Dimas Calif
KAOQ Santa Anita Dam Monrovia "
KFCD Los Angeles Calif
KIIW San Gabriel Dam 2 San Gabriel Canyon Calif
KIPH Los Angeles Calif
KIPN Pacoima Dam Pacoima Canyon Calif
KIPO San Gabriel Dam 1 San Gabriel Canyon Calif
W6XFE San Rafael Hills
KIPW Big Tujunga Dam Big Tugunga Canyon Calif
KQXD Big Dalton Dam Glendora Calif
KQXE Glendora Calif
KQXF Long Beach Calif
Los Angeles Railway Corp 1060 S B'way
KITF Los Angeles DJ Sullivan
KINT (P)
KIPP (P)
KQXN (P)
KQXO (P)
Modesto Irrigation Dist 823 11th St Modesto Calif
KQBZ R Gada
Nevada Irrigation Dist Grass Valley Calif
No fixed stations
Pacific Gas & Elec Co 245 Market San Francisco Calif
KQDX Caribou Power House Plumas Co Calif
Pacific Lighting Co 810 Flower S Los Angeles Calif
KRML Los Angeles HV Harvey
KABS " "
Pacific Tel & Tel Co 140 New Montgomery St San Francisco Calif CH Cole
KDOG Chowchilla
KQEL Yosemite Valley
KAPR Fields Landing
KQEM Ukiah
KFDU Emeryville
KFXD " "
Reclammation Dist No 1500 Robbins CD Bouton
KQXM Robbins Calif
San Diego Gas & Elec Co 861 6th Ave San Diego Calif
KROA San Diego Calif PH Adams
Coast Counties Gas & Elec Co 22 Pacific Ave Santa Cruz Calif W Kellar
KFIB Gilroy Calif
KFIL Hollister Calif
Southern Calif Edison Co Ltd 601 W 5th St Los Angeles Calif
KAMB Alhambra Calif
KAMC Glendale "
KFTH Big Creek "
KFTL " "
KFSJ Alhambra "
KFSL San Gabriel "
KFSR Santa Barbara "
KFSV Kernville "
KQDZ Anaheim "
KQER Chino "
KQES Long Beach "
KQET Torrence "
KQEU Saticoy "
KQEV Vernon "
KQEW Santa Monica "
Southern California Gas Co 810 S Flower St Los Angeles 14 Calif HJ Keeling
KBSB (PM)
KFIU (PM)
Southern California Telephone Co 740 S Olive St San Francisco Rm 428 JH Clark
KDXA (P) "
KDXB (P) "
KFDP (P) "
Southern Counties Gas Co of Calif 810 S Flower St Los Angeles Calif
No fixed stations
Southern Pacific Co 65 Market San Francisco Calif
KAWJ Norden Calif
Superior Oil Co 930 Edison Bldg Los Angeles Calif
KFKY Craig Colo
KFKZ Rio Blanco Co Colo
KIEH Lafayette La

COLORADO

Mountain States Tel and Tel Co Denver Colo
No fixed stations
The Uncompahgre Valley Water Users Assoc 601 N Park Montrose Colo JR Thompson
KGDH Taylor Park Dam Colo
KGDN Montrose Colo

CONNECTICUT

Connecticut Light & Power 250 Freight St Waterbury
WAVX Waterbury Conn QQ Quin
WAVT " " "
WAVY Montville " "
WAWF Devon " "
WAWK New Milford " "
WAWN Stevenson " "
Southern New England Tel Co 227 Church New Haven
WSNU New Haven Conn LB Grew
WSNV " " "
United Illuminating Co 80 Temple New Haven Conn
WBXW New Haven Conn WA Upham
WCBY Bridgeport " "

DISTRICT OF COLUMBIA

Capital Transit Co 3222 M St NW Washington DC
WQHA Washington DC RG Thring
Potomac Elec Power Co 10th & E Sts NW Washington DC TC Pearce
WSIB Washington DC
Chesapeake & Potomac Tel Co 725 13th St NW Washington DC CM Godfrey
WSIL (PM)
WSIM (PM)

FLORIDA

Amer Tel & Tel Co
WITC Jacksonville 325 W Adams JC Leman
WITG Key West Simonton & Southard SW Newland
WATJ Miami 36 NE 2nd St JD Rhodes
WATK Miami " "
Florida Power & Light Co 25 SE 2nd Ave Miami Fla
WNE Bradenton Fla
WNF Sarasota "
WNG West Palm Beach "
WNH Miami "
WNM Lake City "
WNP Palatka "
WNQ Ft Lauderdale "
WNS Punta Gorda "
WNT Sanford "
WNV St Augustine "
WNX Daytona Beach "
WNZ Ft Pierce "
City of Jacksonville 1040 Laura St Jacksonville
WMGQ Jacksonville Fla EW Connell

GEORGIA

Consolidated Timber Protective Organization Homerville Ga
WANA Homerville Ga
Southern Bell Tel & Tel Co 67 Edgewood SE Atlanta
No fixed stations
Superior Pine Products Co Fargo Ga
WNEE Fargo Ga

ILLINOIS

Chicago Surface Lines 231 S LaSalle Chicago Ill
WAYH Chicago Ill
Commonwealth Edison Co 72 W Adams Chicago Ill
WBYU Chicago Ill RV Dondanville
WKGP " "
WKGQ " "
WKGR " "
WKGS " "
WKGT " "
WKGU " "
WKGV " "
WKGW " "
WMJS " "
W9XFR " "
W9XFS " "
Illinois Bell Tel Co 212 W Washington Chicago Ill
WAGV Springfield SE Austin
WAGW " "
Natural Gas Pipeline Co of Amer 20 N Wacker Dr Chicago Ill WT Bulla
KQSV Gray Okla W T Bulla
KQSW Minneola Kans "
KQSV Heizer " "
KQSU Glasco " "
KQSX Beatrice Neb "
KIPI " " "
KIPR Emerson Iowa "
KIPT Truro " "
KIPU Harper " "
KIPQ " " "
WAGQ Geneseo Ill "
Texoma Natural Gas Co 20 N Wacker Dr Chicago Ill
KQWB Fritch Texas WT Bulla
KQWC Stinnett " "

INDIANA

Indiana Bell Tel Co 240 N Meridian Indianapolis
No fixed station JM Hughes
Indiana General Service Co Marion Ind
WSAF Muncie Ind EE Miller
WSAO Marion " "
Indiana & Michigan Elec Co 220-2 W Colfax Ave South Bend Ind MA Kerscher
WAJX RR 2 Allen Co Ind MA Kerscher
WAMN Mishawaka Ind "
WAKS RR 3 Berrien Co Mich "
WAKU Elkhart Ind "
WAUG South Bend Ind "
Indianapolis Power & Light Co 1230 W Morris St Indianapolis Ind
WDBP Indianapolis Ind BW Whaley
Indiana Service Corp 2101 Spy Run Av Ft Wayne Ind
WDDF Ft Wayne Ind HK McKean
WFIA " "
Northern Indiana Pub Service Co 220-222 S Main St Goshen Ind RA Hawk
WDBV Goshen Ind RA Hawk
WMRB Angola " "
WMRG Warsaw " "
WMRM Plymouth Ind "
Public Service Co of Ind Inc 110 N Illinois St Indianapolis Ind HD Ashlock
WKKI Marion Co Ind

KANSAS

Kansas City Power & Light Co 1330 Baltimore Kansas City 10
KQIG Kansas City
Kansas Gas & Elec Co 1900 E Central Wichita Kans
KAOC Wichita Kans L. Reece

