PRICE FIFTY CENTS

FM AND TELEVISION

JULY 1947

COMMUNICATIONS DIRECTORY – Part 1

MUNICIPAL POLICE
COUNTY POLICE
STATE POLICE
FIRE
FORESTRY
RAILROADS
PUBLIC TELEPHONE

LISTINGS REVISED TO JUNE 1, 1947

152 MC. FOR RAILROADS

(SEE PAGES 3 AND 35)

★ ★ Edited by Milton B. Sleeper ★ ★

CHICAGO
TRANSFORMERS and REACTORS

Sealed in Steel

For years, Chicago Transformer has met with outstanding success the varying requirements of the electronics industry for top-quality, custom-built transformers and reactors. Today, C.T. is augmenting this service to the industry with a new catalog line of units, to be manufactured on a standard design basis.

Now, small-quantity purchasers of transformers in the various fields of electronics—broadcast, communications, experimental, amateur, public address, and industrial control—can acquire for their equipment the advantages of progressive, practical C.T. engineering.

Now, large-scale manufacturers of electronic equipment who are in a position to utilize standard components can find in C.T.'s new catalog the transformer ratings and constructions that will fit their latest designs.

Characteristics of this new line are as up-to-date as tomorrow's laboratory project. Ratings have been skillfully selected, by men who know the trends in circuit design, to achieve maximum flexibility of application, close matching with today's preferred types of tubes, and conformance with RMA and FCC standards.

Modern, too, is the type of mounting used. Drawn steel cases and three variations of Chicago Transformer's famous **Sealed in Steel** construction will offer the combined advantages of "steel wall" protection against moisture and corrosion, efficient magnetic shielding, vibration-proof mechanical strength, compactness, and a streamlined appearance that spells "eye appeal" in finished equipment.

For further details, write for catalog

THE POWER LINE

Plate and Filament Supply Transformers with high voltage secondaries for both capacitor-input and reactor-input systems, and with corresponding filament supplies.

Plate Transformers for use in low to medium high power transmitters.

Filter Reactors accurately matched with the Plate and Filament Supply and Plate Transformers above.

Filament Transformers for supplying the filaments of today's most widely used tubes.

Bias Transformers—combination plate and filament supply.

Step-Down Transformers for operating radios and appliances on 220 volts, 50/60 cycles, in the export trade.

THE AUDIO LINE

Full-Frequency Range, 30 to 15,000 Cycles, provides uniform response over this entire band with ± ½ db up to 10 watts of audio power, within ± 1 db over 10 watts. Standard RMA impedances. Included are Input, Output, Driver, and Modulation Transformers; Modulation Reactors.

Public Address Range, 50 to 10,000 Cycles, frequency response within ± ½ db up to 10 watts of power, within ± 1 db over 10 watts, throughout this range. Secondary impedances match 600 and 150-ohm lines, 16, 8, and 4-ohm reproducing systems. Listed are Driver and Output Transformers.

Commercial Range, 200 to 3,500 Cycles, affords response with variations not exceeding ± 1 db over the range of voice frequencies. For use with 600 or 150-ohm lines. Input, Output, Driver, and Modulation Transformers offered.

CHICAGO TRANSFORMER
TRADE MARK REG.

CHICAGO TRANSFORMER

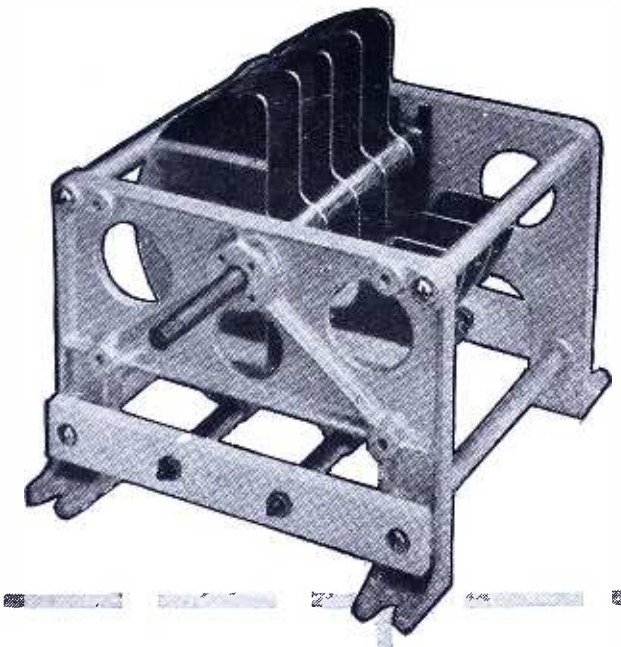
DIVISION OF ESSEX WIRE CORPORATION

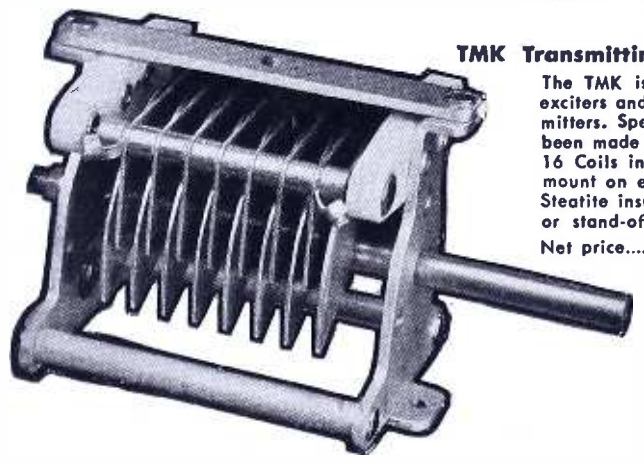
3501 ADDISON STREET • CHICAGO 18, ILLINOIS

TML Transmitting Condenser

The TML condenser is a 1 KW job throughout. Special Steatite insulators prevent flashovers. Thick capacitor plates provide high voltage ratings. Sturdy cast aluminum end frames and drual tie bars permit an unusually rigid structure. Precision end bearings insure smooth turning and permanent alignment of the rotor. End frames are arranged for panel, chassis or stand-off mountings.

Net price.....From $11.50 to $24.60





TMK Transmitting Condenser

The TMK is a condenser for exciters and low power transmitters. Special provision has been made for mounting AR-16 Coils in a swivel plug-in mount on either top or rear. Steatite insulation. For panel or stand-off mountings.

Net price.....From $2.30 To $5.11

The XOA Socket for Miniature Button 7-pin base tubes is made of low-loss mica-filled bakelite. It mounts with two 4-40 screws. Terminals for the Type XOA extend axially from the socket. Type XOR is identical to Type XOA, but has terminals extending radially. Axial or radial contacts can be used in the same socket base.

XOR Type Socket....Net price....$ .50

XOA Type Socket....Net price....$ .50

The XOS tube shield is a two piece shield for Miniature Button 7-pin base tubes. It mounts with the XOA or XOR socket and is available in three sizes, XOS-1 (for 1-3/16" tube body), XOS-2 (for 1½" tube body), and XOS-3 (for 2" tube body).

XOS-1 Shield.....Net price.....$ .48
XOS-2 Shield.....Net price.....$ .48
XOS-3 Shield.....Net price.....$ .48

QUALITY

IS THE ONLY BARGAIN IN RADIO PARTS

If you're building fine apparatus, National parts will help to deliver the kind of performance your equipment must have to sell successfully in today's competitive market.

That's why National parts are a fine investment. They may cost a little more — but in return you get quality materials, careful workmanship and long-life.

Send today for your copy of the new 1947 National catalog, containing over 600 parts.

National Company, Inc.
Malden, Mass.

National NC EST. 1914

Please write to Department 14 National Company, for further information.

MAKERS OF LIFETIME RADIO EQUIPMENT

The *BEST* method of modulating . . .

RAYTHEON

Simplified Phase Shift Modulation

COMPLETE 1KW OR 3KW TRANSMITTER

Transmitter of either power includes exciter unit in left compartment and amplifier in right.

Radio engineers agree that the best method of Modulating is Phase Shift. Investigate FM by Raytheon and *you'll* agree that the new simplified circuiting, inherent stability, and many important improvements engineered into Raytheon equipment render older, more complicated circuits obsolete. Note the advantages offered by Raytheon FM. For detailed information, write for Bulletin DL-R-406-546.

EXCLUSIVE, GREATLY SIMPLIFIED CIRCUIT provides greater stability and efficiency.

DIRECT CRYSTAL CONTROL of mean carrier frequency provides *inherent* stability. Simple linear type tank circuits for all stages in FM band—cannot get out of tune or adjustment.

CIRCUITS COMPLETELY SHIELDED to eliminate radiation, interaction and parasitic oscillation.

INCREASED POWER readily attained, by addition of another unit. All units matched in size, styling, colors.

CONVENIENT CUBICLE SIZES of units facilitate moving through doorways and installing.

LOW FIRST COST and *low operating costs . . .* achieved by greater operating efficiency, low power consumption and long life tubes and components.

RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

COMMERCIAL PRODUCTS DIVISION

WALTHAM 54, MASSACHUSETTS

Industrial and Commercial Electronic Equipment, Broadcast Equipment, Tubes and Accessories

Sales offices: Boston, Chattanooga, Chicago, Dallas, Los Angeles, New York, Seattle

Devoted to Research and Manufacturing for the Broadcasting Industry

FM AND TELEVISION

FORMERLY, FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 7 | JULY, 1947 | NO. 7

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THIS MONTH'S COVER

Air freight costs more, but it has the advantage of speed in handling perishables, and getting goods to market fast. What the Missouri Pacific Railroad is doing to meet that competition is told by Ray Maxwell in an article that starts on page 35. From it, you'll get another slant on the value of FM communications to the railroads.

This month's cover shows a 162-mc. locomotive antenna that is used by the M-P for radio conversation between the engine and caboose on long, red ball freights. The equipment is supplied by General Railway Signal Company.

Entered as second-class matter, August 22, 1945, at the Post Office, Great Barrington, Mass., under the Act of March 3, 1879. Additional entry at the Post Office, Concord, N. H. Printed in the U. S. A.

MEMBER, AUDIT BUREAU OF CIRCULATIONS

WHAT'S NEW THIS MONTH

1. Police Radio
2. Retail Selling

1. Police radio is now so firmly established as a public service that we read very little about it in the press. Like the men who use it, police radio is taken for granted. That's why we got such a kick from an editorial in *The Beatrice Times*, published in Nebraska:

"The city's new police radio gave Beatrice a convincing lesson in the effectiveness of modern crime control yesterday.

"In the amazingly brief time of twenty minutes it steered officers to the capture of a man who had robbed the First National Bank. An event that is most often attended either by a complete get-away, or the tragedy of bloodshed was reduced to a one-sided battle wherein the bandit groped his way blindly to defeat while the police, for once, had a better than even chance.

"Crime is only successful when the cards are stacked against enforcement. When the odds turn the other away, the criminal is as helpless as the next one. His exploit looks more foolish than daring.

"There was a good lesson in yesterday's event. It dawned on Beatrice that it had struck a real blow for the future security of the town. The news of such a fiasco as the bank bandit staged in the face of too-sharp enforcement will discourage many a craftier and more daring lawbreaker.

"In many places today hard faced men will be drawing a pencil line through the name of Beatrice. It's too hot for a surefire job. The police officers know how to make a pinch and the radio does too much talking.

"The community is also aware of another thing. The radio is a life saver for officers who must and who do go where danger calls. It is an unthinking community, a guilty community, that asks an officer to give his life for want of facilities that could have saved it.

"Good law enforcement facilities are more than just a nice thing to protect property. They are a moral obligation in defense of the lives of officers."

We'd like to add this footnote. The installation, supplied by Harvey Radio, cost more than the town could afford to pay. Consequently, the money was raised by public subscription. The First National Bank was one of the largest contributors!

(CONTINUED ON PAGE 56)

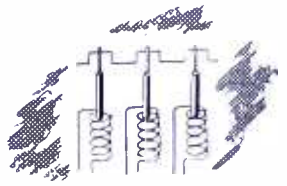
ZENITH IS STILL THE HOTTEST LINE IN THE INDUSTRY

That's Because of the Value-Giving, Sales-Making Features Made Possible By Zenith's Policy of

RADIONICS EXCLUSIVELY

ONLY ZENITH OFFERS SALES FEATURES LIKE THESE

RADIONIC COBRA TONE ARM

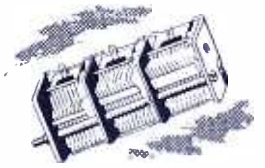


ARMSTRONG F-M

WAVEMAGNET

RADIORGAN

SILENT-SPEED RECORD CHANGER



3-GANG CONDENSERS

NEW SUPER-SIX TUBE

80% MORE POWERFUL PHONOGRAPH MOTOR

FIRST IN FEATURES

Watch shoppers on any radio sales floor. What set catches the interest of the crowds?—a Zenith, of course! That's because *every* model in the Zenith line is packed with features that actually *mean* something—features that reflect the design and engineering "know-how" developed during Zenith's years in the industry—features that insure *value*.

FIRST IN DEMONSTRABILITY

Zenith radios and radio-phonographs are *easy* to sell, because their features are the kind that you can actually *demonstrate*. The Cobra Tone Arm, for example, permits the most dramatic tone arm demonstration ever made. The Zenith "Radiorgan," the Silent-Speed Record Changer, the big, black dial, the Zenith Wavemagnet—all these are features you can show . . . features your customers will notice and want.

FIRST IN PERFORMANCE

From the original engineering blueprint to the finished sets that come out of the final testing booth, every Zenith is built to *work* . . . built with all the skill, the knowledge, the *pride of achievement* that marks this organization. The final test of every radio is how it *performs* . . . and Zeniths are built to pass that test with flying colors. Hundreds of thousands of well-satisfied Zenith owners attest to *that.*

ZENITH RADIO CORPORATION

6001 W. DICKENS AVENUE • CHICAGO 39, ILL.

PRODUCTS & LITERATURE

So many new instruments, components, and materials are being brought out that space does not permit us to publish illustrated descriptions of them all. Accordingly, rather than selecting a few each month, we have established this new department of Products & Literature so that a great number of brief descriptions can be published. From these, you can select items which interest you, and send for catalogs or bulletins. We'll appreciate it if you will mention FM and TELEVISION in your requests.

Portable Oscilloscope for observation of frequencies from .5 to 300,000 cycles is designed for interchangeable cathode-ray tubes with screens of short-, medium-, and long-persistence. — Model WO-60C, Radio Corp. of America, Camden, N. J.

VT Voltmeter for 10 cycles to 1.6 mc. Rated at .5 db variation over this range, or .1 db variation from 20 to 500,000 cycles. Five ranges cover .01, .1, 1, 10, and 100 volts. Also, logarithmic scale calibrated 1 to 10 and decibel scale 0 to 20 db are provided. Operates on 100–125 volts, 50–60 cycles. — Freed Transformer Co., Inc., 72 Spring St., New York 12.

Power Resistors of cement-coated type are illustrated and described in detail in a bulletin entitled "Why Cement-Coated Power Resistors?" — Clarostat Mfg. Co., Inc., 130 Clinton St., Brooklyn, N. Y.

FM Sweep Generator for aligning RF stages at 88 to 108 mc., and IF stages at 9.5 to 11.5 mc. For use with a cathode-ray oscilloscope. — Radio Corp. of America, Camden, N. J.

Eight Power Tubes described in new Eimac data sheets are: 4–65A power tetrode for mobile services in 160-mc. band, 4X150A external anode tetrode for use up to 1,000 mc., 4–1000A tetrode for FM broadcast transmitters, 3X2500A3 external anode triode, 3X2500F3 for industrial service, 3X12500A3 used in the 50-kw. FM transmitter at Mt. Diable, 4125 tetrode, and 4250A tetrode. — Eitel McCullough, Inc., San Bruno, Calif.

Dynamic Noise Suppressor for broadcast station use, to remove scratch and background noise from records and transcriptions. — Catalog 910A, Technology Instrument Corp., Waltham, Mass.

Rod Parters with capacity for cutting up to $\frac{3}{8}$- or $\frac{5}{8}$-in. cold rolled steel bars, features high-speed operation and great precision. — O'Neil-Irven Mfg. Co., Lake City, Minn.

Slide Switch employs lateral instead of rotating movement for FM-AM receiver band selection. Flat strip design reduces length of coil leads. Available with 5 to 20 clips on each side, with 2- or 3-position index. — Centralab Division of Globe Union, Milwaukee, Wis.

Subminiature Triode type CK608CX, capable of delivering 1 watt output as a Citizens' Radio transmitter, 460 to 470 mc. Size is $\frac{1}{4}$ in. in diameter by $1\frac{1}{2}$ ins. long, plus pins. — Raytheon Mfg. Co., Newton, Mass.

FM-Television Antenna comprised of a thin, 70-mc. dipole combined with a heavier, 128-mc. dipole, and connected together by feeder rings. Intended for home installations. — Tricraft Products Co., 1535-F North Ashland Ave., Chicago.

Television Camera designed for the image orthicon operates with about 10% of the light required for present iconoscope cameras. Functions at levels down to 25 ft. candles, produces sharp definition at 100 to 200 ft. candles. Rotary turret carries four Ektar lenses from 35 mm. F:2.8 to 135 mm. F:3.8. Viewfinder has 5-in. tube. — Radio Corp. of America, Camden, N. J.

Special Instruments requiring variations in designs of standard voltmeters, ammeters, and related instruments can now be ordered from the Marion short-run shop. — Marion Electrical Instrument Co., Manchester, N. H.

Radio Hardware items for apparatus construction and replacement, ranging from special, hard-to-get types of screws and nuts to springs, washers, dial cable, and tools. — Catalog 7F, General Cement Mfg. Co., Rockford, Ill.

High-Voltage Battery delivers 300 volts. Test life to 200 volts at 300 microamperes is 200 hours, based on 2-hour constant current per day. Dimensions $2\frac{11}{16}$ by $2\frac{7}{32}$ by $3\frac{13}{16}$ ins. — Type 493, National Carbon Co., 30 E. 42nd St., N. Y. C.

Cathode-Ray Tube for television receivers, 10 ins. in diameter, has aluminum-backed viewing screen to increase brilliance and definition, and to eliminate ion spot. Employs magnetic focusing and deflection. — Type 10FP4, General Electric Co., Tube Division, Schenectady, N. Y.

Tube Data on Hytron transmitter and special purpose types. Includes the new HY75A vhf triode and 12AL5 miniature twin diode for use as a discriminator, ratio or diode detector, AVC diode, clipper, or low-power rectifier. — Hytron Radio & Electronics Corp., Salem, Mass.

Fuses for instrument and equipment protection are described in the new Littlefuse catalog. Many new items are illustrated. — Catalog 9F, Littlefuse, Inc., 4757 Ravenswood Ave., Chicago 40.

Attenuators equipped with 2 Oilite bearings and ground, stainless steel shaft to assure smooth action. — Daven Co., 191-A Central Ave., Newark, N. J.

Parts Catalog of 72 pages, shows new components and sound equipment. — Concord Radio Corp., 901 W. Jackson Blvd., Chicago.

Tube Notes on applications of the 2E24 and 2E26 beam power transmitter types in 162-mc. circuits. — Radio Corp. of America, Harrison, N. J.

Small High-Voltage Condensers rated at 85° C. for DC operation on 8,000 to 20,000 volts. Cases are hermetically sealed, with solder-sealed glass terminal bushings. Among the standard types is a 1 mfd. condenser rated at 10,000 volts, DC with base dimensions $4\frac{1}{8}$ by $8\frac{1}{8}$ by $5\frac{1}{2}$ ins. high, and a 1 mfd. type rated 20,000 volts DC, with base dimensions $4\frac{1}{4}$ by $13\frac{1}{2}$ by 11 ins. high. — Catalog 203-F, Sprague Electric Co., North Adams, Mass.

Headset similar in appearance to stethoscope, weighing only 1.2 oz., has volume control to adjust response level. — Telex, Inc., Northwestern Bank Bldg., Minneapolis 2, Minn.

Facto Meter is a portable instrument which shows by meter indication the FM or AM signal strength picked up on a telescope antenna. Actually, the Facto-Meter is a portable FM-AM receiver for light-socket operation. It can be used to determine the best location for an FM-AM receiver using a built-in antenna, or to show if the signal level is so low that an outside antenna is needed. Price $124.95. — Bendix Radio Division, Bendix Aviation Corp., Baltimore 4, Md.

Textolite Plastics are described in great detail in a 64-page book which lists the properties and applications of 44 grades of fabric-base sheets, as well as rods and tubes. — General Electric Co., Pittsfield, Mass.

IF Converter for use with Measurements Corp. Model 78-FM standard signal generator. The converter makes it possible to obtain output voltages of 10 microvolts to 1 volt in the 4.5, 10.7, and 21.7 mc. ranges. One extra frequency can be added. With this addition, the 78-FM generator, which covers 86 to 108 mc., can be used for testing IF amplifiers and discriminators. — Measurements Corp., Boonton, N. J.

Chart of Miniature Tubes shows applications, characteristics, and socket connections for 48 types. — Chart MNT-30A, Radio Corp. of America, Harrison, N. J.

ENGINEERING SALES

Du Mont: Instrument and tubes sales division has been moved to Du Mont Laboratories Building 16, at 1000 Main Street, Clifton, N. J.

Burlington: New representatives for Burlington Instrument Company, Burlington, Ia., are: Ernest G. Hendrickson, 227 E. Sprague Avenue, Spokane 8, Wash.; Forrest C. Valentine, Ft. Wayne Bank Bldg., Fort Wayne, 2; White Sales Company, 10 High Street, Boston.

Farnsworth: E. J. Hendrickson has succeeded E. H. McCarthy as manager of the sales division at Farnsworth Television & Radio Corp. Hendrickson, who joined the Company in 1939, has been manager of the Chicago distribution branch since 1945. McCarthy has retired because of poor health.

GE: G. S. Perkins, who joined G.E. Supply in 1935, has been appointed sales manager of G.E.'s Musaphonic receiver line. He will make his headquarters at Bridgeport until the receiver division moves to Syracuse later this year.

Electro-Voice: Will be represented by LeRoy Beier Company, 600 S. Michigan Avenue, Chicago, in Wisconsin, eastern Iowa, and northern Illinois except Chicago.

Sprague: Export sales at Sprague Electric Company are now under William McMillan Adams, formerly of U. S. Rubber. His headquarters will be at North Adams, Mass.

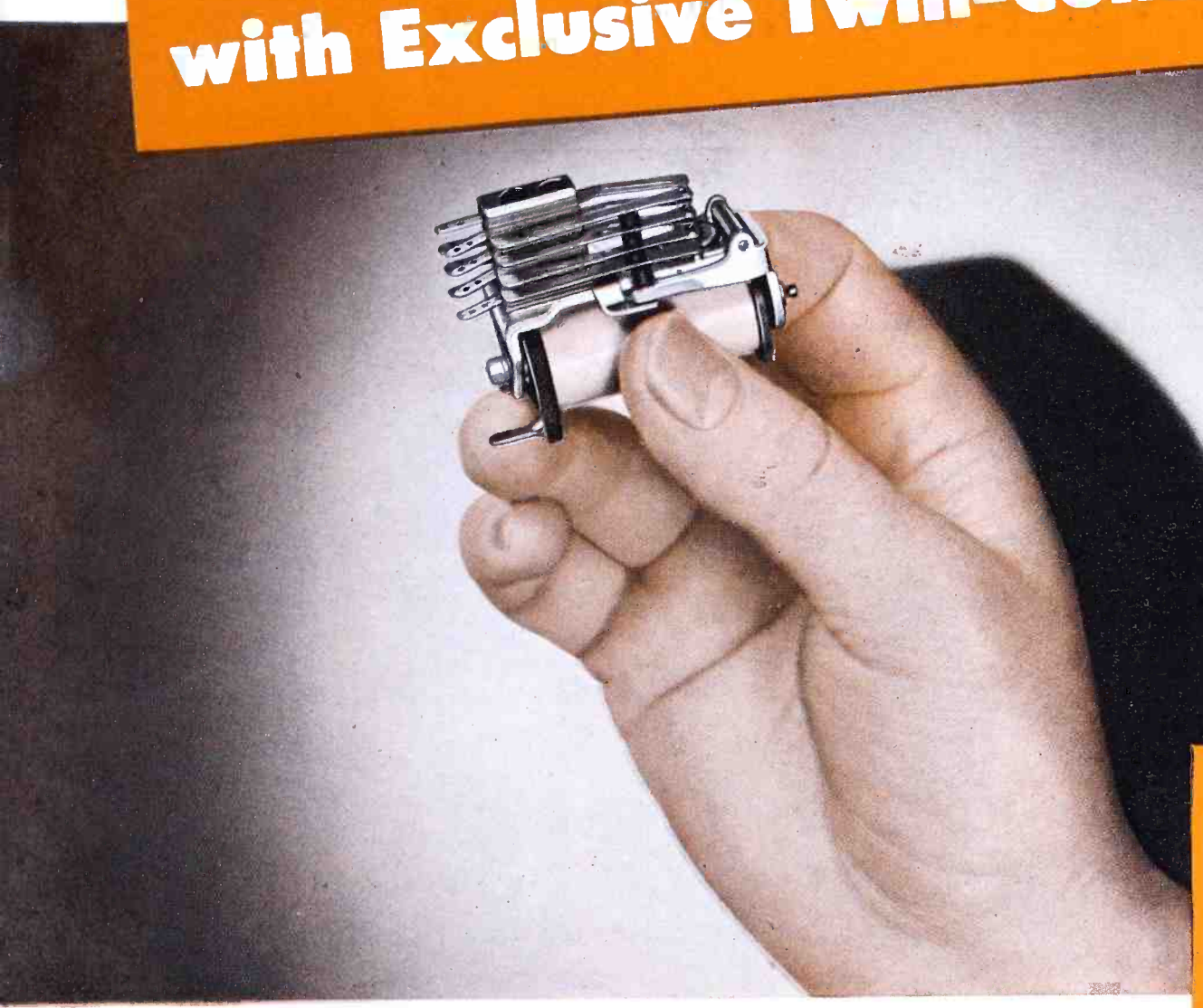
University: Edward Maged, formerly sales engineer for David Bogen, has joined University Loudspeakers, Inc., 225 Varick Street, New York 14. He will handle the coördination of sales engineering, sales promotion, and advertising.

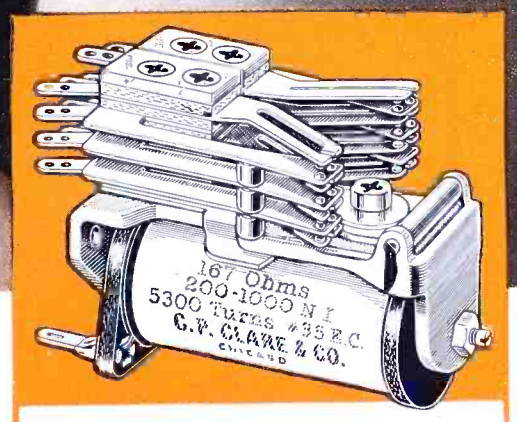
S-C: William J. Kelly, for 9 years the eastern district manager for McGraw Electric, has joined Stromberg-Carlson as district merchandiser for the eastern seaboard as far south as Virginia.

Bendix: Newly appointed distributor for Bendix radios in Seattle and Spokane areas is F. B. Connelly Company, Seattle. They will also handle Bendix distribution in Alaska.

Majestic: Sam F. Arn, Jr., has succeeded Paul Sperling as service manager for Majestic Radio.

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





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

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

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

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

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

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

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

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

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

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

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

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

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

CLARE RELAYS

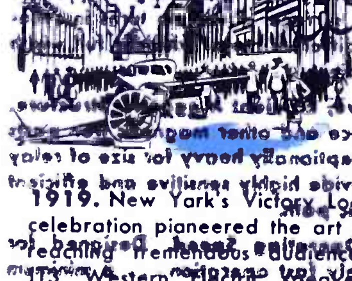
"Custom-Built" Multiple Contact Relays for Electrical and Industrial Use

Why this team can bring

ACTIVE DEVELOPMENT of loudspeakers moved forward after World War I, when Western Electric produced the 196W, employing a non-magnetic diaphragm driven by an armature. First used in the Victory Loan campaign of 1919, the 196W took part in the national political conventions of 1920, the presidential inauguration of 1921, and the burial of the Unknown Soldier later the same year. Success of these pioneer public address systems rested not only on loudspeakers but also on high quality microphones and amplifiers—all Western Electric developments.

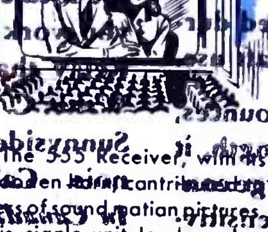
Continual progress in the intervening years has kept pace with the development in Bell Telephone Laboratories of telephone transmitters and receivers for the Bell System. Fundamental to both loudspeakers and telephones have been the Laboratories' pioneering studies in sound, speech, hearing and the theory of vibrating systems.

Sound distribution systems, sound motion pictures and radio broadcasting all have benefited from the teamwork which has done so much to make possible today's efficient, powerful, wide-range



1919. New York's Victory Loan celebration pioneered the art of reaching tremendous audiences. 113 Western Electric speakers made possible this mass demon

1924. Non-directional, small in size, yet extremely wide in range for its day, the 540 cone speaker designed for broadcasting was so popular for home receivers that it became a symbol of early radio.



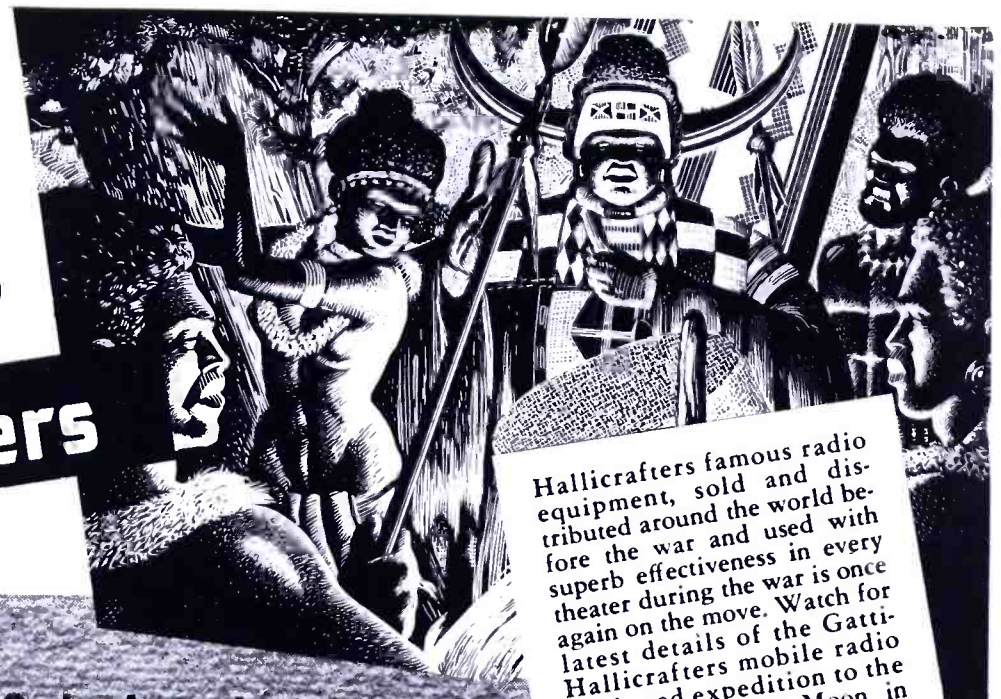
1926. The 555 Receiver, with its large ... contributed to the success of sound motion pictures. From this single-unit loudspeaker grew the high quality wide-range theatre speaker systems of today.

1931. The introduction of the 750 ... the first really wide-range direct radiator. With the proper mounting, this speaker covers a frequency band from 80 to 10,000 cycles. Still a popular speaker.


you loudspeakers like these
728B 12" direct radiator, 30 watts continuous capacity. Frequency response 60 to 10,000 cps.
757A two unit system, using 728B plus separate high frequency speaker. Frequency range 60 to 15,000 cps.
756A 10"
TODAY
Western Electric
direct radiators, high fre
designed by Bell Telephone
ments for highest quality sound whether you
watt speaker, or a giant theatre-type system
No matter which you select,
the public
QUALITY COUNTS
BELL TELEPHONE LABORATORIES
Western Electric
of the Bell System and the nation's largest

Going places (AGAIN)

hallicrafters



Hallicrafters famous radio equipment, sold and distributed around the world before the war and used with superb effectiveness in every theater during the war is once again on the move. Watch for latest details of the Gatti-Hallicrafters mobile radio equipped expedition to the Mountains of the Moon in deepest Africa—a new and exciting test for the ingenuity of hams and the performance of Hallicrafters equipment.

3 GREAT RECEIVERS designed and priced for hams who are going places, too

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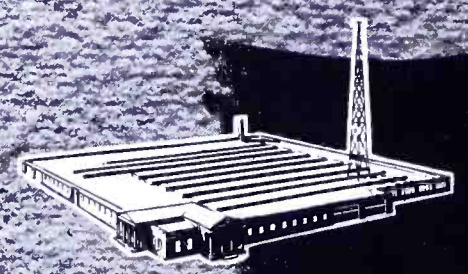

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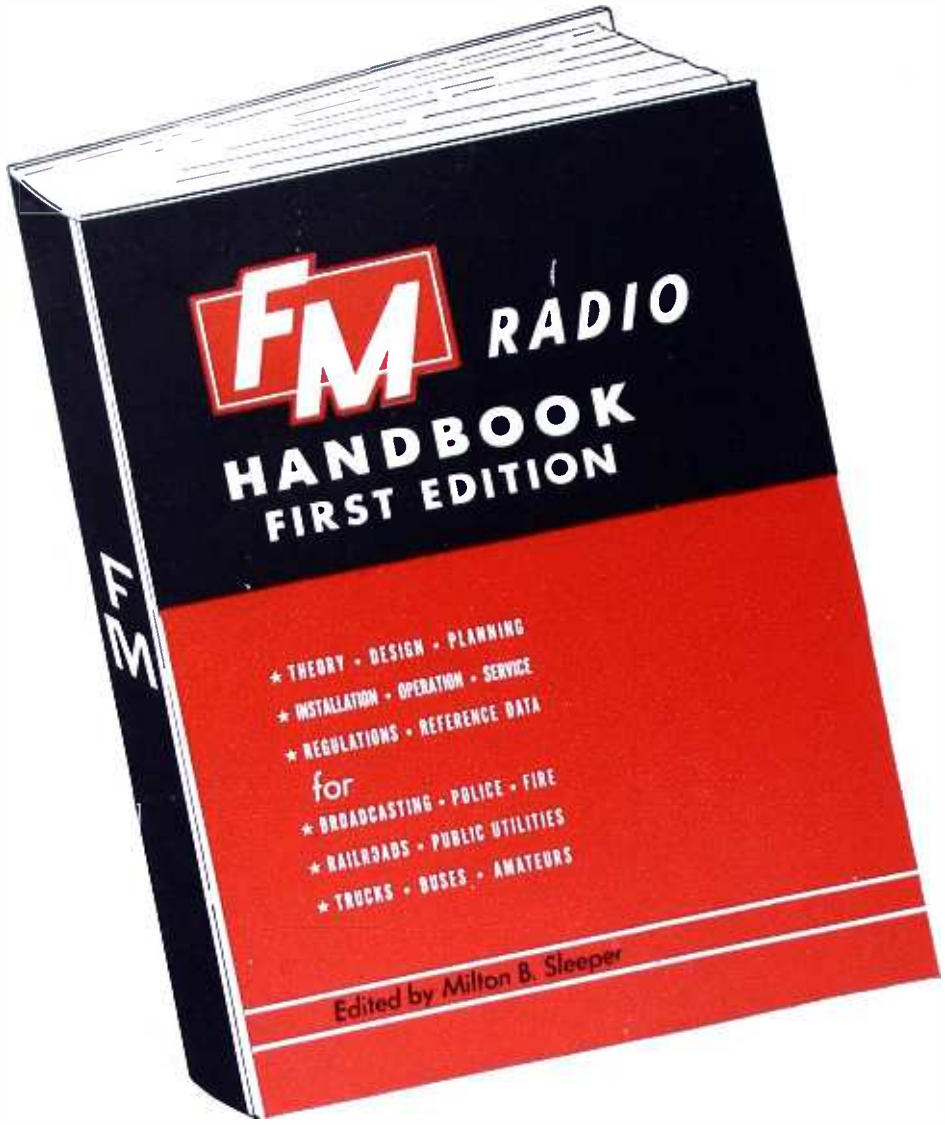

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2. Theory of FM: by Rene Hemmes. This is the most complete and understandable explanation of FM theory ever written. By using charts and diagrams, the functions of FM circuits are shown clearly, without recourse to mathematics. This chapter explains all the special features of receiver design, including AFC; and transmitter design, including the Armstrong dual-channel modulator.

3. Business of FM Broadcasting: by Milton B. Sleeper. Answers questions from those planning to enter FM broadcasting.

4. FM Studio Techniques: by D. W. Gellerup. Explaining fundamental differences between AM and FM techniques.

5. Coaxial Lines for FM Transmitters: by C. Russel Cox. A complete exposition, with working charts and mechanical layouts.

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7. High-Fidelity Reproduction: by John K. Hilliard. Describing the operation and design of coaxial speakers and high-fidelity amplifiers.

8. Antennas for Communications Frequencies: by James A. Craig. Covering all types of antennas for 30 to 44, 72 to 76, and 152 to 156 mc.

9. Selective Calling Methods: by Milton B. Sleeper. Explanation includes a call-number chart for individual and group calling.

10. Maintenance of Communications Systems: by Frank Bramley. How Connecticut State Police handles the maintenance of 332 cars and 11 main stations.

11. Alignment of FM Receivers, by Bernard J. Cosman. The fast, visual method for aligning FM broadcast and communications receivers.

12. WWV Signals for Frequency Checking, by Arthur Fong. Describing a receiver for checking circuits, meters, and modulators from WWV transmissions.

13. Railroad Radio Installations: by Arnold Nygren. Presenting factual data on their operation and performance.

14. Notes on Facsimile Equipment, by Frank R. Brick. Outline of progress for commercial and broadcast services.

15. FCC Standards of FM Engineering Practice, corrected to January 1, 1947.

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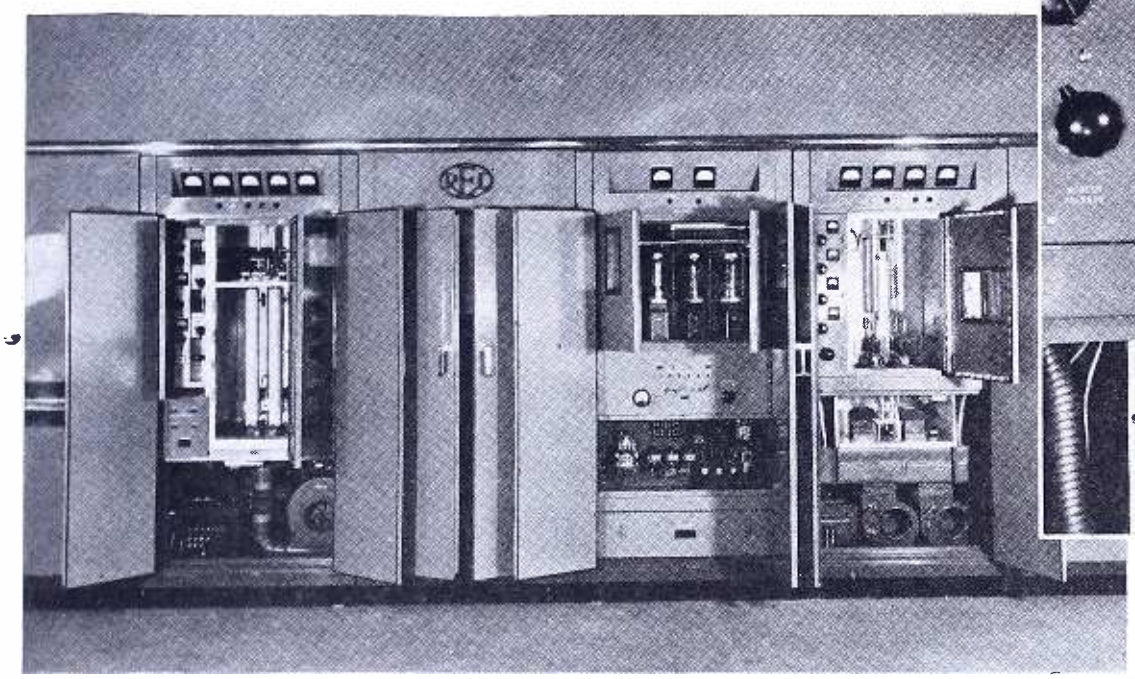

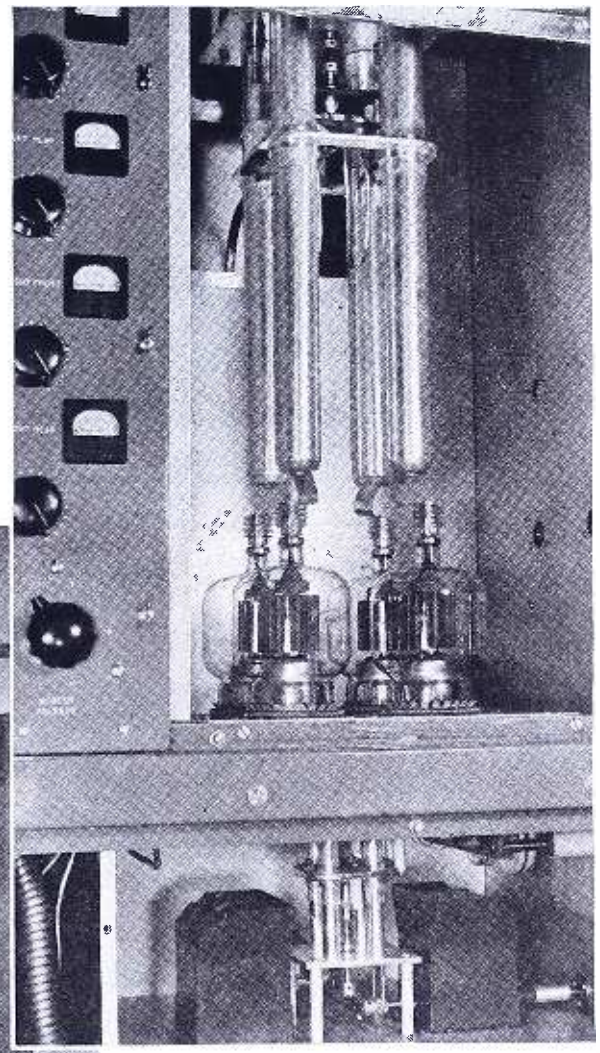

LEFT: COMPLETE REL 10-KW. FM TRANSMITTER, COMPRISING 1-KW. DRIVER, 10-KW. QUADRILINE AMPLIFIER, AND POWER SUPPLY.

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NEW Arc-Back Indicator in Western Electric FM Transmitters spots faulty mercury vapor rectifier tube surely . . . instantly!

Arc-backs in mercury vapor rectifier tubes are rare—but when one occurs it is *essential* that you locate the faulty tube *at once.*

And that is exactly the function of the new Arc-Back Indicator, an exclusive feature of Western Electric FM Transmitters of 10 kw and higher powers.

Gone is the uncertainty as to which tube is at fault, for the Arc-Back Indicator shows you *instantly* . . . enables you to get back on the air in a fraction of the usual time.

The new Indicator is only one of the *major* features which put Western Electric FM Transmitters in a class by themselves. The Power and Impedance Monitor—which gives an accurate, direct measurement of the actual RF power fed to the antenna system and, in addition, a method of measuring standing wave ratio under full power output—is another. The Frequency Watchman for precise, dependable frequency control is a third.

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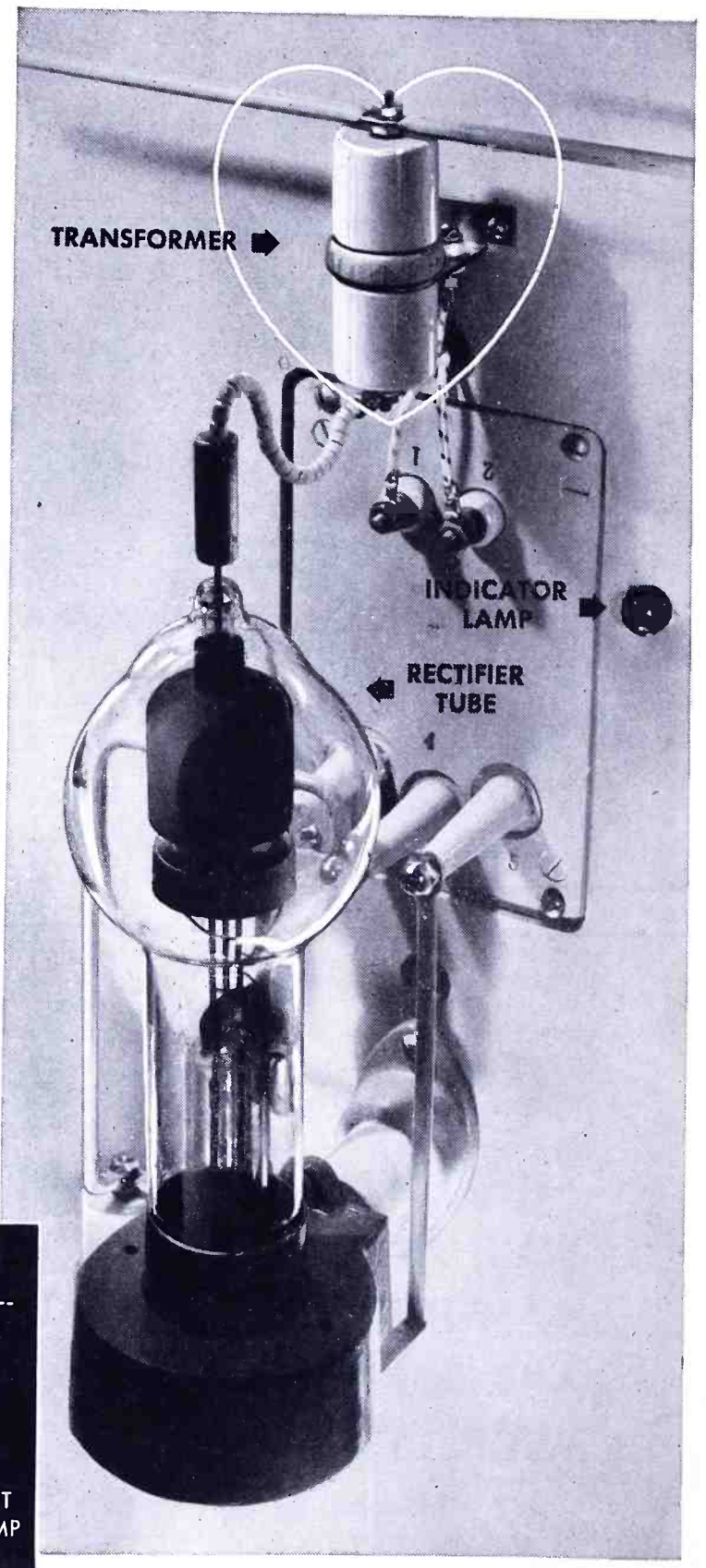

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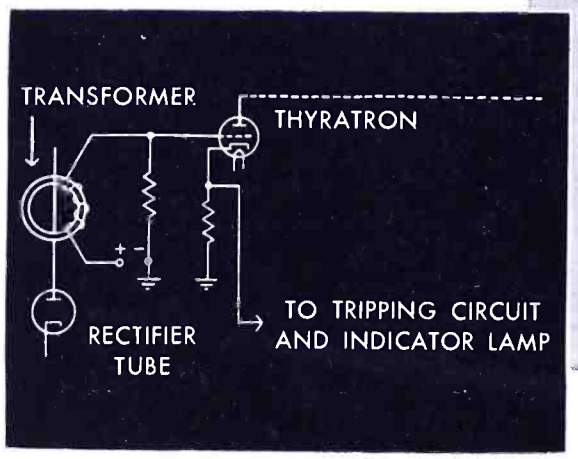


Heart of the new and exclusive Arc-Back Indicator circuit is a saturated toroidal transformer which responds only to reverse current in its associated rectifier tube. When an arc-back occurs, the voltage from the transformer fires a small thyratron tube which removes high voltage and lights the proper indicator lamp, visible through the glass front door of the TRANSVIEW design transmitter. In case of a string of "sympathetic" arc-backs, only *one* indicator lamp is fired—the one associated with the rectifier in which the *original* arc-back occurred.

