FM AND TELEVISION

Price 25 Cents

July 1948

★ ★ *Edited by Milton B. Sleeper* ★ ★

COMMUNICATIONS DIRECTORY – Part 1

SYSTEMS OPERATED BY:

MUNICIPAL POLICE
COUNTY POLICE
STATE POLICE
FIRE
FORESTRY
RAILROADS

LISTINGS REVISED TO JULY 1, 1948

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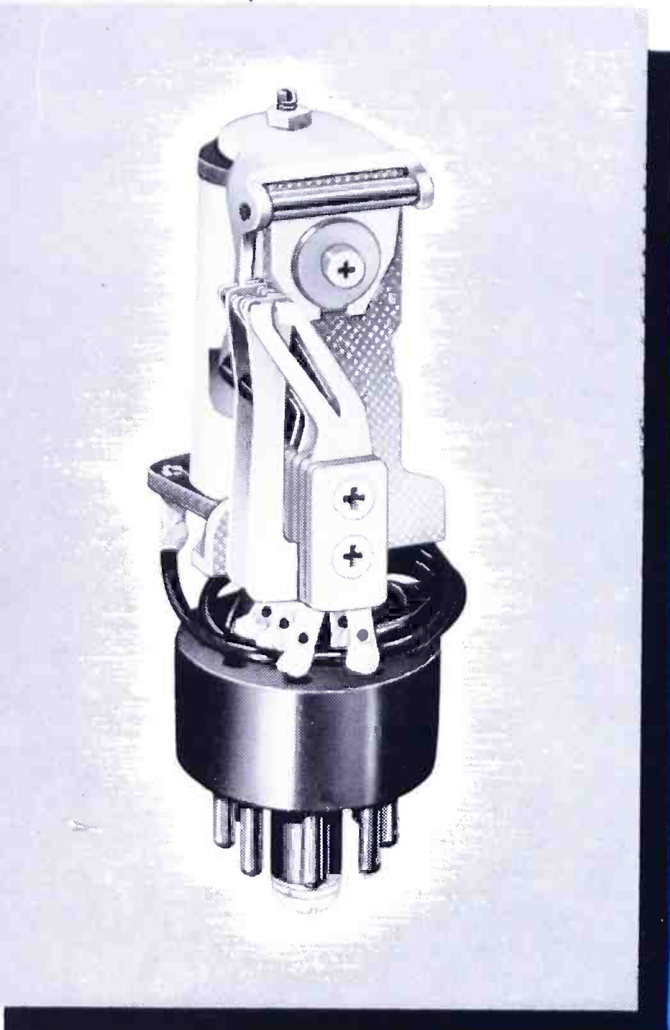
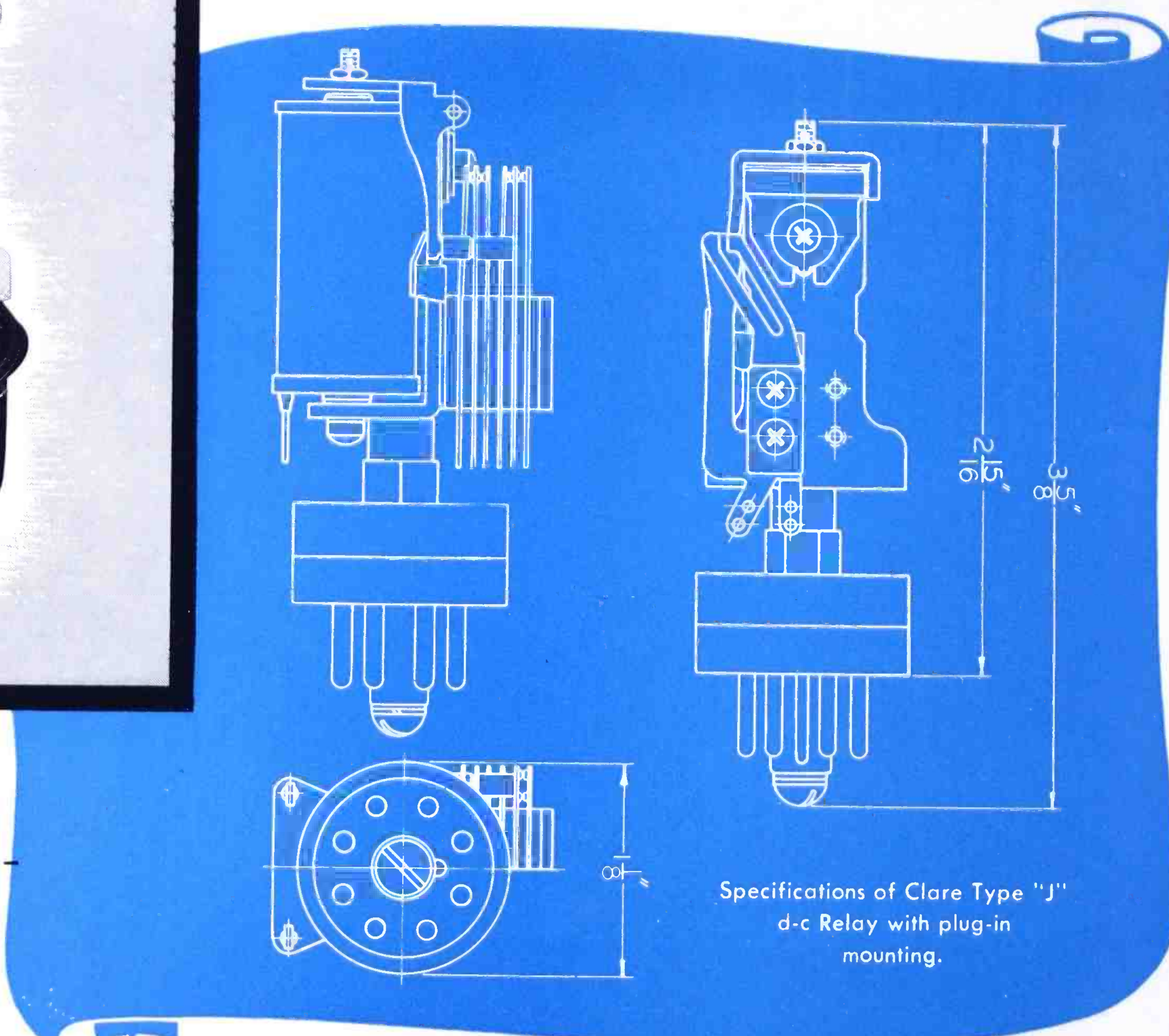
NOW... The CLARE Type "J" Relay can be Mounted as Conveniently as a Radio Tube!



Famous Clare Type "J" d-c Relay now available in plug-in type where quick removal or replacement is desirable



Specifications of Clare Type "J" d-c Relay with plug-in mounting.

Clare Type "J" d-c Relays combine the best features of the conventional telephone type relay with the small size and light weight which modern compact design requires.

Check these outstanding features of Clare Type "J" design which provide hitherto unheard of performance by a small relay:

- ★ **Independent Twin Contacts**
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- ★ **High Operating Speed**
- ★ **Large Contact Spring Pileups**

Clare sales engineers, with long experience in every type of relay problem, are located in principal cities. They will be glad to provide you with complete engineering data on the Clare Type "J" Relay, show you how it may be "custom-built" to meet your exact requirements.

Look for them under "Clare Relays" in your classified phone book . . . or write C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address CLARELAY.

CLARE RELAYS

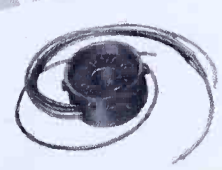
First in the Industrial Field

Over 10,000 different COMPONENTS FOR RADIO AND ELECTRONICS

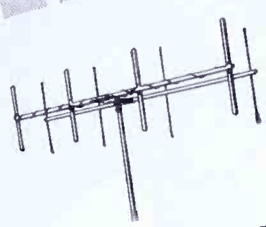
The quality and performance of Amphenol components have set standards for the radio and electronic industry for years. Specify Amphenol and be sure you get the best.

Reduce "down-time" . . . lower wiring costs . . . safeguard personnel with Amphenol Industrial Electron Tube Socket. A wide variety to fit your needs. Write for descriptive literature.

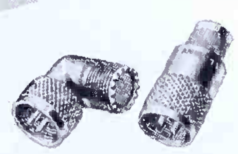
Low-loss Ampnenol Coaxial Cable and Twin-Lead remain flexible indefinitely. Low-loss properties make Amphenol Twin-Lead ideal for television and FM lead-ins and amateur antennas.



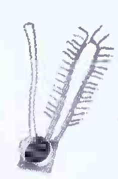
Compact, custom-wired Amphenol Television Tube Sockets are easy to wire and space-saving. They provide the quality short cut to mass production of television receivers.



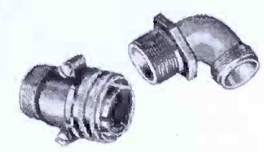
Antennas for many applications . . . railroads, police broadcast stations, truck dispatching, taxicabs, and home reception of TV and FM. Big features are beam control and virtual elimination of noise and interference thru complete scientific insulation.



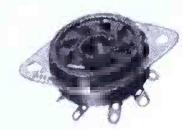
Amphenol RF Connectors provide a low-loss connecting link between coaxial cables. In each type, design and materials are carefully selected to meet your service requirements. All are rugged, compact and provide unsurpassed performance, convenience and dependability.



Amphenol Cable Assemblies, completely wired and assembled ready for installation are available from Amphenol. Enormous stocks of components at Amphenol insure quick delivery of your made-to-order cable assembly.



Amphenol makes thousands of different "AN" Connectors for the aircraft and electronics industries. They provide efficient and economical detachable connections in electrical circuits, insure easy servicing, installation, etc. Write for catalog.



Low-loss Amphenol Radio Sockets have been the standard in the radio industry for years. Manufactured to closest tolerances, they are easy to solder and grip tube pins firmly.

Write today for complete catalog covering your requirements . . .

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A-1—"AN" Connectors
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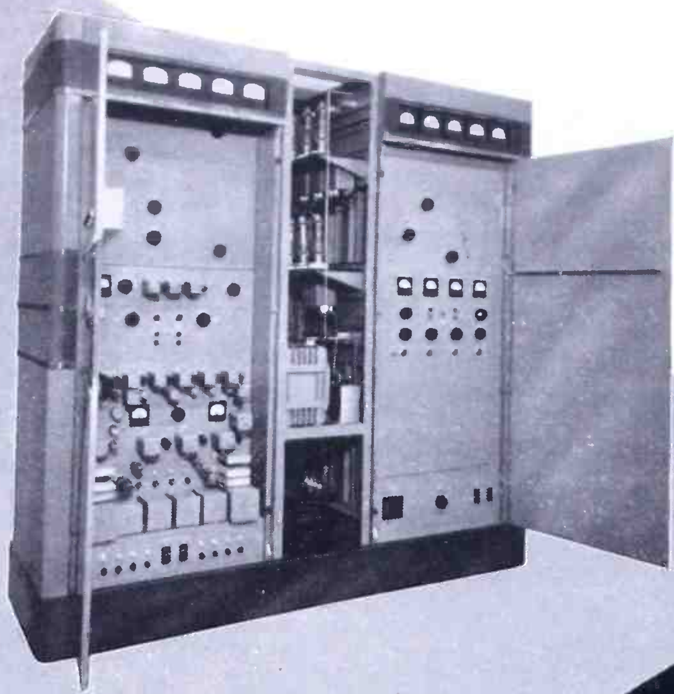

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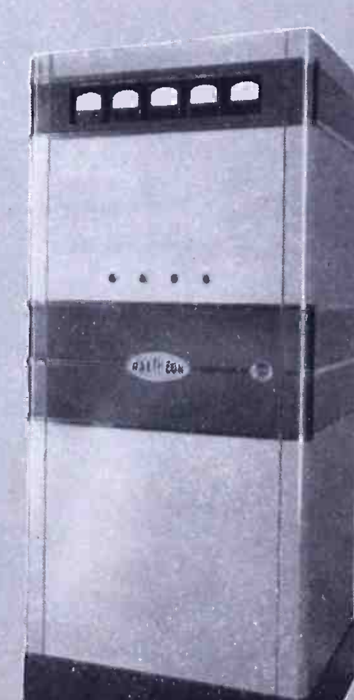
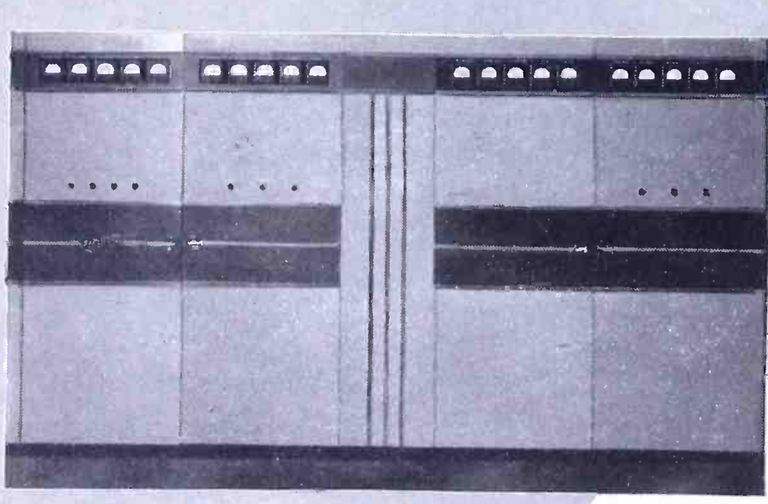


10 KW



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FM AND TELEVISION

★ ★ Edited by Milton B. Sleeper ★ ★

Formerly, FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 8 JULY, 1948 NO. 7

CONTENTS

MILTON B. SLEEPER, *Editor and Publisher*

CHARLES FOWLER, *Business Manager* RICHARD H. LEE, *Advertising Manager*
STELLA DUGGAN, *Production Manager* LILLIAN BENDROSS, *Circulation Manager*

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THIS MONTH'S COVER

As a time-saver, 2-way FM has probably reached its zenith in harbor tugboat service. And time is of the essence in a business that must measure minutes against changing winds, tides, ship movements, and competitors. In the past, communications between tugboats and the shore have been limited to the range of the human voice, aided by a megaphone. Once a tug pulled away from the dock office, it was more isolated than a liner in mid-ocean.