KENTUCKY

Louisville Gas & Elec Co 731 Ormsby Louisville Ky
WRHD Louisville Ky WT Beard

MARYLAND

Chesapeake & Potomac Tel Co of Baltimore City 320 St Paul Pl Baltimore Md AE Nickles
WRCO Salisbury Md AE Nickles
WAXS Baltimore " "
WRCS " " "
WAXQ Cumberland " "
WAXR Hagerstown " "
WBDL Onancock Va "
Consolidated Gas Elec Light & Power Co of Baltimore 39 W Lexington St Baltimore Md
WAQI Baltimore Md

MASSACHUSETTS

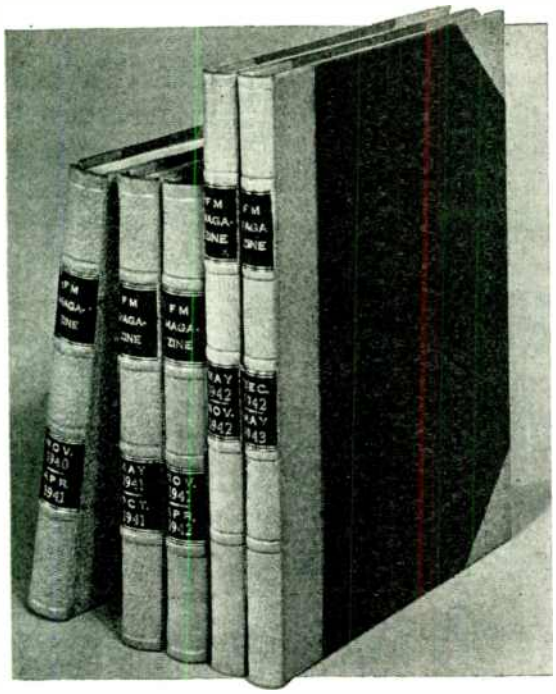
Boston Consolidated Gas Co 100 Arlington Boston
WDDE Boston Mass F Krumscheid
Boston Edison Co 39 Boylston St Boston Mass HC Hamilton
WLDT Framingham Mass
WAZB Weymouth "
WAZC Boston "
WAZD " "
WAZE " "
WAZI " "
WAZK " "
WRIU " "
WAAE " "
WQWP Woburn
Boston Elevated Railway Co 31 St James Ave Boston
No fixed stations
Brockton Edison Co 36 Main St Brockton Mass
WEKS Brockton Mass CW Beals
New England Power Co 441 Stuart St Boston Mass
WAOJ Millbury Mass
New England Tel & Tel Co 6 Bowdoin Sq Boston Mass
WDBG Boston Mass AS Winslow
Western Mass Elec Co 210 Alden St Springfield Mass
W8YA BJ Dowd

MICHIGAN

City of Detroit Dept of Street RR's 12249 Woodward Av Detroit Mich T Kirby
WAIJ Detroit Mich
The Detroit Edison Co 2000 2nd Ave Detroit Mich
WDAX Detroit Mich AA Meyer
WMAV Marysville Mich AA Meyer
WQJL Detroit " "
W8UP Superior " "
Michigan Bell Tel Co 1365 Cass Ave Detroit Mich
No fixed stations WH Blankmeyer

MINNESOTA

Northern States Power Co 15 S 5th St Minneapolis
WPL St Croix Falls Wis
WLP Minneapolis Minn



Essential to Every TECHNICAL LIBRARY

Here is an invaluable source of information on the most important radio development—a complete record of FM progress in all its phases. In addition, these bound volumes of *FM* AND TELEVISION contain a wealth of technical information and design data which should be available in every engineering and patent library.

May 1941 to October 1941
November 1941 to April 1942
May 1942 to November 1942
December 1942 to May 1943
June 1943 to December 1943
January 1944 to June 1944
July 1944 to December 1944

NOTE: *November 1940 to April 1941 is out of print*

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AN HOUR ON THE BENCH SAVES NINE ON THE JOB

Bench assembly and repair means speed-up in production. The use of Cannon Multi-circuit Connectors in the wiring of electrical equipment is the ultimate in assembly efficiency—time saved on the job, less skilled labor, better critical work under better conditions.

Bench wiring by Jean Wheeling of the Curtiss-Wright Corporation, Columbus, Ohio

Various parts of electrical assemblies may be manufactured in different factories and put together and into operation simply by inserting a Cannon Plug into a Cannon Receptacle. The connection will be firm, tight and solid—yet quickly disconnected for replacement or repair.

There are more than ten thousand connector sizes, types and kinds listed in the Cannon catalogs. Thousands of special and intricate circuit requirements may be met right from stock with Cannon Plugs.

Wherever quick, complete and sure electric connections must be made—whether for a single element or a maze of circuits—use a Cannon Connector. Nothing less is so surely satisfactory. Nothing better can be had.

Write for the condensed Cannon Catalog. It gives you a general introduction to the Cannon line. Address Dept. A-195, Cannon Electric Development Company, 3209 Humboldt St., Los Angeles 31, California... *Below is pictured a wall mounting, typical of the famous Cannon AN line of plugs.*

CANNON ELECTRIC

Cannon Electric Development Co.
Los Angeles 31, California

Canadian Factory and Engineering Office:
Cannon Electric Company, Ltd., Toronto

Representatives In Principal Cities — Consult Your Local Telephone Book

Cannon 1C 6045

SPECIAL EMERGENCY STATIONS, Continued

Rainy River Improvement Co 500 Baker Arcade Bldg Minneapolis Minn O Sandstrom
WRRL Kettle Falls Dam Minn
WRRM International Falls "

MISSOURI

Kansas City Power & Light Co 1330 Baltimore St Kansas City Mo L O'Dell
KQIG Kansas City Mo
St. Joseph Light & Power Co 502 Angelique St Joseph Mo O Fisher
KRMK St Joseph Mo
St Louis Pub Service Co 3869 Park Ave St Louis Mo
KEHG St Louis Mo BB Miller
Southwestern Bell Tel Co 1010 Pine St St Louis Mo
No fixed stations
Union Elec Co of Mo 315 N 12th Blvd St Louis Mo
KUEC St Louis Mo JP Woodward

MONTANA

The Montana Power Co 40 E B'dway Butte Mont
No fixed stations Wil Blankmeyer

NEBRASKA

Northwestern Bell Tel Co 118 S 19th St Omaha Nebr
KQJU (PM) RB Peterson
KQJV (PM)

NEW YORK

American Legion IL Spring Post 149 1 Fenton Pl Jamestown NY PT Turner
WANC Jamestown NY
American Tel & Tel Co (Long Lines Dept) 32 6th Ave New York NY
No fixed stations
Buffalo Niagara Elec Corp 535 Washington Buffalo NY
WALI Buffalo NY
City of Buffalo Div of Water Water Intake Pier & Filtration Plant Porter Ave Buffalo NY
WRQI Buffalo NY JB Still
WRQJ " "
City of New York Bd of Transportation 250 Hudson New York City
WRWH Brooklyn NY
New York & Queens Elec Light & Power Co 28-19 Bridge Plaza N Queens NY
No fixed stations
New York Telephone Co 140 West St New York City
WRSD New York NY DS Brown
WRSE " "
Western Union Telegraph Co 60 Hudson St New York NY EC Homer
WRZS Water Mill NY
Consolidated Edison Co of NY 4 Irving Pl New York NY
No fixed stations