— *QUALITY COUNTS* —

REPORT ON 2-WAY FM COMMUNICATIONS

A Review of the Market for Communications Equipment, Its Postwar Expansion, and Future Growth

BY MILTON B. SLEEPER

THE growth of 2-way FM communications systems since the war has been the most astounding and least publicized development in the radio industry. On June 1st, there were 8,250 licensed installations, with upward of 100,000 mobile units in operation. A daily flood of new applications pours into the FCC.

Viewed as a market for equipment supplies, accessories, antennas, and test instruments, it is becoming a close second to home radio sets, and the number of installations has grown to the point where replacements add up to a very substantial secondary market.

FCC figures divide the licenses issued to date in this way:

Emergency Services:	
Police	3,342
Fire	43
Forestry	683
Special Emergency	168
	4,239
Experimental Services:	
Experimental	1,448
General Mobile	1,568
	3,016
Public Utilities	879
Railroads	93
Fixed Public Telephone	23
	8,250

In the Communications Directory which appears in this issue, each listing shows the number of licensed mobile units. However, the FCC is now preparing to ask each new applicant to file for the number of mobile units he *expects* to operate, and the license will cover the operation of that number. The purpose is to eliminate the paper work at the FCC each time a licensee adds another mobile installation.

Growth of the Market ★ The present size of the market for mobile equipment is indicated by Part 1 of the Communications Directory. This, however, covers only police, fire, forestry, and railroads. Part 2, which will be published in January, 1948, will show experimental, general mobile, special emergency, fixed public telephone stations and public utility systems. It has become necessary to divide the Directory in this manner because the magnitude of the work involved in preparing the listings has grown to such proportions that it is no longer possible to do the complete job twice a year.

The present number of systems, large as it has become, is no indication of the ultimate extent of this market. Rather, the postwar expansion is only a beginning of what is to come. Already, 27 railroads are using 2-way FM communications. They are operating 642 mobile units now, but that is barely a start on their ultimate requirements. So far, the roads have done little more than to set up test installations. These have proved successful far beyond their expectations in saving time and money and in accident prevention. From now on, railroad radio will expand at a fast pace.

The use of radio by forestry departments is being extended, particularly since they have found the channels in the 152- to 162-mc. band so well-suited to their needs.

Public utilities, including electric and gas companies, pipeline operators, and street car lines are swelling the number of communications systems at a rapid rate. Adding to this list are patrols covering large oil and other storage installations, and irrigation systems.

Greatest increase of all is in urban and highway communications. This group includes taxicabs, trucks, and buses. Within the next 12 months, the number of systems may exceed the police group. The reason is that the cost of radio equipment is quickly offset by the saving in operating expense.

Sale and Distribution ★ The selection of a particular make of equipment is determined largely by the past experience of the communications engineer in charge of a new installation or, in smaller systems where an engineer is not employed, by the recommendation of some recognized local expert.

The most important factor in the favorable consideration of any particular make is the availability of installation and maintenance service. In other words, the company that gives the best service in any area generally has the greatest number of installations. This, then, is a field which requires aggressive salesmen who can plan systems, solve frequency problems, fill out FCC applications, supervise installations, and service the equipment until local maintenance men can be found and trained. It sounds like quite a job, and it is.

Now, many parts jobbers who have specialized in amateur gear are handling communications equipment sales. They have established places of business, salesmen who cover industrial accounts, and experts who can put their knowledge of amateur equipment to good use in handling installation and maintenance on communications systems.

This, in fact, is the biggest new field of new business that has opened up for the larger parts jobbers.

It also affords new opportunities for highly skilled servicemen. A great many systems are not large enough to justify the employment of a full-time engineer or maintenance man. However, since the failure of the headquarters transmitter or even one mobile unit is a serious matter, it is necessary to have a maintenance expert on call at all times.

Usually, in such cases, a local expert is employed on a monthly basis to handle repairs and to check transmitter frequencies and receiver alignment at regular intervals.

Frequency Problems ★ There are two frequency problems in the communications field that have not been settled, and which are growing more serious as the number of licenses increases. First, there is the matter of assigning frequencies in the bands allocated to 2-way communications. Second, there is the need for widening the present bands. For example, only 2 channels are now available for taxicabs, out of the all-too-few urban mobile channels. Taxi systems are still being given Class 2 Experimental licenses on 152.27 and 157.53 mc., pending a final determination. Since these systems use one frequency to talk to the cars, and the other for talking back, they are faced with a difficult situation in many cities.

The Telephone Company has available only a fraction of the channels needed for mobile equipment in trucks, buses, and private cars to provide communications with regular telephone subscribers.

That refers to common carrier 2-way service, available for the use of all subscribers. In addition, there are concerns engaged in operating fleets of trucks for moving, delivery, and all kinds of public services that want to operate their own radio systems. It is possible that they will be required eventually to subscribe to common carrier service, probably operated by the local Telephone Company, but no decision has come from the FCC on that point. Increasing use of radio by bus lines further complicates this situation.

As to the expansion of communications bands, there is trouble of a different sort. When the lower television channels

were set up on June 27, 1945,[1] the FCC's plan called for them to be "shared by television and police control and relay circuits, point-to-point, marine control circuits, forestry, rural telephone, studio-transmitter links, and railroad, terminal, and yard operations on a mutually non-interfering basis." These are:

Television Channel:

No. 1	44–50 mc.
No. 2	54–60
No. 3	60–66
No. 4	66–72
No. 5	76–82
No. 6	82–88

Now that we have begun to collect actual operating data on television-communications interference, it begins to look as if a "mutually non-interfering basis" may be impossible to achieve.

First official consideration of this problem came at an FCC conference at Washington on June 10 and 11, with FCC Chief Engineer George E. Sterling presiding. Both the television and communications groups were well represented at this initial discussion. However, no decision can be reached until after a public hearing is held. No change in the present situation can be expected, therefore, in the immediate future, but some shift is certain in view of the tremendous expansion of communications services.

Channel Width ★ In considering plans to increase the efficiency of band utilization by narrowing the channels, factors of frequency swing due to modulation and frequency stability must be considered. At present, the maximum deviation of FM communications transmitters is 7.5 kc. each side of the assigned center frequency.

Channel width is:

30 to 100 mc., 40 kc.
100 to 216 mc., 60 kc.

Required frequency stability is:

Below 50 mc., ± .01%
Above 50 mc., ± .005%

The FCC has proposed that the channel widths be reduced 50%. However, this would be worth while only if it can be done in such a manner as to permit alternate-channel assignments in adjacent areas, as is the case now. The FCC recognizes, furthermore, that the channels can be reduced in width only if suitable equipment can be manufactured at no more than a slight increase over the cost of equipment now in use. It is understood that new designs are in process of development, but there is no conclusive evidence to indicate a practical solution to the problem of reducing the channel width.

[1] For allocations from 25 mc. to 30,000 mc., see *FM* AND TELEVISION, May, 1945. For the final allocations from 42 mc. to 108 mc., see *FM* AND TELEVISION, July, 1945. Details of allocations for 42 to 44, 72 to 76, and 152 to 156 mc. will be found in the STANDARD FM HANDBOOK.

Directly related to channel width is frequency stability. At 152 mc., for example, the permissible drift from center frequency (.005%) amounts to 7.2 kc., or nearly as much as the maximum deviation under modulation. At 40 mc., permissible drift is 4 kc. from the center frequency. From this it is clear that any plan to narrow the channels must provide increased center-frequency stability.

FM vs. AM ★ The Communications Directory shows that virtually all new installations employ FM, and that many old AM systems have been changed to FM since the war. We have asked communications engineers: What is the most important advantage of FM over AM. All those consulted agreed that the capture-effect protection against interference from other stations is FM's No. 1 advantage.

That is easy to understand for, as everyone in the communications field knows, the vagaries of long-distance transmission from 30 mc. to frequencies above 100 mc. are such that AM heterodyne squeals would create serious interference under the crowded conditions in the 2-way communications bands, particularly outside the built-up urban areas.

Police Radio ★ The number of police radio installations is still growing steadily, and mobile units are being added to existing systems. The saturation point is not in sight. Police radio now represents a large replacement market because prewar equipment is becoming obsolete, AM systems are being modernized by shifting to FM, and changes are being made to coördinate municipal installations on an area-wide basis to form nets and to utilize channels more effectively.

Facsimile will soon bring further expansion to police radio. There is not yet sufficient experience to indicate how this will be set up. In some states, it is expected that facsimile equipment will be installed at state police barracks, through which information to and from municipal police will be handled. In cases where facsimile transmission will have to be relayed between remote barracks and the state capitol, direct rebroadcasting may be employed, with receivers feeding into transmitters at the intermediate points. This would avoid loss of detail resulting from repeated recording and scanning. By the end of 1948, facsimile will have made considerable progress in police communications.

Fire ★ Many fire department systems are listed for the first time in the new Directory. Also, a large number of mobile units have been installed on fire equipment for operation as part of municipal police radio systems.

The Underwriters still have not given radio communications the recognition it deserves as a means of added protection, however. On the other hand, insurance rates are reduced in many instances as soon as additional fire alarm boxes are ordered for future delivery, in spite of statistics showing that fire alarm boxes are the source of nearly all false alarms, and an increasing number of false alarms!

Some work has been done on radio alarm equipment, particularly for use in isolated locations. However, established manufacturers of fire alarm equipment, whose business has been built up around patented wire-operated systems, are unwilling to go into the sale of radio-operated equipment because that would jeopardize their patent structures. Since these concerns are so well established in their field, it is difficult for a newcomer to break in. Meanwhile, developments in the radio art will eventually bring about the replacement of wire-operated equipment with its high cost of maintaining cables. This will probably create a complete revision of planning systems and locating alarm boxes.

The possibility of power failure at radio alarm boxes is offset by the failures of cables, with the factor of economy greatly favoring the use of radio.

Forestry ★ The use of radio by Forestry and Conservation Departments is growing with our increasing national awareness of the need for protecting timber lands. Wire lines from observation towers to headquarters points are uncertain, at best, and can be depended upon to fail in fire emergencies. Also, they require constant maintenance.

Since fixed stations are always located in observation towers at high elevations, radio communication, particularly on the higher frequencies, is ideal for the forestry services. This is brought out by Ray L. Atkinson, whose report on a survey in Florida appears in this issue.

Public Utilities ★ The use of radio by public utilities has proved highly advantageous, so much so, in fact, that the number of licenses issued in this group is growing to the extent that a shortage of channels may develop unless new provisions are made. Appropriate action can be expected from the FCC, since the dispatching of repair crews to meet emergencies is an important public service.

Taxis ★ To give the taxicab operators a chance to feel their way into the use of radio, this service was started on an experimental basis. Final determinations as to frequency assignments have not been made yet. Meanwhile, cab operators have found that radio dispatching quickly saves the cost of the equipment by reducing cruising mileage, and getting more fare-miles from a given number of cabs. Time is also saved when a cab breaks down on the road. Standard practice is to use one frequency to talk to the cars, and a second for talk-back.

(CONTINUED ON PAGE 61)

153-MC. FM FOR FORESTRY SERVICE

Results of a 6-County Survey Show Consistent 20-Mile Communications

BY RAY L. ATKINSON *

THIS report covers a study of the practical nature of FM radio transmissions on 153.65 mc. over terrain in the State of Florida.

The contents of the report are compiled for the benefit of Forestry Service officials, as well as radio engineers, and should be of interest to Forestry-Conservation and other radio services contemplating the use of 152- to 162-mc. equipment.

The first six of the 35 surveys planned were completed January 15, 1947. Surveys began October 30, 1946. The Florida Forest Service is sponsoring these surveys in the interest of Forestry Conservation and the radio art. Assistant Communications Engineers Ovid R. Gano and R. E. Greene are expediting the technical phase of the work.

General ★ The decision to use low power land station transmitters was based upon the economical factor entering into all purchasing by Forestry Departments. The surveys include measurements made at sea level up to 240 ft. above sea level. Temperatures ranged from 31° to 101° F. Tests were conducted day and night at various elevations and under wet and dry weather conditions.

All tests were carried out from 100-ft. observation towers, except in Bay and Calhoun counties. The Bay County fixed antenna was placed atop a 100-ft. steel antenna tower, while the Calhoun fixed antenna was mounted on a city water tank approximately 100 ft. above ground.

The surveys were conducted over a period of several months, namely October, 1946 to January, 1947, a period deemed sufficient to establish any adverse characteristics of transmission and reception in the 152- to 162-mc. band for Forestry use in this section of the Country.

In all cases, solid dielectric transmission lines were used to feed the fixed antenna. Both 72-ohm and 53-ohm cables were employed. The attenuation factors of the several types of cables and the length of the cables allowed approximately 50% of the output power of the land station transmitter to be delivered to the fixed antennas.

Mobile antennas were of the quarter-wave vertical type mounted directly on top of the car roof. Ground-plane antennas were tested as mobile gear with very satisfactory results.

Radio Equipment ★ Keeping in mind the portability features necessary for making a series of surveys, equipment was selected which would be suitable for repeating electrical and mechanical arrangements with but minor deviation from the original equipment set-up. For this purpose, the following items were used in the tests:

LAND STATION WAWP

Transmitter	Motorola FMTU-30D
Receiver	Motorola FMRU-16V
Transmission Line	RG 11 U 160 Feet RG 8 U 110 Feet
Antennas	Half-Wave Dipole, Concentric Half Wave, Ground-Plane, 3-Element Colinear
Antenna Support	100-Ft. Steel Tower
Transmitter Power	30 watts output
Antenna Power	15 watts approx.
Signal Strength Meter	Motorola P-8100
Frequency	153.65 Mc.

MOBILE STATION WAWQ

Transmitter	Motorola FMTU-30D
Receiver	Motorola FMRU-16V
Transmission Line	RG 8 U 10 ft.
Antennas	Quarter Wave Ground Plane
Antenna Supports	Car top for quarter wave Hand held for ground plane
Transmitter Power	30 watts output
Antenna Power	30 watts approx.
Signal Strength Meter	Motorola P-8100
Frequency	153.65 Mc.

Figs. 1 and 2 show the cars.

Survey Procedure ★ Predetermined locations were first selected from maps of each county. Measuring points were plotted against terrain and road distribution, in order to obtain the most complete collection of effective field strength recordings. Travel schedules and routes were selected and adhered to rigidly during the test runs.

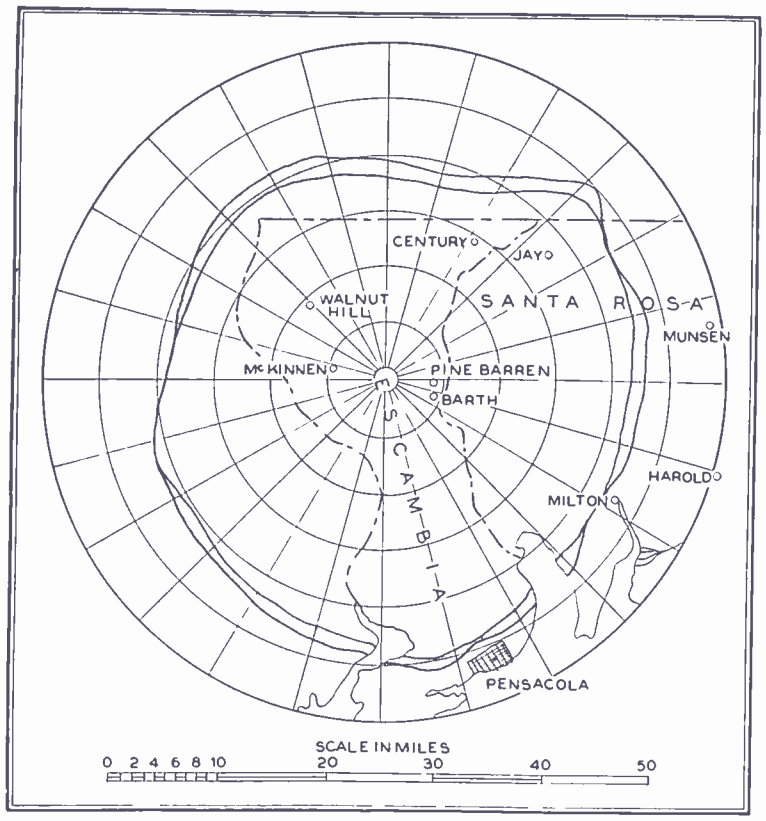
Mechanical and Physical Layout ★ The land station was set up in each location in the same manner. The car containing the radio equipment was placed close to the base of the 100-ft. steel observation tower. Transmission lines were then run upward to the cab of the tower and connected to antennas mounted slightly above the top of the metal roof. A typical installation is shown in Fig. 1. Separate transmission lines were used in order that antennas could be changed by the operator on the ground. After each antenna changeover, transmitter and receiver were retuned to conform with original settings.

The mobile station mounted in the test car made use of the standard equipment. The quarter-wave vertical antenna was seated at the center of the car roof. Ground plane antennas, tested in motion, were held by hand.

Recording Signal Strength ★ Data was recorded in terms of microamperes grid current in the first limiter stage of the receiver. Mobile station data was obtained while in motion by use of extension cable from the receiver to a P-8100 meter in front seat of car. No-signal levels of each receiver were checked several times daily

FIG. 1. TEST CARS AT GAINESVILLE TOWER WITH CABLES RUNNING TO THE ANTENNA

* Communications Engineer, Florida Forest Service, Box 243, Lake City, Fla.



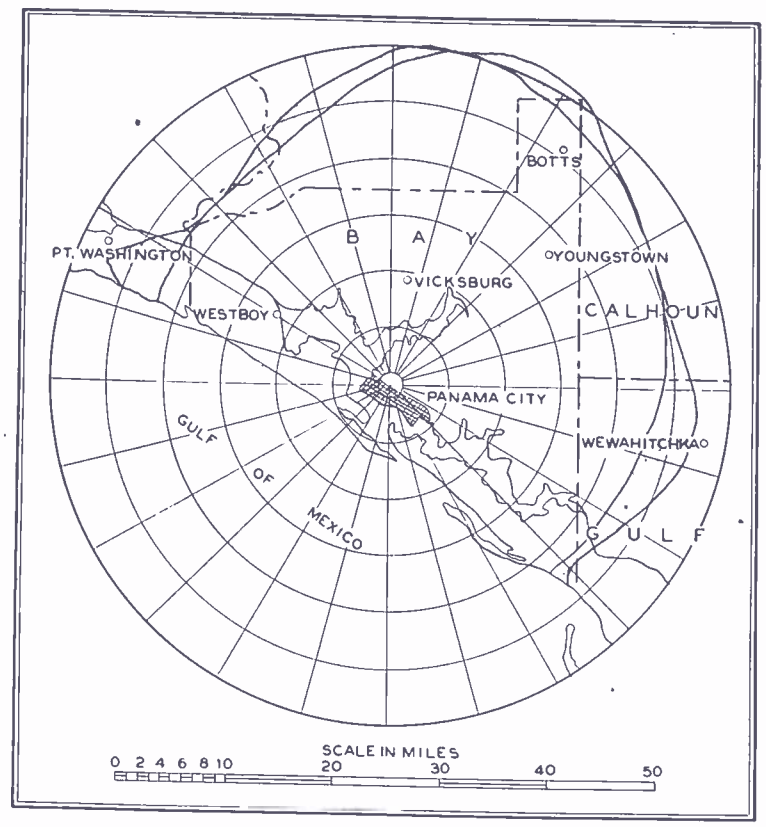


FIG. 4. ESCAMBIA, WHICH RUNS TO THE GULF, IS A MIXTURE OF SAND AND RED CLAY. FIG. 5. BAY COUNTY ALSO LIES ON THE GULF

for consistency of recorded data and meter reading ratios.

Types of Terrain ★ The survey included runs in the Northeastern part of Florida where the earth levels are predominantly flat. The counties of Duval, Nassau, and St. Johns are particularly flat, having sandy soil and elevations from sea level to 45 ft.

In the northwestern counties of Escambia, Calhoun, and Bay, only Bay has characteristics similar to those of the northeastern counties. Escambia county varies from sea level to more than 100 ft. above. Escambia has a mixture of sand and red clay earth. Rolling hills and flat terrain are both encountered here.

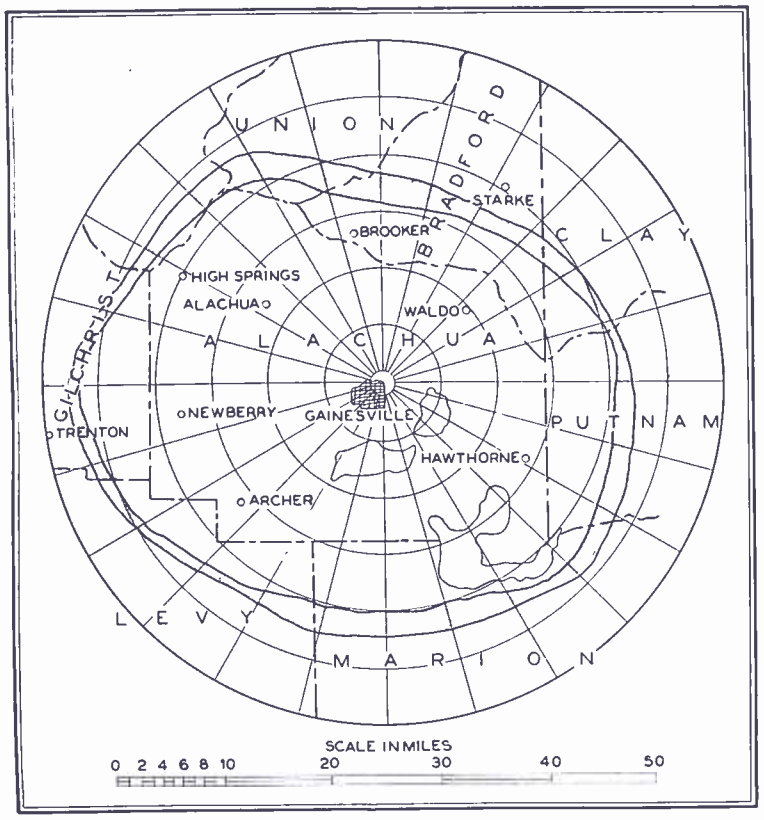
Alachua County is predominantly sandy soil, with low rolling hills and elevations above sea level ranging from 40 to 150 ft.

Forest types in all these counties are primarily pine species, interspersed with oak and other hardwood. Timber stands are usually thick and comparatively evenly spaced. Stands vary from seedlings to average heights of 60 ft. Average tree diameters in these areas are approximately 11 ins.

Lakes, rivers and hammock are numerous throughout the surveyed area. The Atlantic Ocean borders the eastern coast of Duval, Nassau, and St. Johns counties, while the south coast of Escambia and Bay is bordered by the Gulf of Mexico. Calhoun and Alachua are inland counties.

Survey Results ★ General coverage results can be seen by referring to the coördinate graph sheets prepared for each individual county. However, the effective results are very interesting and are treated separately in the following paragraphs. Figs. 4 to 9 depict the conditions encountered.

FIG. 2. MOBILE STATION WAWP LEFT, AND WAWQ, RIGHT, USED WITH TOWER ANTENNAS. L. TO R., THE AUTHOR, EXTENSION RANGER PARNELLE, ASST. ENGINEER GANO, PUBLIC RELATIONS ASSISTANT BOUTWELL, GETTING READY FOR THE ALACHUA COUNTY TESTS



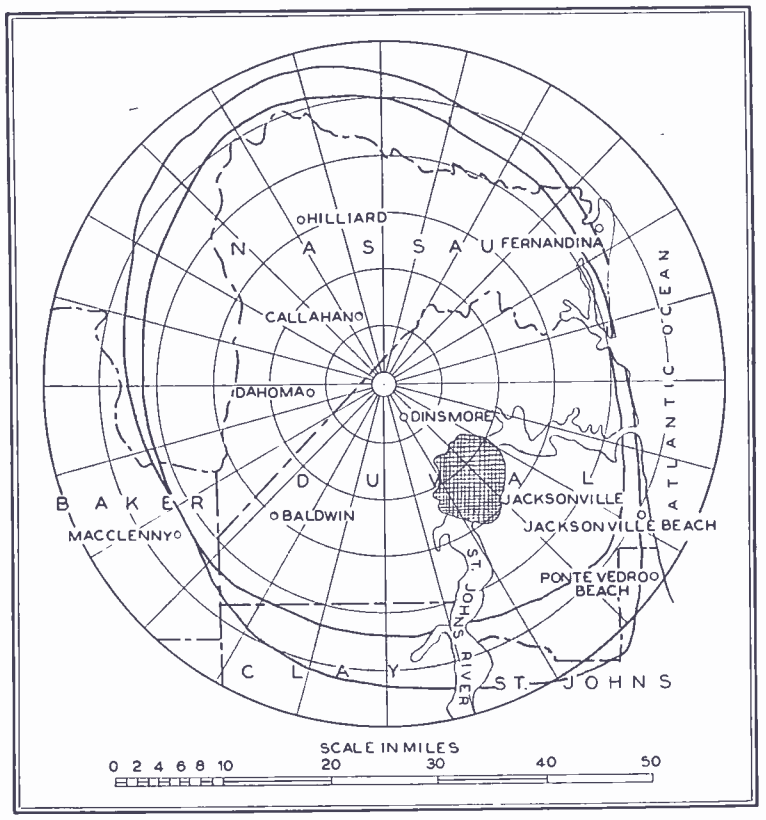


FIG. 6. ALACHUA HAS SANDY SOIL, MAXIMUM ELEVATION 150 FT. FIG. 7. DUVAL AND NASSAU ARE ALSO SANDY, RUN TO 45 FT.

Talk Back Range ★ Most notable feature of 2-way performance is the positive nature of radio contact. In every case where the mobile unit could receive the land station it was also possible for the land station to receive the mobile unit.

Interference ★ No radio signal interference was encountered during the entire survey. This may be due to lack of operation by other services on the frequency of 153.65 mc. Image and like effects were not noticeable.

Inductive noises, such as those caused by power transmission lines, electric motors, and like devices, were not heard except in one instance. In the City of Pensacola, a particularly heavy power noise could not be cut out with the receiver squelch completely closed. This noise was recorded at night and in the vicinity of the east Pensacola downtown district.

Ignition noises from the mobile vehicle were negligible, although the only noise suppressing equipment used was a generator condenser and distributor suppressor.

Transmission Characteristics ★ Selective fading did not appear at any time during the tests. Following the theory that frequencies in this part of the spectrum have line-of-sight manners of propagation, records revealed a very definite loss of signal strength in low areas, and, inversely, increases in signal strength for high points.

Critical points of reception and transmission were definitely found at maximum-radius areas. These critical areas are shown in Figs. 4 to 9 on the shaded portions of the coverage graphs, just outside the 100% coverage contour lines. As the vehicle moved through these critical areas reception and transmission were characterized by chopped-up carrier conditions. When the car was slowed down, signals were received for longer periods but they still varied in strength because the direct and reflected waves arrived at the antenna in varying phase relations, at times adding and at other times cancelling each other.

If the vehicle was stopped completely, reception and transmission were possible only if the car antenna was in a favorable location to pick up transmitted energy. Under those conditions, contact with the land station could be established by moving the car forward or backward a few inches, and 100% two-way communications were obtained under these conditions provided, of course, the vehicle was not beyond the useful range of the land station.

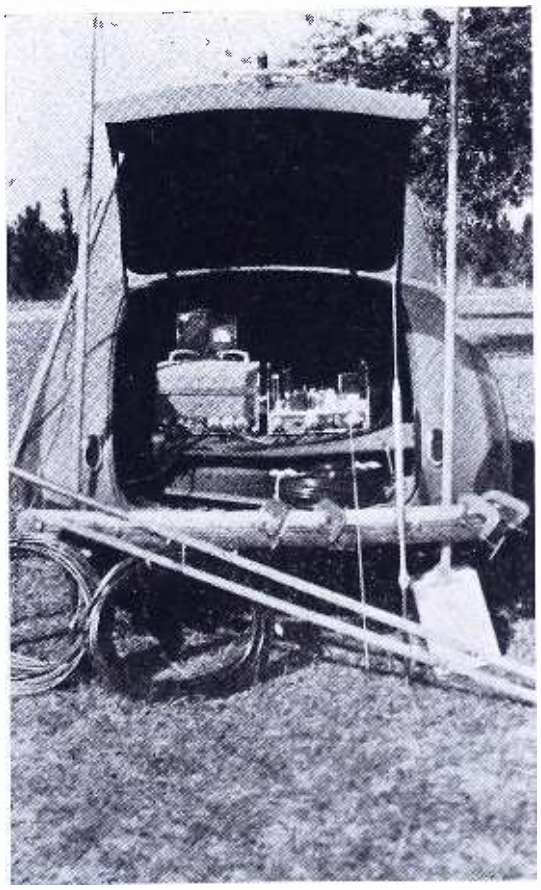


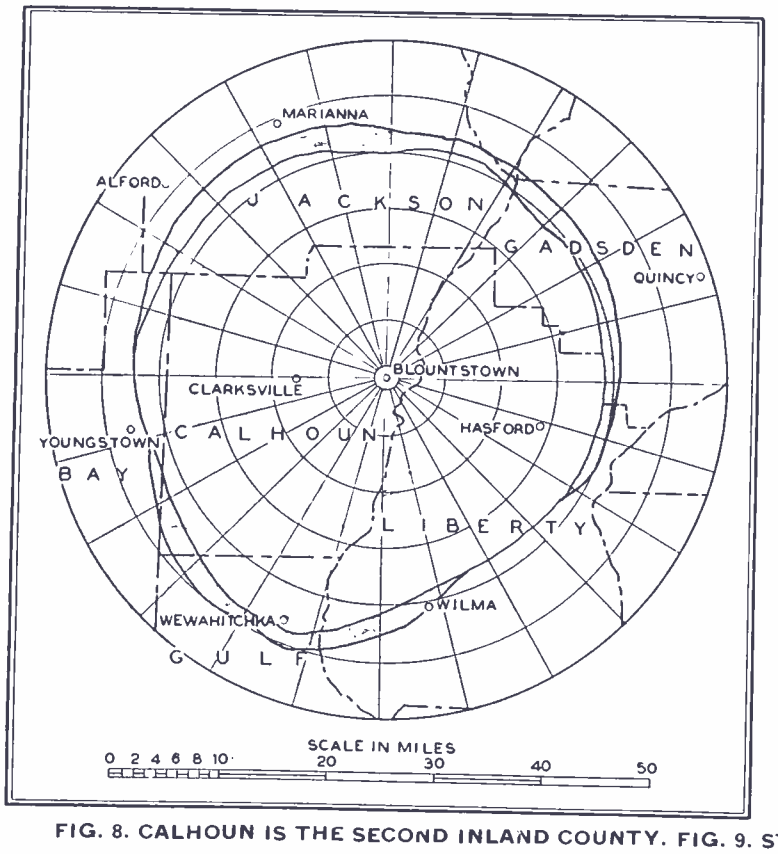
FIG. 3. THIS IS THE EQUIPMENT USED IN THE FLORIDA RADIO SURVEY

Intelligibility ★ Signals were perfectly understandable on the test receivers when the meter indicated 5 microamperes or more. This corresponded roughly to distances of 22 to 25 miles from the land station. Signal strengths below 5 microamperes in flutter areas were readable with difficulty, especially when heavily squelched.

Flutter Conditions ★ It was first thought that definite flutter conditions always occurred at the outer perimeter of the critical signal contours. Fluttering signals were first recorded at distances of 25 miles in terrain only a few feet above sea level. Later on flutter was recorded at 20 miles in rolling hill country.

After the first thousand miles of test runs, a definite pattern of flutter conditions evolved. A theory was formulated whereby it was thought that trees were the primary cause of flutter. Subsequent test runs proved this theory correct, and many interesting angles are opened up for further investigation.

Timber Flutter ★ It was found that Southern slash and longleaf pine timber stands produced certain pulsating effects at different vehicle speeds. This effect was so pronounced that, after a few days practice, the land station operator could immediately detect the presence of pine timber stands as the vehicle passed through forested areas. If the speed of the vehicle remained constant, the land station operator could usually determine the



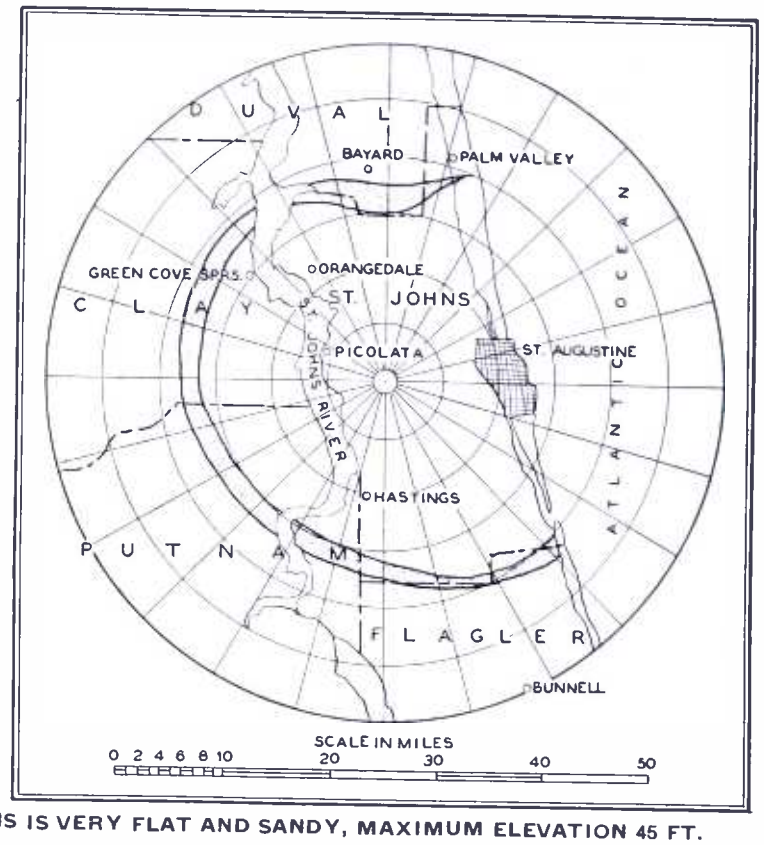


FIG. 8. CALHOUN IS THE SECOND INLAND COUNTY. FIG. 9. ST JOHNS IS VERY FLAT AND SANDY, MAXIMUM ELEVATION 45 FT.

characteristic features of the timber stand, such as large-diameter even stand, or, small-diameter thick stand.

Other outstanding features were discovered during the test runs. For instance flutter has a peculiar sound for pine tree conditions, stands of scrub oak produce a slight hiss preceding each flutter cycle. Certain pecan groves near the coast produce a click just preceding each pulse. During our tests, the operator of the mobile unit was accurately informed from the land station, on a number of occasions, as to the type of timber his vehicle was passing.

Where timber stands were removed from the roadway for distances of 800 to 1,000 ft. or more, flutter decreased to near open-field conditions. Open fields and overwater conditions, where trees were far removed, did not produce flutter effects at the land stations. In passing over long wooden bridges, railings and posts of dried lumber only a few feet away did not produce flutter. However, concrete highway safety posts near a large lake in Alachua county did produce flutter. Metal road side signs and passing cars contributed to miscellaneous flutter.

Although there has been little time to investigate the mechanics responsible for the flutter condition, it is thought that flutter is the result of energy reflection, absorption, re-radiation and the overall mean permittivity of green woods such as pine and oak.

Day and Night Conditions ★ Measurements were made and repeated in several parts of the state for transmissions under like conditions. In each case signal levels were recorded nearly identical to the original. No particular advantage was apparent during the daytime or at night for the Florida surveys.

Weather and Temperatures ★ The surveys were made over a period of more than three months. All kinds of weather were encountered, with the exception of snow and ice. Temperatures varied from 31° to 101° F., but little change in transmission and receiving characteristics was noted.

Buildings and Steel Enclosures ★ With land stations located in rural areas, severe swinging of signals was noted in the heart of the large cities where buildings were high and traffic heavy. The swing was most noticeable where the city lay a distance of 15 to 20 miles away from the land station. Readability remained fairly good, however. In this connection, it should be recalled that the output from the land station antenna was only 15 watts.

When the mobile station parked under metal structures, such as filling stations or grease racks, a definite decrease in signal strength was recorded at the land station 15 miles distant. The reverse occurred in Duval County on top of the St. Johns River steel-enclosed bridge, where signal strengths at 18 miles increased as much as 20 microamps due to higher elevation, and evidenced no flutter effects.

Antenna Comparison ★ An interesting comparison of land station antennas indicated that two types will probably be adopted for use by the Florida Forest Service. The four types, thoroughly tested in this survey were: the concentric half-wave, half-wave dipole, ground-plane, and 3-element collinear array.

First to be eliminated was the concentric half-wave, which gave poor results even though two units were tried and checked carefully. The half-wave dipole gave surprisingly good results, but was discarded in favor of the ground plane and collinear array.

Of all vertically mounted antennas tested, the ground plane and the 3-element collinear gave best results. Theoretically the 3-element collinear antenna should give the best results, but due to the portability features of antennas required for this survey it was not possible to construct the collinear for maximum performance.

At 25 miles the ground-plane seemed to have a slight advantage over the present collinear array. The ground-plane as constructed for these particular tests is not the conventional design. The vertical portion of the antenna was the same as for the usual ground-plane antenna, but only three evenly-spaced quarter-wave elements were used to form the ground-plane. Resonating this type of ground-plane antenna was not critical in the least.

Field Strength Patterns ★ The patterns shown in the accompanying illustrations are presented in simple fashion and in a manner which indicates 100% coverage under various conditions. Patterns are plotted to show positive two-way contact areas within the heavy contour lines. Shaded areas indicate good two-way communication when the vehicle was stopped at a favorable transmitting and receiving position.

Particular attention is invited to the maximum signal range which produces such patterns and illustrating the sharp cut off features which enable many stations to operate on identical channels without undue interference with each other.

Conclusions ★ We were justified in our original calculations, wherein we expected coverage of 20 miles radius from 100-ft. observation towers to mobile stations at

(CONCLUDED ON PAGE 61)

MARKET GUIDE FOR 1947 FM SET SALES

FCC List of Cities Where FM Broadcast Stations Will Be Erected This Year Is a Guide for Planning Distribution and Sales

ALABAMA
8 Cities
ANNISTON
BIRMINGHAM
GADSDEN
HUNTSVILLE
LANETT
MOBILE
MONTGOMERY
TUSCALOOSA

ARIZONA
2 Cities
PHOENIX
TUCSON

ARKANSAS
2 Cities
FORT SMITH
SILOAM SPRINGS

CALIFORNIA
43 Cities
ALAMEDA
ALHAMBRA
BEVERLY HILLS
BAKERSFIELD
BERKELEY
BIG BEAR LAKE
CHICO
EUREKA
FRESNO
GLENDALE
HOLLYWOOD
INGLEWOOD
LONG BEACH
LOS ANGELES
MARYSVILLE
MERCED
MODESTO
MONTEREY
OAKLAND
ONTARIO
PALO ALTO
PASADENA
REDDING
RIVERSIDE
RICHMOND
SACRAMENTO
SALINAS
SAN BERNARDINO
SAN BRUNO
SAN DIEGO
SAN FERNANDO
SAN FRANCISCO
SAN JOSE
SAN LUIS OBISPO
SAN MATEO
SAN PEDRO
SANTA ANA
SANTA BARBARA
SANTA MÁRIA
SANTA MONICA
STOCKTON
TEMPLE CITY
TURLOCK

COLORADO
2 Cities
DENVER
PUEBLO

CONNECTICUT
9 Cities
BRIDGEPORT
DANBURY
HARTFORD
MERIDEN
NEW BRITAIN
NEW HAVEN
NEW LONDON
STAMFORD
WATERBURY

DELAWARE
1 City
WILMINGTON

DIST. OF COLUMBIA
WASHINGTON

FLORIDA
14 Cities
BELLE GLADE
CLEARWATER
DAYTONA BEACH
FT. LAUDERDALE
JACKSONVILLE
MIAMI
ORLANDO
PALM BEACH
PENSACOLA
ST. AUGUSTINE
ST. PETERSBURG
TALLAHASSEE
TAMPA
WEST PALM BEACH

GEORGIA
15 Cities
ATHENS
ATLANTA
AUGUSTA
CEDARTOWN
COLUMBUS
DECATUR
DUBLIN
LA GRANGE
MACON
MOULTRIE
NOWMAN
ROME
SAVANNAH
TOCCOA
VALDOSTA

IDAHO
4 Cities
BOISE
NAMPA
POCATELLO
TWIN FALLS

ILLINOIS
26 Cities
ALTON
AURORA
BLOOMINGTON
BROOKFIELD
CANTON
CARBONDALE
CHAMPAIGN
CHICAGO
DECATUR
EAST ST. LOUIS
EVANSTON
ELMWOOD PARK
FREEPORT
HARRISBURG
HERRIN
JOLIET
KANKAKEE
MARION
MT. VERNON
OAK PARK
PEORIA
QUINCY
ROCKFORD
ROCK ISLAND
SPRINGFIELD
WAUKEGAN

INDIANA
16 Cities
COLUMBUS
CONNORSVILLE
CRAWFORDSVILLE
ELKHART
EVANSVILLE
FT. WAYNE
HAMMOND
INDIANAPOLIS
KOKOMO
LAFAYETTE
MARION
MUNCIE
NEW CASTLE
SHELBYVILLE
SOUTH BEND
TERRE HAUTE

IOWA
14 Cities
ATLANTIC
BURLINGTON
CEDAR RAPIDS
CLINTON
COUNCIL BLUFFS
DAVENPORT
DES MOINES
DUBUQUE
FORT DODGE
KEOKUK
MASON CITY
SHENANDOAH
SIOUX CITY
WATERLOO

KANSAS
7 Cities
GARDEN CITY
HUTCHINSON
KANSAS CITY
LAWRENCE
MCPHERSON
TOPEKA
WICHITA

KENTUCKY
9 Cities
ASHLAND
BOWLING GREEN
HENDERSON
HOPKINSVILLE
LEXINGTON
LOUISVILLE
OWENSBORO
PADUCAH
WINCHESTER

LOUISIANA
7 Cities
ALEXANDRIA
BATON ROUGE
LAFAYETTE
LEWISTON
MONROE
NEW ORLEANS
SHREVEPORT

MAINE
4 Cities
AUGUSTA
BANGOR
LEWISTON
PORTLAND

MARYLAND
9 Cities
ANNAPOLIS
BALTIMORE
BETHESDA
BRADBURY HEIGHTS
CUMBERLAND
FREDERICK
HAGERSTOWN
SALISBURY
SILVER SPRING

MASSACHUSETTS
15 Cities
BOSTON
BROCKTON
FALL RIVER
FITCHBURG
GREENFIELD
HAVERHILL
HOLYOKE
LAWRENCE
LOWELL
NEW BEDFORD
NORTH ADAMS
PITTSFIELD
SALEM
SPRINGFIELD
WORCESTER

MICHIGAN
20 Cities
ANN ARBOR
BATTLE CREEK
BAY CITY
BENTON HARBOR
DEARBORN
DETROIT
ESCANABA
FLINT
GRAND RAPIDS
GROSSE POINT
JACKSON
LANSING
MT. CLEMENS
MUSKEGON
OWOSSO
PONTIAC
PORT HURON
ROYAL OAK
SAGINAW
WYANDOTTE

MINNESOTA
6 Cities
MANKATO
MINNEAPOLIS
ROCHESTER
ST. CLOUD
ST. PAUL
WINONA

MISSISSIPPI
4 Cities
CLARKSDALE
GULFPORT
JACKSON
MERIDEN

MISSOURI
8 Cities
CAPE GIRARDEAU
CLAYTON
JEFFERSON CITY
JOPLIN
KANSAS CITY
ST. JOSEPH
ST. LOUIS
SPRINGFIELD

NEBRASKA
2 Cities
LINCOLN
OMAHA

NEVADA
2 Cities
LAS VEGAS
RENO

NEW HAMPSHIRE
4 Cities
CLAREMONT
KEENE
MANCHESTER
PORTSMOUTH

NEW JERSEY
13 Cities
ALPINE
ASBURY PARK
ATLANTIC CITY
BRIDGETON
CAMDEN
ELIZABETH
EWING TOWNSHIP
NEWARK
NEW BRUNSWICK
PATERSON
SOMERSET
TRENTON
WATCHUNG

NEW MEXICO
1 City
ALBUQUERQUE

NEW YORK
38 Cities
ALBANY
BATAVIA
BAY SHORE
BINGHAMTON
BROOKLYN
BUFFALO
CORAM
CORNING
COURTLAND
ELMIRA
ENDICOTT
GLENS FALLS
HEMPSTEAD
HORNELL
ITHACA
JAMAICA
JAMESTOWN
KINGSTON
LOCKPORT
MASSENA
MT. VERNON
NEW BRIGHTON
NEW ROCHELLE
NEW YORK
NIAGARA FALLS
OGDENSBURG
ONEONTA
OSWEGO
POUGHKEEPSIE
ROCHESTER
ROME
SCHENECTADY
SYRACUSE
TROY
UTICA
WATERTOWN
WHITE PLAINS
YONKERS

NORTH CAROLINA
26 Cities
AHOSKIE
ASHEVILLE
BURLINGTON
CHARLOTTE
CONCORD
DURHAM
FAYETTEVILLE
GASTONIA
GREENSBORO
GREENVILLE
HENDERSON
HICKORY
HIGH POINT
MORGANTOWN
NEW BERN
RALEIGH
REIDSVILLE
ROANOKE RAPIDS
ROCKY MOUNT
SALISBURY
STATESVILLE
WASHINGTON
WILMINGTON
WILSON
GOLDSBORO
WINSTON-SALEM

NORTH DAKOTA
1 City
FARGO

OHIO
37 Cities
AKRON
ALLIANCE
ASHLAND
ASHTABULA
ATHENS
BELLAIRE
CANTON
CHEVOIT
CINCINNATI
CLEVELAND
COLUMBUS
DAYTON
DOVER
ELYRIA
FINDLAY
FOSTORIA
FREMONT
HAMILTON
LAKEWOOD
LIMA
LORAIN
MANSFIELD
MARION
NEWARK
PAINESVILLE
PORTSMOUTH
RAVENNA
ROSCOE
SPRINGFIELD
STEUBENVILLE
TIFFIN
TOLEDO
WARREN
WOOSTER
WORTHINGTON
YOUNGSTOWN
ZANESVILLE

OKLAHOMA
11 Cities
ARDMORE
CLINTON
DURANT
ENID
LAWTON
MUSKOGEE
OKLAHOMA CITY
OKMULGEE
SHAWNEE
STILLWATER
TULSA

OREGON
6 Cities
ALBANY
ASHLAND
EUGENE
GRANTS PASS
MEDFORD
PORTLAND

PENNSYLVANIA
33 Cities
ALLENTOWN
ALTOONA
BETHLEHEM
BRADFORD
BUTLER
CLEARFIELD
DUBOIS
ERIE
EASTON
HARRISBURG
HAZLETON
JOHNSTOWN
LANCASTER
LEBANON
LEWISTOWN
MCKEESPORT
MEADVILLE
NEW CASTLE
OIL CITY
PHILADELPHIA
PITTSBURGH
POTTSVILLE
READING
SAYRE
SCRANTON
SHAMOKIN
SHARON
STROUDSBURG
SUNBURY
UNIONTOWN
WILKES-BARRE
WILLIAMSPORT
YORK

RHODE ISLAND
2 Cities
PAWTUCKET
PROVIDENCE

SOUTH CAROLINA
11 Cities
ANDERSON
CHARLESTON
COLUMBIA
FLORENCE
GREENVILLE
GREENWOOD
LANCASTER
NEWBERRY
ROCK HILL
SHELBY
SPARTANBURG

SOUTH DAKOTA
1 City
SIOUX FALLS

TENNESSEE
9 Cities
BRISTOL
CHATTANOOGA
CLARKSVILLE
CLEVELAND
JACKSON
KINGSPORT
KNOXVILLE
MEMPHIS
NASHVILLE

TEXAS
29 Cities
ABILENE
AMARILLO
AUSTIN
BEAUMONT
BENTON
BROWNSVILLE
COLLEGE STATION
DALLAS
DENTON
FT. WORTH
GALVESTON
GOOSE CREEK
HARLINGEN
HOUSTON
LUBBOCK
LAREDO
LUFKIN
LONGVIEW
MCALLEN
ODESSA
PORT ARTHUR
SAN ANGELO
SAN ANTONIO
TEXARKANA
TYLER
VERNON
WACO
WESTLACO
WICHITA FALLS

UTAH
2 Cities
OGDEN
SALT LAKE CITY

VERMONT
1 City
RUTLAND

VIRGINIA
14 Cities
ALEXANDRIA
ARLINGTON
DANVILLE
FRONT ROYAL
HARRISONBURG
LYNCHBURG
MARTINSVILLE
NEWPORT NEWS
NORFOLK
PORTSMOUTH
RICHMOND
ROANOKE
SUFFOLK
WINCHESTER

WASHINGTON
4 Cities
EVERETT
LONGVIEW
SEATTLE
TACOMA

WEST VIRGINIA
9 Cities
BECKLEY
BLUEFIELD
CHARLESTON
CLARKSBURG
HUNTINGTON
LOGAN
MORGANTOWN
PARKERSBURG
WHEELING

WISCONSIN
18 Cities
BELOIT
GREEN BAY
GREENFIELD
JANESVILLE
LACROSSE
MADISON
MARSHFIELD
MERRILL
MILWAUKEE
NEENAH
OSHKOSH
RACINE
RICE LAKE
SHEBOYGAN
STEVENS POINT
SUPERIOR
WAUSAU
WISCONSIN RAPIDS

WYOMING
1 City
CHEYENNE

PUERTO RICO
2 Cities
RIO PIEDRAS
SAN JUAN

SPOT NEWS NOTES

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

Franklin Jones: Republican Representative from Lima, Ohio, has been nominated by President Truman to succeed FCC Commissioner Ray C. Wakefield, Californian Republican. Although no action has been taken at this time of writing, it is expected that the Jones nomination will be confirmed for a 7-year term starting July 1.

