PRICE—TWENTY-FIVE CENTS

FM AND TELEVISION

JAN. 1945

PROPOSED FREQUENCY ALLOCATIONS

RELEASED BY THE FCC JANUARY 16, 1945 — FOR 25 TO 30,000 MC.

AMATEURS
28–30 mc.
50–54
144–148
220–225
420–450
1125–1225
2500–2700
5200–5750
10000–10500
21000–22000

AVIATION
Airport Control
118–122
Aero Mobile
122–132
225–400
1550–1660
Localizers
108–112
Ranges
112–118
Navigation
960–1125
1450–1550
2300–2600
2700–3900

BROADCAST RELAY
4C:156–162

CITIZENS SERVICE
460–470

ELECTRIC, GAS WATER, STEAM
15C:25–42
5C:156–162
44–78 ▲?
192–204 ▲?

FACSIMILE
Multiplexed on FM
102–108?
470–480

FIRE
15C:30–42
20C:156–162

FREQUENCY MODULATION *
Commercial
78–84?
88–102
102–108?
Educational
84–88

FORESTRY
33C:30–42 mc.
7C:156–162

GOVERNMENT
25.015–27.305 ▲
27.335–28 ▲
30–30.5
32–33
34–35
36–37
38–39
40–40.96
41–42
108–118
132–144
148–152
162–170
180–186 ▲
186–192 ▲
216–220
225–400 ▲
400–420
1325–1450
1650–1900
4550–5200
7050–10000
13000–16000
18000–21000
22000–26000

MOVIE INDUSTRY
22C:25–28 ▲
4C:156–162 ▲

OIL, GEOPHYSICAL
27C:25–28 ▲
9C:156–162 ▲

POLICE
Facsimile
940–960 ▲
Mobile
35C:30–42
21C:42–44
152–156
Repeaters
940–960 ▲
44–216 ▲?
Ship-to-Shore
24C:30–44

PRESS RELAY
22C:25–28 ▲
4C:156–162 ▲

RAILROAD RADIO
End-to-End
Train-to-Train
Station to Train
33C:156–162
Terminals
20C:44–50 ▲
54–78 ▲
192–216 ▲
Yards
20C:44–50 ▲
54–78 ▲
192–216 ▲
Development
1900–2300 ▲
3900–4550 ▲
5750–7050 ▲
10500–13000 ▲
16000–18000 ▲
26000–30000 ▲

RELAY SYSTEMS
1225–1325 ▲
1900–2300 ▲
3900–4550 ▲
10500–13000 ▲
16000–18000 ▲
26000–30000 ▲

RURAL PHONE
1900–2300 ▲
3900–4550 ▲
5750–7050 ▲
10500–13000 ▲
16000–18000 ▲
26000–30000 ▲

SCIENTIFIC, MEDICAL INDUSTRIAL
27.305–27.335
40.90–41

SHIP-TO-SHIP
1C:30–40
1C:156–162

SHIP-TO-SHORE
8C:30–40
6C:156–162

S-T LINKS
192–216 ▲
940–960 ▲

SPECIAL EMERGENCY
4C:30–40
6C:156–162

TELEVISION
Broadcasting
44–50 mc.
54–60 ▲
60–66 ▲
66–72 ▲
72–78 ▲
78–84?
180–186 ▲
186–192 ▲
192–198 ▲
198–204 ▲
204–210 ▲
210–216 ▲
480–920
Relays
1225–1325 ▲
Theatres
1900–2300 ▲
3900–4550 ▲
5750–7050 ▲
10500–13000 ▲
16000–18000 ▲
26000–30000 ▲

TRANSIT
10C:25–44

TRUCKS, BUSSES
12C:30–40
12C:42–44
7C:156–162

See page 4 for further data on these frequencies

▲ Indicates channel shared with other services.

* Recommended tuning for FM Sets, 78–108mc. Channel width 200kc.

Emergency Radio Stations

★ ★ Edited by Milton B. Sleeper ★ ★

TELEVISION

Quiz

FOR PROSPECTIVE STATION OWNERS

1. What firm's pioneering development of the Cathode-ray Tube (the heart of a television set) gave television its first *clear* pictures... and made television commercially possible?

2. What manufacturer's national advertising—for more than a year—has been devoted to answering the public's eager questions about television?

3. What company designed and built 3 of the 9 television stations on the air today (more than any other company)?

4. What firm's extensive experience in television station design, construction and operation has set a pattern for profitable management of an average-size station?

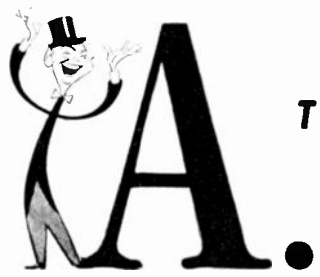
5. What manufacturer's experimental station telecasting equipment provided a week-in-week-out demonstration of low operating cost and rugged dependability since the summer of 1940?

6. What firm's strong patent position assures clients of exclusive and important features not matched by other companies' television station equipment?

7. What company's experimental television station was the first to offer the use of its facilities during wartime to advertisers and advertising agencies to develop commercial techniques... and to provide experienced directors, writers and talent for television's inevitably-swift postwar expansion?

8. What manufacturer has provided a plan to instruct operating executives and technical crews, which will insure the efficient commercial operation of your postwar station?

9. What firm's telecasting equipment is rated "tops" in signal transmitting efficiency and effectiveness... and in installation and operating economies?



***The one-word answer to all these questions is:* DuMONT**

A copy of "Planning Your Television Station" is yours for the asking. This booklet outlines equipment requirements for a complete, low-cost telecast operation... and suggests plans for expediting postwar delivery of equipment and training of personnel.

DUMONT *Precision Electronics and Television*

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

The official caption of this official Navy Photo reads, "Top flight radio operators plus top flight equipment equals top flight performance at an African clearing base for the Italian Front."

FM AND TELEVISION

FORMERLY: FM RADIO-ELECTRONICS

VOL. 5 JANUARY, 1945 NO. 1

CONTENTS

★ ★ ★ ★ ★ ★

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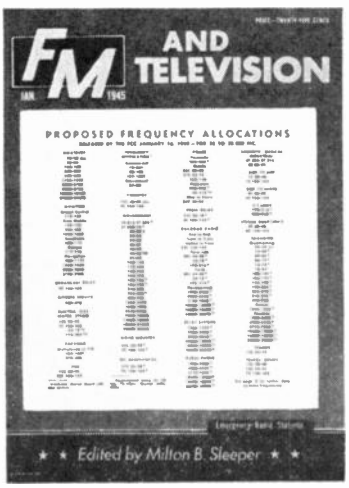
The publishers will be pleased to receive articles, particularly those well illustrated with photos and drawings, concerning radio-electronic developments. Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit. Payments are made upon acceptance of final manuscripts.



THIS MONTH'S COVER

FOR some time to come, the most discussed radio subject will be the FCC's new frequency allocations. Accordingly, for the convenience of our readers, we have put the complete schedule on this month's front cover. That makes it available without having to look inside.

The FCC publication released on January 16th contains two enormous charts, covering the band from 25 to 30,000 mc. Because it is awkward to use, we have boiled it down to the essential information, on the bands proposed for each service. In some cases, a certain number of channels are assigned within a band. In such case, the list shows, for example: 4 C:30–40, indicating that 4 channels will be assigned in the 30- to 40-mc. band.

WHAT'S NEW THIS MONTH

1. Proposed Allocations
2. New and Expanded Services

1. Our front cover presents the FCC's schedule of proposed frequency allocations. This has been prepared from the document released on January 16th. However, for a complete understanding of the proposals and the manner in which decisions were reached for each service, it is necessary to refer to the 214-page report which has been issued and is, presumably, available from the Federal Communications Commission, New Post Office Building, Washington, D. C.

The report explains, among many other things, the details of shared channels.

2. While the assignments to FM and television created the greatest amount of discussion, the real news lies in the provisions made for the expansion of present services and the addition of totally new ones. These have tremendous significance to manufacturers of commercial and amateur equipment.

On the basis of FCC planning, police are assured of channels for facsimile and relays, and for additional fixed and mobile stations. Also, many fire departments will be able to operate their own independent radio systems.

Railroad radio is to have all the ether space needed for yards, terminals, and right of ways. It is safe to predict now that, within five years, the use of radio will become as essential to the operation of railroads as it is now to airlines.

Nor were the bus and truck operators neglected. Even the taxis, ambulances, and doctors' cars will have channels over which they can communicate with their headquarters and offices. Provision is also made for expanding the operation of radio systems by street car lines, gas, water, steam, and oil pipe line companies. Even movie crews on location will be able to use radio for emergencies, and news men will transmit their stories from inaccessible places on press relay channels.

Room has been staked out for thousands of new amateur transmitters. Finally, the public will be allowed to use the Citizens Radiocommunications Service for walkie-talkies on 460 to 470 mc. Only license requirements will be the knowledge of "a few minimum traffic rules"!

All of which is heartening news to crystal manufacturers, since practically every receiver and transmitter will be crystal-controlled.

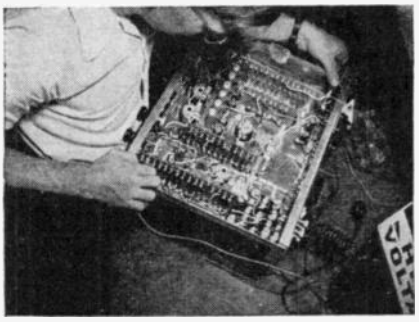
SYLVANIA NEWS

ELECTRONIC EQUIPMENT EDITION

JANUARY *Published in the Interests of Better Sight and Sound* 1945

Electronic Devices Broaden Sylvania's Service to Industry

The manufacture of electronic equipment for certain specialized communications and industrial applications is an important phase of Sylvania service. Manufacture of this type of equipment is carried



An electronic device undergoes test in the laboratories of Sylvania's Industrial Apparatus Plant.

on in a separate Industrial Apparatus Plant located at Williamsport, Pa.

This aspect of Sylvania's activities is a natural outgrowth of the company's intensive experience in the design and application of electron tubes.

DID YOU KNOW...

That Sylvania Tungsten Lamps are standard equipment for signaling purposes on many telephone switchboards? They are made in a range of electrical characteristics for use in any type of switchboard.

* * *

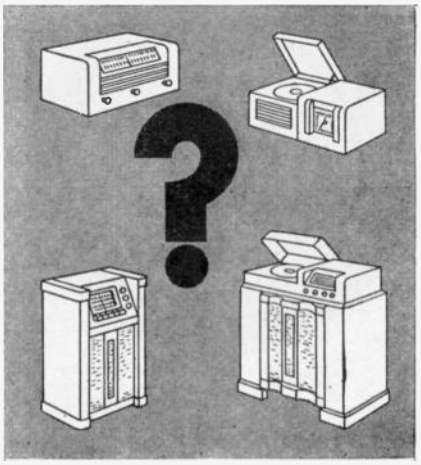
That Sylvania Near Ultra-Violet Lamps activate the fluorescent dials on airplane instrument panels? Lamps are small, compact, designed to operate from a 24-28 volt direct current source.

Sylvania Begins Survey of Public Interest in Television Receivers

Findings Will Assist Manufacturers in Gaging Markets, Determining Price Range

Thousands of personal interviews and an intensive advertising campaign in the pages of leading consumer publications form the twin phases of a comprehensive survey which Sylvania is launching to gage the interest of consumers in the purchase of television sets, and to learn the extent of the potential market for receivers in various selling price ranges. The results of this survey are expected to be of great value in guiding the planning of the manufacturers of television sets.

Television, moreover, is but one of the aspects which will be covered in this



The type of set people prefer—floor or table model, radio only or radio-phonograph combination — will also be studied in the Sylvania survey.

nation-wide poll. Consumers will also be queried on such points as their interest in FM; the desirability of short-wave bands; reaction to push button tuning. The reasons why people decide on new set purchases will also come in for scrutiny.

As the survey progresses, findings will be reported from time to time in future issues of SYLVANIA NEWS.

LOCK-IN TUBES IDEAL FOR UHF

The trend toward the use of ultra-high frequencies brings to the fore the outstanding advantages of Sylvania's Lock-In Tubes. While the name of this line of tubes has tended to emphasize the physical details of mounting, one of the chief motivating forces in their design was the desire of Sylvania engineers to improve the electrical characteristics of tubes, particularly at the higher frequencies.

The Lock-In feature itself has been responsible for the extensive use of these tubes, particularly in automobile radios; electrical features point to wide utilization in television and FM.

"I wonder if I could have your views on what the postwar radio will be like."

ADVERTISERS INDEX

"Tailor-made" ELECTRONIC EQUIPMENT ASSEMBLIES

Designed and produced from stem to stern by recognized experts to match your needs *exactly*.

DIELECTRIC AND INDUCTION HEATING EQUIPMENT • TUNING UNITS • TEST EQUIPMENT • RADIO TRANSMITTERS • HIGH AND ULTRA-HIGH FREQUENCY EQUIPMENT

B & W is neither too large for the smallest job nor too small for the largest. Write for details, outlining your requirements.

B&W

BARKER & WILLIAMSON

AIR INDUCTORS • VARIABLE CONDENSERS • ELECTRONIC EQUIPMENT ASSEMBLIES

DEPT. E-114 235 FAIRFIELD ROAD, UPPER DARBY, PA.

Export: LINDETEVES INC., 10 Rockefeller Plaza New York, N. Y., U. S. A.

ENGINEERING SALES

Radiart: ★ Neal Bear, who started his radio career with the old Charles Freshman Company in 1923, will manage distributor sales of Radiart vibrators and components. He has been with the Company for 7 years, most recently as contact man with the Government agencies.

Centralab: ★ Has issued a very helpful bulletin on selector switch assemblies, covering units with Bakelite and Steatite insulation for receivers, and special types for transmitters.

Sentinel: ★ Announces the appointment of E. J. Crain as representative for Ohio east of and including Springfield. He will make his headquarters in Cleveland.

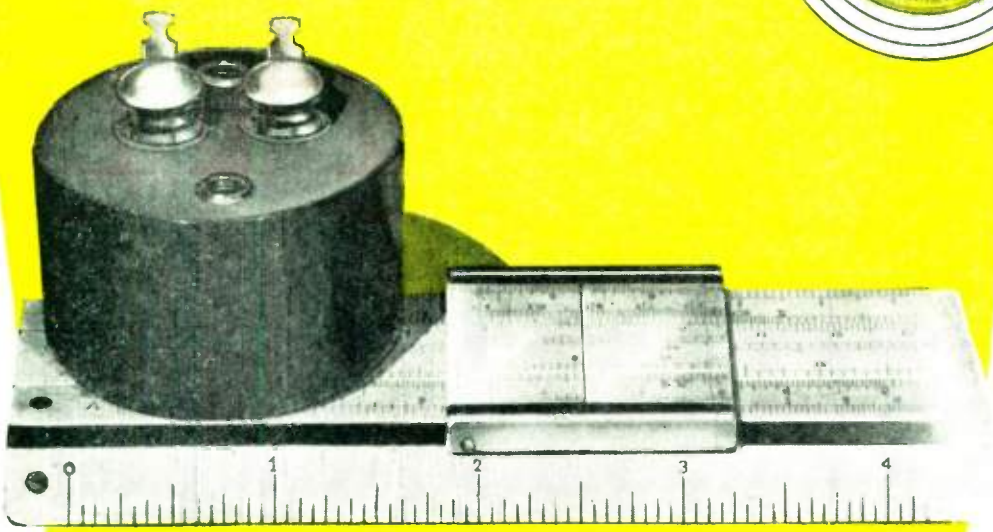
Sylvania: ★ J. T. Millican, formerly with Fisher Body, has been appointed to the radio tube division in the east central territory, with headquarters in Cleveland. Cortland T. Clark is taking over the northwestern territory as manager, covering Washington, Oregon, Montana, and northern Idaho, with headquarters in Seattle. Both men are veterans of World War II.

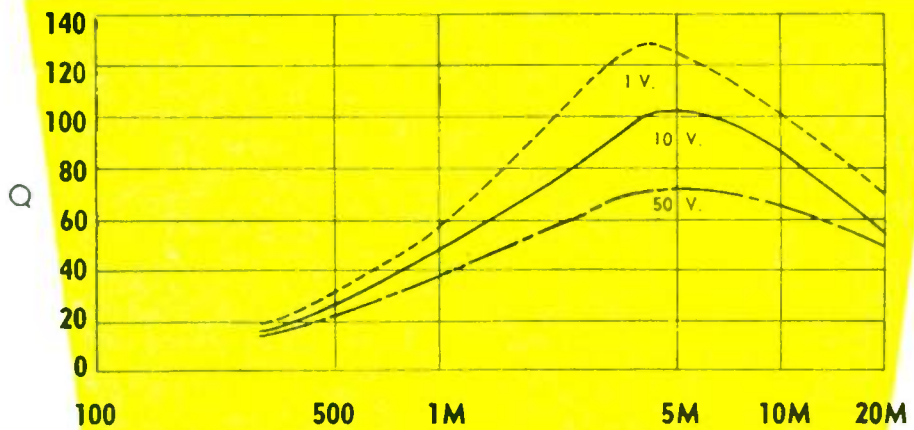
Bendix Radio: ★ Newly appointed distributors include Graybar for southern California, Arizona, Utah, southern Idaho, and western Wyoming; Crest Corporation of St. Louis for eastern Missouri and southwestern Illinois; Newburgh Distributing Company of Newburgh for southern New York state; Loyal Distributors of Wichita for western Kansas; Cleveland Distributing Company of Cleveland for northern Ohio; Southern Bearings & Parts of Charlotte for North and South Carolina, and Mid-Atlantic Appliance Company of Baltimore for the Capital area.

Motorola: ★ Has appointed Brady Electric, Inc., Elmira, as distributor for home, car, and farm sets in the New York Counties of Steuben, Chenung, Yates, Schyler, Tompkins, Tioga, and Broome, and Pennsylvania counties of Susquehana and Potter.

G.E.: ★ Announces four new district sales managers for their electronics department, under general sales manager A. A. Brandt. They are R. L. Hanks, who will handle the New England district from Boston; T. B. Hancock for the Atlantic district, operating from Philadelphia; H. J. Mandernach for the New York district, working from New York City; and R. J. Meigs for the west central district, with headquarters in Kansas City, Mo.

HIGH Q COILS *by* UTC





There are many applications in the audio field requiring coils of high Q and good stability. UTC coils of the type HQA series are ideal in this respect.

Q CHARACTERISTICS of a typical .14 Hy. coil at three voltages are illustrated.

VOLTAGE STABILITY is high. At 1,000 cycles, for applied voltages from .1 to 25 volts, the change in inductance is less than 1%. DC current change in inductance is approximately 1% per 10 Ma. linearly.

HUM PICKUP is low due to a self shielding structure: . . . 70 microvolts per gauss at 60 cycles.

TEMPERATURE effects are negligible. From —60 degrees C. to plus 85 degrees C., inductance variation is less than 1/3%.

MECHANICALLY, these units are hermetically sealed in a drawn steel case 1-13/16" diameter by 1-3/16" high. Weight . . . 5 ounces.

VIBRATION effects are not evident over entire range of normal aircraft tests.

HQA UNITS are available in any inductance value from 5 Mhy. to 2 Hy., and are ordered as: HQA followed by value in Mhy. Typical semi-standard values are:

HQA—12.5	$5.00 net	HQA—200	$8.00 net
HQA—30	$6.00 net	HQA—500	$9.00 net
HQA—80	$7.00 net	HQA—1250	$10.00 net

United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

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

As a result of intensified wartime research at Bell Telephone Laboratories, of improved manufacturing techniques and increased production facilities at Western Electric, many new things are now being produced which will have peacetime applications.

In the years of progress that lie ahead for radio, count on Western Electric to lead the way!

Western Electric

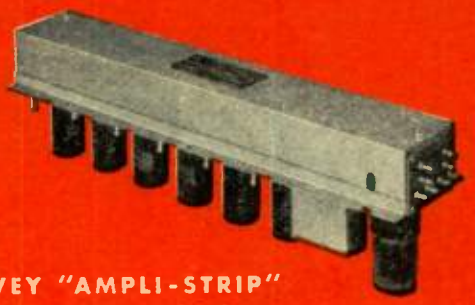
Distributed by GraybaR

Buy all the War Bonds you can . . . and keep all you buy!

knowledge in all of these fields

HARVEY UHX-25

A 25-Watt General Purpose Radio Telephone Transmitter—Available for operation between 1.5 M. C. and 30 M. C.



HARVEY "AMPLI-STRIP"

For I-F and AUDIO Amplification.

HARVEY
OF CAMBRIDGE

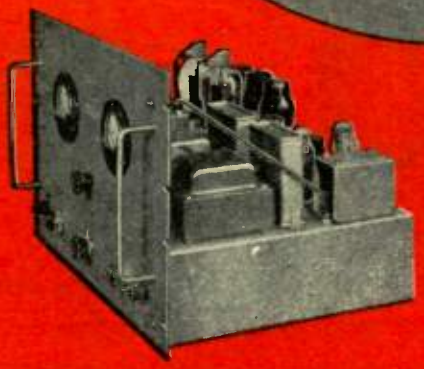
RADIO AND ELECTRONIC EQUIPMENT

The units illustrated are representative of HARVEY OF CAMBRIDGE design and construction "know-how" as well as precision of manufacture and testing. Each is a precision product designed and developed by HARVEY OF CAMBRIDGE to fill specific needs in the radio-electronic fields.

Some, like the 206 PA Power Supply and the "Ampli-Strip" are new developments resulting from HARVEY's one-hundred per cent war work.

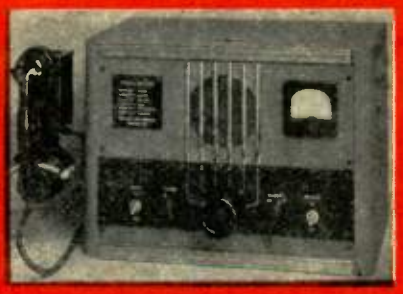
Others, like the UHX-25 Transmitter and Marine 25 Radio Telephone are typical of HARVEY OF CAMBRIDGE products which have long been recognized as standards of quality and dependability.

Years of exclusive specialization in the manufacture and development of this type of equipment are your guarantee of complete satisfaction from all HARVEY OF CAMBRIDGE products and of competent, intelligent assistance in bringing to a successful solution any of your present or projected radio-electronic problems.



HARVEY Regulated Power Supply 206 PA

For laboratory D. C. Source—Range 500 to 1000 volts.



HARVEY MARINE 25

A 6-Channel Marine-Radio Telephone.

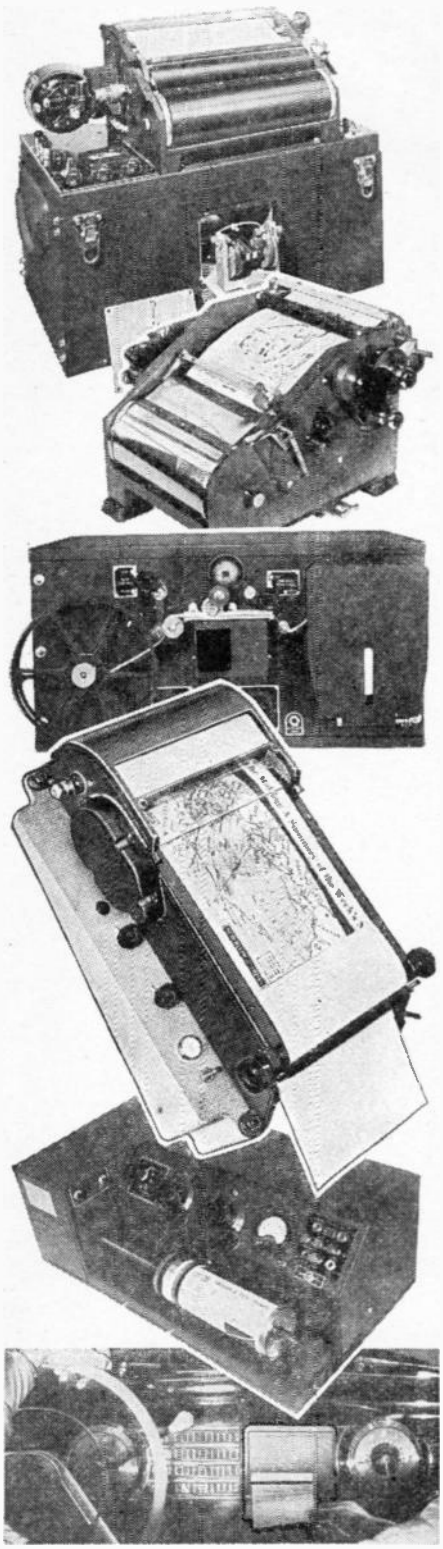
HARVEY
OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.

443 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

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

• • • • • • • •

FACSIMILE

The BUILDING of the EQUIPMENT shown on the opposite page has solved most of the problems (as well as providing us with adaptable UNITS and SUB-ASSEMBLIES) in the design and making of models that are in their advanced stage for:

HOME RECORDERS—that are simple—attractive—and which produce clear black and white copy.

★

DISPATCH RECORDERS—which use a minimum of panel space; for Railroads, Emergency Service Cars, Aircraft, Police Cars, Taxis, etc., etc.

★

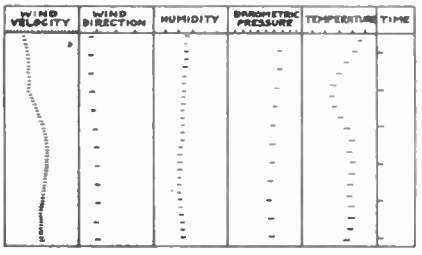
LARGE AREA CONTINUOUS RECORDERS—for maps on paper that is readily drawn on, for interpretation or notes, and which can be made translucent for the making of duplicate prints.

★

INTER-DEPARTMENT, or INTER-COMPANY MESSAGE, DESK SIZE RECORDERS—for memorandum or sketch dispatch, using ordinary typewriting for the scanning, but enlarged one and a half times, for legibility.

★

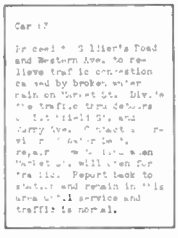
We do not want to miss an opportunity to discuss with you any interest you may have in facsimile or impulse recording. Write . . . or, better still, visit us by appointment.



HOW AN HOUR BY HOUR HISTORY OF FIVE RELATED PHENOMENA IS RECORDED • The above record will suggest the possibilities of recording several different types of phenomena conditions or values (usually related) which need to be recorded or studied together with time indicated. For instance, in process control, recording rate of flow, pressure, velocity, temperature, humidity — is recorded day by day or hour by hour nearby or at a remote center.

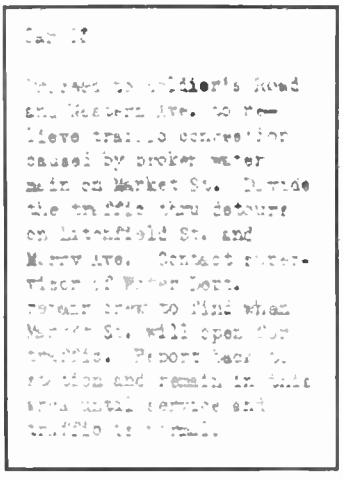
Alden recorders use the medium best suited to the job. Illustrated above are recordings on Photographic film, paper tape and Teledeltos paper.

HOME RECORDERS using ALFAX paper will be ready to meet the demand, when frequency allocations and broadcast programs have been arranged. Clear black and white copy that does not smudge, continuous recordings, simplicity of operation are features of Alfax equipment.

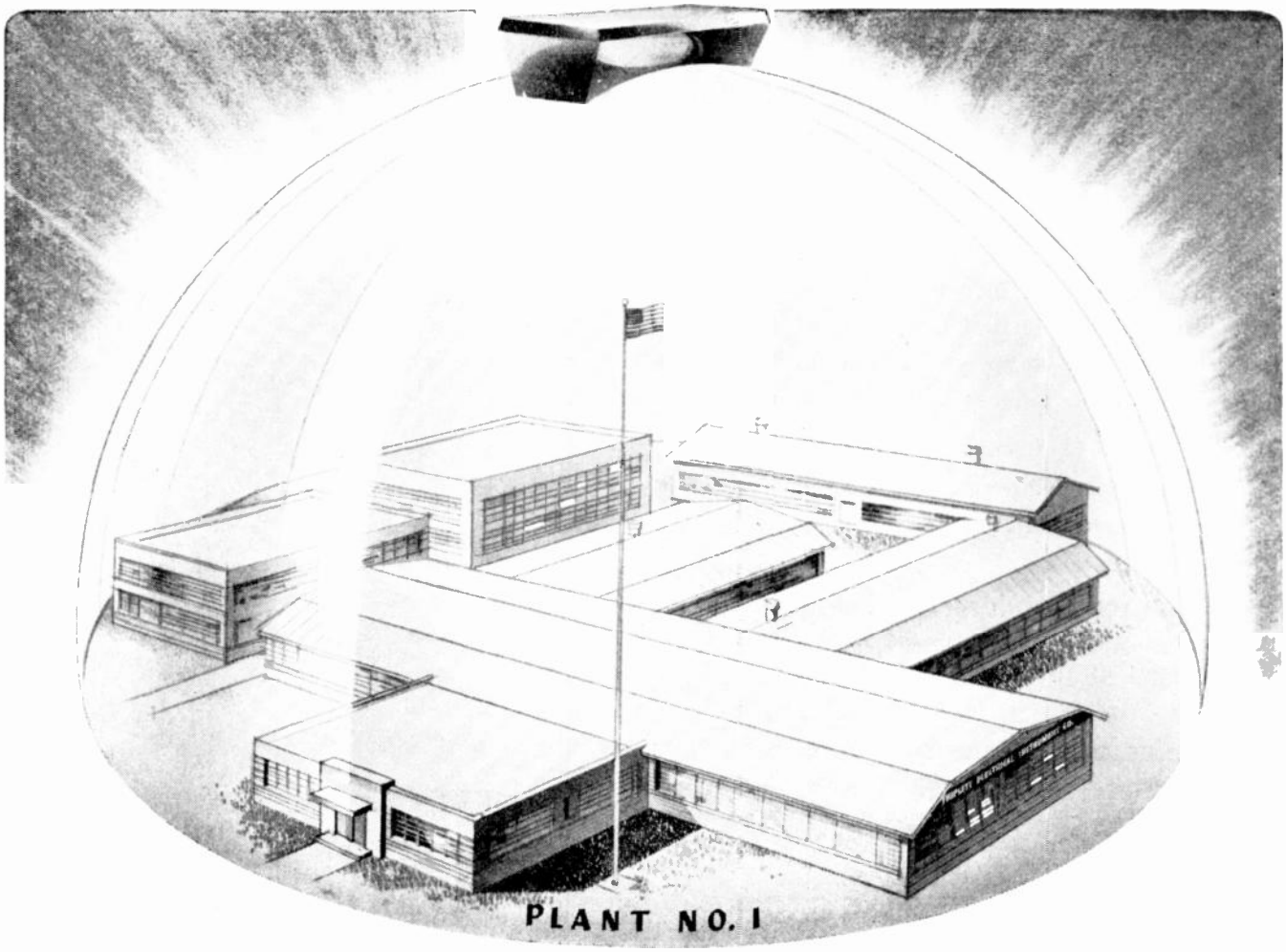


From the original above, the recording at right was made with the latest Alden recorder and associate scanner. Here is a new system that features automatic scanning (start-stop, reset and feed). It is neat, simple, extremely compact, and practical for all kinds of recording.

Recorder can be mounted on any flat surface such as dashboard, panel or desk.



ALFAX **ELECTRICAL IMPULSE RECORDING PAPER**



"DUSTLESSTOWN, OHIO"

● It's the little things that loom biggest in the manufacture of delicate electrical measuring instruments. Little things like specks of dust or breath condensation can play havoc with accuracy. That's why Triplett Instruments are made in spotless manufacturing departments; why the air is washed clean, de-humidified and temperature-controlled; why every step in their mass production is protected. As a result Triplett Instruments perform better, last longer and render greater service value.

Extra Care in our work puts Extra Value in your Triplett Instrument.

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The Greeks gave us a word for it . . . now we give it to *you*

WHEN Sperry first developed its velocity-modulated, ultra-high-frequency tube, the word "KLYSTRON" was registered as the name of the new device.

This name — from the Greek, as coined by scientists of Stanford University — is an apt description of the bunching of electrons between spaced grids within the tube.

"Klystron" is a good name. So good, that it has come into widespread use as the handy way to designate *any* tube of its general type, whether a Sperry product or not.

This is perfectly understandable. For the technical description of a Klystron-type tube is unwieldy, whether in written specifications, in conversation, or in instructing members of the Armed Forces in the operation of devices employing such tubes.

These conditions have prompted many requests from standardization agencies—including those of the Army and Navy—for unrestricted use of the name Klystron. In the public interest, Sperry has been glad to comply with these requests . . .

From now on, the name KLYSTRON belongs to the public, and may be used by anyone as the designation for velocity-modulated tubes of any manufacture.

Sperry will, of course, continue to make the many types of Klystrons it now produces, and to develop new ones.

On request, information about Klystrons will be sent, subject to military restrictions.

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"Make it a Stromberg-Carlson for the main radio in your home." That's the story that Stromberg-Carlson is currently telling to your post-war radio prospects through 475,000,000 impressions in leading magazines.

This is far more than just a 'sales story.' It's a basis for a very sound sales policy for you and for us, alike. For, since the main radio in any home should be as good a radio as the purchaser can buy—a true quality musical instrument—and, since there's nothing finer than a Stromberg-Carlson, it stands to reason that thousands of Stromberg-Carlsons are slated to fill that spot marked "X" in thousands of homes of every type.

So plan your merchandising about this theme, and remember that Stromberg-Carlson is:

—the *important* radio unit
—the radio unit carrying real *profit-opportunity*
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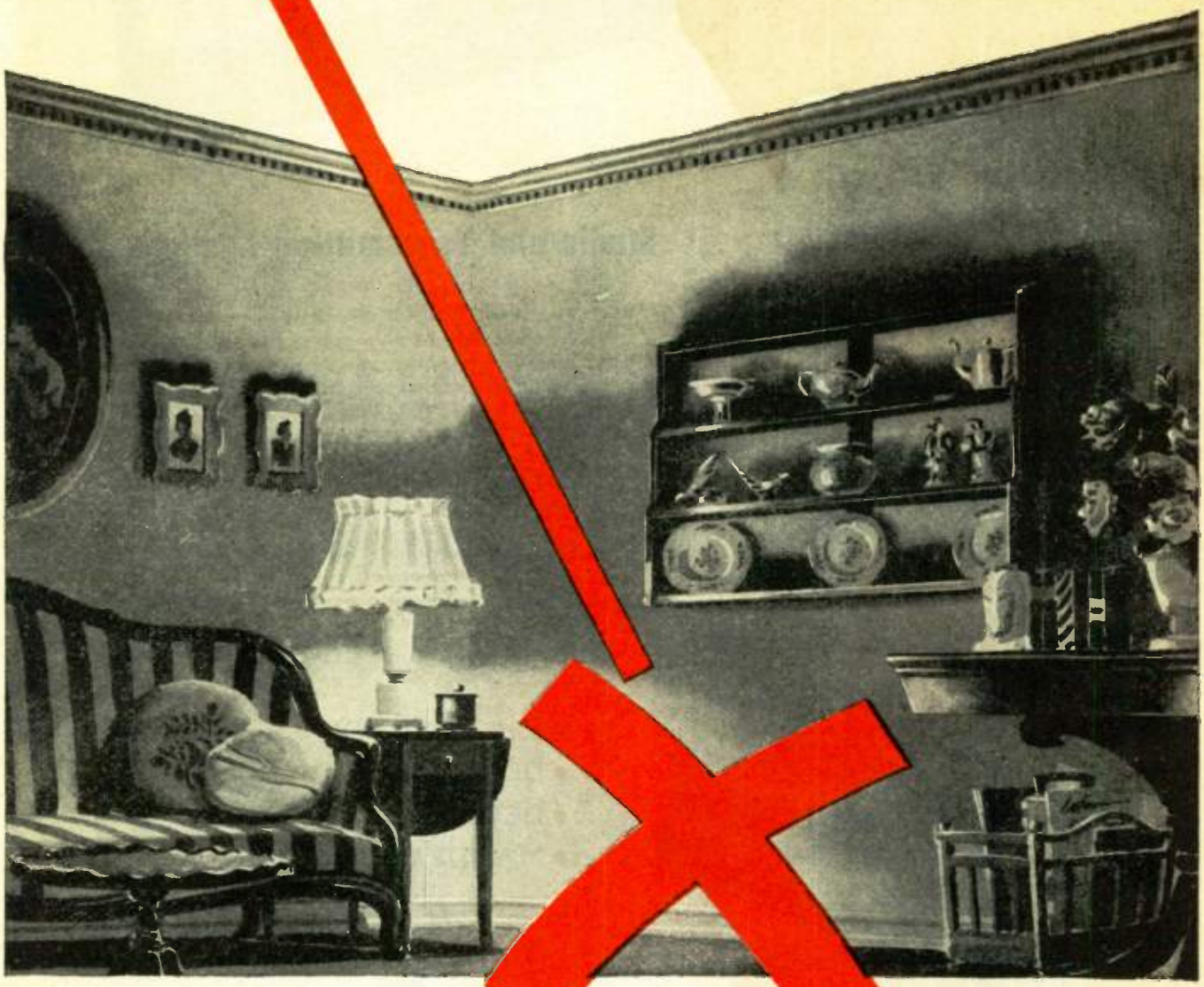
Organize your post-war sales around this potent Stromberg-Carlson sales theme. You'll find the Stromberg-Carlson *"main radio"* a consistent profit maker—whether in an outstanding table model, console, or radio-phonograph combination.