OHIO

Cincinnati Street Railway Co Dixie Term Bldg Cincinnati Ohio GS Cornish
WAQF Cincinnati Ohio
City of Cleveland Div of Transportation 1404 E 9th Cleveland Ohio
WDCZ Cleveland Ohio
Columbus & Southern Ohio Elec Co 215 N Front St Columbus Ohio JN Schwartz
WJGR Harrison Twp Pickaway Co JN Schwartz
WJGN Madison Twp Franklin Co "
WJGK Columbus Ohio "
The Dayton Power & Light Co 25 N Main Dayton Ohio
WAMZ Dayton Ohio WR Maxwell
WBNH Wilmington "
WBNI W Alexandria "
WBNJ Washington Ct House "
WBNK Xenia "
WOBR Dayton "
Ohio Bell Tel Co 750 Huron Rd Cleveland Ohio
WSLU (PM)
WSLV (PM)
WSLW (PM)
WSLX (PM)
Ohio Edison Co 325 E North St Akron Ohio
WOEA Akron Ohio HE Nerhood
The Ohio Power Co 606 2nd St SE Canton Ohio
WABO Bellair Ohio JC Mundorff
WCEG Canton " "
WDBN Tiffin " "
WAFJ Vernon Jct " "
WAGS Kenton " "
WMOK Wheeling " "
The Ohio Pub Service Co Massillon Ohio
WAHI Alliance Ohio CB Schwab
WMLW Elyria " "
WMLX Warren " "
WMLY Port Clinton " "
WRQW Massillon " "
WRRA Sandusky " "
City of Toledo Dept of Pub Service Div of Water Toledo Ohio EM Wilgus
WBOY Toledo Ohio EM Wilgus
WBOU " "
The Toledo Edison Co Edison Bldg Toledo Ohio
WBYT Toledo Ohio A Ketcham-G Dorr

OKLAHOMA

Oklahoma Gas & Elec Co 321 N Harvey St Oklahoma City H Hartman
KRMH Oklahoma City Okla
KRMI Harrah "
KEXA Enid "
KEXC Oklahoma City "
KEXD Ft Smith Ark
KEXS Muskegee Okla
Public Service Co of Okla 600 S Main Tulsa Okla
KGNS Tulsa Okla CR Downing
Stanolind Pipe Line Co PO Box 591 Tulsa Okla
KQWF Pauls Valley Okla FP O'Connor
KQWG Ada "

OREGON

Northwestern Elec Co 920 SW 6th Ave Portland Ore WL Campbell
KAGX (PM)
KAGW (PM)
KBOS (PM)
Portland General Elec Co 621 SW Alder St Portland
KQEB Portland Ore
Portland Gas & Coke Co 920 SW 6th Ave Portland
No fixed stations DB Larsen

PENNSYLVANIA

Bell Telephone Co of Pa 1835 Arch St Philadelphia
No fixed stations
Duquesne Light Co 435 6th Ave Pittsburgh Pa
WCBV Springdale Pa
WETI Pittsburgh "
WETC " "
WETD " "
WFOL Wireton "
Pennsylvania Power & Light Co 901 Hamilton St Allentown Pa
WBI Frackville Pa
WCJ Hazleton "
WPH Williamsport "
WAND Allentown "
Peoples Natural Gas Co 545 Wm Penn Pl Pittsburgh
WCZI Churchill Pa JV Hogue
WJHE Alleghany Co " "
WJHT Brave " "
WJHF Monongahela " "
Philadelphia Elec Co 1000 Chestnut St Philadelphia
WLP Philadelphia Pa
Phila Transportation Co 1405 Locust St Phila
WIVN Philadelphia Pa
Pittsburgh Railways Co 435 6th Ave Pittsburgh Pa
WETL (PM) AC Cappel

SOUTH CAROLINA

Amer Tel & Tel Co Palmetto Bldg Denmark
WITA Denmark SH Woodward
WITJ Denmark "

TENNESSEE

City of Memphis Light Gas & Water Div 179 Madison Memphis Tenn JC Flippin
WMJV Memphis Tenn

TEXAS

City of Beaumont Water Dept Walnut & Mulberry Sts Beaumont Texas JD Southwell
KSEB Wiess Bluff Texas
Central Power & Light Co 120 N Chaparral Corpus Christi P Taylor
KRMV Corpus Christi Texas
KIBQ " "
City Pub Service Bd 201 N St Mary's San Antonio B Gauger
KAXX San Antonio Texas
KNBT New Braunfels "
KRMW San Antonio "

UTAH

Telegram Publishing Co 137-143 S Main Salt Lake City John Baldwin
KASY Salt Lake City Utah
KASZ " "

VIRGINIA

Amer Tel & Tel Co
WAIV Norfolk 120 W Bute St JL Rothgeb
WAIW Richmond 703 E Grace St RC Call

SPECIAL EMERGENCY STATIONS, Continued

Appalachian Elec Power Co 129 E Campbell Ave Roanoke Va
WMOF Charleston W Va
WRIS Roanoke Va WW Krebs
Chesapeake & Potomac Telephone Co of Va 703 E Grace Richmond Va
No fixed stations

WASHINGTON

City of Everett Water Dept 3102 Cedar St Everett
KFQB Everett Wash LH Machin
Puget Sound Power & Light Co 860 Stuart Bldg Seattle
KAQR (P) AA Noon
KAQS (P)
KAQT (PM)
KAQU (PM)
City of Seattle Dept of Lighting 3rd Ave & Madison Seattle Wash RA Benson
KFEC Seattle Wash
KFEJ Cedar Falls "
KFED Diablo "
KFEE Newhalem "
Washington Water Power Co 825 Trent Spokane Wash
KQJD Spokane Wash EH Schuler

WEST VIRGINIA

Wheeling Elec Co Wheeling W Va
No fixed stations EL Miller
The Chesapeake & Potomac Tel Co of W Va 816 Lee St Charleston W Va
No fixed stations

WISCONSIN

Wisconsin Michigan Power Co 137 W Mill St Appleton Wis G Merkl
WBMN Appleton Wis
WQWR Conto Falls Wis
Wisconsin Telephone Co 722 N B'dway Milwaukee Wis RE Holm
No fixed stations

WYOMING

Mountain Fuel Supply Co 615 Conn Ave Rock Spgs Wyo A Buchanan
KQVK Coalville Utah
KAYG Rock Spgs Wyo
KAYH (PM)

SPOT NEWS NOTES

(CONTINUED FROM PAGE 36)

RMA of Canada: R. M. Brophy, president of Rogers Majestic Limited and Rogers Electronic Tubes Limited was re-elected president of the Radio Manufacturers Association of Canada. Also re-elected were vice president S. L. Capell, who is vice president of Philco Corporation of Canada, Limited, and general manager W. W. Richardson.

Sets for Troops: A new Signal Corps broadcast receiver, type R-100/URR, is being supplied to entertain troops overseas. Operating on batteries, AC, or DC, it tunes medium and short waves. About 100,000 sets will be made by Majestic, Emerson, Espey, and Hallicrafters.

W3XO Sold: FCC approval has been asked for the sale of Jansky & Bailey's FM developmental station at Washington, D. C. to the *Washington Post*. Price was said to be $75,000. The new owners have retained Jansky & Bailey as consulting engineers, and they will carry on the development work to which the station is already committed.

30th Anniversary: In 1915, Melville Eastham founded the General Radio Company. Not yet 30 years old at that time, he was already well known and highly respected for the design of Clapp-Eastham receiving and transmitting equipment. General Radio's shipments in 1944 totalled $5,150,000.