Lea Act Upheld: On June 23, the day the Taft-Hartley Labor Bill was passed over the President's veto, the Supreme Court upheld the constitutionality of the Lea Act. Under the provisions of this Act, it is unlawful for the American Federation of Musicians to demand double pay when AM programs are also transmitted over FM. Presumably, the nets will authorize simultaneous AM-FM transmission of their programs.

RCA president Sarnoff said at the RMA Chicago meeting on June 12: "I believe that the fullest benefits to the public and the larger opportunities for (FM) sales will come only when programs now broadcast by standard (AM) stations and networks are permitted to be sent simultaneously over FM stations. Let us hope that the present-day restrictions, which forbid this, may soon be removed." The Supreme Court ruling makes the "restrictions" unlawful. The next move is up to the networks. That should be simple because some network affiliates were putting out musical net programs while the restrictions were in effect.

Price Reduction: Altec-Lansing Corporation has announced substantial reductions in net prices of their Duplex and Dia-cone loudspeakers, effective July 15th.

RMA Officers: New RMA president is Max F. Balcom, vice president and treasurer of Sylvania Electric Products, Inc. R. E. Carlson, vice-president of Tung-Sol Lamp Works, Newark, N. J., and W. J. Barkley, executive vice-president of the Collins Radio Co., Cedar Rapids, Iowa, were elected vice-presidents. Three vice-presidents were reelected. They are: Paul V. Galvin, Motorola; J. J. Kahn, Standard Transformer, and Allan Shoup, Shoup, Inc., all of Chicago. Leslie P. Muter, Muter Co., Chicago, was reelected treasurer for his 13th term.

Facsimile: Automatic Electric Sales Corporation, W. Van Buren Street, Chicago 7, a Finch licensee, is tooling up for production of facsimile equipment. Keith A. Regel, formerly executive assistant to president H. F. Lello, is now manager of facsimile sales. Automatic's facsimile units are intended particularly for business organizations and telephone companies which plan to offer public facsimile service.

New FMA Members: WRAL-FM, Capitol Broadcasting Company, Raleigh, N. C.; WGSO-FM, Champion City Broadcasting Co., Springfield, Ohio; WCLT, Advocate Printing Company, Newark, Ohio; W. M. and C. R. Oliver, Reidsville, N. C.; KFBK, McClatchey Broadcasting Company, Sacramento, Calif.

KERA: At Dallas has revised and extended its operating hours to provide FM broadcasting in accordance with the needs of local dealers. Schedule is now 11:00 AM to 5:00 PM and 6:00 to 9:00 PM. Close liaison with dealers is being maintained by assistant manager Ralph Nimmons, technical development director Ray Collins, and sales promotion director Robert Summers, with the result that FM set sales are climbing steadily in the Dallas area.

CO-CHANNEL INTERFERENCE

IN OUR May issue, there was a brief discussion on this page of co-channel interference and the related subject of capture-effect protection in FM receivers.

The reason for bringing up this problem of receiver design was the recent amendment to the FCC's "Standards of Good Engineering Practice" (see FM & T May, '47, pg. 48) which defines "objectionable interference" on the same channel as a ratio of desired to undesired signals less than 10 to 1.

Our remarks have called forth some dissenting comments on this matter. Since it is the purpose of this journal to serve as a forum for the presentation and exchange of engineering opinions, we shall be glad to publish letters or technical papers on the very vital problems of co-channel interference and the capture-effect characteristics of FM circuit designs.

Low-Priced FM Tuner: Pilot Radio Corp., Long Island City, N. Y., will shortly make a bid for the low-bracket FM set market with a new tuner priced at $29.95 retail. Unit will have 5 tubes, a stage of tuned RF, ratio detector, and an output circuit to work into the phonograph pickup terminals of any AM receiver. Pilot thinking is that this FM tuner will be bought by owners of expensive AM phono combinations.

National Radio Week: Set for October 26 to November 2. FMA president Roy Hofheinz and Ben Strouse of WWDC-FM, Washington, D. C. will represent the FM end of this occasion.

FM Set Servicing: Recognizing that FM poses many entirely new problems for servicemen, and that the success of an FM set line in any area is determined to a considerable extent by the way in which receivers are installed and maintained, Zenith Radio has set up a series of instruction classes under the sponsorship of their distributors. The first, at Morley-Murphy, Milwaukee, will be followed by others in Detroit, Buffalo, Williamsport, Pa.; Boston, New York, Norfolk, Cincinnati, Memphis, Atlanta, Jacksonville, New Orleans, Dallas, Kansas City, Minneapolis, Billings, Spokane, Seattle, San Francisco, Los Angeles, Salt Lake City, and Denver.

WNLC-FM: Station at New London, Conn. came up with a bright idea by broadcasting the Harvard-Yale crew races from the Tide Water Flying-A dirigible, on June 18th.

NAB Conference: Will be held at Atlantic City, September 15 to 18. It will undoubtedly be the most interesting meeting that NAB has held. The exhibition hall, on the same floor with the auditorium, has twice the floor space of the Palmer House, Chicago, where the conference was held last year. Information can be obtained from Arthur C. Stringer, director of special services, National Association of Broadcasters, Washington, D. C.

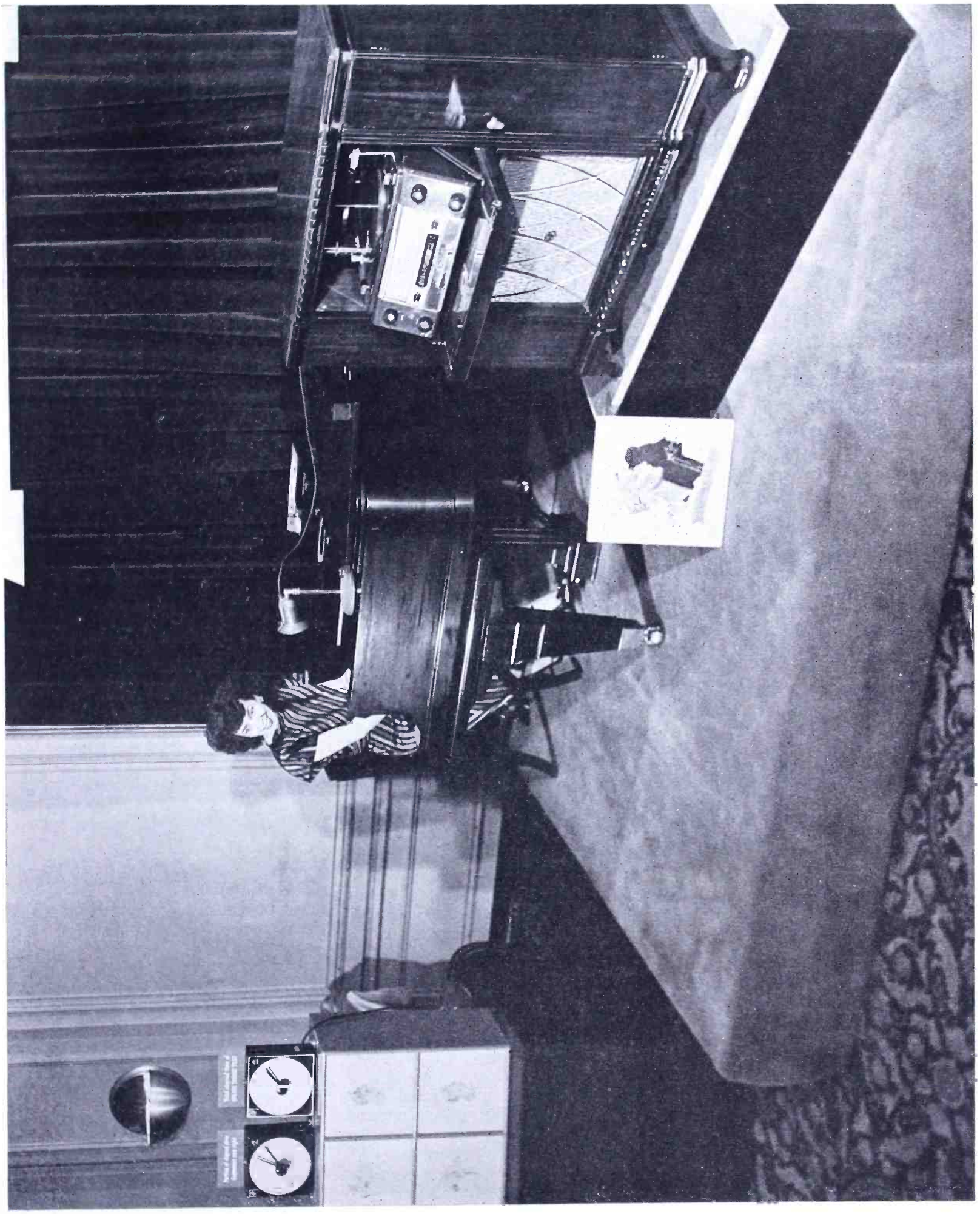
FM Set Design: Rep. Joe Hendricks (D. Fla.) at the House Appropriations subcommittee: "What about FM? Does the FCC have to see that sets are properly constructed, and not a fraud upon the public?" To which FCC Chairman Denny replied:

"We have no jurisdiction over the manufacture of receivers. If anybody can do that, it is the Federal Trade Commission. We do this: We have in our lab every FM receiver that we have been able to get our hands on. We check them for a purpose, not of advising the public — the results of our investigations are confidential — but for our own guidance. It is important for us to know, in the making of our FM policies, how we are going to put transmitters on the air and what these receivers will do, also what they won't do."

Theatre Television: RCA president Sarnoff, addressing RMA in Chicago on June 12th: "There are motion picture people quite alive to the promise of television in the theatre as well as in the home. Their theatres may soon be open to television equipment developed for service of the theatre screen. . . . This much is already evident: the newsreel theatre of today could readily become the television theatre of tomorrow."

Philadelphia: Triangle Publications, owners of WFIL and WFIL-FM, has purchased

(CONTINUED ON PAGE 54)



NEWS PICTURE

MUSIC dealers at Chicago couldn't tell whether music came from the piano before them, or from a remote piano, playing by radio through this RCA FM-AM receiver. Each dealer who tried the test was given a switch, connected to the lower illuminated panels at the right, to indicate his opinion. The master of ceremonies changed the two upper panels to indicate the actual conditions. Thus, the audience could tell whether the dealer taking the test distinguished correctly between actual and reproduced tone quality. One clock showed total elapsed time, and the other the time during which the guinea pig's judgment was right. Most of those who tried were wrong 50% of the time. Frequently, it was clear from the way the lights flashed that the man with the switch couldn't make up his mind.

MAGNETRON: GENERATOR OF CENTIMETER WAVES

The Theory of the Magnetron, and Its Development as a Practical Means for Generating Centimeter Waves—9th Installment

BY J. B. FISK, H. D. HAGSTRUM, AND P. L. HARTMAN

In its first tests at Whippany, the British magnetron was pulse-operated at about 10 kv. and 10 amps. peak current. The pulses were of 1 micro-second duration and recurred 1,000 times per second. The magnetic field required was about 1,100 gauss. The magnetron was loaded with a simple radiating antenna of unknown load impedance. Under these conditions the magnetron generated RF power estimated at the time to be greater than 10 kw.

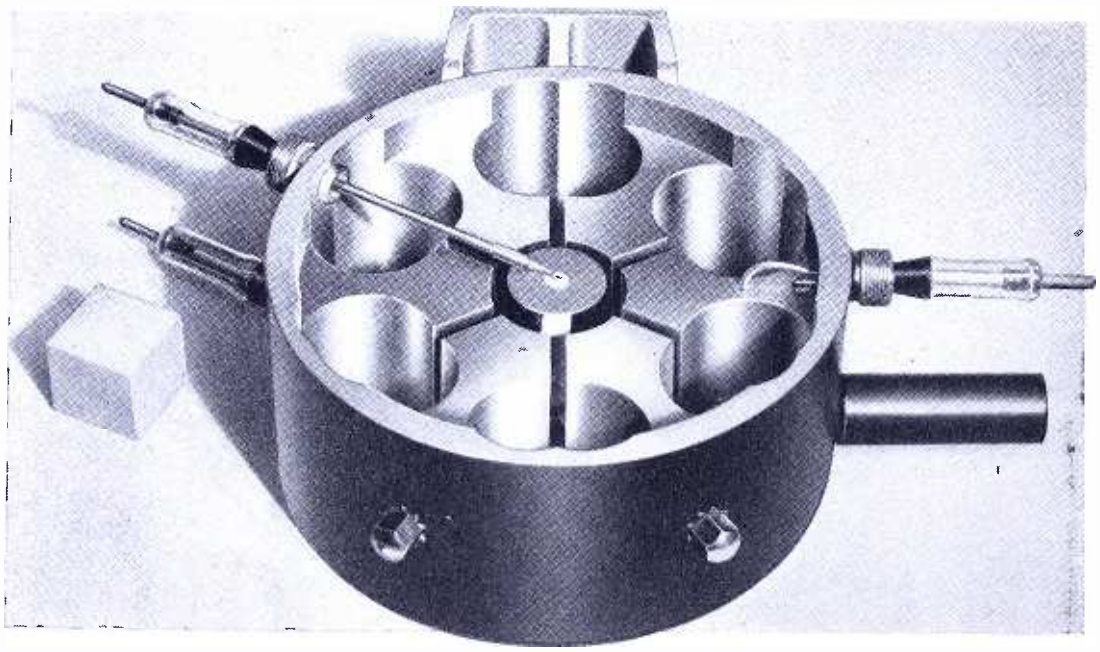


FIG. 46. An internal view of a 700A-D magnetron (40 kw., 700 mc.) showing the unstrapped resonator system of 6 hole and slot circuits, the cathode, the cathode end disks and support leads, and the output coupling loop and lead.

The 8-hole and slot type resonators of the British magnetron were spaced around an anode of 0.8 cm. radius. The resonator system, machined in a block of copper, was 2 cm. long. It was unstrapped, strapping not being known at the time, and in its general features was much like that shown schematically in Fig. 1.

The output circuit of the British magnetron was also similar to that of Fig. 1. It had no particular transformer properties designed into it. The vacuum seal, made of copper, glass, and tungsten, was incorporated in the output coaxial line in very much the same manner as that to be shown in Figs. 60 and 61.

The cathode was a plain, oxide-coated, nickel cylinder, 0.3 cm. in radius. It had nickel end disks of 0.5 cm. radius, and was mounted on radial leads passing through glass vacuum seals like those shown in Fig. 61. The leads were placed diametrally across the resonator hole to minimize RF flux-linkage to the cathode structure. Preliminary British results indicated that the cathode could be activated properly and would possess a reasonable lifetime under the original operating conditions.

The British magnetron had been designed for use with a magnet having a gap of about 1.75 in., and a pole face diameter of 1.25 in., producing a magnetic field of about 1,500 gauss.

Several of the constructional features of the British magnetron were new. The cylindrical block of copper into which the resonator system was machined was used as the vacuum envelope. It was closed at either end by copper disk cover plates. The vacuum seal was made during the pumping and baking process by the alloying at the baking temperature of gold rings between the cover plate and block. The alloying was done at high pressure provided by a clamp bolted across the magnetron. Although no getter was used, satisfactory vacuum conditions could be maintained after seal-off.

By mid-November of 1940, a number of working reproductions of the British magnetron had been supplied in our Laboratories and to the Radiation Laboratory at M. I. T., and a program of study of the magnetron oscillator commenced. The work thus started was continued, on the one hand, to put the new magnetron into production and, on the other hand, to attempt to understand it, improve upon it, and extend its range of usefulness.

13. Magnetrons for 20 to 45 Cm. ★ 13.1 *The 700A-D Magnetrons:* After the British 10-cm. magnetron had been successfully reproduced and an emergency program of research and development of multi-cavity magnetron oscillators commenced, the question immediately was asked: Can a multi-cavity magnetron be designed to operate near 40 cm. in the pulsed radar set under development in the Whippany radio laboratory? Clearly, there now existed the possibility of much greater power than was possible with triodes at this wavelength with reasonable life expectancy. The modulator of the radar set provided pulsed input power to the oscillator at about 12 kv. and up to 10 amps. peak current.[24]

The performance of the 10-cm. multi-cavity magnetrons appeared to make the development of such a generator at 40 cm. feasible. A straightforward enlargement of the 10-cm. magnetron by a factor of 4 was out of the question, however, as it resulted in a magnetron entirely too bulky, requiring a prohibitively large magnet. The development of the 700-mc. magnetron oscillator thus involved departures from the British design. In particular, it was found necessary to reduce the axial length of the resonator system to a considerably smaller fraction of a wavelength than in the 10-cm. design. The development involved design of the interaction space for maximum operating efficiency, the resonator system, for which both 8- and 6-resonator structures were employed, and the output circuit for coupling into the existing radar system.

An early 700-mc. multi-cavity magnetron design employed 8 resonators of axial length less than $\frac{1}{10}$ wavelength; the 10-cm. design was about $\frac{1}{5}$ wavelength long. Operating models initially produced approximately 10 kw. of RF power near the desired frequency. It was found, however, that a smaller and lighter magnetron could be made to operate at the same voltage if the number of resonators were reduced from 8 to 6, permitting smaller anode and cathode radii [equation (16) in Part 1]. The weight and over-all diameter were reduced further by use of elongated holes in the hole and slot resonators. This

[24] This radar development is discussed by: W. C. Tinus and W. H. C. Higgins, "Early Fire Control Radar for Naval Vessels," *Bell Syst. Tech. Jour.*, 25, 1 (1946).

TABLE 1 — MAGNETRONS FOR WAVELENGTHS OF 20 TO 45 CM.

	700A-D Unpackaged	728A-J Unpackaged*			5J23 Unpackaged			4J21-25 Unpackaged			4J26-30 Unpackaged			4J42 Unpackaged Tunable	4J51 Unpackaged Tunable	5J26 Unpackaged Tunable	
N	6	8			8			8			8			6	8	8	
r_c (in.)	0.160	0.266			0.266			0.218			0.230			0.199	0.266	0.375	
r_a (in.)	0.689	0.687			0.709			0.582			0.612			0.689	0.687	0.687	
h (in.)	1.576	1.716			2.360			1.940			2.040			1.451	1.500	1.940	
Magnet gap (in.)	2.980	3.290			3.990			3.540			3.640			2.983	3.290	3.640	
Weight (lb.)	12.5	13.0			16.5			15.0			15.0			16.5	14.5	18 5	
Resonators	hole and slot	hole and slot			hole and slot			hole and slot			hole and slot			hole and slot	hole and slot	slot	
Unstrapped λ (cm.)	43.0	~26.0			~21.5			~18.0			~19.0			~38.0	~23.5	10.3	
Straps	none	double ring			echelon wire			double ring			double ring			wire	double ring	double channel	
λ (cm.)	43.0	32.1			28.6			22.8			24.0			43.0	32.1	23.4	
f (mc/s)	720–680	970–900			1056–1044			1350–1280			1280–1220			670 to 730	900 to 970	1220 to 1350	
Nearest mode	$n = 2$	$n = 3$			$n = 3$			$n = 3$			$n = 3$			$n = 1$	$n = 1$	$n = 3$	
λ separation (%)	−3	~−30			~−20			−20			−20			−16	+4	~−60	
Tuning	—	—			—			—			—			resonator capacitance	resonator capacitance	strap capacitance	
Δλ (%)	—	—			—			—			—			10.2	7.5	10.3	
Tuner travel (in.)	—	—			—			—			—			0.100	0.080	0.154	
Q_o	>5000	~4500			~3200			2800			2800			1600→2500	3500→4500	700→1800	
Q_{ext}	~280	170			150			170			180			285	215	210	
η_c (%)	~95	~96			~95			94			94			87	95	82	
Output circuit	coaxial	coaxial			coaxial			coaxial			coaxial			coaxial	coaxial	coaxial	
V (kv.)	12	19.0	21.0	24.5	16.5	19.0	24.5	15.5	22.0	26.5	16.5	23.0	27.0	12 0	23 0	27	27
I (amps.)	10	19	20	28	20	24	33	25	40	48	25	40	46	9	20	46	46
B (gauss)	650	1000	1100	1200	800	900	1100	900	1200	1400	900	1200	1400	650	1100	1400	1400
τ (μs)	2	1	1	1	1	1.5	1	1.5	1	5	1.5	1	5	1.5	1	1	5
pps	1000	1000	1000	1000	2000	1000	1000	1000	1000	200	1000	1000	200	2000	1000	1000	200
P_o (kw.)	40	210	260	400	170	250	475	175	440	640	200	470	700	30	285	600	600
η (%)	33	58	62	58	55	55	59	45	50	50	48	51	56	28	62	48	48
η_c (%)	~35	~61	~65	~61	~58	~58	~62	48	53	53	51	54	60	32	65	58	58
PF (mc/s)	~1.2	2.5	2.5	2.5	3.0	3.0	3.0	3.4	3.4	3.4	3.0	3.0	3.0	1.2	1.9	3.0	3.0

change resulted in the resonator system used in the 700A-D magnetrons, Figs. 41 and 46. Each hole was made by boring two intersecting cylinders in the resonator block, Fig. 46. No difficulty was encountered in achieving the desired frequency. The frequency differences between the four coded magnetrons near 700 mc. were achieved by variation of the resonator slot width.

The separation of mode frequency between the $n = 3$ mode (π mode) and the nearest other mode is of the order of 3%. Although this is small compared to that obtainable in strapped magnetrons, it is greater than that for the early unstrapped magnetrons near 10 cm. This was reflected in greater operating efficiency.

The cathode in the 700A-D magnetrons was supported, as in the British magnetron, by radial leads extending across the center of one of the hole and slot resonators. The cathode diameter was varied in an experiment designed to determine the value for maximum operating efficiency. Early experiments of this type, involving measurements of output power and efficiency, were quite crude, and conclusions from their results were by no means as significant as those based on measurements of frequency. The primary difficulty lay not in the actual measurement of power or voltage but in the fact that the magnetrons were not loaded in a reproducible fashion. It was considerably later that load impedance measurements were made and used in evaluating magnetron performance. In many early studies the effect of load on operation was not sufficiently disentangled from the effects of other things. In spite of these inadequacies, however, it was generally possible to distinguish a good design change from a bad one, and much of value was gained in early work.

The cathode diameter used in the 700A-D magnetrons is given in TABLE I, along with other data on these and other magnetrons in the 20- to 45-cm. wavelength range. It should be noted that the optimized ratio r_c/r_a is 0.300 as compared to 0.375 in the British magnetron having 8 resonators. Plain oxide coating was used on the cathode. Life expectancy is thousands of hours.

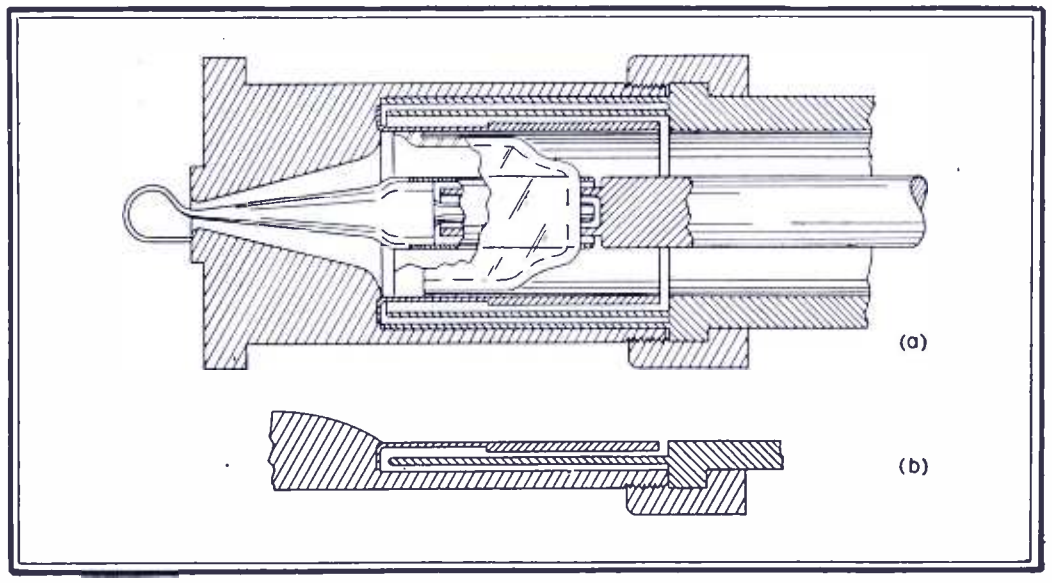


FIG. 47. A schematic diagram of the type of coaxial output circuit used in a number of magnetrons of wavelength 10 cm. or greater. Of particular interest are the means of contact-free or *choke* coupling employed in the inner and outer conductors, consisting of a folded concentric line section which presents zero impedance at the gap in the conductor. (a) and (b) represent two variations of the choke in the outer conductor, as explained in the text.

As may be seen in Fig. 46, the output coupling is accomplished by means of a loop in the end space of the structure. The loop is connected to an anode segment. It is driven by direct coupling to the anode segment and by coupling to the magnetic flux linking the two adjacent resonators. The output circuit was not designed to operate into a matched output line, however, and it was necessary that external impedance transformation be incorporated into the load line.

Mechanical construction of the 700A-D magnetrons involved techniques like those described above. The input and output leads included copper-to-glass-to-tungsten seals much like those in the reproductions of the British magnetron. The end covers were sealed to the resonator body by means of the gold ring technique employed in the British magnetron.

EXHIBIT A—*The* CONTI

High on the list of doubts—that have fallen one by one—about FM was the doubt that FM stations could be hooked up into practical and efficient network patterns. This doubt rested on the sands of unwarranted assumptions like the claim that FM signals couldn't be transmitted over the horizon. These sands of doubt are rapidly running out.

A FORECAST » » »

As long ago as 1943, Major E. H. Armstrong, FM's inventor, well known as an ultra-conservative predictor of things to come, was asked for a forecast of FM's future. His reply as carried in Broadcasting Magazine, April 26, 1943 was: "Were I to make any prediction (on the matter of FM networks) it would be that *the ease with which relaying can be accomplished and the excellence of the performance will be the next surprise.*"

A SURPRISE BECOMES A FACT » » »

On Wednesday evening, March 26, 1947, under the leadership of Major George S. Howard, commanding officer and conductor, the 65 piece Army Air Forces Band Concert Orchestra was playing to a capacity house in the Department of Interior auditorium in Washington, D. C. But besides those listening in person, thousands of surprised and delighted people scattered over a dozen states from Virginia to Maine were "present by ear" at the concert, and they heard it with a clarity that was virtually the equivalent of really being there in person. All this, thanks to the experimental efforts of five FM stations which had hooked themselves up by air and by wire to form the first FM network.

From this beginning the "Continental Network" has grown, through three months of experience, to the point where on Thursday night, June 19th, 18 stations carried the hour-long FM network broadcast of the USAAF Band, 90 pieces strong—plus a 33 male voice chorus and baritone soloist—direct from Bolling Field. The quality of the broadcast, whether carried by 8 kc plus wire line or relayed direct from station to station by air has created great interest and enthusiasm. The experiments to date have undeniably established the practicability of FM networks. They are no longer predictions, but—

A MATTER OF RECORD » » »

Of more importance than to predict the future of the Continental Network is to point out that what it has *demonstrated* can be *duplicated* in the form of area and regional networks elsewhere in the United States.

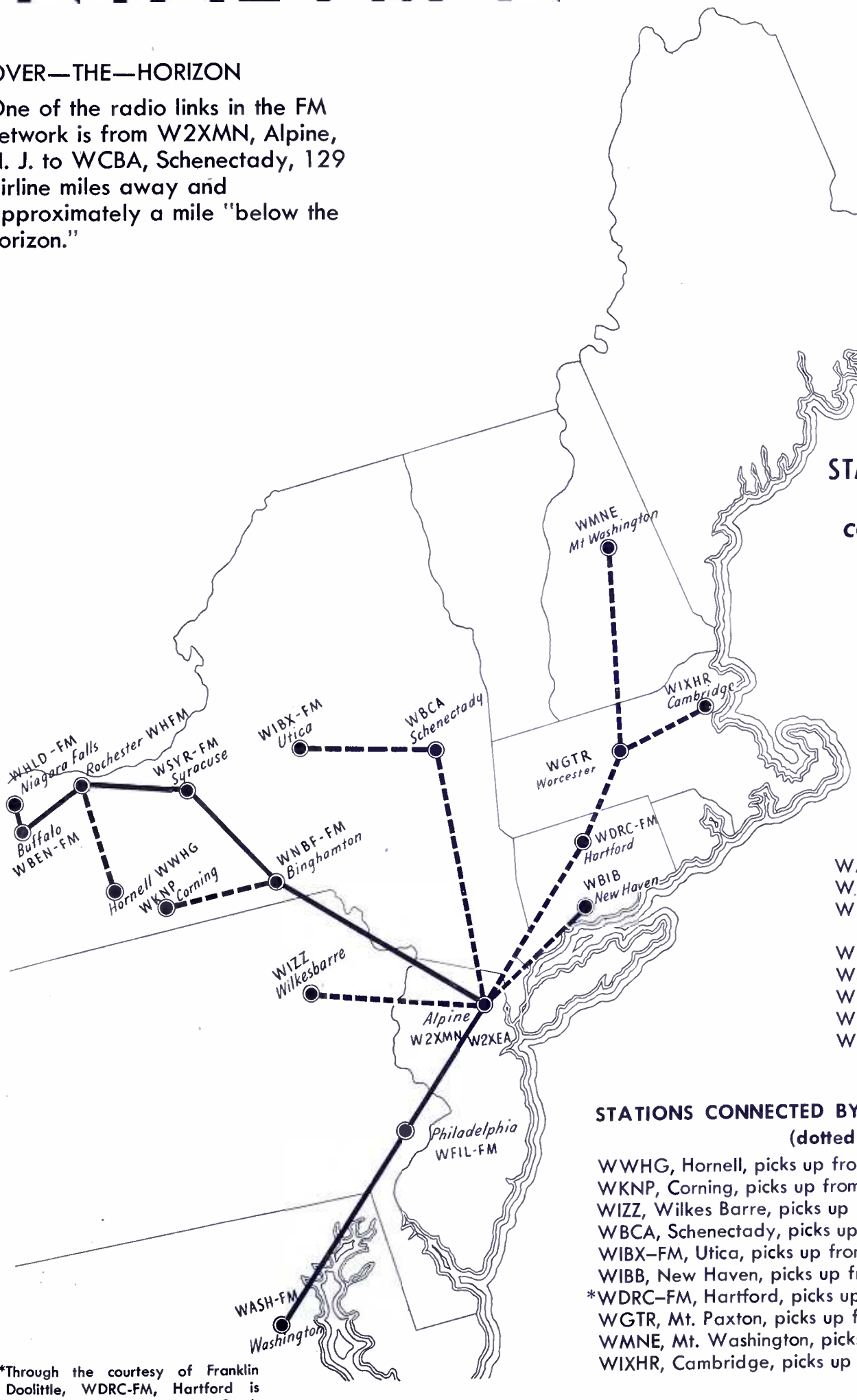
By reason of station-to-station relay by air alone, FM networks are highly flexible as has been demonstrated even with low power. Twelve more stations between Washington, D. C., and Chicago could join the Continental immediately—and may do so.

As more and more FM stations dot the U. S. map there is no practical reason whatever why we cannot have, not one, but many national as well as regional FM networks.

ENTAL *FM* NETWORK

OVER—THE—HORIZON

One of the radio links in the FM network is from W2XMN, Alpine, N. J. to WCBA, Schenectady, 129 airline miles away and approximately a mile "below the horizon."



STATION ARRANGEMENT
in the
CONTINENTAL NETWORK
as of broadcasts for
JUNE 19, 1947

STATIONS CONNECTED BY 8 KC PLUS TELEPHONE CABLE (solid lines)

WASH–FM, originating station
WFIL–FM, Philadelphia, Pa.
W2XMN and W2XEA, Alpine, N. J.
WNBF–FM, Binghamton, N. Y.
WSYR–FM, Syracuse, N. Y.
WHFM, Rochester, N. Y.
WBEN–FM, Buffalo, N. Y.
WHLD–FM, Niagara Falls, N. Y.

STATIONS CONNECTED BY DIRECT RADIO PICKUP (dotted lines)

WWHG, Hornell, picks up from WHFM, Rochester
WKNP, Corning, picks up from either WWHG or WNBF–FM
WIZZ, Wilkes Barre, picks up from W2XMN
WBCA, Schenectady, picks up from W2XMN
WIBX–FM, Utica, picks up from WBCA
WIBB, New Haven, picks up from W2XMN
*WDRC–FM, Hartford, picks up from W2XMN
WGTR, Mt. Paxton, picks up from WDRC–FM
WMNE, Mt. Washington, picks up from WGTR
WIXHR, Cambridge, picks up from WGTR

*Through the courtesy of Franklin Doolittle, WDRC-FM, Hartford is acting as a link to relay the Continental programs to the Yankee Network FM stations.

FOR FURTHER DETAILS and specific information on these experimental FM network broadcasts, communicate with EVERETT DILLARD, THE CONTINENTAL NETWORK, INTERNATIONAL BUILDING, WASHINGTON, D. C.

The 700A-D magnetrons are limited in frequency to the four 10-mc. bands between 680 and 720 mc., respectively. These magnetrons operate at 12 kv. and 8 amps, peak current input at a magnetic field of 650 gauss. Over-all efficiency ranges between 30 and 40%, which is better, as has been explained, than that attained with unstrapped 10-cm. magnetrons. Other data of interest are given in TABLE I.

One feature which is immediately apparent from the rated operating conditions of the 700A-D magnetrons is the fact that the ratings are not nearly as high as one might expect from the size of the magnetron. Back bombardment of the cathode at considerably greater input power could easily be handled. The difficulty lay in the fact that it was impossible to drive the magnetrons in the π mode to much greater currents than the rated currents. If the attempt is made to drive the magnetron harder it either refuses to oscillate at all or oscillates in another mode. This phenomenon has been the single deterrent in the development of higher-power magnetrons at wavelengths greater than 20 cm. It is now recognized as a starting time phenomenon, having to do with the rate at which oscillation builds up and the rate at which pulse voltage is

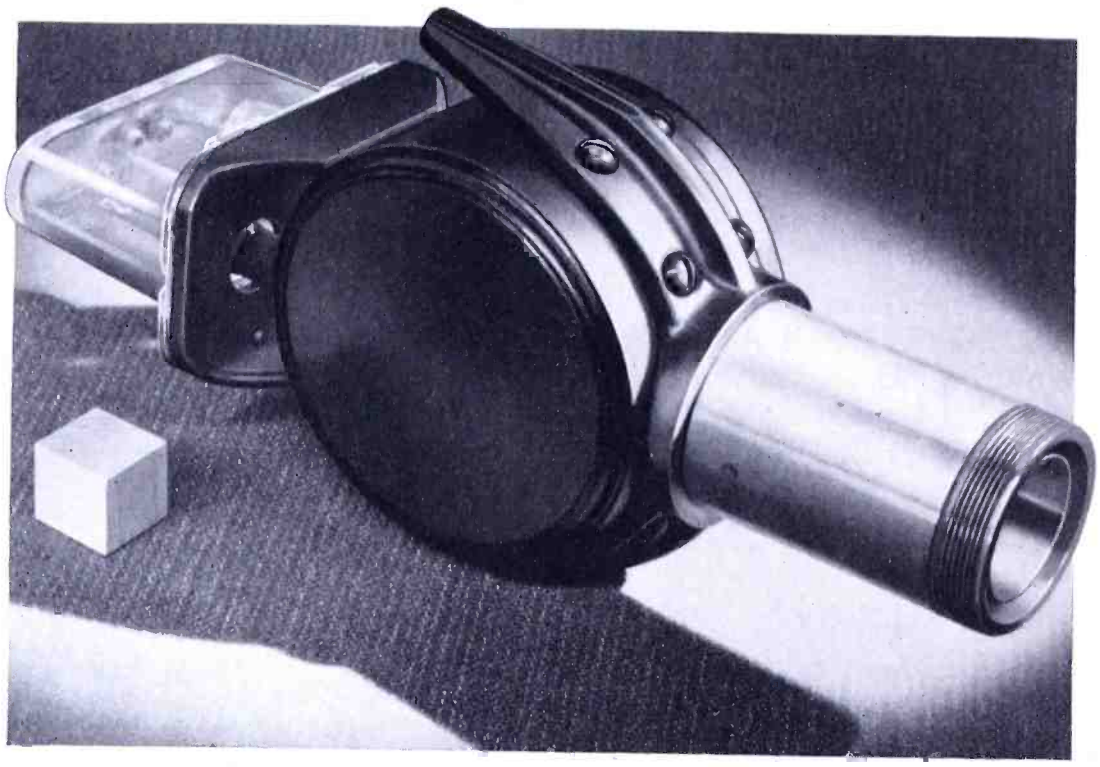


FIG. 48. An external view of a 728A-J magnetron (275 kw., 930 mc.). The concentric cylindrical sleeve to be seen inside the output circuit coupling, from which the magnetron is supported, is a part of the choke, Fig. 47. Note the heavy glass protective housing over the input leads.

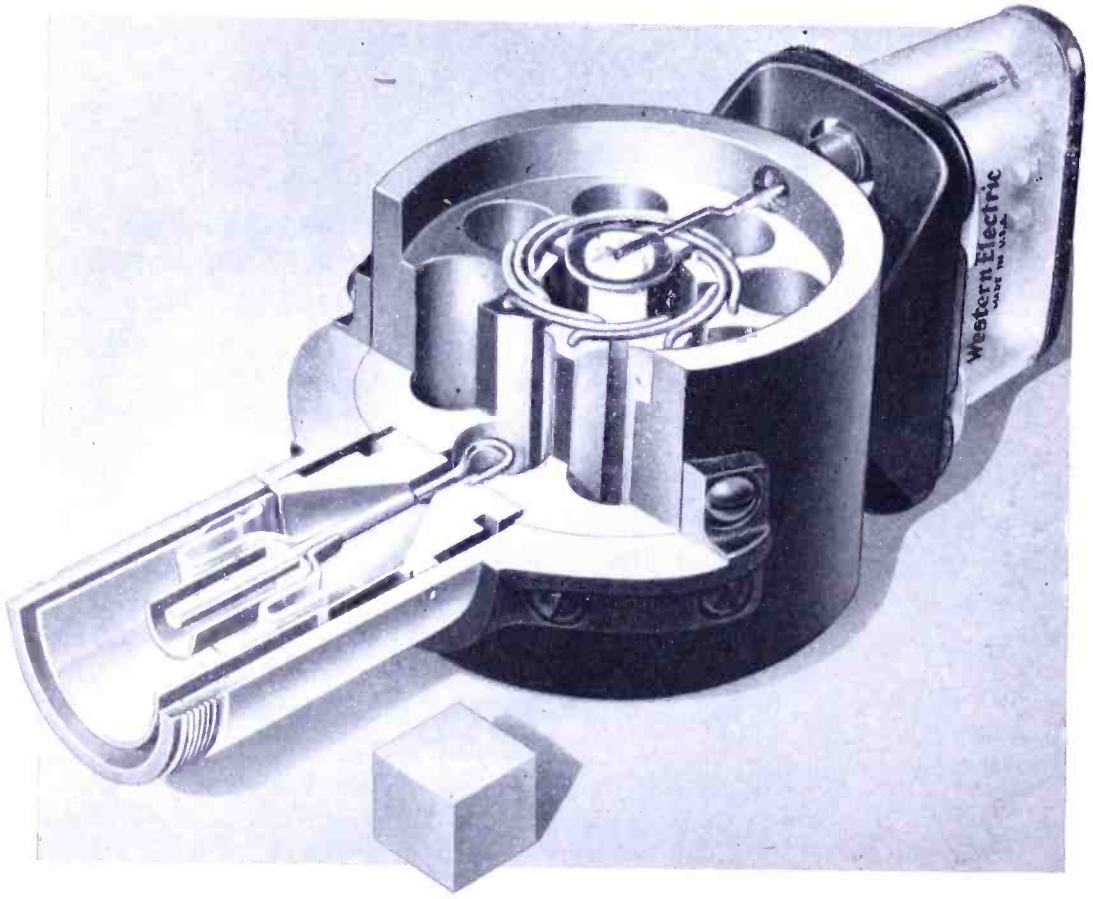


FIG. 49. A sectioned 5J23 magnetron (275 kw., 1050 mc.) showing, among other things, the echelon type of wire strapping and coaxial output circuit with contact-free load connector.

applied (see Section 10.6 *Oscillation Buildup — Starting*). What has been done in studying the phenomenon and in magnetron design to circumvent it will be discussed in some detail in connection with the 5J26, the tunable replacement for the 4J21-30 series.

Quantity production of the 700A-D magnetrons presented new problems, all of which arose because of its size. The oxide coated cathode, having a relatively large surface area, gave off a considerable quantity of gas during cathode activation. In as much as the massive copper anode could be outgassed only by a long baking process at temperatures below the softening point of the glass parts, difficulty with magnetrons going soft after seal-off was encountered initially.

The development of the 700A-D magnetrons was carried on simultaneously with early studies at 10 cm. and with the early attempts to produce power at 3 cm. A number of auxiliary experiments were undertaken which, although they were not a part of the specific magnetron development, contributed results of considerable value complementary to those obtained at the shorter wavelengths. In particular, these experiments had to do with the technique of measurement and of magnetron scaling.

Before the invention of straps, the 700A-D magnetrons were scaled to 10 cm. to explore the possibilities of a more efficient magnetron design at this wavelength. Straps were introduced before the completion of the experiment. The resultant strapped magnetron having 6 resonators was very efficient — 60% — but required a high magnetic field as can be seen by referring to equation (16) of Part 1. Like other magnetrons, the 700A-D became much more efficient when strapped. At the normal test point the efficiency ranged around 50%, while at higher magnetic field and voltage, 75% over-all efficiency was achieved. The introduction of straps into the manufactured design was not undertaken.

One further experiment of interest arose during the development of the 700A-D magnetrons from the desire to measure the gas pressure in a sealed-off magnetron. The non-oscillating magnetron itself was used as an ionization manometer. With the magnetic field set at a high value above cutoff and under conditions of no RF oscillation, electrons which arrive at the anode can do so only after having lost energy by collision with a gas molecule. Under these conditions the anode current is directly proportional to the pressure.

Although by present standards the 700A-D magnetrons might appear somewhat crude and inadequate, they nevertheless have an important place in the

(CONTINUED ON PAGE 59)

ENGINE-TO-CABOOSE FM SPEEDS PERISHABLES

Missouri Pacific Uses Radio to Avoid Delays on Red Ball Freight Bound for Dupo Terminal

BY RAY MAXWELL *

IF HOUSEWIVES in St. Louis, Chicago, Cleveland, New York and other northern and eastern shopping areas have been buying vegetables and citrus fruit that seemed to have an unusual garden freshness recently, perhaps it was because trainloads of these perishables from the Lower Rio Grande Valley of Texas have been reaching the markets in unusually good time. A factor contributing to the expeditious movement of this red ball freight is the increasing use of engine-to-caboose radio in train communication on the 191-mile section of the Missouri Pacific Railroad's line between Alexandria, La., and McGehee, Ark.

The few minutes' saving in time getting in and out of sidings and in other instances may add up to enough time on a late train to insure its making a close connection with northern and eastern lines at the Dupo, Ill., terminal of the Missouri Pacific. Where such saving in time makes a close connection possible, it may mean as much as 24 hours' earlier delivery at the destination than would have been the case had the connection been missed.

Already, 10 locomotives and 6 cabooses have been equipped with radio transmitters and receivers to permit communication between the engineer and conductor on the long and heavy 75- to 100-car fast freight trains of valuable perishables, and on other red ball merchandise trains between New Orleans and Kansas City.

When it is necessary for these lengthy trains to enter a siding to meet an opposing train, or to let a passenger train pass, front-to-rear radio communication facilitates the move. The conductor tells the engineer the exact position of the rear end of the train with reference to the switch in both entering and leaving the siding, and when the rear end is in the clear. This often saves long walks by a member of the crew to transmit hand signals, which are difficult and often impracticable on long trains, especially in curved track territory, or during adverse weather conditions.

Train radio has also simplified the checking of train orders between the conductor and engineer, as well as the routine matter of getting signals to the head end when the flagman has returned after having performed his duty of protecting the rear end of the train. The conductor, with the hand-set of his radio in the caboose, calls the engineer and tells him to "let 'er roll" the moment the flagman is aboard.