This month's cover shows one of the Lackawanna tugs in New York harbor, equipped with Bendix 2-way radiophone. Impressive results have been demonstrated already. We have an article in preparation now which will detail the advantages gained.

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

MEMBER, AUDIT BUREAU OF CIRCULATIONS ABC

WHAT'S NEW THIS MONTH

1. SET PRODUCTION
2. TV RECEIVING ANTENNAS
3. LONG-PLAYING RECORDS
4. FACSIMILE STANDARDS
5. RAILROAD RADIO FLOP

1. RMA figures, set forth in the Production Barometer, show the continued trend from AM to FM and TV home receivers. AM sets produced in the first five months of 1948 are nearly 1,200,000 below the same 1947 period, off 16%. Nevertheless, total 1948 set production is only 420,000 behind the first five months of 1947, because of the increased number of FM and TV sets.

During the rest of the summer AM sets will continue to set record postwar lows, for portables will drop off seasonably and, according to RMA export shipments are not expected to increase.

This month we have added a feature to the Barometer. Broadcasters and time buyers have been asking for information on the increased number of potential FM listeners resulting from the purchase of TV sets equipped with FM tuning. This is an important consideration, and it is not disclosed by the FM-AM receiver figures. A careful check indicates that something over 50% of the TV sets have FM tuning.

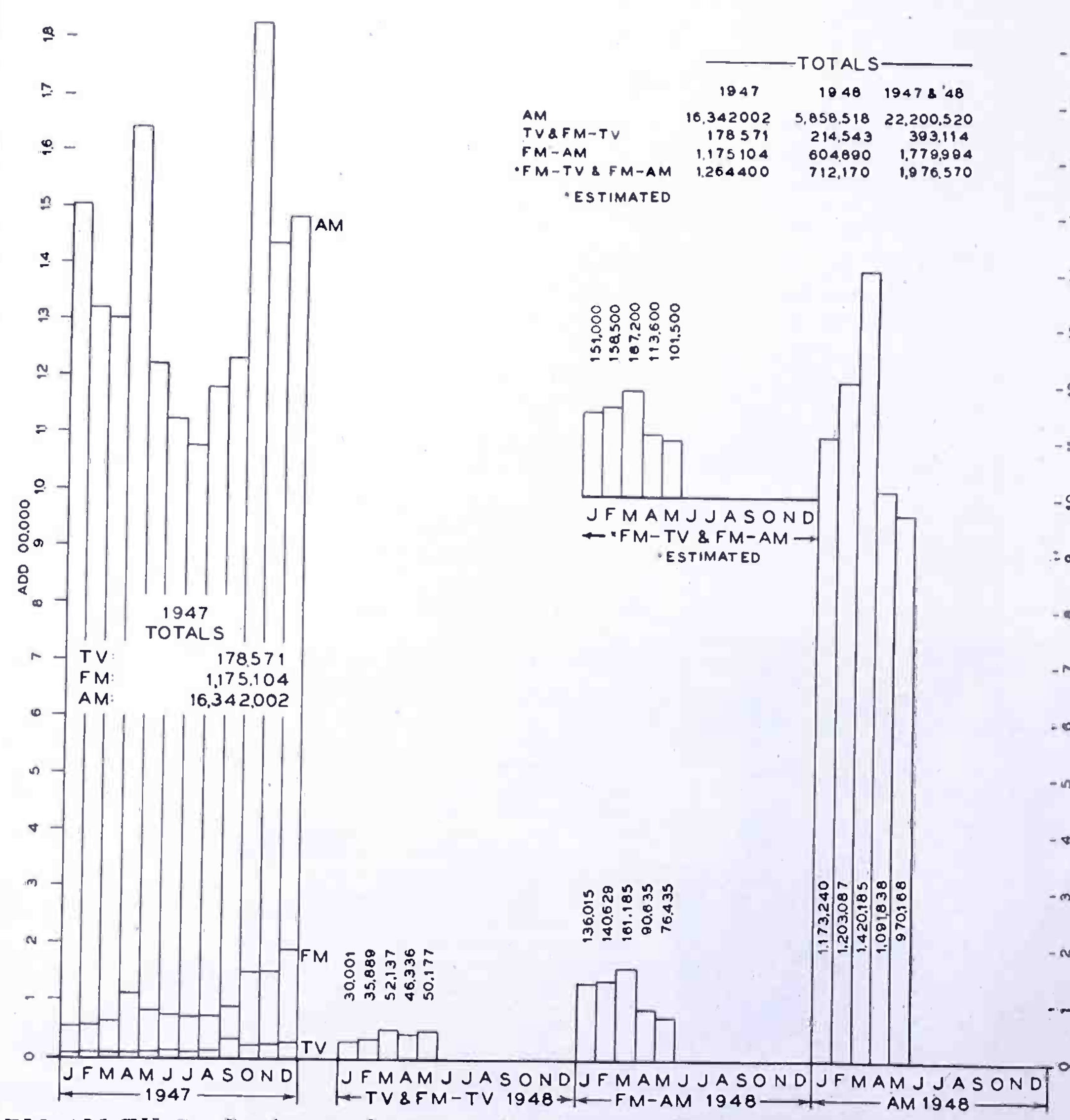
Thus, the blocks marked FM-TV & FM-AM show the estimated total number of sets capable of receiving FM broadcasting. This indicates that, since January 1,1947, almost 2,000,000 sets have been made with FM tuning.

Meanwhile, we have asked RMA if monthly TV figures can be broken down to show how many sets have TV only, and how many tune FM also.

2. If we claim experience in the matter of problems resulting from antennas used for home TV reception, it is because, during the prewar period of television, we were managing sales for Andrea Radio. In number of sets sold at that time, Andrea was probably second only to RCA.

It was with knowledge gained then that, during an FCC press conference on January 15,1945, we asked Commis-

(Continued on Page 12)



FM-AM-TV Set Production Barometer, based on monthly figures released by the RMA

TELENOTES

Fast Work:

Thirteen days after General Electric shipped the television transmitting equipment for WNAC-TV, the station was on the air with a test pattern. A TV installation usually takes thirty days, but this job was rushed to completion in order to transmit the programs from the Republican Convention.

TV from Mt. Wilson:

The first test-pattern transmission from Earle Anthony station KFI-TV, Los Angeles, started on June 21, using channel No. 9.

Stratovision Broadcasting:

An article of unusual interest, now in preparation for our August issue, will give a complete report on the Westinghouse-Martin Stratovision demonstration held on June 23. The discussion of this system will cover the problems of commercial operation.

More TV Sets:

Philco is preparing to step up present TV production of 4,000 sets per day to twice that rate by the end of this year.

WOR-TV New York:

New transmitter, scheduled to start on the air next fall, is being built on the Palisades in North Bergen, N. J., opposite 79th Street in New York City. Same tower will carry FM antenna.

Reallocations Plan:

Dr. Thomas T. Goldsmith, Jr., will present a plan of reallocations, worked out by Du Mont engineers, at the FCC hearings on TV frequency assignments. It is claimed that, under this plan, the addition of a few new channels will make possible substantially interference-free service in many cities from 1, 2, or 3 additional stations.

Channel Numbers:

FCC will make no change in the numbering of TV channels, even though channel No. 1 is to be occupied by mobile communications services.

Charles Curtin:

Former manager of Yankee Network station WMTV, Portland, Me., is now director of radio and television for John C. Dowd, Inc., Boston advertising agency.

Prediction on Production:

Ben Abrams, president of Emerson Radio, expects TV sets to account for 75% of dollar volume in 1949.

No. 1 of a series on the reproduction of music from FM and phonograph records

Realistic Reproduction ... A New Art and Science

THE DEMAND for *realism* in reproduced music is the highest today of any time since the inception of electrical amplification. Music-lovers and engineers alike realize that, for really high quality, the audio circuits are the most important part of the sound system.

The availability of high-grade tuners, particularly for FM, wide-range phonograph pickups, and loudspeakers has made readily apparent the many short-comings of the conventional audio system, particularly the problem of noise, formerly considered as an unavoidable accompaniment of wide-range reproduction.

Recordings are widely used as a source of home and broadcast programs alike. In fact, record sales have surpassed those of "the golden age of the phonograph." No ordinary circuits can separate phonograph surface noise or other audio noises from the music without serious sacrifice. (FM merely prevents the addition of noise in the radio transmission path.) The H. H. Scott DYNAMIC NOISE SUPPRESSOR,* which operates on the dynamic band-pass principle, has been proved both theoretically and practically to provide greater reduction of noise with less effect upon tonal range than any other known method of audio-frequency noise reduction.

Some twenty months since the initial announcement of the DYNAMIC NOISE SUPPRESSOR * have seen a revolutionary change in the entire radio industry. The majority of highest-quality radio-phonographs are factory-equipped with special DYNAMIC NOISE SUPPRESSORS * engineered into the chassis, while in the high-grade amplifier field any non-suppressing amplifier is obsolete. Of the custom installations featured in a recent magazine article, 50% included amplifiers built by DYNAMIC NOISE SUPPRESSOR * licensees. The recorded programs of hundreds of broadcasting stations, both network and independent, are now improved by the use of DYNAMIC NOISE SUPPRESSORS.* These include those stations most famous for the quality of their recorded programs. Perhaps the sincerest flattery is offered by those manufacturers of lower-priced equipment who advertise devices claimed to reduce noise in an obvious attempt to capitalize on the tremendous public acceptance of the DYNAMIC NOISE SUPPRESSOR.*

When combined with the latest techniques for reducing audio-circuit distortion, the dynamic band-pass system gives breath-taking realism. Commercial models are available for broadcast station and home use, as well as featured in the finest radio-phonographs.

An outstanding example is the Type 210-A Amplifier, a product of precision engineering and manufacturing, now available from leading distributors everywhere. If your distributor does not have it yet, order from us directly, mentioning his name. We shall also be glad to supply technical reprints covering the theoretical and practical aspects of the DYNAMIC NOISE SUPPRESSOR * and the operating characteristics of the type 210-A.

** Licensed under United States and foreign patents, pending and issued.*

Herman Hosmer Scott, Inc.
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Representatives and distributors in all principal cities

PRODUCTS & LITERATURE

OSCILLOGRAPH EQUIPMENT: 170-page catalog of oscillographs, tubes and accessories. Elaborately documented with technical data on oscilloscopes and their applications. This publication is not available for general distribution. Catalog 274. DuMont Laboratories, Inc., Clifton, N.J.

SIGNAL GENERATOR: 5 watts RF output into 50 ohms. Continuous scale covers 40 to 400 mc., with attenuation from 15 volts to .1 microvolt. Leakage rated at less than .1 microvolt per meter. Bulletin 70. The Rollin Co., 2070 N. Fair Oaks Ave., Pasadena 3, Calif.

SOUND LEVEL METER: Light-weight instrument 10½ ins. long, 2½ ins. diameter, employs subminiature tubes. Range 34 to 140 db above ASA reference level. Includes all three ASA weighting characteristics. Bulletin 65. H.H. Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.

FM-TV LEAD-IN: Flat 300-ohm twin conductor with weather-resistant polethylene insulation. Bulletin 7. Cornish Wire Co., Inc., 15 Park Row, New York 7.

PULSE GENERATOR: Mega-Pulser delivers ultra-short pulses .025, .05, .1, and .25 microseconds wide. Triggers from internal or external source. For testing television systems, amplifiers, and components, and various applications requiring pulse techniques. Bulletin M6. Kay Electric Co., Pine Brook, N.J.

TV RECEIVING ANTENNA: Multiple array designed for all TV channels. High- and low-frequency elements, separated by divider network, can be oriented separately. Licensed by Amy, Aceves & King. Bulletin 37. Vertrod Corp., 60 E. 42nd St., New York.

AUDIO AMPLIFIERS: Series of rack-mounting or portable amplifiers for broadcast monitoring, recording studios, public address, and wired music, designed to FM standards of low distortion and hum level. Bulletin A1-13. Radio-Music Corp., Port Chester, N.Y.

VISUAL ALIGNMENT GENERATOR: Single instrument combines crystal calibrator, AM marker generator on 3.2 to 250 mc., FM generator covering 40 to 120 and 145 to 260 mc. with adjustable sweep up to 15 mc., 400-cycle AF generator, oscilloscope, and power supply. Model 7008. Bulletin 4A5. Philco Corporation, Philadelphia, Pa.

AUDIO AMPLIFIER: For custom-built radio and phonograph installations. One unit carries the power amplifier and power supply. Smaller, enclosed unit contains preamplifier and controls, with high-gain input for magnetic pickups and three medium-gain inputs for crystal pickups and tuners. Bulletin 342. Brook Electronics, Inc., 34 De Hart Place, Elizabeth, N.J.

RELAY MOUNTING: Comprises a dust-tight base and cover for plug-in AC or DC relays. Terminals are brought through a close-fitting Neoprene gasket. Cover is secured by thumb nut. Bulletin 121. C.P. Clare & Co., 4719 W. Sunnyside Ave., Chicago 30.

TORQUE-DRIVE CRYSTAL PICKUP: Technical data on a new type of pickup cartridge. Bulletin 948. Electro-Voice, Inc., Buchanan, Mich.

PROJECTION TV: Receiver and projector in wheel-mounted cabinet, for pictures of any size up to 6 by 8 ft. Can be used for small audiences in limited quarters, or for large audiences in public places and institutions. Bulletin 72. Cortley Television Corp., 15 W. 27th St., New York 1.

DYNAMOTORS: For mobile radio use, with ratings up 80 watts continuous output, or 150 watts on intermittent duty. Average voltage regulation 19%, efficiency about 61%. Height 4 ins., frame diameter 3½ ins., length 7 1/4 ins., weight 8 1/4 lbs. Model GP-26. Bulletin 371. Gothard Mfg. Co., 2110 Clear Lake Ave., Springfield, Ill.