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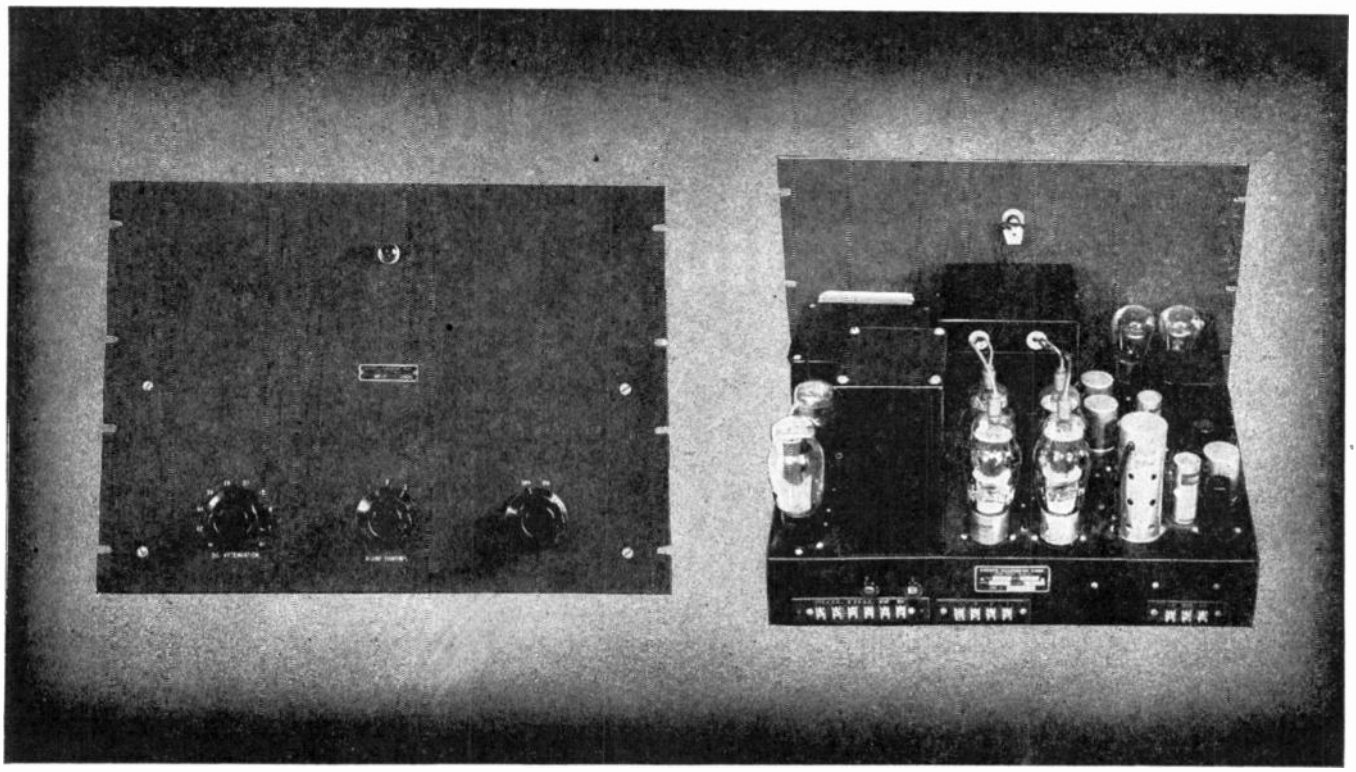

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Under a recent ruling of the War Production Board radio station owners may buy up to $500.00 worth of new capital equipment, using their AA-1 MRO CMP-5 priority.

Here is a piece of equipment that will make a vast improvement in the quality of your instantaneous recordings. And it can be delivered to you promptly.

It is the Presto 88-A amplifier, designed especially for use with Presto 1-C and similar high fidelity cutting heads.

Maximum power output is 50 watts with 4% distortion, measured by the inter-modulation method. Feed back circuits maintain the output impedance essentially constant when driving a cutting head, thus reducing overall distortion. Three frequency response curves are available on a selector switch. (1) Flat response, 30 to 15,000 c.p.s ± db. (2) "NBC ORTHACOUSTIC" recording response. (3) World-AMP lateral recording response.

Designed for relay rack mounting; panel height 14"; input, 500 ohms; output, optional, 15 ohms or 500 ohms; gain, maximum, 85 db. Shipment 4 to 5 weeks after receipt of order placed with your electronic distributor.

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FCC SETS STAGE FOR FINAL ALLOCATIONS

With Frequency Requests Now Scaled Down, Industry Will Participate in Final Decisions

BY M. B. SLEEPER

IT SEEMS quite clear to this observer that the FCC does not intend to assume the entire responsibility for frequency allocations now being planned in preparation for new and expanded peacetime services.

The proposed allocations for 25 to 30,000 mc., covering the various services listed on this month's front cover, were made public on January 16th (Docket No. 6651). Although it is too early, at this time of writing, to correlate opinions from all the groups affected, the FCC proposal seems to meet with general approval except from the FM and television broadcasters and manufacturers. These groups, representing the largest investment and sales volume in postwar radio, are loudly voicing their dissatisfaction.

Judging from answers by Commissioner Jett and other FCC officials to questions asked at their Washington press conference on January 15th, this industry reaction was expected.

FM ★ It seemed certain at the Allocations Hearing that the FCC would not take the responsibility for keeping FM broadcasting on the lower frequencies because of the possible long-distance interference in that band. Rather, if FM is to stay about where it is now, it would only be at the insistence of the industry. The FCC, for its part, proposes 84 to 88 mc. for educational FM, 88 to 102 mc. for commercial FM broadcasting, and promises to keep 78 to 84 and 102 to 108 mc. open for possible FM expansion. In fact, Commissioner Jett proposed specifically that new FM receivers should cover 78 to 108 mc.

Set manufacturers, however, doubt that circuits covering that range can be designed to have an efficiency comparable to existing FM sets, and that even if it can be done, the cost will be prohibitive. Furthermore, the time and expense required to change existing transmitters and to revise existing designs projected for V-E production, added to the effect of making all present FM receivers obsolete, will seriously disrupt their plans for maintaining uninterrupted employment when military production is cut.

In other words, resumption of civilian radio would find this country with neither FM receivers nor transmitters either in use or available for production, and home receiver radio plants shut down for an indefinite period. Why? Because the Dellinger and Norton reports on interference at the lower FM frequencies do not agree.

Best opinions now available indicated that, when oral arguments on the proposed allocations are heard by the FCC, scheduled to start February 14th, it will be recommended that the amateurs be given the 44- to 48-mc. band, and that FM be assigned the band from 48 to 66 or 72 mc. This will meet all the objections now being raised to the new FCC proposal.

Television ★ That the FCC does not expect acceptance of its plan to start commercial television broadcasting on 12 channels between 44 and 216 mc. is indicated by Commissioner Jett's frank statement that this would be a temporary assignment, that the channels would be shared with other services, and that plans should be made immediately to go up to the 480- to 920-mc. band proposed for permanent television use. Moreover, he made it clear that nation-wide television cannot be provided by the number of channels available "downstairs."

This poses an entirely different problem to television than that confronting FM. The RTPB had already scaled down its minimum requirement of 30 channels to 18. It has been generally agreed that television can achieve commercial status only by nation-wide expansion. The FCC can hardly expect the industry to accept the limitation of 12 channels, nor can it be serious in a proposal that would set up a hue and cry of "monopoly" by independent organizations who would not be able to obtain competing frequencies.

This brings the television group face-to-face with the fact that, since the FCC and IRAC have added up the requirements of all services, there is not room to assign the number of channels required to establish a permanent, commercial television structure on the downstairs channels. Even if it were attempted, the public, having endured two shifts in television frequencies and confronted with another on FM, will not accept any new proposal that bears the stigma of uncertainty.

At this moment, we can only be sure of this: When the final decision on FM and television frequencies is rendered, the industry will have an equal responsibility with the FCC on the outcome, whether it proves to be for the better or for worse.

Facsimile ★ Development of facsimile broadcasting is given great encouragement by the FCC. Here again, final responsibility is placed upon the industry. While the Commission is prepared to permit experimental duplexing of facsimile and sound, no blanket authorization will be issued until it has been demonstrated that this will not debase the quality of sound transmission, nor interfere with reception on sets not equipped for duplex operation.

However, provision has been made for alternate sound and facsimile transmission. Also, "the space between 102 and 108 mc. has not been assigned and the use of this space for facsimile as a separate broadcast service to the public will later be considered in conjunction with the demands that may be made by the FM, emergency, and television services." In addition, "the space between 470 and 480 mc. is to be made available for facsimile broadcasting."

Other Services ★ With a few exceptions, services in the 25- to 30,000-mc. band will operate on FM. The FCC report does not go into this or other technical details, since it is specifically concerned with frequency allocations. However, it is clear that most services will have to use FM if for no other reason than to avoid interstation interference.

Of the crowded conditions resulting from the expansion of existing services and the addition of new ones, the FCC report states that "in most cases the requests for non-governmental services far exceed the supply." Further, "This was true throughout the entire spectrum. It was, therefore, obvious that all requests based upon statements as to the number of channels required could not be met and, in most instances, the Commission had to allocate fewer or narrower channels than were requested, or assign the service to a different portion of the spectrum from that sought, or both."

The use of AM for many of the services would seriously limit the number of transmitters that could operate without serious heterodyne interference, but FM's protective ratio of 2 to 1, compared to the AM ratio of 100 to 1, will increase enormously the multiple use of the new channels. This gives FM added importance in the future of radio communications.

FIG. 1. COL. RALPH CASWELL CAN MONITOR THE ENTIRE NEW HAMPSHIRE STATE POLICE COMMUNICATIONS SYSTEM

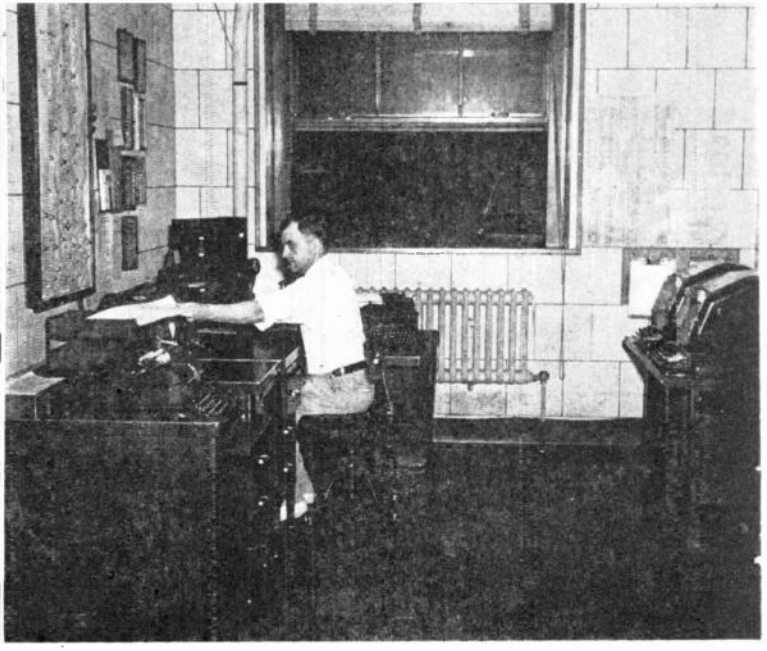


FIG. 2. ALL OPERATING CONTROLS ARE CENTRALIZED HERE AT THE STATE HOUSE ANNEX. DISPATCHER AHERN IS ON DUTY

THE NEW HAMPSHIRE STATE POLICE RADIO SYSTEM

Operating Conditions in New Hampshire Call for an Unusual 2-Way Communications Setup

BY LIEUT. BASIL CUTTING*

THE area served by the New Hampshire State Police, under the command of Col. Ralph Caswell, presents some unusual problems of radio communications engineering. Our State is approximately 170 miles from north to south, by 85 miles at its greatest width, covering 9,031 square miles. Population of 491,000 is almost evenly divided between urban and rural residents. In addition, we have a great number of vacationists in both the summer and winter seasons.

In the mountain valleys, temperature varies from −38° to 102°, and the snowfall in the northern part is 7 to 8 ft. annually. Altitude ranges from sea level at the southeast to 6,293 ft. on Mt. Washington, the highest point on the north Atlantic seaboard. This peak, near Conway, and other mountains 4,000 to more than 5,000 ft. high in the western and northern parts, cut up the State in such a way as to make it impossible for us to use a conventional 2-way radio system. Moreover, we must cover the entire State from Concord, the capital, which is located in the southern part. Our topography and climate combine to put radio equipment to the severest tests.

These conditions were recognized and given full consideration when our system was first planned. Fortunately, an adequate sum was appropriated for the purchase of equipment, and we were able to design ample tolerances into the system, with the result that it has proved entirely adequate under all emergencies and unusual conditions. Total cost of our radio system, including installations on 50-odd cars, was $40,000.

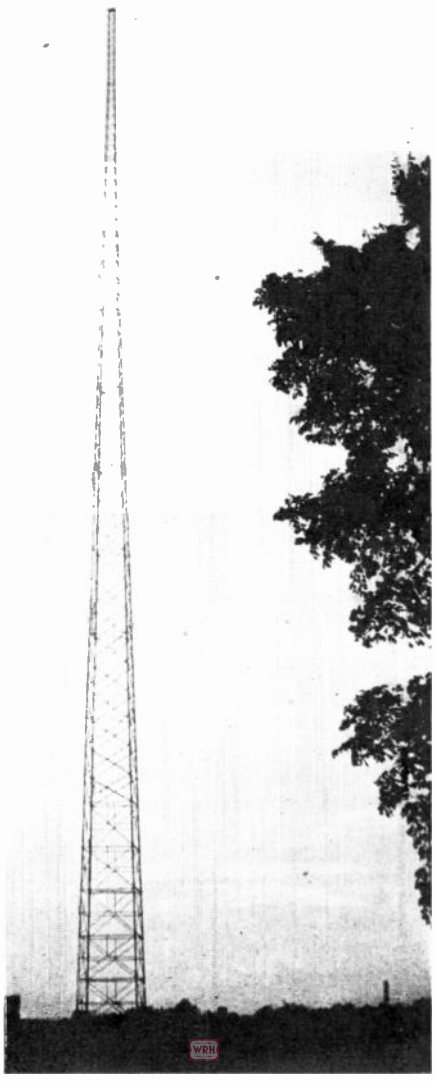


FIG. 3 325-FT. ANTENNA AT THE MAIN AM TRANSMITTING STATION

Plan of Operation ★ From operating headquarters in Concord we have 2-way communication with all our cars and, as will be explained in detail, one car in any part of the State can hold a 2-way conversation with another car in any other part of the State. This special feature has added much to the effectiveness of our system.

We require only one main AM transmitter, WRPT, of 1 kw., operating on 1,682 kc., to reach all our cars. This frequency is best suited for covering our terrain from a station located at Concord. Transmissions to cars up to 150 miles are sometimes necessary, and this range can be covered under normal conditions.

FM car transmitters talk back on 37.38 mc., and are picked up at one or both of two receiving points set up on high ground, adjacent to Concord.

When communication is required between two cars, the output of the headquarters FM receiver is fed into the speech

*Chief Radio Engineer, Department of State Police, Concord, N. H.

FIG. 4. THIS BUILDING HOUSES THE MAIN TRANSMITTER, STATION WRPT

input of the AM transmitter. Thus they can talk to each other just as easily as if they were in direct contact.

On the map in Fig. 7, the main transmitter is marked B, while the two headquarters receiving points are marked A and C. The transmitter B, about 2 miles from headquarters, is connected by a telephone line but, in case of emergency, it can be operated by a radio link transmitter. Receiving point A, on Mt. Kearsarge, relays all signals to headquarters by a directional transmitter, while receiving point C, at Woods Hill, is connected by telephone line only. These installations will be described separately.

Headquarters Control Center ★ The headquarters control center is located in the State House Annex, Concord. In Col. Caswell's office, Fig. 1, is a speaker on which he can monitor all transmissions to and from the cars. This is connected to the dispatching position in an adjacent room, Fig. 2. This is a pleasant, well-lighted room, sound-treated with Johns-Manville material on walls and ceiling.

All operating controls are located on the dispatcher's desk. At the right of the file for incoming and outgoing messages is a switchboard controlling lights on a large map of New Hampshire. These lights are spotted at the approximate center of each patrol area, as indicated in Fig. 7. If any light is turned out, it indicates that no cruiser is on duty in the corresponding area.

Next to the light controls is the speech amplifier for the main transmitter, and above the amplifier is a clock reading in numbers, from which log entries can be made more quickly than from an ordinary dial clock.

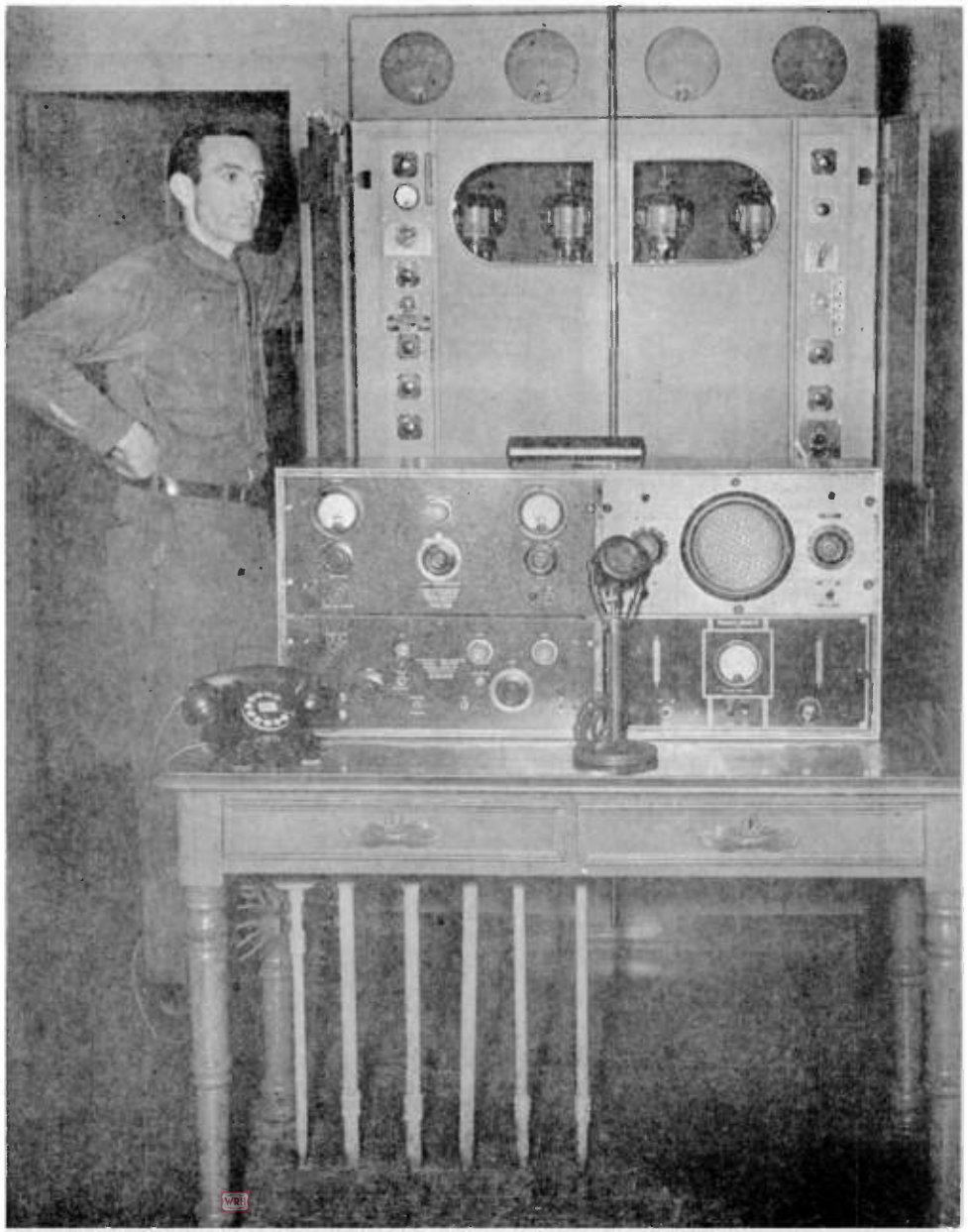
The manner in which the control of the system is arranged can be understood from the block diagram in Fig. 7. A telephone pair running 2 miles to the transmitter station, Figs. 3, 4, and 5, is used to operate the relay which turns on the transmitter. When the transmitter is not in use, the line carries the output of two AM monitoring receivers, located at the transmitting station, to speaker LS1, located at the right of the dispatcher's desk, Fig. 2. A separate pair connect the speech amplifier at headquarters to the speech input of the transmitter.

Speaker LS2, also on the dispatcher's desk, is connected to an FM receiver set on the roof of the State House, Figs. 8, 9, and 10, and also to a telephone pair running 6 miles to FM receivers at Woods Hill, Figs. 11 and 12.

The receiver at the State House picks up the 118.55-mc. relay transmitter on Mt. Kearsarge, which retransmits car signals received there on 37.38 mc. One of the four receivers at Woods Hill picks up our cars directly on 37.38 mc., while the other three sets are tuned to FM stations which we monitor continuously.

Thus, five different receivers run to

FIG. 5. CHIEF RADIO ENGINEER BASIL CUTTING AT THE 1-KW. TRANSMITTER



LS2. The dispatcher can, by a control circuit on the line running to Woods Hill, shut down any or all of the three monitoring receivers. Normally, when listening to one of our own cars, he leaves both the 118.55-mc. relay receiver and the 37.38-mc. Woods Hill receiver on speaker LS2. If, however, there is any noise coming in from either receiver, he can cut it off the speaker.

It might be expected that there would be some distortion resulting from putting both receivers on the same loudspeaker, but none has been observed at any time.

On the FM speaker LS2 there is a toggle switch by means of which the dispatcher can connect the output of the receivers to the input of the transmitter. In this way we can get car-to-car communication up to 150 miles, instead of 10 to 15 miles as is the case in a conventional system. This has proved to be of the greatest value in numerous emergencies.

Behind the dispatcher's desk are teletype machines connected to the Nine State System of the eastern states.

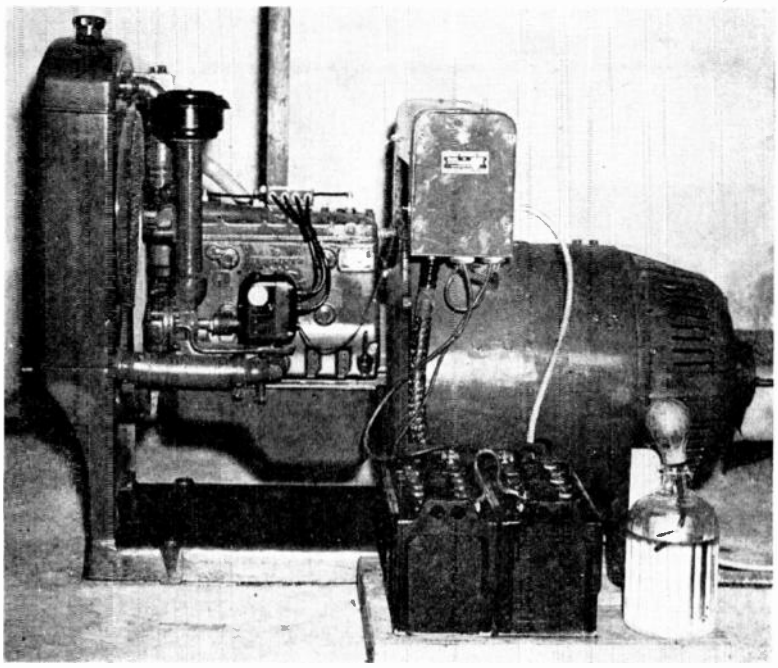


FIG. 6. 10-KVA EMERGENCY POWER SUPPLY ASSURES CONTINUOUS SERVICE

Headquarters-to-Transmitter Link ★ In addition to the telephone line running to the transmitter we have a Motorola FMT-30 FM transmitter which we can use on 37.38 mc. as a link to a Motorola FSR-13B receiver set up at the transmitting station. The author added a vacuum tube relay circuit to the receiver so that when it picks up the carrier of the link transmitter, the

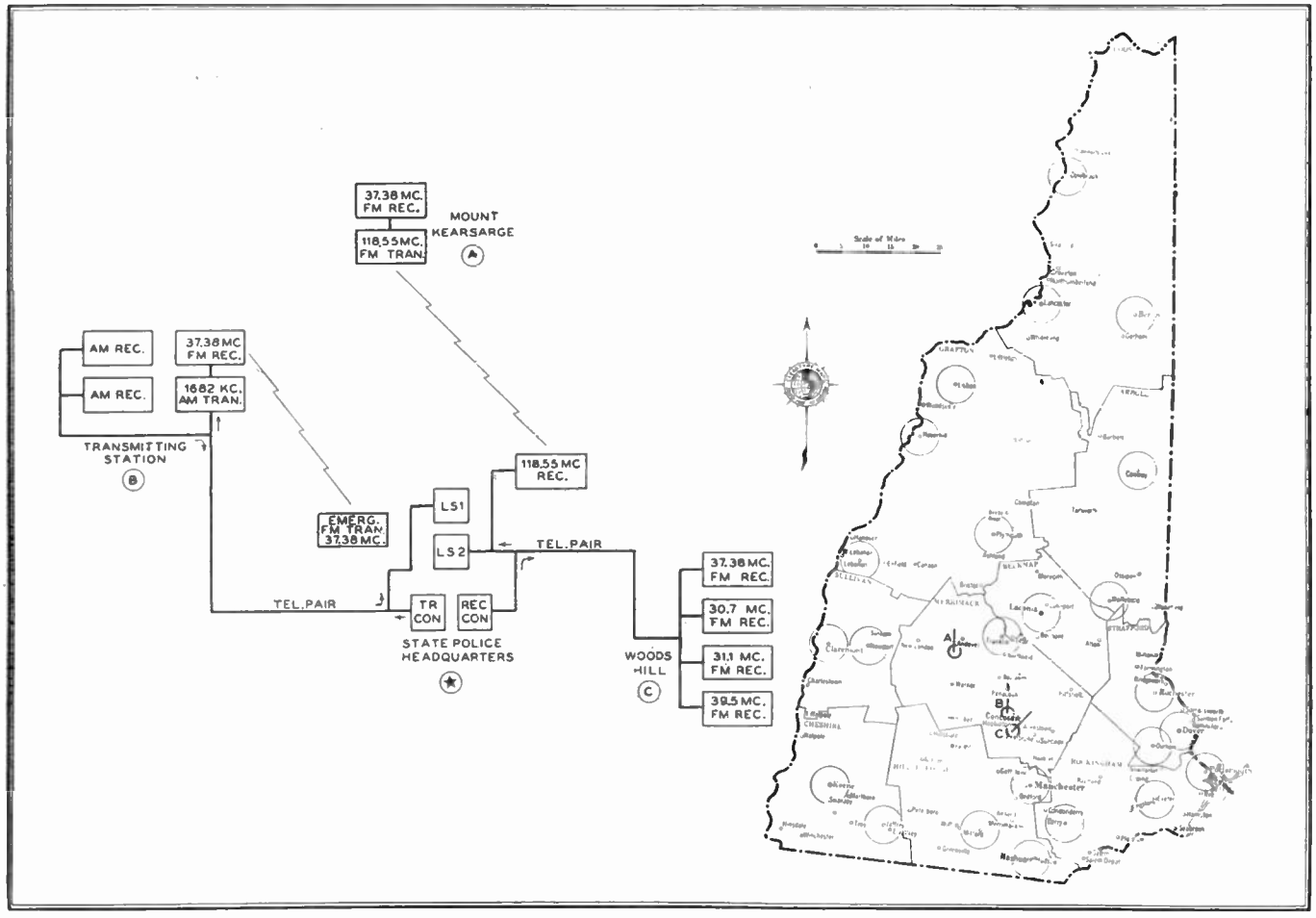


FIG. 7. BLOCK DIAGRAM OF THE N. H. SYSTEM. MAP SHOWS DISTRIBUTION OF 2-WAY RADIO CARS THROUGHOUT THE STATE

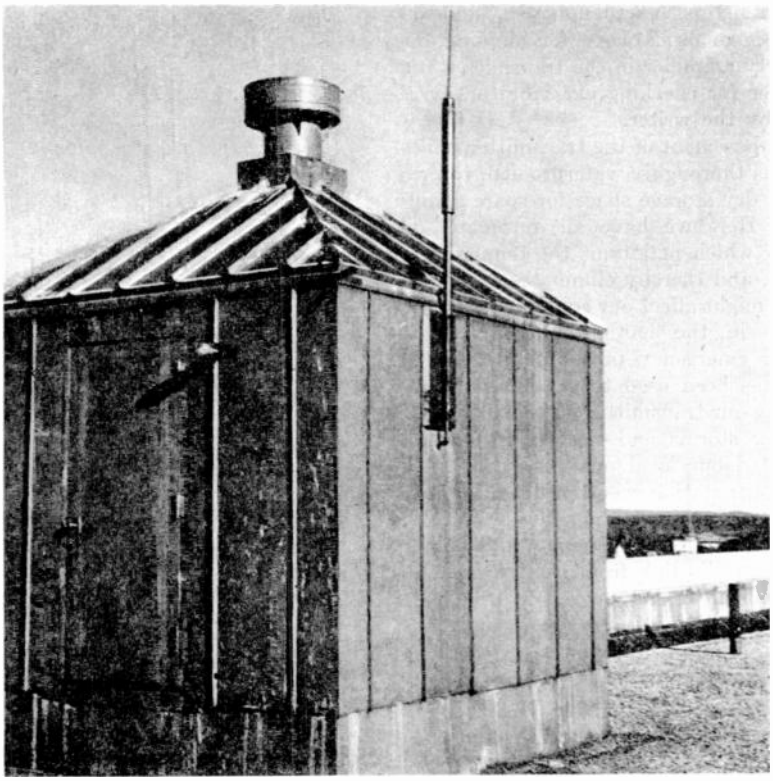


FIG. 8. THIS ANTENNA PICKS UP SIGNALS FROM RELAY STATION ON MT. KEARSARGE

1 kw. main transmitter is turned on, and the audio output of the receiver is connected to the input of the transmitter.

This may give rise to the question: since the link receiver operates on 37.38 mc., the same frequency as that of the cars, what prevents the cars from turning on, and talking into, the main transmitter?

Actually, the link receiver is turned on only when the telephone line fails. It takes only a few minutes to drive out there from headquarters. We have not had any trouble, however, when this emergency connection was in use, partly because the transmitter delivers such a strong signal that the gain on the receiver is turned far down, and partly because cars near enough to operate the receiver are so near headquarters that they do not need to use their radios.

Our emergency circuit has been a valuable aid to maintenance of continuous service. At one period, when the telephone lines were damaged by a severe electrical storm, we used the radio link for 36 hours.

Main Transmitter ★ Going out from headquarters, the first element in our system is the main transmitter. The antenna, Fig. 3, is a Blaw-Knox self-supporting, shunt fed type, 325 ft. high. We chose the shunt fed design because we felt that it afforded better lightning protection, stronger base construction, and an easier method of meeting CAA specifications for tower lighting. The antenna employs 12 tons of steel, erected on concrete footings which total 120 tons. This construction is intended to withstand a wind velocity of 125 miles per hour. The electrical length is .6 wavelength. As the base is grounded, no special arrangement is needed for connecting a 110-volt line up the tower to the lights.

At the base of the antenna is a ground system comprised of 120 radial copper wires of No. 12 gauge, each 325 ft. long, spaced 3° apart. They are buried 4 ins. under ground. In addition there is a ground screen 100 ft. in diameter at the foot of the tower, made of No. 12 copper wire. Altogether, we used 7½ miles of wire for this ground system. A test by the local power company showed the DC ground resistance to be .3 ohm.

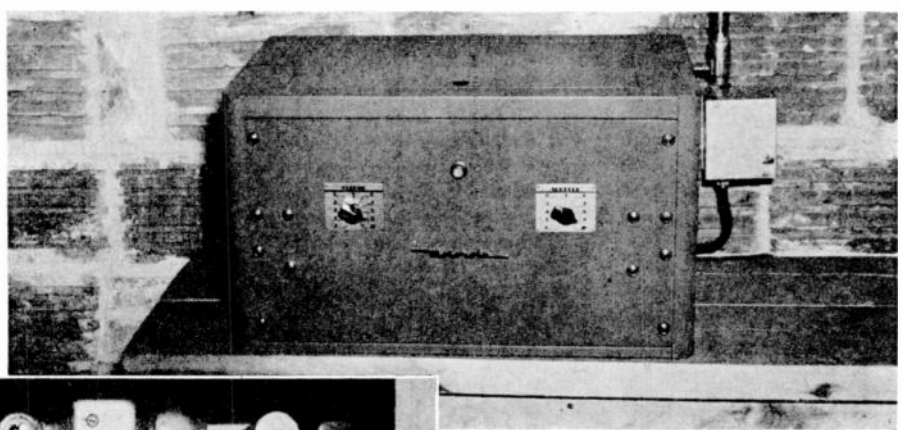
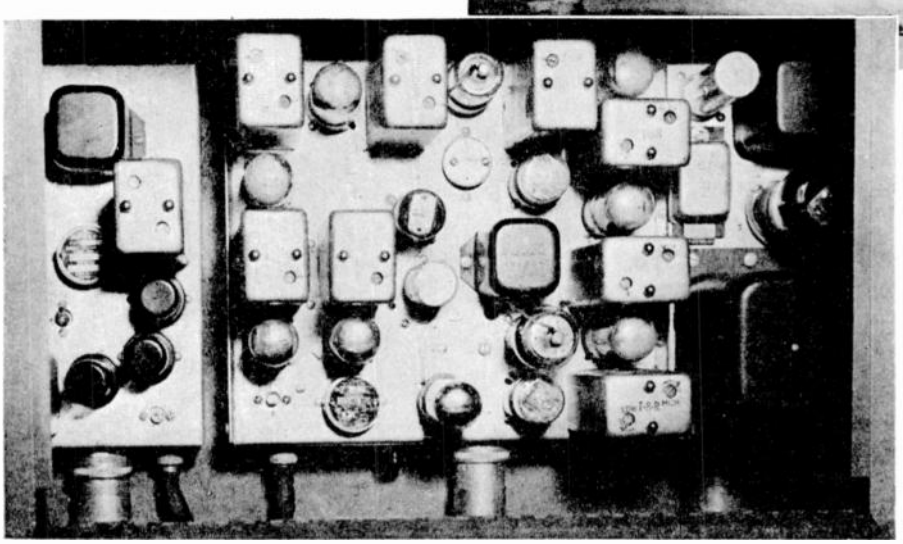


FIG. 9, ABOVE. RELAY RECEIVER SET UP IN STATE HOUSE PENTHOUSE

The building which houses the main transmitter is a one-story brick structure, 32 by 24 ft. This is shown in Fig. 4. It is divided into a one-car garage where car equipment can be serviced in bad weather, a transmitter room 18 by 15 ft., and a service shop.

Fig. 5 shows the 1-kw. Western-Electric

FIG. 10. INTERIOR OF 18-TUBE SET WITH TRIPLE SUPERHETERODYNE



AM transmitter and the control desk. A General Radio modulation monitor to check the frequency and a frequency-limit monitor to check percentage of modulation are set up permanently beside the standard Western Electric transmitter controls. One of the telephone lines running to operating headquarters is used to operate the system at the transmitter. In addition, we can make recordings of two-way conversations by means of a Presto Deluxe recorder set up in the transmitter building. It operates at 78 or 33⅓ RPM.

Receivers are provided to cover frequencies from 400 kc. to 240 mc. One of these monitors the Maine police system, while another is set for any station the dispatcher wants to hear. Both receivers are connected to the headquarters speaker indicated in Fig. 7 as LS1.

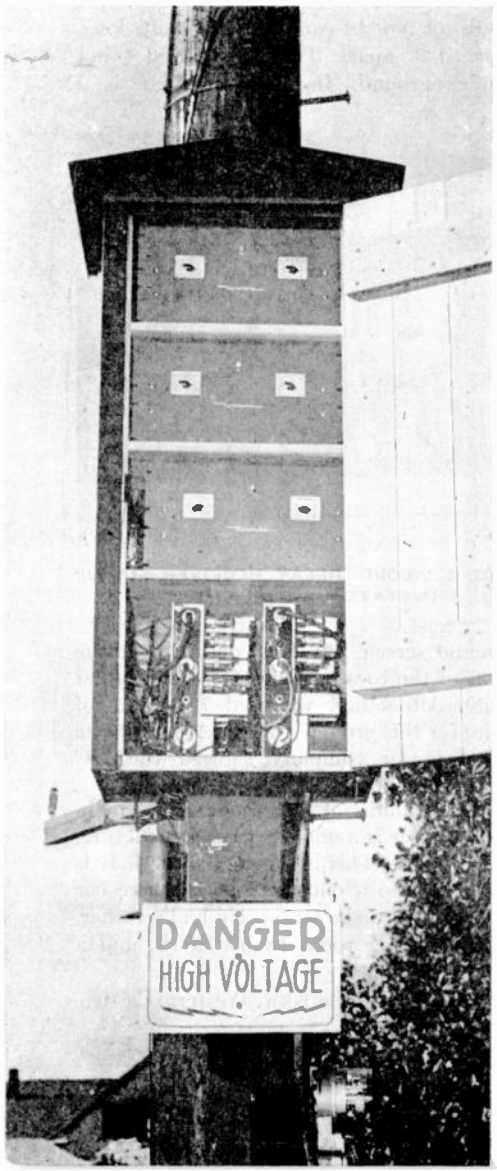
Our service test equipment includes 8 Browning frequency meters for checking car equipment and the relay transmitters, an RCA vacuum tube voltmeter, a Jackson tube tester and capacity bridge, Radio City model 702 signal generator, and a considerable assortment of voltmeters, milliammeters, microammeters, and db meters. An oscilloscope for aligning the Doherty amplifier in the transmitter and a tester for checking car vibrators were built by the writer.

The basement of the transmitter building was thoroughly waterproofed, to provide a dry storage space for spare equipment. Here we have an automatic oil burner which maintains the temperature at 65°, and thereby eliminates dampness which might affect our equipment.

Also in the basement is a 10-kva Kohler emergency power plant, Fig. 6. This has been used to great advantage, keeping our transmitter on the air during thunder storms and sleet storms which disrupted our local power service. As a result, the station was shut down for only 50 minutes during the entire year of 1943.

The cost of the emergency power plant and the radio link from headquarters to the transmitter has proved to be a wise investment, for times when conditions cause a failure of the power or telephone lines invariably cause accidents or other emergencies when our communications system is needed most of all.

FIG. 11. CLOSE-UP OF FM RECEIVERS AT THE WOODS HILL INSTALLATION



Car Equipment ★ Each State Police cruiser has a Motorola 69-13 or 69-18 receiver, operating on 1,682 kc. This is an 8-tube, AM, crystal-controlled unit with a noise-limiter and squelch circuit. We use the Motorola FMT-30-DW FM transmitter of 30 watts output on 37.38 mc. The transmitter circuit employs phase modulation.