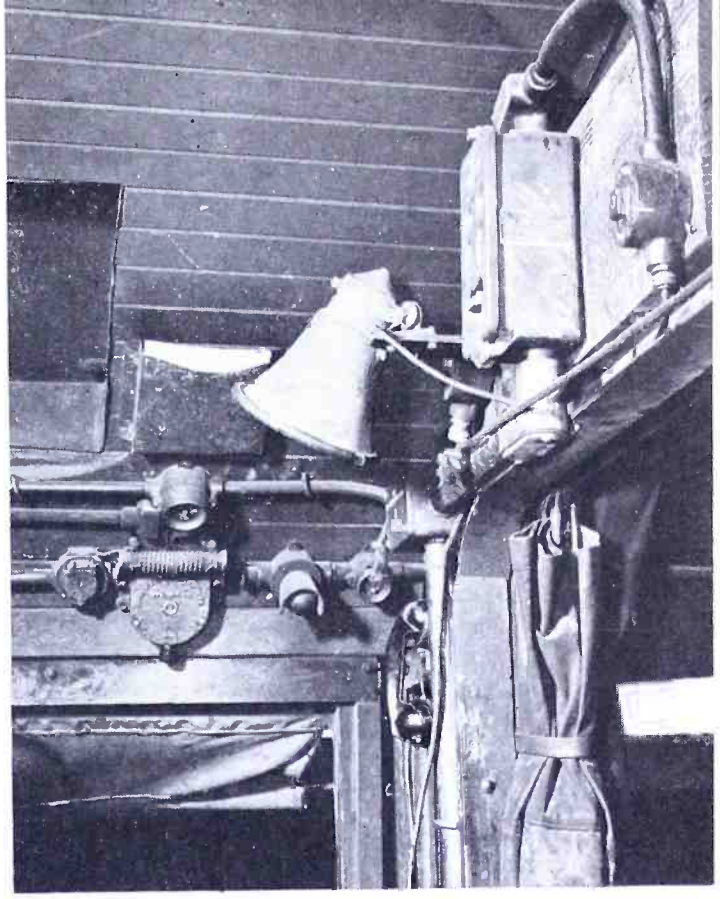


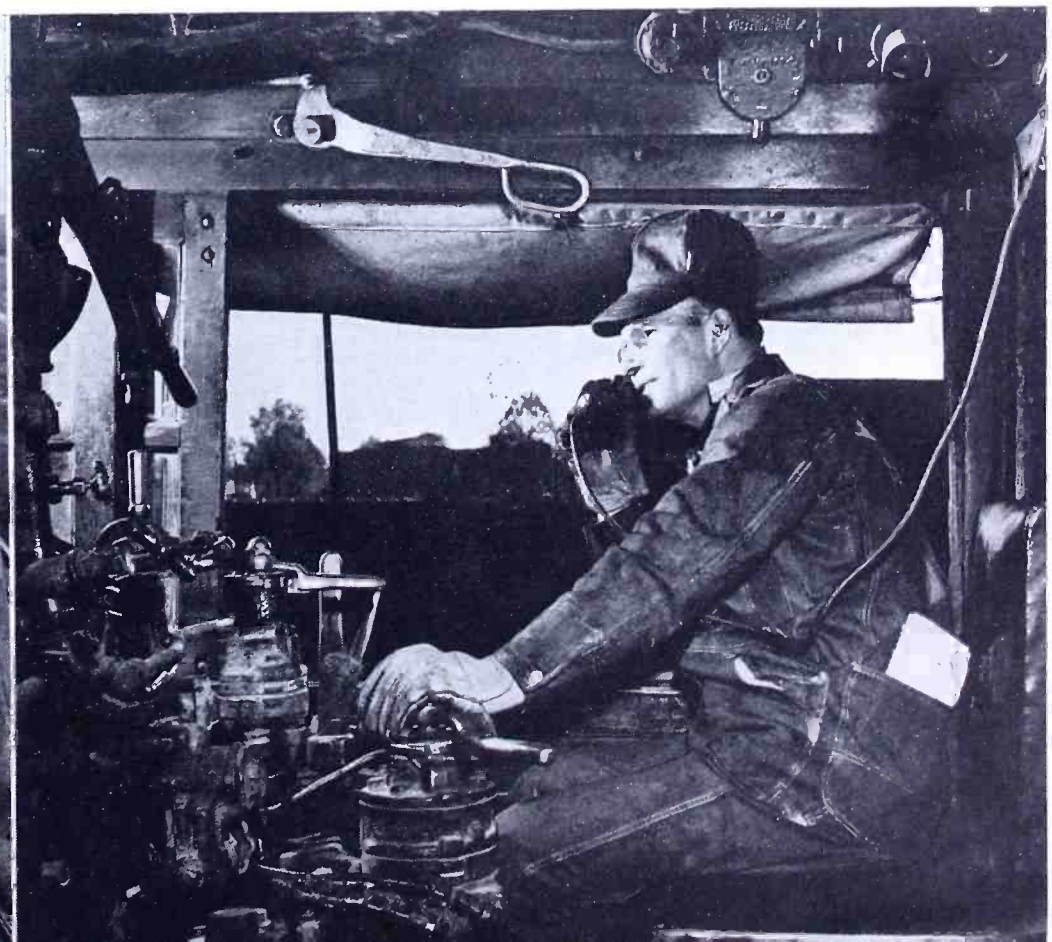
FIG. 1. LOUDSPEAKER ABOVE ENGINEER IS USED FOR INITIAL CALLING, BUT THE HANDSET, FIG. 3, IS FOR CONVERSATION

Train radio has served a useful purpose in avoiding the use of the conductor's air valve in the caboose for stopping trains in case of emergencies. On long freight trains moving at slow speed, as out of a siding, setting the air from the rear has often caused break-in-two's, resulting in serious delays, and damage to cars and their contents. Radio enables the conductor to advise the engineer immediately of hot-boxes, dragging equipment, shifting loads, or other defects discovered from the rear end, so that the train can be stopped by the engineer, and without use of the conductor's valve in the caboose.

Switching moves are being arranged by conversation on the train radio, between the conductor and the engineer, avoiding long walks by members of the

* Missouri Pacific Lines, St. Louis, Mo.

FIG. 2. INSTALLATION OF THE STEAM TURBO-GENERATOR THAT SUPPLIES THE LOCOMOTIVE EQUIPMENT. FIG. 3. ENGINEER'S POSITION



crew. When an unscheduled stop is made by the engineer because of some mechanical condition on the engine, or for other reasons of which the conductor is not aware, the engineer has been able to inform the conductor, tell him the estimated duration of delay, request help if required, and often permit time for a thorough inspection of the train by the crew. Time is also saved in making terminal and on-line air brake tests, by getting prompt action through use of the radio in setting and releasing brakes, instead of depending on hand signals.

These are but a few of the many ways in which front-to-end train radio has already proved itself a time-saver in fast-freight operation. It may be a matter of only 20 to 40 minutes total time saved, but if that saving enabled the train to reach its destination in Dupo, Ill., for example, where these Valley perishable "blocks" make connections with other eastern and northern lines, then the cars can be switched over at once and continue on their journey. A 30-minute delay, sometimes less, may mean that the other train has departed, necessitating a layover of anywhere from 6 to 24 hours. Refrigerator cars in the late arriving train may then have to be switched around for re-icing to afford continued protection to the load, thereby running up handling costs, and perhaps risking a lower price because of lower quality on the next day's market.

FIG. 4. ANTENNA USED IN CONJUNCTION WITH THE CABOOSE TRANSMITTER-RECEIVER

Missouri Pacific is licensed by the FCC to operate its train radios throughout 12 states on 160.41 mc. The sets have a working range of approximately 5 miles. The engine-caboose sets in use, and those yet to be installed, have been built by the General Railway Signal Company, Rochester, N. Y., especially for railroad use to operate under the most trying conditions. As the accompanying illustrations show, a transmitter and a receiver are mounted in a steel case between the trucks of the locomotive tender, with the loudspeaker, handset, and controls within convenient reach of the engineer in the cab. Power is supplied by a compact, weatherproof, steam turbo-generator mounted on the engine boiler. The one antenna used for both transmission and reception is mounted on the brakeman's cabin, or doghouse on top of the tender.

The necessary wires are carried between the generator and the cab to the equipment under the tender through a 10-conductor cable having a massive connector which is opened up when the engine and tender are separated for necessary shop repairs.

The coaxial cable to the antenna on the doghouse roof is carried up through the inside of the tender tank in a 2-in. conduit welded to the bottom of the tank. It was necessary to provide a slip sleeve joint on the top end of the pipe to permit it to move up and down with the undulating motion of the bottom of the tank, due to

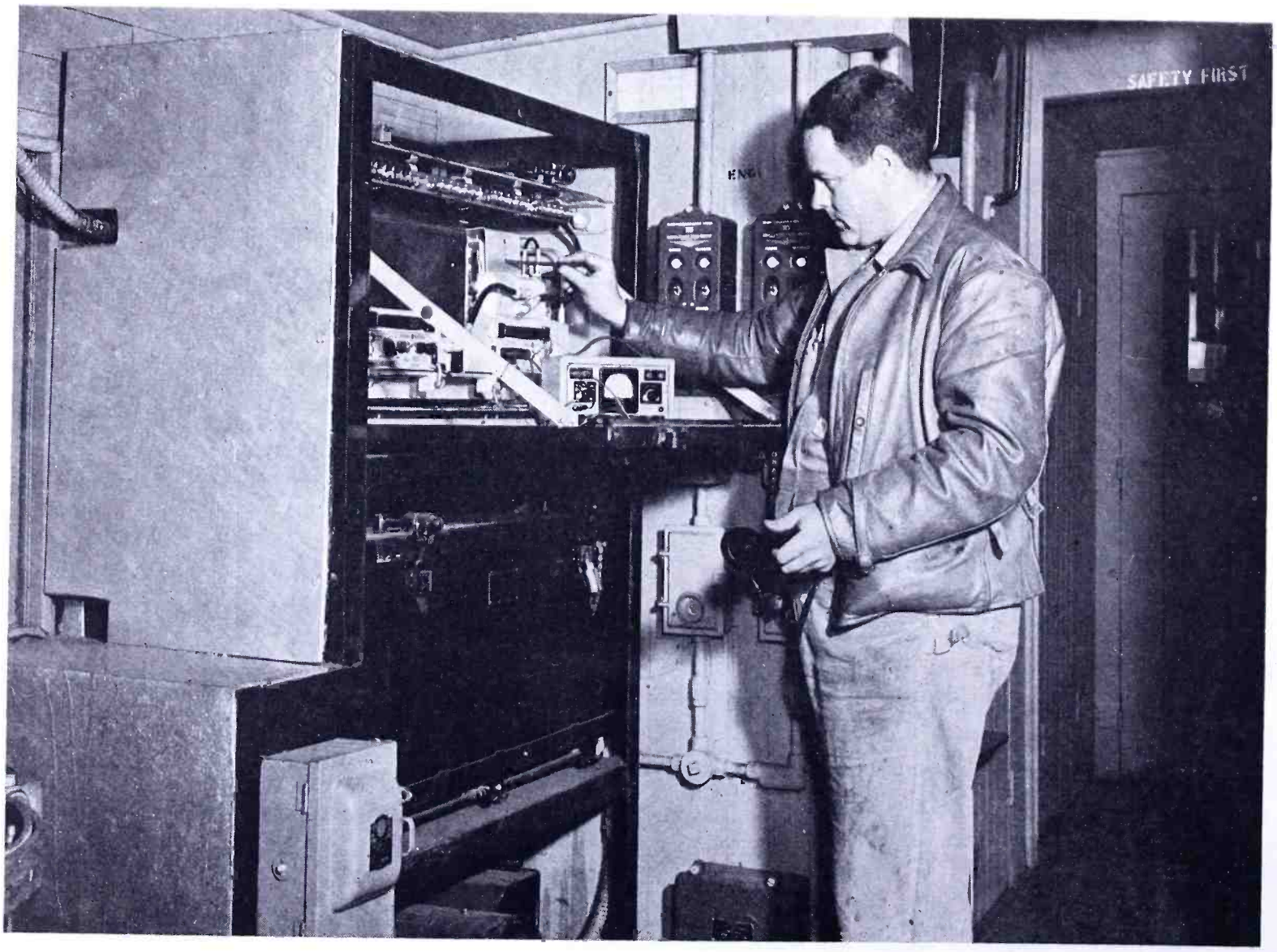


FIG. 5. INSTALLATION AND WIRING IN THE CABOOSE. LOWER CABINET WILL CONTAIN WAYSIDE STATION-TO-TRAIN EQUIPMENT

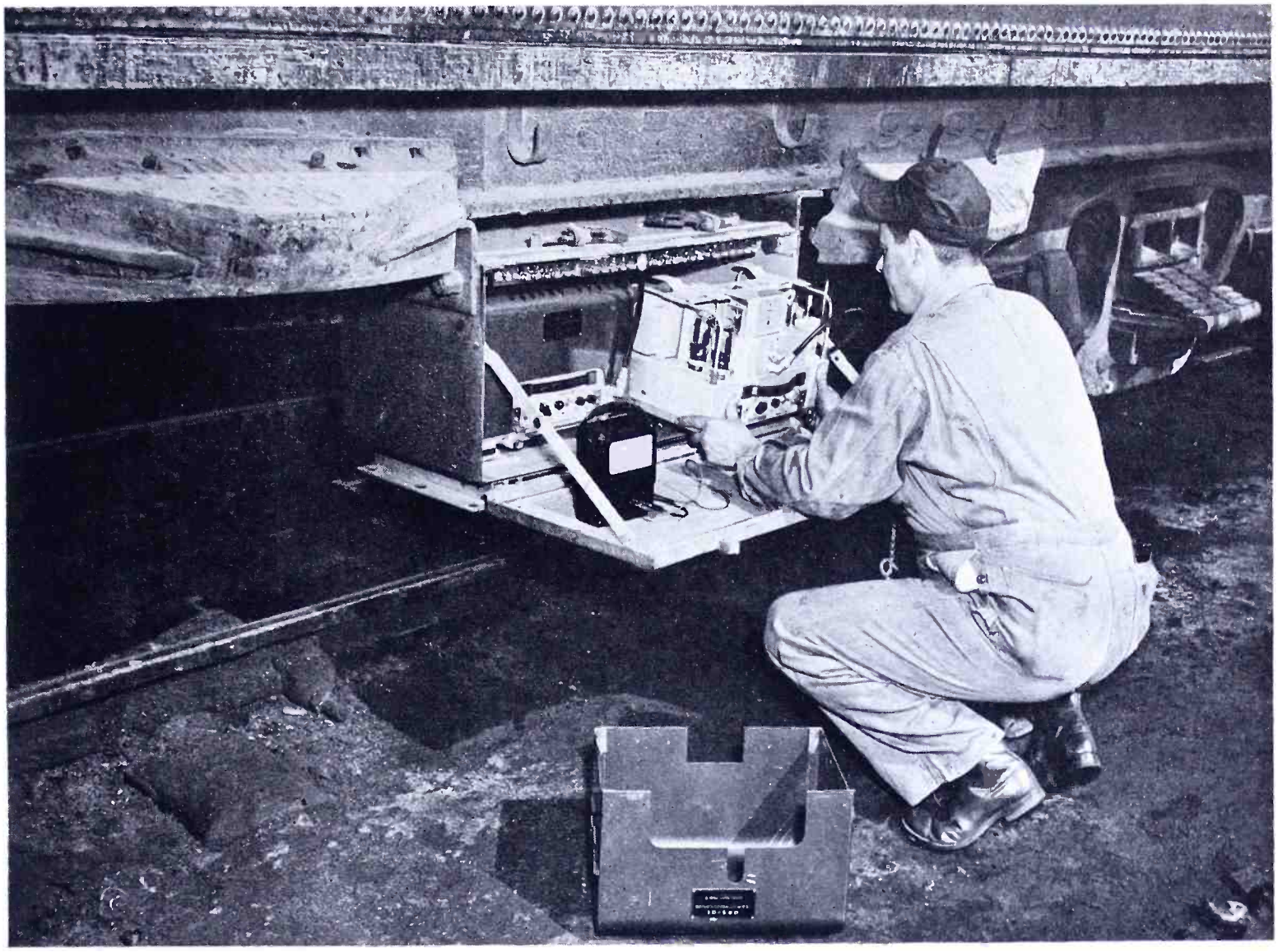


FIG. 6. TRANSMITTER-RECEIVER ASSEMBLY FOR THE LOCOMOTIVE IS MOUNTED UNDER THE TENDER, BUT IS READILY ACCESSIBLE

the surging water in the tank when the engine is in motion.

The radio equipment in the caboose is the same as in the engine, but with no steam available there for a turbor-generator, power is furnished by an electric generator, belt-driven from the truck axle, as on passenger cars. The antenna is mounted on the roof of the caboose forward of the cupola. To provide power for the radio while the caboose is standing, storage batteries are used. These are recharged when the caboose is set off at terminals where special facilities for this purpose are provided.

In the cabooses, facilities for the installation of additional equipment are being readied to afford another type of communication. This will be the inductive carrier system utilizing the telegraph wires beside the track as the antenna from which the carrier equipment in the caboose can receive and send messages to 7 wayside stations between McGehee, Ark., and Alexandria, La. This complicated equipment is on order, and the wayside stations are ready to receive the material when it is delivered.

First tests of radio by the Missouri Pacific were made early in December, 1944, when sets were installed in a yard switch engine in St. Louis, and a fixed station temporarily erected in the general office building.

In March of that year the first real tests of front-to-rear communication by radio were made in the same territory to which the 10 engines and cabooses with the permanent installations are now assigned.

This territory was selected as a further and continuing proving ground for train radio because of the operating conditions there. The line has a very dense flow of freight traffic, and with larger engines pulling longer trains, especially the perishables from Texas and New Orleans gateways, every means to expedite the movement of this traffic was to be encouraged.

Present installation plans call for equipping 15 engines and 15 cabooses. The work of completely reconditioning the cabooses before installation of the cabinets and conduits for the wiring has been going on in the Missouri Pacific's North Little Rock Shops. The communications equipment itself is installed at McGehee, Ark. All work is being done by the railroad's shop forces. Maintenance and periodic checking and testing are handled by employes especially trained for the work.

BATTLE OVER TELEVISION FREQUENCIES ON AGAIN

THE FCC conference held in Washington on June 10 and 11 for the purpose of discussing interference between television and the safety services reopened the question of keeping television on the lower channels. According to the allocations plan issued May 17, 1945, it is to share with 2-way communications.

At this time of writing, the transcript of testimony at the conference is not available, and the only comment received here is a copy of a letter addressed to FCC Chairman Denny, and sent also to members of Congress, by Zenith Radio president E. F. McDonald, Jr. In this letter, he said in part:

"At the FCC television interference conference you held this week it was obvious that a serious mistake was made in placing television in the 50-mc. band, *even temporarily*. Witness after witness testified that television, sandwiched here between police, amateur, mobile phone, and FM channels was being interfered with *by all of these services*. The testimony indicated that television cannot render even a good *temporary* service on this band.

"However, the interference now plaguing television on this band is trivial compared to what will happen when new stations now authorized take the air. Then there will be intolerable interference between television stations in different cities assigned to identical channels. We now have abundant evidence of frequent

(CONTINUED ON PAGE 58)

FM ANTENNA USES WAVEGUIDE PRINCIPLE

High Gain and Freedom from Icing Losses Are Features of New Design

BY GARDINER G. GREENE*

WHAT seems to be the ultimate in simplicity of design for an FM broadcast antenna is the new tower type, shown in the accompanying illustrations. This is a development of The Workshop Associates, an organization of antenna specifists formed during the war. If the appearance of this radiator suggests oversimplification, it is because the construction requires only two short waveguide sections arranged 90° to each other, and fed 90° out of phase. The sections are mechanically secured and electrically connected to supporting plates at the top and bottom, as the scale drawing shows.

The only insulation required in the entire antenna structure is at the center, where the feed lines are connected. This virtually eliminates the problem of icing, since the high-voltage points are separated by an air gap of 15 ins. Wind resistance and the area on which ice or rime can build up has been cut to an irreducible minimum in this structure.

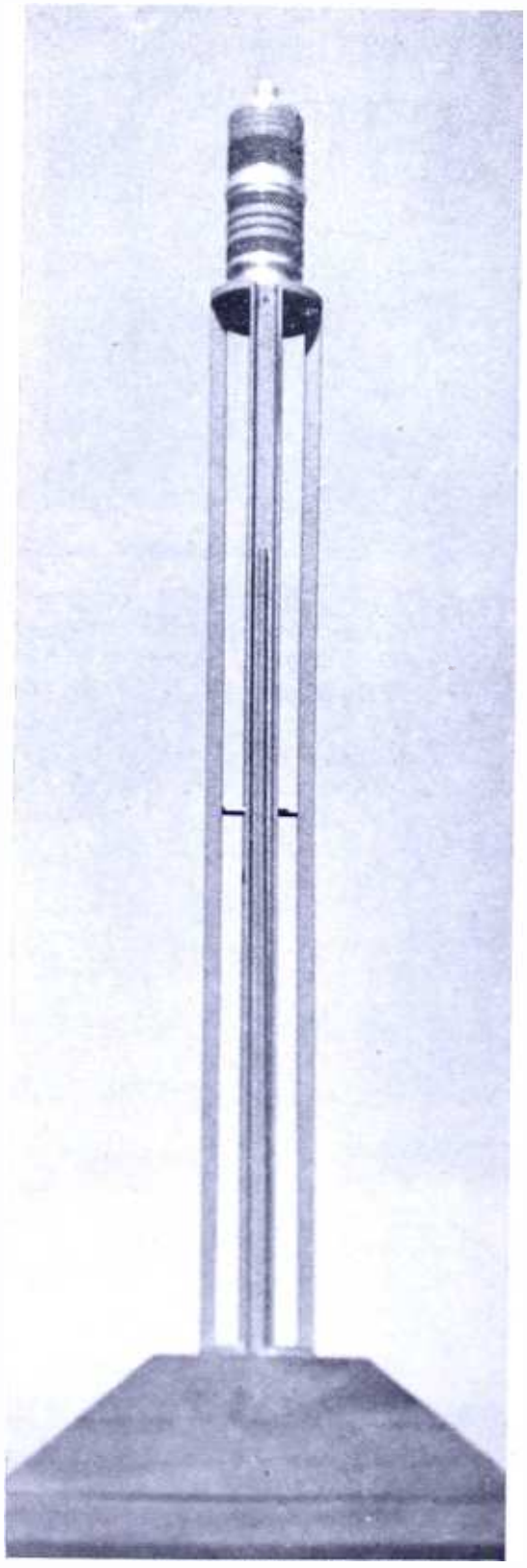
The gain for a single bay is approximately 2, comparable to that obtained from conventional arrays with 3 bays and half-wave spacing. Thus the weight and windload are considerably less than for other structures giving equivalent gain.

Actually, the complete antenna illustrated weighs only 183 lbs., exclusive of the beacon carried at the top. The four vertical-elements are heavy aluminum alloy channels, while the end plates are aluminum castings. The erection can be handled easily by 2 workmen, without the use of the usual elaborate rigging. As a result of the low weight and wind loading, a lighter and less expensive supporting tower can be used.

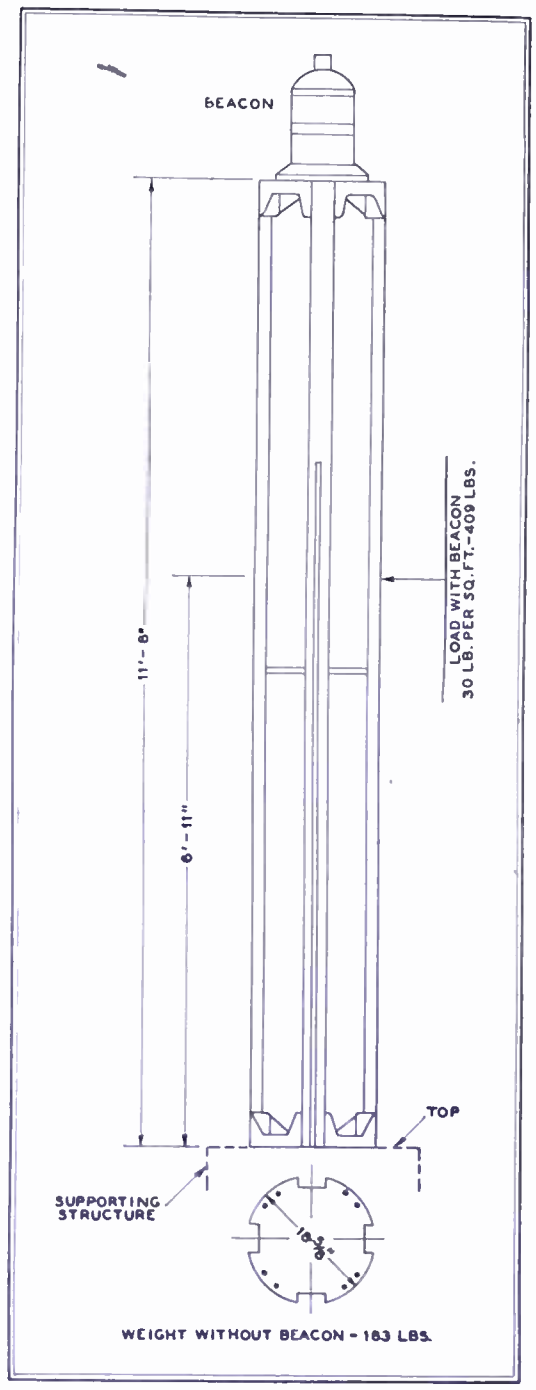
The first of the tower type antennas has been installed at FM station WCFR, Fall River, Mass. Initial deliveries are being made on the single-bay structure. However, additional sections will be available. If a single bay is installed, and a second added later, the second will be used as a support for the first. The gain for two sections is calculated at approximately 3.5, although no actual measurements have been made yet.

Dimensions are given in the accompanying drawing for the 88- to 108-mc. type. All tuning and adjusting is done at the factory. Accurate standing-wave radio measurements are made, and complete data is furnished to the station. Tests already completed show that the azimuth pattern is circular with a ratio of less than 1.1 to 1 in. radiated power.

*President, The Workshop Associates, Inc., 66 Needham Street, Newton Highlands 61, Mass.



WAVEGUIDE TYPE OF FM ANTENNA REDUCES LOSSES FROM ICING TO A MINIMUM



SCALE DRAWING OF A SINGLE-SECTION OF THE WAVEGUIDE-TYPE FM ANTENNA

MORE FM CHANNELS

JULY 1st ended the period during which 1 class B channel out of 5 was reserved in each area where at least 5 were assigned, and all class A channels Nos. 297, 298, 299, and 300 were reserved. Thus, channels are now available for 100 additional FM stations, distributed as follows:

ALA. Birmingham 1, Mobile 1
ARIZ. Phoenix 1
ARK. Ft. Smith 1, Little Rock 1
CALIF. Fresno 1, Los Angeles 4, Sacramento 1, Salinas 1, San Diego 1, San Francisco 3
COLO. Denver 2
CONN. Hartford 1
D. C. Washington 2
FLA. Jacksonville 1, Miami 1
GA. Atlanta 1
ILL. Chicago 3, Peoria 1

(CONCLUDED ON PAGE 58)

finch facsimile

Finch Telefax

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

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

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FACSIMILE HOME RECORDERS
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FACSIMILE DUPLICATING MACHINES
FINCH ANTENNAS FOR FM STATIONS

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U. S. COMMUNICATIONS SYSTEMS: Part 1

Directory of Railroad, Municipal and County Police, State Police, Fire, and Forestry Systems Licensed by the FCC. This Directory Includes Revisions and Additions to June 30, 1947

RAILROADS

ALTON & SOUTHERN 3105 Missouri Ave E. St. Louis Mo
WFKS 158 79 F
ATCHISON TOPEKA & SANTA FE 38 St & Cntl Pk Ave Chicago
WRPK 160.65 F
WIJL 160.65 F
97 KCFK 160 65 F
1 WIJK 160 65 F
56 WRQI 160.65 F
2nd & Santa Fe Sts Los Angeles
KCKB 161 37 F
1001 3rd St San Francisco
KCKC 161 37 F
30 & Powell Sts Argentine Kans
KCKD 159 45 F
BALTIMORE & OHIO Baltimore & Charles Sts Baltimore Md
5 WTUK 159.27 F
New Castle Pa
WBOR 159 27 F
Locust Pt Baltimore Md
WRTO 160 41 F
BESSEMER & LAKE ERIE 700 Union Trust Bldg Pittsburgh Pa
2 WBRR 161 91 F
1 WRYK 158 43 F
2 WRYL 158 43 F
BOSTON & MAINE 150 Causeway St Boston Mass
5 WRIQ 160 11 F
Mechanicsville N Y
WRKC 160 11 F
CHESAPEAKE & OHIO General Motors Bldg Detroit Mich
5 WPMQ 161 49 F
6 WRKK 160 11 F
WBBT 161 49 F
Ludington Mich
WRKN 160 11 F
Manitowoc Wis
WRLU 160 11 F
Milwaukee Wis
WRMD 160 11 F
Newport News Va
WCRR 158 55 F
823 E Main St Richmond Va
15 WCSK 158 55 F
CHICAGO BURLINGTON & QUINCY 547 W Jackson Blvd Chicago
WIAE 159 69 F
30 WBBD 159 69 F
25 WIAF 159 69 F
CHICAGO INDIANAPOLIS & LOUISVILLE Bedford Ind
WRHJ 159 33 F
608 S Dearborn St Chicago
2 WRHL 159 33 F
Bloomington Ind
WRHN 159 33 F
CHICAGO MILWAUKEE ST PAUL & PAC Union Station Chicago
25 KCMS 158 73 F
2 KMHN 158 73 F
CHICAGO ROCK ISLAND & PACIFIC La Salle St Station
WCHZ 161 61 F
42 WHUF 161 61 F
Hinsdale Ill
WCHU 161 61 F
Silvis Ill
WCIY 161.61 F
Blue Island Ill
WCJK 161.61 F
Bureau Ill
WCJL 161.61 F
Kansas City Mo
KCKV 158 55 F
Topeka Kans
KCKW 159 33 F
Minneapolis Minn
KCOA 161 61 F
Council Bluffs Ia
KCOG 161 61 F
Ft Worth Tex
KCOI 161.61 F
Des Moines Ia
KCOJ 161 61 F
Kansas City Kans
KCPT 161.61 F
DELAWARE LACKAWANNA & WESTERN Pier 6 North River Hoboken NJ
WIEB 160.29 F
10 WIEC 160.29 F
DENVER & RIO GRANDE WESTERN 1531 Stout St Denver Colo
60 KRCU 159 81 F
8 KAEJ 160 83 F
8th Ave & Osage St Denver Colo
KAEF 160.83 F
6th & State Sts Alamosa Colo
KCOE 160 83 F
ELGIN JOLIET & EASTN Whiting Ind
WELD 159 21 F
ERIE 101 Prospect Ave NW Clevlnd
20 WERL 158.85 F
Pier 4 Jersey City NJ
WJRP 158 85 F
FLORIDA EAST COAST NE 29 St Miami
WRRG 160.11 F
St Augustine Fla
11 WRRH 160.11 F
GULF MOBILE & OHIO Meridian Miss
WTYF 159.03 F
Mobile Ala
2 WWGM 159.03 F
JACKSONVILLE TERMINAL Co Jacksonville Fla
WTFV 161.25 F
WTVG 161.25 F
12 WTVH 161 25 F
MISSOURI KANSAS TEXAS Katy Bldg Dallas Tex
7 KPFE 159 93 F
KPWY 159 93 F
MISSOURI PACIFIC 310 N 13 St St. Louis Mo
32 KMPQ 160 41 F
NEW YORK CNTRL 466 Lex. Ave NYC
65 WNKX 158 49 F
Cheektowaga Township NY
WNYH 160 41 F
Bethlehem Township NY
WNYJ 158.79 F
Manlius Township NY
WNYP 158.79 F
WNYX 161.61 F
Weehawken NJ
WIHC 161.67 F
NRTHN PACIFIC 176 E 5 St St. Paul
KNCM 160.35 F
4 KNCQ 160.35 F
PITTSBURGH & LAKE ERIE P & LE Terminal Bldg Pittsburgh
WSBS 160.89 F
30 WSFF 161.61 F
McKees Rocks Pa
WSFE 161 61 F
ST. LOUIS SAN FRANCISCO Olive & Jefferson Sts Sprfield Mo
KRRM 161.97 F
15 KRRO 161.97 F
SEABOARD AIR LINE Tampa Fla
WRCL 159.33 F
WRGS 159.33 F
Atlanta Ga
WRGT 160.17 F
Norfolk Va
4 WWSA 158.67 F
26 WSNX 159.33 F
Hamlet NC
WSRR 159.33 F
WSNA 159.33 F
Richmond Va
WWSF 159.33 F
WWSI 159 33 F
Savannah Ga
WWSH 159.33 F
TOLEDO PEORIA & WESTERN Peoria Ill
WRTP 158.43 F
UNION PACIFIC Kansas City Kans
WRUP 161.85 F
Omaha Nebr
25 KRUQ 161.85 F
KUCA 160.89 F

INFORMATION ABOUT THIS DIRECTORY

1. Compilation of this Directory was mode possible through the courtesy and cooperation of the Federal Communications Commission. Responsibility for clerical errors, if any, lies with FM and TELEVISION magazine.

2. Because of the rapid expansion of the communications services, it is no longer possible to publish the complete Directory, with revisions and additions, twice a year. Therefore, Part 2 will appear in January, 1948. Thereafter, each part will be revised once a year.

3. As far as possible, addresses given here are for control points, and not for transmitter locations, as in the past.

4. The letter C denotes a County radio system.

5. The number preceding call letters is the number of mobile units. If no number appears, only a fixed station is licensed under the call letters shown. In some cases, however, licensees may not operate fixed stations, but instead operate mobile units in conjunction with a fixed station in an adjacent area. Letters A or F indicate AM or FM equipment.

6. Under State Police, the headquarters station is indicated by Hq. Other locations are police barrocks.

MUNICIPAL & COUNTY POLICE

ALABAMA

Anniston	7	WRBD	33.1	A
Baldwin C	2	WKUV	37.5	F
Bessemer	25	WKHU	155.13	F
Birmingham	93	WPFM	30.58	F
	1	WJGG	2382	A
Blount	2	WAQR	37.5	F
Calhoun	3	WCTM	37.5	F
Cleburne	2	WCML	37.5	F
Decatur	4	WADN	35.9	F
Dothan	3	WKAD	35.5	F
Etowah	3	WIYU	37.5	F
Florence	4	WKUH	35.9	F
Gadsden	3	WQIG	30.58	A
Huntsville	4	WMKA	35.9	F
Jackson	2	WUAZ	37.5	F
Lee C	2	WCVE	37.5	F
Marshall C	2	WMDO	37.5	F
Mobile	26	WPGW	3058	A
Montgomery	14	WMPM	3058	A
Northport	1	WDBZ	35.9	F
Randolph	2	WKVG	37.5	F
Selma		WASP	2382	A
Sheffield	7	WKIM	33.5	F
Shelby	2	WSFD	37.5	F
Sylacauga	2	WBVS	33.5	A
Tuscaloosa	3	WQJH	35.9	F
	3	WJWM	37.5	F

ARIZONA

Bisbee	5	KRHS	35.1	A
Casa Grande	1	KRQN	35.1	A
Flagstaff C	5	KQOJ	35.1	F
	1	KFPX	39.9	F
Florence C	9	KRAC	35.1	A
Holbrook	8	KICG	39.9	F
Maricopa C	20	KQXU	35.1	A
Mesa	1	KRIZ	30.58	A
Phoenix	34	KGZJ	30.58	A
Prescott	1	KNHG	35.1	A
Prescott C	10	KQHM	35.1	A
Safford C	3	KRJA	35.1	A
South Tucson	1	KEVZ	35 1	A
Tempe	1	KEYU	35.1	A
Tucson	9	KQEP	31.78	A
Tucson C	6	KQPW	35.1	A
Wickenburg	1	KSMG	39.9	F
Winslow	3	KRDW	35.1	A
	1	KQEX	2430	A
Yuma C	6	KADF	35.1	A
Yuma	10	KVNR	39.9	F

ARKANSAS

Ark. City C	3	KSDC	31.5	A
Blythville	1	KPBA	30.58	A
Camden	2	WJXY	31.5	F
Dumas C		KSDD	31.5	A
Fayetteville	1	KRNQ	30.58	A
Fort Smith	4	KNHA	30.58	A
Garland C	1	KQMC	2406	A
Helena	2	KIKS	30.7	F
Hope	1	KHSK	35.78	F
Little Rock	12	KGHZ	30.58	A
Little Rock C	8	KRGI	31.9	A
Marian C	6	KIOC	37.1	F
McGehee C		KSDD	31.5	A
Mississippi C	14	KPMA	33.5	A
N. Little Rock	8	KRAE	33.5	A
Pine Bluff	2	KDBR	37.5	F
Pine Bluff C	4	KQGT	30.58	F
Texarkana	8	KTAP	33.22	A
West Helena	1	KUHE	30.7	F

CALIFORNIA

Alameda C	1	KAKQ	1658	A
	1	KPDB		
KCTP	KCTO	KCTK		
	KCTT	KPDA		
Alameda	15	KQBR	35.1	A
Albany	5	KGWC	37.78	A
Alhambra	12	KQAH	31.5	A
	4	KRBQ	31.5	A
Alturas	1	KSYH	39.38	F
Anaheim	4	KQCL	37.34	A
Antioch	5	KSNW	37.02	A
Arcadia	9	KQAP	33.5	A
Atherton	2	KQXC	33.78	A
Auburn	5	KRQP	39.5	F
Azusa	3	KIBR	39.5	F
Bakersfield	17	KGPS	30.58	A
Bakersfield C	55	KACS	31.78	A
Banning	2	KQLY	30.58	A
Banning C		KQHL	2442	A
Barstow C		KSBB	1714	A
Beaumont	1	KQJH	30.58	A
Bell	4	KPBC	35.5	A
Benicia	3	KQSN	30.98	A
Berkeley	73	KSW	37.78	A
	1	KGIH	37.78	A
Beverly Hls	10	KQAI	37.1	A
Blythe	2	KAPY	30.58	A
Blythe C		LIOD	2442	A
Brawley	6	KBMP	155.01	F
Brea	3	KADQ	37.34	A
Burbank	18	KQBE	33.5	A
Burlingame	9	KQCM	37.22	A
Carmel-by-the-Sea	5	KQFI	35.22	A
Chico	1	KQEO	31.5	A
Chico C	6	KBYA	39.38	F
Chino	3	KQKN	33.22	A
Chula Vista	8	KQJG	37.34	A
Claremont	2	KQRY	33.22	A
Coalinga	2	KOFK	33.5	F
	1	KIHW	35.22	F
Colton	4	KQVO	33.22	A
Colusa	4	KQRO	39.38	F
Compton	1	KQAO	31.78	A
Corcoran	3	KKNE	37.5	F
	1	KKNJ	37.78	F
Corona	4	KRIV	30.58	A
Coronado	5	KQKV	37.34	A
Corte Madera	1	KPCM	33.22	F
Covina	1	KIQH	33.22	A
Culver City	5	KPDC	37.5	A
Daly	5	KILZ	35.9	F
Davis	2	KHOG	35.1	A
Delano	2	KEYG	35.9	A
Dinuba	3	KAAT	35.5	F
	1	KAAT	35.1	F
El Cajon	1	KEIJ	33.7	A
El Centro	2	KNGJ	35.1	F
	1	KQVN	2490	A
El Cerito	4	KAMM	37.78	A
El Monte	1	KROJ	39.5	A
El Paso de Robles	2	KAGT	39.1	F
El Segundo	5	KQJL	37.9	A
Elsinore	1	KGTS	30.58	A
Escondido	3	KQHX	33.78	A
Eureka	3	KQRM	30.7	A
Fairfax	2	KDIC	33.22	F
Fairfield	8	KAGR	30.98	A
Fresno	58	KGZA	35.22	F
		KRDY	2414	A
Fullerton	6	KQBN	37.34	A
Gardena	3	KQEG	39.1	A
Gilroy		KROB	1674	A
Glendale	53	KQCI	33.22	A
		KQZL	33.94	A
Glendora	1	KBPA	155.49	F
Grass Valley	1	KGVC	35.22	F
Hanford C	20	KEWB	37.78	F
Hawthorne	1	KAGS	39.1	A
Hemet	1	KBJT	30.58	A
Hermosa Beach	2	KRMZ	37.9	A
Hillsborough	1	KANQ	1674	A
	7	KSPH	33.22	A
Hollister	4	KDHB	35.1	A
Humboldt C	7	KHCP	39.78	F
Huntington Beach	4	KQAL	37.34	A
Huntington Park	11	KHPM	39.9	F
Imperial C		KEZQ		
Indio	2	KQHJ	30.58	A
Indio C	1	KQAD	2442	A
Inglewood	15	KQXL	39.5	F
Kensington	3	KKFD	35.22	A
Laguna Beach	5	KQEN	37.34	A
Lakeport C	9	KAVL	33.22	F
La Mesa	2	KEZT	33.78	A
Larkspur	1	KDII	33.22	F
La Verne	2	KQPZ	33.22	A
Lindsay	2	KRIM	37.1	A
Lodi	10	KNGY	39.5	F
Long Beach	45	KQAO	31.78	A
	1	KQST	33.1	A
	1	KBQW	33.1	A
		KQXI	33.1	A
Los Angeles	256	KGPL	35.1	A
	50	KGPL	35.1	F
	1	KNGX	1730	A
	1	KQEF	37.5	A
		KQJN	1730	A
		KQJO	1730	A
		KQJP	1730	A
	35	KQBV	31.9	A
Los Angeles C		KQDD	31.9	A
		KRGU	31.9	A
		KRVT	31.9	A
Los Banos	3	KERL	37.22	A
Lynwood	5	KQHK	35.5	A
Madera C	8	KFWH	37.78	F
Manhattan Beach	3	KRIB	37.9	A
Marin C	7	KSRC	33.22	F
	1	KEZB	1610	A
Mariposa C	2	KOBD	37.22	A
Martinez	8	KQKA	35.22	A
Martinez C	50	KQCE	35.22	F
		KRBS	1658	A
		KHNI	1658	A
Marysville	2	KADS	39.38	A
	4	KADS	39.38	F
Maywood	4	KHNJ	35.5	A
Menlo Park	6	KQXV	33.78	A
Merced	3	KQPD	37.22	A
Merced C	11	KSOM	37.22	A
Mill Valley	2	KDIO	33.22	F
Modesto	11	KQDQ	39.38	A
Modesto C	17	KASE	39.38	A
Modoc C	5	KSYJ	39.38	F
Monrovia	7	KWAG	33.5	A
Montebello	1	KQFE	37.9	A
Monterey	5	KRLF	35.22	A
Monterey Park	4	KGKR	31.5	A
Napa C	9	KNCO	33.22	F
Napa	15	KPNC	155.49	F
National City	8	KQBF	33.1	F
Needles	2	KNCF	33.22	A
Needles C		KMXN	17.14	A
Nevada	2	KQRN	35.22	F
Newport Beach	6	KQAF	37.34	A
N. Inyokern C		KEVE	24.14	A
N. Sacramento	2	KQRV	35.22	A
Oakland	77	KALT	31.78	F
	1	KOKL	31.1	F
Oceanside	4	KADI	37.34	A
Ontario	12	KQKT	33.22	A
Orange	4	KQBI	37.34	A
Oroville	1	KSPQ	39.38	F
Oxnard	6	KOXC	30.58	A
Pacific Grove	1	KAZI	30.58	F
Palm Springs	3	KQAS	37.1	A
Palo Alto	12	KGHK	33.78	A
Pasadena	50	KGJX	33.22	A
Perris	1	KIDW	30.58	A
Petaluma	2	KQCY	37.1	A
Piedmont	16	KQCP	37.22	A
Pittsburgh	5	KQBT	30.58	F
Pomona	14	KNFJ	33.22	A
		KALM	17.14	A
Porterville	3	KQAU	37.1	F
	1	KQAX	35.1	F

MUNICIPAL & COUNTY POLICE

Quincy C	5	KBSV	39.38	F
Redding	4	KRTM	156.69	F
Redlands	8	KQFT	33.22	A
Redondo Beach	3	KTEQ	155.61	F
Redwood	9	KRAZ	33.78	A
Redwood City C		KRGX		
Reedley	2	KRCP	33.5	A
Rialto		KROG		
Richmond	47	KRLW	33.78	F
	1	KEYZ	31.5	F
Riverside	24	KQJE	30.58	A
Riverside C	10	KQSG	30.58	A
		KERC	24.42	A
	1	KEZE	24.42	A
Roseville	1	KRPD	35.22	F
Ross	1	KRPC	33.22	F
Sacramento C	20	KEPN	35.22	A
Sacramento	37	KNGF	33.22	A
	1	KSPD	17.22	A
	1	KHSC	17.22	A
Salinas	5	KQHY	35.22	A
Salinas C	11	KQCO	35.22	A
San Anselmo	5	KQBP	33.22	F
	1	KOCM	24.90	A
San Bernardino	28	KQAC	33.22	A
San Bernardino C	49	KSBC	33.22	A
San Buenaventura	14	KACN	30.58	A
San Carlos	3	KRGK	33.78	A
San Diego	179	KGDZ	33.78	A
	3	KGDZ	24.90	A
		KFWL	24.90	A
	2	KHOJ	155.37	F
San Diego C	25	KQOV	37.34	A
San Fernando	3	KRMQ	39.5	A
San Francisco	84	KGPD	39.38	F
San Gabriel	5	KQBL	31.5	A
San Jacinto	1	KQHV	30.58	A
San Jose	100	KGPM	155.13	F
San Luis Obispo	2	KRAW	30.58	A
San Marino	8	KQDW	35.9	A
San Mateo	10	KQDA	37.22	A
San Rafael	2	KSRP	33.22	F
Santa Ana	17	KQAK	37.34	A
Santa Ana C	49	KGHX	37.34	A
Santa Barbara	21	KGZO	30.58	A
		KSBP	24.14	A
Santa Barbara C	34	KQIR	30.58	A
Santa Cruz	20	KGZT	154.77	F
Santa Maria	8	KSMP	30.58	A
Santa Monica	44	KQDF	33.5	A
	1	KRMG	33.5	A
Santa Paula	2	KVSL	30.58	A
Santa Rosa	9	KQDG	154.89	F
Santa Rosa C	11	KSRH	33.22	F
Sausalito	2	KCOS	33.22	F
Seal Beach	1	KQGX	31.78	A
Shafter	1	KDCZ	33.5	F
Signal Hill	2	KQFU	33.1	A
Solano C	25	KBRV	35.22	A
South Gate	16	KQPY	35.5	A
S. Pasadena	7	KBSP	33.22	A
S. San Francisco	9	KGIA	30.98	F
Stockton	80	KQCR	37.78	A
Stockton C	10	KAPH	37.22	A
Susanville C	4	KAEX	39.38	F
Sutter C	3	KBQF	39.38	F
Torrance	6	KRMF	39.1	A
Tracy	3	KACO	39.38	A
Tulare	1	WPDA	30.58	A
Turlock	2	KQCG	39.38	A
Tustin	1	KQJA	33.78	A
Ukiah	1	KHGV	39.5	F
Upland	5	KQKU	33.22	A
Vallejo	22	KGPG	30.98	A
Ventura C	28	KFOJ	30.58	A
Visalia	2	KQBQ	37.1	A
Visalia C	17	KAZF	35.1	F
Watsonville	3	KWCP	35.22	A
West Covina	1	KREQ	31.1	F
Westwood C		KSDM	17.22	A
Whittier	8	KGHY	155.73	F
Woodland	1	KAGD	17.22	A
Yreka		KQGZ	30.58	A
Yuba City	2	KBQY	30.58	F
Yuba C	2	KBQZ	39.38	F

COLORADO

Boulder	4	KQGA	33.78	A
Colorado Spgs	1	KPCS	31.5	A
Denver	118	KGPX	33.78	A
		KQHI	24.42	A
El Paso C	3	KFHR	31.5	A
Englewood	2	KIUE	33.78	A
Fort Collins	2	KQFV	33.78	A
Golden C	36	KRSU	39.5	F
Grand Junction	6	KQXT	33.78	A
Greeley	7	KPDG	33.78	A
La Junta		KPLJ	24.42	A
Larimer C	3	KAEU	33.78	A
Longmont	3	KPDL	33.78	A-
Pueblo	15	KQCX	30.98	A
		KRHY	24.42	A
Sterling	1	KESY	33.78	A
Trinidad	2	KHRI	30.58	A
Trinidad C	3	KEHM	30.58	A