DOUBLE-FACE RECORD CHANGER: Compact unit plays both sides of 12 records. Can be mounted in space required for drop-type changers. Total height 10½ ins; height above motor mounting plate 6 1/4 ins. Price $227.50. Bulletin 42. Fisher Radio Service. 43 E. 47th St., New York.

FM-AM CHASSIS: Three models for custom set-builders, operating with a separate amplifier and power supply unit. Bulletin 87. Espey Mfg. Co., Inc.,528 E. 72nd St., New York 21.

DYNAMIC NOISE SUPPRESSORS: Three amplifier models with noise-suppressor circuits. Described as maintaining response under dynamic operating conditions beyond 12,000 cycles, with effective reduction of objectionable noise amounting to more than 25 db. Ten-watt model $114.50; two 18-watt models $248. and $297., tubes and tax included. Licensed by H.H. Scott. Bulletin 512. Minnesota Electronics Corp., 204 Oppenheim Bldg., St. Paul, Minn.

SERVICE METER: Combines new features in an instrument for use as a capacitance meter, audio voltmeter, AC and DC voltmeter, ohmeter, FM discriminator balance indicator, and VHF voltmeter. Model WV-95A. Bulletin 48. RCA Victor Division, Camden, N.J.

MULTIPLE WINDING MACHINE: For windings of 16- to 42-gauge wire. Maximum arbor space 36 ins. Travel of guide rollers controlled by limit switches to give micrometer adjustment. Gears available for all wire sizes. Bulletin 65. Associated Production Co., 2655 W. 19 St., Chicago 8.

DRY-BATTERY TESTER: Three scales show condition of dry-cell A and B batteries and hearing-aid batteries. 12-point switch selects rated voltage for different batteries from 1.5 to 90 volts, and connects corresponding normal load across the battery. Thus meter indication shows true condition. Bulletin 21. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44.

EMERGENCY POWER PLANTS: Air-cooled Diesel-driven generators of 2,500 watts, 115 or 230 volts, 60 cycles single- or three-phase, and water-cooled models of 10 to 35 kw. to supply communications or broadcast transmitters. Bulletin 105. D.W. Onan & Sons, Inc., 43 Royalston N., Minneapolis, Minn.

TV IF SYSTEM: Shielded transformers and accessories for TV receivers. Complete electrical and mechanical data is given. Bulletin 131. Hillburn Electronic Products Co., 1 Worth St., New York 13.

HEAVYDUTY TAP SWITCH: Up to 12 sections, each with 7 positions, can be operated in tandem. Each section is rated at 50 amperes continuous duty. Microswitch opens power source by detent action when the switch is rotated, to prevent arcing at contacts. Bulletin 257. Eastern Specialty Co., Philadelphia 40.

FM TUNER: Designed for custom set-builders. Armstrong FM circuit with permeability tuning, 3 IF stages, 2 cascade limiters, total of 11 tubes. Rated sensitivity is 10 microvolts for full limiting. Bulletin AL7. Collins Audio Products Co., Box 368. Westfield, N.J.

TRANSFORMERS AND COMPONENTS: Catalog of 24 pages lists over 400 items, including audio and power transformers, and reactors, power packs, transmitter kits, television components. Catalog 81. Standard Transformer Corp., Dept. M, Chicago 18.

SMALL EYELETS: Pure nickel or nickel plated steel, with outside shank diameters of .056 to .067 in. Burnished to insure smooth action in eyelet machines. Bulletin 45. Ramco Mfg. Co., 425 North Ave., E., Cranford, N.J.

. . Bell System Voice Links with the World

wave filter that could accurately select one sideband and suppress the other; a very stable carrier frequency source and many other devices were originated. This accomplished, first transatlantic test of single sideband radio was carried out January 14, 1923.

1927 marked the entry of single sideband into commercial two-way long-wave radiotelephony, and the development by Bell Laboratories of crystal-controlled oscillators soon made possible its extension to short-wave communications.

Today one single sideband transmitter can simultaneously transmit as many as three separate radiotelephone conversations, using but little more frequency space than would be required for one double sideband voice transmission. Now, single sideband equipment—originated and perfected by Bell Laboratories, built by Western Electric—joins the U. S. with practically all major points throughout the world by radiotelephone.

The birth and growth of single sideband

1915. Bell engineers analyze nature of frequency band fed into antenna in voice-modulated transmission.

1918. Bell System makes first commercial application of single sideband, in carrier telephony.

1923. Bell System makes first transatlantic single sideband voice transmission.

1927. Single sideband enters radiotelephony field with opening of long-wave U.S.—England link.

1928. First commercial short-wave transatlantic single sideband radiotelephone circuit opened.

1930-1939. Single sideband service to South America, Honolulu, Paris, Manila.

1941-1945. Single sideband equipment built by Western Electric extensively used by Armed Forces, as well as government agencies.

1945-1948. Many more Western Electric single sideband radio systems put in service throughout the world.

Now... NEWEST IN SINGLE SIDEBAND
the economical, low-power LE System

LATEST development in single sideband is the compact, low-power Western Electric LE System. Like the higher-powered LC now in wide use, the new LE is built to Bell System specifications for operation with a minimum of maintenance.

The LE System consists of three self-contained units: transmitter, receiver and control terminal. New electronic speech privacy equipment is incorporated into transmitter and receiver.

With the LE System, the Bell System now makes use of the demonstrated advantages of single sideband in the field of medium-distance radiotelephony.

—QUALITY COUNTS—

LE-T1 Transmitter LE-R1 Receiver B4 Control Terminal

LE Single Sideband equipment is distributed outside the U. S., Canada and Newfoundland by Westrex Corp., 111 Eighth Ave., New York, N. Y.

Western Electric

Manufacturing unit of the Bell System and the nation's largest producer of communications equipment.

WHAT'S NEW THIS MONTH

(Continued from Page 4)

sioner Jett: "In assigning frequencies to both television and FM, the Commission is concerned about the transmission of signals, but the public is concerned about their reception . . . . Has the Commission given consideration to the problems involved in designing antennas for home use that will give satisfactory operation on the range of frequencies assigned to television and also this new range of frequencies assigned to FM?"

The transcript of this conference shows that Mr. Jett did not answer the question. Instead, he went into a discussion of the impermanent nature of low-band television.

Later, Tom Kennedy of *The Times* brought up the question of TV antenna design. Mr. Jett ducked it by saying: "We have testimony to the effect that an antenna can be built in the set." He did not, however, claim knowledge of satisfactory TV reception from a built-in antenna. Then he disposed of the subject with the statement: "I believe that is an industry problem."

But Tom Kennedy had the last word: "Industry has not in the past shown any great degree of concern over what becomes of their receivers once they sell them. I believe it is going to be a continual problem of service until such time as it becomes very well established."

Subsequent events show that, despite the care with which TV sets have been installed and serviced, Tom Kennedy was still right because 1) set manufacturers are still clinging to the cheapest types of antennas, and 2) new reception difficulties are still cropping up.

Latest kind of trouble is being experienced in New York City. The many thousand antennas already in use were installed when the only stations were WCBS on channel 2, WNBT on channel 4, and WABD on channel 5. This represents a frequency range of 66 to 82 mc.

Now, WPIX has started on channel 11, at 198 to 204 mc., far above the frequencies of the others, and complaints are pouring in from those who can't get the new station!

Gardiner Greene, of Workshop Associates, warned against this kind of situation in his article last month entitled "All-Channel TV". You might expect, since the four New York stations are close together, that reception would be good on all of them from nearby points. However, reports indicate that while conventional antennas pick up enough signal from each one, orientation is now a problem. At greater distances, when ghosts are eliminated from one station, the same orientation is good for the other three, but signal pick-up is too far down on channel 11.

This discussion isn't by way of saying: "We told you so." On the other hand, we've been criticized for putting too much emphasis on the need of good antennas for FM and TV reception. Now it's beginning to look as if former Commissioner Jett really handed the engineers a hot potato when he said of TV antennas: "I believe that is an industry problem."

3. Columbia's new 45-minute Vinylite records have created a considerable stir throughout the radio industry. It's too early for anyone to have a well-informed opinion as to whether or not these records, requiring a special pickup and 33 1/3 RPM drive, are going to gain enough acceptance to make them important.

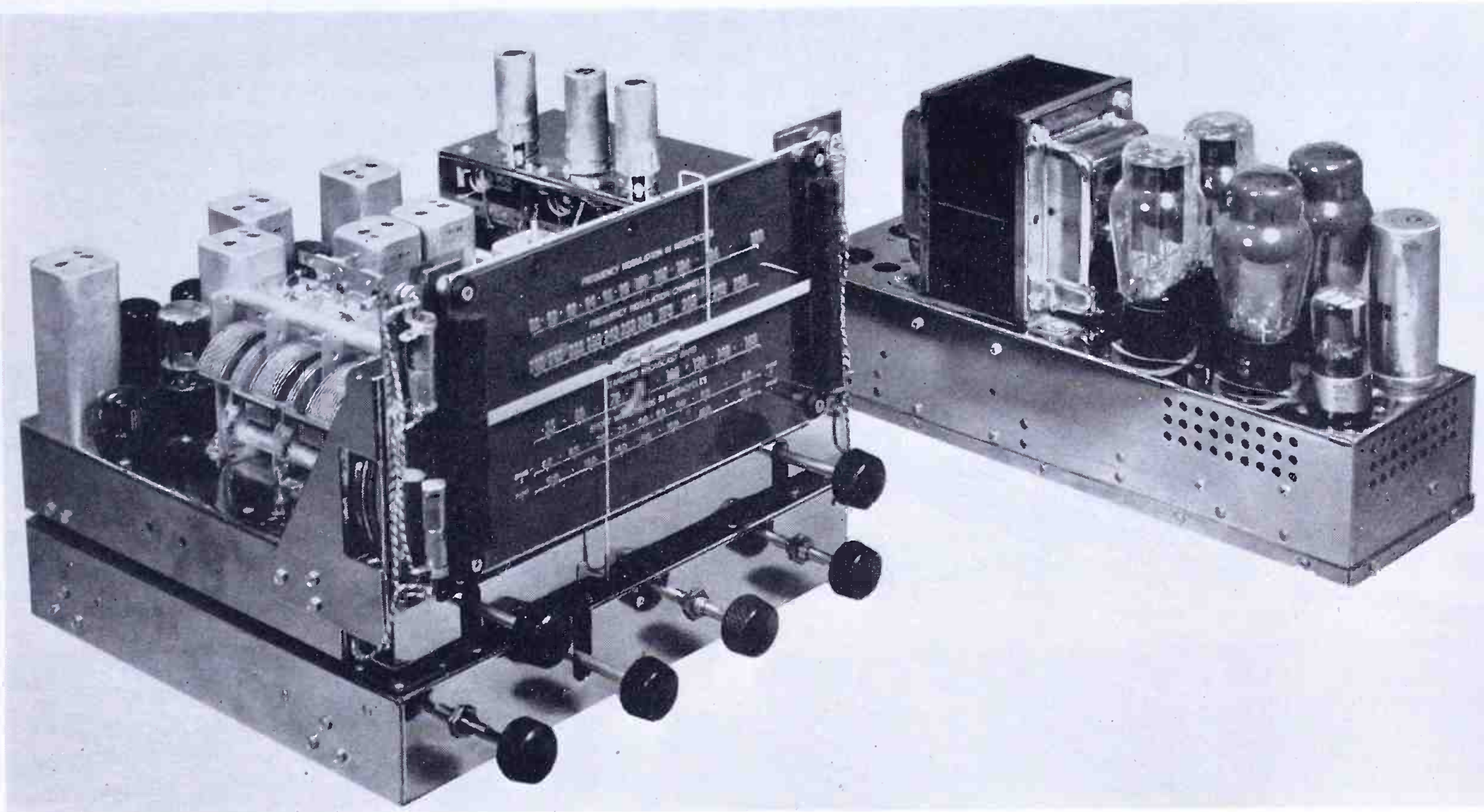
At this moment, we are in favor of them if, along with other advantages, they will meet Columbia's promise of "full fidelity and absence of distortion hitherto unknown." Philco is going to equip its 1949 models for playing both standard 78 RPM and the new Microgroove records. With the support of Philco's promotion, ultimate public acceptance seems assured. Meanwhile, a 33 1/3 RPM turntable attachment has been announced for playing the new records on existing machines.

It is conceivable that other recording companies may follow Columbia's lead. As we see it, there is everything in favor of a 10-in. record that runs 13½ minutes on one side instead of 3 minutes, or a 12-in. record that lasts 22½ minutes instead of 4½. This assumes, of course, that acceptable selections and artists will be available on the new LP records.

First of all, they practically eliminate the need of automatic changers. Thus it will be possible to buy a radio-phonograph with a really good turntable drive at a lower price than even a cheap automatic. And the service troubles experienced with automatic changers will be eliminated. Also, records won't be broken when the changer goes on the rampage. Less storage space will be required. According to Columbia, 101 records, including 325 selections, require only 15 ins. of shelf space, compared to equivalent conventional records in albums, which take up nearly 8 ft. And if the quality consistently meets Columbia's claims, they really have something.

Although AFM is not making new recordings now, that will not stop

(Continued on Page 16)



CUSTOM SET-BUILDERS

Here is Important News if you build or sell custom radio-phonograph installations where precise reproduction of musical values and absolute perfection of engineering detail is required: *You can now obtain Freed-Eisemann chassis equipment for your custom-built jobs.*

Here is the identical tuner and amplifier (plus high-fidelity co-axial speaker and Webster or Garrard inter-mixer record changers, if desired) which have given Freed-Eisemann Radio-Phonographs an acknowledged reputation among radio engineers, musical authorities, broadcasters and dealers as the finest instrument available *any*-where at *any* price. Now they can be built into special, personalized installations for those who demand something finer in radio-phonograph reproduction . . . at prices that represent today's outstanding value.