Sound & Fury: The group of men who control the destiny of a business that has made enunciation an art and sound reproduction a science are surprisingly oblivious to microphone technique and to the performance of the public address equipment used at the FCC hearings. These factors, added to the very bad acoustics of the auditorium at the Museum of Natural History, make it impossible, at times, to follow examination and testimony.

B. G. Erskine: Chairman of the board of directors of Sylvania Products, Inc. passed away at his home in Emporium, Pa., on June 23rd, at the age of 68. In 1924, Sylvania Products Company was formed to manufacture vacuum tubes at the Emporium plant, originally a G. E. property which Mr. Erskine and two associates purchased in 1921. After merging with the Hygrade Lamp Company of Salem, Mass. in 1931, all lamps were sold under the Hygrade name, and tubes under the Sylvania Trademark. Today, the Company's plants in 30 towns employ nearly 30,000 people in the manufacture of lamps and radio tubes.

Henry J. Barreca: After one year as vice president of Amalgamated Radio Television, New York City, Henry Barreca has been elected president. He was formerly chief tool engineer of American Radio Hardware Company of Mt. Vernon, N. Y.

Merger: The 50-year-old Thordarson Electric Manufacturing Company, Chicago, and Meissner Manufacturing Company, Mt. Carmel, Ill., have been merged with Maguire Industries, Inc. Other Maguire acquisitions are Ferrocart Corporation of America and Micro Products Corporation.

L. G. Winney, formerly first vice president and treasurer at Thordarson, has been elected as vice president of Maguire Industries, and will be general manager of the Thordarson Division. William R. Mahoney, formerly secretary and assistant treasurer at Thordarson, has been elected assistant treasurer of Maguire Industries, and Miss L. A. Strohmayer, assistant secretary.

Following the purchase for cash of all Meissner stock, Mr. Maguire announced that there will be no change in policies or operations other than expansion in sales volume due to increased capital now available. James T. Watson and George V. Rockey, formerly the principal stockholders, will continue to head the Meissner management, and Oden F. Jester will carry on as sales manager. Mr. Watson has been elected a vice president of Maguire Industries.

Television in B. A.: A syndicate headed Martin Tow, holding the only franchise for television in Argentina, has consumated negotiations with Allen B. DuMont Laboratories for the purchase of a television station to be erected at Buenos Aires. It is understood that the transmitters will be of 25 kw. peak power for video and 12.5 kw. for audio, and that cameras and control equipment will be furnished for 3 studios. Although other applications have been received for equipment to be used in South America, this is the first actual sale consumated.

Howard E. Kingdon: The appointment of Howard E. Kingdon as chief engineer has been announced by Eisler Engineering Company, Newark, N. J., manufacturers of radio tube and lamp manufacturing machinery and welding equipment. Mr. Kingdon was born in Michigan, and received his engineering degree from the University of Michigan in '23. Before joining Eisler, he was works manager of the transformer division of Commonwealth Electric Corporation, Welland, Ontario.

New Tube Division: All RCA's tube engineering, manufacturing, and sales activities are to be integrated in the new RCA tube division, with L. W. Teegarden as general manager. Division headquarters, now located at Camden, will be moved to Harrison, N. J. RCA tubes are produced in plants at Harrison, Lancaster, Pa., Saugerties, N. Y., and Indianapolis. Newly appointed executives of the division are Dr. G. R. Shaw, chief engineer; F. H. Troup, controller; and T. J. Scanlon, general purchasing agent. Mr. Teegarden will continue to direct tube sales.

W2XMN: Major Armstrong has applied to the FCC for authority to operate his Alpine station on a new frequency of 92.1 mc. with a power of 55.7 kw. to cover 15,610 square miles.

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

and refinements as are necessary. Next, the revised plan will be passed on to the Commissioners for their consideration, and for their guidance in formulating rules and regulations to assure the most effective utilization of the frequencies assigned to the police service.

There, in very broad terms, is what you can expect from the FCC. The Commissioners are not experts on the subject of police communications.

You are the experts in police communications — not the FCC. It is to your advantage and to their credit that they recognize your abilities and their limitations. However, this puts a definite obligation on the membership of the Eastern States Police Radio League and of the Associated Police Communications Officers to formulate plans that will meet your present needs and anticipate future expansion. In fact, it puts every police communications officer under obligation to join either the ESPRL or APCO, and to protect the requirements of his own system by taking part in the overall planning.

These plans must fit within a framework of limitations which the FCC has set up in order to assure the most effective use and distribution of the radio spectrum. I can give you certain information on some of the points to be considered. Even this data, however, is subject to any modifications which may be indicated by further experience.

The number of channels in a given band is limited by the frequency swing of the FM transmitters and the frequency drift that is permitted. In order to accommodate the maximum number of channels in the new, higher bands, both mobile and fixed police equipment will have to meet new standards of frequency precision, and police radio supervisors will have to maintain these higher standards.

It is probable that the allowable tolerance on new mobile equipment for frequencies above 100 mc. will be reduced to .005% or even to .0001%. This is not final, but it is probable that these tolerances will be written into the new requirements.

Initially, it is planned that the channel widths will be:

40 kc. wide at 30 to 44 mc.
50 kc. wide at 74 to 78 or 104 to 108 mc.[1]
60 kc. wide at 152 to 162 mc.

The channel width at 30 to 40 mc. may be reduced to something less than 40 kc., but no final decision has been made yet.

Control and relay circuits seem scheduled to share the television channels where this can be done without mutual interference. If, as many expect, the No. 1. plan[1]

[1] The final decision of the FCC, announced on June 27th, puts the police band at 72 to 76 mc., with channels 40 kc. wide. Television frequencies to be shared by police and other services will probably be 44 to 50 mc., 54 to 72 mc., and 76 to 82 mc.

(CONTINUED ON PAGE 82)

"HYTRON Tubes Are Good—SO WHAT!"

Sure, Hytron tubes are good — so what! All tubes made for Uncle Sam are good. They have to be, or he wouldn't accept them.

But Hytron goes further. Not satisfied just to meet Uncle Sam's JAN-1A specifications, it always sets factory testing specifications to tighter tolerances than the Services require. In this way, Hytron assures top quality despite slight meter inaccuracies and the human element. When more uniform adherence to specifications can be attained, tests simulating actual equipment performance are added.

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RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

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YES! ***They're interchangeable.*** Magnetic shielding permits interchangeability on any type of panel without affecting calibration. The Type HM 2 is directly interchangeable with AWS Types MR 24 and 25. The Type HM 3 is directly interchangeable with AWS Types MR 34 and 35.

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Write today for complete information. Not only do we offer these instruments in standard ranges, but we also specialize in supplying them with special and unusual characteristics for new and unusual applications.