CONNECTICUT

Ansonia	2	WKSS	33.1	F
Bethel	1	WHNK	35.9	A
Bloomfield	1	WLST	33.1	A
Branford	3	WMVO	31.1	F
Bridgeport	23	WPFW	30.58	F
		WKEQ	30.7	F
Bristol	6	WJVO	31.1	F
Danbury	3	WSRE	35.9	A
Darien	4	WQYB	33.78	F
Derby	1	WDPP	155.49	F
E. Hartford	8	WBXC	33.1	A
Enfield	1	WBMW	39.1	A
Fairfield	1	WKGF	31.78	F
Glastonbury	1	WKVQ	33.1	A
Greenwich	15	WQLE	39.9	F
		WWEF	39.9	F
Groton	1	WIZY	31.9	F
Hamden	4	WHPD	37.9	F
Hartford	46	WQRC	33.1	A
Manchester	3	WRZP	33.94	A
Meriden	5	WKSM	35.1	F
Middletown	2	WSKV	37.9	A
Milford	6	WBLB	31.9	A
New Britain	9	WRAF	37.1	A
New Canaan	2	WJPY	37.9	F
New Haven	6	WQFA	37.1	F
Newington	2	WPLZ	33.1	A
New London	6	WAKB	31.9	F
N. Haven	1	WKKD	37.78	F
Norwalk	1	WEIS	35.5	F
Norwich	3	WBXY	39.9	F
Plymouth	1	WHHL	31.1	F
Rocky Hill	1	WJNP	33.1	A
Seymour	3	WMYN	31.5	F
Southington	5	WOQW	155.01	F
Stamford	5	WPHH	37.5	A
	7	WSVL	37.5	A
Stratford	7	WCBH	30.98	F
	2	WKSC	30.98	F
Suffield	3	WCSO	30.7	A
Torrington	4	WKPJ	39.9	F
Trumbull	3	WJUY	30.98	F
Wallingford	7	WMIR	39.9	F
Waterbury	31	WMPW	39.1	F
Watertown	1	WJYX	39.1	F
W. Hartford	9	WQJI	31.5	A
West Haven	4	WBLB	155.25	F
Westport	4	WBLT	33.94	F
Wethersfield	2	WABT	33.1	A
Willimantic	1	WEGJ	31.1	F
Winsted	1	WHUO	30.7	F
Windsor	1	WLSY	33.1	A
Woodbridge	1	WAQX	37.1	F

DELAWARE

Dover	1	WAZO	33.5	A
Milford	1	WMIM	37.50	A
New Castle C	2	WTOS	39.78	F
Newark	2	WNBA	39.5	F
Smyrna	2	WKBL	39.78	F
Wilmington		WRPF	31.5	A
	64	WWPD	30.58	A

DISTRICT OF COLUMBIA

Washington	100	WPDW	37.22	F
	50	WDCS	39.5	F
	1	WJHJ	39.5	F
Lorton, Va. Reformatory		WLOV	39.5	F

FLORIDA

Bartow	8	WBPF	155.31	F
Belleair	1	WAJT	30.58	A
Bradenton	4	WRMO	37.1	F
Clearwater	3	WQOI	30.58	A
	2	WQOI	30.58	F
Clearwater C	8	WAKG	33.78	F
	2	WBUW	33.5	A
Coral Gables	7	WOCG	155.31	F
Dade City C	3	WQHE	30.7	F
Dania	2	WQXM	37.1	A
Daytona Beach	10	WRHQ	155.67	F
Deland C	25	WJQD	154.95	F
Delray Beach	3	WAFD	35.9	F
Dixie C	2	WDKX	31.1	F
Dunedin	1	WBLE	30.58	F
Escambia C	7	WPFR	31.1	F
Ft. Lauderdale	1	WAKO	30.58	A
Fernandina C	3	WMUW	31.1	F
Fort Myers	2	WFMF	37.1	A
Fort Pierce	3	WFPF	35.5	F
Gainesville	15	WQFC	156.03	F
Gulfport	1	WQUT	33.5	A
Haines	1	WITW	35.9	F
Hallandale	1	WSVE	37.1	A
Holly Hill	1	WBJE	37.1	A
Hollywood	5	WQNL	37.1	A
Jacksonville	154	WPFG	155.67	A
Jacksonville Beach	7	WJBH	30.7	F
Lakeland	10	WPFT	31.5	A
Lake Worth	12	WLWL	156.51	F
Leesburg	12	WGPD	37.5	F
Leon C	2	WCGV	33.1	F
Manalapan	2	WMAF	156.51	F
Marianna C	2	WJQR	39.5	F
Miami	20	WPFZ	155.67	F
	42	WDHI	31.5	F
Miami Beach	22	WQMA	156.03	F
Ocala	4	WBTW	35.9	F
Ocala C	10	WKWP	31.9	F
Orlando	22	WPHM	37.26	A
Ormond	1	WMJI	37.1	A
Pahokee	3	WBNO	155.31	F
Palm Beach	2	WPFX	30.58	A
Palm Beach C	3	WSSR	31.1	F
Panama City	4	WAZU	37.1	F
Panama City C	5	WKRE	31.1	F
Pensacola	8	WRGP	30.58	A
Plant City	3	WRFP	35.5	F
Putnam C	3	WKGH	31.1	F
Sanford	4	WQRA	33.1	A
St. Augustine	4	WQSU	33.1	F
St. Augustine C	3	WFLI	39.5	F
St. Petersburg	8	WQMZ	33.5	A
Sarasota	6	WEAG	31.5	F
Sarasota C	4	WBYI	30.7	A
Tallahassee	2	WQSX	33.1	F
Tampa		WFPT	37.9	F
	3	WPHN	37.78	F
Tampa C	30	WRIM	35.5	F
Vero Beach	4	WOGA	155.67	F
W. Palm Beach	2	WRZY	35.5	F
Winter Haven	2	WQFN	35.9	F

GEORGIA

Albany	3	WGYI	30.58	A
Americus		WRJW	2414	A
Athens	3	WMUO	39.5	F
Atlanta	50	WPDY	156.21	F
Augusta	22	WQFV	31.78	F
Bibb C	8	WLAF	30.58	F
Brunswick	12	WQTC	155.61	F
Columbus		WBLV	2414	A
	11	WPFI	30.58	A
	11	WPFI	30.58	F
Dalton	6	WBPJ	37.9	F
Decatur C		WQSJ	30.98	F
Dougherty C	4	WDKK	30.98	F
East Point	10	WBFF	35.5	F
Floyd C	5	WNPQ	35.9	F
Gainesville	2	WHNX	35.5	F
Glynn C	8	WQGI	155.61	F
Griffin		WUET		
La Grange	2	WQTZ	37.1	A
Macon	3	WQFB	30.58	F
Marietta	2	WANT	33.94	F
Richmond C	4	WGMA	35.9	F
Rome	8	WQNQ	35.9	F
Savannah	27	WQTR	33.1	F
Savannah C	15	WJPE	155.13	F
Thomasville	2	WROH	37.1	A
Toccoa	2	WHVT	39.5	F
Valdosta	2	WBYB	33.5	A
Waycross	3	WMPF	35.9	F

TERRITORY OF HAWAII

Hilo C	40	KAKD	35.1	A
Honokaa C	1	KAFR	1714	A
Honolulu	1	KFJD	37.1	F
	30	KGPQ	35.1	A
Kakaako Fire Sta	1	KFJJ	37.1	F
Kalihi Fire Sta	1	KFJP	37.1	F
Kaneohe	1	KHAB	1714	A
Kaunakakai C	10	KRLB	30.58	A
Kealakakua C	1	KHRU	1714	A
Lahaina C	1	KENW	1722	A
Lanai City C	1	KBSN	1722	A
Lihue C	55	KCKT	37.9	F
Oahu	1	KHAC	1714	A
Pala C	1	KQXY	1722	A
Wahlawa	1	KHAA	1714	A
Walluku	1	KAPM	1722	A
Waimea C	1	KCKU	37.9	F

IDAHO

Ada C	4	KAHP	37.22	F
Bannock C	3	KAAL	37.22	F
Boise	1	KQBD	37.22	F
Bonneville	1	KAOA	37.22	F
Burley	2	KREV	37.22	F
Caldwell C	5	KEHK	37.22	A
	2	KEHK	37.22	F
Burley C		KREU		
Coeur d'Alene	2	KXIR	30.58	A
Couer d'Alene C	3	KQGE	30.58	A
Elmore C	2	KECO	37.22	F
Gem C	1	KFEM	37.22	F
Gooding C	1	KCJZ	37.22	F
Idaho Falls	2	KNFB	30.58	F
Jefferson C	1	KCUK	37.22	F
Jerome C	2	KAHA	37.22	F
Jerome	1	KCKK	37.22	F
Kellogg	3	KHFZ	39.5	F
Moscow	1	KQJF	30.58	A
Lewiston	3	KSTD	30.58	A
Lewiston C	3	KRLG	30.58	A
Minidoka C	1	KRET	37.22	F
Moscow	1	KKMT	30.58	A
Nampa	4	KQZS	155.01	F
Pocatello	5	KRBL	30.58	A
Power C	1	KRZH	37.22	F
Twin Falls	6	KRDZ	37.22	F
Wallace C		KHIW		
Wallace		KHFY		

ILLINOIS

Alexander C	1	WKXZ	39.5	F
Aledo C	4	WTWU	39.5	F
Alton	6	WQSR	30.7	A
Arlington Hgts	1	WBNQ	33.78	A
Aurora	4	WQRM	155.61	F
Bartonville	1	WBOF	33.5	A
Batavia	2	WKDV	35.5	A
Bedford Pk	9	WJVI	39.1	F
Bedford Pk C		WSKE	31.9	A
Belleville	3	WQTG	37.1	A
Belvidere C	2	WSKO	2458	A
Bellwood	1	WKGO	31.5	F
Bensenville	1	WJHG	37.22	F
Berwyn	5	WSVH	33.5	A
Bloomington	3	WQRI	31.9	A
Bloomington C		WSGQ		
Broadview	1	WDBL	31.5	F
Brookfield	2	WEUC	31.5	F
Cairo	1	WIPC	30.98	A
Calumet	2	WKJN	39.1	F
Calumet Pk	1	WBWG	33.78	A
Cambridge C	2	WIKD	33.94	F
Canton	2	WHNB	37.1	F
Carlyle C	2	WKNW	33.94	F
Cary	1	WCVP	33.94	F
Carthage C	2	WAFA	33.94	F
Centralia	2	WSKZ	33.94	F
Champaign	4	WQIB	155.61	F
Chicago		WPDB	1714	A
	201	WPDC	35.22	F
		WPDD	1714	A
	89	WQJF	31.1	A
Chicago Hgts	3	WQXZ	33.22	F
Cicero	1	WRHC	33.5	A
Collinsville	1	WBEP	39.1	F
Creve Coeur	1	WNGG	155.73	F
Crystal Lake	2	WCLV	33.94	F
Danville	4	WRGQ	30.58	A
Decatur	10	WQTF	33.1	A
Decatur C	3	WASB	33.94	F
Decatur Pk Dist	1	WAAO	33.1	A
Des Plaines	3	WRIJ	37.9	A
Clinton C		WMPJ		
Dolton	1	WBVY	33.78	A
Downers Grove	1	WRIW	37.22	A
E. Moline	4	WEMY	156.21	F
E. Peoria	1	WJVM	33.5	A
E. St. Louis	19	WSTX	33.1	F
Edwardsville	1	WKIJ	33.94	F
Edwardsville C	3	WQRY	33.94	A
Elgin	6	WQNO	154.89	F
Elmhurst	3	WQJX	37.22	A
Elmwood Pk	1	WIEG	31.5	F
Evanston	11	WQLO	30.7	F
Eureka C	2	WBFG	33.94	F
Evergreen Pk	1	WBKL	33.78	A
Flora	2	WJLA	33.94	F
Flossmoor	1	WEKB	33.78	A
Forest Pk	2	WBXG	37.1	A
Fox River Grove	1	WJUR	33.94	F
Franklin Pk	1	WJWT	31.5	F
Freeport C	4	WKGI	33.94	F
Galesburg	3	WBYF	37.1	F
Geneva	1	WKBP	35.5	A
Geneva C	5	WDAA	35.5	A
Glencoe	4	WQLN	35.9	A
Glen Ellyn	2	WAEX	37.22	A
Glen View	2	WGLI	37.1	A
Granite City	2	WQYC	39.1	F
Harrisburg	1	WALG	33.94	F
Harvey	3	WSOK	37.9	A
Henderson C	1	WMQD	33.94	F
Highland Pk	5	WQRE	35.9	A
Highwood	1	WKMB	35.9	A
Hillside	1	WBRQ	31.5	F
Hinsdale	3	WROG	37.22	F
Homewood	1	WBHY	33.78	A
Homewood C		WSKD	31.9	A
Jacksonville	2	WNRN	33.94	F
Jacksonville C	3	WCUN	33.94	F
Joliet	4	WQLW	33.1	F
Kankakee C	4	WSTU	30.58	A
Kenilworth	2	WKPD	35.9	A
Kewanee	2	WWHO	154.89	F
LaGrange	2	WAFC	31.5	F
LaGrange Pk	2	WMHZ	31.5	F
Lewiston C	3	WLIS	33.78	F
Lake Forest	8	WQLK	20.98	A
Lansing	1	WBMG	33.78	A
LaSalle	2	WQKR	30.70	F
Lawrenceville	1	WQGV	33.94	F
Libertyville	1	WSYW	33.22	A
Lincoln	3	WDBT	31.9	A
Lincoln C	5	WDBU	39.5	F
Lincolnwood	2	WSKR	37.1	A
Livingston C	3	WLCI	39.5	F
Lockport	1	WLIJ	39.5	F
Lombard		WTSA		
Lyons	1	WDCV	31.5	F
Madison	2	WMQK	39.1	F
Maine C		WSCI		
Marengo		WUAV		
Marion	2	WQHX	33.94	F
Marion C		WUEI		
Mattoon	3	WBCX	33.94	F
Maywood	4	WBZD	31.5	F
Midlothian	1	WJXF	33.78	A
Moline	4	WAON	33.5	A
Monmouth	2	WMQS	33.94	F
Monmouth C	2	WMHI	33.78	F
Morton Grove	1	WSKJ	32.78	A
Mt. Carmel	2	WMMO	33.94	F
Mt. Vernon	2	WMTV	39.3	F
Mt. Vernon C	2	WLEB	33.94	F
Mundelein	1	WAJS	33.22	A
	1	WAJS	33.22	F
Murphysboro C		WUEP		
Nameoki	1	WMKU	39.1	F
Naperville	1	WROA	37.5	A
Normal	1	WQJR	155.13	F
Northbrook	1	WOQH	35.9	A
N. Chicago	2	WRLN	33.22	A
	2	WRLN	33.22	F
Oak Lawn	1	WIWZ	33.78	A
Oak Park	12	WQFL	30.58	A
Oglesby	1	WSRZ	33.94	F
Ottawa	3	WQKN	37.1	A
Ottawa C		WQFZ		
Park Ridge	2	WBZD	30.7	F
Paxton C	1	WQWT	33.94	F
Pekin	2	WSTO	33.5	A
Pekin C	2	WANU	33.94	F
Peoria	30	WASE	155.01	F
	1	WRIM	33.5	A
Peoria C	2	WRNK	33.5	A
Peoria Hgts	1	WMWZ	33.5	A
Peru	1	WQKM	37.1	A
Princeton C	2	WKPS	33.94	F
Quincy	5	WBHZ	155.85	F
Riverdale	1	WBMQ	33.78	A
River Forest	3	WQIN	37.9	A
	1	WRIX	37.9	A
River Grove	1	WJWS	31.5	F
Riverside	2	WCEV	31.5	F
Rock Falls	6	WOJQ	155.61	F
Rockford	1	WPGD	30.58	A
Rockford C	5	WPWC	33.94	F
Rock Island	6	WBDI	155.61	F
St. Charles	2	WSTY	35.5	A
Salem	1	WAQL	33.94	F
Salem C	3	WBXM	33.94	F
Saline	3	WMQW	33.94	F
Sangamon C	4	WRSC	39.5	F
Scott C	1	WSPK	33.94	F
Skokie	2	WQXL	37.1	A
S. Beloit	1	WBNP	31.5	A
Springfield	5	WQXJ	31.5	A
Streator	1	WQKE	37.1	A
Taylorville	1	WPTM	33.78	F
Taylorville C	3	WJYF	33.78	F
Urbana	4	WAGR	155.73	F
Vandalia C	1	WBQY	33.94	F
Venice	1	WJAA	39.1	F
Vermilion C	6	WBWJ	30.58	A
Villa Pk	1	WBLS	37.22	A
Washington C	2	WSVI	39.5	F
Watseka C	5	WUED	39.5	F
Wauconda	1	WNVF	33.22	F
Waukegan	4	WQLM	33.22	F
		WJEC	33.1	A
Waukegan C	31	WQFX	33.22	F
	5	WQFX	33.22	A
Westchester	1	WCUC	31.5	F
W. Chicago	1	WDCR	37.22	F
Western Spgs	2	WKYZ	31.5	F
W. Frankfort	1	WDVQ	33.94	F
Wheaton	3	WQJV	39.5	F
Wheaton C	20	WQJW	37.22	F
Will C	2	WJKO	33.1	F
Wilmette	3	WDEY	30.7	F
Winnetka	4	WQTO	35.9	A
Woodstock C	2	WPHD	33.9	F

INDIANA

Alexandria	2	WEDX	154.89	F
Allen C	4	WSKG	30.58	A
Anderson	25	WMPI	155.61	F
Anderson C	4	WSMK	154.89	F
Angola C		WHUM	2490	A
Auburn	1	WAXT	30.58	A
Bedford	2	WBIP	30.58	A
Beech Grove	1	WKBA	154.71	F
Bloomington	2	WBPD	155.13	F
Bloomington C	1	WBJK	155.13	F
Bluffton	1	WAMI	154.89	F
Bluffton C	2	WJAK	154.89	F
Cass C	1	WSLH	154.89	F
Clinton C	2	WBTJ	30.58	A
Columbia City	1	WGHQ	154.89	F
Columbia City C	2	WBJH	155.13	F
Columbus	3	WRJF	155.13	F
Connersville		WAMB		
Crawfdsvle	2	WCIP	154.89	F
	2	WBVG	30.58	A
Crown Point	1	WCPP	37.1	F
Crown Pt C	3	WAGT	37.1	F
DeKalb C	2	WAXU	30.58	A
E. Chicago	11	WRQT	33.94	F
	1	WSGP	33.94	A
Elkhart	13	WBVH	30.58	A
Goshen C	5	WSRY	30.58	A
Elwood	2	WASF	154.89	F
Evansville	35	WQKB	154.89	A
		WETS	30.7	A
Evnsvle C	6	WBXF	30.7	A
Fort Wayne	1	WPDZ	154.89	F
		WBST	2490	A
Franklin	1	WCQO	154.89	F
Franklin C	2	WCPN	154.89	F
Frankfort	8	WAKK	154.89	F
Gary	23	WAEE	39.1	F
Gosher	5	WSKI	30.58	A
Greenestle C	1	WHHB	35.1	A
Hammond	15	WQYK	155.61	F
		WRGW	30.7	A
Huntington	3	WAKA	30.58	A
Huntngtn C	2	WSTA	30.58	A
Indianapolis	1	WLSM	2442	A
	33	WMDZ	35.22	F
Jasper	1	WJAI	30.7	A
Franklin C	2	WCPN	154.89	F
Jeffersonville	4	WMHV	39.1	F
Kokomo	9	WPDT	30.58	A

MUNICIPAL & COUNTY POLICE

Kokomo C	2	WBXD	30 58	A
Warsaw C	2	WHCR	30 58	A
Lafayette	2	WQFQ	154 89	F
Lafayette C	2	WJNU	154.89	F
Crown Point C	3	WAGT	37.1	F
LaPorte	3	WMPL	30 58	A
Logansport	4	WMPQ	154 89	F
Anderson C	4	WBMK	154 89	F
Marion	4	WRAY	30.58	A
	6	WSIF	35 22	A
Marshall	2	WMCJ	155 13	F
Michigan	11	WSVF	155 61	F
Mishawaka	5	WSKP	30.58	A
Muncie	10	WPGP	155 97	F
Mt. Vernon	2	WBTY	30.7	A
New Albany	3	WBWX	39.1	F
New Castle	5	WBNC	155 13	F
New Castle C	3	WUEB	155 13	F
Noblesville	1	WKUO	33 22	A
Noblsvlle C	2	WSVP	33 22	A
N. Manchester	1	WNMD	154 89	F
Peru	1	WASC	30 58	A
Plymouth	1	WPAC	155 13	F
Richmond	14	WPDH	33 5	F
Richmond C	2	WRIP	33.5	F
Rushville	2	WJAF	154 89	F
Shelbyville	2	WDPS	154 89	F
Shelbyvle C	2	WSTL	154 89	F
S. Bend	60	WPGN	154 89	A
Angola C		WIUM	2490	A
Terre Haute	9	WQOE	33.1	A
Terre Haute C	3	WNUZ	155 13	F
Valparaiso	1	WMPV	30.58	A
Valparaiso C	1	WBVT	30 58	A
Vincennes	3	WQKT	155.13	F
Wabash	1	WBIE	30 58	A
Wabash C	2	WBIH	30.58	A
Warsaw	2	WJKM	30 58	A
Warsaw C	2	WHCR	30 58	A
W. Lafayette	2	WRMW	154 89	F
Whiting	2	WQKD	37.1	F
Columbia City C	2	WBJH	155.13	F

IOWA

Ames	5	KQFW	155.01	F
Atlantic C	2	KHQD	35 22	F
Bloomfield C	2	KRPS	37.1	F
Boone	3	KCBI	37.1	F
Burlington	5	KQAR	37.1	F
Burlington C	1	KHGX	37.1	F
Carroll C	7	KCUA	35.22	F
Cedar Rapids	12	KGOZ	33 22	A
	1	KFLZ	33.22	A
Centerville	1	KKNK	37.1	F
Cntrville C	3	KOFI	37 1	F
Clarinda	1	KCJR	37 1	F
	2	KCJJ	37 1	F
Clinton	6	KRIX	31.78	A
Corning C	1	KBIE	35.22	F
Council Bluffs	7	KPCB	33.78	F
Davenport	6	KGPN	31 78	A
Des Moines	50	KGZG	156 69	F
Dubuque	5	KQDT	31 78	A
Fairfield	1	KAMJ	37 1	F
Ft. Dodge	5	KQZF	37 1	F
Ft. Madison	6	KBYS	33 5	A
Guthrie Ctr C	1	WRKL	35.22	F
Harlan C	1	KTUW	37 1	F
Iowa City	4	KAMP	37.1	F
Jefferson C	1	KCHZ	35.22	F
Keokuk	2	KRAT	37 1	F
Marshalltown	2	KRHL	37 1	F
Mason City	7	KQAE	31 78	F
Mt. Pleasant	1	KHIR	37.1	F
Muscatine	3	KCHR	39 9	F
W. Newton	1	KJXH	37.10	F
Oskaloosa	6	KQJI	30 58	A
Ottumwa	8	KPDO	31 78	A
Polk	6	KIGR	35.22	F
Red Oak	1	KCFK	37.1	F
Ruckwell City C		KKLJ		
Shenandoah		KDEN		
Sioux City	13	KGPK	31.78	A
Waterloo	7	KRMJ	37.9	F
Sioux City		KPMF		

KANSAS

Atchison	1	KACA	30 98	A
Chanute	2	KGZF	33.22	A
Coffeyville	3	KGZP	30.98	A
Coffeyville C		KMKE		
Dodge City	1	KNGH	33.22	A
Eldorado	2	KAPD	31.5	F
Emporia	3	KQCJ	30.98	A
Garden City		KNFH	2474	A
Girard C	3	KRHU	31.5	A
Great Bend	2	KBQN	30.58	A
Hutchinson	12	KGHN	35.1	F
Independence C	6	KBPL	31.5	F
Iola		KAPG	31.5	F
Iola C	1	KAKP	31.5	F
Junction City	4	KBNG	31.5	F
Junctn City C	1	KBXW	31.5	F
Kansas City		KROK	33.1	A
		KQBH		
Kansas City C	3	WQJK	31.5	F
Lawrence	3	KQBM	31.5	F
Lawrence C	1	KAEQ	31.5	F
Leavenworth		KNFF	2422	A
Manhattan	7	KRJC	30.58	A
Newton	8	KAMH	31.5	F
	1	KAHZ	31.5	F
Oswego C	3	KANH	31.5	F
Parson	3	KGKD	35.22	F
Pittsburg	5	KPGK	31.5	A
Salina	15	KNGV	31.5	F
Topeka	31	KGZC	30.58	A
Witchita	40	KGPZ	31.5	F
Winfield	3	KWCL	31.5	F
Winfield C	2	KCFJ	31.5	F

KENTUCKY

Anchorage		WMHD	30.7	A
Ashland	3	WSAG	35.1	A
Bowling Green	4	WRNM	30.7	A
Covington	10	WKXC	156.69	F
Hazard	1	WMHK	39.5	F
Henderson	2	WQTT	30.7	A
Hendrsn C	8	WKKZ	30.7	A
Hopkins	2	WKYP	30.7	A
Hopknsvle	1	WRPE	30.7	A
London C		WUEW		
Lexington	17	WPET	39.5	F
Lexington C	6	WQOB	37.1	F
Louisville		WPDE		
Madisonville	1	WMKY	30.7	A
Maysville	2	WRPG	31.5	A
Mitchell Hill C	34	WRGJ	30 7	F
	1	WKJC	30.7	A
Owensboro	13	WRPJ	30.7	A
Paducah	4	WQNP	30.7	A
Shively	1	WSYK	30.7	F

LOUISIANA

Alexandria	29	KPAL	33.22	A
Alexandria C	5	KHML	39.5	F
Baton Rouge	25	WBRP	155 61	F
Bogalusa	3	WFKK	39 55	F
Crowley	4	KISP	155.01	F
E. Baton Rouge	11	WAME	39.5	F
Franklinton C	2	WKKO	39 5	F
Houma C	8	KANX	39.5	F
Lafayette	8	KRRA	39.5	F
Lafayette C	3	KLFN	39.5	F
Lake Charles	3	KRKP	37.22	A
Lake Chris C	4	KIHT	39.5	F
Leesvle C	2	KHOX	39.5	F
Monroe	5	KPML	33.22	A
Natchitoches C	3	WNPD	39.5	F
New Iberia	2	KRAV	155.13	F
New Orleans	4	WPEK	31.78	A
Opelousas	2	KVOK	37.1	F
Martinville	1	KHBM	39.5	F
Shreveport	1	KNGO	2430	A
	18	KNGP	33.22	A
W. Monroe	2	KIOQ	155.01	F

MAINE

Auburn	3	WSAH	30.7	A
Augusta	1	WALR	39.1	F
Bangor		WJTM		
Bath	2	WLBM	39.1	F
Brewer	1	WAQT	39 1	F
Brunswick	2	WECT	39.1	F
Houlton	3	WLDU	39 1	F
Lewiston	7	WRQH	33.5	A
Portland	11	WPFU	37 78	A
Presque Isle	1	WPIN	39 1	F
Rockland	5	WJLL	155 01	F
Saco	1	WMQT	39 5	F
Sanford	8	WMHB	39 5	F
S. Portland	1	WCAD	39 1	F
Waterville	2	WJYE	39 1	F
Westbrook	2	WAWL	39 5	F
Winslow	1	WBAG	39 1	F

MARYLAND

Annapolis	2	WAMD	33.94	F
Baltimore	121	WPFH	33 22	A
Bel Air C	6	WMHF	35 9	F
Catnsvle C		WMPY	37 5	F
Cheverly C		WJLW	39 9	F
Cumberland	5	WMEY	39 5	F
Dundalk C		WMQG	37 5	F
Eastport C	1	WHRP	31 9	A
Edgemere C		WMHE	37 5	F
Essex C		WMPT	37.5	F
Ferndale C	6	WJHS	31.9	A
Frederick	5	WAUM	35.5	F
Frederick C	1	WFMQ	39 1	F
Fullerton C		WMPU	37.5	F
Galesville C		WHRO	31.9	A
Greenbelt	2	WABV	39 9	F
Hagerstown	4	WHMD	31 1	F
Hagerstown C	2	WRHO	39.1	F
Halethorpe C		WMQE	37 5	F
Hyattsville	2	WAOL	39.9	F
Montgomery	42	WKYX	37.9	F
LaPlato C	2	WCAI	39 1	F
Pikesville C		WMPP	37 5	F
Reistertn C		WMQA	37 5	F
Salisbury	2	WBVQ	35 5	F
Silver Spg C	36	WHMM	37.9	F
Towson C	3	WPFL	37.5	F
Upper Marlboro C	35	WJLU	39 9	F
Woodlawn C		WMPX	37.5	F

MASSACHUSETTS

Acton	1	WITY	37.9	A
Agawam	2	WMKZ	39.38	F
Andover	3	WBRJ	39.1	A
Arlington	12	WPED	30.58	F
Athol	3	WBJA	31.9	F
Attleboro	2	WBVC	33.5	F
Auburn	1	WBHC	33.78	A
Barnstable C	3	WRAR	39.9	A
Barre		WAMQ	37.5	A
Bellingham	1	WBBA	37.9	A
Belmont	5	WRJZ	33.94	A
Beverly	10	WBMP	154.77	F
Bolton	3	WKTJ	37.1	F
Boston	1	WQIF	35.5	A
	125	WRAS	154.89	F
	1	WAGJ	35.5	A
	1	WQRF	37.5	F
	1	WQRG	37.5	F
	1	WQRH	37.5	F
	5	WQRT	35.22	F
Bourne C	4	WRAG	39.9	A
	1	WRAQ	39.9	A
Brockton	6	WMPB	30.98	A
Brookline	32	WQKK	33.5	F
Burlington	1	WCAW	31.5	A
Cambridge		WKWU	33.1	F
	5	WQLF	39.38	F
Carver	1	WDOF	30.58	F
Chatham C	2	WEWE	39.9	A
Chelmsford	2	WSTI	37.1	A
Chelsea	5	WAFL	31.1	F
Chicopee	5	WBMT	30.58	A
Clinton	3	WQKY	37.1	F
		WBGV	37.5	A
Cohasset	3	WPGU	37.78	A
Concord	2	WRAC	37.9	A
Danvers	2	WRAU	33.1	A
Dartmouth	2	WRJT	31.5	A
Dedham	4	WRNU	30.7	A
Dracut	1	WKTK	37.1	A
Duxbury	1	WDBI	31.9	F
Easthampton	1	WAMT	31.78	F
Everett	9	WAKF	37.78	A
Fall River	9	WAKV	33.1	F
Falmouth C	3	WQTL	39.9	A
	1	WQTM	39.9	A
Fitchburg	7	WPHA	33.22	A
Fairhaven	2	WFMP	30.7	F
Foxboro	1	WKMF	33.78	A
Framingham	3	WJMG	35.1	F
Franklin	2	WFKB	37.9	F
Gardner	2	WBWZ	33.94	A
Gloucester	6	WGMP	31.78	A
Greenfield	3	WKQT	39.9	F
Groton	4	WJQN	37.9	F
Hanson	1	WBGF	31.9	F
Haverhill	8	WHGF	155.85	F
Hingham	5	WQTI	37.1	A
Holliston	1	WDMN	35.1	F
Holyoke	15	WQIF	156.57	F
Hudson	2	WEHB	31.78	A
Hull	6	WQYD	37.1	A
Hyannis C		WRJH	39.9	A
Ipswich	2	WMJQ	37.9	A
Kingston		WKDX	31.9	F
Lawrence	7	WBLC	39.9	A
Leominster	3	WBND	33.5	A
Lexington	3	WBTZ	39.9	A
Lincoln		WBOQ	37.9	A
Longmeadow	1	WBUI	37.22	A
Lowell	14	WQNR	37.1	A
Lynn	9	WKLM	33.22	F
Lynnfield	2	WLDP	35.9	F
Malden	13	WSVC	33.22	A
Manchester	1	WBRT	33.94	A
Mansfield	3	WAQO	33.78	A
Marblehead	4	WBVZ	33.5	A
Marlborough	1	WRTX	39.1	F
Marshfield	2	WJHU	31.9	F
Maynard	1	WMUL	155.01	F
Medford	8	WPGH	31.78	A
Medway	1	WBBN	37.9	F
Melrose	4	WMEJ	39.9	F
Methuen	5	WBGA	30.7	F
Middleborough	3	WMAH	30.58	F
Millis	1	WUEK	37.9	F
Milton	6	WRBA	35.1	F
Natick	2	WQJH	37.8	F
Nantasket		WQYE	37.1	A
Nantucket C	1	WBYJ	39 9	A
Needham	9	WMPN	33.22	A
New Bedford	7	WPFN	31.1	F
Newburyport	1	WBMF	37.9	F
Newton	1	WBSW	1714	A
	23	WPFA	31.78	A
Norfolk	1	WFZL	37.9	F
North Adams	2	WQOV	37.1	A
Northampton	3	WBMB	31.78	F
N. Andover	3	WEHL	35.1	A
N. Attleborough		WIEN	33.5	F
Norwood	3	WCET	31.1	F
Osterville C	1	WMUV	39.9	A
Pembroke	1	WAVN	31.78	F
Pepperell	1	WAVN	37.9	F
Phillipston	1	WIEW	31.78	A
Pittsfield	10	WJKH	30.58	F
Plymouth	4	WQYJ	31.9	F
Provnetwn C	1	WMUZ	39.9	A
Quincy	30	WQRP	39 1	
Reading	3	WQID	37.9	A
Revere	5	WMPR	33.78	A
Rochester	1	WTND	37.9	A
Rockport	1	WQYI	155.01	F
Salem	2	WRCQ	39 38	A
Salisbury	2	WHNS	37.9	F
Saugus	3	WAYU	35 1	A
Sharon	5	WQSO	33.1	A
Scituate	2	WQOJ	37.1	F
Shirley	1	WHIQ	37.9	F
Shrewsbury	5	WBOG	37.9	A
Somerset	4	WKRM	33.1	F
Somerville	14	WPEH	35.1	F
Southbridge	6	WBTV	31.1	A
Southborough		WAMX	37.5	A
Springfield	3	WQMD	39.38	F
Stoneham	2	WRHB	31.1	A
Taunton	3	WKTB	37.22	F
Tewksbury	1	WQTY	37.1	A
Tyngsboro	1	WCNX	39 5	A
Wakefield	5	WKWM	30.58	F
Walpole	4	WHNQ	31.1	F
Waltham	8	WRNA	37.78	A
Ware	9	WAGL	37.5	A
Wareham	2	WSTW	37.9	A
Watertown	2	WBNE	31.9	F
Webster	3	WMKW	33.22	A
Wellesley	7	WQJG	33.78	A
W. Bridgewtr	1	WMBM	30.98	A
Westfield	2	WAKW	37.9	A
Westford	2	WBVI	37.1	A
Westport	2	WMWP	155.37	F
W. Yarmouth C		WRLQ	39.9	A
	3	WGBU	39.9	A
	7	WRPW	39.9	A
W. Springfield	4	WFLL	39.38	F
Weston	2	WHTE	33.94	F
Westwood	3	WKYA	31.1	F
Weymouth	4	WBVN	39.9	A
Wilmington	1	WJYI	37.9	A
Winchendon	2	WJHQ	31.9	F
Winchester	1	WQSV	37.22	F
Woburn	3	WAKZ	33.78	A
Worcester	20	WPGX	33.78	A
Wrentham	1	WMGT	37.9	F

MICHIGAN

Adrian C	5	WGIU	33.1	F
Adrian	2	WWEJ	33.1	F
Albion	1	WARZ	33.1	F
Algonac	1	WNQT	37.38	F
Allegan C	4	WQGJ	33.1	F
Allen Pk	2	WSKH	31.5	F
Alpena	2	WQKV	31.5	F
Ann Arbor	11	WQRK	35.1	F
Ann Arbor C	23	WBJG	35.1	F
Bad Axe	2	WQGS	33.1	F
Battle Creek	17	WRLM	33.1	F
	1	WMLU	33.1	F
Bay City	12	WPGA	39.5	F
Bay City C	3	WEKA	39.5	F
Benton Harbor	5	WSVO	33.1	F
Berkley	2	WRIZ	39.38	A
St Joseph C	12	WSTJ	33.1	F
Birmingham	10	WRIY	155.73	F
Bloomfield Hills	6	WQOG	155.73	F
Bloomfield	5	WBBJ	155.97	F
Cassopolis C		WUEJ		
Center Line	1	WGBX	39.9	A
Center Line	3	WBNR	39.9	AF
Charlotte C	4	WHNA	33.1	F
Clawson	1	WRJA	39.38	A
Dearborn		WQND		
Detroit	258	WCK	39.1	AF
	4	WAEZ	39.9	A
Dowagiac	1	WJHK	33.1	F
Ecorse	6	WQMH	35.9	F
Escanaba	2	WAYA	35.9	F
Ferndale	4	WRJB	35.5	A
Flat Rock	1	WQZY	37.5	F
Flint	20	WPDF	31.78	A
Grand Haven	2	WSOJ	33.78	A
Grand Haven C	3	WOMN	33.1	F
Grand Rapids	89	WPEB	33.78	F
	1	WCPX	2442	A
Grosse Pointe	4	WQMT	37.1	A
Grosse Pointe Woods	17	WRDR	30.58	A
Hamtramck	7	WQTD	37.9	F
Hart C	2	WHUJ	33.1	F
Hastings	1	WAVQ	33.1	F
Hastings C	2	WAVO	33.1	F
Hazel Pk	3	WJUG	39.38	A
Highland Pk	10	WNO	33.22	A
Holland	3	WHBM	33.1	F
Huntington Wds	2	WRJC	39.38	A
Jackson	12	WPHP	33.1	F
Jackson C	5	WAUK	33.1	F
Kalamazoo	17	WAMG	33.22	AF
	1	WJVE	33.22	A
	6	WBVU	33.1	F
Lansing	5	WPDL	33.1	F
	1	WMLF	33.1	F
	1	WKWQ	2442	A
Lawrence	1	WKLN	33.1	F
Lincoln Pk	3	WQLL	31.5	F
Ludington C	2	WCSV	33.1	F
Ludington		WLRB		
Mt Clemens	7	WRPV	39.9	F
	3	WSRQ	39.9	A
Marshall C	8	WBPK	33.1	F
Marine	1	WQXA	37.38	F
Marquette	7	WSLJ	30.7	A
Marysville	2	WDBM	33.1	F
Menominee	1	WRZQ	33.5	A
Midland	7	WBLA	31.5	A
Monroe	2	WQTB	33.22	F
Monroe C	3	WEUG	33.22	F
Mt Pleasant	1	WLEF	37.38	F
Muskegon	14	WPFC	30.58	AF
Muskegon C	8	WBSU	39.38	F
Muskegon Hgts	6	WBKD	39.38	AF
New Haven	1	WBHW	39.9	F
Niles	6	WRQF	30.58	A
N. Kuskegon	1	WKVJ	39.38	F
Oak Pk	1	WDBK	35.5	A
Orchard Lake	1	WOLX	155.97	F
Ovid	1	WAQN	33.1	F
Owosso	6	WDDI	33.1	F
Parchment	1	WBXO	33.22	A
Paw Paw	1	WCJI	33.1	F
Pleasant Ridge	2	WRJD	39.38	A
Pontiac	44	WQMG	31.1	AF
Pontiac C	20	WQRZ	155.97	F
Port Huron	8	WPGB	33.1	F
River Rouge	5	WROQ	155.49	F
Roseville	5	WRIR	39.9	AF
Royal Oak	7	WQMB	39.38	A
	1	WBWM	35.5	A
	3	WQVX	39.38	A
Saginaw	30	WPES	31.78	AF
	7	WRNH	31.78	A
St. Clair	5	WSPV	33.1	F
	1	WNGF	37.38	F
St Clair Shores	4	WAFP	39.9	F
St Joseph	4	WSQM	33.1	F
Sault Ste Marie	2	WCBQ	37.9	F
Southfield	1	WTSW	39.38	A
South Haven	7	WOGC	155.61	F
South Lyon	1	WHVI	37.38	F
Spring Lake	1	WMVF	37.38	F
Sylvan Lake	1	WNVE	155.97	F
Traverse City	2	WRMB	37.22	A
Trenton	2	WQWN	31.9	F
Wayne	48	WQMF	30.98	F
W. Bloomfield	5	WBOL	155.97	F
Wyandotte	5	WRHV	39.5	F
Ypsilanti	3	WQOK	31.78	A

MINNESOTA

Austin	2	KQBG	37.1	A
Brainerd	1	WRJP	30.98	A
Cloquet	4	WFJC	37.1	A
Duluth C	1	KKNF	30.58	A
Duluth	27	KNFE	30.58	AF
	1	KQRK	2382	A
Faribault	1	KQED	37.78	A
Hastings C	2	KPDW	33.94	A
Hibbing	3	WJUI	33.5	A
Hopkins	1	KIJW	39.9	F
International Falls	3	KSOZ	155.25	F
Mankato	5	KQAA	39.38	A
Minneapolis C	15	KANN	39.9	F
Minneapolis	83	KGPB	30.98	F
	1	KGPR	30.7	F
Moorhead	2	KRSG	39.9	F
New Ulm		KPFJ		
Owatonna	4	KOGC	155.13	F
Red Wing	1	KQDB	33.5	A
Rochester	4	KQAM	37.1	F
St Cloud	2	KQFY	154.65	F
St Paul	47	WPDS	33.94	A
St. Paul C	3	KQKW	33.94	A
S. St Paul	3	KQGR	33.94	A
W. St Paul	1	WMRV	33.94	A
Willmar C	15	KRIN	31.5	A
Winona	3	KBZB	35.9	F
Virginia	2	WDCX	31.5	A

MISSISSIPPI

Biloxi	3	WJJN	35.9	F
Columbus		WUEL	35.9	F
Greenville	6	WMPG	35.9	F
Greenwood	7	WSRW	33.5	A
Gulfport	3	WGPP	33.5	F
Gulfport C	3	WJYG	33.5	F
Hattlesburg	3	WBJC	33.5	A
Jackson	20	WAMK	39.18	F
Jackson C	2	WJEU	39.18	F
Laurel	3	WLCP	30.98	F
Meridian	12	WJUA	35.9	F
Natchez	4	WAMJ	39.5	F
Natchez C	3	WAUA	31.78	F
Vicksburg	4	WRNC	35.1	F

MISSOURI

Cape Girardeau	1	KQBS	30.98	A
Carthage	6	KCMU	155.61	F
Columbia	4	KQDE	155.13	F
Clayton C	100	KSLC	155.13	F
Hannibal	4	KQRU	155.13	F
Independence	3	KRLK	35.9	F
Independence C	14	KRHW	155.61	F
Joplin	5	KQAJ	30.58	A
Kansas City	125	KGPE	155.61	F
Ladue	5	KQOU	33.5	A
Pemiscot City		KRSK		
Sedalia	2	KAME	30.98	A
Springfield	14	KQBO	33.1	A
St Charles	1	KQCD	31.9	F
St Charles C	2	KBMB	39.78	F
St Joseph	16	KQBW	39.1	F
St Louis	150	KGPC	155.85	F

MONTANA

Anaconda	2	KQHU	39.38	A
Billings	5	KQIZ	39.38	A

For its Statewide Police 3-way Radio System

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BUILDERS OF PRECISION RADIO COMMUNICATIONS EQUIPMENT

MUNICIPAL & COUNTY POLICE

Bozeman	1	KBSO	39 38	A
Bozeman C	3	KROI	39.38	A
Butte	5	KBPD	39.38	A
Gt. Falls	6	KPGF	39 38	A
Helena	3	KHMP	39.38	A
Kallspell	3	KGKC	39.38	A
Livingston	3	KVRI	39.5	F
Livingston C	3	KVRD	39.5	F
Miles City	1	KFMW	39 38	A
Miles City C	2	KGRC	39 38	A
Missoula	2	KQKD	39.38	A

NEBRASKA

Alliance	2	KANB	33 94	F
Beatrice	4	KSJV	39 9	F
Falls City	4	KRAF	30 58	F
Fremont	2	KCVB	39 9	F
Grand Island	3	KQAV	33 1	A
Hastings	4	KRLX	30 7	F
Imperial		KVTX		
Lincoln	16	KGZU	30 58	A
Norfolk		KNGN	2490	A
N. Platte	3	KRGW	33.5	A
N. Platte C		KPIJ		
Omaha	3	KGPI	33.78	F
	1	KSDZ	33.94	F
Omaha C	1	KRNY	37.1	F
	7	KRNX	37 1	F
Plattsmouth C	1	KSKU	39 9	F
Scottsbluff	3	KRKV	33 5	A
S. Sioux	1	KWQD	31 78	A
Wahoo C	1	KDBX	39 9	F

NEVADA

Elko	10	KIXN	39.38	F
Ely C	20	KSML	39 38	F
Fallon C	10	KHFS	39 38	F
Las Vegas	16	KGHG	155 73	F
Las Vegas C	8	KNEW	39 38	F
Reno		KGHM	1634	A
Reno	5	KKWC	39 38	F
Sparks	2	KGHC	39.38	F

NEW HAMPSHIRE

Berlin		WUBK		
Claremont	4	WKTX	33.5	F
Concord	7	WRJV	37 9	A
Dover	1	WMYQ	30 7	F
Keene	2	WJLR	33 5	F
Keene C.	1	WKUY	33 5	F
Laconia	2	WCOT	30 7	F
Manchester		WQLQ		
Nashua	6	WPHB	39 5	A
Portsmouth	2	WKSA	33 5	F
Rochester	2	WHHL	39 38	F