A Carter generator supplies an input of 600 volts at 100 milliamperes to the final amplifier. The car generator is adjusted to deliver at least 30 amperes to the standard 120-ampere-hour, 17-plate battery. The antenna is a standard ¼-wave design, mounted on the side of the car and worked against the body as a ground.

Woods Hill Receivers ★ One of our two receiving points for picking up car signals is located at Woods Hill, in the town of Bow, six miles from headquarters. This point, 1,000 ft. above sea level, was chosen after field strength surveys had been made at various locations where telephone lines were available.

A 65 ft. mast, Fig. 12, was put up to carry the antennas, and the receivers were built into a cabinet mounted at the foot, Fig. 11. The coaxial antenna at the top is connected to our 37.38 mc. car receiver. It brings in car signals up to 100 miles in all directions.

The horizontal dipole and the vertical wire are used for the other three receivers.

FIG. 12. MAST AT WOODS HILL. COAXIAL ANTENNA PICKS UP STATE POLICE CARS

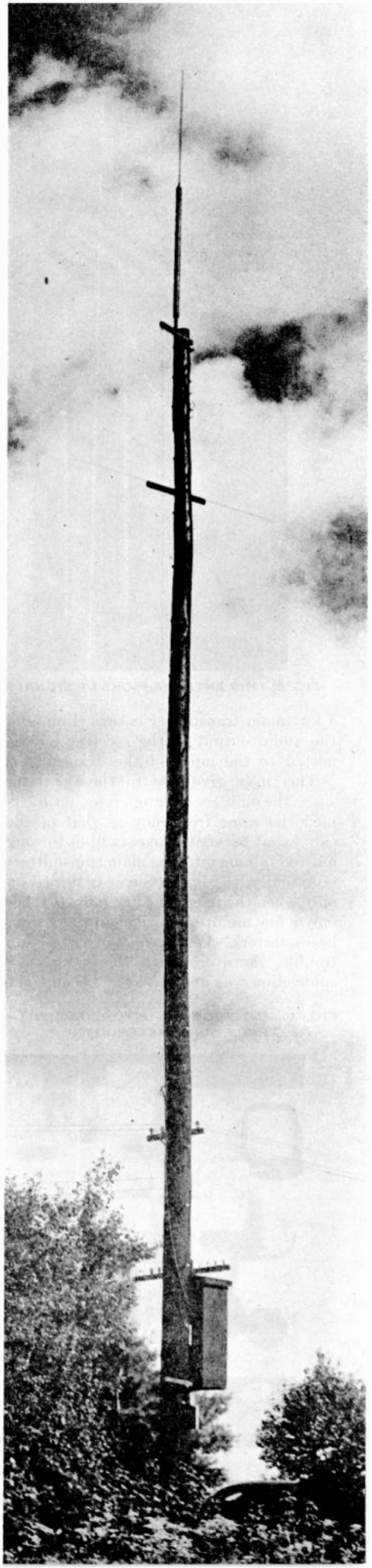


FIG. 13. CAR SIGNALS ARE PICKED UP HERE ON MT. KEARSARGE AND ARE THEN BEAMED BY FM RELAY TO CONCORD HEADQUARTERS, 28 MILES DISTANT

These monitor Portsmouth, Keene, and Claremont on 33.5 mc., Laconia and Dover on 30.7 mc., and Rochester on 39.5. As Fig. 7 shows, all these receivers come into headquarters over one telephone pair to loudspeaker LS2. It is necessary, of course, to cut off the monitor receivers if and when they interfere with signals from our own cars. This is done automatically by a relay circuit in the output of the 37.38-mc. receiver. In addition, if signals come in on two monitor receivers, any one can be cut off. This is done by controls at headquarters and 24-volt DC relays at the receivers, of which one is connected across the line, another from one wire to ground, and a third from the other wire to ground. The voice circuit over this pair is isolated by coupling condensers.

This control arrangement for monitoring purposes has proved most useful, and its operation has been highly satisfactory — far more so than if the receivers had been installed adjacent to headquarters in Concord.

Mt. Kearsarge Relay ★ In order to increase the talk-back range of our cars to 150 miles, and to give us a second point of reception, it was necessary to install another 37.38-mc. receiver. Field strength surveys were made on a number of mountains 3,000 ft. or more in height. Even Mt. Washington was considered, because of the problem of clearing mountains in the northern part of the State. However, tests showed that Mt. Kearsarge, 3,000 ft. high, in the town of Warner, gave satisfactory talkback reception, even though it is not at all in line of sight with points where, nevertheless, cars came in without difficulty.

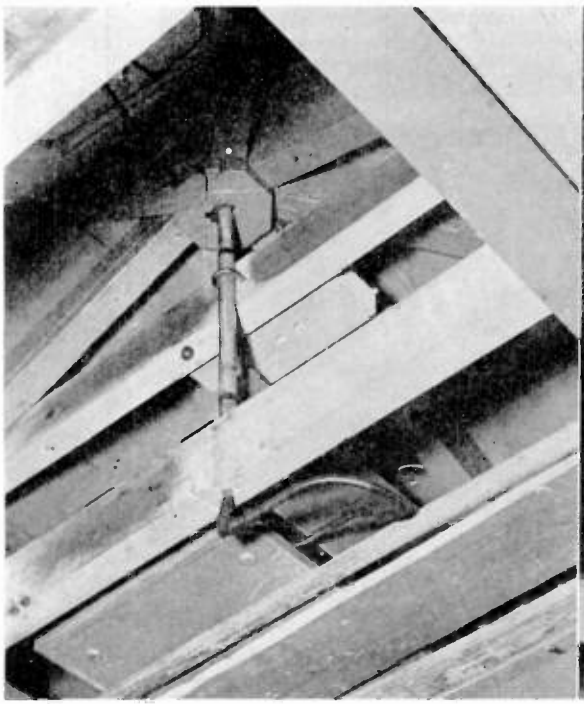
Fig. 13 shows the location. A fire-watcher's tower was already available to house the installation, and the R.E.A. power company ran a line up the mountain that is designed to withstand a wind of 100 miles per hour with a 1-ft. coating of ice.

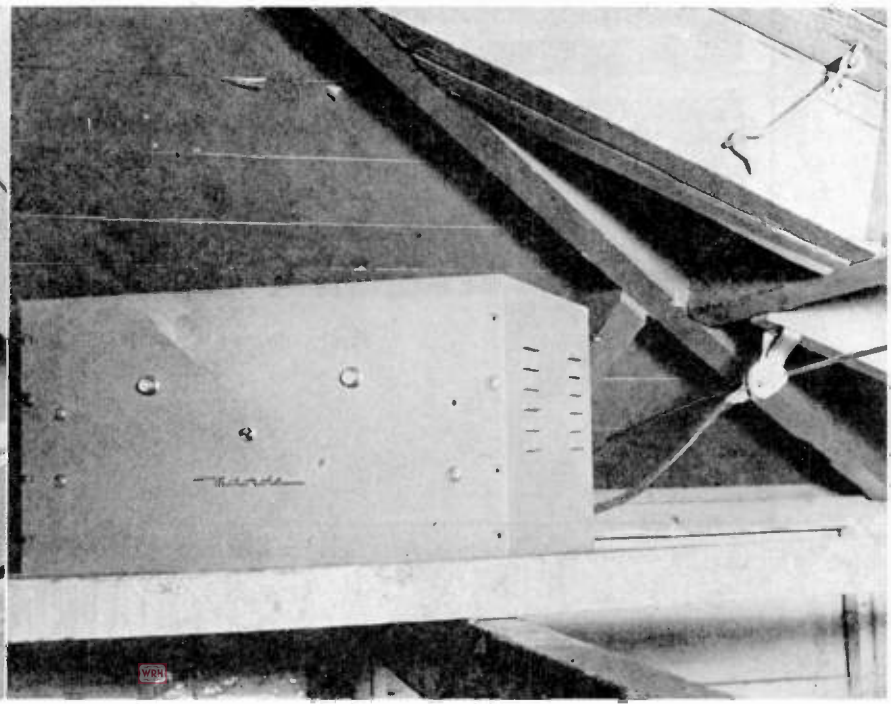
Because of the cost of putting in a telephone line, it was decided to connect a 118.55-mc. relay transmitter to the receiver. The receiver, on our 37.38-mc. frequency, runs continuously. When a carrier is received, a relay turns on the transmitter. Line-voltage fluctuation at this point was sufficient to upset the operation of our equipment, and we installed a Thordarson constant-voltage transformer to overcome this difficulty.

Figs. 14 and 15 show the equipment as it is set up under the roof of the tower. In Fig. 14 you can see the coaxial cable which runs from the receiver to a ¼-wave matching stub on the roof. This is supported by a 4-corner umbrella antenna of ¾-wave sections which act as guy-wires also. An ordinary coaxial antenna would not stand up here, particularly in the winter when ice builds up on the stub to a thickness of 2 ft. The antenna has a

(CONTINUED ON PAGE 87)

FIG. 14, LEFT. RECEIVING INSTALLATION AT MT. KEARSARGE. FIG. 15, RIGHT. RELAY TRANSMITTER AND ITS DIPOLE





FM CARRIER COMMUNICATIONS EQUIPMENT

For Multiplex Phone Communication and for Remote Selective Controls

BY FREDERICK T. BUDELMAN*

UP TO this time, very little information has been published on the subject of the simultaneous operation of two or more communication circuits over a single radio channel. This has been due largely to two factors. First, the use of multiplexing prior to the war was limited to a few very special applications. Second, although the development of multiplex radio operation has advanced enormously during the past few years, its use was in military service.

It is true that, in certain isolated cases, VHF multi-channel telephone circuits using AM were installed where the use of cables or wire circuits under or over water was not economically practical.

However, the simple and low-cost operation of multi-channel circuits was not possible until the advent of FM communication. Information can now be released on the application and performance of FM carrier relay equipment being used by our Armed Forces.

*Chief Engineer, Link Radio Corp., 125 West 17th Street, New York 11, N. Y.

Military Use ★ With the advent of high-speed armored equipment in modern warfare, the need for rapid communication became of paramount importance. Advances of 35 miles into enemy territory in a space of hours became commonplace but suicidal if the advancing forces were cut off from constant communication with the main forces behind. Wire lines, always considered the backbone of an army's communication system, could not be established fast enough to keep up with the armored units. The solution and its success are explained in the following excerpts from a censored report number 2055, Headquarters Communications Zone, European Theater of Operations, 4 November 1944.

"After our landing on Normandy, there were times during the smash through when even wire could not keep immediate pace with fast moving armored columns. The Signal Corps was faced with a new contingency. To meet the need, a system of VHF radio relay equipment was utilized, employing stations taking about four hours to install and sight.

"This radio relay system consists of stations 25 to 100 miles apart, each beamed on the next like a rifle on a target. The military possibilities of this system were developed in America and England after it was first tried out in North Africa.

"A considerable quantity of FM police scout car radio equipment had been

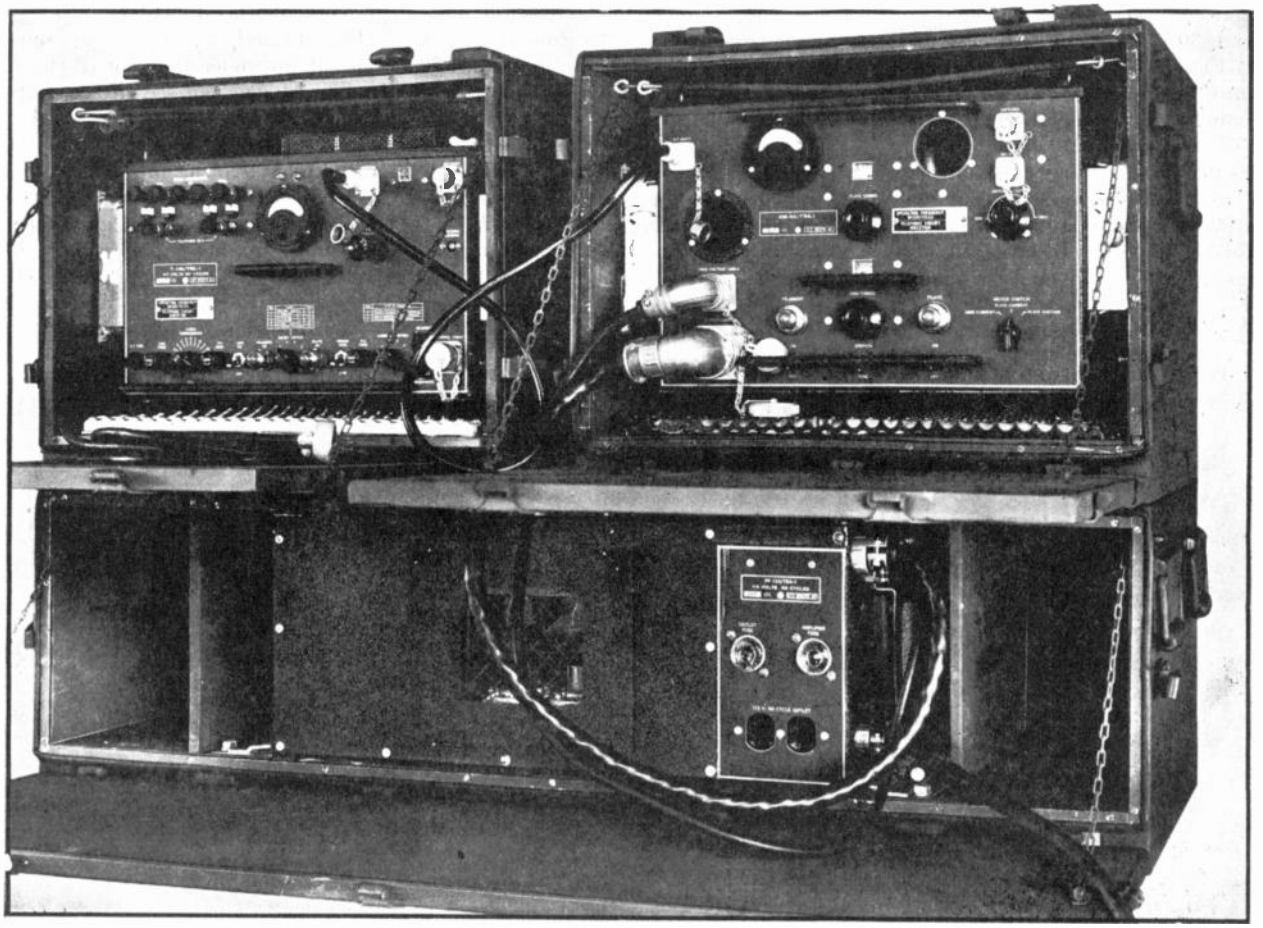


FIG. 1. THE 250-WATT FM CARRIER TRANSMITTER AND RECEIVER USED FOR MILITARY RELAY COMMUNICATION NETWORKS

procured for expected police communications requirements in North Africa, and this equipment was found admirably suited to provide communications for the rapid advance. As a result of this successful experiment and concurrent British groundwork, the amazing radio relay link equipment in use today was developed in the U. S. and in England, and was made to provide four teleprinter circuits plus three radio telephone circuits, as compared with one teleprinter circuit of the experimental models in Africa.

"Before the opening of the Second Front, the Signal Corps in Great Britain mapped out conditions expected for trans-channel communications and sent the information to the War Department. A topographical replica of these conditions, which include water path and elevation factors, was discovered along the coast of Maine. Here, the problems in invasion communication by high frequency relay equipment were worked out in detail and smooth signal operations were planned for the greatest amphibious assault in history.

"Although this equipment had not been subjected to severe tests under combat, the Chief Signal Officer in Washington anticipated the wide application of this equipment, and embarked on a production program immediately. The European Theater was fortunate in that the task of planning the combat communications for the invading army fell to Col. Grant Williams, a Signal Officer who had served as Division and Corps Signal Officer in Algeria, Tunisia, and Sicily and who is now Signal Officer of General Bradley's Army. Col. Williams anticipated an extensive utilization of radio relay equipment, ordered what seemed like fantastic quantities and, as a result, the Army was able to meet the demands of the rapid advance from the shores of Normandy to the Siegfried line and to share this valuable equipment with others. This VHF radio with its speed of installation and accurate transmission was one of the chief factors which enabled the American Armies to continue their rapid drive through France. VHF relay also provided the initial contact between the Continent and Great Britain on D-Day. Signal men in England could actually hear the shells and machine guns as they listened to the messages of their comrades on the far side.

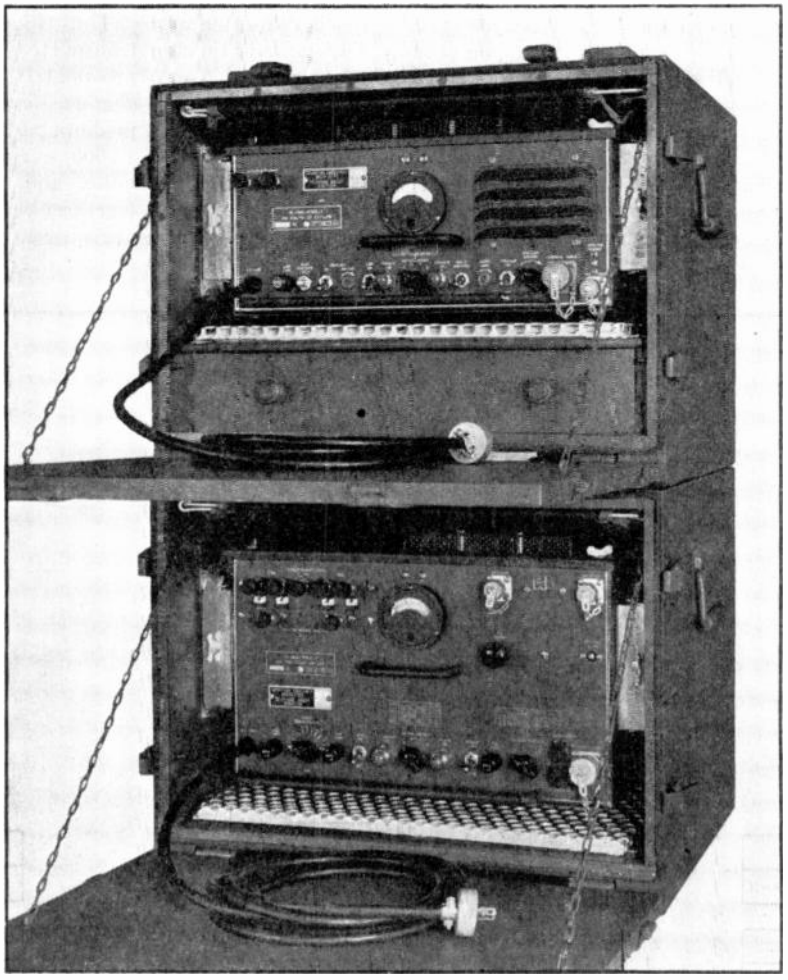


FIG. 2. A 50-WATT FM CARRIER TRANSMITTER AND RECEIVER

"One of the outstanding Signal Corps outfits in this war, from a radio standpoint, is the 980th Signal Service Company, commanded by Captain Donald J. Lake of Johnstown, Ohio. His men landed soon after D-Day, operating the high frequency relays. They were scattered in groups of five or so all the way from the front at Cherbourg, along the French Channel coast, back to the Southern ports of England. Other units operate in similarly isolated groups over a vast area. Living like hermits in tiny stations on hill tops and towers, their only contact with the world was radio and semi-weekly visits of the ration trucks.

"It is no secret now that, exploiting their break through with amazing skill and courage, our fighting men moved much faster than had been expected. It is no secret, either, that our Signal men were called upon to do the impossible in unprecedented operations. For each gain that the combat troops made forward, Communications Zone Signal men have had that much additional area to consolidate with permanent signal connections."

The military advantages of such a system as described are enormous. Instead of having to take, hold, and constantly patrol hundreds of miles of territory through which wire lines are run, a radio relay station can be set up and maintained in an area of an acre or so and provide the equivalent of seven ordinary telephone wires for a distance of 25 to 100 miles in each direction. The accessibility or military vulnerability of the intervening terrain need not be seriously considered. Large bodies of water no longer become a serious obstacle in the communication network. The saving in weight per mile per communications channel is a tremendous factor in planning transportation facilities in warfare. The total weight of a given system may be reduced to only a few per cent of an equivalent wire system. The saving in strategic materials, particularly copper, is enormous. The radio equipment used in these relay systems is shown in Figs. 1 and 2.

Method of Operation ★ First, what is the general method of transmitting simultaneously many voice and teletype channels over a single radio circuit? The apparatus is very similar to that used to superimpose a number of communications channels on a single wire circuit. Under the name of "carrier telephone" it is used to provide additional telephone circuits over a single telephone pair. It is well known that most of the important speech frequencies lie in the range of 250 to 2500 cycles, and any system transmitting this range of frequencies without distortion will provide an excellent telephone circuit. Almost any properly designed wire circuit, however, can transmit frequencies higher than 2750 cycles, and this capability has been put to use to provide additional telephone channels by the use of carrier telephone equipment.

A system known as single side band transmission is used for carrier telephone circuits. When a carrier frequency is amplitude-modulated, there results a complex wave consisting of the carrier frequency and two side-band frequencies, one above the carrier frequency by the amount of the modulating frequency, and one below the carrier frequency by the amount of the modulating frequency. For instance, if speech with a frequency range of 250 to 2500 cycles is applied to amplitude-modulate a carrier frequency of 6000 cycles, it produces 1) a component of 6000 cycles representing the carrier, 2) a range of side-band frequencies from 6250 to 8500 cycles (6000-cycle carrier plus 250- to 2,500-cycle speech), and 3) a range of side-band frequencies from 5750 to 3500 cycles (6000-cycle carrier minus 250- to 2500-cycle speech). It is not necessary to transmit all of these components to carry all the initial speech intelligence. One side band and the carrier can be eliminated, and the original speech signal transmitted by only one side band, provided a 6000-cycle carrier is reinserted at the receiving station. Thus an additional telephone circuit could be provided over a given pair of wires by transmitting an additional band of frequencies from 3500 to 5750 cycles.

For example: If a 6000-cycle carrier is modulated with a 1000-cycle tone, upper and lower side bands of 7000 cycles and 500 cycles are created. By means of filters, the 6000-cycle carrier and the 7000-cycle upper side band can be eliminated, and only the 5000-cycle lower side band transmitted. At the receiving point the 5000-cycle wave is recombined with a locally generated 6000-cycle carrier, producing side bands of 1000 cycles and 11,000 cycles. Removing the 6000-cycle carrier and 11,000-cycle upper side band leaves our original 1000-cycle tone.

By an extension of this process, additional speech channels can be added to a given transmission medium such as a wire line or radio circuit as long as that medium will transmit additional bands of frequencies about 3000 cycles wide.

Thus, four telephone channels may be transmitted within a total range of approximately 250 to 12,000 cycles. The channels can be transmitted over any medium that will accommodate 250 to 12,000 cycles with low distortion, low noise, and without great variations in level or circuit gain. All of these facilities are inherently provided by FM radio to a greater degree than by wire lines or AM radio telephone communications systems.

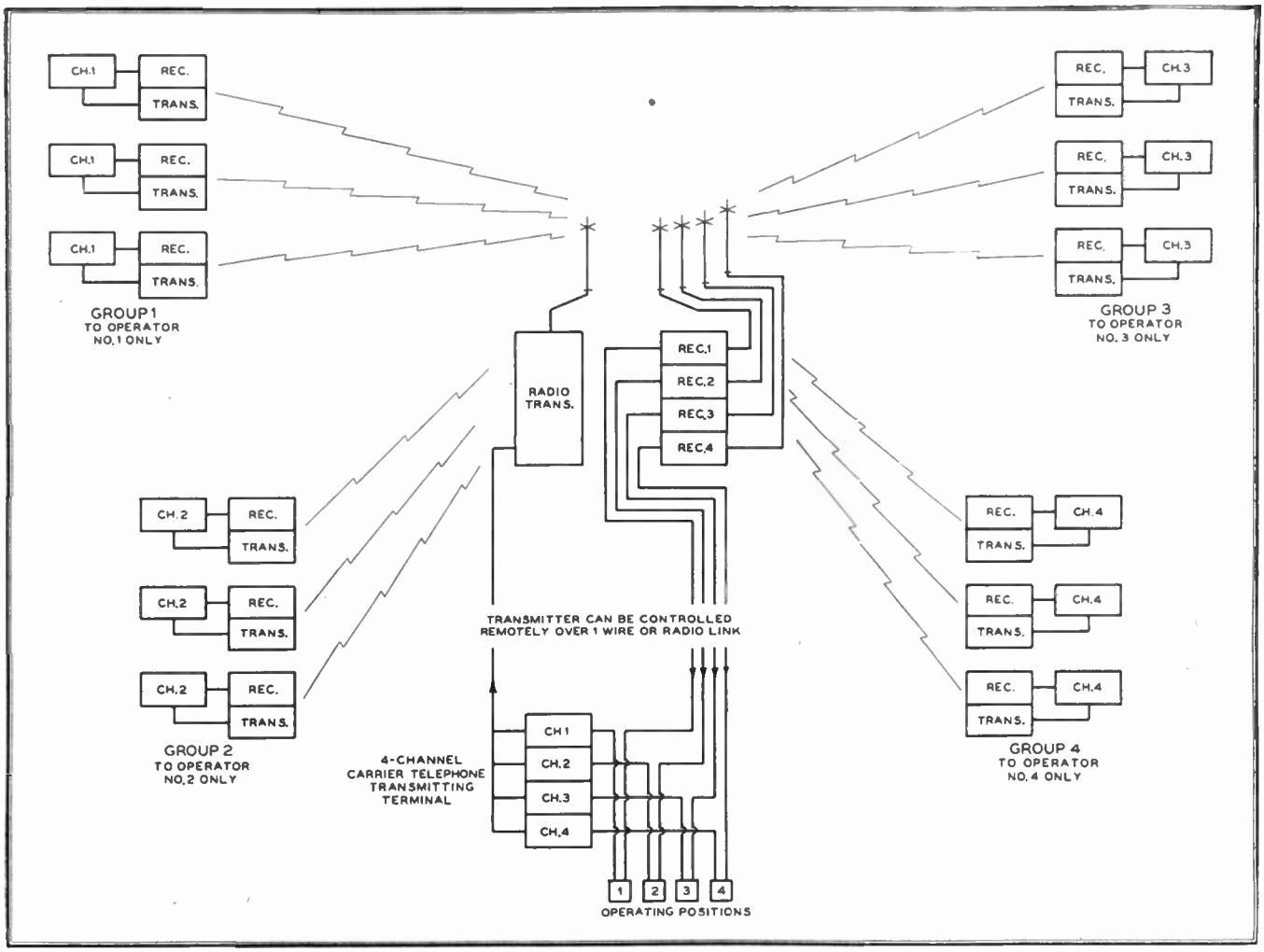
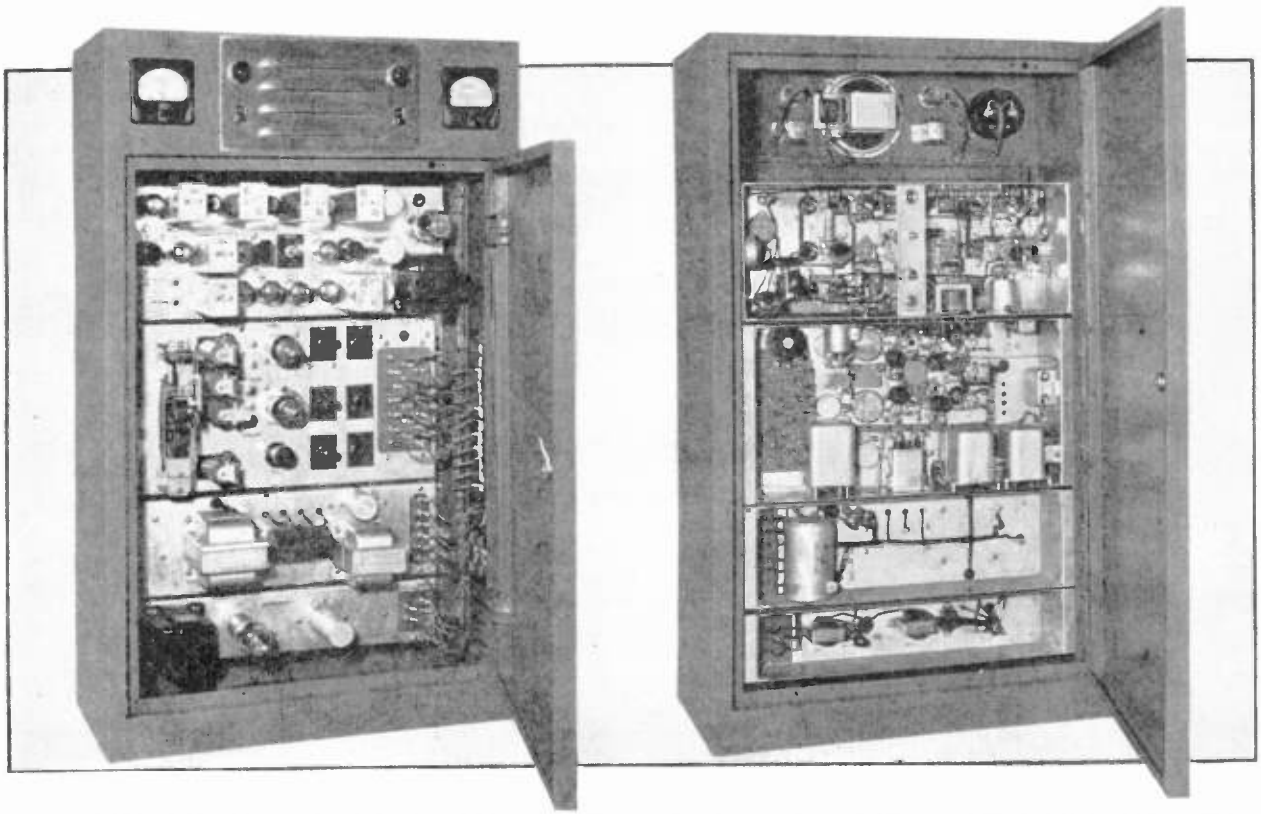


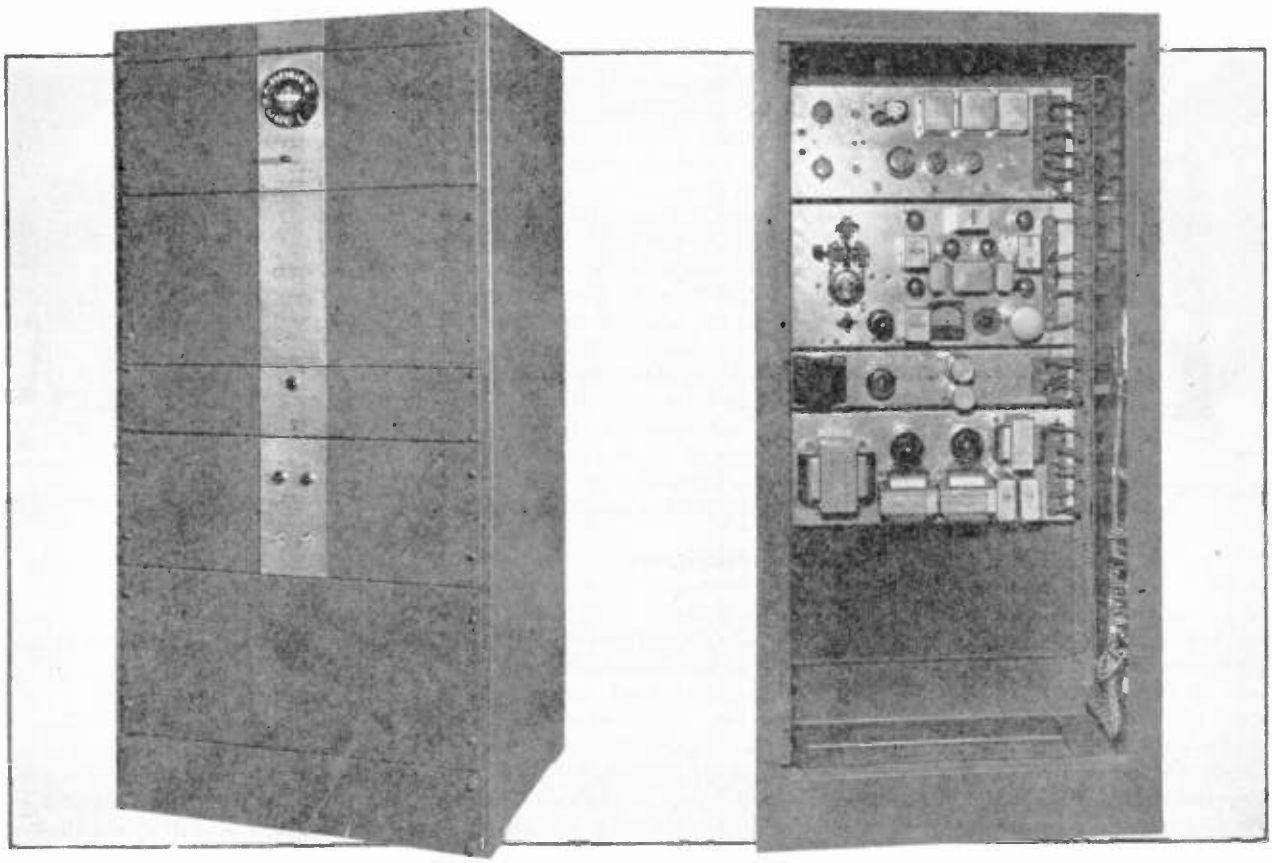
FIG. 7. THIS FM CARRIER SYSTEM MAKES POSSIBLE 4 SIMULTANEOUS CONVERSATIONS WITHOUT INTERFERENCE

Use at Airports ★ One of the earliest practical applications in regular service of multiplexing on FM radio communication equipment was installed by the Civil Aeronautics Authority. The radio transmitters and receivers are used to control, key, and modulate the remote radio communication facilities of a large airport. It is common practice to locate the major radio facilities of a large airport some distance from the airport itself for several reasons.

First, it is desirable to keep tall towers away from the landing strips. Second, the



FIGS. 5 AND 6. MULTI-CHANNEL RECEIVER FOR REMOTE RADIO CONTROL OPERATION OF AIRPORT RADIO FACILITIES



FIGS. 3 AND 4. FRONT AND REAR VIEWS OF THE MULTI-CHANNEL TRANSMITTER FOR CONTROL OF AIRPORT RADIO FACILITIES

airport is very often a center of electrical disturbances which would affect good radio reception. Third, possible blocking of receivers due to the proximity of planes on the field to the control tower can be averted by locating the ground radio facilities at a distance.

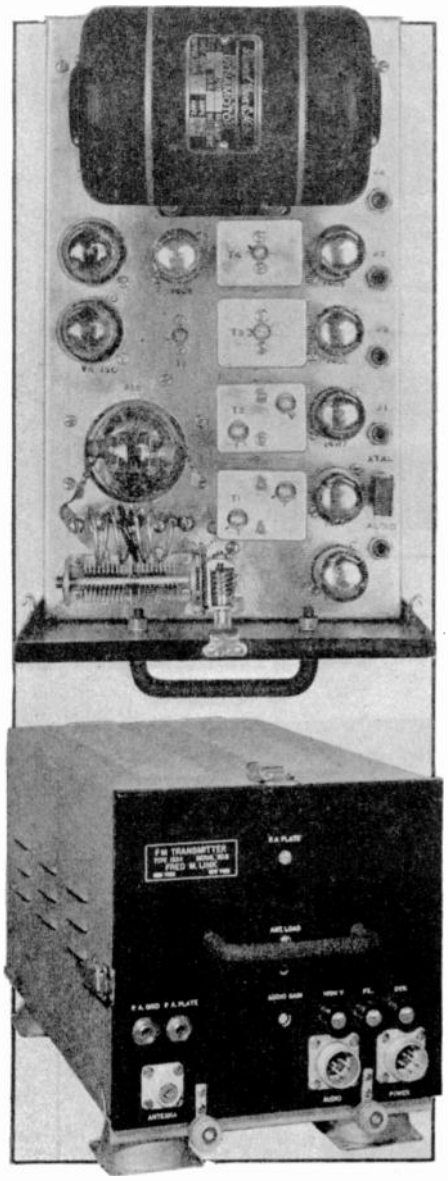


FIG. 8. AIRBORNE FM TELEMETERING TRANSMITTER

Radio was used in preference to multiple wire lines because of lower first cost, lower maintenance cost, and greater reliability. The FM equipment transmits with low distortion, modulating signals in the range of 250 to 40,000 cycles. This wide range allows the simultaneous transmission of several voice channels, a number of teletype channels, and a number of tone telegraph keying channels.

Another example of remote control of airport facilities is shown in Figs. 3, 4, 5 and 6. Figs. 3 and 4 show the transmitting equipment which was arranged for dial selection of the remote facilities. By means of the dial on the front of the relay transmitter, the control tower operator selects the transmitter and type of operation (cw or voice) that he wants to use. The receiver, Figs. 7 and 8, automatically selects and connects the operator to the particular transmitting facilities dialed. In some cases, after the particular transmitter is selected, the operator again dials to change the transmitter to the desired operating frequency. The operator at the control tower can also dial to connect the output of the remote receiver to a loudspeaker so that he can give orders to anyone at the transmitting station.

Remote Control of Transmitters ★ The widespread adoption of two-way mobile emergency communication systems and the need for greater and greater operating range has led to installation, in many cases, of transmitting and receiving equipment on high points of terrain. Remote control of these facilities is necessary in most cases because the operating or control point must be located many miles away.

Initially and at present, the majority of such installations are controlled over a single telephone wire circuit. Experience has shown that over 90% of the off-the-air time of such radio systems is due to failure of the wire circuit between the operator and the radio station and only 10% or less is attributable to failures in the radio or power equipment. These facts have lately justified plans for the widespread use of radio relay equipment to relay messages to and from the transmitting location and, in addition, to provide complete remote control of transmitting and receiving facilities. During the coming spring there will be erected a number of remotely controlled headquarters stations of this type to provide two-way coverage of the whole of one of our eastern states — coverage which was not economically possible if the headquarters stations had to be located near existing telephone and power lines. In this case the radio equipment will be entirely powered by storage batteries, wind-driven generators and auxiliary gasoline generators.

Application to Police Systems ★ In the field of police radio, there are numerous cases where the number of mobile units has become so large that at certain times of the day it is impossible to handle all the desired traffic through a single headquarters station. In a large city this means delaying the transaction of police business, or establishing duplicate headquarters and transmitting facilities on another radio channel.