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- MASTER CONTROL BOARD . . . 5 Available Video Channels
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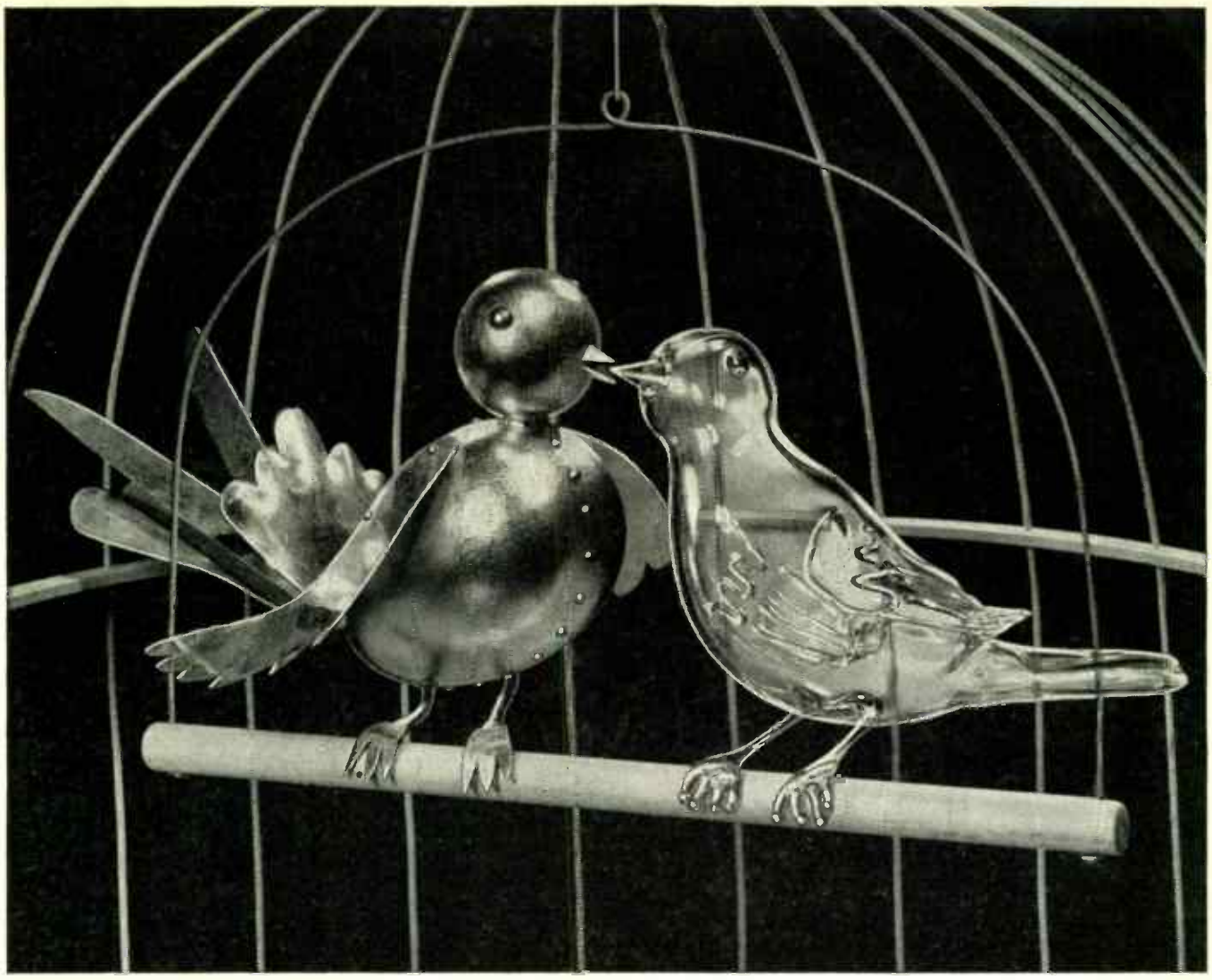

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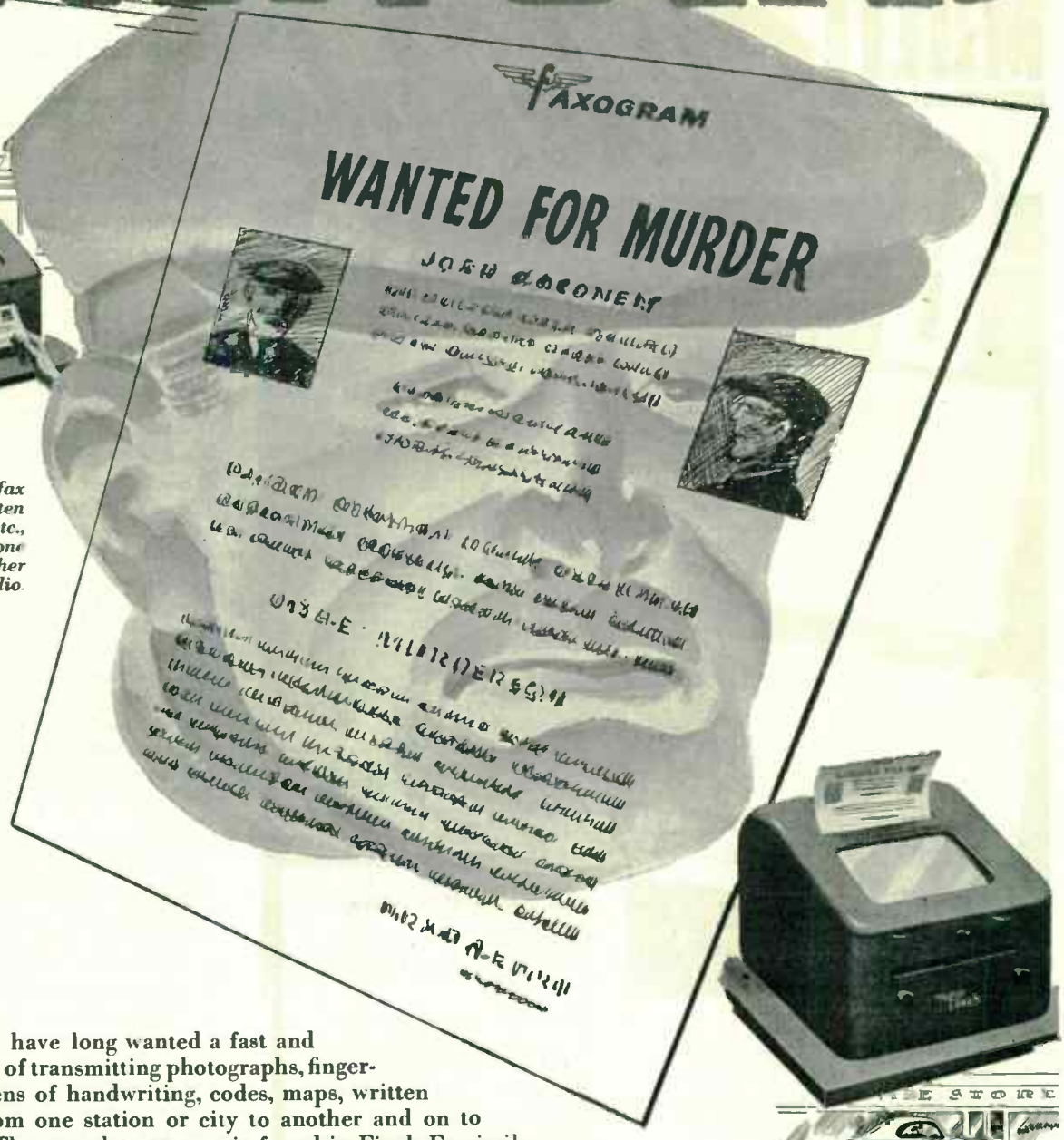

RECEIVING

With Finch Telefax Equipment, written orders, photos, etc., can be automatically received at high speed by cars and boats in motion.

Police have long wanted a fast and accurate means of transmitting photographs, fingerprints, specimens of handwriting, codes, maps, written orders, etc., from one station or city to another and on to mobile units. The complete answer is found in Finch Facsimile, the "instant courier."

In 60 seconds, Finch Telefax Equipment will send and receive everything that can be written, drawn or printed on a sheet of paper as big as a standard letterhead—as far as radio will reach! Because it eliminates errors and omissions, Finch Facsimile is the world's most accurate as well as fastest communication system.