NEW JERSEY

Allenhurst	1	WMQZ	39 9	F
Alpine	1	WQRO	37 78	A
Alpine	9	WSOE	31 78	F
Asbury Pk	2	WABM	31 1	A
Atlantic	1	WQIY	33 1	A
	1	WLDN	33.1	A
	1	WIYB	33 1	A
Atlantic Highlands	1	WJZB	37 78	F
Audubon	2	WETQ	39 9	F
Avon by the Sea	1	WBSK	39.9	F
Bay Head	1	WIZN	33 5	F
Bayonne	20	WQXN	155 49	F
Beach Haven	1	WJXE	33 5	F
Beachwood	1	WKBX	33 5	F
Belmar	2	WQNT	37 1	A
Belleville	9	WBQX	33 1	F
Bergenfield	3	WRJU	35.9	A
Bloomfield	9	WAKH	37.22	A
Bloomingdale	1	WAKD	37.1	A
Bogota	3	WIUA	39.5	A
Boonton	1	WFUA	37.9	F
Bound Brook	1	WQKA	37.9	A
Bradley Bch	2	WQHW	39.9	F
Brant Bch	2	WKTS	33 5	F
Bridgeton	1	WSKA	31.1	A
Brielle	1	WDBX	37.78	F
Brigantine	1	WJVN	33.1	A
Budd Lake	1	WQNA	33 1	A
Burlington	2	WBSX	37.9	A
Butler	1	WANZ	37.1	A
Caldwell	1	WAFP	37 9	F
Camden	14	WQNI	37 1	A
Camden C	3	WFZG	156 21	F
Cape May	3	WFUM	156 69	F
Carlstadt	1	WKVZ	37.78	A
Carteret	3	WANV	33.1	F
Cedar Grove	2	WAWX	33.1	F
Cinnaminson	1	WKTH	156 69	F
Clark	2	WFZQ	156.33	F
Cliffside	2	WBVX	35.5	A
Clifton	10	WSQO	31.1	A
Closter	3	WRLZ	155.85	F
Collingswood	5	WQNG	156.21	F
Cranford	3	WQMC	155.25	F
Cresskill	1	WRPR	39.9	A
Deal	4	WQOQ	33.1	A
Denville	2	WEDE	33.5	F
Dover	4	WDHM	33.5	F
	2	WECV	33.5	F
Dumont	1	WBNW	37.5	A
E. Hanover	1	WETX	35.9	A
E. Orange	8	WQKI	39 5	A
Eatontown	1	WFJV	37.78	F
Edgewater	4	WBOO	39.1	F
Elizabeth	13	WRAD	39.1	A
Emerson	1	WHBA	37.9	A
Englewood	5	WQIK	33.5	A
	1	WBMC	37.78	A
Englishtown	1	WJJE	37.78	F
Essex Falls	3	WIHC	155.37	F
Ewing	1	WRKY	33.1	F
Fair Lawn	3	WCAK	37.9	F
Fanwood	2	WQYZ	154.77	F
Florham Pk	1	WSRL	35.5	A
Ft Lee	2	WBKN	35.5	A
Franklin	1	WNKR	37.78	A
Freehold	2	WAHI	37.78	F
Freehold C	31	WAKC	37.78	F
Garfield	4	WRQE	39.1	A
Garwood	1	WGIP	155.25	F
Glen Ridge	3	WBYY	37.22	A
Glen Rock	2	WSFB	155.73	F
Guttenburg	1	WAVK	39.9	F
Hackensack	9	WQIJ	37.5	A
Hackensack C	20	WPFK	37.1	F
Haddon Twp	2	WBKH	33.5	A
Haddon Hgts	2	WRAN	35.9	A
Haddonfield	3	WRBJ	155.49	F
Haledon	1	WBTK	35.5	A
Hamilton Twp	6	WQJM	33.1	F
Hanover Twp	1	WLSH	35.9	A
Hasbrouck Hgts	2	WBYX	33.1	F
Hawthorne	2	WRGN	39.9	A
Highland Pk	2	WBXL	33.94	F
Highlands	1	WJSR	37.78	F
Hightstown	1	WBGG	37.78	F
Hillsdale	1	WHNG	37.9	A
Hillsdale Twp	1	WSYZ	35.5	A
Hoboken	7	WMFH	35.9	F
Hohokus	1	WSRP	37.78	A
Interlaken	1	WAAG	37.78	F
Irvington	7	WLSN	35.9	F
Jersey City	46	WQRS	31.9	A
	1	WRMJ	31.9	A
Kearny Twp	11	WRPH	39.9	A
Keyport	1	WDCM	37.78	F
Kinden	12	WAJQ	31.1	A
Lakewood	2	WRBT	37.9	A
Lavallette	1	WSGD	33.5	F
Lawrence	2	WQJN	33.1	F
Leonia	5	WSTB	35.9	A
Lincoln Pk	1	WRBO	3 15	A
Little Falls	1	WJKI	33 1	F
Little Silver	1	WFAB	37.78	F
Livingston Twp	3	WQMK	35 9	A
Long Branch	6	WQNF	37 1	A
Longport	4	WQMP	37.1	A
Lower Penns Neck	1	WBTT	35.5	F
Lyndhurst Twp	3	WSOM	37.5	A
Madison	2	WQJU	35 5	A
Madison Twp	1	WJSH	37.78	F
Mahwah Twp	1	WCBB	31.1	A
Manasquan	1	WMNJ	37 78	F
Manville	1	WBYR	31.9	A
Maplewood	6	WAPK	37.5	F
Margate City	3	WRLY	37 1	A
Matawan	1	WCBL	37.78	F
Matawan Twp	1	WKZB	37 78	F
Maywood	1	WQMX	39.1	A
Metuchen	2	WQLT	37 1	A
Middlesex	1	WFZD	37.9	A
Middletown	2	WBXZ	37.78	F
Midland Pk	1	WRBX	33.5	A
Millburn	5	WQKJ	37.1	F
Milltown	1	WMNS	33 94	F
Millville	1	WRHR	33 94	F
Monroe Twp	1	WKJE	155 25	F
Montclair	12	WQMO	156.57	F
Montvale	3	WKQL	156 21	F
Montville Twp	1	WKPM	37 1	A
Moorestown	3	WGNQ	37.5	A
Morristown	2	WQXK	39.1	A
Morris Twp	9	WFRR	155 01	F
Mt. Holly	1	WBOD	30 7	A
Mountainside	1	WBXE	33 5	F
Neptune	3	WBYD	31 9	F
Neptune City	1	WKKG	37.78	F
Newark	100	WQIE	156 21	F
	1	WNHT	30 7	A
New Brunswick	5	WQRV	39 38	A
New Milford	1	WGCS	37 9	A
N. Arlington	2	WBRZ	31 5	A
N. Bergen	12	WAHG	31 1	F
N. Caldwell	1	WAMM	39 1	F
Northfield		WKGE		
N. Haledon	1	WBVF	35 5	A
N. Plainfield	2	WQJS	156 33	F
Nutley	3	WRHG	37.1	A
Oakland	1	WBGU	37 1	A
Oaklyn	1	WRMG	33 5	A
Ocean City	4	WHTV	39 1	F
Oceanport	2	WCBU	37.78	F
Oradell	1	WGMU	37.9	A
Orange	6	WQTS	154 65	F
Pallsades Pk	1	WPPP	37.1	F
Paramus	2	WBKE	37.78	A
Park Ridge	6	WKQJ	156 21	F
Passaic	8	WQKH	35 9	A
Paterson	7	WRGO	35 5	A
Paulsboro	5	WWBS	155 25	F
Pennsauken Twp	4	WSPT	39 1	A
Penns Grove	1	WBSL	35 5	F
Pequannock Twp	1	WANX	37.1	A
Perth Amboy	5	WFTK	37.9	F
Phillipsburg	2	WENX	156.09	F
Piscataway	3	WQJY	39 9	A
Pitman	4	WAOW	155.25	F
Plainfield	10	WQKG	154 77	F
Pleasantville	4	WQMQ	37 1	A
Pt Pleasant	1	WANV	37.78	F
Pompton Lakes	3	WSWI	37 1	A
Princeton	2	WQTA	37.1	A
Princeton Twp	2	WRBI	37.1	A
Prospect Pk	1	WBTL	35.5	A
Rahway	3	WQYZ	31.5	A
Raritan Twp	4	WQJC	37.22	A
	1	WBWI	37.78	F
Red Bank	5	WIEJ	39.38	F
Ridgefield	2	WBKP	37.5	A
Ridgeport Pk	3	WSKM	39.5	A
Ridgewood	9	WQYF	33.5	A
Ringwood	1	WAKJ	37.1	A
Riverdale	1	WBZJ	37.1	A
River Edge	3	WDYY	156.09	F
Rockaway Twp	1	WTVY	33.5	F
Rockaway	1	WEDQ	33.5	F
Roseland	1	WIZM	35.9	A
Roselle	3	WQMY	35.5	A
Roselle Pk	2	WQJQ	37.5	A
Rumson	4	WQKQ	35.9	A
Rutherford	4	WBMJ	37.9	A
Saddle River	1	WMHT	37.78	A
Salem	1	WSQK	35.5	F
Scotch Plains	2	WSPP	33.5	F
Sea Girt	1	WFUO	37.78	F
Seaside Hgts	2	WBBF	33.5	F
Seaside Pk	1	WCYC	33.5	F
Secaucus C	30	WUAM	156.69	F
Secaucus	3	WQIL	37.1	A
Ship Bottom	1	WKQV	33.5	F
Somerville	2	WRSO	31.1	F
S. Bound Brook	1	WBXJ	37.9	A
S. Belmar	1	WBJD	37.78	F
S. Orange	4	WKVR	31.9	F
S. Plainfield	1	WABU	39.9	A
S. River	2	WNRF	155.97	F
Sparta Twp	2	WSLG	31.5	A
Springfield	3	WBHG	39.1	F
Spring Lake Hgts	1	WSLL	37.78	F
Spring Lake	2	WRAZ	35.5	A
Summit	5	WQRX	39.9	A
Teaneck	7	WQJO	154.77	F
Teaneck Twp	1	WGVZ	31.5	A
Tenafly	3	WRGI	39.9	A
Totowa	1	WJKC	31.5	A
Trenton	23	WQIZ	33.1	F
	1	WRPI	33.1	A
Toms River C	1	WBAK	33.5	F
Union Beach	1	WDJQ	37.78	F
Union City	12	WQNY	155.61	F
Union Twp	5	WQJB	37.9	A
Upper Penns Neck	1	WAYE	35.3	F
Ventnor	4	WQKX	37.1	A
Verona	2	WQYH	37.9	F
Vineland	5	WJED	39.1	F
	4	WLPH	156.21	F
Wall	1	WPHL	37.78	F
Wanaque	1	WAKM	37.1	A
Washington	1	WCWD	37.9	A
Watchung	1	WSPE	156.33	F
Wayne Twp	3	WSLC	31.5	A
Weehawken Twp	1	WKGL	31.5	F
W. Caldwell	1	WSQN	35.9	A
Westfield Twp	3	WQOM	33.1	A
W. Long Branch	1	WFOV	37.78	F
W. Milford Twp	1	WBNG	37.1	A
W. New York	7	WQRN	37.9	A
W. Orange	5	WSKN	39.5	A
W. Patterson	1	WIUO	31.5	A
Westwood	3	WRMZ	37.9	A
Wharton	1	WEDH	33.5	F
Wildwood	2	WBOJ	31.5	A
Woodbridge	4	WQJE	37.5	A
Woodbury	1	WRLV	31.9	F
Woodcliff	3	WKRH	156.21	F
Woodlynne	2	WPYV	156.21	F
Wyckoff		WKJZ		

NEW MEXICO

Albuquerque	7	KGZX	39.1	F
Albuquerque C		KSTH		
Chaves C	2	KRHQ	33 22	F
Clovis	8	KNFA	39 9	F
Deming C	6	KSLY	39 9	F
Hobbs	2	KHMQ	39 9	F
Roswell	2	KRNM	33.22	A
Santa Fe	3	KGPF	39.5	F

NEW YORK

Albany	1	WPFD	2458	A
Amsterdam	4	WKNI	37.9	F
Arcade	1	WMLG	37.9	F
Asharoken	1	WTCK	39.38	F
Auburn	5	WPDN	39.5	F
Albion C	3	WAZN	37.9	F
Armonk	3	WAUF	35.9	F
Babylon	3	WROI	35.9	A
	3	WROP	35.9	A
Batavia	2	WRJS	33.5	F
Bedford Hills	4	WTUR	155.37	F
Binghamton	14	WHTZ	37.9	F
	1	WPGL	2442	A
Broome C	8	WBZN	37.9	F
Bath C	14	WEJZ	37.9	F
Buffalo C	6	WBTQ	37.22	F
Buffalo	111	WMJ	30.58	AF
Briarcliff Manor	2	WBDN	37.1	A
Bronxville	3	WQOY	155.49	F
Caledonia		WCNF		
Canandaigua	1	WFTM	37.9	F
Celeron	1	WRAX	37.9	F
Cheektowaga	12	WKQZ	156.57	F
Clarkstown	2	WBLF	31.1	A
Corning	3	WKPI	37.9	F
Cortland	2	WBID	35.1	F
Croton on Hudson	2	WRLB	37.1	A
Canandaigua C	6	WCAV	37.9	F
Chappaqua	2	WEKU	39.1	F
Canton C	1	WKJX	2414	A
Depew	2	WDPB	37.9	F
Dunkirk	3	WALK	37.9	F
Eastchester	6	WQLC	33.1	F
East Hampton	1	WKVI	155.13	F
Easthampton	1	WHTU	31.9	F
Elmira	14	WBLL	37.9	F
Endicott	20	WIKE	155 13	F
Elliott C	43	WANK	31.5	F
Floral Pk	5	WBDO	31 5	A
Fonda C	2	WHOH	37.9	F
Freeport	2	WAFR	37.9	A
Fulton	2	WBIC	33.5	A
Garden City	1	WQKO	37.1	A
Geneseo C	4	WAZS	37.9	F
Geneva	2	WQOU	31.5	F
Glen Cove	6	WRJG	33.78	A
Glens Falls		WQQR		
Gloversville	2	WJQL	33.1	F
Goshen C	5	WQHS	37.9	F
Grand View on Hudson	1	WBVK	31.1	A
Greenburgh	4	WQKZ	33.1	F
Hanover	1	WSRX	37.9	F
Harrison	7	WQLX	37.5	A
Haverstraw	1	WBLG	31.1	A
	1	WQTK	31.1	A
Hempstead	1	WQKP	39.5	A
Herkimer	1	WAKN	2414	A
Hillburn	1	WBOY	31.1	A
Hornell	4	WRAP	37.9	F
Huntington	9	WPGO	39.38	A
Ilion	10	WXCK	155.61	F
Islip	4	WHTI	31.9	F
Ithaca	2	WQNS	31.5	A
Ithaca C	50	WJPL	37.9	F
Jamestown	11	WJNY	37.9	F
Johnson	11	WMOJ	37.9	F
Johnston C	2	WNKU	37.9	F
Kings Point	3	WIHJ	39.9	F
Kingston	7	WQXP	155.61	F
Lakewood	1	WDCT	37.9	F
Lake Success	2	WMQO	35.1	F
Lancaster	5	WBAW	37.9	F
		WLSB		
Larchmont	3	WQJT	33.1	A
Larchmont Twp	4	WRIO	39 1	A
Lindenhurst	1	WROJ	35.9	A
Little Valley	10	WAXZ	37.9	F
Lockport	10	WLOC	39.5	F
	1	WLOD	39.5	F
Lockport C	6	WKHR	37.9	F
Long Beach	5	WLBP	155.37	F
Lynbrook	4	WBDK	35.1	F
Mahopac C	3	WQEZ	39.9	F
Mamaroneck	10	WSNK	155.25	F
Massena	2	WMJX	37.9	F
Middletown	2	WSRN	31.9	A
Mineola C	120	WPGS	35.1	F
	1	WRMF	2490	A
	1	WITU	2490	A
	1	WITX	2490	A
Newburgh	3	WEUA	39.9	F
New Rochelle	5	WQKC	31.5	A
New York C	1	WQIM	31.1	A
	29	WRFN	33.94	F
New York	100	WJIJ	39.9	F
	1	WNAJ	33.94	F
	31	WNYM	33.94	A
		WPEE	33.94	A
		WPEF	33.94	A
	40	WPEG	33.94	A
	150	WRQP	39.58	F
Niagara Falls	30	WNFP	37.1	F
Nissequogue	1	WETY	31.9	A
N. Pelham	3	WQLD	37.1	A
Northport	1	WRKD	31.5	F
N. Tarrytown	1	WBXN	37.1	A
N. Tonawanda	12	WBTI	35.9	F
Norwich C	1	WJFX	31.1	F
Nyack	2	WRGM	31.1	A
Ogdensburg	5	WHJC	39.5	F
Olean	2	WQMV	37.9	F
Oneida	4	WJAM	35.1	A
Oneonta	1	WQFJ	30.58	A
Onondaga C	9	WBVJ	37.78	AF
Ossining	2	WQNH	37.1	A
Ossining Twp	1	WMVE	37.1	A
Oswego C	14	WJZX	37.9	F
Palisades Pk	7	WJXL	31.78	F
Peconic	3	WHTT	31.9	F
Peekskill	2	WBZW	31.5	A
Pelham	2	WQOT	37.1	A
	1	WDAG	37.1	A
Pelham Manor	1	WFJU	37.1	A
	4	WQOS	37.1	A
Plattsburg C	1	WIKG	37.9	F
Piermont	1	WRHE	31.1	A
Plattsburg	1	WDGS	37.1	F
Port Chester	6	WRSY	33.5	A
Port Jervis	2	WQXY	33.1	A
Port Washington	3	WABN	35.22	A
Poughkeepsie	8	WRCV	30.7	A
Putnam Valley Twp	1	WIKI	31.5	A
Ramapo Twp	2	WBLH	31.1	A
Riverhead Twp	2	WAYT	31 9	F
Rochester	1	WPDR	30.58	A
Riverhead C	12	WJPV	31.9	F
Rockville Ctr	11	WRAH	35.5	F
Rome	5	WKHZ	37.9	F
Rotterdam	2	WGOD	35.5	F
Rye	6	WQKU	31.9	A
Salamanca	2	WBSB	37.9	F
Sands Point	2	WQHZ	35.9	A
Saratoga Spgs	2	WJGB	35.9	F
Scarsdale	5	WQKL	33.1	A
Schenectady	12	WQRB	37.1	F
	2	WBGJ	39.5	F
Selden	16	WRNE	155.49	F
Shelter Island	1	WAYV	31.9	F
Sloatsburg	1	WCUJ	31.1	A
Smithtown Br	3	WAFV	31.9	A
Solvay	2	WCOY	35.9	F
Southampton		WHTS		
Sparkill	3	WSWJ	31 1	A
Spring Valley	2	WBLI	31.1	A
Suffern	1	WBLM	31.1	A
Suffolk	1	WBLM	31.1	A
Suffolk C		WDQU		
Syracuse	2	WPEA	155.13	F
Tarrytown	3	WBLN	35.5	F
Troy	6	WRCD	33.1	A
Tuckahoe	2	WQJD	33.1	A
Upper Nyack	1	WBLO	31.1	A
Utica	20	WPGJ	31.5	F
Warsaw	1	WMLJ	37.9	F
Watertown	4	WCDX	37.1	F
Watervliet	1	WMJN	37.9	F
Warsaw C	6	WBPE	37.9	F
Westfield	1	WEQK	37.9	F
White Plains C	27	WJKS	30.58	F
White Plains	14	WQKS	37.1	A
Williamsville	5	WRNJ	31.5	F
Yonkers	4	WPFY	37.22	F
Yorktown	1	WNHO	31.5	A

NORTH CAROLINA

Albemarle	3	WFAO	154.89	F
Asheboro		WKRD		
Asheville	10	WQMJ	30.58	A
Asheville C	20	WPFS	30.58	A
Burlington	3	WRJE	33.5	A
Charlotte	20	WPDV	35.9	F
	2	WRPL	33.94	A
Concord	2	WQNE	33.1	A
Charlotte C	10	WSLF	37.9	F
Durham	25	WDMP	39.1	F
Durham C	10	WUEV	39.1	F
Edentown	4	WQZE	35.9	F
Elizabeth	5	WBIV	39.5	F
Fayetteville	11	WROS	33.5	F
Gastonia	4	WQNZ	37.1	F
Gastonia C	12	WMHY	37.1	F
Goldsboro	3	WABQ	35.9	F
Goldsboro C	1	WJDZ	35.9	F
Greensboro	22	WQMR	37.1	A
Greensboro C	4	WLSG	39.5	F
Greenville	4	WJPT	33.9	F
Greenville C	5	WTJE	35.9	F
Halifax C	10	WUAY	35.9	F
Hendersonville	6	WHSD	39.1	F
Hickory	5	WRGY	37.5	A
High Point	6	WHPP	39.5	F
Kings Mountain	2	WIUD	37.5	A
Kinston	5	WQLR	35.9	F
Leaksville C	8	WBJF	37.5	A
Lenoir	11	WBNL	37.5	A
Lexington	2	WRNT	33.1	F
Lumberton	15	WKQM	39.5	F
Monroe	2	WKZM	39.5	F
Morganton C	8	WBXT	37.5	A
Mt. Airy	2	WQME	35.9	F
New Bern	3	WADX	35.9	F
Newton	2	WBTX	37.5	A
Raleigh	10	WQLY	31.5	F
Reidsville	2	WRPW	37.5	A
Roanoke Rapids	10	WPXC	35.9	F
Rocky Mt	3	WQLI	33.5	F
Rutherfordton	2	WATU	33.5	F
Salisbury	5	WQLU	33.1	F
Shelby	3	WANY	37.5	A
Statesville	2	WDBS	33.94	F
Thomasville	1	WETO	39.5	F
Washington	6	WDPJ	35.9	F
Wilmington	15	WDPW	39.5	F
Wilson Twp	3	WQNU	35.9	F
Winston Salem	4	WQMS	33.5	A

NORTH DAKOTA

Bismarck	1	KQRL	33.5	A
Fargo	5	KNHM	39.9	F
Grand Forks	1	KQSO	33.5	A

OHIO

Akron	28	WPDO	37.9	F
Akron C	5	WCAY	30.7	A
Alliance	4	WJUK	33.94	F
Amberly	2	WBIU	31.5	A
Ashland	2	WAXC	37.9	F
Ashtabula	3	WSTK	37.1	A
Athens	1	WMPZ	37.9	F
Barberton	3	WJGD	31.9	A
Beachwood	1	WANW	37.9	F

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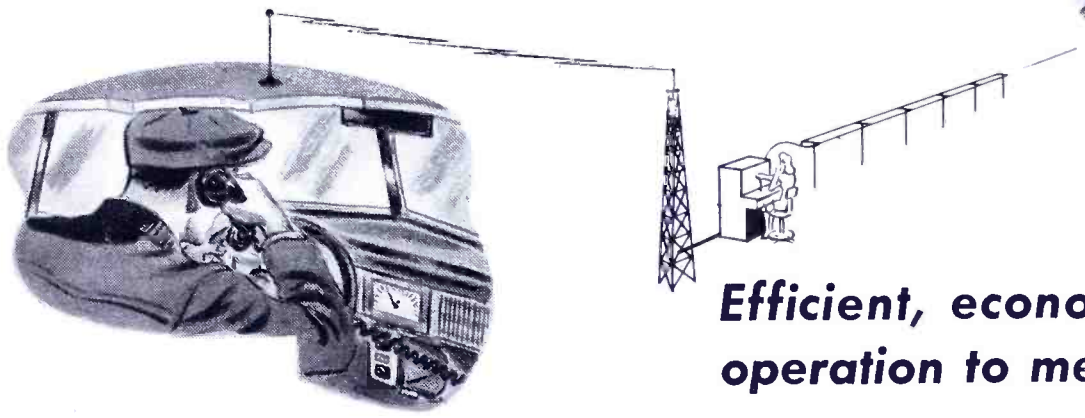

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You're probably aware of the many advantages that your own mobile radio-telephone system can provide: Speeded up communications, increased efficiency throughout your operations, better service to your customers.

Now two great names in the field of communications, Philco and Kellogg, are cooperating to bring you the benefits of this modern communication method at its most advanced stage.

Amazing compactness, new standards of operating efficiency, design and construction that assure trouble-free operation suggest that you investigate Kellogg Mobile Radio-Telephone before you invest in equipment. Check the many advantages listed below. Write for full information on how Kellogg Mobile Radio-Telephone can serve you in your line of business or industry.

Check These Advanced Features:

- The Kellogg Mobile Radio-Telephone Equipment conforms to both the present and proposed requirements of the Federal Communications Commission and the Radio Manufacturers Association.
- "Private Line" service over a party line system—no listening in by any other mobile station.
- Advanced circuit design and components assure interference-free communication because of superior rejection of unwanted signals in adjacent channels.
- Uniform volume level regardless of strength of incoming signal.
- Positive modulation control, preventing distortion.
- Unexcelled performance over wide ranges of temperature and humidity.
- Drawer type, plug-in chassis permitting quick, easy maintenance service to subscribers.
- Very low stand-by drain from power source. Easily adaptable to various power sources.
- Rugged shock-proof mounting assures long, trouble-free life of the equipment.

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MUNICIPAL & COUNTY POLICE

Bedford	2	WBQF	31.5		A
	3	WMVH	37.9		F
Bellevue	1	WBAU	39.78		F
Berea	10	WTNE	155.61		F
Bexley	4	WBTR	154.65		F
Bucyrus	2	WQTQ	30.98		A
Canton	27	WQKW	156.57		F
Canton C	10	WBYZ	39.38		F
Campbell	2	WNKQ	37.22		A
Chardon C	4	WJJO	37.9		F
Chillicothe	3	WRIC	33.22		A
Cincinnati C	1	WLOZ	37.9		F
Cincinnati	81	WKDU	35.22	AF	
Cleveland		WEND	33.5		A
		WRBH	33.78		F
	1	WRPD	33.5		A
Cleveland Hgts	11	WSXO	37.5		F
Clyde	1	WLDO	30.58		F
Columbus	131	WPDI	37.22	AF	
Columbus C	10	WJKB	37.9		F
Coshocton	5	WDQH	155.85		F
Cross Creek Twp	5	WWRV	33.1		A
Cuyahoga Falls	8	WBUJ	35.9		F
Dayton	117	WPDM	156.33		A
Defiance C	2	WJES	39.78		F
Delaware	1	WHIV	37.9		F
Delaware C	2	WHNL	37.9		F
E. Cleveland	15	WMSZ	31.1		A
E. Liverpool	4	WMLC	37.9		F
Elyria	10	WRNS	31.5		A
Elyria C	4	WBYO	37.9		F
Euclid	11	WLSD	39.9		F
Fairfield	1	WMHX	156.33		F
Fremont	3	WMPK	30.58		F
Forestville C	1	WKOI	37.9		F
Galion	1	WRQM	30.98		F
Garfield	3	WBHA	37.9		F
Gates Mill	2	WKWB	37.9		F
Gibsonburg		WGBY			
Girard	1	WJSD	37.22		A
Grandview Hgts	5	WKTI	154.65		F
Greenville	1	WQZC	37.9		F
Hamilton	7	WQOX	37.1		A
Hamilton Twp	6	WUEO	37.9		F
Hills and Dales	1	WHCO	37.9		F
Hunting Valley	4	WKUW	37.9		F
Indian Hill	4	WQST	33.1		A
Ironton	2	WBVL	31.5		A
Jackson	1	WSPX	2430		A
Jefferson C	8	WSIG	37.5		A
Kenton C	1	WHCO	37.9		F
Kenton	2	WKMP	37.9		F
Lakewood	11	WHTL	37.9		F
Lancaster	2	WQFO	33.22		F
Lima C	2	WAAL	37.9		F
Lima	3	WAFU	37.9		F
Lockland	3	WBMZ	37.9		F
Logan	1	WBOH	31.5		A
Lorlan	8	WLOP	37.1		F
Lyndhurst	2	WKVE	37.9		F
Mansfield C	3	WJMH	37.5		F
Millersburg C	5	WKNC	39.9		F
Mansfield	4	WQFY	37.9		F
Marietta	2	WRGL	31.5		A
Marion	2	WJJI	37.9		F
Marion Twp	1	WKUI	154.65		F
Massillon	5	WBGT	37.1		A
Maumee	2	WMFS	30.7		F
Mayfield Hgts		WKVF			
Menton	1	WMOP	31.5		A
Menton on The Lake	1	WAIS	31.5		A
Middletown	11	WBVB	35.9		A
Montgomery C	9	WBAV	31.78		A
Moreland Hills		WKVH			
Mt Gilead C	1	WKTR	39.78		F
Mt Vernon	2	WMVK	37.9		F
Mt Vernon C	4	WAWI	37.9		F
Newark	5	WQRW	37.9		F
Newark C	6	WIHA	37.9		F
Niles	1	WRQL	37.5		A
Norwalk	2	WJUM	37.9		F
Norwood	5	WBYG	39.5		F
Oakwood	4	WBKC	33.5		A
Osborn	3	WEQS	156.33		F
Ottawa Hills	2	WQOL	31.5		F
Painesville	3	WKHL	37.9		F
Painesville C	4	WBOK	31.5		A
Parma	8	WTAK	35.9		F
Pepper Lake	2	WKVK	37.9		F
Perrysburg	4	WKYF	37.9		F
Piqua	2	WQTP	155.13		F
Port Clinton	1	WSTM	37.1		A
Portsmouth	9	WPGI	30.58		A
Ravena C	4	WFRK	37.9		F
Reading	2	WCDE	37.9		A
Rocky River	7	WAFX	39.5		F
St Bernard	3	WJSB	37.5		A
St Clairsville C	4	WAKL	33.1		A
Salem	1	WBGW	37.1		F
Sandusky	4	WAKI	30.98		F
	2	WBTU	30.58		F
Sandusky C	5	WALU	30.98		F
Shaker Hgts	5	WQHN	37.9		A
Shelby	1	WAMH	30.98		A
Sidney	1	WSGO	31.5		A
Silver Lake	1	WKUJ	35.9		F
Solon	1	WBUG	37.9		F
Springfield C	1	WQYL	155.25		F
Springfield	15	WQMI	33.1		A
Steubenville	3	WPHD	154.65		F
Steubenville C	5	WWRV	33.1		A
Sylvania	1	WSFI	30.7		F
Tallmadge	1	WTAJ	37.9		F
Terrack Pk	1	WNAZ	37.9		F
Tiffin C	2	WBNA	31.78		A
Tiffin	2	WKTP	31.78		A
Toledo C	7	WMFO	3.07		F
Toledo	33	WRDQ	35.22		F
Toronto	1	WRIL	33.1		A
Troy	3	WQTX	37.9		F
University Hgts	1	WKIK	37.9		F
Upper Arlington	5	WUAP	154.65		F
Urbana	2	WJVQ	37.9		F
Urbana C	1	WJWO	37.9		F
Van Wert C	2	WBPG	39.78		F
Waite Hill	1	WKKU	31.5		A
Warren C	4	WAFE	37.78		F
Warrensville Hgts	1	WMYP	37.9		F
Wellsville	2	WMPO	33.1		A
Westlake	1	WKMZ	29.38		A
W. Union	2	WJQB	30.7		F
Wickliffe	1	WJZV	31.5		A
Willoughby	3	WQHM	31.5		A
Willowwick	2	WQWO	31.5		A
Wooster	8	WJST	155.61		F
Wooster C	4	WNEG	39.9		F
Wyoming	3	WBYA	33.5		F
Xenia	1	WEGH	33.94		F
Youngstown	32	WPDG	37.22		A
Youngstown C	7	WRMY	37.22		A
Zanesville	6	WPHO	33.22		A

OKLAHOMA

Ada	1	KNHC	2450	A
Altus	2	KACL	30.58	A
Ardmore	4	KARD	33.22	A
Bartlesville	1	KQFM	2450	A
Blackwell	3	KEZY	33.22	A
Bristow	1	KOKB	2450	A
Canadian C	2	KBYH	31.5	F
Chickasha	4	KACF	31.5	F
Cushing	1	KAPB	2450	A
Duncan	2	KNGK	33.22	A
Durant	4	KRBK	33.22	A
Edmond	2	KRHT	30.58	A
El Reno	2	KQAB	30.58	F
Enid	6	KAPK	33.22	A
Guthrie	1	KGOP	33.22	A
Guthrie C		KHUO		
Hugo C	5	KPMZ	31.5	F
Lawton	1	KGHP	33.22	A
Miami	5	KNCE	31.5	F
Muskogee	9	KNGT	31.5	F
Nichols Hills	2	KQDI	33.22	A
Newkirk C	2	KQTV	33.22	A
Norman	3	KRAY	33.22	A
Norman C	1	KAPE	2450	A
Nowata C	1	KHOC	31.5	F
Oklahoma City	15	KQDS	33.5	F
Oklahoma City C	10	KGPH	33.5	F
Okmulgee	1	KAPF	2450	A
Pawhuska	5	KOPM	31.5	F
Ponca City	1	KACP	2450	A
Pryor	2	KCNO	31.5	F
Sapulpa	8	KPDS	30.58	F
Seminole	3	KACR	30.58	A
Shawnee	2	KWCM	33.22	A
Stillwater	4	KSWP	30.58	A
Tulsa	137	KQEI	156.69	F
Wewoka	1	KWMP	2450	A

OREGON

Albany	1	KIOA	33.5	F
Astonia	5	KQKX	30.98	A
Beaver Creek	1	KSAD	33.5	F
Bend	2	KQIN	35.22	A
Canby	1	KSAB	33.5	F
Coos Bay	1	KHFX	2442	A
Corvallis	3	KFZO	33.5	F
The Dalles	4	KHNX	33.5	F
	1	KRWF	33.5	F
Eugene C	3	KCSK	31.78	F
Eugene	7	KADV	31.78	F
Gladstone	1	KSAG	33.5	F
Hillsboro C	2	KRJB	30.98	A
Klamath Falls	4	KGZH	35.22	A
Medford	2	KRIQ	35.1	A
Milwaukie	2	KSAK	33.5	F
Molalla	1	KEHJ	33.5	F
Mominnville	1	KRLA	30.98	A
Oak Lodge	1	KSAH	33.5	F
Oregon City	5	KGOQ	33.5	F
Oregon City C	8	KBSX	33.5	F
Oswego	1	KIAD	33.5	F
Pendleton	3	KPOL	33.5	F
Portland	95	KGPP	30.58	A
	25	KPFD	33.1	A
	4	KQEJ	33.1	A
Salem	11	KGZR	30.98	A
Salem C	1	KORM	30.98	A
Sandy	1	KSAJ	33.5	F
Sheridan	4	KNHL	33.5	F
Springfield	1	KJML	31.78	F
Tillamook C	3	KIKO	33.5	F
Wasco City		KAUK		
W. Linn	4	KHWL	33.5	F
Willamina	4	KNHK	33.5	F

PENNSYLVANIA

Abington	10	WQNW	33.94	F
Aliquippa	4	WRIK	33.5	F
Allentown	8	WQJZ	30.58	A
Altoona	5	WSRD	35.9	F
Ambridge	3	WRHZ	35.5	F
Ardmore	22	WQNX	156.33	F
Aspinwall	1	WOBZ	39.38	F
Baldwin Twp	1	WNBX	39.38	F
Beaver	1	WQQR	37.1	A
Beaver C	2	WJVY	30.7	A
Beaver Falls	4	WRHA	37.1	A
Ben Avon	1	WNIB	39.38	F
Berwick	2	WKJH	37.5	F
Bethel	1	WAEU	39.38	F
Bethlehem	4	WQJJ	33.5	A
Bethlehem C	8	WPEZ	31.9	A
Bradford	5	WBRA	37.9	F
Brentwood	1	WDED	39.38	F
Bristol	1	WHRL	31.5	A
Brookline	5	WQOR	31.1	F
Brownsville	1	WDAH	39.1	F
Butler	2	WMBT	35.9	F
Chambersburg	2	WMCB	39.5	A
Charlerol	2	WKWY	39.5	F
Chester	18	WKLC	37.5	F
Clairton	25	WQRD	156.33	F
Clifton Hgts	1	WBRS	39.5	F
Coatesville	2	WBRV	33.1	A
Collingdale	1	WBEV	31.5	F
Coraopolis	2	WSRC	33.5	F
Crafton	1	WPMG	37.5	F
Darby	1	WKEF	31.5	F
Dormont	1	WDSN	39.38	F
E. Lansdowne	1	WKDQ	39.5	F
Easton	10	WKWA	155.49	F
	2	WIJQ	155.13	F
Elkins Pk	9	WQON	31.1	F
Ellwood City	2	WKMG	33.94	F
Ephrate	1	WBHV	31.5	F
Erie	17	WQLS	37.1	A
Etna	1	WPWR	39.38	F
Farrell	3	WBGH	37.1	F
Folcroft	1	WKKX	37.9	A
Forest Hills	1	WPWZ	39.38	F
Fox Chapel	2	WQGD	39.38	F
Franklin	1	WBPT	37.9	F
Glenolden	1	WRJX	37.9	A
Hanover	3	WQHP	35.9	F
Harrisburg	6	WQOD	37.9	A
Hazelton	5	WUEQ	156.21	F
Indianola	1	WCMF	39.38	F
Ingram	1	WREZ	37.5	F
Jefferson Twp	1	WCPE	39.38	F
Jenkintown	1	WBKO	33.94	F
Johnston	3	WIED	35.5	F
Keannette	1	WRMA	33.5	A
Kingston	2	WRHW	31.1	A
Lancaster	2	WQTW	37.1	F
Lansdowne	2	WQNB	39.5	F
Latrobe	1	WRLH	35.9	F
Lebanon	3	WBMV	33.5	A
Lewiston	2	WBXR	33.5	F
Lock Haven	1	WBSN	33.5	A
L. Moreland Twp	1	WBWA	33.94	F
Marple Twp	1	WBRH	31.78	A
McKeesport	5	WQIC	33.1	A
McKees Rocks	1	WEAY	39.38	F
Meadville	2	WRGZ	37.9	F
Media	2	WBRX	31.78	A
Media C	1	WDPK	37.9	F
Midland	2	WKJQ	33.5	F
Millbourne	1	WFIF	39.5	F
Millvale	1	WPWM	39.38	F
Milton	1	WCVD	35.5	F
Monaca	2	WWCC	33.5	F
Monessen	2	WQFF	39.5	F
Monongahela	1	WIEQ	39.5	F
Morrisville	1	WRMC	33.1	A
Morton	1	WMGP	31.78	A
Mt. Oliver	1	WMOV	39.38	F
Nether Providence Twp	2	WANE	31.78	A
New Castle	3	WPGT	37.78	F
New Kensington	3	WLDI	31.9	F
Morristown	4	WQMU	33.5	F
	2	WMJE	30.58	A
Norristown C	39	WMCN	30.58	F
Norwood	1	WRHY	37.9	A
O'Hara Twp	1	WCRQ	39.38	F
Oil City	2	WPHZ	37.9	F
Parkside	1	WBJI	31.78	A
Philadelphia	131	WPDP	30.98	F
	300	WIYP	155.97	F
Phoenixville	1	WQNJ	30.7	F
Pittsburgh	1	WPDU	1714	A
	68	WPIM	39.38	F
	3	WMLK	37.5	F
Plymouth	4	WPPD	155.25	F
Pottsville	5	WJPP	35.9	F
Prospect Pk	1	WSTQ	37.9	A
Reading	10	WPFE	33.22	A
Reserve Twp	1	WBQD	39.38	F
Ridley Twp	2	WBKV	31.78	A
Ridley Pk	1	WABH	37.9	A
Rose Valley	1	WBHE	31.78	A
Ross Twp	1	WOQG	39.38	F
Scranton	5	WQTV	33.1	A
Sewickley	2	WBXP	31.1	A
Sewickley Hgts	3	WQIA	33.1	A
Shaler Twp	1	WRFY	39.38	F
Sharon	4	WQFU	31.5	F
Sharon Hill	2	WQOC	37.9	A
Sharosburg	1	WBFH	39.38	F
Spring City	1	WFUQ	30.58	F
Springfield Twp	2	WSRT	31.78	A
Spring Garden	2	WKVS	37.78	F
State College	1	WJZD	37.9	F
Steelton	5	WSPI	155.49	F
Stowe Twp	1	WCHX	39.38	F
Swarthmore	2	WPFQ	31.78	A
Tinicum Twp	1	WBOI	31.78	A
Tredyffrin	3	WBEQ	30.58	F
UnionTown	2	WQTN	39.1	F
Upper Dublin	1	WSVN	33.94	F
Upper Moreland	1	WSVB	33.94	F
Upper Providence Twp	1	WBLP	31.78	A
Upper Southampton Twp	1	WRMU	30.58	F
Warminster Twp	1	WKIJ	30.58	F
Warren	1	WENZ	31.1	F
Washington	2	WKYR	39.5	F
Waynesboro	2	WHUY	33.5	A
W. Chester	3	WQNV	33.1	F
W. Deer Twp	1	WDKV	39.38	F
W. Goshen Twp	1	WBQE	33.1	F
W. Mifflin	2	WMII	37.5	F
West View	1	WTQD	39.38	F
Wilkes Barre	1	WQFM	2442	A
Williamsport	3	WQOH	33.1	A
Yeadon	5	WRLO	31.5	F
York	4	WAKX	156.33	F

PUERTO RICO

Aguadilla	1	WSJP	155.13	F
Arecibo	1	WSJH	155.13	F
Bayamon	1	WSJI	155.13	F
Caguas	1	WSJK	155.13	F
Camp Maravilla	1	WSJC	155.13	F
Caribbean	1	WSJO	155.13	F
Culebra	1	WSJE	155.13	F
Gov. of Puerto Rico	30	WSJR	155.13	F
Guayama	1	WSJG	155.13	F
Humacao	1	WSJF	155.13	F
Maricao	1	WSJL	155.13	F
Ponce Puerto	1	WSJB	155.13	F
San Juan	1	WSJQ	155.13	F

RHODE ISLAND

Bristol	1	WBRI	1714	A
Central Falls	3	WKAA	39.38	A
Cranton	14	WPGK	31.78	F
E. Providence	11	WPEI	33.22	A
Newport	6	WMPH	30.50	A
N. Kingston	8	WNHZ	37.1	F
Pawtucket	8	WPFV	39.38	A
Providence	30	WPGF	30.58	A
Wakefield		WBTF		
Warren Twp	1	WPIA	1714	A
Warwick	1	WSYV	155.13	F
Woonsocket	8	WPEM	35.1	F

SOUTH CAROLINA

Aiken	3	WRXP	39.5	F
Anderson	3	WRJQ	37.5	A
Charleston	1	WCPD	2430	A
Chester	5	WJSU	155.37	F
Chester C	10	WJVF	155.25	F
Clinton	4	WCQW	155.73	F
Columbia C	12	WMGU	37.5	F
Columbia	14	WCMP	39.38	F
Florence	4	WMYR	37.5	F
Gaffney	1	WBDW	33.1	F
Gaffney C	5	WBGS	33.1	F
Greenville	5	WQLG	33.1	A
Greenville C		WPGR		
Greenwood	4	WSVQ	33.5	A
Lancaster	6	WIAT	35.5	F
Laurens	2	WOMU	31.5	F
Laurens C	6	WONH	31.5	F
Orangeburg		WJQC		
Rock Hill	4	WPRH	39.1	F
Spartanburg C	20	WBPB	35.9	F
Spartanburg	13	WSSC	35.9	F
Sumter	3	WLAH	33.1	F
Union C	15	WKQW	155.13	F
Yorkville C	6	WJKE	39.1	F

SOUTH DAKOTA

Aberdeen	2	KAWC	39.1	F
Aberdeen C	2	KRQA	39.1	F
Alexandria	1	KAMW	39.1	F
Custer	2	KXIY	39.8	F
De Smet	1	KCIA	39.1	F
Elk Point	1	KDCQ	39.1	F
Huron C	1	KRQG	39.1	F
Huron	2	KVPB	39.1	F
Lake Andes C	2	KVWI	39.18	F
Lake Andes	2	KVUF	39.18	F
Madison	2	KHFT	39.18	F
	2	KTIV	39.18	F
Mitchell C	1	KCLK	39.18	F
Mitchell	1	KQSP	39.1	F
Pierre	2	KBKV	39.1	F
Rapid City C	2	KRTX	39.18	F
Rapid City	4	KNGM	39.5	F
Redfield	1	KHQR	39.1	F
Redfield C	1	KSCD	39.1	F
Sherman	1	KBPR	39.18	F
Salem	2	KXIV	39.18	F
Sioux Falls C	2	KXAB	39.18	F
Sioux Falls	5	KBTY	39.1	F
Spearfish	1	KSDI	39.18	F
Sturgis	2	KTIA	39.18	F
	2	KTHV	39.18	F
Vermillion C	1	KHPG	39.18	F
Vermillion	1	KROE	39.1	F
Watertown	1	KQJM	39.18	F
Watertown C	4	KJXP	39.18	F
Webster C	2	KRID	39.18	F
Winner	1	KBVU	39.1	F
Yankton	1	KQXR	31.5	A

TENNESSEE

Bristol	1	WHTW	38.9	F
Chattanooga	19	WRCK	33.1	A
Chattanooga C	5	WFJN	33.1	A
Cleveland	2	WNOX	33.5	F
Columbia	16	WDDV	37.44	F
Columbia C	10	WEAA	37.26	F
Dyersburg	4	WBSV	39.38	F
Gallatin	10	WEBG	37.26	F
Jackson	6	WRSJ	31.5	F
Johnson City	3	WPGZ	35.1	F
Kingsport	3	WQTJ	37.1	A
Knoxville	12	WPFO	30.58	F
Maryville	2	WNPO	33.5	F
Memphis	70	WPEC	30.58	A
Murfreesboro	2	WEBT	37.26	F
Nashville	30	WBYH	37.1	F
Paris	2	WBTB	37.1	A
Springfield	6	WTWR	155.25	F
Tullahoma	6	WTPP	155.25	F
Union City	1	WRLX	37.9	A

TEXAS

Abilene	14	KADR	30.98	A
Alamo Hgts	1	KQZW	33.22	A
Amarillo	4	KQDH	30.58	A
Angleton	9	KBMI	35.5	F
Anahuac C	3	KFTX	37.22	A
Austin	40	KGHU	33.22	A
Beaumont	44	KGPJ	37.22	A
Big Spring	2	KACM	33.22	A
Big Spring C	1	KFEA	33.22	A
Belton C	1	KFEB	30.58	A
Borger	3	KGCV	30.58	A
Brownwood C	5	KAGJ	2458	A
Brownwood	4	KNGW	30.58	A
Brownsville	5	KGHT	35.1	A
Brownsville C	3	KOGA	35.1	A
Bryan	1	KPBR	1714	A
Carthage	1	KHIU	35.5	F
	2	KRSY	35.5	F
Cleburne	4	KNGE	35.1	A
Conroe	6	KCOP	35.5	F
Corpus Christi	18	KGHV	33.22	A
Corsicana	5	KRGA	30.98	A
Cuero	4	KLFG	35.5	F
Dallas	61	KVP	33.22	A
	1	KVPA	1714	A
Dallas C	11	KRMB	33.22	A
Denison	9	KQAT	31.5	A
Denton	4	KNHF	37.1	A
Electra	2	KPDE	30.58	A
El Paso	17	KGZM	33.1	A
El Paso C	8	KRHV	33.1	A
Ennis	1	KAAV	35.1	F
Fort Worth	94	KQAN	33.1	A
	1	KRLJ	33.1	A
Freeport	5	KSME	35.5	F
Gainesville	9	KADM	30.58	A
Galena Pk	2	KBZQ	35.5	F
Galveston	18	KRPW	33.22	A
	5	KGCT	33.22	A
Gladewater	1	KBYN	33.22	A
Grand Prairie	3	KISE	39.1	F
Greenville	10	KIFH	39.5	F
	12	KIFH	39.5	F
Henderson	6	KDLV	35.1	F
Highland Pk	7	KQGS	37.1	A
Houston	1	KHPR	1714	A
	13	KHCZ	35.5	F
	113	KHTP	33.1	AF
Kilgore	4	KKPD	33.22	A
Kountze	2	KSYO	35.5	F
Longview	8	KACU	31.78	A
	7	KBPI	39.1	F
Lubbock	9	KGZW	33.22	A
Lufkin	5	KQDN	37.22	A
Lufkin C	3	KHFW	37.22	A
Marshall C		KSVH		
Marshall	5	KADT	33.22	A
McAllen	11	KBQI	155.13	F
McKinney	4	KTWP	37.22	A
Mexia	3	KQXW	33.22	A
Midland	3	KRLE	33.22	A
Midlothian	1	KRPJ	35.1	F
Nacogdoches	1	KRAN	37.22	A
Odessa	5	KBGC	35.1	A
Olmos Pk	1	KOTP	33.22	A
Orange	7	KEZU	37.22	A
Pampa	3	KPAM	30.58	A
Paris	1	KQKM	1714	A
Pasadena	3	KPPD	33.22	A
Pelly C	1	KHGC	33.22	A
Plainview	1	KRKQ	2458	A
Port Arthur	8	KPAT	37.22	A
Richmond	15	KSRT	37.26	F
Rosenburg	15	KRTP	37.26	F
San Angelo	4	KASD	33.22	A
San Antonio	70	KGZE	33.22	A
San Antonio C	14	KPBT	33.22	A
Sherman C	1	KFXL	31.5	A
Sherman	6	KVUW	39.1	F
Stinnett C	3	KOGH	30.58	A
Sweetwater	1	KAPJ	2458	A
Temple	4	KRKW	30.58	A
Terrell Hills	1	KQJB	33.22	A
Texas City	3	KTWL	33.22	A
Tyler	6	KQCF	31.9	F

THE BROWNING MODEL S-4 FREQUENCY METER IS STANDARD FOR ALL COMMUNICATIONS SERVICES

PREFERRED BY COMMUNICATIONS SUPERVISORS:

The BROWNING FREQUENCY METER

SPEED — ACCURACY — STABILITY — the three reasons why the BROWNING Frequency Meter is so widely preferred by communications supervisors.

THE BROWNING model S-4 is *quick and easy* to use, either for measuring car transmitter frequency on the air, or for readjusting transmitters when they have drifted off frequency. Operates from 110–115 volts AC or DC.