In order to conserve already overcrowded radio channels, it has been suggested that the headquarters station be equipped to transmit two or more messages simultaneously by adding carrier telephone channels to the existing equipment. The mobile units would be divided into groups, and all the receivers in the cars of each group would be equipped with a simple filter and demodulator so that

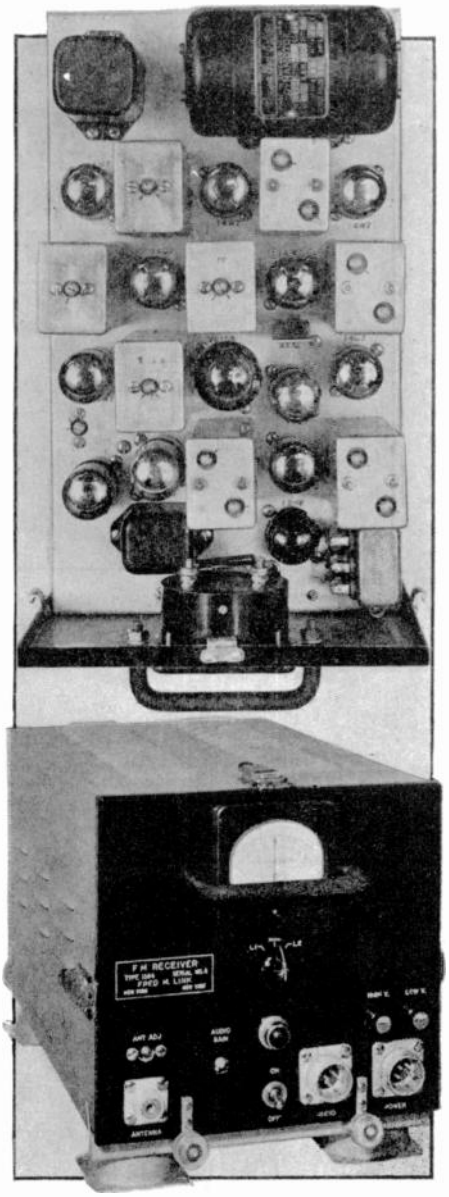


FIG. 9. AIRBORNE FM TELEMETERING RECEIVER

they would hear only the messages intended for that group. In this way more than one dispatcher could use the same radio transmitter to transmit simultaneously to the different groups of mobile units. Similarly, the operator covering one group of cars would be able to carry on a conversation with a mobile unit of that group without interference with the communication between headquarters and any other group. A diagram illustrating the operation of a typical system of this type, made by the Lenkurt Electric Com-

pany of San Francisco is shown in Fig. 7.

Another use of multiplexing in police radio applications is the addition of facsimile or teleprinter service to existing police radio nets without interfering with normal emergency communications. In this case, the facsimile or teleprinter signals are placed on a sub-carrier frequency sufficiently above the highest speech frequency so that no appreciable interference is caused to the regular voice transmission. The low-pass filter networks normally incorporated in police-type FM receivers effectively prevent such interference.

Telemetering by Radio ★ An interesting example of the use of the high fidelity, low noise, and constant level characteristics of FM radio circuits lies in their use as the means of transmitting accurately multiple meter, gauge, or vibration readings from an airplane to the ground or to another airplane so that they can be recorded and studied while tests are actually in progress, and with a facility and accuracy impossible in the airplane itself. Figs. 8 and 9 show typical radio transmitters and receivers for this type of service. As many as 20 separate readings have been transmitted simultaneously over such equipment with excellent accuracy.

Radio Relay System ★ The accelerated progress in the use of multi-channel radio relay systems during the war has also been felt in its effect on civilian applications. A number of permanent radio-relay systems for the transmission of multi-channel telephone and telegraph circuits have been installed and a number more are in construction stages at the present time.

Up to the present time, security regulations have made it impossible to describe these systems, but they will be covered very shortly in a future issue of *FM* AND TELEVISION. One interesting system now being planned forms a radio trunk line 1000 miles long, capable of carrying 19 telephone and countless telegraph messages simultaneously. Eleven entirely unattended repeaters are to be used with distances between repeater from 70 to 100 miles. These plans are not mere dreams, but are based on operating results from systems already proven in regular commercial service.

The proving-in of multi-channel radio relay service which will bridge rivers, bays and lakes, hop from island to island and pass right over wilderness is beginning to bring communications to millions of people who have never been able to have it before because of economical considerations.

Typical surveys show that the installation of a radio relay system costs only about one-quarter as much as a wire system to give the same service, that the upkeep is less and, most important of all, that the reliability is greater. To provide the maximum of reliability, duplicate radio equipment is to be installed at each repeater point, with provisions for automatic changeover in case of failure of any kind.

The Advantages of FM ★ In any multi-channel carrier telephone system, it is of utmost importance that the transmission characteristics of the circuit be held extremely constant. It is also very important that the overall distortion of the circuit be very low in order that no cross-modulation between channels be created. In the case of wire or cable circuits, the attenuation of the circuit changes appreciably with humidity and temperature variations, and special compensating apparatus must be used to maintain a usable circuit. In addition, the distortion introduced by each repeater amplifier must be kept very low so that the accumulated total remains tolerable.

In the long-range FM radio-relay systems, the signals are not detected or demodulated at the repeater stations, but are merely amplified and converted to a new radio frequency for transmission to the next repeater station. Since the transmitted intelligence consists of frequency variations only, amplitude variations due to fading, variation of gain in repeater circuits, and moderate detuning have no effect on the modulation level of the repeated signal.

Repeater amplifiers can be made amply broad to allow for wide variations in tuning during unattended operation, and to allow for future expansion *without adding noise* to the signal. For all practical purposes, the control of the RF band width, noise, cross-modulation, distortion and audio level are almost entirely in the control of the terminal station, accessible to maintenance personnel. Each repeater is no more complicated than an ordinary receiver and uses no more tubes. No level, modulation, or gain adjustments are necessary or possible at the repeater station.

Due to the simplicity of the RF repeater, it is economic to provide duplicate equipment in every case, so that in the event of any kind of failure, except power, the standby repeater is automatically switched into use. Defective apparatus can be replaced on routine service calls. Dual power sources are always provided at radio relay stations. When available, commercial AC power is used for normal operation, and a gas engine generator with a ten-day supply of gasoline provides an automatic standby.

In some cases it is impossible to obtain commercial power and the primary source of energy is a bank of storage batteries charged continuously by wind-driven generators. The battery bank is usually designed to be able to carry the load for five days without recharging. In the case of longer periods of insufficient wind velocity, a gas engine driven charger automatically recharges the batteries.

Every multi-channel radio system is a new problem in itself, and must be engineered to suit the particular requirements of the application. A series of articles, each describing a particular application or describing the technical aspects in more detail, is now in course of preparation.

NOTES ON THE PROPOSED FCC ALLOCATIONS

AT THE FCC's press conference, when the new allocations were announced, the statement was made that there would be less interference resulting from sky-wave effects in the lower frequencies — 44 mc. upward — if television is put there instead of FM. This is not confirmed by the simple arithmetic of AM and FM interference ratios. While it is true that the contour limit for television is taken as 500 microvolts, the 100 to 1 AM ratio indicates that a signal of only 5 microvolts would interfere with television reception. On the other hand, the minimum signal of 50 microvolts for FM, protected by a 2 to 1 ratio, would require a 25-microvolt signal to cause interference. Therefore, if sky-wave interference is going to cause trouble in the 44-mc. neighborhood, it will do much more harm to television on AM than to sound programs on FM.

Concerning the proposed plan to split television frequencies downstairs into 6 channels from 44 to 84 mc. and 6 from 180 to 216 mc., the FCC pointed out that: "No additional frequencies can be assigned to television between 225 and 300 mc. because all these frequencies are required for Government services." However, it is not planned to assign any television station to the 78- to 84-mc. band at once, as that may be required for FM broadcasting. Therefore, the number of downstairs television channels might be limited to 11, under the proposed allocations plan. This compares with the original minimum RTPB request for 26 channels below 300 mc., which was later revised to 18 as a minimum.

As to the choice between 6-mc. channels downstairs and 20-mc. channels upstairs, the FCC said: "The Commission does not believe that broadcast service to the public

(CONTINUED ON PAGE 85)

SPOT NEWS NOTES

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

Police Radio: According to the FCC, on June 30, 1944, the total of police land, portable, and portable-mobile transmitters stood at: municipal police, 15,014; state police, 3,844; zone police, 93; interzone police, 22; and experimental, 72. This does not include, of course, the receivers installed in cars for 1-way operation.

Patent Reference: For those interested in locked-in oscillator circuits for FM receivers: A patent application dated September 14, 1935 and issued to Major Armstrong on May 10, 1938 describes a system of reception which appears to be very much like the Beers circuit.

New Ownership: W. Myron Owen "and a few associates" have purchased the stock of Aerovox Corporation, New Bedford, Mass. Sam Cole, who organized the Company in 1923 and built it up to the point where it now employs 3,500 workers, will carry on as general manager, with Mr. Owen as president and his long-time associate, Stanley Green, as vice president and chief engineer. No other changes in personnel are contemplated. Mr. Owen is a director of Duncan Electrical Mfg. Company, Chicago Rivet & Machine, and Seneca Falls Machine Company.

Seymour F. Johnson: Back at KFI after 2½ years at the M.I.T. Radiation Laboratory, has been appointed FM and Television facilities engineer for the radio division of Earl C. Anthony, Los Angeles. He will work under co-chief engineers H. L. Blatterman and Curtis Mason.

New Business: It doesn't take much imagination to realize that the newly-established Citizens Radiocommunications Service will create a demand for talkie-walkies and semi-portable variations, operating on both batteries and AC, that may exceed the prewar sale of portable broadcast receivers. Circuits will be FM.

An added feature which will be much in demand is a relay-operated calling bell on AC operated receivers. What a market these sets will provide for crystals, microphones, small speakers, telescope antennas, and tiny tubes!

Station KEX: In Portland, Ore. has been taken over by Westinghouse Radio Stations, Inc., after approval by FCC of purchase for $400,000. This is a 5-kw. affiliate of the Blue Network, operating on 1190 kc. As soon as possible, FM transmitting facilities will be added.

Facsimile: May get its first big start in police service, since the FCC has now provided for its use. Several state police organizations have been working on plans to install equipment in all their barracks, and they will encourage municipal police to install receivers so that they will be tied in on the service. Multiplexing facsimile with sound on present FM transmitters is generally favored over the use of separate transmitters and frequencies. New Hampshire may be the first to put a state-wide facsimile system into operation.

New Plant: For the Capacitron Company, at 849 North Kedzie Avenue, Chicago 51, is nearly ready to start production of electrolytic condensers. In addition to standard types, the new plant will produce special capacitors of high life expectancy for use under severe service and temperature conditions. The general offices are already installed in the new building, almost a block long, which will eventually house all manufacturing facilities.

Railroad Radio: According to William P. Hilliard, general manager of Bendix Radio, seven railroads have completed 30,000 miles of test runs with Bendix radio equipment. These are: Atcheson, Topeka & Santa Fe; Southern Pacific; Denver, Rio Grande & Western; Seaboard Airline; Missouri Pacific; Baltimore & Ohio; and Chicago, Burlington & Quincy. Tests will start soon on the Père Marquette; Chicago, Milwaukee; St. Paul & Pacific; and the Chicago & Northwestern railroads.

WCEMA: Howard D. Thomas, Jr. general manager of the Packard-Bell Company, Los Angeles, has been elected president of the West Coast Electronic Manufacturers Association, Los Angeles Council. The retiring president, H. L. Hoffman, Hoffman Radio Corporation, was elected to the board of directors. The new vice president is Lew Howard, Peerless Electrical Products, and treasurer James L. Fouch, Universal Microphone. Other directors are D. A. Marcus, Electronic Specialty; Ashford M. Wood, Littlefuse; and Clay F. Fisher, Radiation Products.

Pig-Squeal Broadcasting: The FCC's allocations proposal makes no provision for subscription broadcasting which would be transmitted with a strong squeal, and paid for by listeners who would rent squeal-removers. Proponents of this plan to support stations that would carry no advertising asked for three frequencies to accommodate three types of programs transmitted simultaneously.

It's a bright idea in theory, but it sounds as if it originated with someone who has no first-hand knowledge of the broadcasting business. The amateurs would welcome it because they could do a nice business selling homemade squeal-removers, made up from junk parts, to their friends. In fact, they would probably sell more of these gadgets than the broadcasting stations could rent!

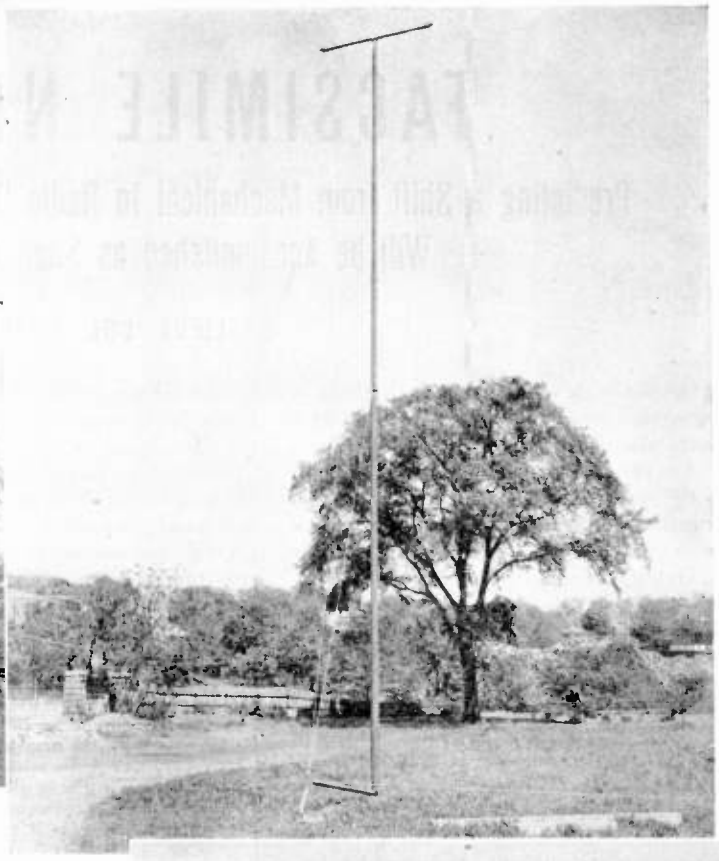
FM in Boston: Matheson Radio Company, Inc. has selected Nobscot Hill, Framingham, Mass. as the site for its developmental FM station. A temporary 100-ft. wooden mast will provide an elevation 700 ft. above sea level. Construction is under way and, upon completion, antenna studies and comparisons of horizontal and vertical polarization will start. The permanent installation will have a 400-ft. steel tower.

Fire Department FM: Allocation of frequencies to fire departments will create a new market for FM communications equipment estimated at more than $2,000,000. Already 92 cities of more than 100,000 population have indicated their desire to purchase fixed and mobile equipment, together with 890 cities of 10,000 to 100,000 population. The value of this service to the public is indicated by statistics which show that 40 home fires are reported in the U. S. A. every hour, and that 30 people are burned to death every day.

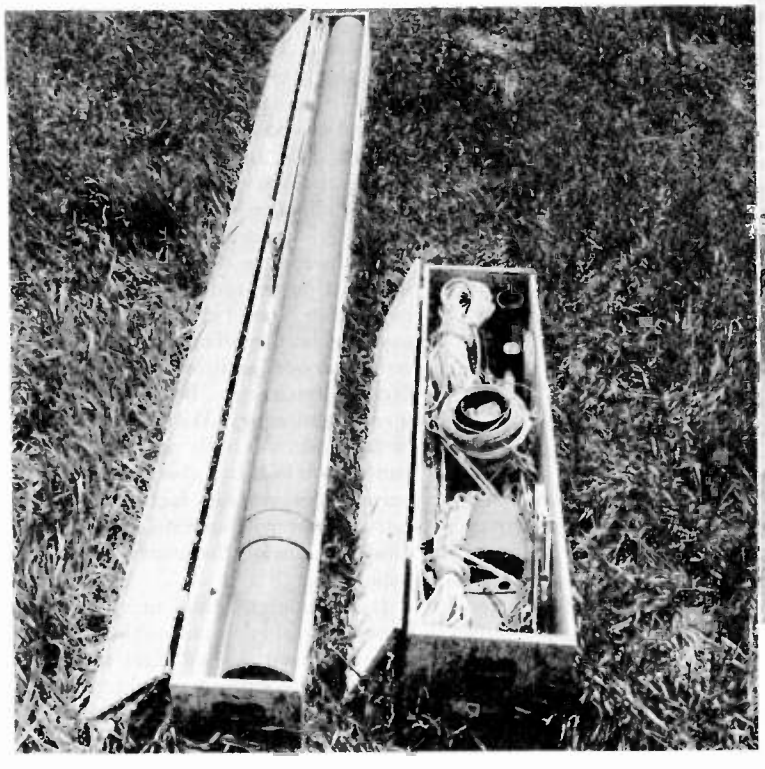
Not Necessary: This question is being asked frequently right now: "Will the final determination of frequencies be held up until the next international conference, or will the decision of the FCC be final so far as applicants are concerned in the United States?" The answer, according to the FCC, is that the final determination will be made by the FCC soon after the February hearing on the proposed allocations is concluded.

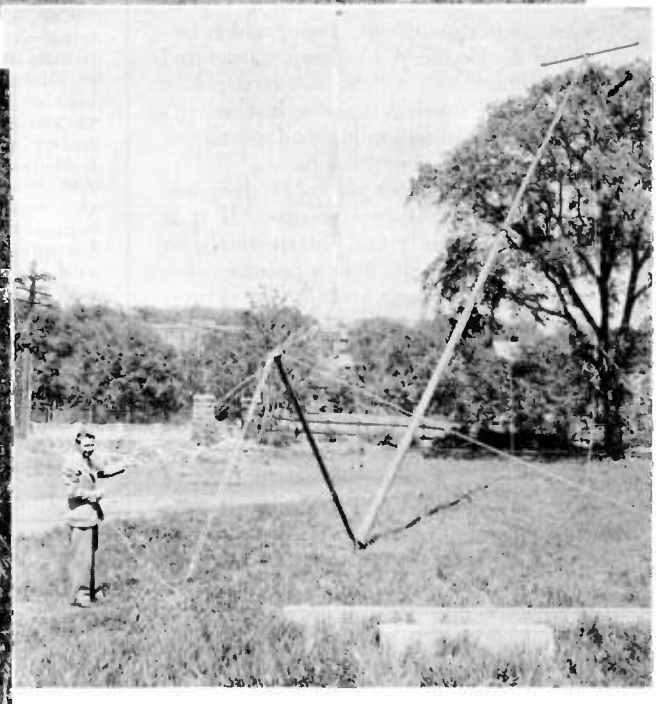
The need for international agreement in the 25- to 30,000-mc. band relates only to navigation aids on ships and airplanes in international commerce, where the standardization of frequencies is a practical necessity.

Omitted: As a result of the wartime vagaries which plague the post office as well as the public, the FM Handbook series will not start until next month. Somewhere between our editorial workshop at Great Barrington, Mass., and Rumford Press at Concord, N. H., the illustrations went astray.



ABOVE, TWO MEN CAN ERECT THIS 75-FT. MAST WITHOUT SPECIAL EQUIPMENT. RIGHT, THIS IS AN IDEAL MAST FOR USE ON APARTMENT HOUSE ROOFS





LEFT, THIS BOX CONTAINS A 55-FT. MAST AND ALL ITS FITTINGS. TOTAL SHIPPING WEIGHT IS ONLY 200 LBS. ABOVE, METHOD BY WHICH ONE MAN CAN ERECT THE 55-FT. MAST AFTER ASSEMBLY

NEWS PICTURE

THE need for lightweight masts to support FM and television receiving antennas may result in a widespread post-war demand for tubular plywood supports to be erected on apartment houses as well as at private homes. Able to withstand winds of 125 MPH, they can carry safely the light load of a simple receiving antenna, even though it uses a tuning motor at the top.

Types illustrated here, so light that one man can erect a 55-ft. mast, are now being manufactured by the Plymold Corporation, Lawrence, Mass. The masts in standard lengths are 50 and 75 ft., and are made up of 12-ft. sections which can be handled easily.

FACSIMILE NEWSPAPERS

Predicting a Shift from Mechanical to Radio Distribution, and the Manner in Which It Will be Accomplished as Soon as Equipment Is Available

BY LIEUT. COL. ROBERT D. LEVITT*

AMONG the developments in the field of communications is one which offers a particular challenge to the enterprise and vision of the newspaper publishers. That is the radio-operated facsimile process of transmission, reception, and reproduction of graphic images, by which it is possible to create permanent, identical, black-and-white copies of photographs, drawings, printed material — even entire newspapers!

Facsimile has already progressed to the point beyond which the only further development needed is that which may be dictated by consumer demand, and such development invariably comes with astonishing speed. Before the war, this new service could have been started with equipment then available. The period of wartime postponement, during which facsimile development has been accelerated for military use, will have served public interest by making superior instruments available when facsimile broadcasting can be launched on a postwar basis.

To the newspaper publisher, facsimile is either a threat or a promise. If it is set up intelligently and enterprisingly on a commercial basis, it is a promise of a wonderful refinement and advance in present newspaper publishing techniques. But, ignored by newspaper publishers and exploited by others, it is a threat of deadly competition.

To begin with, facsimile, as it affects newspapers, must be regarded only as a new, superior method of distribution. It is not a newspaper; it is merely a means for delivering newspapers to the home.

For the purpose of this analysis, let us divide the operation of publishing a newspaper into two basic phases. The first phase, which includes the gathering and writing of news and features, obtaining photographs, solicitation of advertising, typography, engraving, composition, and make-up, we may call the "production phase." The second phase, onward from the stage at which page forms are locked up, including the familiar progression to presses, to mail room, to delivery trucks, and to dealers or carriers, we may call the "distribution phase."

Facsimile, then, offers a modern substitute for the conventional "distribution phase" of newspaper publishing. Once the page forms are locked up, completing the "production phase," facsimile takes up the task of distributing the newspaper. At this point, instead of continuing with the present succession of printing and distribution stages, reproduction proofs of the pages will be inserted into the transmitting mechanism and broadcast direct to recording units in the homes of newspaper readers.

THIS discussion of facsimile is of particular interest and significance because it was not written by a radio engineer, but by a newspaper man whose knowledge of publishing was gained with one of the largest newspaper organizations in the world.

Col. Levitt lays down a challenge to the most progressive minds in the fields of engineering, publishing, and broadcasting. The idea of shifting from mechanical to radio distribution is entirely sound, and the plan of employing both methods, as is projected for AM and FM broadcasting, until the new can supplant the old, represents a reasonable and logical advance in service to readers and advertisers alike.

While it is startling to think that simple home facsimile machines can take the place of those amazing machines that print and fold thousands of newspapers per hour, this is no more amazing than the contrast between those machines and the crude hand presses used not so many years ago!

The economics of substituting radio for mechanical distribution offers a most interesting study. Annual cost per family for a facsimile reception is no more than the price of daily morning and evening papers, yet facsimile distribution eliminates the newspaper publisher's largest factors of labor, cost, expense, and capital investment.

Obviously, facsimile is useless without the organization and equipment to accomplish the "production phase." Without reporters, photographers, writers, editors, advertising solicitors, and all the rest of the complex creative set-up, facsimile is an empty vehicle. It is a train without freight. But it is a beautiful, streamlined, air-conditioned train, and if the present-day newspaper publisher doesn't provide the freight, it is an odds-on bet that someone else will.

The publisher who has spent years in perfecting the "production phase" of his paper to suit the reader-market he serves must either extend his usefulness by utilizing the new substitute for his old "distribution phase" or resign himself to the inevitable consequences. Others, perhaps the radio broadcast station operators themselves, can, and undoubtedly will, set up organizations to accomplish the "production phase" of newspaper production, and employ facsimile as a dramatic substitute for the "distribution phase" of the old-style newspaper. When facsimile has developed into an economically sound enterprise, and there is every indication that this can happen very quickly, its competition will render obsolete the newspaper as we know it today.

Analysis of the present competitive position of the newspaper further emphasizes the significance of facsimile. At present, the only important competitor of the newspaper in the dissemination of current information is standard-band radio. The newspaper has two major advantages over radio: the advantage of visual presentation over auditory; and the advantage of permanence. But both of these are merely temporary. With the development of facsimile, not only will the visual advantage be lost, but also the advantage of permanence, and new factors of speed and convenience will operate to the distinct disadvantage of the conventional newspaper.

It is apparent that unless the newspaper publisher swims with the technological current, he will find himself submerged. The current is rising behind the dam of wartime restrictions, and there are cogent reasons why the newspaper publisher had best prepare to swim with it now, instead of letting someone else take the initiative when peace releases the commercially profitable torrent.

Of course, facsimile transmission of newspapers cannot be a profitable enterprise until there are in American homes

(CONTINUED ON PAGE 80)

*25 Central Park West, New York City. Former promotion director, *New York Journal American* and circulation promotion manager, *The American Weekly*.

DO YOU PLAN TO BUILD AN FM STATION?

With the Aid of the Data Presented Here, You Can Estimate Required Capital, Potential Revenue, and Possible Profits—Part 2, Conclusion

BY KEITH KELSEY

Note: Any change in FM broadcasting frequencies will have no appreciable effect on cost data presented here.

Construction Costs ★ Unlike the AM station, the construction cost of an FM transmitting station depends considerably upon the antenna site. The range of an FM station being dependent much more upon the height of the antenna than upon the power input to the antenna, it is of utmost importance to locate the transmitter on a high point overlooking the market area. If a tall building does not give sufficient coverage, an adjacent hill-top may be ideal technically, but the cost of getting electric power and water service at the hill-top might be very high. Likewise, if the transmitter site is at a considerable distance from the studio, a radio studio-to-transmitter link (STL) or telephone line will be required at additional cost. Because of these and other factors peculiar to each location, it is very difficult to generalize as to the cost of construction of an FM station. However, for comparative purposes, the costs given in Table 6 are approximate average costs, including license fees to Major Armstrong, but not including a studio-to-transmitter link, land, or buildings, or preliminary engineering.

If a particular market area and suitable station site have been selected, and it is desired to make a preliminary determination of power and cost, the curves of Figs. 2 to 6 may be used. Fig. 2 gives the power and effective antenna height for different range requirements, and Fig. 3 the range gain for multiple bay antennas. Fig. 4 gives the costs of towers of different heights. Fig. 5 gives the costs of different sizes of antennas, and Fig. 6 the balance of the cost of the station excluding preliminary engineering and station-transmitter relay link, assuming that space requirements are rented.

The use of these curves is illustrated by the following example:

SERVICE AREA: A city of 175,000 population in about 20 sq. mi. centrally located in trading area of about 4,700 sq. mi. having a flat terrain and including a suburban and rural population of 75,000, or a total population of 225,000. Ground conductivity assumed to be average or about 5×10^{-14} emu.

TRANSMITTER SITE: A centrally located 16-story office building, 200 ft. high, in which studio and transmitter space can be rented and whose roof can support a 150 ft. tower.

TABLE 6—COST OF FM TRANSMITTERS

1 kw.	$ 42,000
3 kw.	50,000
10 kw.	75,000
50 kw.	150,000

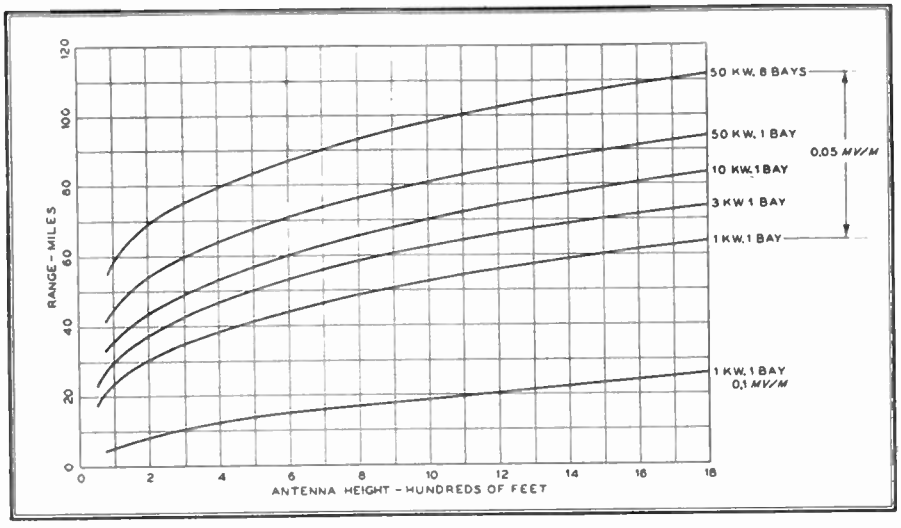


FIG 2. ANTENNA HEIGHT AND POWER OUTPUT REQUIRED FOR A GIVEN TRANSMITTING RANGE

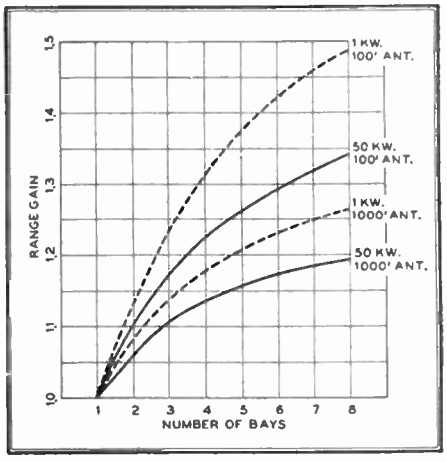


FIG. 3. RELATION OF GAIN TO NUMBER OF ANTENNA BAYS

REQUIRED: a) Height of tower, size of antenna, and station power.
b) Approximate cost.

SOLUTION: a) The urban area of 20 sq. mi. has a radius from the transmitter of about 2½ miles. Within this area the FCC requires a field strength of 1,000 microvolts per meter[5]. In rural areas the FCC field strength requirement is 50 microvolts per meter, and the station should be designed to give this strength at the outer edge of its trading area of 5,000 sq. mi. or a range of 40 miles. Fig. 2 shows that, to meet this specification, an antenna height of 445 ft. is required for a 1-kw. station with a 1-bay antenna, and 260 ft. for a 3-kw. station and a 1-bay antenna. Figs. 2 and 3 show that for an equivalent range of $\frac{40}{1.1}$ = 36.2 mi. a 325-ft. 2-bay antenna is required for a 1-kw. station and a 180-ft. 2-bay antenna for 3 kw. For the 1-kw., 2-bay combination having an effective antenna height of 325 ft., the tower would be 325-200-(2 × 10) = 105 ft. high, if located on top of a 200 ft. building.

SOLUTION: b) From Fig. 4, the tower cost

[5] Where the station is in or near an urban area of small or medium size, a field strength of 1,000 microvolts per meter will be reached in the urban area when 50 microvolts per meter is maintained at the outer edge of the trading area. To check this, refer to formula and curve in *Standards of Good Engineering Practice*, obtainable from the FCC.

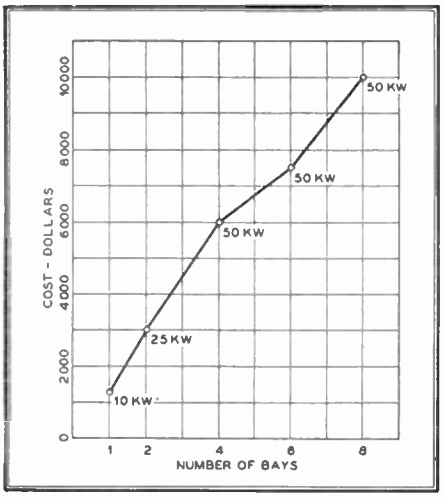


FIG. 5. COST OF FM ANTENNAS

erected is seen to be $3,000; from Fig. 5, the antenna and transmission line, $3,000; and from Fig. 6, the balance of the installation cost, $36,000, to which must be added preliminary engineering for the location of the site, which is estimated at $5,000, giving a total cost of $47,000. The estimate in more detail is as follows:

Preliminary Engineering		$ 5,000
Installation		
Preparing FCC applications	$ 2,200	
Antenna System	6,000	
Equipment, incl. installation	18,000	
Royalty and proof of performance	3,000	
Furniture, fixtures and sound-proofing	12,000	42,000
Total Cost		$47,000

Similarly, it would be found that the 1-kw., 1-bay station would cost $48,250; the 3-kw., 1-bay station $50,450; and the 3-kw., 2-bay station $50,500 for the same service area coverage. This comparison shows that a 1-kw., 2-bay station is the lowest cost combination which will service the area to be covered under the conditions set forth. In situations where a studio-to-transmitter link (STL) is required, add $12,000 for equipment plus cost of land and building where the latter cannot be leased.

The foregoing method is only roughly approximate. For an accurate estimate of a particular site, a competent radio engineer should be employed.

Station Purchase Prices ★ Sales of radio stations were fairly frequent in the first half of 1944, a number of them being at record or near-record figures for their power and service areas. These make an interesting comparison with cost estimates of FM stations and indicate the price ranges which will confront the investor who decides to break into FM via AM. Table 7 gives a number of these transactions with reported sales prices.

The preceding data shows no consistent unit price per watt or per capita, indicating that considerable value is given to undisclosed assets, including the magnitude of the listening audiences or to earning power.

If, for the cost example previously given for a 1,000 watt FM station, preliminary engineering is assumed to be $5,000 and $90,000 is provided to operate the station for two years without material revenue, then the total capital requirement would be $137,000. This is in fair agreement with sales prices of AM stations in Table 7, which includes two 1,000-watt stations which sold at higher figures and two which sold for less. It must be remembered that the power of an FM station is not related directly to coverage, and hence to value or earnings since, serving the same area, there might be a 10-kw. FM transmitter with a high antenna, and a 50-kw. transmitter with an antenna located less advantageously as to height.

Operating Costs and Revenues ★ The approximate operating expenses of the average 1-kw. FM station will be about $60,000 a year, including rent, personnel, depreciation, maintenance, power and program

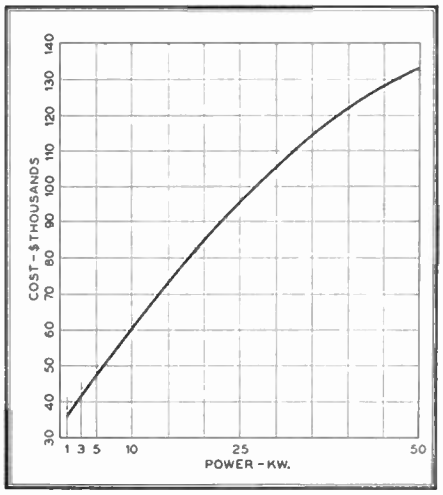


FIG. 6. OTHER TRANSMITTER COSTS

production. The operating expenses will vary widely, depending upon the choice of programs, network affiliations, music royalties, news services and the like.

The potential revenues available to FM broadcasting stations generally are even more difficult to estimate than the operating expenses. The FCC regards as confidential the financial statements filed annually by its licensees. However, the Commission does publish revenue figures for all of its reporting licensees grouped by the size of station which are given in Tables III and VIII. It is reasonable to expect that the average FM station will have a service area greater than that of an AM station of the same power, so that the potential income should be about the same after FM receivers have been widely sold and an audience has been built up. Applying this premise to Table 3 leads to the conclusion that the typical 1-kw FM station should have a potential net time sales of about $100,000 per annum. Deducting operating expenses leaves a net operating income of $40,000 per year, before taxes, or 40% of sales. If, in addition to the station cost of $42,000, a total of $95,000 is provided for preliminary engineering, contingencies, and operating losses in the first two years, the return from sales of $100,000 in the third year therefore would be about 30% on the total capital requirement of $137,000.

In comparison, Table 8 shows that on the average network AM stations of comparable size are earning, before Federal Income taxes, about 20% of sales and 40% of investment cost. Table 8 also

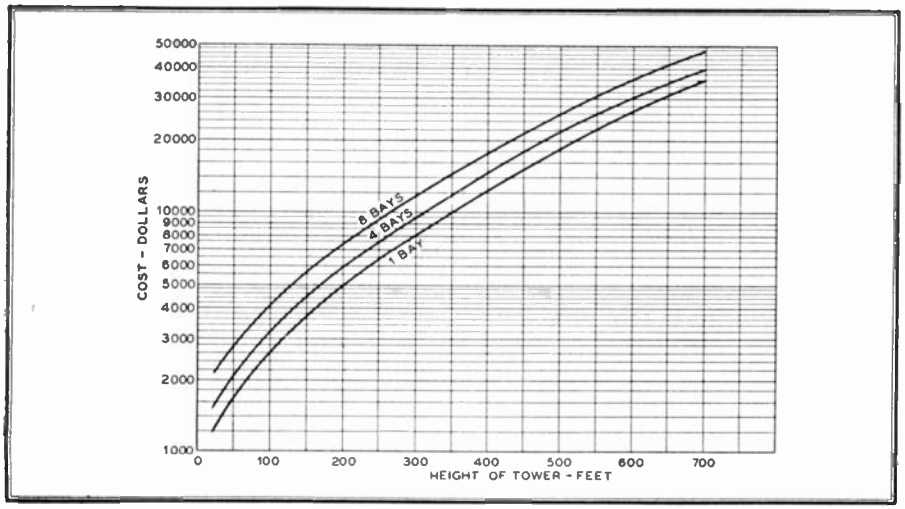


FIG. 4. APPROXIMATE COST OF TOWERS FOR FM TRANSMITTER ANTENNAS

gives the cost, revenue and expense for network and non-network stations of different sizes and classifications.

Other important checks on estimates of revenues for FM stations can be made from Figs. 7 and 8 which show for AM stations the average broadcast revenue as a function of population, number of stations in each area and class of station.

Procedure ★ If, after preliminary consideration of the foregoing data and application of the estimating methods described to specific locations, the investor decides he should enter the field of FM broadcasting, then the next question is how to go about it. There are several ways to become the owner and operator of an FM broadcasting station in the postwar period, and the selection of the most suitable procedure should be guided by competent management and engineering advisors. These acquisition methods are:

1. The application by the client for an FM construction permit and license, the station to be built when materials become available.

2. The purchase of the assets of an organization which has an application pending before FCC.

3. The purchase of an FM station that is now in operation.

4. The purchase of an existing AM station which has an FM license.

5. The purchase of an AM station and the filing of a construction permit and license application for an FM station.

Each of the methods listed above requires the consent and approval of FCC.

METHOD 1: This requires that a suitable site in an adequate market area be determined. This can best be done by a consulting engineer familiar with radio technique and market analysis.