Furnished complete with 21 tubes*, the Freed-Eisemann No. 100 Tuner is a compact unit suitable for the most diverse cabinet applications. Connected by plug-in cable to the P.S. 1 Amplifier and any record changer and speaker system in your design, the actual installation of the equipment becomes simplicity itself.

Spanning the complete AM and FM tuning range, and with band-spread shortwave from 6.2 to 17.5 megacycles, the Freed-Eisemann No. 100 Tuner provides separate RF and IF circuits for both AM and FM sections. The FM section incorporates the Armstrong receiving system and employs a double superheterodyne to provide excellent stability and sensitivity, and dual limiters to give full limiting on 5 microvolts. Broadband IF circuits in the AM section offer maximum fidelity. Separate bass and treble controls, of course.

The Freed-Eisemann No. 1 Amplifier delivers an undistorted output of 20 watts, with flat audio response from 30 to 15,000 cycles. All laboratory readings are carefully made . . . *and carefully maintained in production testing procedures.*

For further information and for prices on this magnificent chassis equipment, write today to Freed Radio Corporation, 200 Hudson Street, New York 13, New York.

*Two 6SK7, two 6SA7, two 6J5, three 6AG5, two 6L6-G, two 5U4-G, two 6SG7, two 6SH7, one 6SL7-GT, one 6H6, one 6J5-GT, one 6U5.

Freed-Eisemann

ONE OF THE WORLD'S GREAT RADIO-PHONOGRAPHS

FM LINK EQUIPMENT

—STL for Better FM Broadcasting

This equipment is the result of many months of research. It is presented to satisfy increasing demands for equipment to link studio and transmitter with very great fidelity and without the use of wire lines. The equipment operates line-of-sight over distances under 30 miles at 940 to 960 megacycles. Units are compact, easy to install, can be arranged to mount in single relay rack. Antenna equipment is optional.

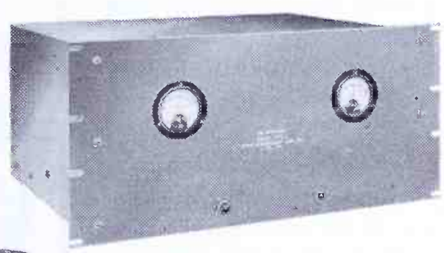
*Transmitter input to receiver output — does not include space attenuation.

- ★ AUDIO RESPONSE: 0.3 db FROM 50 TO 15,000 CYCLES
- ★ SIGNAL TO NOISE RATIO: 75 db BELOW 100% MODULATION*
- ★ DISTORTION: 0.3% MAX. AT 100% MODULATION FROM 50 TO 15,000 CYCLES.

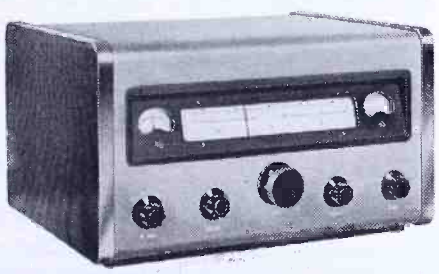
PROFESSIONAL FM RECEIVERS

—for the Finest FM Reception

Model 670-L at right — $465.00. Model 646 below $340.00. Prices, net FOB factory



FIXED-FREQUENCY, CRYSTAL-CONTROLLED FM RELAY RECEIVER for network relay reception on any frequency from 88 to 108 megacycles. Features high reserve sensitivity; distortion less than 0.5% between 50 and 7,500 cycles; flat response ±0.5 db to 15,000 cycles; audio output +18 dbm in 600 ohms for 100% modulation.



DUAL BAND FM RECEIVER for studio monitoring or superb home reception. Features input circuit noise limiting; distortion less than 1.5% at 10 watts output from 50 to 7,500 cycles; frequency response ±1 db from 30 to 15,000 cycles including de-emphasis of 75 microsecond time constant. Calibration permits use as relative field strength meter.

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OTHER *REL* FM SPECIALTIES

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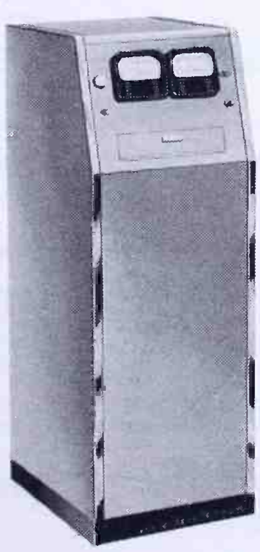

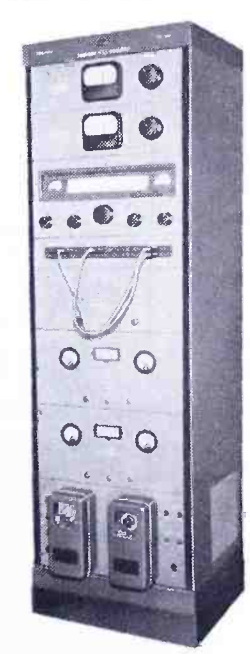

An extremely flexible arrangement combining both crystal controlled and tunable receivers together with provision for aural and visual monitoring. This unit is designed for the relaying of programs from one transmitter to another for FM network programming. Unit provided with facilities which allow semi-unattended operation.

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LONG ISLAND CITY 1, NEW YORK

WHAT'S NEW THIS MONTH

(Continued from Page 12)

the development of long-playing records because they can be made from existing masters. What about the present stocks of 78 RPM records? Well, the radio industry has always thrived on obsolescence. Besides, there will be plenty of time to clean out the old records. It's even possible that Columbia's idea will prove a flop for some reason we don't know now, but from where we sit, it looks as if they have something very good.

4. In our not-always-humble opinion, the FCC made one of its characteristic blunders in setting facsimile standards which eliminate the use of 4.1-in. recorders. The Commission's explanation that the 8.2-in. width "will permit greater flexibility in programming" and that "by and large, an 8.2-in. paper should be capable of handling practically any program material that is carried by a newspaper" shows that the Commissioners 1) failed to appreciate the possibilities of facsimile as a completely new medium of information and advertising, or 2) they yielded to the newspaper interests who have insisted that if they can't have 8.2-in. recording they won't go into facsimile at all.

Now, the FCC has no assurance that the newspapers will put aggressive support behind facsimile. It may well be that they will quietly shelve it, since 8.2-in. recording will be supported by no one else.

In any case, the higher cost of wide recorders and receivers capable of running them seem to preclude wide-spread use in homes and particularly on farms. Also, multiplex facsimile-sound reception is greatly complicated by the 8.2-in. standard.

The situation with respect to those actively identified with facsimile development was unusual. Capt. Finch was prepared to go ahead with either type of equipment, and saw no disadvantage in the wider standard. Milton Alden, building all sizes of facsimile equipment for many different applications, was firm in his contention that general home use of facsimile called for developing a new format completely unrelated to other printed media. For such a purpose the low-cost 4.1-in. recorder is entirely adequate. John Hogan had no choice but to support the views of the newspapers, since they are the sole support of his operations. It is to the credit of the three principals, however, that they agreed to support the adoption of both widths as operating standards.

(Concluded on Page 17)

WHAT'S NEW THIS MONTH

(Continued from Page 16)

Nevertheless the FCC, still playing its official role as dispenser of infinite wisdom, rejected the opinions of the experts, gave out that the double standard was too limited " from a practical point of view ", and settled on wide recording.

Because the decision is so arbitrary and so lacking in evidence of any practical point of view, we hasten to add that Chairman Coy and Commissioners Walker and Webster did not participate in the decision.

5. In the postwar assignments of communications frequencies, the railroads received the most-favored treatment. The practicality of 2-way service on 152 to 162 mc. had been demonstrated beyond any question, and the FCC expected that the railroads would take full advantage of this new means to safeguard the lives of passengers and personnel, and to reduce costs by speeding operations.

Radio manufacturers moved quickly to meet expected demand for equipment. To start the ball rolling, they spent huge sums on demonstrations, tests, and surveys. But as the months went by, orders did not materialize. True, a few installations were made in freight yards, and some equipment was purchased for front-to-rear train communications, but the total activity was so limited that now, after three years, the FCC plans to reassign 19 railroad radio channels.

Meanwhile, taxicab companies using only two channels, have invested more money in radio equipment, and are operating more fixed stations and mobile units than all the railroads.

Why? The answer is very simple. Two companies, Union Switch & Signal and General Railway Signal, control all the railway signal equipment business between them. In their field they have built the same situation of control through patents and elimination of competitors that Gamewell has in the police and fire alarm systems.

Gamewell could have had the leading position in police radio, but after selling a few installations, not even of their own manufacture, they dropped out of the field. And why? Because they would not pioneer in a field open to competitors.

To be sure, Union Switch & Signal and General Railway Signal can supply radio equipment, not of their own manufacture, to the railroads. But they will no more develop the use of railway radio communications than Gamewell did in the police field. Until some independent outsider takes the initiative in railroad radio, it will never come into widespread use.

Western Electric 3 KW FM transmitter—ready for delivery now. So are the 1 KW and 10 KW models.

"We *like* to live in glass houses!"

"At last we components can live wherever our jobs say we should—instead of all of us being pushed around to let a few tubes sit behind windows. That's why we like this TRANSVIEW design as much as you do!"

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- Low intermodulation and harmonic distortion.
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This straightforward functional design results naturally in a clean-cut equipment layout—and, with full-length glass doors to show it off, provides an unusually attractive over-all *appearance.*

A further result of this unique TRANSVIEW design is maximum visibility during operation, *accessibility* for speedy inspection, maintenance and replacement.

For the full story on TRANSVIEW design, as well as the other unique features of Western Electric FM Transmitters, call your Graybar Broadcast Representative or write Graybar Electric, 420 Lexington Ave., New York 17, N. Y.

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—QUALITY COUNTS—

MORE SPACE FOR MOBILE RADIO

FCC PLANS MORE CHANNELS TO PERMIT THE EXPANSION OF MOBILE COMMUNICATIONS, DESPITE OPPOSITION FROM FM AND TV—*By* JEREMIAH COURTNEY *

SWEEPING revisions of frequency assignments recently proposed by the FCC for the portion of the radio spectrum presently useful for land and maritime mobile purposes, and summarized in the accompanying table, reveal two new policies of prospective application which are of the greatest significance to the entire communications industry:

1. In making future frequency assignments as between broadcast and non-broadcast interests, increasing consideration will be paid to the expanding needs of the land-mobile and maritime-mobile safety radio services.

2. In making future frequency assignments as between non-broadcast users, increasing consideration will be paid to actual use made of previous frequency assignments by the competing non-broadcast radio services.

Declaration of the first of these policies came in clear and unequivocal terms in the Commission's recent deletion of television channel No. 1 and the reassignment of the entire band of 44 to 50 mc. to fixed and mobile service use, despite the most determined opposition on the part of the FM broadcast interests, which had sought that band for network relay broadcast purposes, and the less active opposition of the television interests. The FM opposition, moreover, had extended to the Congress, where the House Committee on Interstate and Foreign Commerce held extended hearings on House Joint Resolution 78. This bill was introduced by Congressman Lemke and, if enacted, would have required the Commission to assign a section of the 50 mc. band, presumably 44 to 50 mc., for frequency modulation.

The Commission's action, looking to the deletion of television channel No. 1 and turning over this band to the fixed and mobile services, remains in the proposal stage, subject to objections and oral argument. Nevertheless, the fact that the action was taken despite the vigorous opposition of the FM interests, and in advance of any House Committee report on the hearings held with respect to the Lemke bill, leaves little doubt as to the ultimate outcome of the proposal. The quantum of doubt remaining regarding finality of this proposal may be easily evaluated in the light of the statements made by the FCC Chairman Wayne Coy, in speaking on May 18, 1948 before the National Association of Broadcasters' Annual Convention in Los Angeles, where he told the assembled broadcasting fraternity that it would be necessary for the Commission to look for even more space for the non-broadcast services. Observed Chairman Coy on that occasion:

"The Commission's order of early this month abolished the previous arrangement of sharing television channels with other services. In order to accomplish this, it was necessary to delete channel No. 1, 44 to 50 mc., and to assign it to the fixed and mobile services. I now know, and you may as well know, that the Commission will be looking for more space for these important services very shortly."

Although the disposition of the 44- to 50-mc. band thus developed into a test of strength between the broadcast and non-broadcast services in which the broadcast interests met resounding defeat, it must be remembered that the assignment of this band to the fixed and mobile services was really designed only to compensate these services for the loss of their sharing privileges in 12 of the 13 television channels, and for the loss of their unrestricted use of the band from 72 to 76 mc. These results followed the proven impracticability of having the fixed and mobile services share the television channels, and of using the 72- to 76-mc. band for mobile purposes because of adjacent-channel interference to television. It was, therefore, little short of mandatory for the Commission to compensate the fixed and mobile services for the serious losses in spectrum space occasioned by the interference problems to television reception from mobile transmissions in the shared bands and the adjacent 72- to 76-mc. band. Since television channel No. 1 was the least used and least useful for television broadcasting purposes, it was perhaps the natural portion of the spectrum to be turned over to the fixed and mobile services in compensation for their losses. For that reason, indeed, the proposal had the lukewarm support of the television industry to the extent that its representatives stated their preference for 12 exclusive channels over 13 channels, 12 of which were subject to sharing, although they naturally objected to the deletion of even one of their channels.

While, therefore, the Commission's proposal may not only seem unremarkable in character, but probably the most logical solution to the difficulties caused by co-channel and adjacent-channel interference between television and the fixed and mobile services, nevertheless the manner in which the battle lines were drawn between the broadcast and non-broadcast interests demonstrates convincingly that in any such test of strength under the present allocations the non-broadcast services are definitely a force to be reckoned with.