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SELF SYNCHRONIZING

finch facsimile

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 72)

for 44 to 108 mc. is adopted, these frequencies will come in from 78 to 108 mc., and 174 to 216 mc.

Some communications officers I have talked to feel that there are now more police frequencies than there will be services to use them. If that proves to be so, they will be assigned to other services, but I do not hesitate to predict that when new equipment can be purchased, it will not take long to fill up all the channels.

As you probably know, APCO is now working on a plan for the 30- to 40-mc. and 42- to 44-mc. bands that will eliminate most of the long-distance interference which now causes so much annoyance. I presume that the Eastern States Police Radio League is taking part in this planning, since it is for the entire United States. This will mean new frequency assignments for some systems where there has been co-channel interference.

Systems operated by towns and small cities, intended to cover limited areas, are scheduled for the 152- to 162-mc. band. The manufacturers say that the initial installations and maintenance will cost more in this band, but the FCC is obliged to put effective spectrum utilization first, and price must, therefore, be a secondary consideration in assigning frequencies.

I have no information about prices of new fixed and mobile equipment, but when the present prewar designs are replaced by postwar models, it seems reasonable that all prices will be raised. At least, we know that new home radios are going to be up about 25% over comparable prewar receivers.

The most important and interesting new development ahead is facsimile. On this subject, the FCC has no convictions. First, the police must find out exactly what use they will make of this service, but this cannot be settled until it is known what equipment will be made available by the manufacturers. Nothing will be settled until you and the manufacturers get together to decide the broad specifications. For example: Are you going to transmit only photographs and fingerprints, or will you also use typewritten messages? Will you want to receive facsimile in the patrol cars, or will it be limited to point-to-point service? And will you want to transmit facsimile alternately or simultaneously with speech from your present transmitters, or will you want separate transmitters and receivers?

These and other questions of practice and policy will not be settled for you by the FCC. They will not urge you to use facsimile at all. You must determine your own needs, and then ask the FCC for what you want.

Some state or large city police department will probably pioneer with facsimile just as Connecticut did with 2-way FM.

(CONTINUED ON PAGE 85)

HERE'S THAT NEW TRIPLETT 625-N

LONG SCALE, WIDE RANGE VOLT-OHM-MILLIAMMETER

DOUBLE SENSITIVITY D. C. VOLT RANGES
0-1.25-5-25-125-500-2500 Volts, at 20,000 ohms per volt for greater accuracy on Television and other high resistance D.C. circuits.
0-2.5-10-50-250-1000-5000 Volts, at 10,000 ohms per volt.

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OHM-MEGOHMS
0-400 ohms (60 ohms center scale)
0-50,000 ohms (300 ohms center scale)
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TEMPERATURE COMPENSATED CIRCUIT FOR ALL CURRENT RANGES D.C. MICROAMPERES
0-50 Microamperes, at 250 M.V.

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Condenser in series with A.C. Volts for output readings.

ATTRACTIVE COMPACT CASE
Size: 2½" x 5½" x 6". A readily portable, completely insulated, black, molded case, with strap handle. A suitable black, leather carrying case (No. 629) also available, with strap handle.

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First with GLAZED CERAMIC SHELLS and New Style End Seals for 5-, 10-, 25-, 50- and 120-watt resistors. (One type of Koolohm—the standard type—does the job under any climatic condition, anywhere in the world)

First and STILL EXCLUSIVE with MEGOMAX
(The high-resistance, high-voltage resistors. Megohms of resistance operated at thousands of volts!)

One after another, Sprague Koolohm Resistors have established new performance records as proved indisputably by the record. One after another Koolohm Resistors have revolutionized traditional limitations to wire wound resistor usage—because radically different Koolohm construction permits a higher degree of physical protection, better electrical characteristics, smaller sizes, and easier mounting arrangements than are possible with conventional resistor types. Write for catalog.

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WIRE WOUND RESISTORS

SPRAGUE ELECTRIC COMPANY
(Resistor Division) North Adams, Mass.

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 82)

Frequency assignments will be issued on an experimental basis, as was the case initially with FM. Then, when practical experience indicates the permanent place for facsimile in police communications, the FCC will be ready to formulate rules for its use throughout the Nation.

Lieut. Basil Cutting, in charge of the New Hampshire State Police radio system, told me some interesting things about his ideas for using facsimile. I'll pass them on to you:

At the present time, when a suspect is picked up in New Hampshire, it may be necessary to hold him until his fingerprints can be checked at headquarters in Concord, where such records are kept. If the mails are used, this requires two days in most instances, although the actual checking at Concord takes only a matter of minutes. Otherwise, an officer must take time from his regular duties to drive to the Capital. With facsimile service available, this could be handled over the air in less than half an hour from the time the information is requested until it is received.

If the State Police could cover New Hampshire with facsimile transmission, the fingerprints of any criminal suspected of being in the State could be sent to every town and city in five minutes' time.

Basil Cutting told me that when a car is reported stolen, the dispatcher at Concord calls each town where the car might be located, and waits for an acknowledgment of each transmission to come in on one of a group of receivers tuned to the municipal frequencies. That takes considerable time, and holds up regular message traffic. All this could be done quickly on facsimile.

These two examples only scratch the surface of facsimile applications to police service. Its use is only limited by your imagination. How soon the equipment will be available in models designed for your particular use will depend largely upon your coöperation with the manufacturers, so that they may know your initial requirements.

The truth is that police communications officers are now in a most fortunate position. The manufacturers have accumulated a tremendous fund of technical and production experience which will be at your disposal by the time you are ready to tell them what new equipment or improvements you want.

Moreover, you have one of the ablest and most open-minded engineers in the FCC as chief of the Safety and Special Services Division, with which you are concerned. In case you haven't had a chance to become personally acquainted with Chief William Krebs, let me tell you something about him.

He came originally from Baltimore, and attended the Baltimore Polytechnic Insti-

(CONCLUDED ON PAGE 86)

tute and Johns Hopkins. He has been an active ham operator since 1918. After serving at station WBAL, Baltimore, and at the radio laboratory of the Washington Navy Yard, he joined the FCC in 1930 as an associate radio engineer. For six years, his work was concerned with amateur, point-to-point, and marine services. Subsequently, he was made chief of the Marine Division. Nearly four years ago, he was appointed assistant chief of the Safety and Special Services Division, and six months later, he became chief of the Division.

I have told you these facts so that you will realize that the man with whom you deal at the FCC has the background necessary to understand your problems, and to cooperate intelligently in their solution.

But he's not going to do your job for you. It is for you to analyze your requirements, to fit them into a practical, organized plan that will meet the needs of individual, local conditions, and at the same time operate successfully throughout our 48 states. Then you must present and promote that plan vigorously and aggressively at the FCC. If you do this, you can get everything you need to build a police communications system that will meet all emergencies encountered in your work of protecting lives and property, and maintaining law and order.

ENGINEERING SALES

(CONTINUED FROM PAGE 8)

will carry a stock of plant sound equipment, inter-office communication units, speakers, and amplifiers.

Stewart-Warner: Radio line will be handled in 12 Pennsylvania counties by Kile-Jacobs & Company, Wilkes-Barre. Owners are A. C. Kile and Peter Jacobs.

In the Binghamton, Elmira, and Syracuse territories, this line will be distributed by Northrup Supply Corporation, Binghamton, N. Y., under the direction of C. E. Gulbran. Northrup operates branches in Johnson City, Oneonta, and will soon open another in Syracuse.