Because the FCC leans toward local ownership, sites in the region of the home of the prospective operator should be studied first. The engineer, by the use of trading area maps, and the data in Figs. 2 to 6, FCC Standards of Good Engineering Practice, and similar sources, will determine the area to be covered, the buying power in the area, the best location for the transmitter, the transmitter power required, height and type of antenna, the field strength of signals along eight radials, and will estimate the construction cost, operating cost, and potential revenue. Careful consideration will be given to competition, both present and potential.

If this study does not disclose a favorable local situation, a general study should be undertaken of other market areas. When several locations have been determined to have possibilities, they should be visited to locate transmitter and studio sites and to make further studies and estimates. When the best available site is determined and it appears to be economically and technically desirable, a lawyer should be brought in to work with the engineer to prepare and file FCC Form 319.

As new equipment will be required and the manufacturers will be rushed with orders when WPB lifts its restrictions, it appears advisable to take advantage of one of the equipment reservation plans offered by leading manufacturers.

Inasmuch as suitable hill-top and high office building sites are being rapidly tied up, the transmitter site determined upon by the foregoing studies should be leased, optioned or otherwise secured.

In planning the financial set-up, working capital should be provided or available to carry on operations for at least two years without appreciable income. Some FM licensees are now operating

TABLE 7—STATION SALES IN 1944

Station	City	Watts	Price
WOV	New York	5,000	$ 350,000*
WBIR	Knoxville	250	135,000
KPHO	Phoenix	250	60,000
WHEB	Portsmouth, N. H.	1,000	60,000
KSLM	Salem, Oregon	1,000	69,000
KBKR	Baker, Oregon	250	20,000
WIBC	Indianapolis	5,000/1,000	440,000
WJJD	Chicago	20,000	700,000
WQXR and WQXM (FM)	New York	10,000	1,100,000
KOBH	Rapid City	250	48,000*
WFTL	Ft. Lauderdale	10,000	275,000
WCOL	Columbus	250	250,000
WPDQ	Jacksonville	5,000	300,000
WELI	New Haven	1,000/5,000	220,000
WJBK	Detroit	250	700,000
WINX	Washington	250	500,000
KSO	Des Moines	5,000	275,000
KEVE	Everett	500	35,000
KID	Idaho Falls	5,000/500	100,000
KTBI	Tacoma	250	24,000*
KECA	Los Angeles	5,000	500,000
WSBC	Chicago	250†	100,000
WPAY	Portsmouth, Ohio	250	40,000*
KTOK	Oklahoma City	250	150,000
KYUM	Yuma	250	35,000*
WSAR	Fall River	1,000	175,000

* Equivalent total price where sale was less than 100% of common stock.
† ⅓ time.

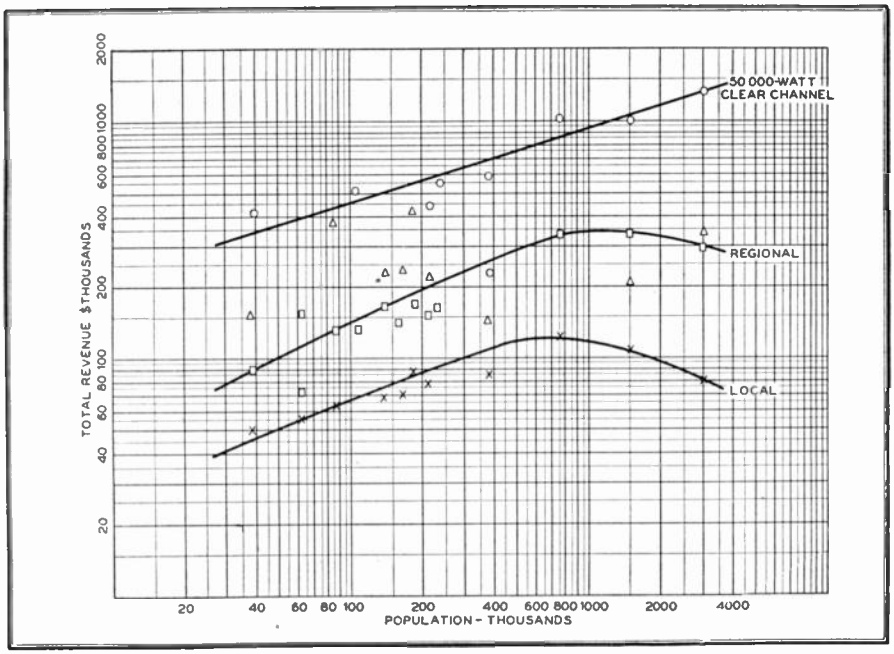


FIG. 7. RELATION OF POPULATION TO INCOME OF RADIO BROADCAST STATIONS

TABLE 8—AVERAGE COST, REVENUE AND EXPENSE OF AM STATIONS IN 1942

($ figures are in thousands per station)

	Major Network Outlets					Other Stations				
	Cost	Rev.	Exp.	Net Inc. to Rev.	Net Inc. to Cost	Cost	Rev.	Exp.	Net Inc. to Rev.	Net Inc. to Cost
	$	$	$	%	%	$	$	$	%	%
CLEAR CHANNEL										
50,000 watts										
Unlimited	413.0	949.0	628.0	33.8	80.2					
Part-time	176.0	625.0	482.0	22.9	81.2					
25,000–5,000 watts										
Unlimited	115.0	226.0	183.5	18.8	36.9	284.0	337.0	311.0	7.7	9.2
Part-time	83.9	207.0	148.0	28.5	70.3	172.3	226.7	179.7	20.7	27.3
Total Clear Channel	321.0	750.0	504.0	32.8	76.7	251.0	305.4	273.2	10.5	12.8
REGIONAL										
Unlimited	125.1	222.0	162.0	27.0	48.0	67.7	108.1	106.4	1.6	2.5
Limited & Day	60.5	83.8	71.2	15.0	20.8	65.8	88.0	80.9	8.1	10.8
Part-time	49.9	115.8	88.8	23.3	54.1	117.1	122.5	129.2	−5.5	−5.7
Total Regional	118.7	210.0	154.2	26.6	47.0	72.1	100.1	96.8	3.3	4.6
LOCAL										
Unlimited	29.3	55.3	49.7	10.1	19.1	24.6	40.5	37.9	6.4	10.6
Day and Part-time	25.4	48.1	46.6	3.1	5.9	22.8	32.3	29.2	9.6	13.6
Total Local	29.3	55.2	49.6	10.1	19.1	24.4	39.4	36.7	6.9	11.1

with substantial revenues and others have made contracts with advertisers to become effective when the stations qualify for commercial operation, indicating that under favorable circumstances all of this additional capital may not be required.

METHODS 2 TO 5: All these methods contemplate the purchase of assets, and the procedure should include a careful valuation of these assets, particularly with reference to the postwar period. Otherwise, Method 1 may be followed, with modifications applicable to the particular conditions encountered.

Choice between the foregoing methods will depend largely upon availability of stations and sites at reasonable prices, upon preference between acquisition of a going business and building up from scratch, and upon the aims and purposes of the investor. Each of the methods is feasible if the cost and other factors are favorable and the enterprise is managed intelligently.

Conclusion ★ In view of the usual care which investors and business executives exercise before making substantial commitments, it hardly seems necessary to repeat that final choice of transmitter site, size of station and procedure should not be made without direct and competent technical assistance. The statistics, facts, and methods presented here will give a very accurate picture where average conditions prevail. However, it is obviously impossible to take into account the special situations which may be encountered in any specific location.

One of the most important modifying factors is the number of smaller, surrounding cities or towns from which retail trade is drawn.

INDUCTION TELEPHONE SYSTEMS FOR RAILROADS

The FCC report on allocations contained some interesting information on the subject of induction telephone systems for railroads. One of the reasons for providing radio channels for this service was given in these words: "The Commission is convinced that the carrier current system of operation is not, at present at least, a practical solution for all the communication needs of the railroad industry as a whole. It was the unanimous opinion of all the carrier current manufacturers testifying that the operation of this system depended for satisfactory operation on the presence of wayside wires within a relatively short distance — about 100 or 200 feet — from the railroad tracks. That requirement alone makes the use of carrier current impractical for many railroads.

Concerning this dependence upon wires, the report quotes from the Superintendent of Communications for the Atchison, Topeka & Santa Fe: "During the last six months, we have had 47 cases of total wire line prostration at various points on the Santa Fe system, ranging in duration from a few hours to 9 days, when communication systems dependent upon the presence of wire lines would have been inoperative."

Similar testimony quoted from other witnesses indicate that, in many cases, the very conditions which will make radio communication most valuable as an aid to safety are those which would most disrupt a system dependent upon wire lines, and defeat the very purpose for which a carrier system would be intended.

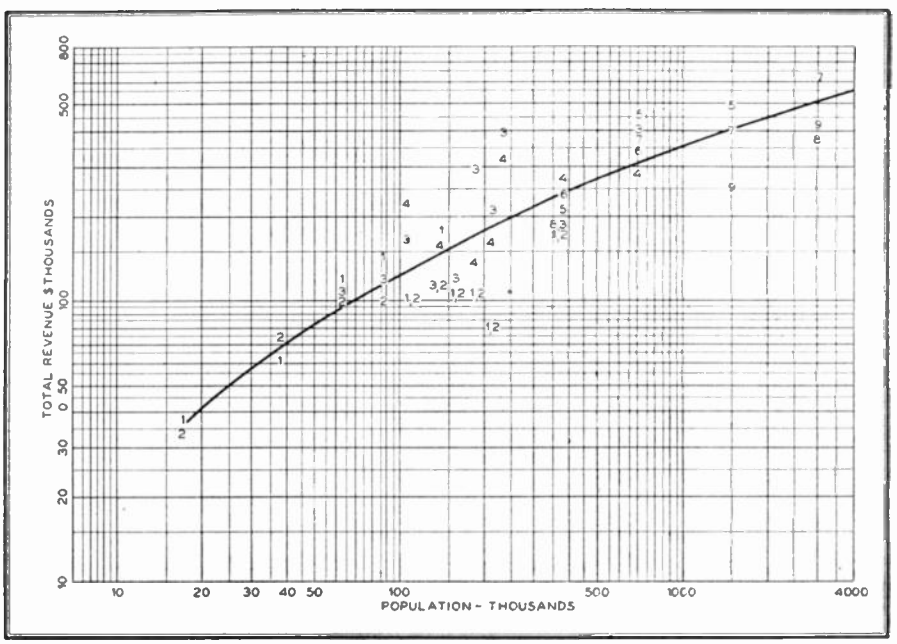


FIG. 8. AVERAGE INCOME OF STATIONS IN CITIES OF VARIOUS POPULATION. THE FIGURES ON THE CHART SHOW THE NUMBER OF STATIONS IN EACH CITY

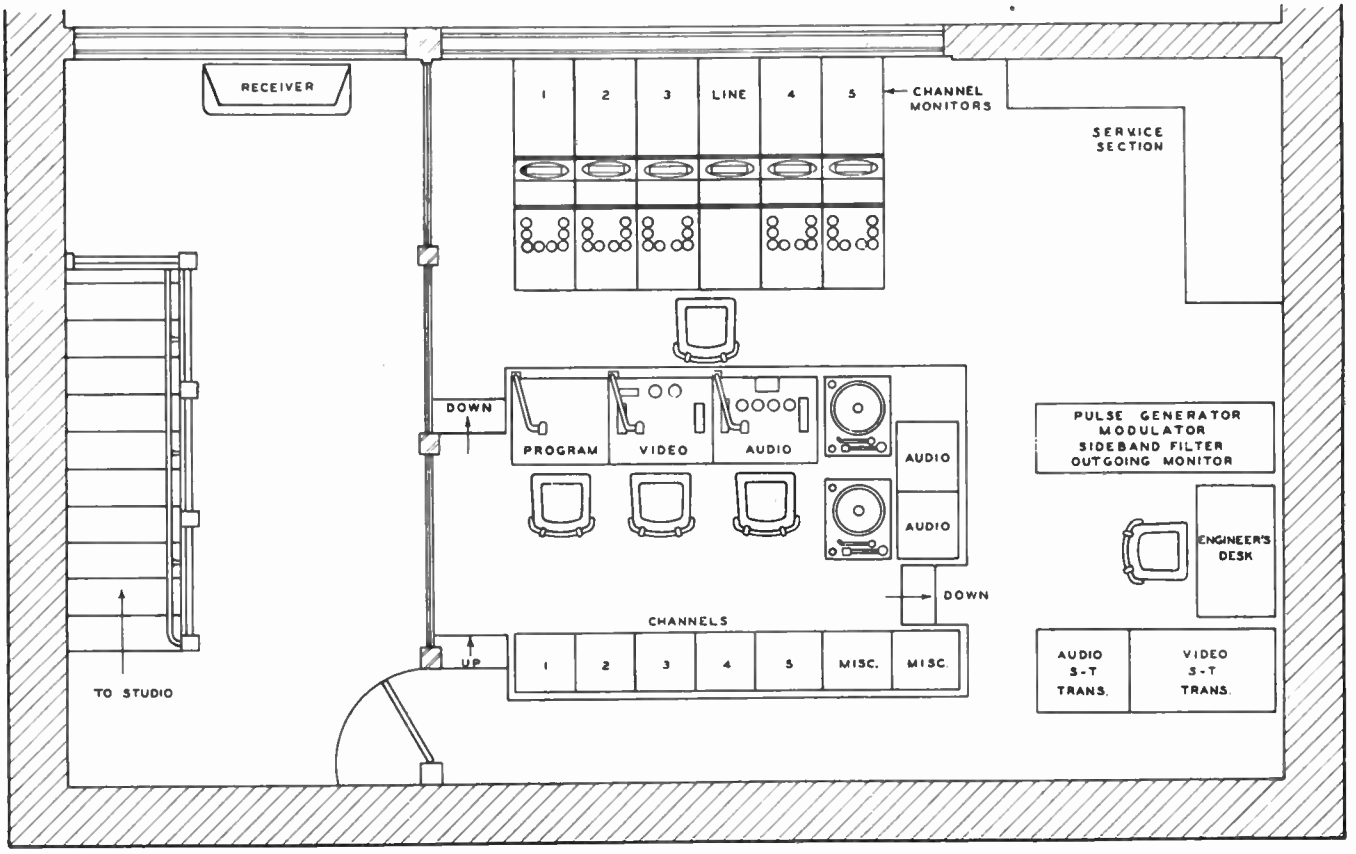


FIG. 17. PLAN OF THE CONTROL ROOM, SHOWING THE MONITOR CONSOLE AT THE FRONT, WITH THE CONTROL POSITIONS, AT A HIGHER LEVEL, TO THE REAR

DETAILS OF TELEVISION STATION WRGB

Part 2. The Studio Equipment and the layout of the Operating Controls

BY JAMES D. McLEAN*

Editor's Note: The beginning of Part 2 appeared in the December issue, describing the cameras, microphones, and lighting equipment employed in the studio at the General Electric television station WRGB.

Motion Picture Equipment ★ Projectors and cameras for televising motion picture film and slides are located on the studio level, beneath the control room. This arrangement is shown in Fig. 5.

The projection room contains two 35-mm. theatre type motion picture projectors, Fig. 15, modified extensively to adapt the 24-frame per second speed of standard 35-mm. movies to the 30-frame per second speed of television scanning.

Every frame of television pictures is scanned in two interlaced fields, each in 1/60th of a second. The modified projectors permit every other film frame to remain in the projector gate during three film scans (1½ television frames, taking 3/60th of a second) and then moves the alternate film frames out after the two field scans (one television frame, taking 2/60th of a second). The average velocity of the film is thus two frames in 5/60th of a second, which is equivalent to 24 pictures per second, the correct speed at which the film must travel.

The basic projector is a Super-Simplex model E-7, modified in the manner described by General Electric. The projection lenses of these machines are so adjusted that they focus the film image on the light-sensitive mosaic of a camera tube set up in front of the opening in the fire wall. The same type of camera tube is used as in the studio cameras. Both projectors and cameras are mounted very rigidly so that there can be no movement or vibration to shift the picture projected on the mosaic.

In the projection room there is also located a 16-mm. silent Bell & Howell Filmo-Master motion picture projector which has been modified extensively for television use. It is equipped with a synchronous motor drive so that 16-mm. silent film, normally projected at the rate of 16 frames per second, can be run at 15 frames per second. This is one-half the scanning speed for television.

Additional projection facilities include a slide projector manufactured by the Spencer Lens Company. This allows the use of transparent photographic slides 3 by 4 ins., and opaque slides for titles. An adaptation of an old-fashioned postcard projector has been added and so arranged that the slide carrier can be used for either transparent or opaque slides. By reversing the polarity of the video signal generated by the television camera, either positive or negative slides can be used in this device.

* Electronics Dept., General Electric Co., Schenectady, N. Y.

"The People's

IN TURNTABLE EQUIPMENT

Elections come and go, but the broadcasters' favorite is always...RCA Turntable Equipment. Here is sturdy, dependable construction; equipment particularly designed for broadcast station needs.

In the RCA 70-C1 Turntable with its combination head, the broadcaster will find equipment of great flexibility. These turntables will be available for delivery on rated orders early in 1945. Inquire now!

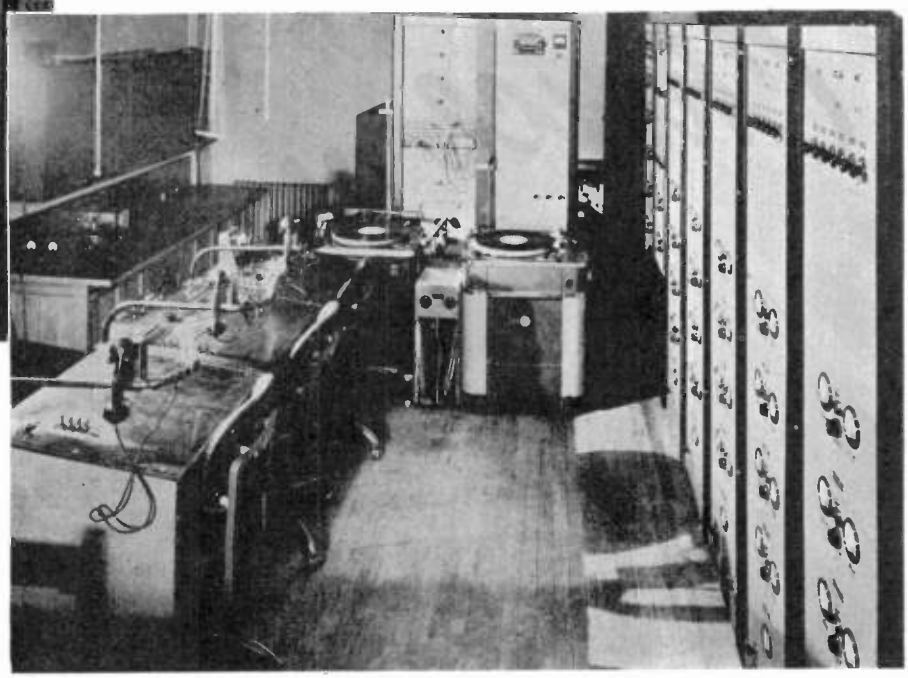
For broadcasters interested in postwar reservations of turntables, new AM, FM or Television equipment, speech input equipment, etc.—write the Broadcast Equipment Section for information on the RCA Broadcast Equipment Priority Plan.

FEATURES OF THE RCA 70-C1 TRANSCRIPTION TURNTABLE

- Combination pickup for vertical and lateral transcriptions.
- Counter balanced tone arm, free of noise and vibration. Six-position switch for control of compensation.
- Excellent speed regulation. High torque for quick starting.
- Turntable operation within proximity of microphone possible. (Silent type power switch; low motor noise.)
- Isolation of motor noise from cabinet. Filters securely mounted and arranged for minimum hum pickup.
- Modern cabinet design, attractive trim. Umber gray cabinet finish.

FIG. 18. AUDIO AND VIDEO OPERATORS AND THE PRODUCER IN ACTION

FIG. 19. THE CONTROL POSITIONS, WITH THE TURN TABLES AT THE FAR END, AND THE FIVE VIDEO CHANNELS AT THE RIGHT



Complete facilities are provided in the projection room for cutting and editing motion picture film. There is also a fireproof vault for storing the film. The projectors are not controlled by the operator during a television program because, in many cases, the use of the projection machines must be cued in very accurately with parts which originate in the studio. Accordingly, the machines are equipped with remote controls by means of which they can be stopped and started from the control room above.

The two film pickup cameras, on the opposite side of the firewall, Fig. 16, are mounted on casters so that they can be rolled in position and locked in place in front of any of the film or slide projectors, thus allowing complete flexibility of operation. Heavy flexible leads run from the cameras to separable connectors which, in turn, are wired permanently to the corresponding video equipment racks in the control room.

Control Room Equipment ★ The control room and its equipment are shown in detail in Fig. 17. This is the coördinating center of all program activities. Located here are the terminations of all the camera cables, from which signals are carried to amplifiers in the video equipment racks and on to

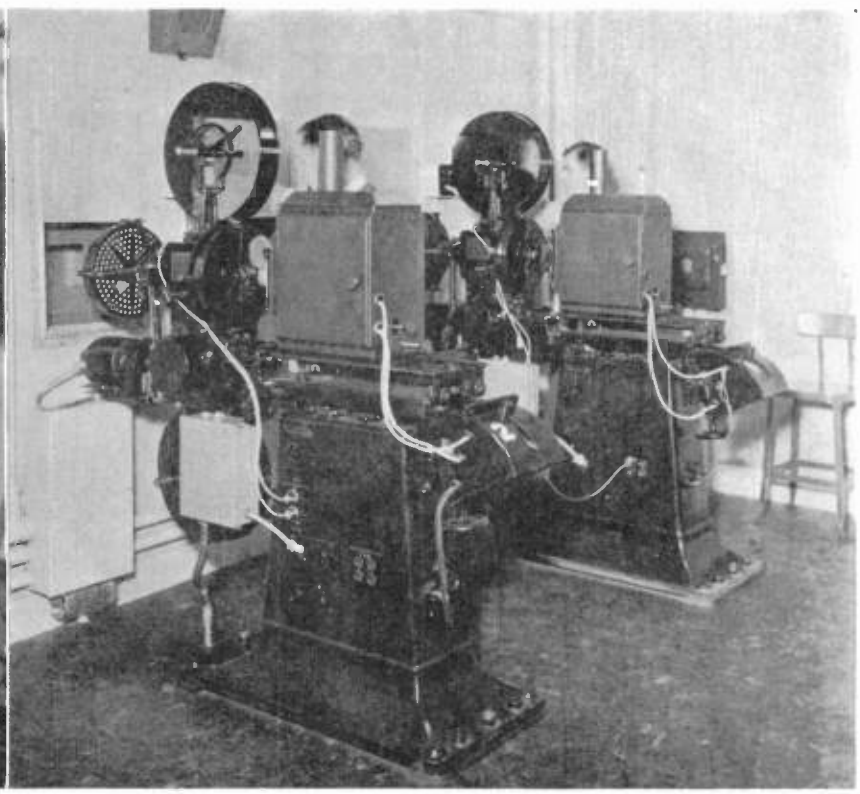


FIG. 16. FILM PICKUP CAMERA IN POSITION. FIG. 15. STANDARD FILM PROJECTORS MODIFIED FOR TELEVISION TRANSMISSION OF MOTION PICTURES

the channel monitors. Video equipment, even of the simplest type, necessarily comprises a great many separate circuits which must work together with precision measured in fractions of micro-seconds.

Thus, precise synchronization of all the electrical operations occurring within the system is a basic consideration in the design of control room equipment. A single camera system requires the following apparatus for the production of television signals:

In addition to the camera, there must be a video amplifier, horizontal and vertical deflection circuits, a monitor which includes means for viewing both the voltage wave form of the picture signal and the picture as it will appear on the television receivers, a shading control which permits the control operator to vary the brightness of various parts of the image, a synchronizing pulse generator, a line amplifier, and power supplies for all these units.

A multiple camera system such as is used at WRGB, requires duplication of the video amplifier, the vertical and horizontal deflection circuits, the monitor, and the shading control. In addition, space must be provided on the control console for the monitor so that the operator can see that the next camera to be used is ready before the cue is given to turn it on. That is one of the reasons why it is not possible to use only one monitor and switch it to whatever camera is on the air.

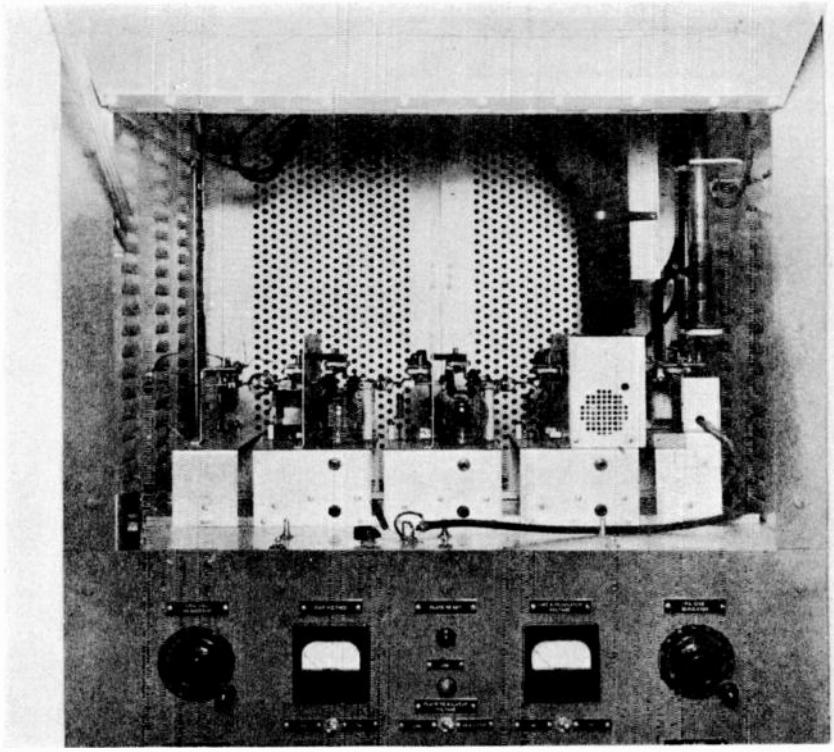


FIG. 21. FINAL AMPLIFIER STAGE OF THE 60-WATT VIDEO LINK TRANSMITTER

This is illustrated in Fig. 9, where the operators are seated before the individual channel and line monitors and the shading controls. Each monitoring position includes shading mixture equipment, deflection generators for the picture and waveform monitors, and video amplifiers for both of these monitors. The picture monitors are 12-in. cathode ray tubes, while the waveform monitors are 3-in. tubes. The controls on the face of each monitor are for adjusting picture size, contrast, linearity, and position.

The shading controls are on the desk directly in front of the monitor. Supervisory lights on each monitor and on the line monitor are operated in conjunction with the signal lights on the cameras in the studio. Green lights indicate that the channel is available, and red lights warn that the channel is on the air.

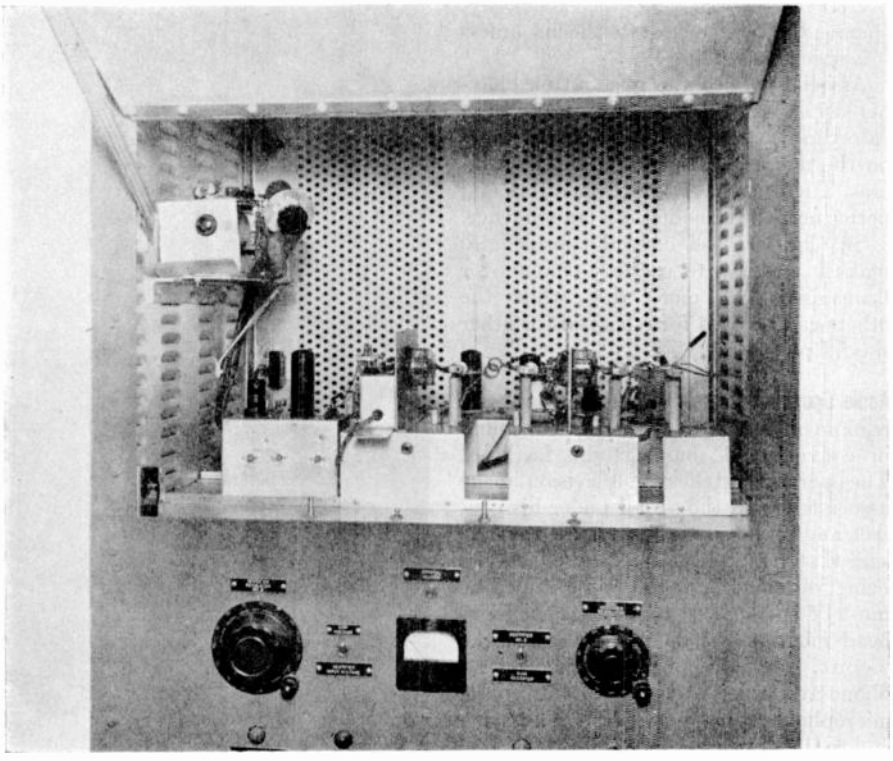


FIG. 20. INTERMEDIATE STAGE OF THE VIDEO LINK TRANSMITTER, OPERATING ON 163.25 MC.

Operating Consoles ★ Directly behind the monitors and on a higher level are the three operating positions, one for the producer, one for the video operator, and a third for the audio operator. The arrangement is shown in Fig. 17, with additional details in Figs. 18 and 19.

The microphone at each position is connected to the communications system by which instructions are conveyed to the studio.

During the broadcasts, the cameramen, microphone boom operators, dolly operators, and the stage manager wear headphones on which they receive running instructions from the program director. For rehearsals, a loudspeaker in the studio can be switched on, in addition, for giving directions to the players.

The film pickup room has a loudspeaker from which the operator receives cues, instructions, and the program sound, so as to monitor the film sound track.

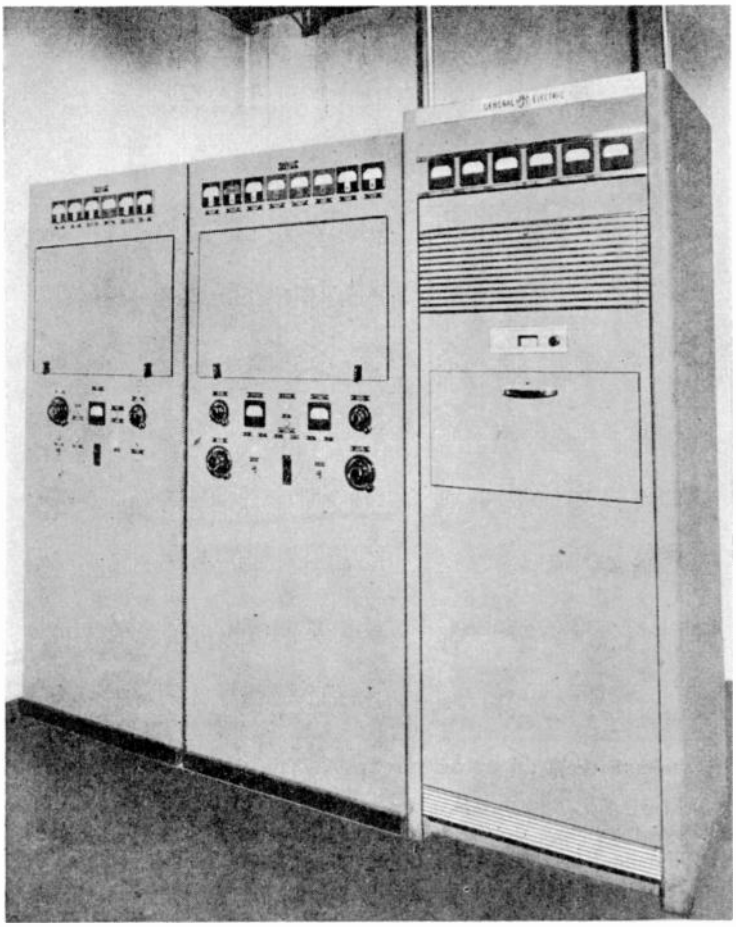


FIG. 23. COMPLETE RELAY TRANSMITTER INSTALLATION. AUDIO UNIT IS AT THE RIGHT, VIDEO UNITS CENTER AND LEFT

Switches for the communications system are of the lever type, located at the left of each position, as can be seen in Fig. 19.

Producer's Console ★ The program producer's console is indicated as PROGRAM in Fig. 17. He has only the lever switches for the communications system, a microphone, and a telephone set. Here he sits during the presentation of a program, following the script before him, watching the players through the big window facing the studio, and giving directions to the personnel on the floor and to the video operator beside him.

Video Operator's Console ★ Next to the producer is the video operator. He has pushbuttons and faders before him so that he can start and stop the motion picture projectors, switch any camera channel to the line amplifier and monitor, and fade from one camera to another. Arrangement of these faders allow lap dissolve and permit special effects to be created smoothly and easily. The operation of the relays which these switches control is practically instantaneous. All relays are interlocked, so that not more than one channel can be connected to the line unless it is specifically desired.

Associated with the pushbutton channel switching controls is a group of indicator and marker lights similar to those on the monitor console and on the cameras. These indicate to the operators and performers the intended camera sequence.

Switches on the control console also make it possible to use any channel for transmission or monitoring while the others can be used for rehearsals or other special purposes.

Audio Operator's Console ★ The audio control equipment has certain features not found in conventional sound studio facilities. The operator watches the television image associated with the sound under his control, and listens in his headphones to make sure that the proper acoustical effects are being obtained. At the same time, he must be on the alert to see that the overhead microphones do not appear in the picture. The audio operator has a microphone available so that he can talk to the microphone boom operator if necessary, and to the projection room.

In addition to the usual audio controls, the audio console is equipped with controls for studio cue amplifiers, telephone circuits, and an illuminated volume level indicator. Provision is made for simultaneous sound transmission and for monitoring rehearsals of programs in the studio. This is particularly important since programs are frequently rehearsed in the studio while films are being broadcast. The monitor speaker on the wall of the control room can be heard by all the operating personnel.

At the right of the audio control operator are two transcription turntables for producing music and sound effects. These can be seen in Fig. 19.

Additional Equipment ★ Other equipment in the control room includes the sound amplifier racks, a silent picture monitor, the modulator for the picture transmitter, and the studio-to-transmitter link trans-

(CONTINUED ON PAGE 83)

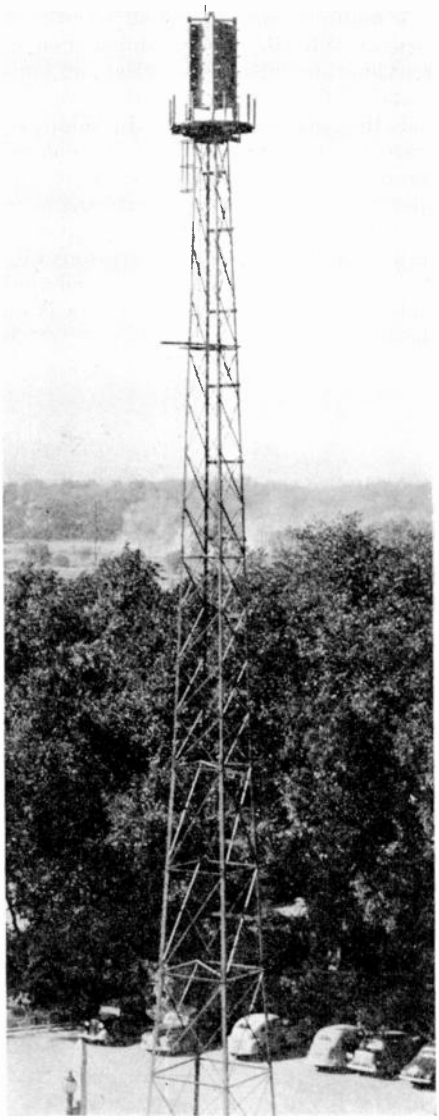
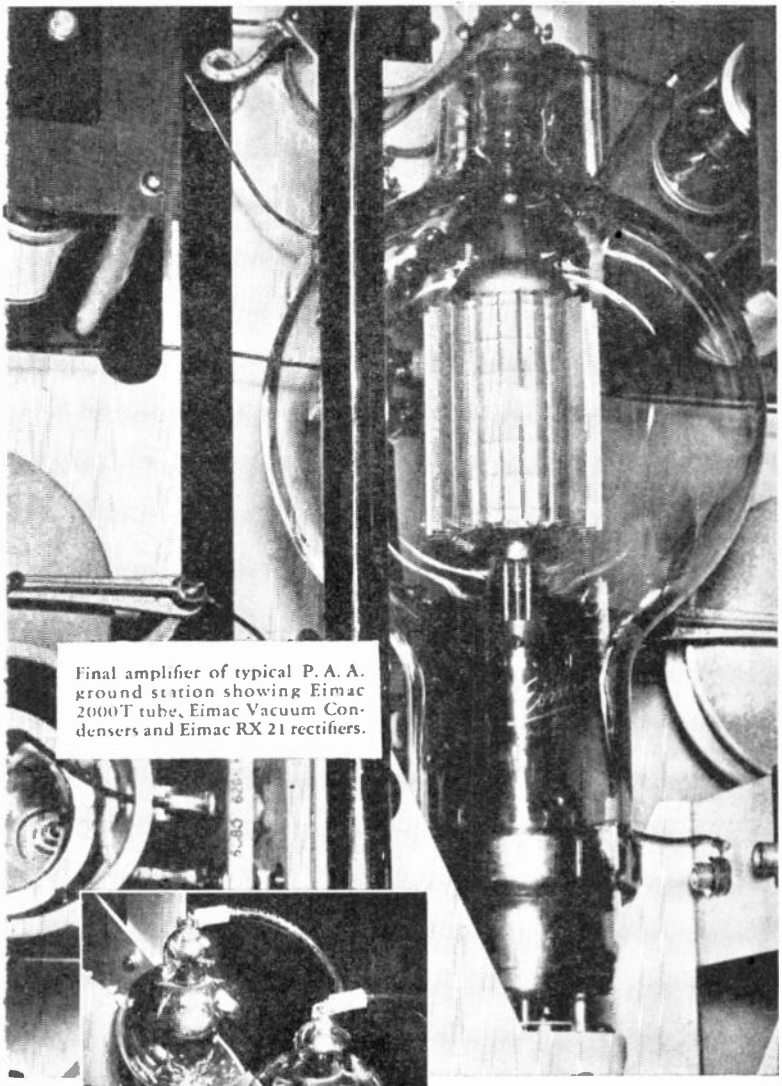


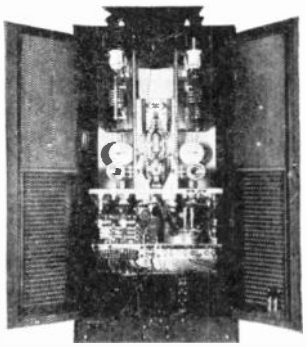
FIG. 23. ANTENNAS FOR VIDEO AND AUDIO RELAY TRANSMITTERS

PAA PAN AMERICAN USES EIMAC TUBES

Pan American World Airways, which has done so much to advance the war-time goals of the nation, has just announced a plan for a new service to South America. Employing a fleet of stratosphere planes, carrying 108 passengers, flying at more than three hundred miles an hour, Pan American proposes to take travelers from New York to Rio de Janiero in less than twenty hours instead of the present sixty-six hours, charging $175 for the trip, as against the current rate of $491.