Extreme *accuracy* is made possible by the large dial that can be read to approximately 25 cycles, and the tuning eye indicator which shows zero-beat adjustment. Meets FCC requirements of ±.0025%.

Crystal control with a highly stable electron-coupled oscillator and line-voltage regulation assure the degree of *stability* in the BROWNING S-4 necessary to withstand the rigors of communications service.

Original calibration is made with a frequency standard accurate to 1 part in 10,000,000. Available as listed below, hand-calibrated at one to five frequency bands between 1.5 and 100 mc. Prices, complete with tubes, F.O.B. factory:

1 Frequency Band $170 *3 Frequency Bands $210*
2 Frequency Bands $190 *4 Frequency Bands $230*
5 Frequency Bands $250

BROWNING LABORATORIES, Inc.
750 Main Street, Winchester, Massachusetts
In Canada: Measurement Engineering, Ltd., 61 Duke Street, Toronto

MUNICIPAL & COUNTY POLICE

University Pk	13	KQZ1	31.5	A
Vernon	1	KHGZ	30.58	A
	2	KBLB	30.58	A
Victoria	6	KDJD	33.5	F
	1	KEPL	1714	A
Waco C	1	KRVH	30.58	A
Waxahachie	4	KRKC	35.1	F
	1	KQIH	35.1	F
Waco	17	KGZQ	30.58	A
Westover Hills	1	KRIW	33.1	A
W. Univ. Place	2	KHQK	33.22	A
Wharton	18	KWSO	33.5	F
Wichita	16	KGZ1	30.58	A

UTAH

American Fork City	1	KDDA	35 78	F
Brigham C	3	KASK	37.5	F
Brigham City	1	KBUO	37 5	F
Clearfield	1	KAIJ	35.78	F
Farmington C	2	KBIJ	35.78	F
Helper City	1	KHGB	35 9	F
Logan C	2	KBGZ	37 5	F
Logan City	2	KHQW	37.5	F
Midvale	1	KSHA	35.78	F
Morgan C	1	KBPJ	35.78	F
Murray	1	KIKN	35.78	F
Ogden	8	KQCH	30.58	F
Orem City	1	KAHS	35 78	F
Payson City	1	KBNL	35.78	F
Price	1	KPGB	35 9	F
Provo	5	KPMU	33 5	F
Salt Lake City	25	KGPW	154 65	A
	1	KBLO	35 78	F
Springville	1	KRWA	35 78	F

VERMONT

Brattleboro	3	WBQG	33 5	F
Burlington	3	WRCW	35.9	A
Rutland	2	WBMH	39 1	F
Springfield	4	WIUF	39.1	F

VIRGINIA

Alexandria	16	WAVA	31 1	F
Appomattox C	1	WNKV	39 38	F
Arlington	10	WPAV	33 5	F
Bedford C	2	WBCL	39 38	F
Bristol	2	WPHV	37 9	F
Charlotte C	1	WATO	39 38	F
Charlottesville	4	WQTE	33 94	F
Chesterfield	11	WMSO	39 1	F
Colonial Hgts	1	WAVP	37 9	F
Danville	6	WRGU	33 1	F
Fairfax	6	WMFC	35 9	F
Falls Church	2	WHCN	35 9	F
Fredericksburg	2	WRQG	33 1	F
Hampton	4	WTPH	37 5	F
	2	WELH	33 1	A
Hanover C	2	WCAQ	39.38	F
Harrisonburg	2	WBXS	37 9	F
Harrisonburg C	3	WMMG	37 9	F
Hopewell	1	WQOZ	37 1	A
Lexington C	2	WKGB	35 78	F
Lynchburg	10	WQFH	35 1	F
Marion	2	WKME	39 5	F
Martinsville	3	WHTJ	39 1	F
New Kent C	1	WTNF	35.78	F
Newport News	12	WRIV	35 9	A
Norfolk	46	WQNK	37.1	A
Orange C	2	WBSJ	42 7	F
Petersburg	7	WQFI	37 9	F
Phoebus	1	WOZI	37 5	F
Portsmouth	20	WPVL	37.9	F
Portsmouth C	7	WKNR	39 9	F
Pulaski	2	WDGL	39 5	F
Radford	4	WTMY	39 5	F
Richmond	67	WPHF	31.78	A
Richmond C	3	WEUG	31.78	A
Roanoke	5	WSYC	37.78	F
	45	WQFG	155.13	F
S. Norfolk	2	WHTG	155 13	F
Stafford C	1	WHNJ	33 1	F
Staunton	7	WRID	37 9	F
Staunton C	2	WKUG	37 9	F
Suffolk	5	WRGV	39 5	F
Suffolk C	2	WFRU	39.5	F
Virginia Bch	9	WADB	33 94	F
Waynesboro	1	WIGV	37.9	F
Williamsburg	2	WKYT	33.1	F
Williamsburg C	1	WAQJ	33.1	F
Winchester	2	WSKQ	37.9	F
Winchester C	1	WAPT	37.9	F

WASHINGTON

Aberdeen	4	KGZV	31.78	A
Anacortes	4	KAEB	35.5	F
Asotin	1	KBXM	30.58	A
Bellingham	16	KACK	39.9	F
Bellingham C	4	KAJS	39.9	F
Bremerton	26	KASF	33.5	F
Camas	1	KREB	30.98	A
Centralia	2	KGHW	35.5	F
Clarkston	1	KIHBX	30.58	A
Colfax	1	KQKC	30.58	A
	4	KQDM	30.58	A
Cowlitz	6	KBJA	30.58	A
Chehalis	12	KQWA	35.5	F
Davenport	2	KAEV	35.5	F
Ellensburg	3	KBGR	35.5	F
	6	KCNQ	35.5	F
Everett	21	KNEP	37.1	F
Everett C	10	KSCP	37.1	F
Ephrata	3	KABI	30.58	A
Hoquiam	4	KAPL	30.58	A
Kelso	2	KQEQ	35.5	F
Longview	4	KSLB	30.58	A
Montesano C	1	KRQF	35.5	F
Montesano	12	KRQB	35.5	F
Mt Vernon	4	KCNR	35.5	F
Oak Harbor	1	KOGX	37.5	F
Olympia	5	KACE	35.5	F
Olympia C	4	KRHM	35.5	F
Pasco	1	KIBS	35.5	F
Port Angeles	1	KRXY	39.74	F
Port Orchard	14	KADL	33.5	F
Pullman	1	KQVP	30.58	A
Puyallup	1	KPWP	35.9	F
Port Townsend	1	KQEC	30.58	A
Ritzville	2	KRAU	30.58	A
Renton	10	KGLB	35.5	F
Seattle C	33	KAXT	37.78	F
Seattle	1	KAFO	37.9	F
	40	KATH	37.9	F
	24	KGPA	37.78	F
Shelton	2	KHLD	35.5	F
Spokane	25	KBTO	39.42	F
	46	KBQE	39.42	F
	25	KGHS	30.58	A
	1	KRLI	2414	A
Tacoma	100	KGZN	156.57	F
Vancouver	8	KRDM	30.98	A
Vancouver C	8	KRDL	30.58	A
Walla Walla	3	KWWX	35.5	F
	6	KACV	35.5	F
Wenatchee	5	KHGW	35.5	F
Yakima	9	KNGU	30.58	A
	8	KRSI	35.5	F

WEST VIRGINIA

Beckley	2	WKHK	35.5	F
Bluefield	3	WBWV	33.1	F
Charleston	6	WPHI	37.9	F
Clarksburg	3	WPFP	30.58	A
Dunbar	1	WJQA	37.9	F
Fairmont	3	WPHJ	35.1	A
Follansbee	1	WSLE	33.1	A
Hollidays Cove	4	WRHF	37.1	A
Huntington	15	WQOW	33.1	F
Keyser	1	WAEF	2490	A
Martinsburg	3	WCHD	37.9	F
Morgantown	7	WJWZ	35.9	F
Parkersburg	2	WPHQ	37.9	F
Princeton	1	WSTH	31.5	A
Wellsburg	1	WRIN	33.1	A
	4	WRGH	33.1	A
Wheeling	7	WQTU	33.1	A
Williamson	1	WCWF	37.9	F
Weirton	9	WEIR	33 1	F

WISCONSIN

Antigo		WQWS		
Appleton	14	WBIQ	33 5	A
Arpin	8	WJZH	31.9	A
Baraboo	1	WKLG	31 5	A
Baraboo C	5	WJUP	31.5	A
Barron C		WKIV		
Beaver Dam	2	WSTG	31.5	A
Beloit	6	WRNI	31.5	A
Blooming Grove	1	WBVE	37.78	F
Burlington	1	WTYV	37.9	F
Cedarburg	1	WJAQ	37.78	F
Chilton	7	WKLU	33.5	A
Chippewa Falls	3	WNGX	37.9	F
Chenequa	2	WGUX	30 58	A
Crandon C	3	WKMX	37.9	F
Custer	2	WRNG	31.5	A
De Pere	1	WHNP	33.22	A
Douglas	1	WDTO	30 58	F
Eau Claire	4	WBHT	33 5	A
Edgerton	1	WFXQ	31.5	A
Eagle River	2	WQZA	37 9	F
Elkhorn	18	WMPE	37 78	F
Evansville	1	WSUB	31 5	A
Fond Du Lac C	17	WFDW	30 98	A
Fort Atkinson	1	WRLP	31.5	A
Glenmore	18	WHNO	37 9	F
Green Bay	5	KNHB	33.22	A
Green Lake	2	WJLH	37 9	F
Janesville	6	WRNQ	37.78	AF
	7	WRIT	31.5	A
Jefferson	3	WRAJ	37 78	F
Juneau	9	WQXO	37.78	A
Kenosha	24	WPEP	31.5	A
Kohler	3	WQZJ	33 5	A
LaCrosse	1	WSLM	31.5	A
	7	WQTH	37.1	A
	7	WSTF	31.5	A
Lake Geneva	1	WQRJ	30 38	A
Madison C	13	WTNR	37.78	F
Madison	20	WASD	37.78	F
	1	WSVY	37.78	F
	1	WBQC	37.9	F
Manitowoc	8	WBSY	33.5	A
Maple Bluff	1	WRNF	37.78	F
Marinette	2	WALF	37.1	A
	10	WBAJ	37.9	F
Mauston	3	WJUL	37.9	F
Menomonie	2	WEKD	37.9	F
Milwaukee	275	WPDK	33.78	F
Minocqua Twp	1	WPQF	37.9	F
Monona	1	WSWH	37.78	F
Monroe	1	WRJM	30.58	A
Monroe Twp	7	WRJK	30.58	A
Montello	2	WMVS	37.9	F
Mosinee	1	WNJE	31.9	A
Neenah	5	WFUD	33.5	A
Nellisville	6	WJWR	37.9	F
Oconto	9	WPEV	37.9	F
Oshkosh	5	WCJR	30.58	A
	14	WAKE	37.78	AF
Peshtigo	1	WPWL	37.9	F
Plymouth	1	WKOL	33.5	A
Portage	1	WAGH	31.5	A
Portage C	1	WHIX	31.5	A
Port Washington	5	WDAW	37.78	F
	2	WRJL	37.78	F
Racine	15	WQLJ	37.78	F
Racine C	6	WRNP	37.9	F
Rhinelander	6	WITL	37.9	F
	1	WKSE	37.9	F
Sheboygan	5	WQMW	33.5	A
Sheboygan C	6	WBOA	33.5	A
Shorewood Hills	1	WCKO	37.78	F
Stevens Pt C	4	WELA	31.5	A
Sparta	6	WMRQ	37.9	F
Stoughton	1	WDBD	37.9	F
Superior	5	WSWE	30.58	A
Tomahawk		WTAV		
Two Rivers	2	WDCJ	33.5	A
Viroqua	6	WBWL	31.5	A
Wausau	19	WBDX	31.9	A
Watertown	2	WRHX	31.5	F
Waukesha	3	WQML	30.58	A
	9	WMPD	30.58	A
Wantoma C	2	WCKT	37.9	F
West Allis	11	WGSO	155.61	F
West Bend	1	WJAJ	37.78	AF
West Bend	4	WRPQ	37.9	F
Wisconsin Rapids	1	WNRG	31.9	A

WYOMING

Casper	4	WEYD	33.22	A
Cheyenne C	2	KQRZ	33.22	A
Cheyenne	9	KQOI	33.22	A
Laramie	2	KRTQ	33.22	A
Rawlins	1	KEYH	33.22	A
Rock Springs	1	KEYI	33.22	A
Sheridan	1	KEYJ	33.22	A

STATE POLICE

STATE POLICE

Locations of State Police barracks from which transmitters are operated. All mobile units are shown as the total number in use.

ALABAMA

Montgomery Hq		WRBU	37.5	F
	125	WEAI	37.5	F
Box Springs		WHTX	37.5	F
Hamilton		WKRF	37.5	F
Decatur		WKSD	37.5	F
Cadsden		WKSG	37.5	F
Selma		WKSJ	37.5	F
Demopolis		WKSK	37.5	F
Huntsville		WKSP	37.5	F
Blakely Island		WKSQ	37.5	F
Anniston		WKVG	37.5	F
Dothan		WKXR	37.5	F
Birmingham		WLBA	37.5	F
Evergreen		WQXE	37.5	F
Tuscombia		WQXF	37.5	F
Opelika		WQXG	37.5	F
Montgomery		WRBU	37.5	F

ARIZONA

Phoenix Hq		KNGG	1598	A
	1	KNGG	1598	A
	77	KAXR	39.9	AF

ARKANSAS

Little Rock Hq		KASP	1722	A
	54	KAOB	35.78	F
	1	KHAD	1722	A
Newport		KBSL	1722	A
Hope		KEZX	1722	A
Forrest City		KFDK	1722	A
Clarksville		KFDL	1722	A
Warren		KFDO	1722	A
El Dorado		KQSR	1722	A
Karrison		KWBQ	1722	A

CALIFORNIA

Sacramento Hq		KAAS	1690	A
		KADJ	1690	A
	467	KAPA	39.78	F
	2	KGNW	1690	A
	14	KKJW	156.69	F
Bakersfield		KADC	1682	A
Grass Valley		KAPI	1690	A
Willows		KASG	1690	A
Culver City		KAWF	1682	A
Oak Glen		KEPE	1682	A
Ridge Rt. Sta		KFPH	1682	A
Alturas		KHNW	1690	A
Vallejo		KHNY	1690	A
Ventura		KIUF	1682	A
Oakland		KKJW	156.69	F
Oroville		KPDF	1690	A
San Luis Obispo		KQDO	1682	A
Pomona		KQUG	1682	A
Newhall		KQUI	1682	A
Oakland		KRBU	1690	A
Chino		KSCC	39.9	F
Yreka		KSCY	1690	A
Redding		KSPR	1690	A
San Quentin		KSQP	39.9	F
Represa		KSRF	39.9	F

COLORADO

Denver Hq	36	KQKY	33.78	A
	1	KRAR	33.78	A

CONNECTICUT

Hartford Hq		WJTH	39.5	F
	345	WCSE	39.38	F
	3	WQUB	39.5	F
Brookfield		WJTA	39.5	F
Canaan		WJTB	39.5	F
Stafford Spgs		WJTC	39.5	F
Danielson		WJTD	39.5	F
Croton		WJTE	39.5	F
Westbrook		WJTF	39.5	F
Westport		WJTG	39.5	F
Hartford		WJTH	39.5	F
Bethany		WJTI	39.5	F
Litchfield		WJTJ	39.5	F
Colchester		WJTK	39.5	F

DELAWARE

Dover Hq		WJRF	39.5	F
	60	WJIH	39.78	F
Bellefonte		WAFF	39.5	F
Georgetown		WAYY	39.5	F
Bridgeville		WAYZ	39.5	F
New Castle		WDSP	39.5	F

FLORIDA

Tallahasee Hq		WKTF	31.1	F
	8	WJXC	2466	A
	182	WJXD	31.1	F
	4	WKGJ	31.1	F
Deland		WJJX	31.1	F
Melbourne		WJMV	31.1	F
Cross City		WJSK	31.1	F
Ocala		WJXI	31.1	F
Penny Farms		WJXJ	31.1	F
Lake City		WKDR	31.1	F
Tampa		WKGZ	31.1	F
Highland		WKSO	31.1	F
Chipley		WLIU	31.1	F
Pahokee		WRSF	31.1	F
Ft Myers		WSPF	31.1	F
Pensacola		WSWR	31.1	F
Palatka		WSWY	31.1	F
Miami		WSYP	31.1	F
		WSYU	31.1	F

GEORGIA

Atlanta Hq		WGSP	1666	A
	15	WGSP	1666	A
Perry		WKPG	1666	A
Reidsville		WSIJ	1666	A
Albany		WSIK	1666	A
Griffin		WSIN	1666	A
Washington		WSIO	1666	A

IDAHO

Boise Hq	50	KFEO	37.22	F

ILLINOIS

Springfield Hq		WQPS	1610	A
	1	WQPY	1610	A
	1	WQPX	1610	A
	1	WQPZ	1610	A
	1	WQPQ	1610	A
	1	WQPV	1610	A
	1	WQPI	1610	A
	200	WSTE	42.66	F
Blue Island		WQPB	42.5	F
Chicago		WQPC	1610	A
DuQuoin		WQPD	1610	A
Elgin		WQPE	42.5	F
Effingham		WQPF	1610	A
Sterling		WQPG	1610	A
Urbana		WQPH	42.5	F
E. St. Louis		WQPJ	1610	A
Peoria		WQPL	1610	A
Macomb		WQPM	1610	A
Joliet		WQPO	42.5	F
Pontiac		WQPP	1610	A
Rock Island		WQPR	42.5	F

INDIANA

Indianapolis Hq		WPHE	1634	A
	1	WAHO	1634	A
	1	WAHQ	1634	A
	1	WAHR	1634	A
	1	WAHP	1634	A
	1	WRSH	1634	A
	262	WSPC	35.78	A
Connersville		WBII	1634	A
Charleston		WBMO	1634	A
Indianapolis		WPHE	1634	A
Chesterton		WPHS	1634	A
Jasper		WPHU	1634	A
Seymour		WQFE	1634	A
Ligonier		WQFW	1634	A
Putnamville		WQGB	1634	A
Pendleton		WRNR	1634	A
W. Lafayette		WROR	1634	A

IOWA

Des Moines Hq		KGHO	1682	A
	136	KADW	35.78	AF
	4	KRPA	35.78	A
Fairfield		KACC	1682	A
Atlantic		KACD	1682	A
Maquoketa		KCMW	35.9	F
Cedar Falls		KNFN	1682	A
Storm Lake		KNFO	1682	A
Ladora		KNGI	73.42	F
Belmond		KOBA	73.42	F
Essex		KRPE	73.42	F

KANSAS

Topeka Hq		KAZZ	1698	A
	25	KAHR	42.46	F
	1	KANI	42.46	F
	41	KAQB	42.46	F
		KRXE		
Hutchinson		KAHR	42.46	F
		KJLV	42.46	F
		KJLZ	42.46	F
Chanute		KAQB	42.46	F
Wheaton		KBGD	42.46	F
Council Grove		KBGE	42.46	F
McLouth		KBGF	42.46	F
Wichita		KCJI	42.46	F
Concordia		KJFT	42.46	F
Salina		KHNS	42.46	F
Garden City		KHSN	42.46	F
Norton		KJAD	42.46	F
		KJPR	42.46	F
Garnett		KHAF	42.46	F
Hutchinson		KJLV	42.46	F

KENTUCKY

Frankfort Hq		WQWY	39.8	F
	4	WMLI	39.78	F
Bowling Green		WIHE	39.9	F
Mayfield		WIHG	39.9	F
Elizabethtown		WKBE	39.9	F
London		WKBF	39.9	F
Hazard		WKBG	39.9	F
Morehead		WKPE	39.9	F
Madisonville		WKYM	39.9	F

LOUISIANA

Baton Rouge Hq		WLSP	42.10	F
	28	KBLJ	39.5	F
	2	WBGR	39.5	F
	3	KCVJ	39.5	F
Alexandria		KRAD	1682	A
Lake Charles		KSPR	1682	A
Monroe		KSPC	1682	A
Franklin		KSPF	1682	A
Leesville		KSPL	1682	A
Shreveport		KSPS	1682	A
New Orleans		WNHI	39.5	F
		WNHN	1682	A
LaPlace		WNJB	1682	F

MAINE

Augusta Hq		WBNV	39.9	F
	2	WBAE	39.9	F
	69	WSYD	39.9	AF
W. Scarboro		WBVW	1642	A
		WEAH	39.9	F
Houlton		WLDQ	39.9	AF
Thomaston		WSTR	39.9	AF

MARYLAND

Annapolis Hq	232	WMSI	39.18	F
Belair		WEVN	39.1	AF
Waterloo		WHWN	39.1	AF
Dan' Rock		WMEV	39.1	F
Cumberland		WMSC	1698	AF
Easton		WMSE	39.1	AF
Frederick		WMSF	39.1	AF
Conowingo		WMSH	39.1	AF
Randallstown		WMSR	39.1	F
Waldorf		WMSW	39.1	F
College Pk		WWCP	39.1	F
Salisbury		WWSG	39.1	AF

MASSACHUSETTS

Boston Hq	121	WEGI	35.78	F
	6	WEQH	35.9	F
Andover		WKFA	35.9	F
Northampton		WKFI	35.9	F
		WPEW	35.9	F
Bridgewater		WKGC	35.9	F
		WPEL	35.9	F

152-162 mc. Communication Equipment With the *Power Saver* circuit . That means longer life for . . . *quick-heat* tubes

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

RECEIVER MODEL 541

Characteristics:

Frequency Range — 152-162 mc.

Type — Crystal controlled, single conversion superheterodyne FM Receiver.

RF Stages — Two, insuring excellent sensitivity.

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

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

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

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

Standby Drain — 6 amperes.

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

TRANSMITTER MODEL 542

Characteristics:

Frequency Range — 152-162 mc.

Exciter Stages — Latest miniature tubes used.

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

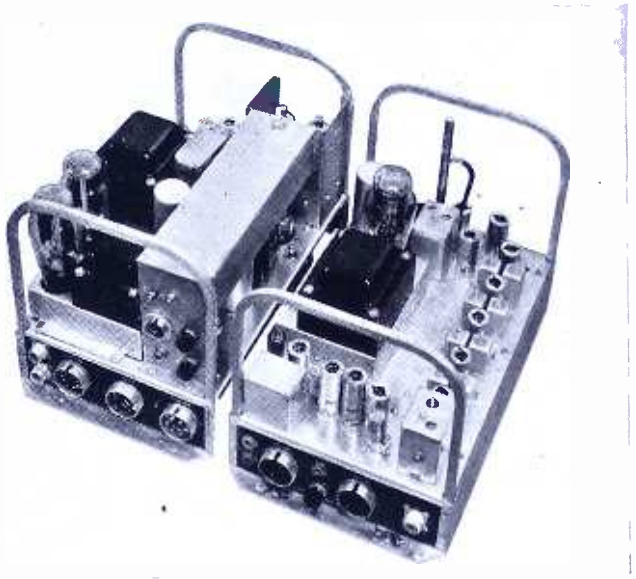
Final Amplifier — Push-pull, shielded parallel-line tank circuit, with a series-resonant link coupling circuit to antenna gives simple, effective and flexible antenna matching to mobile or fixed antennas.

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

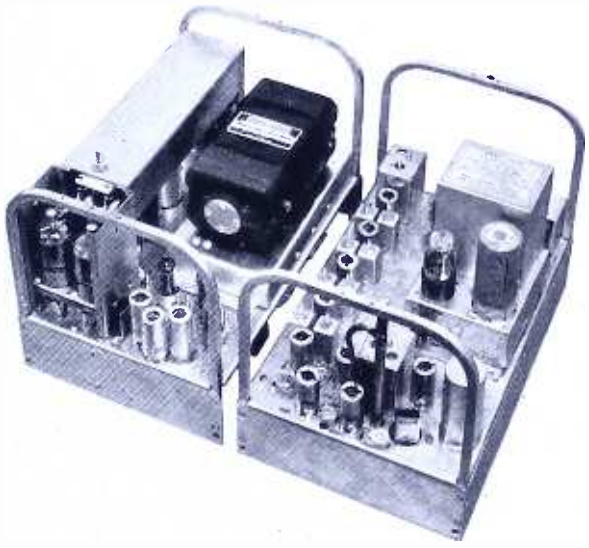
Power Output — 30 watts from AC or DC input. Standard deviation and pre-emphasis characteristics incorporated in the transmitter.

Standby Tube Drain — .45 amperes.

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



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



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

TWIN-LEAD

TRANSMISSION LINE adopts a *New* complexion

● Amphenol, originator of low loss twin-lead of extruded polyethylene insulation for transmitting and receiving, now announces an important improvement. At no increase in price, the dielectric insulation has been changed to solid brown Amphenol Ethylon-A containing an anti-oxidant. This new insulation is equal to the old in low loss properties. It is far superior in resistance to the effects of sunlight and moisture.

Preferred by amateurs for antennas and transmission lines, Twin-Lead transmits signals with minimum loss, is durable and inexpensive. The Ethylon-A dielectric is full thickness edge to edge, minimizing impedance changes caused by moisture collecting on the surface. Amphenol Twin-Lead is unaffected by acids, alkalies and oils. Flexibility remains unimpaired at temperature down to —70°F

The new *brown* Amphenol Twin-Lead is available in 75 ohm, 150 ohm and 300 ohm impedances for receiving use, and in 75 ohm type for transmitting. Write today for full data on electrical characteristics.

AMERICAN PHENOLIC CORPORATION

1830 SOUTH 54TH AVENUE • CHICAGO 50, ILLINOIS

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

STATE POLICE

Framingham		WMP	35.9	F
Nantucket		WSPN	35.9	F
Oak Bluffs		WSPO	35.9	F
[illegible]		W[illegible]	35.9	F
MICHIGAN				
Lansing Hq	421	WBLU	37.38	F
	2	WBMU	37.5	A
Brighton	1	W[illegible]	[illegible]	
Ypsilanti		W[illegible]	37.5	
Flat Rock		W[illegible]	37.5	
Detroit		WAPU	37.5	F
Mio		WBKZ	37.5	F
Jonesville		WBNF	37.5	F
[illegible]		WBOI	37.5	
[illegible]		[illegible]	37.5	
[illegible]		[illegible]	37.5	
E. Tawas		WBQL	37.5	F
Newberry		WBQP	37.5	F
West Branch		WBQQ	37.5	F
Baraga		WBQR	37.5	F
Cadillac		WBQS	37.5	F
Bad Axe		WBQT	37.5	F
Gladstone		WBQU	37.5	F
Wakefield		WBQV	37.5	F
Atlanta		WBRD	37.5	F
Palmer		WBRE	37.5	F
Iron Mountain		W[illegible]	37.5	F
Centerline		WBTO	37.5	F
Manistique		WBT[illegible]	37.5	F
Gladwin		WBXA	37.5	F
Kalkaska		WYK[illegible]	37.5	F
Baldwin		WDAJ	37.5	F
Boyne City		WDAS	37.5	F
Ewen		WDSO	37.5	F
Jackson		WITN	37.5	F
Keego Harbor		WITP	37.5	F
Flint		WITQ	37.5	F
Bay City		WITR	37.5	F
Roscommon		WIVA	37.5	F
Battle Creek		WIWG	37.5	F
Allegan		WIXD	37.5	F
Sandusky		WJAT	37.5	F
White Pigeon		WJAW	37.5	F
St Clair		WJBI	37.5	F
[illegible]		WJBL	37.5	F
Clinton		WJBR	37.5	F
Blissfield		WJBS	37.5	F
S. Haven		WJBT	37.5	F
Traverse		[illegible]	37.5	F
Mt Pleasant		WKJM	37.5	F
[illegible]		[illegible]	37.5	F
Cheboygan		[illegible]	37.5	F
Sault [illegible]		[illegible]	37.5	F
Rockford		[illegible]	37.5	F
St Ignace		WOSY	37.5	F
[illegible]		[illegible]	37.5	F
Paw Paw		WRDP	37.5	A
E. Lansing		[illegible]	37.5	F
Reed City		WRLE	37.5	F
[illegible]		[illegible]	37.5	F
Escanaba		WRRC	37.5	F
Niles		WSWI	37.5	F
Crystal Falls		WSWK	37.5	F
MINNESOTA				
St Paul Hq		WAMV	1658	A
Redwood Falls		KNHD	1658	A
MISSISSIPPI				
Jackson Hq		W[illegible]	42.02	F
[illegible]		[illegible]	42.02	F
Greenwood		WJBD	42.02	F
Batesville		[illegible]	42.02	F
Gulfport		WJBG	42.02	F
Starkville		WJBJ	42.02	F
New Albany		[illegible]	42.02	F
Brookhaven		[illegible]	42.02	F
Hattiesburg		WMHP	42.02	F
Meridian		WNRJ	42.02	F
MISSOURI				
Jefferson City Hq		KHPF	42.06	AF
[illegible]		[illegible]	42.06	AF
Lee's Summit		KHPA	42.06	AF
[illegible]		KHPB	42.06	AF
[illegible]		[illegible]	42.06	AF
Springfield		KHPD	42.06	AF
Poplar Bluff		[illegible]	42.06	AF
St Joseph		KHPH	42.06	F
MONTANA				
[illegible]		[illegible]		
NEBRASKA				
[illegible]	60	KREP	42.46	F
[illegible]		KBJ[illegible]	[illegible]	
Grand Island		KHIK	42.26	F
N. Platte		KHNB	42.46	F
McCook		KHNP	42.46	F
Holdrege		KHNP	42.46	F
Oshkosh		KRXN	42.46	F
Gering		KRXW	42.46	F
NEVADA				
[illegible]	7	KRNP	1634	F
	1	KRGL	1634	A
Reno		KRNP	1634	A
NEW HAMPSHIRE				
Concord Hq		WRPT	1682	A
	1	WAJA	1682	A
	67	WJJF	37.38	F
	217	WBPR	37.1	AF
Hampton		WEJY		
Bow		WMOE	33.5	F
NEW MEXICO				
Santa Fe Hq		KCQA	39.9	F
[illegible]		KCQ[illegible]	39.9	
NEW YORK				
Albany Hq	417	WNEH	42.14	F
	1	WSYQ	1658	A
	10	WFLJ	42.14	F
Sidney		WAKP	1658	A
Batavia		WBTC	1658	A
Valley Stream		WIZA	37.5	F
Lake Success		WIZC	37.5	F
Riverhead		WJGA	37.5	F
Bayshore		WJKW	37.5	F
Babylon		WKRI	42.14	F
Jones Beach		WKRL	42.14	F
Kings Pk		WKRN	42.14	F
Altamont		WKVA	1658	A
Fishkill		WKVC	1658	A
Commack		WLSA	37.5	F
Lloyd Twp		WNBO	42.14	F
Hawthorne		WNDV	42.14	F
Athol Spgs		WNGU	42.14	F
Homer		WNGW	42.14	F
N. Syracuse		WNHA	42.14	F
[illegible]		WNHE	42.14	F
[illegible] Lake		WNHG	42.14	F
Fort Henry		WNHL	42.14	F
Duanesburg		WNHM	42.14	F
Herring		WNHP	42.14	F
Auburn		WNHR	42.14	F
Bath		WNHU	42.14	F
Allegany		WNHV	42.14	F
Westfield		WNHW	42.14	F
Masonville		WNHX	42.14	F
Newfield		WNHY	42.14	F
Scottsburg		WNIO	42.14	F
W. Plattsburg		WNJA	42.14	F
[illegible]		[illegible]	42.14	F
Lewiston		[illegible]	42.14	F
[illegible]		[illegible]	42.14	F
Ferndale		[illegible]	42.14	F
Millbrook		[illegible]	42.14	F
Wellsville		[illegible]	42.14	F
[illegible]		[illegible]	42.14	F
Canandaigua		WNQK	42.14	F
S. Glen Falls		[illegible]	42.14	F
Tupper Lake		[illegible]	42.14	F
Alder Creek		WNQY	42.14	F
[illegible]		[illegible]	42.14	F
[illegible]		[illegible]	42.13	F
Troy		WNWG	42.14	F
Brightwaters		[illegible]	42.14	F
Catskill		[illegible]	42.14	F
Oneonta		WNWV	42.14	F
Schenectady		[illegible]	1658	A
Oneida		WPJK	1658	A
NORTH CAROLINA				
Raleigh Hq		WANI	42.62	F
	123	WIUK	39.78	F
[illegible]		[illegible]	42.68	F
Swannanoa		WANJ	1658	A
[illegible]		[illegible]	42.62	F
Elizabeth[illegible]		[illegible]	42.62	F
[illegible]		[illegible]	42.62	F
Waynesville		WKVL	42.62	F
NORTH DAKOTA				
Bismarck Hq		KAZB	1674	A
OHIO				
[illegible]		[illegible]	39.1	AF
	1	WDCW	1730	A
[illegible]		[illegible]	39.1	F
	300	WDQR	39.78	F
[illegible]		[illegible]	39.1	F
Warren		[illegible]	39.1	F
Luray		[illegible]	39.1	F
Georgetown		[illegible]	39.1	F
Gallipolis		[illegible]	39.1	F
Portsmouth		WHNT	39.1	F
[illegible]		[illegible]	39.1	F
Defiance		WJAV	39.1	F
[illegible]		[illegible]	39.1	F
Mt. Vernon		WKFO	39.1	F
Mansfield		WLSV	39.1	F
[illegible]		[illegible]	39.1	F
[illegible]		[illegible]	39.1	F
Dayton		WODH	39.1	F
Perrysburg		[illegible]	39.1	F
Salem		[illegible]	39.1	F
Marion		WOGN	39.1	F
Bellevue		[illegible]	39.1	F
Middleton		WOUB	39.1	F
[illegible]		[illegible]	39.1	F
Athens		WOZY	39.1	F
Van Wert		WPEE	39.1	F
Findlay		[illegible]	39.1	AF
Columbus		WPGO	39.1	AF
Massillon		[illegible]	39.1	AF
Wilmington		WPHK	39.1	AF
Cambridge		[illegible]	39.1	AF
Bellefontaine		WPIJ	39.1	F
[illegible]		[illegible]	39.1	F
Medina		WWCI	39.1	F
[illegible]		[illegible]	39.1	F
New Philadelphia		WWCK	39.1	F
Chillicothe		[illegible]	39.1	F
Steubenville		WWCM	39.1	F
[illegible]		[illegible]	39.1	F
OKLAHOMA				
Oklahoma City Hq		[illegible]	1626	A
[illegible]		[illegible]	1626	A
[illegible]		[illegible]	35.78	AF
Pawnee		[illegible]	1626	A
Claremore		KOSU	1626	A
McAlester		[illegible]	1626	A
Clinton		KOSX	1626	A
[illegible]		[illegible]	1626	A
Coalgate		[illegible]	1626	A
[illegible]		[illegible]	1626	A
OREGON				
Salem Hq		KOHS	1706	A
	14	KOHS	1706	A
	1	KOHH	1706	A
	1	KOHF	1706	A
	1	KOHT	1706	A
	1	KOHV	1706	A
	1	KOHW	1706	A
	1	KOHX	1706	A
	1	KOHZ	1706	A
	10	KQZH	30.98	A
	7	KOHQ	1706	A
	14	KOHS	1706	A
Astoria		KOHA	1706	A
Baker		KOHB	1706	A
[illegible]		KOHC	1706	A
The Dalles		KOHD	1706	A
Eugene		KOHE	1706	A
Grants Pass		KOHG	1706	A
Gov. Camp		KOHI	1706	A
Santiam		KOHJ	1706	A
Klamath Falls		KOHK	1706	A
La Grande		KOHL	1706	A
Portland		KOHM	1706	A

DAYTON POLICE MOBILIZE FOR FAST ACTION

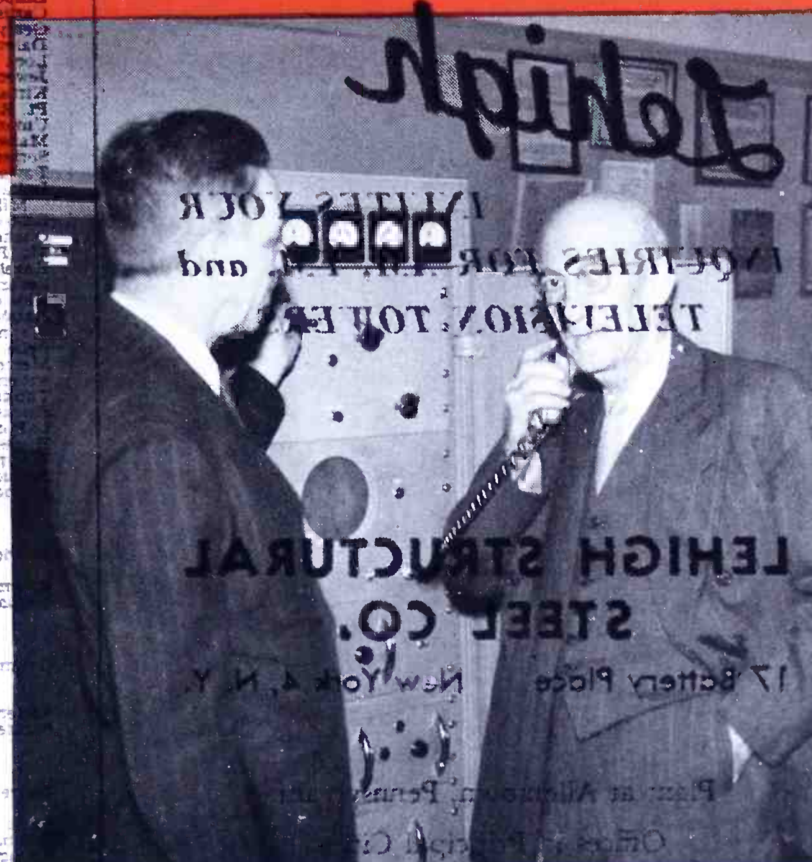
with Federal's Mobile Two-Way FM Radiotelephone

Complete new communication system operates at 156.33 megacycles

IN DAYTON, OHIO, the arm of the law is longer and stronger than ever before . . . with Federal's Mobile FM Police Radio Equipment. By changing their old AM system to FM by Federal, the Dayton police department now gets finer static-free operation, greater transmitting power in the mobile units, more sensitive reception—which adds up to better coordination, faster action in emergencies!

This police radio system—one of the largest in the midwest—is in continual operation, 24 hours a day. Federal equipment was selected for this important job, after more than a year of thorough investigation and testing. The initial installation includes a 250-watt transmitter and 48 mobile units.

To find out why Federal's Mobile FM Radiotelephone Equipment is your best buy—for police and fire departments, taxis, buses, service cars—write today for complete information. Dept. I420.



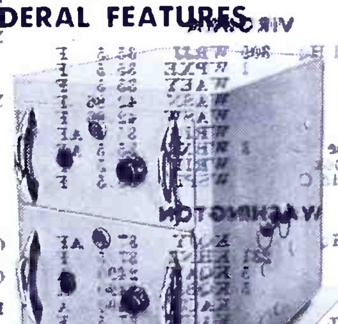
City Sup't. of Signals, Perry Benton (right) and L. J. Boss, Federal's mobile equipment sales manager, test the 250-watt transmitter installed at Dayton's police signal office.

Mr. Benton operates the Federal mobile unit installed in a patrol car. Clear reception up to 35 miles from the station is obtained.

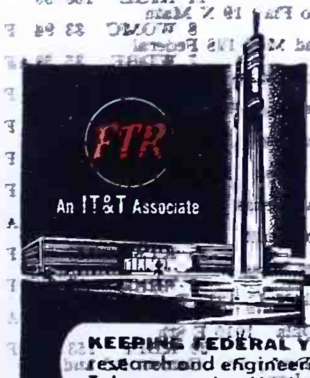
And here he shows how the compact transmitter and receiver units slide in and out like a desk drawer—can be replaced in a matter of minutes!

OUTSTANDING FEDERAL FEATURES

- **Selective Calling**
- **Low Current Drain**
- **Small Size**
- **Interchangeable Units**
- **Low Maintenance Costs**



The complete mobile transmitter-receiver is only 11¾ inches high—leaves plenty of room in any luggage compartment. Also available in a horizontal design, with side-by-side units.



Federal Telephone and Radio Corporation

KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

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

STATE POLICE — FIRE

Bend	OH0KN	176	A
John Day	KOHO	1706	A
Pendleton	KOHP	1706	A
Medford	KOHQ	1706	A
Salem	KOHS	1706	A
Burns	KOHU	1706	A
Odell Lake	KOHY	1706	A

PENNSYLVANIA

Harrisburg Hq	WNTD	42.62	F
	WPSP	42.62	AF
	WPVW	42.62	F
1	WAMF	1674	A
18	WPAZ	33.94	F
1	WSVR	1674	A
Willow Hill C	WBJL	37.5	A
Irwin	WBJM	37.5	A
New Stanton Int	WBJN	37.5	A
Donegal Int	WBJO	37.5	A
Somerset	WBJP	37.5	A
Somerset Maint. Shed	WBJQ	37.5	A
Kegg Maint. Shed	WBJR	37.5	A
Everett	WBJS	37.5	A
Newville	WBJT	37.5	A
Bedford	WBJU	37.5	A
	WNSH	42.62	F
Breezewood	WBJV	37.5	A
Ft. Littleton	WBJX	37.5	A
Blue Mt. Int	WBJY	37.5	A
Carlisle	WBJZ	37.5	A
Lebannon	WDLL	42.62	F
Unity Twp	WHNI	42.62	F
Reading	WKPP	42.62	F
Lancaster	WNRZ	42.62	F
Bethlehem	WNSA	42.62	F
Carbondale	WNSG	42.62	F
Punxsutawney	WNSI	42.62	F
Chamberburgh	WNSL	42.62	F
Warren	WNSY	42.62	F
Sunbury	WNTA	42.62	F
Washington	WNTE	42.62	F
Pt. Pleasant Gap	WNTF	42.62	F
Altoona	WNTK	42.62	F
Philadelphia	WNTN	42.62	F
Montoursville	WNTZ	42.62	F
Windsor Twp	WOVK	42.62	F
Milford	WOVM	42.62	F
Pine Grove	WOVS	42.62	F
Wyoming	WPAJ	42.62	F
Clearfield	WPJR	42.62	F
New Milford	WPJT	42.62	F
Ebensburg	WPJX	42.62	F
Meadville	WPKP	42.62	F
Tamaqua	WPKX	42.62	F
Clarion	WPLR	42.62	F
Corry	WPLS	42.62	F
Indiana	WPML	42.62	F
Franklin	WPMU	42.62	F
Huntington	WPMW	42.62	F
Erie	WPNA	42.62	F
McConnellsburg	WPNT	42.62	F
Ridgway	WPNU	42.62	F
Lewiston	WPNX	42.62	F
Imperial	WPOA	42.62	F
Coatesville	WPQE	42.62	F
Butler	WPVK	42.62	F
Lykens	WQSA	42.62	F
York	WQSB	42.62	F
Bloomsburg	WQSC	42.62	F
Coudersport	WQSD	42.62	F
Emporium	WQSE	42.62	F
Carlisle	WQSF	42.62	F
Gettysburg	WQSG	42.62	F
Daleville	WQSH	42.62	F
Lock Haven	WQSI	42.62	F
Jewett	WTIQ	42.62	F
Kittanning	WTIX	42.62	F
Pt. Rochester	WTJJ	42.62	F
Uniontown	WTJP	42.62	F
Mansfield	WTJQ	42.62	F
Somerset	WTJZ	42.62	F
Towanda	WTKF	42.62	F
Indiantown Gap Mil. Res. C	WTKK	42.62	F
Easton	WTLT	42.62	F
Quakertown	WTLU	42.62	F
Mt. Pocono	WTNH	42.62	F
Hazelton	WTNL	42.62	F
Lehighton	WTNW	42.62	F
New Castle	WTPB	42.62	F
Pittsburgh	WTPI	42.62	F
Waynesburg	WTPJ	42.62	F
Belle Vernon	WTQB	42.62	F
Mercer	WTQT	42.62	F
Athens	WTQV	42.62	F
Tunkhannock	WTRL	42.62	F
Shickshinny	WTRO	42.62	F
LaPorte C	WTSS	42.62	F
Honesdale	WTTA	42.62	F
W. Springfield	WTTB	42.62	F
Stroudsburg	WTTC	42.62	F
Avondale	WTTD	42.62	F

RHODE ISLAND

Providence Hq	1	WRSW	1634	A
	50	WRSA	1624	A
Richmond		WKQI	42.63	F
Scituate		WRSA	1624	A

SOUTH CAROLINA

Columbia Hq		WKLD	42.1	F
	8	WCMU	42.1	F
	175	WKBY	42.1	F
Anderson		WKED	42.1	F
Sumter		WKLD	42.1	F

SOUTH DAKOTA

Pierre Hq		KSDP	39.1	F
	84	KSDK	39.1	F
Faith		KRBD	39.1	F
Kimball		KRBE	39.1	F
Arlington		KRBW	39.1	F
Gettysburg		KRCE	39.1	F
Parker		KSDA	39.1	F
Deadwood		KSDG	39.1	F
Huron		KSDH	39.1	F
Custer		KSDL	39.1	F
Webster		KSDW	39.1	F

TENNESSEE

Nashville Hq	85	WAMW	35.78	A
Jordonia		WBVM	1618	A
Memphis		WDBW	1618	A
Huntington		WEBD	1618	A
Kingsport		WEOM	1618	A
Chattanooga		WJBV	1618	A
Knoxville		WKVT	1618	A

TEXAS

Austin Hq		KTXA	1658	A
	1	KTXB	1658	A
	1	KTXH	1658	A
	1	KTXR	1658	A
	75	KRXJ	1658	A
Arlington		KTXF	1658	A
Houston		KTXU	1658	A

UTAH

Salt Lake City Hq		KUHP	1674	A
	4	KHQU	35.9	F
	3	KPRV	35.78	F
	53	KUHP	1674	A
	2	KUSH	35.78	F
	1	KBTS	1674	A
Provo		KPRV	35.78	A

VIRGINIA

Richmond Hq	309	WRJJ	35.5	F
	1	WPXE	35.5	F
Warwick		WAEY	35.5	F
Norton C		WASN	42.86	F
Culpeper		WASW	42.86	F
		WRIG	35.5	AF
Wytheville	3	WBXQ	35.5	AF
Appomattox		WRIF	35.5	F
Chesterfield C		WSPH	35.5	F

WASHINGTON

Tacoma Hq		KQJY	37.5	AF
	231	KHNZ	37.5	F
	5	KQAW	2490	A
	5	KQBX	2490	A
Okanogan		KACB	2490	A
Bellingham		KAUW	37.5	F
Colville		KAXV	2490	A
Kelso		KBKK	2490	A
Hoquiam		KBPY	37.5	F
Yakima		KCFH	37.5	F
		KNGB		
Everett		KFDG	37.5	AF
Olympia		KFPM	37.5	F
Mercer		KGHD	2490	A
Snoqualmie Pass		KGHE	37.5	AF
Shinook		KGHG	2490	A
Seattle		KKNK	37.5	F
Little Mountain		KLEZ	37.5	F
Chehalis		KLFE	37.5	F
Olympia		KNFG	2490	A
Bellington		KNFK	2490	A
Shiksan		KNFL	2490	A
Ellensburg		KNFX	37.5	F
Ilwaco		KNFY	2490	A
Lodge Pole Camp		KNFZ	2490	A
Goldendale		KNGA	2490	A
Vancouver		KNGC	37.5	AF
Walla Walla		KNGD	37.5	F
N. Wenatchee		KNGQ	37.5	F
Spokane		KNGR	2490	A
Ephrata		KNGZ	2490	A
Colfax		KQCS	2490	A
Mason City		KQDY	2490	A
Pasco		KQEK	2490	A
K-M Hill		KQGF	2490	A
Bremerton		KQZT	37.5	F
Port Angeles		KRGS	37.5	F
Raymond		KWSE	2490	A
Davenport		KWSE	2490	A

WEST VIRGINIA

Charleston Hq	81	WBSQ	39.9	F
	2	WRPC	39.9	AF
Beckley		WBSP	39.9	AF
Stollings		WDKE	39.9	F
		WSLT	39.9	F
Romney		WRMP	1626	A
Parkersburg		WSJA	39.9	F
Elkins		WSPL	39.9	AF
Morgantown		WSWO	39.9	F
Shinnston		WSWV	39.9	

WISCONSIN

Madison Hq	43	WDAU	31.5	AF
Delafield		WCJA	42.38	F
Hayward		WDAZ	42.38	F
Irma		WEBH	42.38	F
Sumpter		WIZR	31.5	A

WYOMING

Cheyenne Hq		KWHC	1642	A
	37	KWEL	42.70	F
Rock Springs		KWHA	1642	A
Rawlings		KWHD	1642	A
Sheridan		KWHE	1642	A
Casper		KWHG	1642	A
Lander		KWHG	1642	A
Basin		KWHH	1642	A
Laramie		KWHQ	1642	A

MUNICIPAL FIRE

Akron Ohio	158 S High			
	13	WMUI	35.58	F
Bakersfield Calif	2101 H St			
	20	KVWG	154.07	F
Berkeley Calif	City Hall			
	40	KWAD	154.19	F
Big Bear Lake Calif	Fire Sta			
	10	KTQM	154.19	A
Bernardsville N J	35 Hill St			
	10	WNQL	154.43	F
Boston Mass	Pemberton Sq			
	51	WEY	37.74	AF
Cleveland Ohio	721 Schaaf			
	26	WFDC	37.74	F
Columbus Ohio	2205 Karl Rd			
	2	WBFM	153.89	F
Martinez Calif				
	47	KXIZ	33.9	A
Denver Colo	9th & Columbine			
	40	KEWT	154.31	F
Detroit Mich	697 Macomb			
		WKDT	1630	A
Washington D C	4th & Douglas			
	32	WAKY	153.89	F
EauClair Wis	216 S Dewey			
	15	WECP	154.31	A
Hamilton Twp N J	State & Adela			
	3	WNWR	154.43	F
Haverhill Mass	17 Hamilton			
	10	WTYH	153.95	F
Honolulu T H	City Hall Bldg			
		KFJY	37.74	F
		KFJO	37.74	F
	50	KFJC	37.74	F
	1	KFJR	37.74	F
Jacksonville Fla	Signal Bureau			
	35	WBVR	154.31	F
Long Beach Calif	1417 Peterson			
	21	KCJA	37.74	A
San Pedro Calif	638 S Beacon			
	1	KCJB	35.58	F
Los Angeles Calif	14415 Sylvan			
	1	KCUG	35.58	F
	117	KCJE	35.58	F
	2228 W 6th			
	1	KCJD	35.58	F
Madison Wis	18 S Webster			
	14	WJVD	153.89	F
Miami Fla	Co Courthouse			
	35	WJRV	154.31	F
Minneapolis Minn	City Hall			
	47	KCNX	37.74	F
New Haven Conn	152 Court			
	14	WMUJ	35 58	AF
New Orleans La	Fireboat "Samson"			
	1	WSKK	1630	A
	2 Canal St			
	1	WSKW	154.25	F
New York N Y	Manhattan Fire Alarm			
Central Office				
	30	WNYF	37.74	A
	32-02 Queens Blvd			
		WNYF	1630	A
	Richmond Boro Hall			
	1	WHGH	35.58	A
	695 Park Ave			
	1	WNYQ	1630	
Oklahoma City Okla	428 W Calif			
	11	KIGE	153.89	
Orlando Fla	19 N Main			
	8	WOMC	33.94	F
Portland Me	118 Federal			
	7	WDBE	35.58	AF
Rehoboth Mass	Winthrop St			
	4	WTSG	154.43	F
Rockford Ill	Fire Dept Hdqs			
	15	WROF	154.19	F
San Francisco Calif	Turk & Octavia			
	32	KSFF	154.07	F
Seattle Wash	223 4th Ave N			
	40	KRMO	35.58	F
Sherman Texas	315–19 S. Travis			
	4	KQIS	33.5	A
Stockton Calif	City Hall			
	25	KTSH	153.83	F
Sudbury Mass				
	2	WDGI	37.74	F
Teaneck N J	1217 Teaneck Rd			
	8	WGVZ	35.58	A
Tulsa Okla	1010 E 8th			
	20	KBPF	153.89	F
Upper Darby Pa	Garrett Rd and			
Long Lane				
	4	WKBQ	72.9	F

(*Concluded on page 55*)

KAAR FIRST with INSTANT HEATING FM

in ALL THREE Mobile Bands!