The dilemma in which the Commission was placed in being forced to choose between the broadcast and non-broadcast services is not without its note of irony, being largely self-earned for the following reasons:

At the present state of the radio art, the only portion of the spectrum that can be used economically by the non-broadcast services is that located below 216 megacycles. A goodly portion of that space was reserved for government radio stations. Of the portion subject to the Commission's assignment for non-government purposes below 216 mc., a total of 99 mc. were assigned by the FCC to the broadcast services (1 mc. plus to AM, 20 mc. to FM, 78 mc. to television). If the Commission in making assignments in that portion of the spectrum usable by the mobile services had not been so generous to the broadcast services in its 1945 allocations, then it is probable that the Interdepartment Radio Advisory Committee might now assist the Commission by turning over a portion of the spectrum now earmarked for Government purposes to the fixed and mobile safety services whose sound operations are so important to national security. It is more than likely, however, that IRAC had warned the Commission at the time that the 1944–45 allocations were decided upon that, in distributing the portion of the spectrum earmarked for non-government uses, the Commission was assigning entirely too much space below 216 mc. for broadcast purposes. It is not remarkable, therefore, that the IRAC, if approached, left the Commission to stew in its own juice; or, if not approached, failed to volunteer its aid to the Commission in providing the space urgently needed by the non-broadcast services but which the Commission was able to supply only at the expense of broadcast allocations.

The second significant policy to emerge from the Commission's recent proposals for reallocation of 25 to 30, 44 to 50, 72 to 76, 152 to 162 and 450 to 460 mc. came in the proposed deletion of 19 of the 60 frequencies assigned for railroad purposes exclusively in the 152 to 162-mc. band. The Commission's report on this aspect of its allocations stated:

"There is nothing in the Commission's proposal, including the new classifications of land mobile service, i.e., public safety, industrial, land transportation, public

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* Member, Courtney, Krieger & Jorgensen, Washington, D. C. Formerly FCC Assistant General Counsel in charge of non-broadcast radio matters.

25- TO 30-MC.

GOVT.
24.99–25.01

LAND MOBILE–INDUST.
25.01–25.33 (16)

GOVT.
25.33–25.85

INTERNATIONAL BCSTG.
LAND MOBILE
REMOTE PICKUP BCST.
25.85–26.49 (19)

GOVT.
26.49–26.95

AMATEUR FIXED, MOBILE
LAND MOBILE–INDUST.
26.95–27.53 (12)[1]

GOVT.
27.53–28.00

AMATEUR
28.00–29.70

LAND MOBILE–INDUST.
29.70–29.81 (5)

FIXED PUBLIC & AERO.
29.81–29.89 (7)

GOVT.
29.89–29.91

FIXED PUBLIC & AERO.
29.91–30 (8)

44- TO 50-MC.

LAND TRANSP.
44.00–44.58 (30)

PUBLIC SAFETY
44.60–47.66 (154)

INDUSTRIAL
47.68–49.98 (116)

72- TO 76-MC.[2]

PUBLIC SAFETY, LAND TRANS.
72.02 (1)

PUB. SAFETY, INDUST.
72.06–72.10 (2)

PUBLIC SAFETY, LAND TRANS.
72.14 (1)

INDUSTRIAL
72.18–72.22 (2)

PUBLIC SAFETY, LAND TRANS.
72.26 (1)

PUB. SAFETY, INDUST.
72.30–72.34 (2)

PUBLIC SAFETY, LAND TRANS.
72.38 (1)

PUB. SAFETY, INDUST.
72.42–74.46 (2)

PUB. SAFETY, LAND TRANS.
72.50 (1)

PUB. SAFETY, INDUST.
72.54–72.58 (2)

PUBLIC SAFETY, LAND TRANS.
72.62 (1)

PUB. SAFETY, INDUST.
72.66 (1)

PUBLIC SAFETY
72.70–74.58 (47)

AERONAUTL MRKR BCNS
74.60–75.40

INDUSTRIAL
75.42–75.50 (3)

PUB. SAFETY, INDUST.
75.54 (1)

INDUSTRIAL
75.58–75.66 (3)

PUBLIC SAFETY
75.70–75.98 (7)

152- TO 162-MC.

PUBLIC RADIO
152.03–152.09 (2)[3]

LAND TRANSP.
152.15–152.33 (4)

PUBLIC RADIO
152.39–152.69 (6)[3]

INDUSTRIAL
152.75–153.71 (17)

PUBLIC SAFETY
153.77–154.43 (12)

INDUSTRIAL
154.49–154.57 (2)

PUBLIC SAFETY
154.65–156.09 (25)[4]

MARITIME MOBILE
156.10 (1)[5]

PUBLIC SAFETY
156.15 (1)[4]

MARITIME MOBILE
156.20 (1)[6, 7]

PUBLIC SAFETY
156.21–156.27 (2)[4]

MARITIME MOBILE
156.30 (1)[8]

PUBLIC SAFETY
156.33–156.39 (2)[4]

MARITIME MOBILE
156.40 (1)[6, 7]

PUBLIC SAFETY
156.45 (1)[4]

MARITIME MOBILE
156.50 (1)[6, 7]

PUBLIC SAFETY
156.51–156.57 (2)[4]

MARITIME MOBILE
156.60 (1)[6, 7]

PUBLIC SAFETY
156.63–156.69 (2)[4]

MARITIME MOBILE
156.70 (1)[6, 7]

PUBLIC SAFETY
156.75 (1)[4]

MARITIME MOBILE
156.80 (1)[6, 10]

PUBLIC SAFETY
156.87 (1)[4]

MARITIME MOBILE
156.90 (1)[6, 7]

PUBLIC SAFETY
156.93–156.99 (2)[4]

MARITIME MOBILE
157.00 (1)[6, 7]

PUBLIC SAFETY
157.05 (1)[4]

MARITIME MOBILE
157.10 (1)[6]

PUBLIC SAFETY
157.11–157.17 (2)[4]

MARITIME MOBILE
157.20 (1)[6]

PUBLIC SAFETY
157.23 (1)[4]

PUBLIC RADIO
157.29–157.35 (2)[3]

LAND TRANSP.
157.41–157.59 (4)

PUBLIC RADIO
157.65–157.95 (6)[3]

INDUSTRIAL
158.01–158.31 (6)

PUBLIC SAFETY
158.37–159.45 (19)

LAND TRANSP.
159.51–161.91 (41)[11]

MARITIME MOBILE
161.97 (1)[12]

450- TO 460-MC.[13]

REMOTE PICKUP
450.05–451.95 (20)

LAND TRANSP.
452.05–453.95 (20)

PUBLIC SAFETY
454.05–455.05 (20)

INDUSTRIAL
456.05–457.05 (20)

PUBLIC RADIO
458.05–459.05 (20)

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[1] 27.12 mc. is designated for industrial, scientific, and medical purposes. Emissions must be confined within 160 kc. of that frequency. Radiocommunication services operating between 26.96 and 27.28 mc. must accept harmful interference that may be experienced from the operation of industrial, scientific, and medical equipment.

[2] Future assignments to be limited to fixed circuits which, as a result of an engineering study, may be expected to operate in this band on non-interference basis to the television service.

[3] The fixed (rural subscriber) service may be authorized to use this frequency provided no harmful interference thereby will be caused to the land mobile service.

[4] Assignments to base and land mobile stations in the Public Safety Radio Services for operations at points within 150 miles of coastal areas and navigable gulfs, bays, rivers and lakes are subject to the condition that no harmful interference will be caused to the maritime mobile service and will be made only after a factual finding indicates that, on an engineering basis, no harmful interference will be caused to the Maritime mobile service.

[5] This frequency is allocated to ship stations on a duplex basis and is paired with the frequency 161.97 mc. for ship-shore public correspondence (telephony).

[6] Public correspondence is not permitted on this frequency. Public correspondence as used in this footnote means: "Any telecommunication which the office and stations, by reason of their being at the disposal of the public, must accept for transmission." From Annex to Madrid Convention, 1932.

[7] This frequency is not available for assignment to stations in the maritime mobile service until such time as it is demonstrated, on an engineering basis, that such use will not cause harmful interference to the use by the maritime mobile service of any frequency in the band 152–162 mc.

[8] This frequency is for intership communications in the maritime mobile service (simplex telephony).

[9] This frequency is for communications of the type which the frequency 156.80 mc. is allocated, and is reserved primarily for harbor control communications between ships and coast stations, and between ship stations (simplex telephony).

[10] The frequency 156.80 mc. has been designated for world-wide use for safety, calling and intership and harbor control communications in the Maritime mobile service (simplex telephony).

[11] Up to 14 frequencies in the block 159.51–161.91 mc. inclusive may be made available in any area to base and land mobile stations in the Public Safety Radio Services after July 1, 1950, if a factual finding, made on an engineering basis, indicates that no harmful interference thereby will result to the Land Transportation Radio Services.

[12] This frequency is allocated to coast stations on a duplex basis and is paired with the frequency 156.10 mc. for ship-shore public correspondence (telephony).

[13] In the band 420–460 mc., the aeronautical radio-navigation service is to be permitted only until February 15, 1950.

radio, etc., which in itself changes, or will necessarily result in changes in the apportionment of frequencies for particular uses within a category except for railroads. This one use has been considered in detail. . . .

"The Commission has reviewed the background leading to the current allocation to the Railroad Radio Service. This review, *together with an evaluation of the use which has been made of the 36% of the band 152–162 mc. allocated for this purpose since May, 1945, and a comparison of this use with the use in the past three years made by the other mobile services of the remaining 64% of the band 152–162 Mc.*, indicates that continued provision should be made for 33 train frequencies in this band, but that the relatively long period of time which has elapsed since the allocation of May, 1945, has been ample to permit the development of equipment using every 60-kc. channel. The Commission stated in its May 25, 1945, Report (page 120):

"'A greater (than 60-kc.) band width may be used temporarily during the development period of the service. Any user of such equipment, however, may be required to replace it when the Commission is of the opinion that proper equipment is readily available or that needs of other users require better use of the assignment.'

"The Commission is aware that 60-kc. equipment is not readily available for train communications, but does believe that ample time has elapsed for the development of such equipment. However, to permit a still further period of time in which to determine the extent of interest of the railroads in the use of radio for

(*Concluded on page 23*)

ST EQUIPMENT USING KLYSTRONS

THE CIRCUIT DESIGN OF THIS FEDERAL STUDIO-TRANSMITTER LINK EQUIPMENT IS SIMPLIFIED BY THE USE OF SRL-17 REFLEX KLYSTRONS—*By* M. SILVER & H. FRENCH *

THE application of radio circuits to point-to-point communications has seen considerable growth in recent years. The practicability of such systems was field-proven in the past war. The intensive development of microwave equipment and techniques has opened these frequencies to adaptation to many communications needs. UHF and SHF are particularly suited to fixed point-to-point transmission of wide-band modulation by reason of their intrinsic system characteristics, namely 1) high antenna directivity, yielding line-of-sight transmission, 2) high antenna power gain, reducing transmitter output power requirements for a given coverage, and 3) the relatively large system bandwidth that can be accommodated.

To these characteristics can be added the advantages of frequency modulation for high-fidelity, broad-band communications. Among them are 1) the use of high modulation indices, affording improved output signal-to-noise ratios, 2) discrimination against low-level interfering signals, and 3) availability of simple methods of high-linearity modulation and detection.

This paper will describe a frequency-modulated radio link designed and developed by the Federal Telecommunications Laboratories, primarily to meet the requirements of high-fidelity broadcast studio-transmitter service. The broadband characteristic of the equipment makes it also adaptable to transmission of any wide-band modulation, the limits of which fall within the design of the system. These, by the way, are particularly adapted to operation with multiplex telephony.

General Description:

The equipment consists of a UHF transmitter and receiver with associated parabolic antennas, designed to operate in the band from 920 to 960 mc. thus including the 940- to 952-mc. band authorized by the FCC for STL application. Development and testing work on this equipment, extending over the last two years, has confirmed the suitability of this band for reliable, high-fidelity transmission of program material. Propagation tests have been conducted over a 12-mile path between New York City and Nutley, New Jersey, and a 30-mile path between Telegraph Hill, N. J., and Nutley.

Maximum fades of about 6 db have been observed over the New York to Nutley link. This includes seasonal variation. This transmission path is 16% over water. Recordings of field strength over the 30-mile distance from Telegraph Hill to Nutley, 30% of which is over water, yielded maximum fades of approximately 10 db. The conditions of these latter measurements were somewhat abnormal since the transmission path was barely line-of-sight, and an airport was located directly in the beam.

The FCC has prescribed operational characteristics for studio-to-transmitter link equipment with definite performance specifications. Among these are:

1. Transmitter carrier frequency stability must be held within .005% of the assigned frequency.

2. Channel bandwidth for the transmitter is limited to 500 kc., thus automatically setting the maximum frequency deviation for full modulation at ± 200 kc.

3. Spurious radiation from the transmitter, although not quantitatively specified, must be held to a minimum.

4. Audio response without pre-emphasis must be flat within 0.5 db from 50 cycles to 15,000 cycles.

5. System noise and distortion requirements of broadcast transmitters of – 60 db and 1 to 1.5% respectively set the requirements of at least 65 db noise and 0.5% distortion for ST equipment.

The link equipment to be described meets the foregoing specifications fully.