Aerovox: New sales assistant to president W. Myron Owen is Frank L. Marshall, former assistant sales manager of Bundy Tubing Company, Detroit. He will handle sales to equipment manufacturers.

Hallicrafters: Has appointed R. J. Sherwood as sales manager. Formerly assistant to the president of General Dry Battery, he will set up a program of sales expansion for Hallicrafters. This will include sales to amateurs, which should account for about 40% of the Company's output; commercial equipment for marine, aviation, laboratory, bus, and railroad use; equipment for the Army, Navy, and other Government agencies; a high-quality FM-AM radio-phonograph for brand-name sales through mail order houses; expansion of export sales, formerly 10% of total output; and a new program of Echophone products for commercial and citizens radio communications service.

Bendix: Radio line will be distributed in the Buffalo and Rochester areas by Graybar Electric Company of Buffalo and Syracuse. A new Graybar radio division has been set up under the supervision of V. J. Corsaro.

Motorola: Krisch-Delevan Company, 801 Main Avenue, San Antonio, Texas, will handle Motorola radios in the southern part of the state below a line formed by the counties of Val Verde, Edwards, Kimble, Mason, Llano, Lampasas, Bell, Milam, Lee, Fayette, Lavaca, DeWitt, Galiad, Refugio, and Aransas. Radio sales will be directed by general manager A. J. Krisch.

FM Sales Planning: Very encouraging to sales executives is the news that present FM stations will be able to continue programs on their old frequencies for an indefinite period and that, at the same time, they will transmit also on their new frequencies even before new FM-AM receiver models can be put on the market. Moreover, assurance that delivery of new transmitters will start without delay means that FM-AM set sales can be started promptly in territories where there has been no FM transmission if applications for local FM stations have been filed.

NATION-WIDE FM EXPANSION

(CONTINUED FROM PAGE 27)

"Alpine will start dual operation as soon as materials, manpower and a license are available. Application has been made today to the Commission for the frequency in the new band corresponding to Alpine's position in the old one.

"The second statement above referred to will be made in due course."

Bridging the Transition Period ★ The effect of a radical shift of FM frequencies most feared by broadcasters was the period of transition, because new sets would not be able to tune the existing FM stations on the air at lower frequencies and, while these stations will continue on their present frequencies for a considerable period of time, there is no way for them to quickly install transmitters on the new, high frequencies. Thus, if receiver manufacturers waited to start production until new transmitters could be put on the air, and station operators waited for new receivers to be produced, the whole plan for nation-wide FM broadcasting would bog down.

This would be a real disaster, for the rapid expansion of FM must be sparked by the immediate availability of programs on the new frequencies.

Apparently sensing that, as it now appears certain, the shift of FM to the higher frequencies was settled last year, before the FCC hearings even started, Major Armstrong secretly developed and perfected a relatively inexpensive method by which FM stations now on the air can radiate signals on their present frequencies and, simultaneously, on their new, higher frequencies.

By this arrangement, existing FM stations will be able to hold their present audiences, and give immediate service to purchasers of postwar receivers.

At the same time that this development was made public, Radio Engineering Laboratories, Inc., of Long Island City, announced that they are prepared to take orders for the dual-frequency equipment.

Preparations at WMFM ★ The first word of new plans on the part of FM broadcasters came in a telegram from Walter J. Damm, general manager of *The Milwaukee Journal's* WTMJ and the affiliated FM station WMFM:

"The Journal Company will take the necessary steps to begin operating an FM transmitter in the 92- to 106-megacycle band as soon as possible. It is the plan of the Company to construct a low-powered transmitter to operate on 43.9 megacycles, the interim frequency assigned WMFM, at its Radio City Building, 720 East Capitol Drive, with the antenna on top of its 300-foot television tower, so that it may continue to serve the greatest possible number of the present 21,000 set

(CONTINUED ON PAGE 91)

The New Drake No. 75AP is designed for 110 volt circuits. However, the Resistor we can supply readily adapts it for use with 220 volt circuits if desired. This sturdy, rigid, Jewel Light Assembly never needs replacement. Every detail of construction is designed for long, dependable service under the most severe conditions. This is an underwriter's approved unit, for use with Mazda S6, 110 volt, 6 watt, candelabra, screw base lamp. We can ship the 75AP complete, with lamp installed, if so specified. The lamps are easily removed with our S6 Lamp Remover — a real convenience when large numbers of these units must be serviced. You can depend upon DRAKE for any type of standard or custom built unit required. Do you have our catalog handy?

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NATION-WIDE FM EXPANSION

(CONTINUED FROM PAGE 89)

wners in the Milwaukee area. The plant t Richfield, Wisconsin, which houses the resent WMFM 50-kw. transmitter, will e rebuilt to operate in the new band ith the highest power and the most effiient antenna available. The Journal ompany does not intend to relinquish its eputation in the Milwaukee radio field or bringing to the listeners the latest adio developments as soon as available. Therefore, it will not withhold service on the new frequency until a substantial number of sets are in the hands of the public but, instead, expects to be ready to deliver signals to the first purchaser of a set incorporating the new FM band."

Although no formal statement has been issued at this time of writing by the Yankee Network for its famous Paxton station WGTR, it is known that it will take the lead in furnishing transmission for new receivers in the New England area.

Radio Set Production ★ It will be recalled that, on May 17, 1945, the FCC announced that the decision on FM frequencies would be postponed so that further tests could be made during the summer. To justify the delay, it was explained that this would not in any way hamper the future development of FM because the Commission had received advice from WPB that production of transmitters and receivers would not be resumed in 1945 or even in the first part of 1946 unless Japan capitulated. Moreover, "the WPB has also advised the Commission that in event there is any change in its prediction, it will give 90 days advance notice."

It now appears that the FCC made this statement with its characteristic disregard for the truth. No such advice was issued to the FCC from WPB. In fact, WPB is prepared to grant spot authorizations to manufacturers who can show that materials and components are available, and that the use of labor and facilities will not interfere with the war effort. It is doubtful, however, that many authorizations will be issued during the third quarter of this year, but military cutbacks will result in an increasing number of authorizations in the fourth quarter. WPB now expects that 1,000,000 sets will be produced by the end of January, 1946.

FCC Plans ★ Meanwhile, Chairman Porter has promised that present regulations and standards of good engineering practice for FM, television, and facsimile stations will be revised and brought up to date with all possible speed.

A bulletin issued on June 29th stated: "The Commission expects to confer at an early date with representatives of industry groups with the view to scheduling a

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NATION-WIDE FM EXPANSION

(CONTINUED FROM PAGE 91)

meeting sometime in July of all interested parties to formulate the industry's proposals for rules and standards.

"It has been the consistent aim of the Commission from the very beginning of this proceeding to reach a decision in time to permit the industry to prepare to move ahead the moment that manpower and materials became available.

"Companies which will manufacture FM receivers should build the sets to cover the entire band from 88 to 108 mc. This will make possible the expansion of FM in the event facsimile is ultimately located in the 400-mc. region and vacates the band of 106 to 108 mc. Also, if the public is to enjoy the full capabilities of FM, manufacturers must build receivers which will reject undesired signals and noise up to one-half the strength of the desired program."