- **30-44 MC BAND**
- **72-76 MC BAND**
- **152-162 MC BAND**

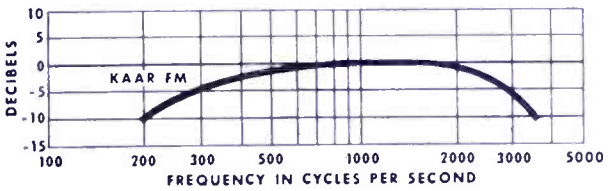
Kaar instant-heating mobile FM radiotelephones are now available in ALL THREE mobile bands! With Kaar instant-heating, the average power taken from the battery is cut approximately 90%, eliminating the need for special batteries or generators. Kaar 20, 50, and 100 Watt mobile radiotelephones powered by standard 6 volt vehicle batteries give you superior performance and more dependable service, at less cost.

Kaar precision engineering and expert craftsmanship have made possible amazing improvements in tone performance. All Kaar radiotelephones give you voice quality that actually permits recognition of a speaker's voice!

The rugged, compact Kaar radiotelephones are easily serviced or checked. A quarter turn of two airlock fasteners allows dust cover to be lifted off; the entire chassis may be removed by releasing two slide catches.

Write to Kaar Engineering Co., 603 Emerson Street, Palo Alto, California, for catalog describing the Kaar instant-heating radiotelephones and specify the equipment in which you are most interested. Write us today!

IMPROVED OVER-ALL FREQUENCY RESPONSE THROUGH KAAR FM TRANSMITTER AND RECEIVER



READY TO GO . . . INSTANTLY! KAAR

KAAR ENGINEERING CO. — KAAR ENGINEERING CO.

SPOT NEWS NOTES

(CONTINUED FROM PAGE 28)

the Philadelphia Arena, and will set up television studios at that location.

...peaking at the NAMM Chicago con... on June 4th, vice president Fr... Freima... pointed ... nov... set ... are ... prewar price... and th... expect-ed. A... hou... granted ...vox June 1st, puts workers' ...roximately twice the 1941

...e Talent FM: Some FM stations complain that local live talent is impossible to get, but WFAH-FM Alliance, Ohio is featuring such shows in its newspaper advertising. Per... ... the fact that 36 advertisers have been signed for 52 weeks. Now lines are being laid to the Union College stadium in preparation for picking up college and high school football games. Present 8-hour schedule will be expanded soon to 11 hours.

FMA Region 2: Officers elected at Cincinnati: ... G. Taft, WCTS Cincinnati; secretary, Paul E. Wagner, WCSI Columbus, Ind.; vice chairman, Robert F. Wolfe, WFRD-FM Fremont, for Ohio; E. J. Hodel, WCFC Beckley, for West Virginia; Foster Fudge, Crawfordsville, for Indiana.

WFRS-FM: Grand Rapids FM station, owned by four World War II veterans, has upped its power to 10.5 kw. This is now the most powerful FM station in Michigan, according to treasurer Donald H. Foster, who adds the information that WFRS is operating in the black. Schedule is 8:00 ... to 11:00 ... seven days a week. Programs have included Mutual's ... shows. Staff includes president Gordon Thorpe, program director Robert Epstein, manager Gerald Loop.

Television by Coaxial Cable: Release of proposed rates on AT & T's coaxial lines for tele-... ...work ...com- ... use ... and ...d be ...thly ...little ...base ... are ...rminal ...pment ...al. It is quite possi-... ...ays, on which RCA and ... will prove less expensive.

... station, now using a Technology Instrument dynamic noise suppressor on transcriptions, is getting telephone calls from listeners who think that live-talent shows were mistakenly announced as being transcribed.

(CONCLUDED ON PAGE 50)

Ventnor N J New Haven and Winchester Sts

Worcester Mass
5 WQWV 35.58 F

FORESTRY

Except where noted otherwise, these stations are licensed to State Forestry and Conservation Departments

ALABAMA

1 WOLH 152.99 F
Brewton 1 WOLM 152.99 F
Chapman 1 WRBG 152.99 F
Hacoda 1 WEVD 152.99 F
Montgomery 1 WTTW 152.99 F
Stapleton 343 WRXU 152.99 F
Vredenburg 1 WOMF 152.99 F

ARKANSAS

28 KSWP 31.94 F
Dierks 1 KQHK 37.66 A
Fordyce 1 KSWE 31.94 F
Hampton 1 KSWF 31.94 F
Hot Springs 1 KSWD
Malvern 1 KSWO 31.94 F

17 additional AM mobile units, operating on 37.66 mc. are licensed with individual call letters.

CALIFORNIA

158 KAGI 35.94 AF
1 KHOS 2226 A
1 KRKM 2226 A
6 KQNJ 35.94 A
6 KRNL 31.34 A
3 KLYG 31.58 A
1 KQPV 2212 A
1 KQPU 2212 A
Alma 1 KRRG 2226 A
Auburn 1 KBWZ 2226 A
Bakersfield 2226 A
Camino 1 KRVO 2226 A
Carmel 1 KROJ 2226 A
Fortuna 2226 A
Hollister 1 KSNH 2226 A
King City 1 KBIQ 2226 A
18 KFRW 2212 A
La Mesa 2226 A
Los Angeles 1 KQXB 2212 A
Madera 1 KGMI 2244 A
Mariposa 1 KRWY 2226 A
Ukiah
Howard Forest Forestry Sta
Nevada City 2226 A
Newhall 1 KRJO 2212 A
Oroville 1 KBGK 2226 A
Perris 1 KAIV 2226 A
Redding 2244 A
1 KRRE 2226 A
Sacramento
San Andreas 1 KBGN 2226 A
San Luis Obispo 2244 A
1 KBBF 2226 A
San Bernardino
Santa Rosa KBJX
1 KBXR
Sonora 1 KBCM 2226 A
Susanville
Twenty-Nine Palms
Visalia 1 KRDS 2244 A
Yreka 1 KBGL 2226 A
Yucca

CONNECTICUT

25 WJOQ 35.74 A
Glastonbury
Norwich 2 WBSO 35.74 A
Sterling
Storrs 3 WROZ 35.74 A

DELAWARE

1 WAPL 37.66 A
1 WAPM 37.66 A
1 WHNU 37.66 A
1 WHNV 37.66 A
1 WHNW 37.66 A

FLORIDA

33 WAWP 153.63 AF
1 WBUQ 2226 A
1 WBWO 35.94 A
1 WBWP 35.94 A
1 WBWQ 35.94 A
1 WBWR 35.94 A
Lake City 2226 A
Munson 1 WNWY 2212 A
Panama City 1 WSTD 2226 A
Port St Joe 1 WSRM 2226 A
Secotan 1 WGWW 2226 A
Shamrock 1 WAGI 2226 A
Valrico 1 WRQO 2226 A

GEORGIA

17 WQWZ 2226 A
Brunswick 1 WGSF 2226 A
Colquitt
Macon 1 WNES 2226 A
Townsend Co. 15 WEGK 2226 A

IDAHO

10 KRFO 2212 A
Coeur d'Alene
Elk River 1 KRFW 3312 A
McCall
Orofino 1 KRFP 2212 A

LOUISIANA

1 KBTI 39.94 F
27 KBTK 39.94 F
Franklinton 39.94 F
Hammond 1 KBRK 39.94 F
Mandeville 39.94 F
Oberlin 1 KBRW 39.94 F
Pine Grove 1 KBSH 39.94 F
Robert 1 KBSS 39.94 F
Springfield 39.94 F

MAINE

4 WAQE 35.94 A

MARYLAND

Belair
Avalon
Brandywine
Church Creek
Cumberland
Dans Rock
Great Mills
Green Hill
High Knob
Hollofield
Laurel
Long Hill
Madonna
New Germany
Salisbury
Welcome
Woodlawn

MASSACHUSETTS

Acushnet
Andover
Billerica
Bourne
Boston
Brimfield
Buzzards Bay
Carver
Chester
Chelmsford
Falmouth
Foxboro
Fall River
Harvard
Holbrook
Manchester
Middleborough
N. Easton
N. Reading
Osterville
Palmer
Petersham
Plymouth
Princeton
Savoy
Sharon
Sterling
Stoughton
Stow
W. Wareham

3 WQWL 31.34
2 WAPE 31.34
1 WQYR 31.34
3 WSVG 31.34 F
7 WQYX 31.34 F
2 WBQY 31.34 F
1 WBQY 31.34 F
1 WQYU 31.34 F
1 WQYA 31.34
WTYG
1 WBKX 31.34 F
1 WMZI 31.34
1 WCXG 31.34 F
1 WQYS 31.34 F
3 WRGE 31.34 F

MICHIGAN

Atlanta
Baraga
Escanaba
Ewen
Marquette
Newberry
Roscommon
Sault Ste Marie

WBRD 35.74
WDAI 35.74
WSWB 35.74
WSWK 35.74
WRRC 35.74
WDAQ 35.74
WDSO 35.74
WBXA 35.74
35.74 A
35.74 A
35.74 A
35.74 A
35.74 A
35.74 A

35 additional AM mobile units, operating on 35.74 mc. are licensed with individual call letters.

MINNESOTA

AM mobile units, operating on 39.74 mc. are licensed with individual call letters.

MISSISSIPPI

54 WWBI
106 WCPY 39.74 F
Canton Central Fire
8 WIGF 37.66 F
1 WPMZ 39.74 F
Electric Mills Flintkote
1 WBGK 39.42 F
6 WBGP 39.42 F
Meridian Flintkote Co 1 WBGI 39.42 F

MISSOURI

21 31.34 F
39 KQGH 31.34 A
Camdenton
1 KOAQ 31.34 F
Eminence 1 KOAJ 31.34 F
1 KOAP 31.34 F
Sullivan 1 KSHG 31.34 F

NEW HAMPSHIRE

Concord
Franklin
Hampton
Loudon 1 WLOM 39.42 A
Manchester 1 WAYI 39.42 A
Nashua 1 WNWQ 39.42 A
Wolfeboro 1 WFZW 39.42 A

NEW JERSEY

33 WHCL 39.94 A
WQVN 39.74 A
39.74 A
39.74 A
39.42 A
39.74 A
39.74 A
37.46 A
35.74 A
39.94 A
McKeetown
Millville
Mizpah
Union Hill
Windbeam
39.94 A
35.94 A
39.74 A

NEW YORK

31.94 A
39.42 A

OHIO—NONE

OKLAHOMA

OREGON

284 KQSN 31.94 A
1 KQGO
1 KGLM
1 KQSD
1 KRNI 31.58 A
31.58 A
31.58 A
31.58 A
Klamath Falls 1 KOIB
La Grande 31.58 A
1 KRDP 31.94 A
Molalla
Monument 2236 A
Salem 1 KQHQ
Springfield 1 KQJS
1 KGLS 31.58 A
Sweet Home
Tillamook

PENNSYLVANIA

1 WJAB 35.74 A

RHODE ISLAND

Scituate 22 WAWR 35.94 A

SOUTH CAROLINA

75 WCNI 31.94 F
Bonneau 1 WJGI 31.94 F
Columbia 1 WCNA 30.94 F
1 WJHJ 31.94 F
Conway 1 WJGE 30.94 F
Georgetown 1 WJGS 31.94 F
Johns Island 1 WJGP 31.94 F
1 WJGO 30.94 F
1 WCNE 31.94 F
WGJC 31.94 F

SOUTH DAKOTA

Hermosa

TEXAS

43 KHTM 35.94 F
Cushing 1 KBWP 2226 A
Jefferson 1 KBWO 2226 A
1 KBXT 35.94 F
1 KHJF 2226 A
Newton 1 KBWK 2226 A
1 KBWR 2226 A

VIRGINIA—NONE

WASHINGTON

5 AM mobile units, operating on 31.94 mc. are licensed with individual call letters.

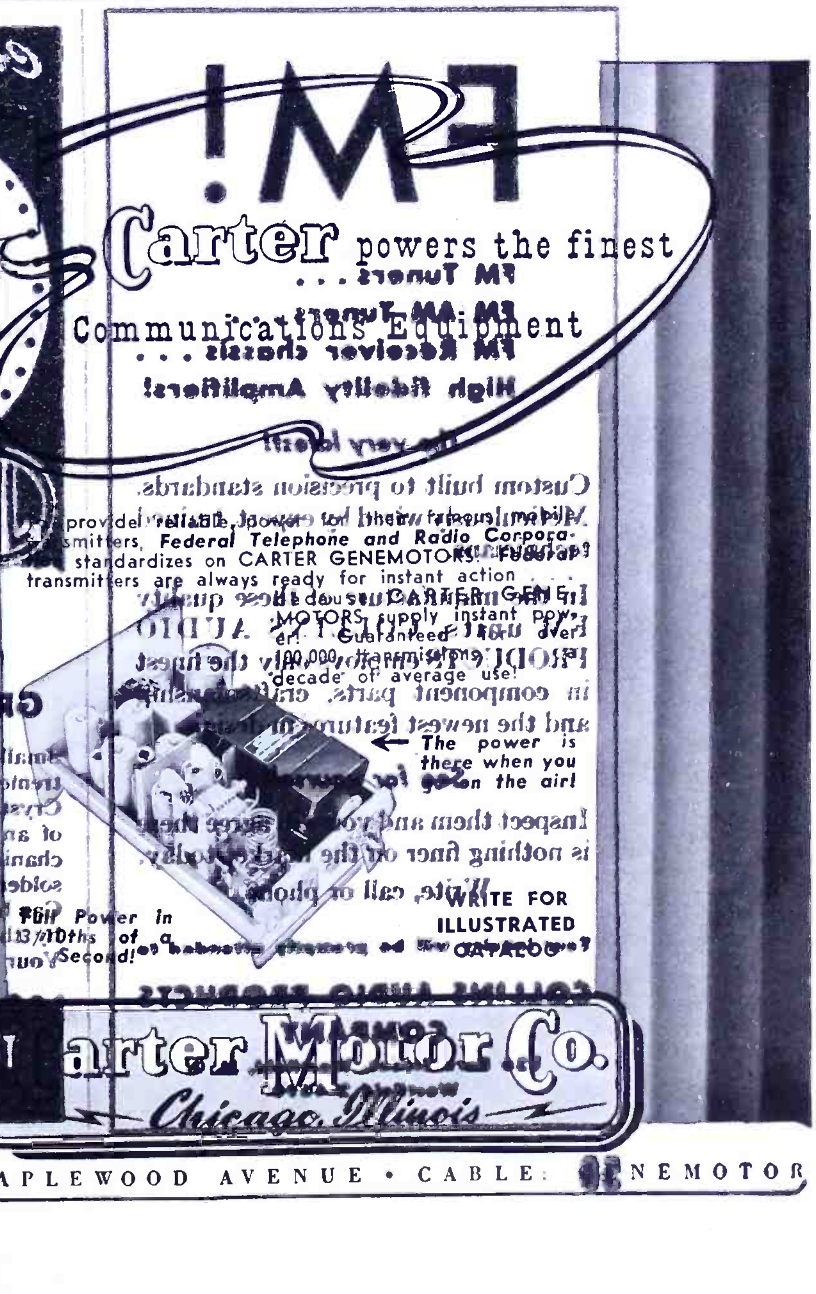
Castle Rock Weyerhaeuser Timber Co.
1 KWPF 31.34 A
16 KBTS 31.94 A
Olympia C
1 KGMD 2212 A

WEST VIRGINIA

42 WMGX 35.74 F
35.74 F
Charleston 1 WBLZ 35.74 F

WISCONSIN

letters.



SPOT NEWS NOTES

(CONTINUED FROM PAGE 54)

WNBW: NBC's television station at Washington, D. C. was formally launched on June 27th. It is located at the Wardman Park Hotel. Detailed information concerning the future operating schedule can be obtained from Jay Rogers, 724 Fourteenth Street NW.

APCO Conference: Will be held August 25 to 28 inclusive, at the Police Academy, Los Angeles. Information can be obtained from Lieut. W. H. Durham, Police Dept., Los Angeles 12.

Wisconsin: *The Milwaukee Journal* has purchased AM station WSAU, Wausau, and has taken over the C. P. already issued for WSAU-FM. In addition *The Journal* has a C. P. for an FM station at Green Bay.

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

2. *Retailing Home Furnishings* for June 23rd reported Philco's promotion of their model 1000 television receiver as "considerably below expectations, according to the majority of dealers and department stores in this (Philadelphia) area."

Further: " 'We've had very little response', one department store spokesman observed, 'but it's a bad time for any promotion right now, and I doubt whether anything would draw.' "

Anything? A bad time? What's bad about it? Was that department store spokesman talking about his current mental state, or about conditions that affect results from aggressive merchandising?

On June 20th, 3 days before the report above was published, the *New York World-Telegram* offered this factual information:

"It's a reassuring thought that the cost of living isn't the only thing that's high just now. Among yesterday's news items we found:

"The United States Bureau of Labor Statistics reported that employment by business and industry stood firm at record levels in May. Forty-two million wage and salary earners had non-farm jobs. (Total civilian employment last month, including agricultural workers and self-employed persons, reached an all-time peak of 58,330,000, according to the Census Bureau.)

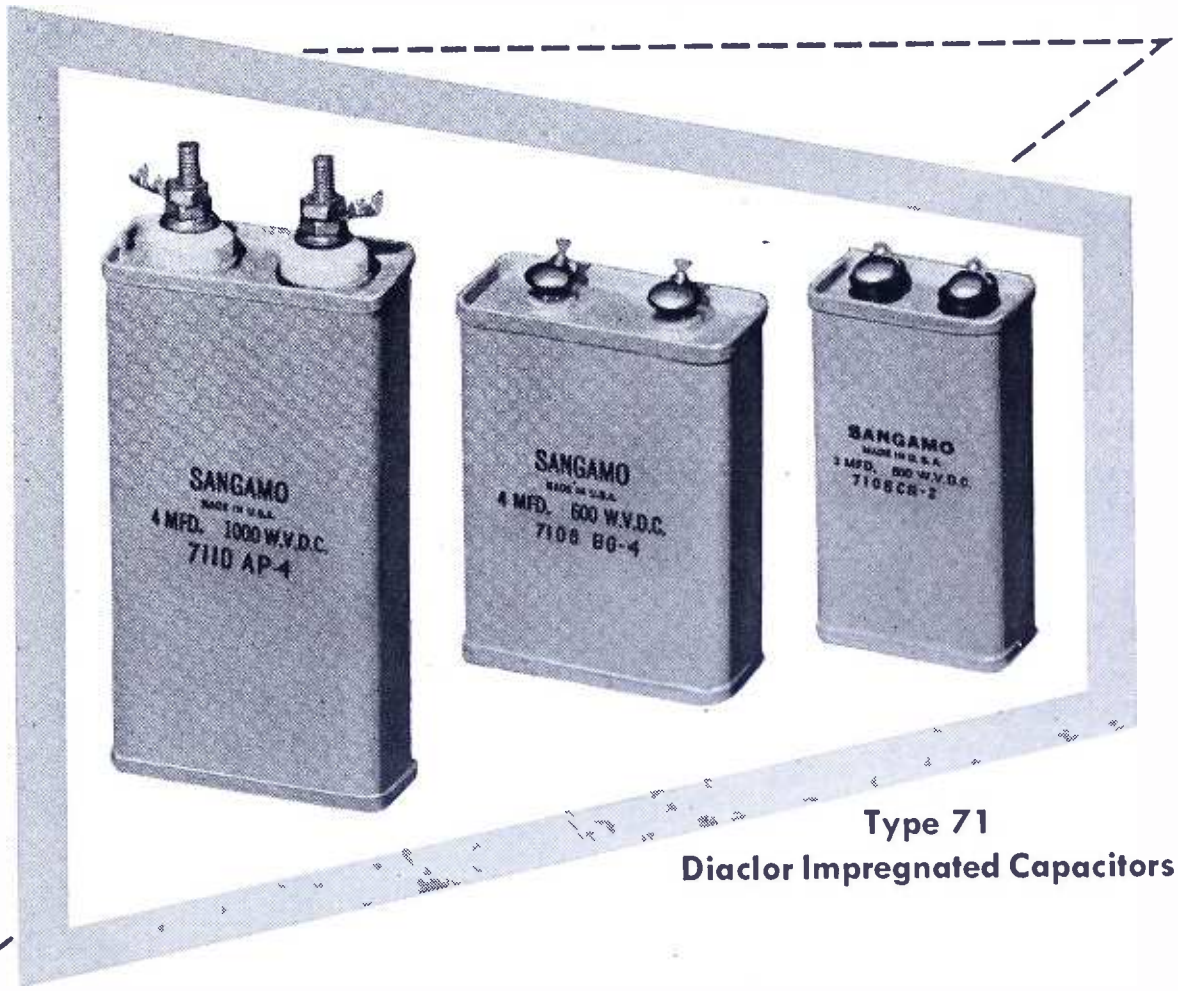
"The Labor Statistics Bureau also said that May's average weekly earnings by persons employed in manufacturing industries set a new record — $48.86, compared with $47.50 in April. This in spite of the fact that the average manufacturing work week was down to 40 hours and 12 minutes — six or seven hours less than in wartime.

"And the Institute of Life Insurance

(CONCLUDED ON PAGE 58)

SANGAMO

CAPACITORS
PAPER
MICA • SILVER



Type 71
Diaclor Impregnated Capacitors

CREDENTIALS *that* QUALIFY

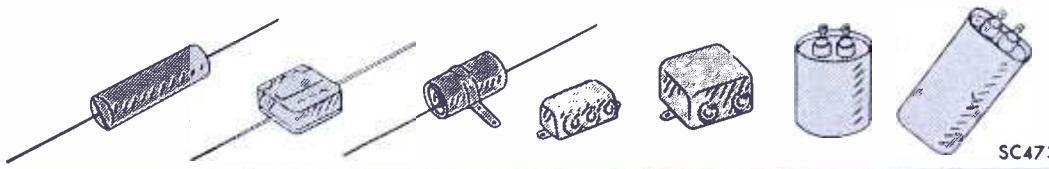
• Diaclor Impregnated to Assure Greater Uniformity of Production • Stable Capacity Over a Wide Range of Temperatures • Excellent By-Pass and Coupling Qualities • Available Within a Range of 600 to 6000 Volts Working, or Higher . . . these are the credentials that qualify Sangamo Type 71 Diaclor Impregnated Capacitors as Blue-Ribbon entries for broadcast and aircraft transmitters, industrial applications, and in high-voltage circuits of all kinds.

Diaclor, the chlorinated dielectric used by Sangamo, permits greater uniformity of production because of its controllable characteristics. *Smaller sized capacitors, for use where space is at a premium, are made possible because of its high dielectric constant.* Fire hazard due to accidental leakage is eliminated because Diaclor is non-inflammable and non-explosive.

Type 71 capacitors have high insulation resistance and low direct current leakage. They can be supplied with either composition rivet, screw type, hermetically-sealed pyrex glass or stand-off porcelain terminals, and with your choice of four types of mounting brackets. They are available in a wide range of capacities.

Sangamo manufactures a complete line of paper, mica, and silver capacitors for every radio and electronic application. A quarter of a century of experience in building better capacitors, with new and more exacting requirements and greater accuracy demanded each year, give Sangamo capacitors—of all kinds—Credentials that Qualify!

Write for the new Sangamo Capacitor Catalog.



SC473

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD · ILLINOIS

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 56)

reported that long-term savings of individuals in the first three months of 1947 increased about 3 billion dollars to an all-time high of 154.6 billion dollars. That means money in savings accounts, savings bonds, life insurance, and savings-and-loan associations. Long term savings have almost exactly doubled since 1942.

"These reports seem to us to justify a fairly high degree of optimism among the American people. They certainly don't indicate any early arrival for that over-advertised 'recession'."

We don't propose to tell any department store executive how to run his business, but we do know from personal experience that all retailers had a 5-year field day of effortless order-taking, when they had people fighting for merchandise so inferior in quality that, before the war, they wouldn't have bought it at a fire sale.

We said last March (page 53): "9 out of every 10 dealers and servicemen are so thick and dumb that they'll starve to death before they will exert any more mental energy than is required to sell and service cheap AM table models."

From what we have observed in department and furniture stores, the same ratio applies there, too. It's hardly fair to expect men who, in private life, scarcely think beyond getting their shoes off at night to exhibit, during working hours, the intellectual capacity required to sell television and FM sets, even when employment, income, and savings accounts are at an all-time high. Sears Roebuck employs college graduates in their retail stores. We think radio selling calls for a higher intellectual level than is represented in the average radio store or radio department. — *Milton B. Sleeper*

MORE FM CHANNELS

(CONTINUED FROM PAGE 37)

IND. Evansville 1, Indianapolis 1
IA. Des Moines 1
KANS. Wichita 1
KY. Louisville 1
LA. New Orleans 1, Shreveport 1
MD. Baltimore 1
MASS. Boston 2, Holyoke 1
MICH. Detroit 2, Grand Rapids 1
MINN. Minneapolis 1
MISS. Jackson 1
MO. Kansas City 1, St. Louis 2, Springfield 1
NEBR. Omaha 1
N. Y. Albany 2, Buffalo 2, New York 4, Rochester 1, Syracuse 1
N. C. Raleigh 1
OHIO Cincinnati 1, Cleveland 1, Columbus 1, Dayton 1
OKLA. Oklahoma City 1, Tulsa 1
ORE. Portland 1
PENN. Harrisburg 1, Philadelphia 2, Pittsburgh 1, Scranton 1, Sharon 1
R. I. Providence 1
TENN. Chattanooga 1, Knoxville 1, Memphis 1, Nashville 1
TEX. Brownsville 1, Corpus Christi 1, Dallas 1, Ft. Worth 1, Houston 1, San Antonio 1
UTAH Salt Lake City 2
VA. Norfolk 1, Richmond 1
WASH. Seattle 2, Spokane 1, Tacoma 1
W. Va. Charleston 1, Clarksburg 1, Huntington 1
WIS. Milwaukee 2

TELEVISION FREQUENCIES

(CONTINUED FROM PAGE 37)

long-range transmissions on channels between 44 and 100 mc. and we know that television is at least 100 times as vulnerable to interference as FM. Consequently, it is certain that there will be interference between stations on the same channel in Chicago, St. Louis, and Detroit, for example, and that the same thing will happen throughout the country."

Commander McDonald also quoted the FCC's comment on the allocations plan released May 17, 1945, in which it was stated that: "the Commission is still of the opinion that there is insufficient spectrum space available below 300 megacycles to make possible a truly nationwide and competitive television system. Such a system, if it is to be developed,

(CONCLUDED ON PAGE 59)

TELEVISION FREQUENCIES

(CONTINUED FROM PAGE 58)

must find its lodging higher up in the spectrum where more space exists and where color pictures and superior monochrome pictures can be developed through the use of wider channels."

It should be noted that this statement was issued while Paul Porter was Chairman of the FCC. The same opinion may or may not be held by Chairman Denny and the present Commissioners.

MAGNETRONS

(CONTINUED FROM PAGE 34)

story of wartime magnetron development. They filled an immediate need in the radar system for which they were designed, providing the U. S. Navy with a radar set which saw service in a number of crucial engagements. Furthermore, the development of the 700A-D magnetrons provided invaluable experience.

13.2 *The 728A-J Magnetrons:* The 728A-J magnetrons were developed for fire control and search radar systems to supersede those which had used the 700A-D magnetrons. In these new systems a magnetron generator was to be required which could deliver 200 kw. peak output power in the frequency range of 920 to 970 mc., later extended to 900 mc.

In an early design, the resonator system had eight resonators and was strapped with wire straps in the early British configuration, see Fig. 24(a) of Part 1. The anode length was 4 cm., the same as was used in the 700 A-D, which on a wavelength basis was about ⅔ that used in the British 10-cm. magnetron. The first models were designed for operation at pulse voltages of about 27 kv. When, subsequently, it was decided to reduce this voltage, a redesign involving a reduction of size of the interaction space became necessary. Since more had been learned about the technique of strapping in the meantime, it was decided that straps of the double ring type, Fig. 24(d) of Part 1, should be used in the new design. At first, the straps were set on the ends of the anode structure projecting into the end spaces, but were later recessed into channels cut into the copper resonator structure for the purpose of electrostatic shielding from electrons in the interaction region. The frequency range required was spanned by the use of anode structures having three different slot widths for the primary frequency separation, small additional frequency shifts being obtained by slight distortions of the straps. Resonant frequencies of magnetron resonator systems were now being determined prior to sealing for pumping by measurements like those described in Part 1, during which any necessary strap adjustment could be made.

The cathode was a plain, oxide-coated, nickel cylinder much like that used in the 700A-D magnetrons. The heater inductance was considerably higher than that of any previous cathode assembly. It was found that sudden and severe transient conditions, such as those imposed by a momentary internal arc between cathode and anode, would cause relatively high voltages to develop between the cathode and the open end of the heater. This could break down the heater insulation and cause either open or short circuits. The difficulty was minimized by incorporating in the driving equipment a condenser across the heater, and an RF choke in series with the heater. Before final design specifications were submitted, the input leads and cathode structure were completely redesigned to provide greater rigidity and strength. To withstand violent shock and vibration, the structure was designed to have as high frequencies of mechanical resonance as possible. The structure looked much like that to be seen in the 5J23 magnetron, Fig. 49. Direct mechanical injury to the input leads was prevented by the use of a heavy glass housing.

The output circuit in early experimental models was a coaxial type, fed by a loop in one of the resonators. The central conductor was a tungsten rod to which the glass seal was made and to which the inner conductor of the load coaxial was clamped. When the resonator system was

(CONTINUED ON PAGE 60)

MAGNETRONS

(CONTINUED FROM PAGE 59)

redesigned for lower voltage, a new design of output circuit was made, using a choke or contact-free load coupling like that designed for the 720A-E. This removed the possibility of stress being applied to the glass of the output seal at either the inner or outer conductors. Except for the critical dimensions determined by frequency, the output circuit is identical to that used on the 5J23 shown in the photograph of the cut-away model, Fig. 49.

Fig. 47 shows a schematic diagram of this type of coupling. On both inner and outer conductors an electrical short-circuit is produced at the gap between magnetron and load coaxials by folded, low-impedance coaxial sections incorporated into the bodies of the conductors. In the outer conductor, a half-wave section folded once is employed. In the section shown at (a), the joint is made at the current node in the choke section by the outer of two cylinders which project from the load end of the coupler into the magnetron lead. In the partial section shown at (b), this outer cylinder is not used, and the joint occurs at the end of the section where there is a current antinode. With this method there exists the greater possibility of sparking should the coupling not be clamped tightly. A folded quarter-wave section is built into the inner conductor. If the wavelength is short enough, as in the 5J26 and the 720A-E, Figs. 58 and 63, this section need not be folded; the inner post on the magnetron center conductor can be eliminated and replaced by a solid-center conductor on the load side. The more recent designs of magnetrons for wavelengths greater than 10 cm. have some form of this coupling.

The impedance required at the output coupling to load the 728A-J magnetron for sufficient power output necessitated a rather high standing-wave in the output line. This standing wave was provided by a transformer built into the radar system to which the magnetron was attached. No trouble was caused, since the output power was below the point where RF voltage breakdown in air in the line or coupling would occur. The press of time necessitated the adoption of this output circuit, although pre-plumbing, by incorporating inside the vacuum the necessary transformer action for coupling directly to a matched load line, would have been preferable. Such a design was executed, but its completion came too late for its incorporation into the manufacturing specifications.

Ten different magnetrons, coded the 728A-J, were put into manufacture. These covered the frequency range from 900 to 970 mc., a 7-mc. range being allotted to each code type. The operating characteristics of the final design together with

(CONCLUDED ON PAGE 61)

MAGNETRONS

(CONTINUED FROM PAGE 60)

other pertinent data are tabulated in TABLE I. An external view of the magnetron is shown in Fig. 48. A maximum current limitation for satisfactory operation in the π mode was also encountered in this magnetron, but at current values above the 20-ampere operating point at which the required output power was attained. Because of the shorter wavelength, the current limitation was not as severe as that encountered in the 700A-D.

The 728A-J magnetrons were driven by a spark wheel, line type modulator. The greater tendency of the driving voltage to overshoot with this modulator, by virtue of the slowness of buildup of RF oscillation, was reduced by the use of a series resistance and capacitance network coupled across the magnetron input like that used earlier with 720A-E magnetrons at 10 cm.

(To be continued)

FORESTRY SERVICE

(CONTINUED FROM PAGE 26)

frequencies on the order of 152 mc. Further, it is now clear that Forestry Conservation services can establish large statewide radio systems successfully in the 152- to 162-mc. band provided a coördinated channel-utilization plan is soon adopted throughout the nation.

Equipment presently designed and manufactured for service in this part of the radio spectrum appears to be stable and rugged. While unit packaging is still too bulky and awkward at this stage of development it is nevertheless adaptable to Forestry Conservation needs. Price conditions continue to hamper Forestry Conservation radio progress due to lack of sufficient funds for purchasing the required number of radio units to complete the desired radio systems.

Technical aspects of maintenance for 152- to 162-mc. equipment will most certainly require better test equipment and well qualified technical personnel.

An average two-way communication radius of 23 miles can be realized, utilizing land stations capable of delivering 15 or more watts power to a ground-plane antenna mounted several feet above a 100-ft. steel tower, where the antenna is fed with low-loss coaxial transmission lines having a minimum standing wave ratio at the frequency of 153.65 mc.

REPORT ON COMMUNICATIONS

(CONTINUED FROM PAGE 22)

There was some apprehension that equipment would take a beating at the hands of the drivers, but that has not proved to be the case. Rather, the drivers like to use the radio. In a number of instances, they have reported robberies and fires to their headquarters which, other-

(CONCLUDED ON PAGE 62)

REPORT ON COMMUNICATIONS

(CONTINUED FROM PAGE 61)

wise, would have been reported only after a considerable delay or not reported at all.

The only complaints have come from manufacturers who, in some instances, have had trouble collecting from the operators after the equipment was installed.

Urban & Highway Radio ★ The one thing certain about the future of urban and highway communications is that it will grow far beyond the most optimistic prediction anyone would dare to make today. Whether it will be handled entirely by the telephone companies or divided between them and various private operators is a matter for the future to determine.

AT & T is setting up fixed stations for urban service, and along principal highways, so that private cars, trucks, and buses can call or can be reached by any telephone subscriber. A selective-calling device in each mobile installation operates a signal when the fixed station dials the car's individual number. Until that number is dialed, the speaker is cut off. Thus the driver does not hear other conversation on the air.

Notable among the private operators is the Greyhound system. They are bringing buses into Chicago now by radio dispatching. Routing trucks and buses by 2-way radio is showing a substantial return on the investment in equipment, not only by increasing the pay load miles per hour but in better service. Thus, competition is extending the use of radio communications. It is generally agreed that the number of mobile installations for urban and highway operation will soon exceed the number used in any of the other mobile services.

Railroads ★ After many years of unsuccessful efforts to use low-frequency AM radio, the railroads are learning that FM in the 152- to 162-mc. band is practical and dependable in operation, and highly versatile in application.

Here, again, radio is winning friends among the operating personnel. They like to use it, it gives them a definite sense of added security, and they quickly develop the habit of depending upon it. So far, radio communications has been limited to the yards, but investigations are being extended, and another year will see the beginning of continuous operation between cities. In numbers of fixed and mobile installations, the railroads will probably be second only to the urban and highway service.

Relays ★ An increasingly important link in mobile installations is the microwave relay. Simple and inexpensive to install and maintain, these links can be used over distances of 20 to 30 miles as a substitute for wire lines. In addition, they are coming into use for remote signalling and control purposes.

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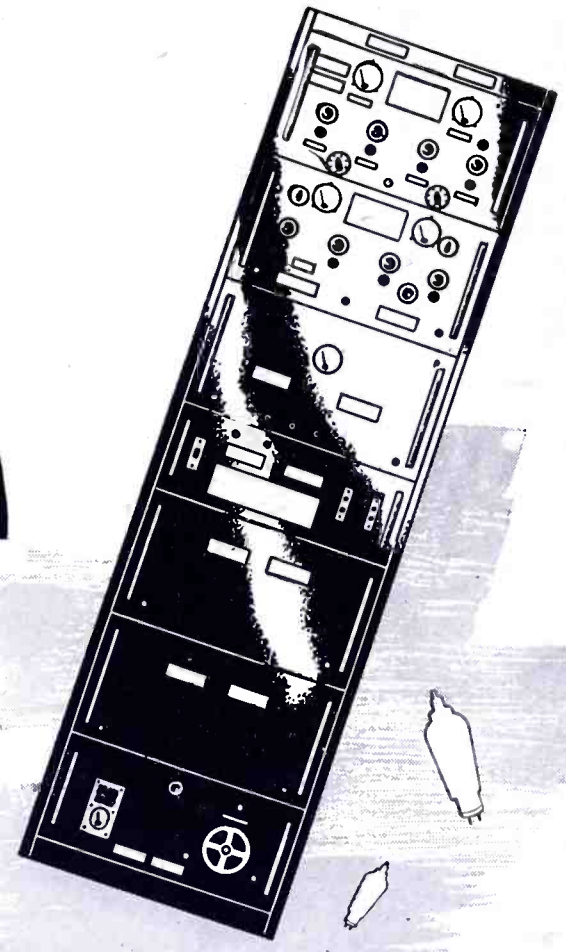

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76—9th Ave.
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Johanns & Keegan Co., Inc.
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242 W. 55th St.
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SALEM, MASS.
Hytron Radio & Electronics Corp.
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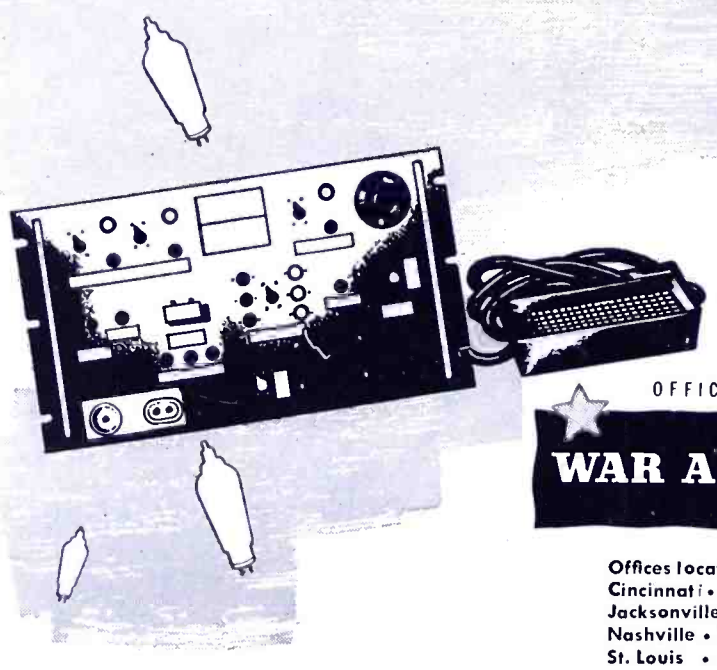
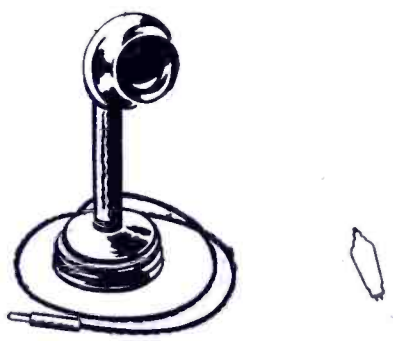
SCHENECTADY, N. Y.
General Electric Co.
Bldg. 267, 1 River Road

WASECA, MINN.
E. F. Johnson Co.
206—2nd Ave., S. W.





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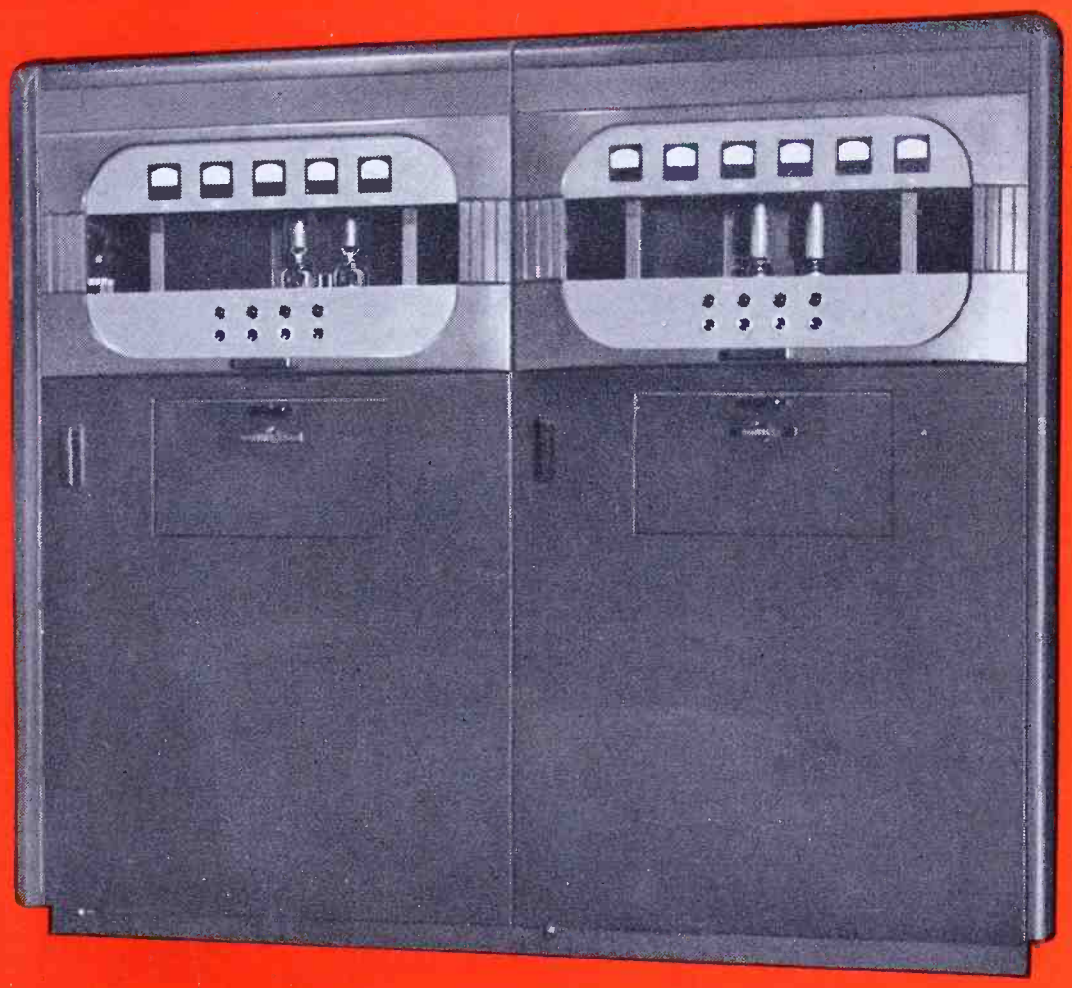

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Collins FM assures you of CONTINUED low cost operation

FEWER COMPONENTS . . . Collins FM transmitters are designed for the greatest possible economy *consistent with high performance and reliability*. Each stage performs its function completely and efficiently; thus the equipment requires a minimum of components. That's why there are only 26 tubes in the three kilowatt 733A, and only 10 tube types. Excluding power supply circuits, 9 of the 16 tubes used are of the receiving type. All tubes are operated well within their power ratings. The transmitting frequency is controlled directly by a quartz crystal, and no conversion or reference mechanisms are necessary.

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