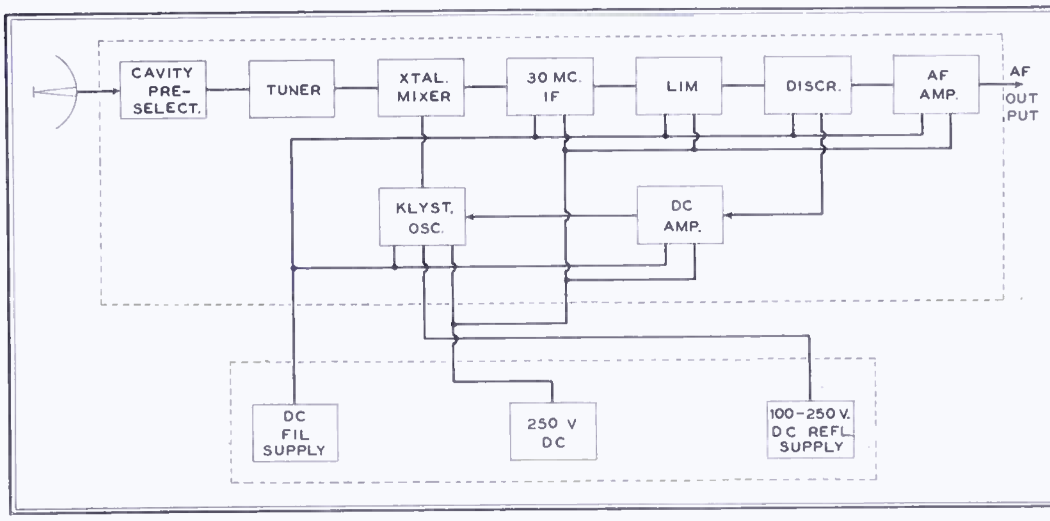


FIG. 1. Block diagram of Federal ST transmitter, designed around the SRL-17 Klystron

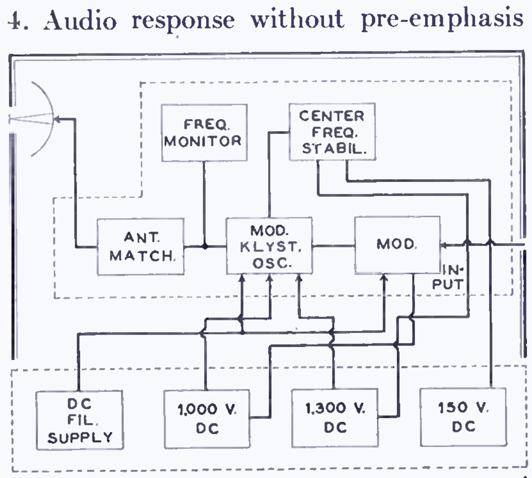


FIG. 4. The ST receiver uses a Klystron also, operated at reduced beam voltage

Transmitter Unit:

The transmitter circuits are indicated by the block diagram in Fig. 1. Here may be seen the essential components of the transmitter chassis: the directly-modulated power oscillator, modulator unit, center-frequency stabilization circuits, output matching transformer, frequency monitor, and associated power supplies. The transmitter utilizes a Sperry type SRL-17 reflex Klystron, designed for operation in the 920- to 960-mc. band. Spurious radiation is minimized by the use of a single power-oscillator output tube. Direct frequency modulation of the Klystron oscillator is effected by operating on the reflector electrode with the output of a two-tube, three-stage modulator unit at a level of approximately 20 volts. Overall feedback is employed in the modulator for minimum distortion. A simple crystal-reference type of automatic frequency control circuit maintains the transmitter frequency within .005% of its assigned value.

In this system, a portion of the Klystron output is mixed with the output of a crystal oscillator frequency-multiplier chain to produce a 30-mc. intermediate frequency. This intermediate frequency is amplified and fed to a discriminator, and the resulting zero-center balanced direct voltage is used to control the

* Federal Telecommunications Laboratories, Inc., Nutley, N. J.

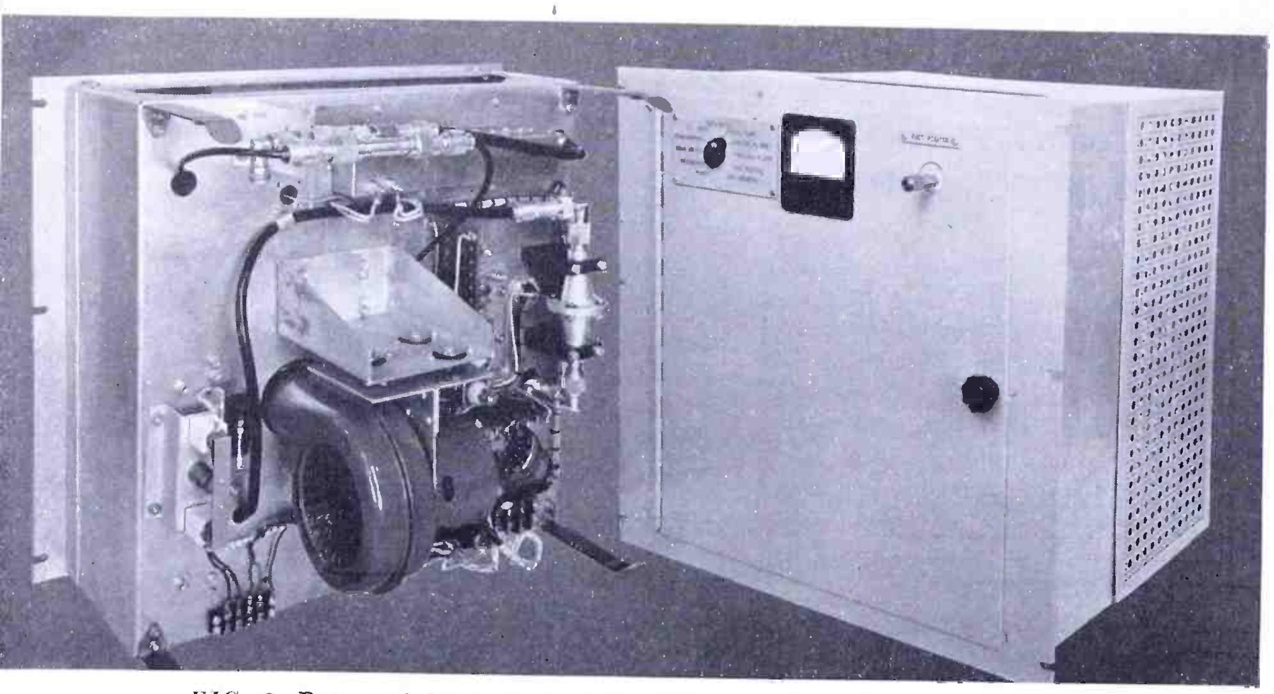


FIG. 3. Rear and front views of the ST transmitter show extreme simplicity of design

Klystron reflector voltage. Electronic tuning of the transmitter to its assigned center frequency is thus effected. Beam, reflector, and filament supplies for the Klystron and plate and filament supplies for all the other tubes are provided by separate power units.

A standard 10-dbm input level, pre-emphasized by a standard 75-microsecond network, modulates the transmitter to a maximum deviation of ± 200 kc.

Fig. 2 shows the RF transmitter chassis with the door open and the Klystron shield cover in place, at the right, and removed, at the left.

The Klystron frequency is continuously tunable over ± 5 mc. at any point of the 920- to 960-mc. band by a single cavity control, and adjustable over the entire band by a simple setting of the cavity and an adjustment of the reflector voltage.

The Klystron is easily and quickly removed in case of failure, and can be replaced with a pre-tuned unit in a matter of a few seconds. The perforated sheet-metal shield is required to prevent accidental contact with the Klystron shell while the transmitter is in operation, since the Klystron is operated with grounded cathode and shell 1,000 volts above ground potential. It can be seen that the entire Klystron unit is carried on brackets, with shock mountings and snap-type holders which permit easy and rapid removal of the unit when necessary.

A two-stub coaxial transformer is used to match the transmitter to the output transmission line. Output frequency is monitored with a calibrated high-Q resonant cavity and crystal rectifier circuit. Frequency can be determined precisely by interpolation between symmetrical readings about resonance. Relative power output is monitored by the DC output of an RF sampling crystal diode. A common microammeter, associated with a selector switch, provides monitor readings of all tube cathode currents and voltages which are essential to evaluating transmitter performance or locating trouble.

The frequency-monitor tuning control, monitoring meter, and switch are located on the front of the hinged door, Fig. 3.

This illustration also shows the rear of the chassis with the dust cover removed. Snaps on the four arms at each corner of the chassis hold the cover when it is in place. A blower is provided for cooling the Klystron. The transmitter output terminal is a type N coaxial fitting for connection to RG-8/U or RG17/U solid dielectric cable, or to an adapter for semi-rigid air-dielectric transmission line.

Receiver Unit:

The receiver employs a single superheterodyne utilizing a reflex Klystron local oscillator and 30-mc. IF amplifier, as indicated by the block diagram in Fig. 4. Circuit components comprise a cavity pre-selector, matching transformer, line-type crystal mixer, local Klystron oscillator, 30-mc. IF amplifiers with limiters and discriminators, AFC feedback circuits, audio section, and power supplies. As in the transmitter, the local oscillator tube is a type SRL-17, but operated at a reduced beam voltage.

Front and rear views of the rack-mounted receiver and power supply are shown in Fig. 5. An 80-db spurious and image response is obtained through the use of a tunable, resonant-cavity pre-selector. A two-stub tuner matches the pre-selector circuit to the line-type crystal mixer, which is in turn coupled to the 30-mc. IF input through a matching network. The IF amplifier comprises five 6AK5 stagger-tuned amplifier stages, having a total band width of 2 mc., and two 6AK5 limiting stages. The first limiter feeds a balanced zero-center discriminator for a polarized DC output for AFC use, as well as providing drive for the final limiter stage. This, in turn, drives a simple off-resonant type of discriminator for

FIG. 5. Views of the ST receiver. Note similarity to the layout of the transmitter

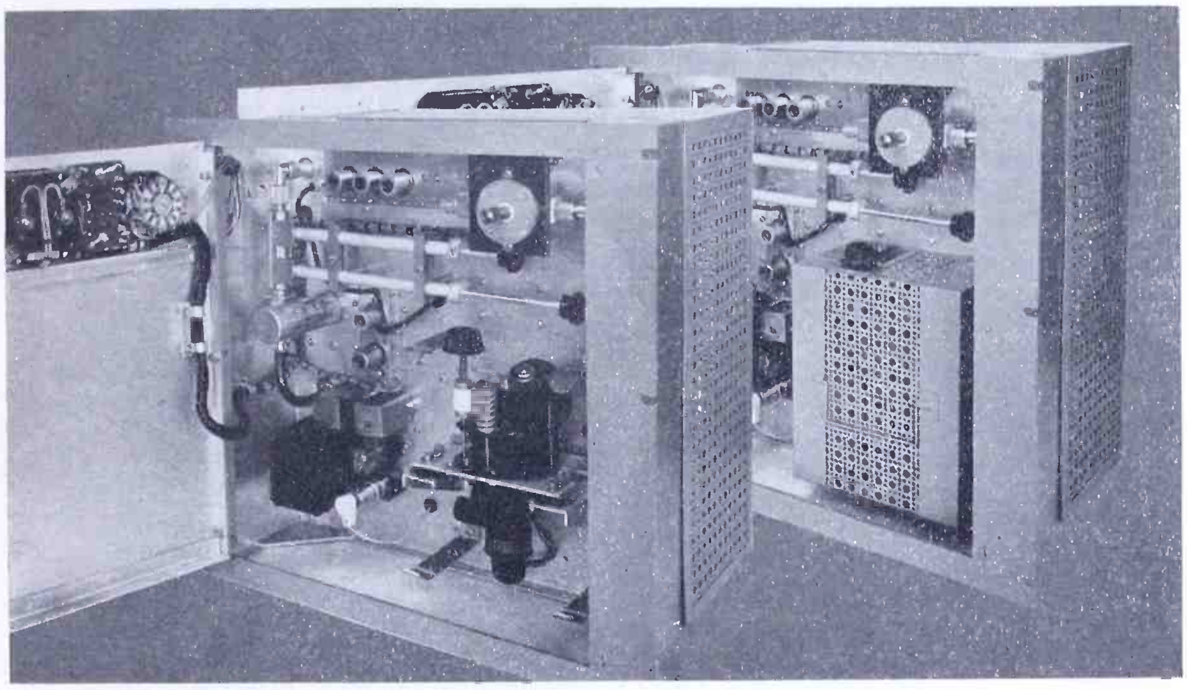


FIG. 2. ST transmitters viewed from the front, showing method of mounting the Klystron

low-distortion detection of modulation. The balanced discriminator output is fed through a stabilized DC amplifier, the negative output voltage of which supplies the Klystron reflector voltage. The combined distortion of the off-resonant discriminator and its audio amplifier is less than 0.3%. Output level is standard 10-dbm ± 2 db, into balanced 50, 250, or 600 ohms. Operation of the system with rated 65-db signal-to-noise ratio is obtainable with an RF signal input to the receiver of only 40 microvolts.

As in the transmitter, a single DC microammeter with two associated selector switches monitors all tube voltages and tube cathode currents for determination of tube operation, as well as measuring crystal mixer current for checking local oscillator injection, and first-limiter grid current as a measure of received signal level.

A squelch circuit is incorporated in the receiver to disable the receiver output, and to provide an alarm indication and facilities for automatic switch-over to standby equipment in the event of link failure.

Antennas:

Identical antennas are used for the transmitter and receiver. They are of circular parabolic type, 6 ft. in diameter, with simple dipole radiators providing horizontally polarized excitation. Antenna gain is approximately 24 db.

Such an antenna, used in the New York-to-Nutley link experiments, is illustrated in Fig. 6. This antenna was mounted near the bottom of the 75-ft. mast used for experimental FM broadcast station W2XFZ, at the Nutley laboratories. RG-8/U or RG17/U solid dielectric coaxial cable is suitable for the lead to such an antenna up to 50 ft. Semi-flexible, air-dielectric transmission line can be used up to 250 ft.