Concerning FM and television applications: "We have had a number of inquiries as to the status of the 420 FM applications and the 119 Television applications now in our pending files. For the time being, these applications must remain in the pending files as there has been no modification of the Freeze Policy (restricting the use of critical materials) which is still in force. We shall, however, keep in daily contact with the War Production Board so that we will be in a position to give immediate notice as to when the Freeze Policy will be modified or cancelled. . . . No construction permits will be granted until 60 days after a change in the Freeze Policy but the Commission's staff will, in the meantime, get to work on the applications which are in the pending files. In this connection it will not be necessary for persons with pending FM and Television applications, who have supplied full engineering data with reference to the old band, to amend them to conform to the new allocations except with respect to any changes in equipment that are proposed. The Commission's staff will go through these applications as soon as possible and call for whatever further information may be required. Everything possible will be done to eliminate unnecessary procedure steps so that when WPB gives the green light these new industries may go forward without delay.

"Prior to the adoption of revised rules and standards for the FM and Television services, the following suggestions are offered as an aid in the preparation of applications for these services. FM applications having complete engineering studies need not be recomputed to determine the coverage in the new FM band, since, in the majority of cases, there will be no material difference in the distances to the 50-microvolt-per-meter contour in either band. Changes in equipment causing a change in the service area will, of course,

(CONTINUED ON PAGE 93)

NATION-WIDE FM EXPANSION

(CONTINUED FROM PAGE 92)

equire a new engineering study by the pplicant. Any changes in areas resulting om the change in frequency will be aken care of in the Commission's processng of such applications. FM applications ow in preparation and using the 42- to 50-mc. coverage chart in the present standards will be accepted by the Commission until August 1, 1945. A chart showing coverage in the new FM band is now being prepared and is expected to be available within the next few weeks; prior to the availability of this chart, however, coverage in the new FM band may be computed by using the 105-mc. coverage chart now available in the television standards. Applicants using this chart should indicate coverage computed on the basis of the 105-mc. chart or new FM coverage chart. In the event complete FM applications have been filed for the 42- to 50-mc. band which are found to include major errors, the applicant will likely be requested to complete a full engineering study for the new band. At this time FM applications need not specify a particular channel in the new FM band. Frequencies within the new band will be selected by the Chief Engineer but applicants will be given an opportunity to state whether they agree to such frequencies in lieu of the ones applied for.

"Television applications for particular channels should be prepared in accordance with the method now prescribed in the television standards, providing for interpolation by using the several charts incorporated therein. A chart for 300 mc. is now available from the Commission upon request. Applications now pending for commercial television stations may be modified for particular channels in accordance with this method. While television applications should specify particular channels and coverage, the Commission in passing on applications may not be able to assign the channel requested."

FM Receiver Standards ★ In 1941, prompted by complaints that sets sold as "FM" receivers did not deliver the performance that purchasers had been led to expect from Frequency Modulation, the National Better Business Bureau, Inc. undertook an investigation of this subject.[1] At that time, the writer was asked to assist one of their investigators in interviewing New York radio dealers.

Several days spent on these interviews disclosed definite evidence of misrepresentation in the advertising and sale of receivers capable of picking up FM signals, but incapable of delivering the performance that purchasers had been led to expect from the advertising of genuine "Armstrong FM" designs.

[1] See "B.B.B. Asks Questions" by Milton B. Sleeper, *FM* Magazine, Sept. 1941.

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Undoubtedly, there would have been a very useful outcome to the Better Business Bureau's investigation had it not been dropped at the time of Pearl Harbor.

The matter of setting standards for FM receiver performance[2] was brought up again last year, but there was no response until recently when the following letter was received from Dr. Ray Manson, president of Stromberg-Carlson:

"It may interest you to know that FM broadcasters, as well as manufacturers of FM receivers, have from time to time tried to find a workable plan for grading the operating qualities of FM radio receivers. So far, all attempts to do a constructive job in this direction have been failures. This is due, primarily, to the restrictions on any commercial organization entering into a plan of this kind, without getting into legal difficulties with the government. Apparently, the only way for this to be done and avoid such difficulties is for Better Business Bureaus or some similar organization to set up terms and definitions and probably certain specifications which must be met so that the merchandise may qualify as meeting some accepted trade name or term.

"For example, an FM receiver might be defined as a type of instrument which will receive FM signals with the various improvements in performance specified by the inventor or set up by the FCC in its rules covering the providing of a satisfactory quality of FM signal in connection with the operation of FM broadcast stations.

"It might be necessary to go as far as to say that an FM receiver must contain a limiter or something equivalent, which will perform the same purpose as the limiter described by Major Armstrong in his technical papers on FM. Of course, there should be specified a certain amount of limiting; otherwise, the keeping of background noise down to a reasonably low limit would not be provided by those who are interested only in selling receivers which will reproduce an FM signal, without respect to whether the signal is one considered satisfactory for FM reproduction.

"In the above, nothing has been said as to audio fidelity. This is a matter which I believe comes secondary in importance to quietness of operation and freedom from cross-talk. Furthermore, good audio fidelity requires considerable extra cost in production and a fairly large-size radio cabinet in order to ensure the low-frequency response. Also, with better bass response come requirements for higher audio power and a much larger power plant in the receiver than would be required otherwise.

[2] See "FM Receiving Set Standards" by Milton B. Sleeper, *FM* AND TELEVISION, April, 1944.

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"This all adds up to fairly high costs but, in all cases, the purchaser gets his money's worth in overall performance, provided the receiver is honestly designed and manufactured. However, the receiver of lowest audio fidelity should have just as good an RF system, as regards noise discrimination and freedom from crosstalk, as the higher priced models.

"If a plan of this kind were followed, then the features which make FM a worthwhile new system could be realized by the public."

Shortly after, Myles Loucks, managing director of FMBI, wrote, in part:

"The set-grading idea has been one of my concerns for months. I think you will be interested to know that George Adair has several times brought up the subject to me. He believes it is a job that must be done by somebody though, he admits, he doesn't know how best to do it.

"I believe the educators can do it best. As you perhaps know, they have already adopted something in the way of minimum standards for school-room equipment.

"Dr. Lowdermilk, of the Office of Education, has, at my suggestion, begun work on something along this line.

"Talking to him just a few moments ago, I refreshed myself on his plan for the general set yardstick. The tuner would be rated according to selectivity, stability, and fidelity; the audio, according to electrical fidelity, power, and class of amplification; the loud speaker and baffle characteristics, according to fidelity, diffusion angle, and power handling characteristics. Then there would be ratings on technical design as concerns proper controls, and labelling, and of special features."

There have been other discussions of this subject, but in every case the idea has been to pass the responsibility to someone else, as if there were something dangerous about the undertaking.

With all due respect to Dr. Lowdermilk, radio manufacturers and broadcasters should not ask the federal Office of Education to set up the standards for FM receiver performance. If the industry does not do this job, and it certainly should, the FCC's engineering department very likely will. And, if we are to judge by its conduct of the recent FM hearings, we are liable to be saddled with some more bureaucratic ideology.

So the rating of FM receiver performance — for voluntary, not compulsory use by manufacturers — falls naturally upon the FM licensees and the broadcasters. That is where this job belongs. If they cannot agree to do it themselves, at least they can finance the cost of having the work done by the American Standards Association or by some other independent organization. However it is done, it must be done without delay.

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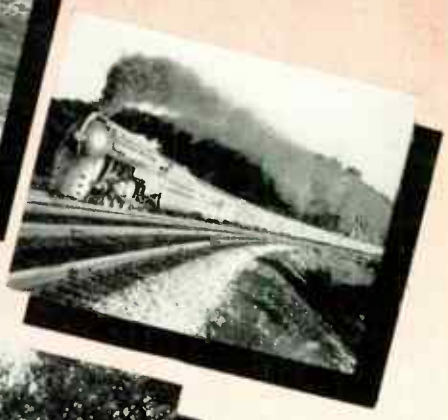

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