Final amplifier of typical P. A. A. ground station showing Eimac 2000T tube, Eimac Vacuum Condensers and Eimac RX 21 rectifiers.



Pan American Airways and all its associated and affiliated companies, which comprise the P. A. A. World System, have been using Eimac tubes in the key sockets of all ground stations for a number of years.

Because of the extensive operations of Pan American World Airways, these tubes have been subjected to about every test possible — altitudes; ground level; extremely cold climates and high temperatures found at the equator; conditions of high and low humidity; and in some instances, when new bases are being built, perhaps somewhat trying power conditions. The high regard which P. A. A. engineers have for Eimac tubes is clearly evidenced by their continued and more extensive use, as the years roll by.

The fact that Eimac tubes are the number one favorite of the commercial airlines is important evidence to substantiate the oft repeated statement that "Eimac tubes are first choice of leading electronic engineers throughout the world."

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DIRECTORY OF EMERGENCY RADIO STATIONS

Forestry, Fire, Municipal Police, County, State Police & Special Emergency, with Names of Radio Supervisors

FORESTRY STATIONS

ALABAMA

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

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 "
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 213 State Bldg Sacramento Calif
W6XGK Box Spgs Mountain
KGSC La Mesa
KGMI Madera
KAIV Perris
KBZC Redding
KFSC San Luis Obispo
KBXR Santa Rosa
KRDS Visalia
KBIA Twenty-Nine Palms
W6XBT Calistoga

CONNECTICUT

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

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 Valrico
WAGZ De Leon Spgs
WANB Dinsmore

National Turpentine & Pulpwood Corp Jacksonville
No fixed stations

GEORGIA

State of Georgia Div of Forestry Brunswick 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 1409 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
WSVG 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

FM and TELEVISION wishes to express appreciation to those who coöperated in checking the entries by returning the requests for information. Replies were received from all state police officials, and 100% replies came in from municipal police chiefs in many states. The score for the entire directory is better than 95%, assuring the accuracy and completeness of the listings. The great increase in the number of stations since our July 1944 Directory made it necessary to omit the separate listing of radio supervisors.

MICHIGAN

State of Mich Dept of Cons Lansing Mich
WBRD Atlanta RA Thompson
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
No fixed locations

MISSOURI

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

NEW HAMPSHIRE

State of New Hampshire Forest & 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 & Dev 1206 Broad Trenton NJ RW Davis
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 Millville
WQVJ Milton
WQVM Mispah
WQVO Retreat
WQVK Toms River
WQVA Trenton
WQVD Union Hill
WQVH Windbeam

NEW YORK

State of New York Cons Commission Albany NY
No fixed locations

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
KQSD Dallas
KQJS Eugene
KRNJ Forest Grove
KQHN Gold Beach
KQSC Grants Pass
KRNJ Jewell
KQFD Klinzua
KOIB Klamath Falls
KRDQ LaGrande
KGLM Marshfield
KRDP Medford
KGLK North Fork
KGLP Roseburg
KQHQ Salem
KGLS Sisters
KOIA Tillamook
KRLY Toledo
KQSE Veneta
KQFP Wallowa

PENNSYLVANIA

Commonwealth of Pennsylvania Dept of Forest & Waters Harrisburg Pa
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

TEXAS

State of Texas Texas Forestry 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 Capitol Bldg Madison Wis
No fixed locations

MUNICIPAL FIRE STATIONS

CONNECTICUT

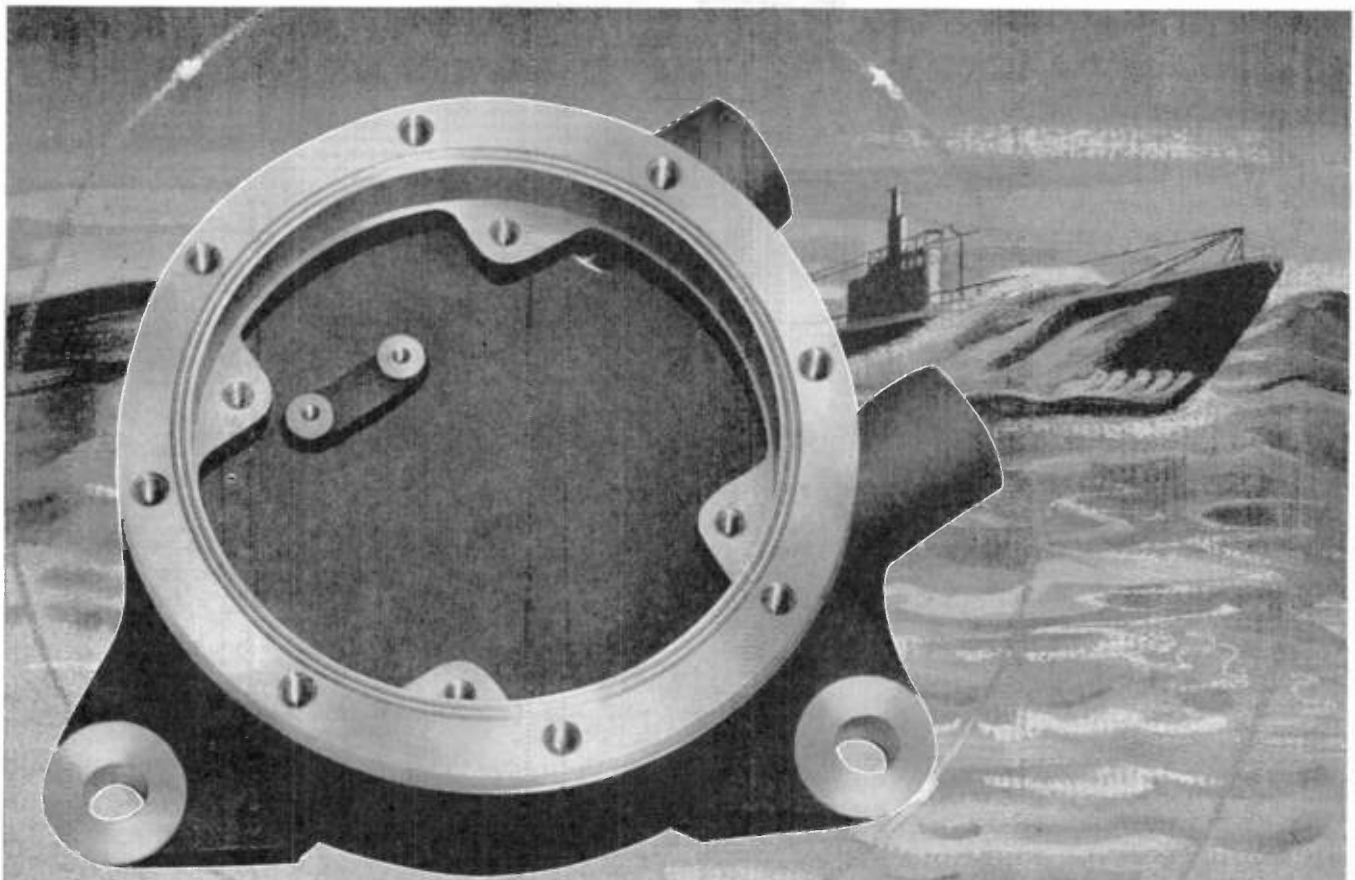
City of New Haven Fire Dept 152 Court St New Haven Conn
WMJJ New Haven PP Heinz

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



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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
WNYQ Brooklyn
WNYF New York City

WASHINGTON

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

MUNICIPAL POLICE

ALABAMA

WRBD Anniston City Hall J Hudson
WPFM Birmingham City Hall L Kron
WJZG " (P) " "
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
WQLH Tuscaloosa 2524 7th St HD Billingsley

ARIZONA

KRIZ Mesa
KEZV Phoenix 17 S 2nd Ave
KGZJ " " "
KNHG Prescott (PM) 117 W Goodwin R LaRue
KEYZ South Tucson
KEYU Tempe 31 E 5th St R LaRue
KQEP Tucson
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 JD Fields Jr
KGHZ Little Rock B'dway & Markham EP 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
KRBQ " " "
KQCL Anaheim (PM)
KQAP Arcadia 50 Wheeler St A Locher Jr
KQXC Atherton (PM)
KGPS Bakersfield (PM) City Hall RH Fox
KQLY Banning (PM) 4000 Orange St HO Platt
KQJH Beaumont (PM)

KPBC Bell 6326 Pine Ave A Rizzio
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 Burbanks 271 E Olive ES Barber

KQCM Burlingame
KQEI 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
KWRY Claremont (PM) 221 W 2nd H Ziegler
W6XHU Coalinga (Fresno)
W6XHV " "
KQVO Colton (PM) Sheriff's Office RC Anderson
KQAQ Compton

KRIV Corona Police Hdqtrs Capt H Platt
KQKV Coronado (PM) 1011 6th G Lewis
KPCM Corte Madera (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)
KROJ El Monte
KQJL El Segundo 209 W Franklin FE Dine

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
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 " (P) "
KQAL Huntington Beach (PM) Sheriff's Office Santa Ana Calif
KHPM Huntington Park 6400 Pacific Blvd W Hoyt
KQHJ Indio (PM)
KQXL Inglewood
KKFD Kensington Park

KQEN Laguna Beach (PM)
KEZT La Mesa (PM)
KDII Larkspur (PM)
KQPZ La Verne (PM) City Hall HM Case
KRIM Lindsay
KNGY Lodi Police Hdqtrs

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
KQXV Menlo Park (PM) 1098 El Camino Real W Harrington
KQDP Merced
KDIO Mill Valley (PM) Police Hdqtrs
KQDQ Modesto 614 10th St R Gada
KQAG Monrovia 140 E Lime Ave A Locher Jr
KQFE Montebello
KRLF Monterey 158 W Garvey Ave M Culkins
KGKR Monterey Park

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)
KADI Oceanside 305 N Nevada TH Berg
KQKT Ontario (PM) 225 S Euclid RC Anderson
KQBI Orange (PM) City Hall Mt Whiteman

KOXC Oxnard 617 A St CD Smith
KAZI Pacific Grove City Hall C Simpson
KQAS Palm Springs
KGHK Palo Alto 450 Bryant E Amsler
KGJX Pasadena 142 Arroyo Pkwy HB Calvert
KIDW Perris (PM)
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
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
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 J Kirby
KGPM " "
KRAW San Luis Obispo (PM) 865 Higuera
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)
KGZO Santa Barbara City Hall HW Brittain
KSBP " " "
KGZT Santa Cruz City Hall
KSMP Santa Maria City Hall
KQDF Santa Monica 1685 Main E Cayaness
KRMG Santa Monica (P & PM) 1685 Main E Cayaness
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
KRMF Torrance 1511 Cravens Ave
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
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
KRKN " (P) " "
KAGD Woodland 300 1st St CD Bouton

KQGZ Yreka City (PM) City Hall
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
KGPX "
KIUE Englewood (PM)
KQFV Fort Collins City Hall KH Cooper
KQXT Grand Junction 214 S 6th RL Dexter
KPDG Greeley
KPLJ La Junta 13 E 3rd St
KPDL Longmont 4th & Kimbark K Cooper

KQCX Pueblo City Hall RE Barraclough
KRHY " " "
KESY Sterling 214 Poplar St EG Beehler
KHRI Trinidad (PM) Police Hdqtrs JP Shew

CONNECTICUT

WHNK Bethel (PM) Police Hdqtrs
WPFW Bridgeport 398 Fairfield Ave
WKEQ " Police Hdqtrs C Frazer
WJVO Bristol 17 N Main CD Muckel
WQYB " (P) " "
WSRE 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
WIZY Groton (PM) 359 Thames St
WHPD Hamden Memorial Town Hall
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
WBKA New Haven (P) 165 Court St
WQFA " "
WAKB New London 57 N Bank St
WEIS Norwalk City Hall JF Dorney
WBXY Norwich City Hall
WHHL Plymouth (PM)
WPHH Stamford
W8VL "
WCBH Stratford 2725 Main St C Frazer

WKSC Stratford 2725 Main St C Frazer
WCSM Suffield Town Hall
WCSO " "
WKPJ Torrington 106 State St New Haven
WJUY Trumbull (PM)
WJYX Watertown (PM)
WMPW Waterbury 235 Grand St E Sullivan
WABT Weathersfield (PM)
WQJI West Hartford 28 S Main St HQ Starheil
WBLB West Haven Town Hall FH Brill

WBLT Westport Town Hall W Whitbeck
WLSY Windsor (PM) Town Hall JH Sipple

DELAWARE

WAZO Dover
WMDM Milford City Hall A Nutter Jr
WRPF Wilmington Police Bureau 10th & King ML Dull
WWPD Wilmington " " "

DISTRICT OF COLUMBIA

WPDW District of Columbia 750 Park Rd FM Beall
WDCS Washington DC 4th & Doublas NW HL Thaden
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)
WAKO Fort Lauderdale
WFMF Fort Myers Police Hdqtrs
WFPF Fort Pierce " "
WQFC Gainesville City Hall OR Gano
WSVE Hallandale (PM)

WBJE Holly Hill (PM) 1061 Ridgewood WR Billingsley
WQNL Hollywood
WPFG Jacksonville
WJBH Jacksonville Beach 316 S 1st EW Connell

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	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. 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	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. 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

WPFT Lakeland 121 N Mass Av BE Atwood
WLWP Lake Worth
W4XJY Miami (P)
W4XKJ " "
W4XKK " "
WDHI "

WPFZ Miami
WRLU " (P)
WQMA Miami Beach 100 Meridian Ave GC Bate
WBTW Ocala
WPHM Orlando
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
WQSX Tallahassee
WFPT Tampa Florida Ave & Jackson DC Bailey
WPHN " " " "
WRZY West Palm Beach City Hall ME Curl

GEORGIA

WRJW Americus 101 Lee St
WPDY Atlanta 175 Decatur SE JC Fleming
WQDV Augusta 104 9th St SL Price
WQTC Brunswick
WBLV Columbus
WPFI "
WHNX Gainesville Police Hdqtrs CM Callicott
WQTZ LaGrange Police Hdqtrs RE Hawkins Jr
WQFB Macon
WQNQ Rome 601 Broad St

WQTR Savannah Police Hdqtrs
WROH Thomasville
WBYB Valdosta
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 ON 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)
WQRM Aurora 15 Fox St
WBOF Bartonville (PM)
WKDV Batavia (PM)
WJVI Bedford Park
WQTG Belleville 103 S Illinois LE Dechant
WSVH Berwin 6700 W 26th St W Ponshe
WQRI Bloomington
WDBL Broadview (PM) 16th Ave & Roosevelt 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
WSKZ Centralia
WQIB Champaign 102 N Neil St J Wainscott
WPCB Chicago 1121 S State St FW McLaughlin
WPDC " " "
WPDD " " "
WQJF " 425 E 14th St "

WQXZ Chicago Heights 1600 Halsted St
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)
WRIW Downers Grove
WJVM East Peoria (PM)
WSTX East St Louis 111 N Main St B Ruyle

WJYL Elgin
WQNQ "
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 Glencoe 675 Vernon Ave AC Kadow
WAEX Glen Ellyn (PM) 498 Penn Av CP Fettweis
WGLI Glenview 965 Glenview Rd E Melka
WQYC Granite City
WSOK Harvey 156 E 154 St CV Corliss
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 Blorn
WBHY Homewood (P) " "

WQLW Joliet 76 N Joliet St W Bowdre
WKPD Kenilworth
WAFC La Grange 27 W Calendar Ave RV Dondanville
WQLK Lake Forest 665 Forest Ave R Rolf F Tiffany
WBMG Lansing (PM) 3404 Lake E VanLaningham
WQKR LaSalle City Bldg
WSYW Libertyville (PM) 116 W Cook Ave J Saam

WDBT Lincoln City Hall JD Farnsworth
WSKR Lincolnwood (PM) 6918 N Keeler Ave EG Melka
WDCV Lyons (PM) 7801 W Ogden Av L Dutton

WMQK Madison 1529 3rd St
WBZB Maywood
WJXF Midlothian (PM) 3822 W 147th St LW Brown
WAON Moline Police Hdqtrs R Anderson
WSKJ Morton Grove (PM) 8531 Callie Ave
WMTV Mt. Vernon 1100 Main St AH Featherstun
WAJS Mundelein (PM) Hawley St JJ Shields
WROA Naperville
WQJR Normal 128 E Beaufort St JD Farnsworth
WRLN N Chicago (PM) 1815 Sheridan Rd HF Quandt

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)
WQKM Peru 1530 4th St
WBHZ Quincy 301 Hampshire St W Lindsey
WBMQ Riverdale (PM) Police Hdqtrs

WQIN River Forest 7810 Central Ave WK Ingle
WRIX " (P) " "
WJWS River Grove (PM)
WCEV Riverside
WPGD Rockford 410 Walnut St LS Ward
WBDI Rock Island 316 16th St R Anderson
WQXL Skokie 5127 Oakton St E Melka
WBNP South Beloit (PM)
WQXJ Springfield 617 E Jefferson VO Lehman
WQKE Streator Police Hdqtrs RM Nicholson

WSTY St Charles (PM)
WAGR Urbana
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
WQJV Wheaton 300 W Wesley St CP Fettweis
WDEY Wilmette Village Hall J Dodman
WQTO Winnetka 510 Green Bay Rd L Halbert

INDIANA

WEDX Alexandria 123 N Wayne A Titus
WMPI Anderson
WACT Auburn City Hall MJ Hull
WBIP Bedford
WBPD Bloomington
WAMI Bluffton 128 E Market
WGHQ Columbia City (PM)
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)
WPDZ "
WAKK Frankfort 16 N Main St E Green
WAEE Gary

WSKI Goshen (PM)
WQKY Hammond City Hall G Maynard
WRGW " " "
WAKA Huntington
WMDZ Indianapolis
WJAI Jasper (PM) City Hall HC Nolan
WPDT Kokomo Police Hdqtrs
WQFQ Lafayette 6th & Columbia HC Garba
WMPL La Porte 803 Indiana Ave JE Corns Jr
WMPQ Logansport City Bldg R Barnes

WRAY Marion
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
WBWX New Albany
WBNC New Castle Police Hdqtrs CM Wood
WKUO Noblesville 838 Maple Ave
WASC Peru
WPDH Richmond 5 N 5th St R McDonald

WKRI Richmond (P) 5 N 5th St R McDonald
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 G Nutly
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
KFLZ Cedar Rapids (Portable)
KGOZ Cedar Rapids
KRIX Clinton City Hall R Johnson
KPCB Council Bluffs (PM) Police Dept
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 J Ebert
KRHL Marshalltown Police Dept GR Sutton
KQAE Mason City
KQJI Oskaloosa
KPDO Ottumwa
KGPK Sioux City 116 6th St RL Beck
KRMJ Waterloo 619 Lafayette St

KANSAS

KACA Atchison 515 Kansas Ave
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 H Davis
KNFH Garden City Police Dept
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 Bilesne
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 T Bayne
KGZC Topeka 204 W 5th St EN Johnston
KGPZ Wichita 115 E Williams HO Byers

KENTUCKY

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 ND Covert
WRPE Hopkinsville 500 S Main St
WPET Lexington
WPDE Louisville
WMKY Madisonville
WRPG Maysville 223 Court St H Stone

WRPJ Owensboro 325 St Ann L Goodaker
WQNP Paducah 4th & Kentucky

LOUISIANA

KPAL Alexandria 518 Lee St
WBRP Baton Rouge
WFKK Bogalusa Arkansas & Memphis A Gatlin
WAME E Baton Rouge Parish (PM)
KRKP Lake Charles City Hall AP Kay
KPML Monroe City Hall HE Griffith
KRAV New Iberia 110 W Main St
WPEK New Orleans 2700 Tulane Ave
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
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
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
WHMD Hagerstown City Hall GW McIntire
WBVQ Salisbury City Hall MT Bohler

MASSACHUSETTS

WITY Acton (PM)
WBRJ Andover
WPED Arlington 7 Central St C Scannell
WBJA Athol 206 Exchange St WJ Callahan
WBVC Attleboro Wall St H Burns
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) "
WIXWE " " "
WIXWF " " "
WQRF " (MDC) (P) 20 Somerset DJ McFarlane
WQRG " " (P) "
WQRH " " (P) "
WBUA Braintree Police Dept
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 A Adams
WAFL Chelsea 19 Park St
WBMT Chicopee Police Dept WG Patterson
WBGV Clinton
WPGU Cohasset S Main St A Sylvester
WRAC Concord
WRAU Danvers 7 School St FA Stacey
WRJT Dartmouth Police Dept J Medeiros

WRNU Dedham
WDBI Duxbury (PM)
WAKE Everett
WFMP Fairhaven 31 William St ET Parker
WPFN Fairhaven (New Bedford)
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

WKQT Greenfield Police Dept L Wheeler
WHAV Haverhill Court St PD Tribou
WQTI Hingham Lincoln St A Sylvester
WQIF Holyoke 206 Maple St A Senay
WEHB Hudson Main St
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
WQNR Lowell Market St HA Morrison
WKLM Lynn 18 Sutton St ED Callahan
WLDP Lynfield Summer St RE Anderson
WSVC Malden 15 Middlesex St JF Porter
WBRT Manchester
WAQO Mansfield Police Dept AJ Nielsen

WBVZ Marblehead
WPHG Medford
WPHG Medford 80 Main St JA MacInnis
WBGA Methuen
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 JE Sullivan

WBSW Newton (P) 1321 Washington W Hartford

History of Communications. Number Thirteen of a Series

MILITARY RADIO COMMUNICATIONS

Today the allied military radio equipments represent the "tops" in engineering design. Progress from the spark transmitter of World War I to present-day equipment is, indeed, a far cry. Taking up where they left off December 7, 1941, Universal Engineers, with their added experience with precision military equipment, shall produce for the public, electronic devices not of fantastic design – but of proven utility and quality.

After Victory is ours, radio amateurs, affectionately known as "hams," will be back after their experience with military radio equipment with an even greater desire to operate their own "rigs." It will be then that Universal will again have Microphones and recording components available on dealers' shelves.

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EXCELLENCE IN PRODUCTION

UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA

FOREIGN DIVISION: 301 CLAY STREET, SAN FRANCISCO 11, CALIFORNIA ·· CANADIAN DIVISION: 560 KING STREET WEST, TORONTO 1, ONTARIO, CANADA

MUNICIPAL POLICE, CONTINUED

WPFA Newton (P) 1321 Washington W 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
WEIW Phillipston
WJKH Pittsfield 39 Allen St R Coakley
WQYJ Plymouth Police Dept
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
WQOJ Scituate First Parish Rd AF Sylvester
WQSO Sharon
WBOG Shrewsbury 12 Church Rd
WPEH Somerville 67 Union Sq JA MacInnis
WAMX Southborough

WBTV Southbridge Police Dept
WQMD Springfield
WRHB Stoneham
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
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
WAKW Westfield
WBVI Westford (PM)
WHTE Weston Police Dept JS Vlies
WMWP Westport Main Rd JE Harrington
WFLL West Springfield (PM)
WKYA Westwood (PM)
WBVN Weymouth 1393 Pleasant St

WJHQ Winchendon
WJYI Wilmington (PM)
WQSV Winchester
WAKZ Woburn 10 Common St A Stockellburg
WPGX Worcester Police Dept

MICHIGAN

WSKH Allen Park (PM)
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 Mich
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
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)
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
WRDR " "
WQTD Hamtramck 8521 Jos Campau Ave SA Jerzykowski

WJUG Hazel Park (PM)
WMQ Highland Park 23 Gerald Av AG Sanderson
WHBM Holland 63 West 8th
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
WPDL " "
WQLL Lincoln Park Police Dept
WSLJ Marquette 210 Washington St G Brozek

WDBM Marysville (PM) 29 Huron Blvd
WMLF Mason (Lansing)
WRZQ Menominee 715 Sheridan Rd M Lund
WBLA Midland 202 Ashman LW Burd
WQTB Monroe
WSRQ Mount Clemens (PM)
WPFC Muskegon Walton & Jefferson FE Castenholz
WBKD Muskegon Heights (PM)
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
WRQQ River Rouge
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
WJUI Hibbing
KQAA Mankato
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

MISSISSIPPI

WJJN Biloxi Police Dept AH Ryan
WMPG Greenville 222 Main St AN Rankin
WSRW Greenwood
WGPP Gulfport 1510 24 Ave D Murphy
WBJC Hattiesburg
WAMK Jackson
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
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 Lt RH Davis
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
KQWD South Sioux City (PM)

NEVADA

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

NEW HAMPSHIRE

WKTX Claremont Court House B Cutting
WRJV Concord 3 Warren St H Bean
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) D. Homarks
WSOE "
WABM Asbury Park 646 Mattison Ave 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
WSKA Bridgeton
WDBX Brielle (PM) Boro Hall R Johnson
WJVN Brigantine
WQNA Budd Lake (Mt. Olive) Rte 6 HM Warner

WBSX Burlington
WANZ Butler (PM) Belleview Ave HM Warner
WQNI Camden City Hall JA Howell
WFZG Camden (PM)
WAWX Cedar Grove Police Dept S O'Neill
WBCX Cliffside Park
WSGQ Clifton
WRLZ Closter Boro Hall
WQNG Collingswood 26 W Collings Ave
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
WETX East Hanover (PM)
WQKI East Orange 61 N Munn Ave TO Laird
WFJV Eatontown (PM)
WBOO Edgewater 916 River Rd S O'Neill
WRAD Elizabeth 35–39 Morrell St F Week
WHBA Emerson (PM) Linwood Ave S O'Neill

WQIK Englewood Police Dept JH Bellingham
WBMC Englewood Cliffs (PM)
WJJE Englishtown (PM)
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
WAII Freehold (PM)

WRQE Garfield
WGIP Garwood (PM)
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
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
WBXL Highland Park Police Dept JL Potter
WSYZ Hillside
WMFH Hoboken Police Dept G Baumann
WSRP Hohokus (PM)
WCBB Hohokus Twp (PM) Franklin Turnpike
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 M Theibault
WQJN Lawrence (PM)
WSTB Leonia
WAJQ Linden Police Dept
WJKI Little Falls Stevens Ave H Warner
WFAB Little Silver (PM) Boro Hall
WQMK Livingston 62 S Livingston Ave RH Hunt
WQNF Long Branch 344 Broadway R Johnson
WQMP Longport

WBTT Lower Penns Neck (PM)
WSOM Lyndhurst Municipal Bldg JS O'Neill
WQJU Madison
WMNJ Manasquan (PM)
WBYR Manville
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
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
WQXK Morristown 110 South St
WBXE Mountainside (PM)
WBOD Mount Holly 21 Washington St

WBYD Neptune 137 S Main St RJ Reynolds
WKKG Neptune City (PM)
WHTQ Newark
WQIE " "
WQRV New Brunswick Rear 78 Bayard St
WGCS New Milford 249 Center St HL Jordon
WBRZ North Arlington
WAHG North Bergen
WBVF North Haledon (PM)
WQJS North Plainfield 255 Somerset St MJ Kane

WRHG Nutley
WBGU Oakland (PM)
WRMG Oaklyn (PM) Police Dept
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)
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 8 N B'dway
WQKG Plainfield Cleveland Ave F Linder
WQMQ Pleasantville 14 N 1st WH Atkinson

WAXV Point Pleasant (PM)
WSWI Pompton Lakes 25 Lenox Ave HM Warner
WQTA Princeton 50 Stockton St R Applegate
WRBI Princeton Twp (PM)
WBTL Prospect Park (PM)
WQYG Rahway 1470 Campbell St F Linder
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
WBMJ Rutherford
WSQK Salem Market St
WSPP Scotch Plains
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
WQIZ Trenton Chancery Lane LF Neese
WRPI " (P) " "
WQJB Union 981 Caldwell Ave WW Knapp
WQNY Union City
WAYE Upper-Penn's-Neck (PM) Carney's Pt NJ FL 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

LIEUT. BASIL CUTTING, CHIEF RADIO ENGINEER, N. H. STATE POLICE

New Hampshire State Police Use Eight

BROWNING FREQUENCY METERS

THE speed and accuracy with which police radio equipment can be checked makes the BROWNING Crystal-Controlled Frequency Meter worth twice its cost to hard-pressed engineers.

No one knows this better than Lieut. Basil Cutting, Chief Radio Engineer of the New Hampshire State Police. He maintains single-handed a state-wide system employing a unique combination of FM and AM. Still, he finds time to coöperate with municipal officials.

The BROWNING Frequency Meter is always ready for use. It is AC operated, eliminating the need of dry cells. Accuracy is better than required by FCC standards.

Models are available on prompt delivery for use on one, two, three, or four frequencies at any specified points between 1.5 and 120 mc. Calibration at specific frequencies makes these instruments quick, easy, and accurate to use.

For further details and prices address:

BROWNING LABORATORIES, Inc.

751 MAIN STREET — WINCHESTER, MASS.

MUNICIPAL POLICE, CONTINUED

WSPE Watchung (PM)
WSLC Wayne
WKGL Weehawken 400 Park Ave
WSQN West Caldwell (PM) 3 Fairfield Ave
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
WIUO West Paterson (PM)
WRMZ Westwood
WBOJ Wildwood
WQJE Woodbridge
WRLV Woodbury 33 Delaware St

NEW MEXICO

KGZX Albuquerque
KNFA Clovis
KRNM Roswell Police Dept
KGPF Santa Fe

NEW YORK

WPGH Albany
WHDI Amityville Police Dept
WKNI Amsterdam 292 Locust Ave W Conrad
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 Pondfied Rd
WKQO " (PM) "
WMJ Buffalo Church & Franklin Sts J Buchanan
WEKU Chappaqua (New Castle)
WBLF Clarkstown (PM) Nanuet NY W McDermott
WKPI Corning Police Dept
WBID Cortland 23 Court St J Frye
WQLC Eastchester Police Dept
WBLL Elmira
WIKE Endicott Police Dept CJ Yeager
WBDO Floral Park 9 Floral Blvd
WAFR Freeport 40 N Ocean Ave P Elar
WBIC Fulton 67 S First F Maude
WQKO Garden City 110 7th St
WQOU Geneva Police Dept
WRJG Glen Cove
WBVK Grand View on Hudson (PM) 118 River Rd
WQKZ Greenburgh
WQLX Harrison
WBLG Haverstraw (PM)
WQTK "
WQKP Hempstead 10 N Franklin St
WAKN Herkimer
WBOY Hilburn (PM) Police Dept AZ Starr
WRAP Hornell 110 B'dway F Clark
WPGO Huntington 219 Main St
WQNS Ithaca
WJNY Jamestown 210 E 3rd St HA Carlson
WQXP Kingston Police Dept
WQJT Larchmont Municipal Bldg
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) " "
WSNK Mamaroneck 169 Mt. Pleasant Ave J Porkorny
WMJX Massena Police Dept
WSRN Middletown Police Dept
WQLV Mount Vernon Police Dept MI Silverstein
WEUA Newburgh 81 B'dway TH Brown
WQKC New Rochelle 23 Lawton St JP Doege
WBIS New York (P) 240 Center St
WBIT " (P) "
WBKF " (P) "
WKNP " "
WMNY " "
WNYM " (P) "
WPEE " "
WPEF " "
WPEG " "
WRGS " (P) "
WNFP Niagara Falls
WBAH " (P)
WBAT " (P)
WBAW " (P)
WBBJ " (P)
WBBP " (P)
WBBQ Niagara Falls (P)
WBBS " (P)
WBBT " (P)
WBBU " (P)
WBBV " (P)
WBBY " (P)
WBCB " (P)
WBCN " (P)
WBCX " (P)
WBCY " (P)
WETY Nissequogue (PM)
WQLD North Pelham
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
WJXL Palisades Park (PM)
WRNE Patchogue (Brookhaven)
WBZW Peekskill 926 Central Ave J Doherty
WDAG Pelham (P & PM) 195 Sparks Ave
WQOT " (PM) "
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
WQRB Schenectady 301 Clinton St GH Wells
WBWN Sloatsburg (PM)
WAEV Smithtown Branch Police Dept
WBVR South Nyack (PM)
WBLI Spring Valley (PM) Police Dept
WBLM Suffern (PM)
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
WCDX Watertown City Hall J Lewis
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
WPDV Charlotte 625 E 4 St
WRPL "
WQNE Concord
WDNP Durham Police Dept AL de Bruyne
WBIV Elizabeth City 100 S Martin St
WROS Fayetteville Police Dept
WQNZ Gastonia City Hall J Abernathy
WABQ Goldsboro City Hall D Trueblood
WQMR Greensboro 200 N Greene St
WRGY Hickory
WHPP High Point 200 E Commerce RP Boyd
WIUD Kings Mountain
WQLR Kinston 110 W King HB Civils
WBNL Lenoir Box 736 AY Cottrell
WRNT Lexington Police Dept
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
WQAU Salisbury 115 W Fisher HA Kanoy
WANY Shelby
WDBS Statesville 120 N Center St HA Kanoy
WETO Thomasville
WDPW Wilmington
WQNU Wilson Municipal Bldg W Wooten
WQMS Winston-Salem 1st & Main Sts RG Simpson

NORTH DAKOTA

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

OHIO

WPDO Akron
WJUK Alliance City Hall JK Young
WBIU Amberly
WAXC Ashland 16 W 2nd St F Atterholt
WSTK Ashtabula Police Dept H Johnson
WJGD Barberton 585 W Tuscarawas AW Bock
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
WBUJ Cuyahoga Falls 2006 Front St
WPDM Dayton 15 E Monument Ave PE Benton
WHIV Delaware 1 S Sandusky AB Shirk
WRNS Elyria City Hall I Finegold
WLSD Euclid 585 E 222 St H Fitzgerald
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
WQFO Lancaster Main & Broad St T Schneider
WAFU Lima 215 E High St RG Albridge
WBOH Logan Police Dept RR Loomit
WLOP Lorain Central Police Station HC Kaufman
WQRL Lorain
WQFY Mansfield 2nd & Walnut Sts LW Campbell
WRGL Marietta
WJQM 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
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 Sander
WBYG Norwood
WBKC Oakwood
WQOL Ottawa Hills Richards Rd RF Mayers
WKHL Painesville
WKYF Perrysburg 111 W Second St JF Doake
WQTP Piqua 219–221 W Water St D Davis
WSTM Port Clinton 130 Adams GW Swartzlander
WPGI Portsmouth City Bldg WC Gammon
WCDE Reading
WJSB St. Bernard 4701 Vine St
WBGW Salem
WAKI Sandusky Police Dept GW Swartzlander
WAMH Shelby 16 W Main
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
WCBK Warren Police Station JK Young
WMPO Wellsville 5th & Main R Villers
WKMZ Westlake
WJZV Wickliffe (PM) Euclid Ave
WBYA Wyoming 500 Grove Ave E Laakko
WPDG Youngstown 2107 Market St RS LaCivita
WPHO Zanesville

OKLAHOMA

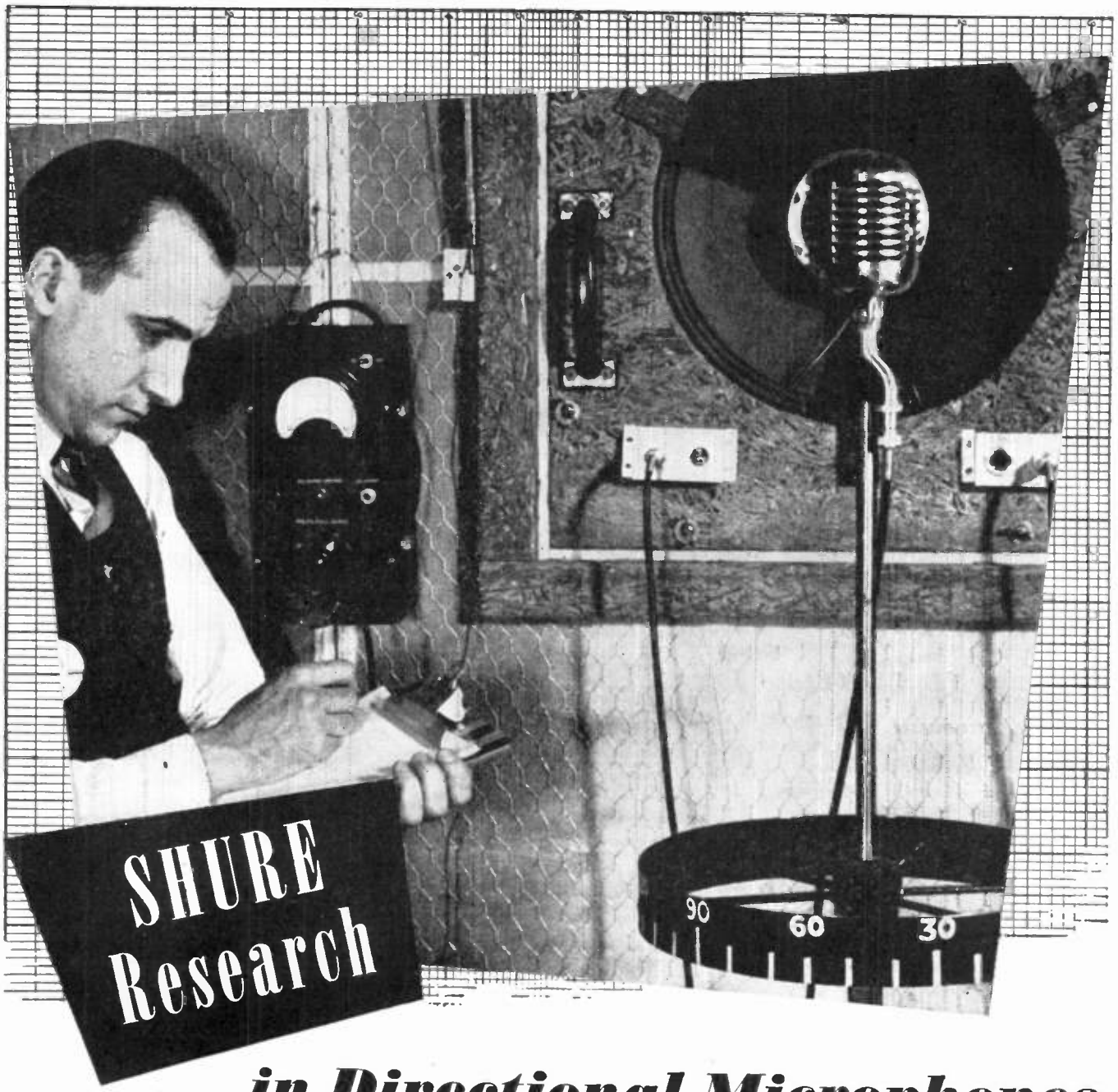
KNHC Ada
KACL Altus
KARD Ardmore
KQFM Bartlesville
KEZY Blackwell 224 W Blackwell Ave R Frampton
KOKB Bristow
KACF Chickasha 113 N 6th St OL Jenkins
KAPB Cushing
KNGK Ducan 714 Main St CW Cooper
KRBK Durant Police Dept
KRHT Edmond (PM) 29 E First WR Green
KQAB El Reno
KAPK Enid
KGOP Guthrie City Hall JM Patterson
KGHP Lawton
KNGT Muskogee 230 Court St SE Bernard
KWDI Nichols Hills (PM) 6407 Avondale Dr LM Corbett
KRAY Norman (PM) 122 N Peters E Corbin C Blackert
KQDS Oklahoma City (PM)
KAPF Okmulgee City Hall WC Wynn
KQFL Pawnee Police Dept
KACP Ponca City 500 E Grand Ave JE McFadden
KPDS Sapulpa 123 E Hobson
KACR Seminole
KWCM Shawnee City Hall EM Moore
KSWP Stillwater
KQEI Tulsa
KWMP Wewoka 112 S Wewoka Ave JC Howe

OREGON

KIAO Albany
KWKX Astoria 15th & Duane J Titus
KQIN Bend 142 Louisiana St M Dick
KFZO Corvallis Police Hdqtrs GS Felkert
KADV Eugene City Hall S Miller
KGZH Klamath Falls City Hall LD Hunt
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 O Scott
KHWL West Linn (PM)

PENNSYLVANIA

WQNW Abington 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
WQQB Beaver 468 Third St J Mills
WRHA Beaver Falls Police Dept
WKJH Berwick
WQJJ Bethlehem 100 E Third St
WBRA Bradford City Hall
WHRL Bristol Pond & Mulberry Sts
WQOR Brookline (Haverford) Darby & Manoa Upper Darby Pa
WMBT Butler 130 W North St
WMCB Chambersburg
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 Godschall
WBEV Collingdale (PM)
WSRC 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)
WQOD Harrisburg Walnut & Aberdeen RW Delmotte
WRMA Jeanette 2nd & Clay CE Walter
WBKO Jenkintown (PM) Leeden & West Aves
WRHW Kingston 166 S Sprague Ave M Krupa
WQWH Lancaster 27 E Grant St
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
WBRX Media (PM) Police Dept
WDBF Milton 28 N Front St MC Budd
WQFF Monessen 3rd St & Donner Ave W Horlbeck
WIEQ Monongahela
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
WPJJ Parkside (PM)
WBQW Philadelphia City Hall H Simon
WPDP " " "
WQNJ Phoenixville 140 Church St
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



. . . in Directional Microphones

It is not enough to design a Microphone that merely converts sound waves into electrical impulses. A Microphone, to be truly useful in modern broadcasting, should be discriminating enough to accept wanted sounds —and reject unwanted sounds. Shure Research was the first to develop a single unit uni-directional Microphone, both crystal and dynamic.