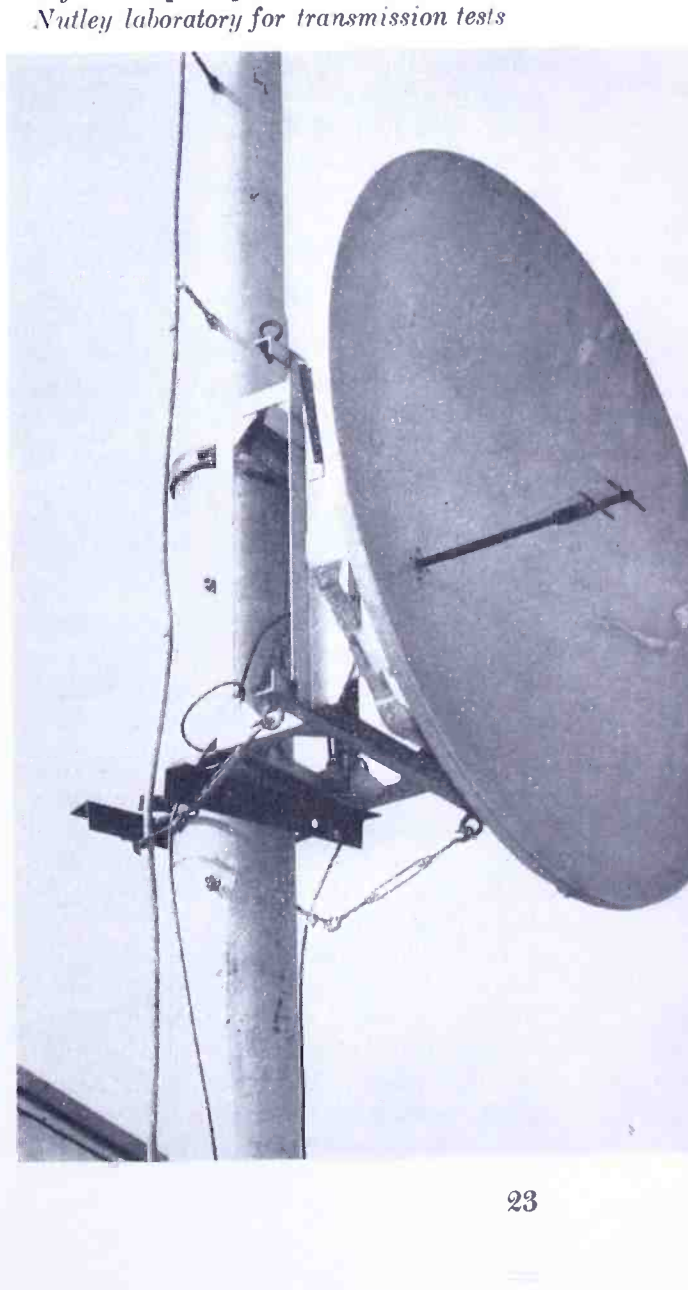
Performance:

On the link between New York City and Nutley, usable program signals were received at all times, with consistent overall system signal-to-noise ratios of better than − 65 db, and audio frequency distortion of less than 0.5%. The link equipment used in these tests, while only of an experimental type, gave exceptionally reliable performance due to the basic simplicity of the design. Still another relay system has been put into operation in a round-robin arrangement. Program material originating in the Federal Telecommunications Laboratories was beamed to the IT & T building in New York, where it was demodulated and rerouted over a similar link to the Nutley Laboratories. Here again the overall system noise was approximately 65 db below full modulation, and audio distortion 0.5%.

Acknowledgment

The authors desire to acknowledge the contributions made by Mr. E. M. Ostland and Mr. A. Rothbart to the success of this project.

Fig. 6. Simple dipole antenna used at the Nutley laboratory for transmission tests



MOBILE RADIO

(Continued from page 20)

train communications, the Commission proposes to retain, not merely the 33 train frequencies required, but a total of 41 frequencies, 159.51 to 161.91 mc. inclusive, and believes that this number of frequencies will be more than ample for some years to come, based upon the current rate of growth of the service and the interest demonstrated by railroads in the use of radio for train communications." (Italics added above)

However gently phrased (and partially compensated for elsewhere in the spectrum), it is clear from the italicized words above that the railroads lost 19 of their frequencies in the desirable 152-to 162-mc. band because they didn't use them, at least not to the degree that other services have availed themselves of the natural resources allocated to them. In effect, the Commission announced to all the non-broadcast services to whom frequencies have been or may be assigned: "Use them or lose them." The principle is as salutary as it is novel and deserving of continued application by the Commission.

FM HELPS DEWEY

With a Hooper-record audience waiting to hear Gov. Dewey's acceptance speech from Convention Hall, Philadelphia, the eastern seaboard was suddenly lashed by a violent electrical storm that virtually wiped out AM reception, except at homes in the immediate vicinity of AM stations. As a result, much of Gov. Dewey's speech was heard only in eastern homes on FM sets.

Continental Network, with complete high-fidelity gear set up at Philadelphia, supplied FM listeners with electrifying realism that made AM reception of the Convention proceedings seem dull and lifeless by comparison. Shifting from AM to FM gave the impression of adjusting the focus of a camera from a fuzzy image to a sharp, close-up picture, due to the presence effect of FM reception.

FM-TV CONTROVERSIES CONTINUE

FM-TV INVESTIGATION DISCLOSES A YEAR-OLD LETTER FROM FCC INFORMATION CHIEF E. W. ALLEN, AND PROMPTS MAJOR E. H. ARMSTRONG TO WRITE A NEW ONE

IN the final hours of the night session that ended the 80th Congress, the House and Senate voted separate investigations of the FCC, to start this fall. These investigations, concerned with the personnel, policies, and administration of the Commission, may have far-reaching effects on future trends of radio development, and should be followed closely by industry executives and engineers.

Because some of the testimony already taken has been concerned with the shift of FM broadcast frequencies to the upper band, certain press comment has characterized the investigations as a "witch-hunt" that cannot have any significance because, regardless of what happened in 1944 and 1945, FM is now settled, for better or worse, at 88 to 108 mc.

Actually, past errors of omission and commission require examination to provide future protection against their recurrence. That is the real purpose of the investigations.

Copies of testimony already taken are available from the Clerk of the House Committee on Interstate and Foreign Commerce, House of Representatives, and the Clerk of the Committee on Interstate and Foreign Commerce, U. S. Senate, Washington, D. C. The testimony is highly informative both as to the discussion of radio problems and the manner in which they are handled in committee.

During the Senate hearing on May 21, 1948, a highly significant letter came to light. The letter was introduced by Senator Tobey. Marked "Confidential," it had been written by E. W. Allen, Chief of the FCC Technical Information Division, to George Sterling, then Chief Engineer of the FCC, under the date of June 26, 1947. This letter is of great interest because it contains some astonishing admissions of errors made by the FCC. Here is the complete text:

Confidential

June 26, 1947

Chief Engineer
Chief, Technical Information Division
Television Reallocation Proposal

The following comprises certain comments concerning the television reallocation proposed as an alternative to sharing the television channels with the communication services, which has developed to be impractical.

It would be highly desirable to have the television channels in a continuous block in order to avoid adjacent channel interference from other services. The most practical place in the spectrum for such a block would appear to be in the order of 200 megacycles. Other advantages will accrue to a more or less degree, such as greater freedom from interference, from man-made interference and elimination of long distance interference via F2 and Sporadic E layer transmission.

With respect to the greater freedom from interference on channels in the vicinity of 200 mc., there does not seem to be any question that diathermy, amateur and ignition interference will be materially lessened in the higher band. However, can we be sure that harmonics from other services will not also be a serious problem on the higher channels? Second harmonic interference from FM broadcast stations has already caused difficulty on the higher channels presently allocated. At present, only minor difficulty from amateur and diathermy has been reported on channels above 60 mc.

It is expected that the channels above 60 mc. will suffer very little limitation from F-layer transmission. The Commission's testimony in Docket 6651 shows what interference from a single station may be experienced for 0.01 per cent of the time at 62 mc. and will disappear entirely at around 72 mc. This is for year with a sunspot number of 120 and for paths from South America to the United States.

As far as Sporadic E is concerned Channel 3 (60–66 mc.) will support transmissions for 0.1 per cent of the year and Channel 6 for somewhat in excess of .01 per cent of the year. While interference from Sporadic E is important, it should be considered in the light of the comparable limitations due to tropospheric transmission at current co-channel separations which will be discussed in this memorandum.

In connection with the exchange of the lower channels for additional channels in the high band, it is of interest to note certain testimony presented in the color television hearing. It was shown that the theoretical advantage of increasing frequency (based on a smooth earth) is nullified by factors obtaining in typical coverage areas. Unless special receiving antennas are employed a power increase of about ten times will be required in going from 70 mc. to 200 mc. to maintain the same quality of service.

Equipment for the lower channels is more thoroughly field tested than that for the higher channels. While present information indicates that more power will be needed on the higher channels for equivalent service, it seems likely that higher power will be available sooner on the low channels. If it is determined that television will ultimately go to a continuous band in the vicinity of 200 mc., it is recommended that future grants be made for a number of years on channels between 60 and 88 mc. The replacement cost of transmitters and antenna systems should not interfere with the overall television economy. Furthermore, a "freeze" on the lower channels will have a demoralizing effect on the growth of television.

At present no account is taken of tropospheric transmission in the allocation of Television and FM stations, although comparable order of interference from F2 and Sporadic E was the basis for the allocation of the present FM band and is now urged as a basis for shifting television upwards in frequency. For the sake of consistency and sound engineering, it is urged that tropospheric interference be taken into account in planning for the future allocation of television. While the theory of tropospheric transmission is not thoroughly understood and sufficient measurements have not been made to accurately determine exact values under all conditions, there is sufficient data on hand to establish a first approximation which will be far more accurate than assigning stations on the basis of theoretical groundwave propagation.

The present television plan is based on a nominal co-channel separation of 150 miles and an adjacent channel separation of 75 miles. The following single station limitations for 1 per cent of the time will occur on the basis of the best data presently available.

	Co-channel	*Adjacent channel*
45 mc.	2200 μv/m	520 μv/m
84 mc.	6000	1100
200 mc.	between 8500–15500[1]	2300

[1] The lower figure is obtained from interpolation of data in the vicinity of 100 mc. The upper is obtained from an extrapolation of available data for 150 miles distance and a frequency of 200 mc.

In order that two television stations will not cause interference for more than 1 per cent of the time, separations in the order of the following should be used:

	Co-Channel	*Adjacent Channel*
45 mc.	270 miles	120
84 mc.	300[2]	140
200 mc.	300[2]	180

[2] There is no data for these frequencies at these distances; the distances given represent estimates from available data.

While the separations indicated in the above may not prove to be feasible from an administrative standpoint, we should be realistic and not assume that 100 per cent service will be rendered to the boundary of the 500 microvolt contour.

It should be noted that the available information indicates that the tropospheric signal exceeded for 1 per cent of the time increases with frequency in these ranges at distances in the vicinity of 100 miles but may tend to become comparable in the range from 200 to 300 miles.

As we go from 60 to 44 mc., occurrences of F layer transmission will increase by a factor of 50 and Sporadic E by a factor of 10 for the same range. A determination that frequencies above 60 mc. are undesirable imply that Channel 1 would be unusable. It is doubted that any real utility would be obtained from Channel 1 when it became occupied by television and sharing stations.

In conclusion, it is recommended that:

(a) If any weight is given the long distance transmission characteristics of frequencies between 44 and 88 mc., it would be inconsistent to retain Channel 1, even temporary, especially on a shared basis. It appears that television could very well afford to give up channels 1 and 2, which could be put to good use by other services.

(b) While the incorporation of all the television channels in a continuous block would be desirable in making an original allocation, it does not appear that a wholesale reallocation is justified by the facts known at this time. There do not appear to be any overwhelming practical disadvantages to the use of the four channels between 60 and 88 mc. for television broadcasting.

(c) The determination of the channel requirements for television and the allocation of television stations be based upon mileage separations which make allowance for tropospheric transmission. In the alternative, the service contours should be corrected for the limitation due to tropospheric signals.

E. W. Allen

The statements in Mr. Allen's letter indicate that the FCC's Technical Information Division has come to accept the facts established by the laws of radio propagation. Also apparent is the belated agreement with the advice on this subject given to the Radio Technical Planning Board by Dr. Dellinger of the Bureau of Standards, in 1944 when new allocations were under consideration.

* * * *

One of the witnesses before the House Committee on Interstate and Foreign Commerce, March 31, 1948, was Dr. Charles B. Jolliffe, executive vice-president in charge of RCA Laboratories.

From March, 1930 to November, 1935, when he joined RCA, he was Chief Engineer of FRC and its successor, the FCC. His testimony before the House Committee,[3] concerning the history of high-frequency communications has been published by RCA. The circulation of this pamphlet has called forth the following caustic comment from Major Armstrong in a letter to the Editor. Following is the complete text, dated June 28, 1948:

[3] Dr. Jolliffe's testimony is contained in a booklet which can be obtained from the Department of Information, Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y.

June 28, 1948

To the Editor,
FM and Television

The Radio Corporation of America is circulating widely a booklet entitled "Statement of Dr. Charles B. Jolliffe, Executive Vice President in Charge, RCA Laboratories Division, Radio Corporation of America, before House Committee on Interstate and Foreign Commerce, March 31, 1948."

This booklet contains the testimony given by Dr. C. B. Jolliffe before the House Committee on Interstate and Foreign Commerce, which held a series of hearings on H.J.Res. 78, a Bill introduced by Congressman Lemke of North Dakota providing for the assignment by law of channel space in the vicinity of 50 megacycles for the FM service to provide rural coverage in the United States.

Dr. Jolliffe attempts by his testimony to refute evidence in the record given by other witnesses and myself. That evidence showed that the Radio Corporation of America had endeavored to discourage and to block the introduction of FM broadcasting for its own particular advantage. That history of FM development is well known to most of your readers; and in any event the points of Dr. Jolliffe's testimony which were germane to the hearing were fully answered before the Senate Committee on Interstate and Foreign Commerce.

Those of your readers who are interested in obtaining the full report of all the proceedings will find them in the records of the hearings held, respectively, by the Committee on Interstate and Foreign Commerce, House of Representatives; and the corresponding Committee on Interstate and Foreign Commerce of the United States Senate.

Dr. Jolliffe's version of FM history — a subject of which he has little first hand knowledge — will not be taken seriously in the industry, where the facts are pretty generally known. It will be recognized as a history written by lawyers, to bolster up a weak case. But Dr. Jolliffe and his lawyers do not stop with the rewriting of modern radio history. They go back also into ancient history, which is not so generally known, and they rewrite an important chapter of that history, distorting it so as to make RCA the chief actor in a drama where its actual role was a minor one. You readers will be interested in this excellent example of word-twisting and phrase-making to paint a picture utterly unlike the reality of what actually happened.