Shure Research is the reason why practically every major broadcasting station uses the Shure 556 Unidyne. Shure Research is your assurance of postwar microphone superiority.

SHURE BROTHERS, 225 West Huron Street, Chicago

Designers and Manufacturers of Microphones and Acoustic Devices

SHURE MICROPHONES

MUNICIPAL POLICE, CONTINUED

WQIA Sewickley Heights Club Road
WQFU Sharon Police Dept
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)
WSVN Upper Dublin (PM) Ambler Pa J Guinan
WSVB Upper Moreland (PM)
WBLP Upper Providence (PM)
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

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 J Petit
WPGF Providence 209 Fountain St J Lawless
W1XVI " " "
WJAF Wakefield
WPIA Warren

WJWR Warwick Police Dept LJ Boss
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
WCMP Columbia 1415 Lincoln St JP Davenport
WQLG Greenville
WSVQ Greenwood Box 208 EC Nieman
WPRH Rock Hill 128 E White St
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 RE Richmond
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 GW Upchurch
WPFO Knoxville
WPEC Memphis
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
KQCV Borger 111 E 6th St J Bonnett
KNGW Brownwood City Hall AW Stewart
KGHT Brownsville

KPBR Bryan Police Dept
KMGE Cleburne
KGHV Corpus Christi
KRGA Corsicana Municipal Bldg
KVP Dallas c/o Station WRR DJ Tucker
KVPA " " " "
KQAT Denison 108 W Main PS Borum
KHNF Denton City Hall C Phillips
KPDE Electra
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 Main St C Phillips
KRPW Galveston
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
KQDN Lufkin
KTWP McKinney 112 S Kentucky J Floyd
KADT Marshall
KQXW Mexia
KRLE Midland
KRAN Nacogdoches
KEZU Orange 803 A Green Ave
KOTP Olmos Park (PM)
KPAM Pampa City Hall J Bonnett

KQKM Paris
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
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

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 Simon

VIRGINIA

WAVA Alexandria 126 N Fairfax
WPHV Bristol 123 Water St HG Cross
WROM " (PM) " "
WQTE Charlottesville
WRGU Danville
WHCN Falls Church (PM) 119 S Washington GE Simpson
WRQG Fredericksburg 809 Princess Anne St
WELH Hampton City Hall N King St
WBXS Harrisonburg Police Dept
WQOZ Hopewell 404 E Poythress St

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
WSYC Richmond
WQFG Roanoke
WRID Staunton 15 N New St

WRGV Suffolk City Hall
WADB Virginia Beach 20th & Arctic Ave
WIGV Waynesboro 126 Wayne Av LL Kennedy
WKYT Williamsburg 400 N Boundry St
WSKQ Winchester 5 N Cameron R Campbell

WASHINGTON

KGZV Aberdeen
KACK Bellingham 210 Lottie St M Featherskile
KASF Bremerton Police Dept L E Gruber
KREB Camas (PM)
KGHW Centralia
KWKC Colfax (PM)
KNFP Everett Central Fire Station LH Machin
KFQB " " " "
KAPL Hoquiam
KATH Nr. Issaquah (Seattle)

KQEQ Kelso
KNFI Mt Vernon
KACE Olympia
KPAP Port Angeles 3rd & Lincoln J Ernst
KQVP Pullman (PM)
KPWP Puyallup Police Station EC Dahl
KGLB Renton 207 Wells CS Williams
KAFO Seattle 416 Yesler Way F Hatfield
KGPA " " "
KHLD Shelton (PM) City Hall R Quantz

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 CE Cole

WEST VIRGINIA

WKHK Beckley
WBWV Bluefield
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

WJWZ Morgantown 389 Spruce St RC Spence
WPHQ Parkersburg Police Hdqtrs CR Knowles
WSTH Princeton 1018 Mercer St
WBUB South Charleston
WRIN Wellsburg City Hall R Villers
WQTU Wheeling City Bldg EL Keim

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)
WRLP Fort Atkinson Police Dept L Skalitzky
KNHB Green Bay City Hall P Kehl

WRNQ Janesville (PM) Rock Co Sheriff's Bldg
WPEP Kenosha
WQTH La Crosse City Hall L Jenks
WQRJ Lake Geneva (PM)
WASD Madison 14 S Webster St R 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 Sarles
WFUD Neenah 208 S Commercial Ch Stilp
WCJR Oshkosh (PM) City Hall H Davis
WKOL Plymouth (PM) City Hall G Zimmermann
WRJL Port Washington Lake & Jackson Sts J Miller
WQLJ Racine 103 3rd St RT Beck
WQMW Sheboygan
WRNG Stevens Point 612 Clark St VW Nickel
WSWE Superior (PM) Police Dept
WDCJ Two Rivers Police Dept W Duben

WRGX Watertown 110 N 1st St EC Knight
WQML Waukesha (PM) 130 Delafield St Lathrop

WYOMING

KEYD Casper (PM) City & Co Bldg
KWOI Cheyenne Police Dept
KEYH Rawlins (PM)
KEYI Rock Springs (PM)
EKYJ Sheridan (PM)

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
KDAF Yuma 256 2nd Ave TH Keiling

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
KSDE McGehee
KPMA Mississippi Co (PM)
KQGT Pine Bluff Sheriff's Office

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
KQRO Colusa Sheriff's Office
KHCP Eureka
6XHP Fiat Hill
6XLL Grapevine
KEWB Hanford Court St O Wood

KDHB Hollister Sheriff's Office MJ Barlich
KEZQ Imperial Co (PM)
KQAD Indio 4000 Orange St Riverside HO Platt
W6XIA Kings Co Point LaCima O Wood
KAVL Lake Port Sheriff's Office LM Reese
KQBV Los Angeles 271 Hall of Justice
KQDD " (P) Lancaster
KRGU " 271 Hall of Justice
KEWH 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
W6XGX Mt Tamalpais
W6XHG Mt Toro
KOCM Orange Co (P)

W6XHO Pise Hill
KBSV Quincy
KRGX Redwood City 715 Middlefield Rd WH Harrington
KERC Riverside 4000 Orange St HO Platt
KQSG " " "
W6XEI " " "
KEZZE " 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)
W6XIB South Mountain
KAPH Stockton Court House Bldg
W6XAB Strawberry Peak
KAEX Susanville Court House NA Soule

KBQF Sutter Court House M LeBoeuf
KFOJ Ventura Co (PM) Court House
KAZF Visalia
KBQZ Yuba Co (PM)

COLORADO

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

FLORIDA

WBSM Alachua (PM)
WAKG Clearwater 100 N Garden Av HR Weaver
WKWP Marion Co (PM) Ocala Fla
WKRE Panama City
WBSR Pensacola
WBUW St Petersburg (PM) 123 3rd St ST Tucker
WBYI Sarasota Court House DC Bailey

TERRITORY OF HAWAII

KENU Hana
KADK Hilo
KHAB Kaneohe
KFLB Kaunakakai Molokai
KIRU Kealakekua Kona
KENW Lahaina
KBSN Lanai City
KQXY Paia
KHAC Pearl City
KHAA Wahiawa
KAPM Wailuku

IDAHO

KAHP Ada (PM)
KEHK Caldwell Sheriff's Office
KQGE Coeur d'Alene Sheriff's Office C Brown

COUNTY SYSTEMS, CONTINUED

KRLG Lewiston Court House HF Steiner
KQJF Moscow Sheriff's Office M Hart

ILLINOIS

WSKE Bedford Pk 6700 S Archer Argo Ill N Biorn
WSKO Belvidere
WAZV Bloomingdale Twp
WMPJ Clinton
WASB Decatur 235 E Wood
WQRY Edwardsville
WKGI Freeport 7 N Walnut CW Price
WDAA Geneva 3rd & James Sts
WSTU Kankakee 441 E Court St E Chinski
WLIS Lewiston

WDBU Lincoln Logan Co Jail JD Farnsworth
WSCI Maine Twp
WABV Marion
WSGQ McLean 310 N Madison St
WLEB Mt Vernon Court House AE Featherstun
WQFZ Ottawa
WANU Pekin 360 Court St K Patterson
WRNK Peoria (PM)
WKPS Princeton Sheriff's Office G Billeaux
WPWC Rockford 417 Elm St WA Wallingford

WRSC Sangamon Co (PM) Sheriff's Office
WJYF Taylorville Court House HA Trapp
WBWJ Vermillion (PM)
WQFX Waukegan
WQJW Wheaton
WKJO Will Co (PM) 4 N Chicago St

INDIANA

WSKG Allen Co (PM)
WIUM Angola
WSLH Cass Co (PM)
WBTJ Clinton Co (PM)
WAGT Crown Point
WAXU DeKalb Co (PM)
WSVP Hamilton Co (PM)
WSRY Goshen Sheriff's Office R Hawk
WBXD Howard Co (PM)
WSTA Huntington Co (PM)

WMBR LaPorte Co (PM)
WBMK Madison Co (PM)
WSIF Marion Co (PM)
WBTY Mt Vernon 530 Main ND Covert
WBVG Montgomery Co (PM)
WBVT Porter Co (PM)
WHHB Putnam Co (PM)
WSTL Shelby (PM)
WBXF Vandeburgh Co (PM)
WBIH Wabash (PM)

WHCR Warsaw (PM)
WRIP Wayne Co (PM)
WBJH Whitley 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 Brookiyn 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
WMQA Reisterstown
WHMM Silver Spring Court House L Rice
WPFL Towson
WJLU Upper Marlboro
WMPX Woodlawn

MASSACHUSETTS

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

MICHIGAN

WEKA Bay Co (PM) 500 Center Ave F Simons
WHNA Charlotte Sheriff's Dept 126 N Bostwick
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)
WQRZ Oakland (PM)
WRNH Saginaw (PM) Police Dept

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 LJ Aro
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

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

NEVADA

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

NEW HAMPSHIRE

WKUY Cheshire Co (PM)

NEW JERSEY

WAKC Freehold Court House RS Johnson
WPFK Hackensack

NEW MEXICO

KRHQ Chaves Co (PM) Sheriff's Office

NEW YORK

WEJZ Bath Sheriff's Dept
WCAV Canandaigua Sheriff's Dept
WKJX Canton Sheriff's Dept C Moore
WAXK Ellicott Sheriff's Dept
WHOH Fonda Sheriff's Dept GK Nellis
WAZS Geneseo Sheriff's Dept
WBIF Mayville Sheriff's Dept VD Chipman
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	
WEUA	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
WJDZ	Goldsboro (PM) Court House DB Trueblood
WLSG	Guilford Co (PM)
WDHR	Iredell Co (PM)
WHJF	Leakesville Sheriff's Office RL Bynum
WSLF	Mecklenburg Co (PM)
WBXT	Morganton
WBTX	Newton
WATU	Rutherfordton 217 N Washington GB Patterson
WRPU	Winston Salem (PM) City Hall

OHIO

WCAY	Akron 212 S B'dway LP Hennigan
WAAL	Allen Co
WBYZ	Canton 1727 Mahoning Rd NE NS Walker
WJWO	Champaign Co (PM)
WJJO	Chardon 219 Main St J Bay
WJKB	Columbus County Jail 36 E Fulton St
WLOZ	Colerain Twp
WSRS	Cross Creek
WHNL	Delaware Co (PM)
WBYO	Elyria Co Jail H Kauffman
WSPX	Jackson
WSIG	Jefferson Court House H Johnson
WHHA	Licking Co (PM)
WRMY	Mahoning Co (PM)
WBAV	Montgomery Co (PM) 2107 Market St
WBOK	Painesville 74 E Erie St
WFRK	Ravenna
WMGW	Richland Co (PM)
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
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	" " "

OREGON

KBSX	Clackamas Co (PM)
KQJR	Multnomah Co (PM)
KORM	Salem (PM) Sheriff's Office O Scott
KRJB	Washington Co (PM)

PENNSYLVANIA

WJVY	Beaver
WPEZ	Bethlehem Bethlehem Steel Co
WMCN	Norristown
WSRT	Springfield (PM)

SOUTH CAROLINA

WJKE	York Co (PM)

TENNESSEE

WPHY	Elizabethton
WFJN	Hamilton Co (PM)
WRHT	Nashville

TEXAS

KFTX	Anahuac
KETP	Beeville
KBPT	Bexar Co (PM)
KNQW	Brownwood Court House AW Stewart
KRMB	Dallas Co (PM)
KRHV	El Paso Co (PM)
KGCT	Galveston Co (PM) Court House GR Clough
KFEA	Howard Co (PM)
KACU	Longview Court House EM Moore
KFWT	Newgulf Sheriff's Office WB Preston
KWSP	Newgulf Sheriff's Office WB Preston
KBLB	Vernon County Jail O Key
KEPL	Victoria 210 W Constitution RL McCown
KRKC	Waxahachie 200 E Franklin J Carlker
KWSO	Wharton County Jail B McLean
KRGC	Wilson Co (PM)

VIRGINIA

WPAV	Arlington Court House
WMFC	Fairfax Police Dept
WEUG	Henrico Co (PM)
WMVP	Nr. Radford
WHNJ	Stafford Co (PM)

WASHINGTON

KBSM	Asotin
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
KBJA	Kelso Court House CH Pritchard
KAEV	Lincoln Co (PM)

COUNTY SYSTEMS, CONTINUED

KQBA	Pierce Co (PM) Court House Tacoma			
	EC Dahl			
KADL	Port Orchard Sheriff's Office JW Clanton			
KQEC	Port Townsend			
KRAU	Ritzville			
KHKE	Shelton Sheriff's Office EF Martin			
KBRW	Spokane Co (PM)			
KRHM	Thurston Co (PM) Court House Olympia			
	FC Tamblyn			

WEST VIRGINIA

8XZK	Grant District			
WEIR	Weirton			
WRGH	Wellsburg			

WISCONSIN

WBIQ	Appleton S Walnut St G Merkl			
WHNO	Brown Co (PM)			
WKLU	Chilton Sheriff's Office			
WHIX	Columbia Co (P & PM)			
WTNR	Dane Co (PM)			
WBHU	Eau Claire Co (PM) 305 W Grand Ave			
	T Jogenson			
WMPE	Elkhorn			
WFDW	Fond Du Lac 226 Linden St RS Matteson			
WRIT	Janesville 102 Water St			
WRAJ	Jefferson 608 Main St LA Skalitzky			
WQXO	Juneau 30 N Main St E Beneditz			
WPEP	Kenosha			
WCCP	La Crosse Court House S Mattison			
WSTF	" " "			
WBSY	Manitowoc Sheriff's Office W Dubin			
WRJK	Monroe RFD 4 FJ Sarles			
WAKE	Oshkosh Court House H Davis			
WBIQ	Outagamie Co (PM)			
WSOR	Portage Court House OL Jones			
WRNP	Racine (PM)			
WJUP	Sauk Co (PM)			
WBOA	Sheboygan Court House R Endlich			
WKZQ	Sturgeon Bay			
WBWL	Viroqua Court & Dunlop Sts AJ Latimer			
WMPD	Waukesha Sheriff's Office R Lathrop			
WBDX	Wausau			
WRPQ	West Bend 340 5th Ave H Baehring			
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 " "			
WKSK	Demopolis " "			
WKXR	Dotan " "			
WQXE	Evergreen Police Barracks LJ Smyth			
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 (Rep) R LaRue			
KNGG	Phoenix Police Barracks R LaRue			
WJXEJ	" (Rep) " "			

ARKANSAS

KFDL	Clarksville Police Barracks C Kiehl			
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 Boos			
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 RW Carpenter			
WAYZ	Bridgeville " "			
WJRF	Dover* " "			
WAYY	Georgetown " "			
WDSP	State Road " "			

* Headquarters Station

FLORIDA

WLIC	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 " "			
WKGZ	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 " "			
WQRN	Gainesville " "			

* Headquarters Station

ILLINOIS

WQPB	Blue Island	Police Barracks	CH Nicholson
WQPC	Chicago	"	"
WQPD	DuQuoin	"	"
WQPF	Effingham	"	"
WQPE	Elgin	"	"
WQPJ	French Village	"	"
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	(PM)		"
WSTE	(PM)		"
WQPI	(P & PM)		"

* Headquarters Station

INDIANA

WBMO	Charlestown	Police Barracks	WV Mentzer
WPHS	Chesterton	"	"
WQFW	Columbia City	"	"
WBII	Connersville	"	"
WPHE	Indianapolis *	126 State House	"
WPHU	Jasper	Police Barracks	"
WBDK	Ligonier	"	"
WRNR	Pendleton	"	"
WQQB	Putnamville	"	"
W9XGC	Rochester	"	"
WQFE	Seymour	Police Barracks	WV Mentzer
WROR	West Lafayette	"	"
WAHO	(PM)		"
WAHP	(PM)		"
WAHQ	(PM)		"
WAHR	(PM)		"
WISP	(PM)		"
WRSH	(PM)		"
WSPC	(PM)		"
W8PI	(PM)		"

* Headquarters Station

IOWA

KACD	Atlantic	Police Barracks	GR Sutton
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

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

MAINE

WBNV	Augusta *	66 Hospital St	RH Parker
WKQP	Bangor	629 Main St	"
W8YX	Boothbay Harbor	Oak St	"
WLDQ	Houlton	North Rd US 1	"
WSTR	Thomaston	US Route 1	"
W8WD	Wells	US Route 1	"
WBVW	West Scarboro	US Route 1	"
W8YD	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	RA Thompson
WBQT	Bad Axe	Police Barracks	FW Walker
WDAI	Baldwin	Dept Cons	RA Thompson
WIWG	Battle Creek	Police Barracks	FW Walker
WITR	Bay City	"	"
WJBS	Bilssfield	"	"
WDAQ	Boyne City	Dept Cons	RA Thompson
WAOD	Brighton	Police Barracks	FW Walker
WBQS	Cadillac	"	"

STATE POLICE, CONTINUED

WBTO	Center Line	Police Barracks	FW Walker
WKJU	Cheboygan	"	"
WJBR	Clinton	"	"
WSWK	Crystal Falls	Dept Cons	RA Thompson
WAPU	Detroit	Police Barracks	FW Walker
WRDS	East Lansing *	"	"
WBQL	East Tawas	"	"
WJBP	Erie	"	"
WRRC	Escanaba City	Dept Cons	RA Thompson
WDSO	Ewen	"	"
WAPW	Flatrock	Police Barracks	FW Walker
WITQ	Flint	"	"
WKJR	Gaylord	"	"
WBQU	Gladstone	"	"
WBXA	Gladwin	Dept Cons	RA Thompson
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	Milo	Dept Cons	RA Thompson
WKJM	Mt Pleasant	Police Barracks	FW Walker
WBYK	Muskegon	Dept Cons	RA Thompson
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	"	"
WBTS	Romulus	"	"
WIVA	Roscommon	Dept Cons	RA Thompson
WJBI	St Clair	Police Barracks	FW Walker
WQSY	St Ignace	"	"
WJAT	Sandusky	"	"
WMIC	Sault Ste Marie	Dept Cons	RA Thompson
WJBT	South Haven	Police Barracks	FW Walker
WKJK	Traverse City	"	"
WBQV	Wakefield	"	"
WBQQ	West Branch	"	"
WJAW	White Pigeon	"	"
WAOG	Ypsilanti	"	"
WBMU	(P)		
WBLU	Patrol Boat No 1	Dept Cons	RA Thompson

* 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	"
WRJI	Jackson* 2550 N State		"

* Headquarters Station

MISSOURI

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

* Headquarters Station

MONTANA

KRNW	Helena	(PM)	Civic Center	GF Pfeiffer

NEVADA

KRNP	Reno	Police Hdqtrs	A Sowle
KRGL	"	(PM)	

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	Police Barracks	FA Kelly	
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*	"	"	
WSPZ	Boat Anne E	"	"	
WRXN	" Director	"	"	
WPJF	" Elizabeth	"	"	
WRSL	" Navigator	"	"	
WRSM	" 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	JF Johns
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	Elizabeth	Police Barracks	CD Farmer
WANH	Raleigh*	State House	"
WANK	Salisbury	Police Barracks	"
WANJ	Swannanoa	"	"
WANI	Williamston	"	"

* Headquarters Station

OHIO

WOZV	Athens	Police Barracks	
WOHO	Bellevue	"	
WAZB	Bismarck	"	
WPHT	Cambridge	"	
WPGQ	Columbus	"	
WODH	Dayton	"	
WPGG	Findlay	"	
WOUG	Lorain	"	
WOGN	Marion	"	
WPHC	Massillon	"	
WOUB	Middletown	"	
WODX	Perrysburg	"	
WHNT	Portsmouth	"	
WOEX	Salem	"	
WBGQ	Warren	"	
WPHK	Wilmington	"	
WDCW	"	(P)	
WQFT	"	(P)	

OKLAHOMA

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

* Headquarters Station

OREGON

KOHA	Astoria	Police Barracks	CD Cannon
KOHB	Baker	"	"
KOHN	Bend	"	"
KOHU	Burns	"	"
KOHC	Coquille	"	"
KOHD	The Dalles	"	"
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	"	"
KOHR	Roseburg	"	"
KOHS	Salem	"	"
KOHJ	Santiam Junction	"	"
KOHF	(P)		
KOHT	(P)		
KOHH	(PM)		
KOHV	(PM)		
KOHW	(PM)		
KOHX	(PM)		
KOHZ	(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	
WRSW	"	(P)		"

TENNESSEE

WJBV	Chattanooga	110 E 9th St	PE Grifith
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	"	"
KTXB	(P)		
KTXR	(P)		
KTXU	(P)		

* Headquarters Station

UTAH

KUSH	Ogden	Police Barracks	JB Littlejohn	
KPRV	Provo	"	"	

JHP	Salt Lake City*	Capitol Bldg	JB Littlejohn
JBTS	(P)	"	"

* Headquarters Station

VIRGINIA

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

WASHINGTON

KNFK	Bellingham	Police Barracks	RG Quantz
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	"	"
KNFY	Ilwaco	"	"
KBKK	Kelso	"	"
KQGF	K-M Hill	"	"
KNFZ	Lodge Pole Camp	"	"
KQDY	Mason City	"	"
KFHP	Mt Vernon	"	"
KACB	Okanogan	"	"
KFPM	Olympia*	Legislative Bldg	RG Quantz
KNFG	Olympia*	"	"
KQEK	Pasco	Police Barracks	RG Quantz
KRGS	Port Angeles	"	"
KWSE	Raymond	"	"
KGHD	Seattle	"	"
KNFL	Shuksan	"	"
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	HC Myers
WSUA	Chapmanville	"	"
WSPL	Elkins	"	"
WMWV	Moundsville	"	"
WSJA	Parkersburg	"	"
WRMP	Romney	"	"
WSWV	Shinnston	"	"
WPWV	South Charleston	"	"
WSLT	Stollings	"	"
WRPC	(P)		
WBSQ	(PM)		

WISCONSIN

WIZR	Madison	Police Barracks
WAQZ	(PM)	
WKWS	(PM)	

WYOMING

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

SPECIAL EMERGENCY STATIONS

ALABAMA

Birmingham Gas Co	1200 6th Ave N	Birmingham
WBXH	Birmingham Ala	TG Humphreys Jr
WBXI	"	"
Southern Natural Gas Co	Box 2563	Birmingham
WBVO	Wetumpka Ala	
WKHT	Tarrant	"
WKHU	Atlanta Ga	

ARKANSAS

Little Rock Municipal Waterworks			Little Rock
KQCJ	Resevoir 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	
KEPE	Grapevine	
KFPH	Los Alamos	
KQGC	Marysville	
KATU	Mineral	
KATR	Mt Shasta City	
KATV	Pulga	
KATQ	Quincy	
KASN	Redding	
KQGN	San Bernadino	
KBTD	Sonora Junction	
KATS	Susanville	

STATE POLICE, CONTINUED

KQGD Truckee
KATT Yreka
KQGB Yuba Gap
KASO Test Car (PM)
KQGG (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

City of Los Angeles Dept of Water & Power Box 240 Arcade Annex Los Angeles Calif WW Matney
KQS Independence Calif
KQT Los Angeles "
KFMQ " "
KIIE Victorville "
KIIG Silver Lake Camp Calif
KIKH Boulder City Nevada

Hayside Co 40 Spear St San Francisco
No fixed stations

Dept Natural Resources 312 State Bldg Sacramento WF Koch
W6XGK Box Springs Mountain
KGSC La Mesa
KGML Maderia
KAIV Perris
KBZC Redding
KFSC San Luis Obispo
KIXR Santa Rosa
KRDS Visalia
KBIA Twenty Nine Palms
W6XBT Calistoga

Los Angeles Co Calif Flood Control Dist 751 S Figueroa St Los Angeles Calif
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
KIPW Big Tujunga Dam Big Tugunga Canyon Calif
KQXD Big Dalton Dam Glendora Calif
KQXE Glendora Calif
KQXF Long Beach Calif

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
No fixed stations

Pacific Tel & Tel Co 140 New Montgomery St San Francisco Calif CA Robb
KFTM Bucksport Calif

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

Coast Counties Gas & Elec Co 22 Pacific Ave Santa Cruz Calif
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 Calif
No fixed stations

Southern California Telephone Co 140 New Montgomery San Francisco Calif
No fixed stations

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 Nordeu 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 WH Wells
WAVT " " " "
WAVY Montville " " "
WAWF Devon " " "
WAWK New Milford " "
WAWN Stevenson " " "

Southern New England Tel Co 227 Church New Haven
WSNU New Haven Conn LB Breen
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

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
WKGP "
WKGQ "
WKGR "
WKGS "
WKGT "
WKGU "
WKGV "

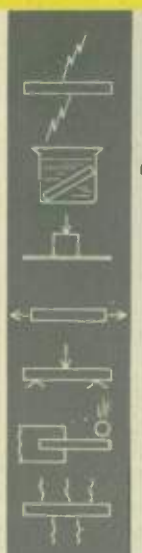
Illinois Bell Tel Co 212 W Washington Chicago Ill
WAGV Springfield SE Austin
WAGW " "

Natural Gas Pipeline Co of Amer 20 N Wacker Dr Chicago Ill WT Bulla
KQSV Gray Okla W T Bulla
KQSW Minneola Kans "
KQSV Helzer " "
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 " "

(CONTINUED ON PAGE 74)

The Birth of the "Little Sun" Every Home Welcomed



HIGH DIELECTRIC STRENGTH

LOW MOISTURE ABSORPTION
CORROSION RESISTANCE

COMPRESSIVE STRENGTH

TENSILE STRENGTH

FLEXURAL STRENGTH

IMPACT STRENGTH

STABLE OVER A
WIDE TEMPERATURE RANGE

Many More Properties—Combined

OF ALL man's inventions, one of the greatest, universally, was Edison's incandescent filament . . . a fine thread from which a new pattern of life was woven.

Edison simply experimented with known substances until he found one that met his singular requirements. You may have material problems, too. However, knowing your requirements, you may find your special answer in technical plastics.

If excellent electrical properties, resistance to corrosion, mechanical strength, easy machineability and many other combined characteristics are desirable, our type of technical plastics—Synthane—can be very helpful to you.

You are invited to send for the complete Synthane catalog and compare your needs with Synthane's advantages.

Synthane Corporation, Oaks, Pa.

SYNTHANE TECHNICAL PLASTICS

SHEETS • RODS • TUBES • FABRICATED PARTS **SYNTHANE** MOLDED-LAMINATED • MOLDED-MACERATED

Plan your present and future products with Synthane Technical Plastics

WRH

A comparison of SYNTHANE TECHNICAL PLASTICS with certain metals, debunking a popular notion that plastics being "magic" can be used indiscriminately

IT IS CHARACTERISTICALLY HUMAN to back a winner . . . to ascribe precipitately to vitamins or sulfa drugs or plastics more powers and claims than sober research can keep up with. Plastics have their possibilities . . . and their limitations. Good design is the reward of knowing both.

Plastics are doing many jobs that metals used to do, especially since certain critical metal shortages have cropped up. But, basically, plastics are *not* substitute materials. Correctly applied, they should and do stand solely on their own merits.

INTERESTING COMPARISONS TO PROVE the point can be made between our type of plastics—Synthane—and certain metals. Synthane is made by applying heat and pressure to paper or fabric impregnated with thermo-setting resins. It is non-metallic, a fact which should at once suggest uses fundamentally different from those of metals. Actually, Synthane is an excellent electrical insulator, and so you find it in hundreds of radio and electrical products and applications, not in place of metal, but to insulate metal. That does not imply Synthane cannot replace metal. As a matter of fact, Synthane has taken over for metals in pulleys, bearings, panels, structural members, scales, dials. The reasons can usually be traced to one or a combination of the many properties of Synthane technical plastics.

ONE OF THE PRINCIPAL REASONS at present is light weight. Synthane has a specific gravity ranging from 1.20 to 1.70, about half that of aluminum, less than magnesium. So in many unstressed parts for aircraft Synthane is a logical consideration.

SYNTHANE LAMINATED PLASTICS GENERALLY have lower mechanical strength than metals for a given cross section. For example, an approximate comparison might read like this:

	Tensile Strength (p.s.i.) ultimate	Compressive Strength (p.s.i.)
Alloyed Aluminum	16,000–60,000	9,000– 47,000 (y)
Brass	40,000–80,000	28,000–126,000 (u)
Cast Iron	16,000–45,000	80,000–200,000 (u)
Synthane	8,000–12,000	30,000– 50,000 (u)

(y—yield strength
u—ultimate strength)

IT IS IMPORTANT, HOWEVER, TO REMEMBER that on a *weight* basis, Synthane may be stronger though redesign of a part for plastics may be necessary.

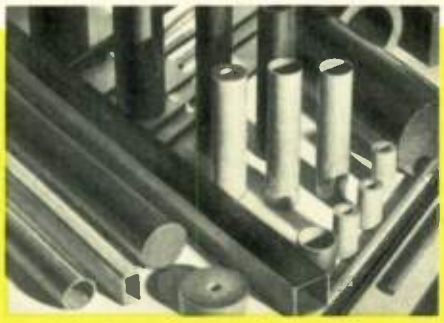
HARDNESS IS A PROPERTY in which another interesting comparison of Synthane with metals can be made. Brinell hardness, tested with 500 Kg. load, 10 mm ball, shows approximately these values: Alloyed aluminum 45–110, Brass 95–150, magnesium (drawn annealed) 29, annealed cast iron 77, Synthane 24–40.

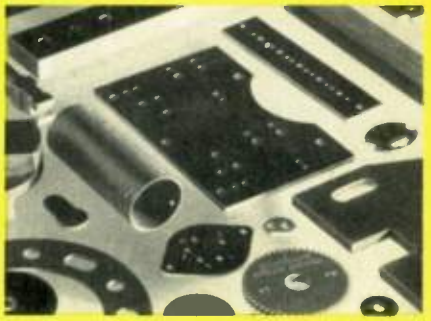
BEHAVIOR UNDER TEMPERATURE CONDITIONS is characteristic of Synthane's non-metallic composition. For instance, whereas the thermal conductivity of aluminum alloys may range from .20 to .54 calories per second per square centimeter per centimeter of thickness per degree C., Synthane's thermal conductivity is about .0005 to .0008. The coefficient of thermal expansion of Synthane is about .0000140 inches per inch per degree F., approximately the same as alloyed aluminum, slightly more than pure aluminum, copper, brass.

CORROSION RESISTANCE IS A SUBJECT of such complications as to temperature, degree of concentration, and type of agent that any comparison with metals would necessarily be lengthy. Synthane does resist corrosion from water, many acids, oils, and salts, and to a greater or lesser extent than metals depending on the metal with which it is compared and the corrosion conditions. Synthane is extensively used as a corrosion resistant material.

APART FROM ITS PHYSICAL, CHEMICAL, electrical and chemical properties, Synthane may be easily and quickly machined by ordinary shop methods, a point which may occasionally influence selection when other factors are the same. And, just as metals are cast for economy in large quantities, so Synthane is available in two molded forms, molded-laminated and molded-macerated, for economy of duplication.

OBVIOUSLY, IN CERTAIN CASES there can be no question of whether to use Synthane plastics or a metal such as when the material must be an electrical conductor or an electrical insulator. In other cases, weight or strength may decide, or corrosion resistance, resilience, hardness, machinability. Or as often happens, the decision may rest upon the extent to which the material required meets many combined specifications. Synthane technical plastics are usually more desired for their combination of properties than for any one specific property for which another specific material or metal may be the only logical answer.





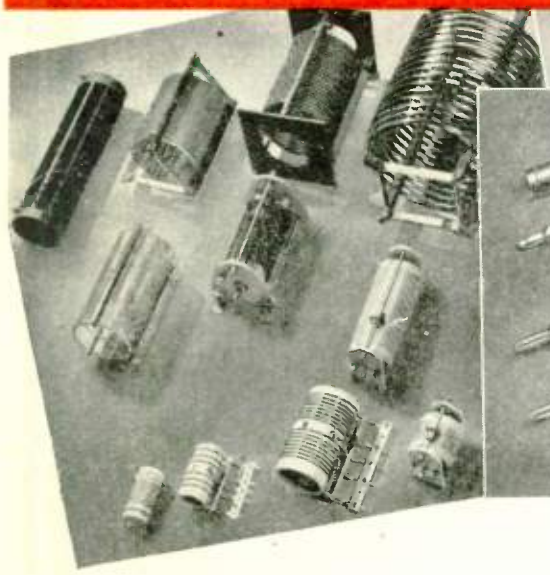
SYNTHANE

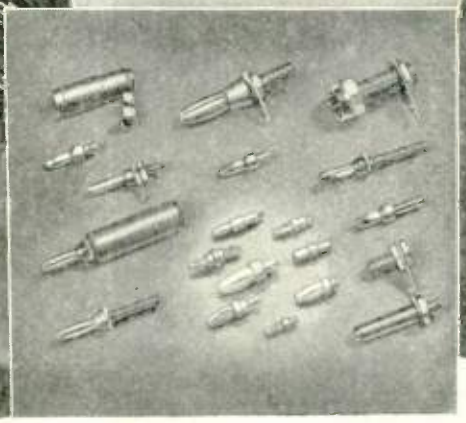
PLAN YOUR PRESENT AND FUTURE PRODUCTS WITH SYNTHANE TECHNICAL PLASTICS · SHEETS · RODS · TUBES · FABRICATED PARTS · MOLDED-LAMINATED · MOLDED-MACERATED

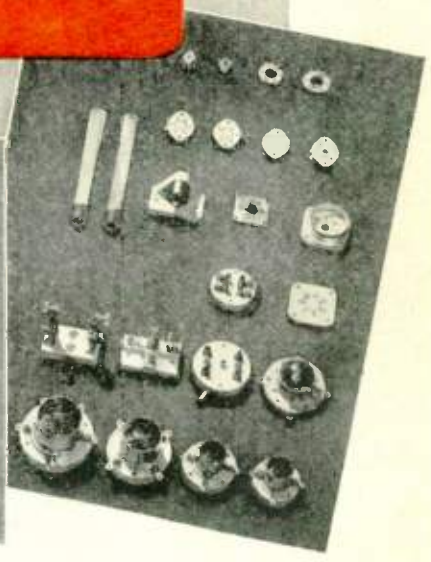
SYNTHANE CORPORATION, OAKS, PENNA.

REPRESENTATIVES IN ALL PRINCIPAL CITIES

GEARED TO WAR DEMANDS







Johnson production facilities are flexible - - 10 or 10,000 - - standard specifications or special - - repeat items or new - - any plating - - any metal or alloy - - any insulation. If it's metal or insulation or a combination of both, try Johnson first.

Ask for Catalog 968 (T)

SPECIALISTS IN

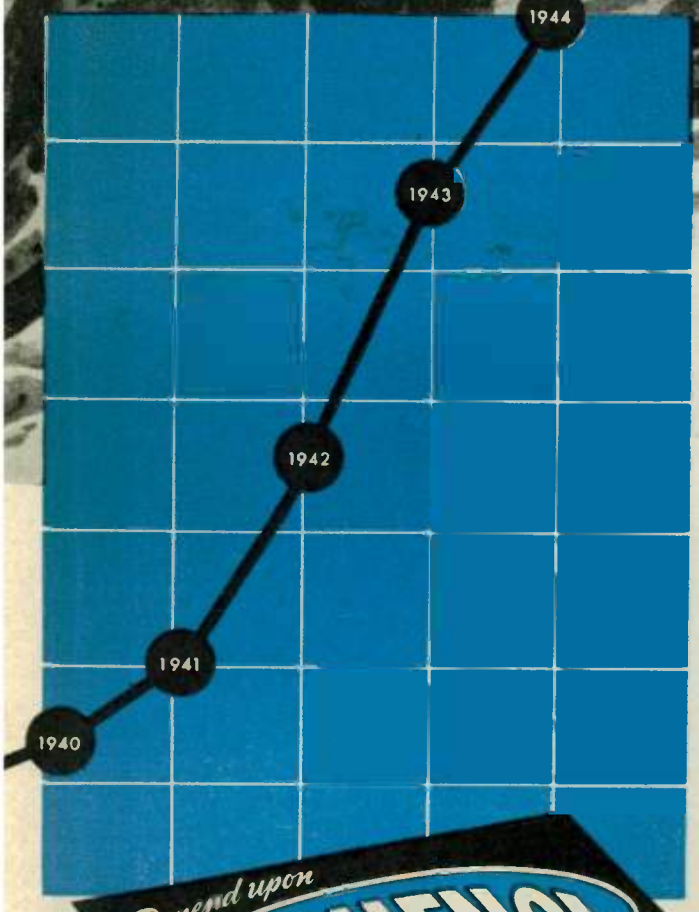
- Fixed and Variable Condensers
- Porcelain and Steatite Insulators
- Plugs, Jacks, Clips and Connectors
- Fixed and Variable Inductors
- Radio Frequency Chokes
- Flexible and Rigid Insulated Couplings
- Antenna Systems and Equipment
- Mycalex Machining and Parts
- Special Insulated Assemblies
- Broadcast Station Equipment

JOHNSON

a famous name in Radio

E. F. JOHNSON COMPANY • WASECA • MINNESOTA

Equipped to Surmount NEW PEACETIME PEAKS



● Up to 1940 when war construction began, Amphenol had a long, proud record of achievement in the production of electrical transmission equipment of the better—more critical—kind. Among other "firsts" Amphenol had developed, and built, the first ultra-high frequency cable.

When production for the Air Corps, Army and Navy demanded precision far beyond that of civilian manufacture, Amphenol went to work exclusively for the Armed Forces . . . will continue working for Uncle Sam until the last bomb burst. When that time comes, the years of experience "under fire", the broadened perspective and knowledge will mean new and improved products, a source of supply of unlimited capacity. This is a rich background of experience in the production of parts for the users of electrical transmission equipment in the electronic, radio and electrical fields.

Depend upon AMPHENOL Quality

AMERICAN PHENOLIC CORPORATION, Chicago 50, Illinois • *In Canada:* Amphenol Limited, Toronto

Connectors (AN, British, U. H. F.) • Conduits • Fittings • Cable Assemblies • U. H. F. Cables • Radio Parts • Plastics for Industry

WRH

GLASS-TO-METAL SEALS

by the Thousand!

HUMIDITY-PROOF
SHOCK-PROOF
LEAK-PROOF

Another modern electrical development pioneered and perfected by Sprague

Pioneered many months ago by Sprague, glass-to-metal seals for Sprague Capacitors and hermetically-sealed *Koolohm Resistors have progressed far beyond any "laboratory curiosity" stage. Not only are they being produced commercially at better than 10,000 seals per day, but they have proved highly efficient both electrically and mechanically. Seal sizes range from very small up to 3" diameter. They work equally well with practically any metal including steel, brass, and monel metal, and do not require the use of glass bushings and adjacent metal rings with "matched" temperature coefficients of expansion.

There are, of course, plenty of "scientific" reasons why glass-to-metal seals of this type are not feasible. Here again, however, the allegedly impossible has simply provided the incentive for another outstanding Sprague engineering achievement. Actually, the only disadvantage to the seals so far uncovered is the fact that corona voltages are a little lower than we'd like them to be—yet this limitation only becomes a factor at voltages upwards of 25 KV. In all respects, the Sprague glass-to-metal seal answers the old problem of guarding Capacitors and Resistors adequately against leaks and moisture—and without organic bushings or other materials which might be attacked by fungus.

Today, glass-to-metal sealed Sprague Capacitors and *Koolohm Resistors are available in 8,000 electrical characteristic combinations—which is another way of saying that there is a sealed unit for every application that needs one. Details gladly sent on request.

SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASS.
(Formerly Sprague Specialties Co.)

ARMY E NAVY

*T. M. REG. U. S. PAT. OFFICE

SPRAGUE

PIONEERS OF ELECTRICAL-ELECTRONIC PROGRESS

SPECIAL EMERGENCY STATIONS
(CONTINUED FROM PAGE 68)

INDIANA

Indiana Bell Tel Co 240 N Meridian Indianapolis
No fixed stations
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
WAMM 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
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
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 " "
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 " "
Boston Elevated Railway Co 31 St James Ave Boston
No fixed stations
Brockton Edison Co 36 Main St Brockton Mass
WEKS Brockton Mass
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
WSYA BJ Dowd

MICHIGAN

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

MINNESOTA

Northern States Power Co 15 S 5th St Minneapolis
WPL St Croix Falls Wis
WLP Minneapolis Minn
Rainy River Improvement Co 500 Baker Arcade Bldg Minneapolis Minn
WRRL Kettle Falls Dam Minn
WRRM International Falls "

MISSOURI

Kansas City Power & Light Co 1330 Baltimore St Kansas City Mo
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
KEIG 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

NEBRASKA

Northwestern Bell Tel Co 118 S 19th St Omaha Nebr
KQJU (PM) TH Smith
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 J Buchanan
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
No fixed stations
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 WM Phillips
WCEG Canton " "
WDBN Tiffin " "
WAEJ Vernon Jct " "
WAGS Kenton " "
WMOK Wheeling " "
The Ohio Pub Service Co Massillon Ohio
WAHI Alliance Ohio CH 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
WBOV 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
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

PENNSYLVANIA

Bell Telephone Co of Pa 1835 Arch St Philadelphia
No fixed stations
Duquesne Light Co 435 6th Ave Pittsburgh Pa
WCBV Springdale Pa
WET1 Pittsburgh "
WETC " "
WETD " "
WFOL Wireton "
Pennsylvania Power & Light Co 901 Hamilton St Allentown Pa
WBH Frackville Pa
WCJ Hazleton "
WPH Williamsport "
WAND Allentown "
Peoples Natural Gas Co 545 Wm Penn Pl Pittsburgh
WCZI Churchill Pa CD Campbell
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)

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
KSEB Wiess Bluff Texas
Central Power & Light Co 120 N Chaparral Corpus Christi P Taylor
KRMV Corpus Christi Texas
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

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

WASHINGTON

City of Everett Water Dept 3102 Cedar St Everett
KAAU Everett Wash
Puget Sound Power & Light Co 860 Stuart Bldg Seattle
No fixed stations
City of Seattle Dept of Lighting 3rd Ave & Madison Seattle Wash
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
The Chesapeake & Potomac Tel Co of W Va 816 Lee St Charleston W Va
No fixed stations

WISCONSIN

Wisconsin Michigan Power Co 825 S Oneida St Appleton Wis G Merki
WBMN Appleton Wis
WQWR Conto Falls Wis
Wisconsin Telephone Co 722 N B'dway Milwaukee Wis
No fixed stations

WYOMING

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

NOTES ON THE DIRECTORY LISTINGS

THE usual practice of the FCC is now to assign the same call letters to mobile units as to the headquarters station with which they operate.

Consequently, in most cases, only one call letter appears in this directory for the main station and its cars. Where separate calls have been assigned to mobile units, they are indicated by (P) for portable or (PM) for portable-mobile transmitters.

Some municipal police transmitters are listed without addresses for the headquarters. That is because replies were not received to our requests for this information and for the name of the individual responsible for the operation and maintenance of the radio equipment. However, it can be assumed that the address is simply Police Headquarters.

In the case of special emergency systems, it will be noted that the company operating the system is listed under the state where its main office is located. However, there may be stations listed under the company name which are in other states. When that occurs, the name of the state is given in the listing.

Here all similarity ends...

from this point on, it's craftsmanship!

In one important respect there is a striking similarity between the millions of Bliley crystals which we now produce and the mere handful of custom made units that constituted our annual production when radio was still young.

In those early days of radio, when each quartz crystal was painstakingly cut and ground by hand, a tradition was born. It was a tradition of craftsmanship that has grown with the years—a tradition that Bliley engineers have successfully translated into the more intricate techniques of volume production.

Etched crystals are an outstanding discovery and development of Bliley research engineers. This technique, by means of which crystals are finished to frequency by acid action rather than abrasive action, was an established part of Bliley production long before Pearl Harbor. It has since proven to be an essential element in the manufacture of crystals that have the dependable characteristics necessary for military communication in global warfare.

We have been called upon to solve some knotty problems. But that is nothing new at Bliley. It has been our habit to parallel new developments in radio with the right crystal for each application.

Things will be different soon. Peacetime projects will again come first. But our engineers and craftsmen will be ready, as always, with the right answer to your requirements. Don't fail to include Bliley crystals in the component specifications for your peacetime equipment.

A new star has been added

Bliley CRYSTALS

Do more than before...

buy **extra** War Bonds

BLILEY ELECTRIC COMPANY UNION STATION BUILDING · ERIE, PENN.

GREAT NEWS! SUPERIOR'S WELL-KNOWN

Model 710

VOLT—OHM—MILLIAMMETER

is now available for shipment within 10 days after receipt of order on priority of AA3 or better.

Sensitivity—

1,000 OHMS PER VOLT
ON BOTH A.C. AND D.C.!!

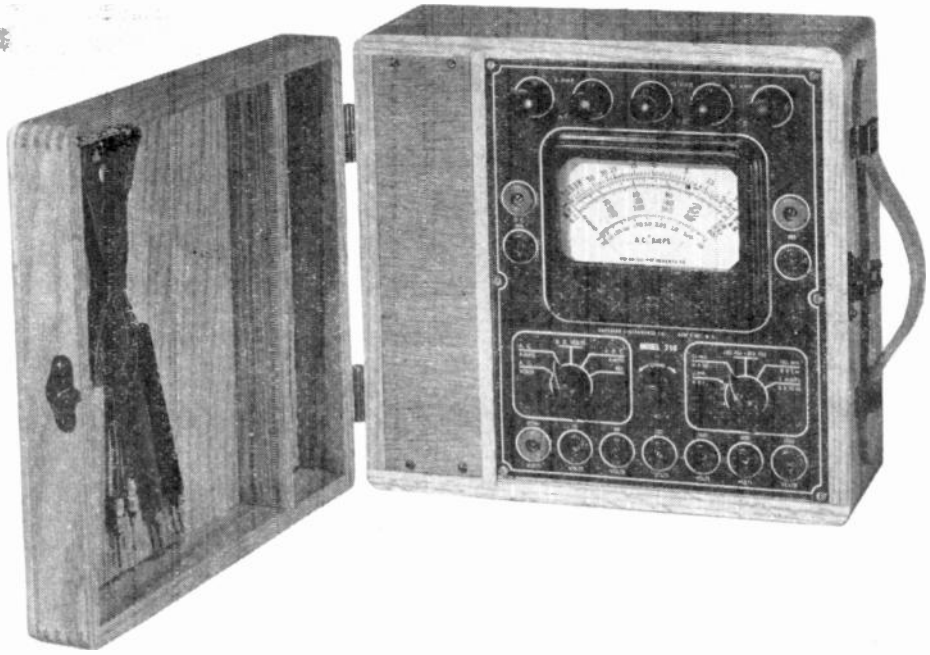
Measures:—

A.C. AND D.C. VOLTAGES UP TO—
1500 VOLTS

A.C. CURRENT UP TO—
3 AMPERES

D.C. CURRENT UP TO—
30 AMPERES

RESISTANCE UP TO—
10 MEGOHMS



Features:—

★ Uses New 4½" Square Rugged 0–400 Microampere Meter.
★ Direct Reading—All Calibrations Printed Directly on Meter Scale in Large Easy-to-Read Type.
★ Housed in Rugged Heavy Duty Portable Oak Cabinet.
★ Completely Self-Contained—No External Source of Current Required.

Designed and perfected in wartime to meet the exacting requirements of America's War Producers for a dependable volt-ohm-milliammeter, the Model 710 is being used by war plants engaged in the production of planes, ships, tanks, guns, etc.; also by various Army, Navy and other government agencies.

Specifications:—

6 D.C. VOLTAGE RANGES (1000 OHMS PER VOLT)
0 to 15/60/150/300/600/1500 Volts.

6 A.C. VOLTAGE RANGES (1000 OHMS PER VOLT)
0 to 15/60/150/300/600/1500 Volts.

7 D.C. CURRENT RANGES:
0 to 3/15/60/150 Milliamperes 0 to 3/15/30 Amperes.

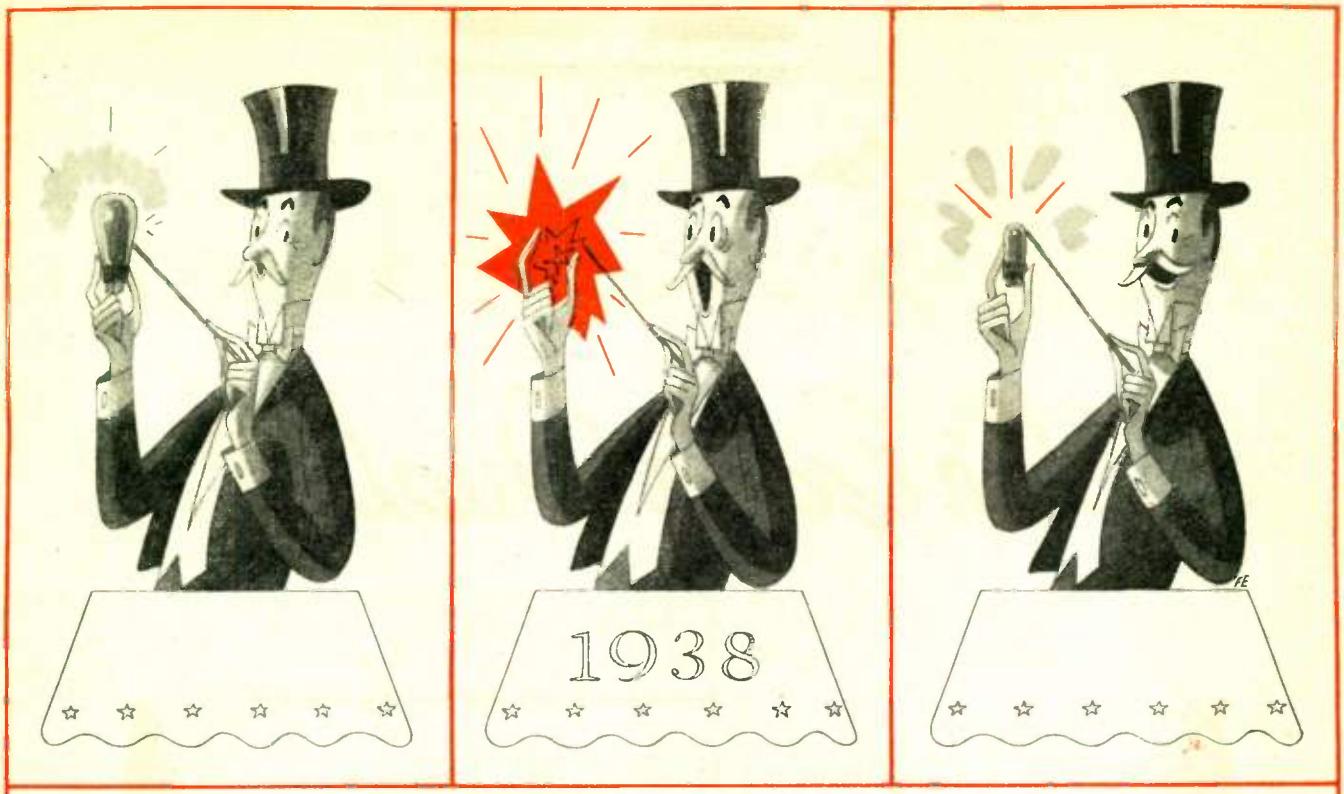
A.C. CURRENT RANGE:
0 to 3 Amperes.

5 RESISTANCE RANGES:
0 to 1,000/10,000/100,000 Ohms. 0 to 1 Megohm 0 to 10 Megohms.

The MODEL 710 comes complete with cover, self-contained batteries, test leads and instructions. Size 6" x 10" x 10". Net weight 11 pounds. Price.....

$34.50

SUPERIOR INSTRUMENTS CO., Dept. F
227 FULTON STREET NEW YORK 7, N. Y.



THEY SAID IT COULDN'T BE DONE!

Back in 1938, Hytron began designing new dies and converting production machinery for the first BANTAM GT tubes. The industry said in effect: "You're crazy; it won't work. You can't telescope standard glass tubes to BANTAM size and get the same results." Beam tetrodes, such as the 50L6GT, particularly were considered impossibilities. The intense heat developed during normal operation would warp the elements and crack the small glass bulb.

But Bruce A. Coffin, originator of the BANTAM GT, stuck to his guns. In a few short years, Hytron developed over fifty GT types. The GT became the most popular receiving tube.* Short leads, low capacitances, advantages of shorter bombardment at lower temperatures, ruggedness of compact construction plus both top and bottom mica supports, smaller size, standardized envelopes and bases — all contributed to that popularity.

The BANTAM GT permitted new space economies in pre-war receivers. Only its universal acceptance as standard by all manufacturers makes possible fulfillment of the Services' demands for receiving tubes. In increasing numbers, as this war draws to its ultimate conclusion, Hytron will continue to supply you with the popular BANTAM GT tubes which everyone said just couldn't be made.

**1941 industry production figures: GT—52,000,000; metal—27,000,000; standard glass, G, and loctal—56,000,000.*

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

BUY ANOTHER WAR BOND

The Extra Quality

THAT GIVES CHAMPIONSHIP PERFORMANCE

ANY horse can run a race, but only a thorobred wins consistently.

Where performance counts, Turner Microphones win top recognition in every field of electronic communications. On land, on sea and in the air — in education, business, entertainment and science, Turner applications deliver that EXTrA quality that is the measure of a thorobred.

Turner pioneers the communications field with scientific engineering that reproduces only those vibrations received by the diaphram without adding any of the harmonics. The full meanings of sound are delivered with their delicate gradations of tone and volume. A soft whisper or a shrill fortissimo come clear and crisp in the full focus of intelligibility.

Let Turner Microphones "spark" your electronic communications with life-like performance.

Crystals Licensed Under Patents of the Brush Development Company

The TURNER Company CEDAR RAPIDS, IOWA

Write for *Free* CATALOG

TURNER — *Pioneers in the Communications Field*

TURNER 22

TURNER 211

TURNER HAN-D

TURNER 99

How Motorola Radio PLANS ITS NATIONAL ADVERTISING

NATIONAL MAGAZINES

The Motorola schedule calls for regular large space advertisements in the largest weekly magazines: Life, Liberty, Saturday Evening Post, Colliers, Newsweek and Click. This powerful mass magazine circulation is fortified by the addition of the biggest and best monthlies: Fortune, National Geographic, American Magazine, Cosmopolitan, Esquire and Popular Mechanics.

SUNDAY NEWSPAPER MAGAZINES

More than 10 million families do not read magazines of any kind . . . weekly or monthly . . . but they *do* read the Sunday Magazines distributed with their favorite newspaper. To reach this vital section of the American buying public, Motorola uses color pages in The American Weekly, world's largest circulation, and dominant color space in This Week, second only to The American Weekly in family coverage. These two Sunday magazines reach more than 15 million families.

NATIONAL ROAD SIGNS

More than 20 million automobiles are still traveling the highways of America and after the war this total will rise to more than 30 million. The Motorola all steel highway signs in their familiar yellow and black color combinations are known from coast to coast on every major highway in America. To this dominant outdoor campaign Motorola has added a schedule of painted bulletins on the main thoroughfare of our largest cities.

DAILY NEWSPAPERS

To reach the American public with spot news and new merchandise Motorola has regularly used leading newspapers which serve the retail buying areas in the nationwide Motorola distributor network.

LIKE THE "HANDIE TALKIE" THIS TINY PORTABLE WAS A NOTABLE MOTOROLA RADIO FIRST!

• Thousands know the Motorola "Playboy" as the smallest, most powerful personal portable radio on the market. It plays richly, beautifully, on planes, trains, everywhere. The new postwar Motorola "Playboy" will be a "Honey"!

Motorola National Advertising blankets the nation and soon after Victory in Europe will tell the American public about the NEW Motorola Radios for Home and Car.

SOON TO BE READY FOR DELIVERY!

GALVIN MFG. CORPORATION • CHICAGO 51

Motorola Radio

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

FACSIMILE NEWSPAPERS

(CONTINUED FROM PAGE 38)

enough facsimile receivers to support an economically sound advertising rate structure for participating newspapers. It is assumed that facsimile will afford no sources of revenue to newspapers other than paid advertising. But, profitable or not, preparation for the transmission of newspapers by facsimile broadcasting will have to start before the first recorders are offered for sale, because that is the only way to create a demand for recorders. No one will buy a facsimile machine unless something he wants to receive is being broadcast.

Who will broadcast the first regular facsimile newspapers which will create the demand for facsimile recorders? In the answer to this question is contained the destiny of the newspaper business.

The facsimile newspaper which is used to create a demand for facsimile reception will simultaneously create a demand for itself. As the product improves and the promotion effort increases, the sale of receiving equipment will grow. Concurrently, the chances of competitive success for belated entries in the field will diminish in inverse ratio to the multiplying acceptance of the pioneer.

This natural law of competition is the most obvious argument for early, foresighted action by newspaper publishers. As the slow but inevitable transition from mechanical to electrical distribution progresses, the laggard publisher will see his reader market lost, probably beyond any belated effort to recapture it.

Government regulation will undoubtedly establish standards of transmission so that any recorder can be operated by facsimile signals from any station to which the receiver is tuned. It appears that there will be ample facilities available for facsimile transmission, which is another reason for early enterprise. Only by early entry into the facsimile field can the newspaper publisher assure himself of a leading position. He must have a part in the formulation of the master plan if he hopes to derive any benefit from its ultimate realization. He must be there when the regulations are made or he may be regulated out of business.

The soundest course for the newspaper publisher seems clearly indicated. It closely parallels that taken by standard-band radio broadcasters in dealing with Frequency Modulation. They have decided to make FM an accessory to standard-band broadcasting until it assumes the stature of a substitute. They channel their standard-band programs over FM as well, offering this as a plus value to their advertisers. As the use of FM receivers grows, the broadcasters will constantly be in the sound position of deciding at what point they will abandon standard-band broadcasting in favor of exclusive

(CONCLUDED ON PAGE 81)

FACSIMILE NEWSPAPERS

(CONTINUED FROM PAGE 80)

FM broadcasting, without any disruptive or costly transition.

Similarly, the newspaper publisher should use facsimile as an accessory to his "distribution phase" until it has become an economically feasible substitute. The moment there is one facsimile receiver offered for sale in the circulation (or, in this case, broadcast) radius of the newspaper publisher, he should commence facsimile transmission of his newspaper. By doing this, he himself will be able to decide at what time, be it a year or a decade later, he will shut down his presses and sell his trucks, or take any intermediate action. It will not be decided for him, with disastrous consequences, by irresistible competition.

At this point it should be considered that FM broadcast stations can transmit sound and facsimile signals simultaneously, by the mere addition of a scanning machine and its associated electrical circuits. Similarly, FM receivers can operate loud-speakers and recorders simultaneously or separately. This fact, considered in connection with the manifest interest of many publishers in sound broadcasting, suggests new avenues of mutual radio-newspaper enterprise. The vast possibilities inherent in the simultaneous transmission and reception of sound and facsimile are not properly a part of this discussion, but rather serve to emphasize the broader significance of its theme.

Now is the time for the newspaper publishers to decide not how they are going to combat facsimile, but how they are going to use it. In speaking of newspaper publishers, it has been intended to include them all, for facsimile is clearly an instrumentality for newspaper publishers collectively. It does not set one publisher against another, although it does set publishers as a group against non-publishers who may enter the newspaper field.

Facsimile can probably be of greatest service to newspaper publishers if employed in a manner that will neither disrupt their present competitive positions in relation to one another nor destroy the stability of their economic structures.

This can be done. But it can be done only by intelligent, cooperative, planned action — and, above all, by early planned action, now! That is possible because if, in any area, there is more than one facsimile broadcasting service, the "readers" will be able to choose their newspapers by tuning to the transmission they want, just as they now select their papers from the stands. Moreover, the same receiving equipment will produce the morning paper from one publisher and the evening paper from another.

All this can be done. It calls for prompt and careful planning between the publishers and the manufacturers of broadcast transmitters, radio receivers, and facsimile scanners and recorders.

FM NETWORK FACILITIES IN THE U.S.A.

The February issue of *FM* AND TELEVISION will contain a 4-page wall map, 21 by 15 ins., showing the Bell System routes, now carrying 15,000 cycles or more, which will be available after the war for a national high-fidelity FM broadcasting network. This map contains information for broadcasters which has never been published before. — See it in the February issue.

DETAILS OF TELEVISION STATION WRGB

(CONTINUED FROM PAGE 48)

mitters for video and audio signals. Locations of this apparatus are shown in Fig. 17, with detailed views in Figs. 18 to 22.

Two complete synchronizing generators with facilities for instantaneous switchover are provided, so that, in case of failure in one, the program can be continued without interruption on the other. The output of the line monitor and line amplifier is fed into the monitor racks where synchronizing signals are added, and a modulated picture signal is generated. This composite picture signal is fed at very low level to the picture relay transmitter. Linear Class B radio frequency amplifier stages in the transmitter pass a 5-mc. band.

The output of the video relay transmitter is 60 watts peak at a carrier frequency of 163.25 mc. This output is obtained from a Class B amplifier stage employing a pair of 834 tubes in push-pull. Fig. 20 shows the details of the intermediate amplifier, and Fig. 21, the final stage. These two units are installed adjacent to the audio relay transmitter, as can be seen in Fig. 22.

The audio transmitter operates on a frequency of 167.75 mc., corresponding to the video frequency of 163.25 mc. It has a peak output of 50 watts, obtained from an 829 dual tetrode in the output stage.

Additional picture waveform and sound monitors are located near the transmitters so that the transmitter operator can follow the outgoing picture and sound at all times.

Relay Antenna ★ Standard coaxial transmission lines, employing ceramic insulation, carry the video and audio signals from the transmitters to the relay antennas set up on a tower near the studio building. The tower, Fig. 23, is of lattice construction, 125 ft. high. In this view, the wooden box which ordinarily covers the antennas to protect them from the weather has been removed.

The picture relay antenna consists of four vertically-stacked elements, each with a driven director, while the sound relay antenna is a vertical coaxial type mounted at the top of the supporting structure.

From this antenna, signals are transmitted 12½ miles to the main WRGB transmitter in the Helderberg Mountains.

That site was chosen for the main transmitter because of its high elevation, by means of which ample transmission range is obtained to cover the trading area of which Schenectady is the center.

Note: Part 3 of this series, dealing with the physical facilities at the main station, will appear in the next issue.

PROPOSED ALLOCATIONS

(CONTINUED FROM PAGE 35)

through the use of a 6-mc. channel, with the improvements now available over prewar developments, should be abandoned and commercial television held in abeyance until a wide-channel system in the ultra-high frequencies can be developed and proven. . . . The time which may elapse before a system can be developed to operate on wider channels in these ultra-high frequencies is indefinite and primarily dependent upon the resourcefulness of the industry in solving the technical problems that will be encountered."

Home facsimile broadcasting: "To provide for the future growth of facsimile broadcasting — the sending of script, printed or typed matter, sketches, drawings, or pictures — the Commission will permit it to use the regular FM channels and also a band between 470 and 480 mc."

A very large amount of space has been reserved for aviation, and it is understood that the bands provided are not subject to revision in the interests of any of the other services. About this, the FCC said that the heavy demands of the aviation industry for radio channels above 25 mc. in the postwar period were granted almost exactly as specified. "The importance of aviation to our present and postwar transportation and economy does not require elaboration. Aviation operations are wholly dependent upon the use of radio for insuring the safety of life and property in the air."

Plans for the new and intriguing CRS — citizens radiocommunications service — were described in this way: "The success of the walkie-talkie on the battlefront and the possibilities for its varied uses in peacetime have induced the Commission to allocate the band from 460 to 470 mc. for a new radio service to be known as the citizens radiocommunications service. Small portable radios can be used, for example, to establish a physicians' calling service, for communication to and from trucks and tractors operating in and around large plants, on farms and ranches, on board harbor and river craft, in mountain and swamp areas. Sportsmen and explorers can use them to maintain contact with camps. Department stores, dairies, laundries, and other business organizations can use the service to communicate with their delivery vehicles.

"Common carrier operation will not be permitted, and no charge can be made for messages. Only the minimum requirements of the Communications Act plus a few minimum traffic rules will be set up. No technical knowledge will be required."

The reference to use by doctors and delivery vehicles, however, should not be confused with the separate services provided for general mobile service. This was described separately: "Certain frequencies have been designated for ultimate

(CONCLUDED ON PAGE 86)

PROPOSED ALLOCATIONS

(CONTINUED FROM PAGE 85)

use by urban and interurban mobile units such as trucks, buses, taxicabs, doctors' cars, ambulances, etc. Before assigning any frequencies in this band, however, the Commission will determine the most efficient plan by which they may be employed."

The proposed allocations for this purpose are: 12 channels between 30 and 40 mc. for mobile units and 12 channels between 42 and 44 mc. for land stations operating on highway communications, and 7 channels between 156 and 162 mc. for mobile and land stations on urban communications.

In this connection: "The Commission is of the opinion that if highway mobile radio service develops, persons undertaking to furnish such service should be required under Rules and Regulations of the Commission to establish and maintain a distress system similar to that of the coastal stations. In this connection, the Commission will, in the future, give consideration to the assignment of a low frequency for land calling and distress purposes."

"In addition, if the demands for such mobile service grows beyond the channels contemplated, the proposed allocation provides for a number of bands of frequencies, beginning at 1900 mc., for experimental operation of various services pending adequate showing as to need and technical requirements." These are 1900 to 2300, 3900 to 4550, 5750 to 7050, 10,500 to 13000, 16000 to 18000 and 26000 to 30000 mc.

Comment on FM broadcasting was that this service, "notable for high fidelity and freedom from static, is proposed to be moved from its 42- to 50-mc. space in the spectrum up to 84 to 102 mc. on the grounds that sky-wave interference in the lower region would be severe enough to impair the utility of FM to such an extent that its full development might be retarded."

Futhermore, according to the report: "Public interest requires that FM be established in a permanent place in the radio spectrum before a considerable investment is made by the listening public in receiving sets and by the broadcasters in transmitting equipment."

Accordingly, "the Commission proposes to assign 90 channels, beginning at 84 mc. and continuing to 102 mc., of which 20 (84 to 88 mc.) will be reserved for noncommercial educational stations.

"To provide room for expansion, should this space not prove adequate, the space from 102 to 108 mc. will be left unassigned for the present, and if a need arises in the future, FM stations can be considered along with others for assignment in these additional 6 mc."

NEW HAMPSHIRE RADIO SYSTEM

(CONTINUED FROM PAGE 29)

ground wire running to a swamp, about 500 ft. below, for lightning protection in the summer. The summit of the mountain is solid rock, as can be seen from Fig. 13.

The transmitting antenna, Fig. 15, is a simple dipole, oriented toward Concord headquarters, 28 miles away. It operates from a Motorola FSTR-15-B FM transmitter on 118.55 mc.

Performance of this relay system has exceeded all our expectations. In spite of exposure to extremes of heat, cold, and dampness, the total maintenance cost over a period of nearly 3 years is $4.75 — the price of an 815 tube. It would have cost $5,000 in rental for a telephone line during this period. Operation, despite the fact that the Concord receiver is not in line of sight, has been just as satisfactory as over the line to Woods Hill.

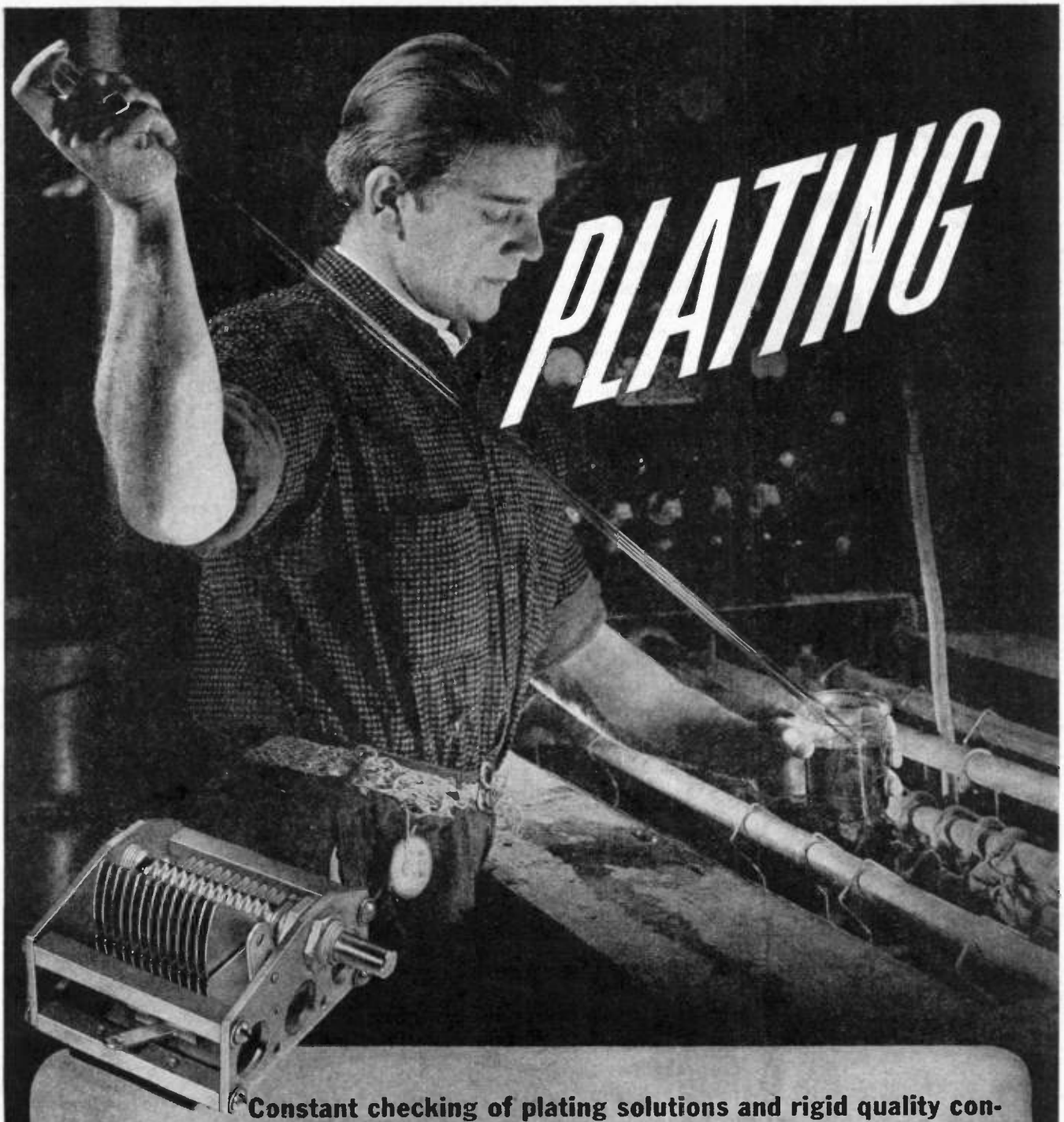
Relay Receiver ★ The final link on our communications chain is the relay receiver on the roof of the State House, adjacent to operating headquarters. Fig. 8 shows the coaxial receiving antenna on the penthouse where the set is installed. Figs. 9 and 10. This is a special design employing 18 tubes in a triple heterodyne circuit with 3 crystals. Surprising as it may seem, this receiver, after nearly three years of continuous operation, is still running on the original tubes.

A signal of approximately 100 microvolts is delivered to the receiver by the Mt. Kearsarge relay transmitter.

Volume Control Limiters ★ One addition to our system is not illustrated here. That is the Western Electric volume control limiters, employing Thermistors. These very simple units, employed on all telephone lines and on the AM transmitter, maintain a constant volume level without attention from the dispatcher.

Summary ★ The dependability of our system and the low replacement and maintenance cost emphasizes the soundness of Col. Caswell's policy of open-minded consideration of improvements resulting from technical progress, and his stern insistence that nothing new be made a permanent part of our facilities until, under service tests, it has demonstrated the stamina required to maintain our high record of completed transmissions. In other words, we are encouraged to improve the service our system performs for the public, but no extra flourishes are permitted that might fail under critical circumstances.

Thus, while we employ what may appear unusual methods in order to meet special conditions encountered in New Hampshire, every element in the system was selected as being best suited to the operating requirements of our State Police organization, and with cost a secondary consideration.



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