The statements in question appear on page 25 of the booklet and are as follows:

"It is history that RCA's transoceanic communication business was founded on the Alexanderson alternator, one of the great radio inventions of all time. Millions were invested by RCA at Rocky Point, Long Island, and elsewhere, in Alexanderson alternators, and wide publicity was given to them. The Alexanderson alternator operated on very low frequencies from 18 to 26 kilocycles.

"In spite of this investment, RCA commenced research in the higher frequencies during the very period it was completing the installation of its alternators. And by 1923 this research had borne fruit. In that year RCA began the installation of short wave apparatus in connection with transoceanic communication. An ultimate result of this and of the electron tube was to obsolete the very equipment (the alternators) on which a large part of RCA's business had been built. This came in 1927, when the fact of obsolescence was faced, and a special reserve of $4,500,000 was provided out of earnings that year as a recognition of the price of progress."

It is true that RCA's transoceanic communication business was founded on the Alexanderson alternator, but it is not true that the worldwide revolution in communication which brought about the obsolescence of the alternator was an ultimate result of anything that the Radio Corporation did. That revolution was brought about by a great discovery by Marconi and by one of the finest pieces of pioneer engineering in the history of the art by one of Marconi's associates, C. S. Franklin.

Marconi uncovered the unbelievable fact that if one went to a short enough wavelength an axiom of radio communications that had been drilled into the mind of every radio engineer since the beginning of radio, i.e., that short waves were useless for daylight transmission, was no longer an axiom. In fact unbelievably good transmission over thousands of miles could be obtained because of a natural phenomenon previously undreamed of — that of transmission by reflection during daylight hours from an ionized layer of the upper atmosphere (the F-2 layer).

To those who for years had sat through the night watches, as the writer has done on innumerable occasions, to witness the inevitable morning "fade," this will probably rank as the most astounding discovery of all time. It was the missing link that was to make short-wave signalling a practical reality, and start the revolution in worldwide communication.

Franklin completed the revolution begun by Marconi with the development of his epoch-making beam system. He it was who first visualized and engineered the system introduced by the British Marconi Company, and established by them on a worldwide basis before the Radio Corporation of America had awakened to what was going on. By a series of chance occurrences the writer happened to have had a unique insight into the awakening of the Radio Corporation to the greatness of Franklin's work. The circumstances of that insight were the following:

(*Continued on Page 60*)

SPOT NEWS NOTES

ITEMS AND COMMENTS, PERSONAL AND OTHERWISE, ABOUT MANUFACTURING, BROADCASTING, COMMUNICATIONS, AND TELEVISION ACTIVITIES

Madame Commissioner:

Nomination of Miss Frieda B. Hennock as a member of the FCC was confirmed by the Senate on June 20. Her term as Commissioner is for seven years, running to June 30, 1955.

New Engineering Firm:

Communications Research Corporation has been formed by three outstanding specialists. President is William S. Halstead, consultant to Rural Radio Network and formerly president of Halstead Traffic Communications; Murray G. Crosby, of Crosby Laboratories, is vice president in charge of engineering; and Dr. Miller McClintock, senior consultant to Rural Radio Network, is board chairman. Offices are at 60 East 42nd Street, New York.

FM-AM Set at $49.95:

Zenith Radio is in full production on an FM-AM table model that makes the Armstrong FM circuit available for the first time at a price below $50. Performance is described as giving the sensitivity and noise-eliminating characteristics of genuine FM receivers.

Charles R. Denny, Jr.:

Former FCC Chairman who joined NBC as vice president and general counsel last November has been made executive vice president. This gives Mr. Denny the supervision of all NBC activities, on which he will report directly to president Niles Trammell. Under this new setup, Mr. Denny succeeds Frank E. Mullen, who resigned in May to join the G. A. Richardson station as president. Gustav B. Margraf, NBC's Washington attorney, moves up to the post of vice president and general counsel.

Milestone of TV Progress:

Smart planning and skillful engineering made the TV coverage of the Republican Convention at Philadelphia an unqualified success. Effective handling by all concerned gave reassurance that TV has now reached the stage where it can perform outstanding public service. Eighteen stations were connected by cables or relays. They were: WBAL-TV and WMAR-TV Baltimore; WBZ-TV and WNAC-TV Boston; WATV Newark; WABD, WCBS-TV, WNBT, and WPIX New York; WCAU-TV, WFIL-TV, WPTZ Philadelphia; WTRV Richmond; WRGB Schenectady; WMAL-TV, WNBW, WTTG Washington. Control room facilities were handled alternately by ABC, CBS, Du Mont, and NBC.

Western FM Network:

Opened officially on June 28, comprises 58-kw. KKLA, Los Angeles independent, and KWFM, independent San Diego station. Other stations will extend the net to San Francisco. Policy of operations is explained by David S. Ballou: "FM is in direct competition with AM, and programs are being developed to meet this challenge."

Pipe Line Maintenance:

Buckeye Pipe Line Company, Lima, Ohio, parent company of Northern Pipe Line and New York Transit, will replace wire phone with 2-way FM communications. Lines extend through Indiana, Pennsylvania, Ohio, and into New York, with branches in Illinois and Michigan. Initial installation of 5 fixed stations and 100 mobile units will be supplied by Motorola.

New Sales Policy:

Bendix Radio has shifted to direct-to-dealer distribution. New plan features factory shipments, prepaid freight, and nationally advertised prices competitive with mail order houses.

Long-Distance TV Reception:

WCBS-TV New York reports reception of their signals for 1½ hours by Conrad Harrington, Little Rock, Ark., at a distance of 1,100 miles, on June 4.

Two FCC Investigations:

Separate investigations of the FCC are to be conducted by the House Select Committee and the Senate Interstate Commerce Committee. Presumably, Senator Tobey will make good his promise to put Kenneth Norton and former FCC Chairman Porter on the stand, under oath, to testify concerning the alteration of the records of the secret FCC hearing on interference at 40 to 50 mc.

Correction, Please:

In our June issue, the address of Mr. A. H. Sherrin, whose radio-phonograph installation was shown on the front cover, was given as Summit, N. J. His correct address is 30 Hillcrest Road, Glen Ridge, N. J.

Stratovision Demonstration:

On June 23, Westinghouse and Glenn Martin staged a dramatic press demonstration of long-distance Stratovision reception at Zanesville, Ohio. A detailed report of this event and a discussion of Stratovision broadcasting is being prepared for publication in our August issue.

Andrew Alford:

Newcomer to our Professional Directory is engineering consultant Andrew Alford. Although best known for his work on antennas, his laboratory handles a very wide range of development work, including the manufacture of pilot models.

FMA Convention:

Annual meeting and exhibit of FM sets and broadcasting equipment at Hotel Sheraton, Chicago, September 27–29, will establish 1949 plans for audience building. Frank discussions between broadcasters and set manufacturers are expected to bring a record attendance. More production and sales promotion will be demanded of manufacturers. Broadcasters will be put on the pan for excessive use of low-fidelity records. Result will be a dog-fight worth attending, and should produce specific plans for rapid FM progress in '49.

San Francisco Audio Society:

Organization meeting was attended by thirty audio specialists on June 22. Information on meetings and membership can be obtained from Frank Haylock, 190 Hickory Lane, San Mateo, Calif.

Nothing New:

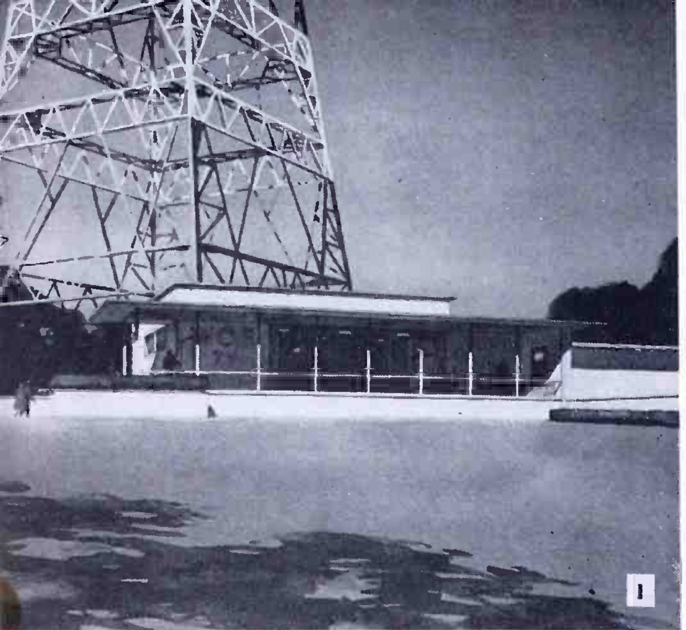
Informal talk by acting FCC Chief Engineer John A. Willoughby before the South Carolina Broadcasters Association, when he voiced the personal opinion that TV channels 2 to 6 may be assigned to mobile communications within two years, has been greeted with dismay and consternation. Actually, his comments should not come as a surprise, for Chairman Coy warned of this change at his IRE speech on March 23, 1948, and more emphatically in his NAB speech on May 18. These speeches were published in full in our April and June issues. Details of FCC plans will come to light after the upper-band hearing which starts September 20.

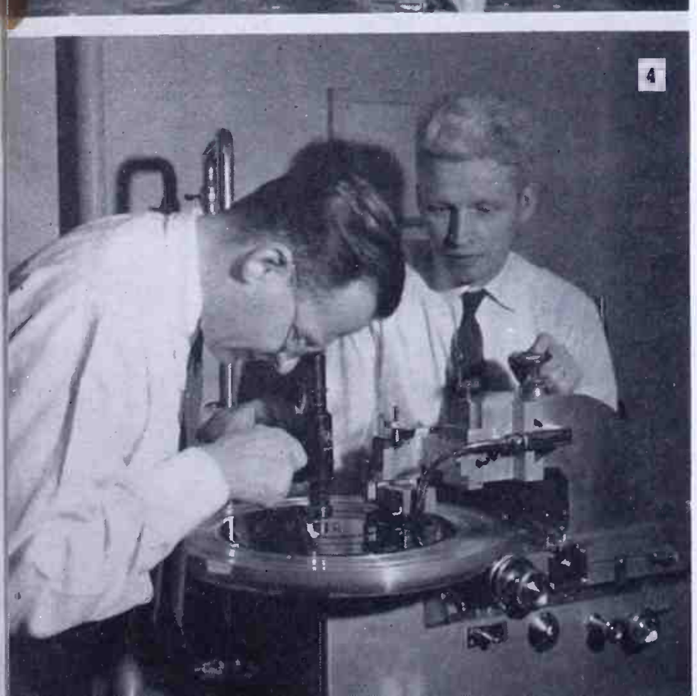
Eastern Office:

An eastern sales office has been opened by Andrew Corporation at 421 Seventh Ave., New York. James F. White, will be in charge, assisted by Paul F. Walker. Both were previously at Chicago headquarters.

APCO Conference:

With radio communications men from all fields invited to attend the national conference of the Associated Police Communications Officers, Inc., this event at Houston, Tex., will set a record in attendance and number of exhibitors. Date is September 20–23. Information can be obtained from Paul Franklin, Radio Supervisor, Houston Police Department.





NEWS PICTURES

1. Artist's sketch of transmitter building and tower base for WOR-TV and WBAM, under construction at North Bergen, N. J., across the Hudson River from New York City. The new TV transmitter will be a GE type 6B, with 5 kw. video and 2½ kw. audio output.

2. Hewlett-Packard is completing an ultra-modern addition to their instrument plant at Palo Alto, Calif. Features of the 20,000-sq. ft. structure are radiant heating, steel truss construction for maximum unobstructed floor space, sound insulation, and color-conditioning.

3. As a special public service, Keystone Automobile Club, Philadelphia, equipped three of its service jeeps with Philco TV receivers, and stationed them at strategic points during the Republican Convention. The idea, suggested by WCAU-TV, was carried out by Philco project engineer Joseph Fisher, left. Filament current was supplied to TV set by one 6-volt storage battery, while two others operated Mallory Vibropacks supplying high voltages.

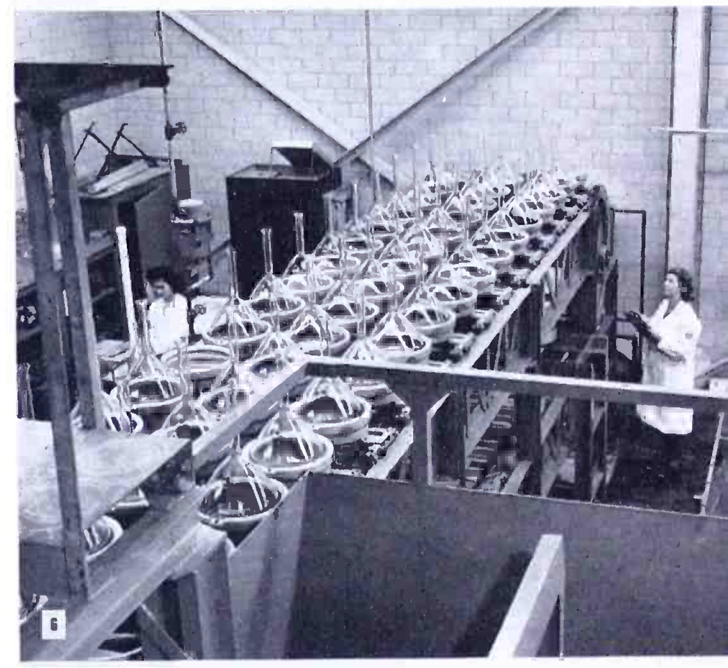
4. Columbia's long-playing Vinylite records are cut at 224 to 300 grooves per inch, instead of the conventional 90 grooves. Still, lateral cutting is employed. This Microgroove record development was carried out by Dr. Peter C. Goldmark, left, CBS Director of research and development. Right, project engineer Rene Snepvangers.

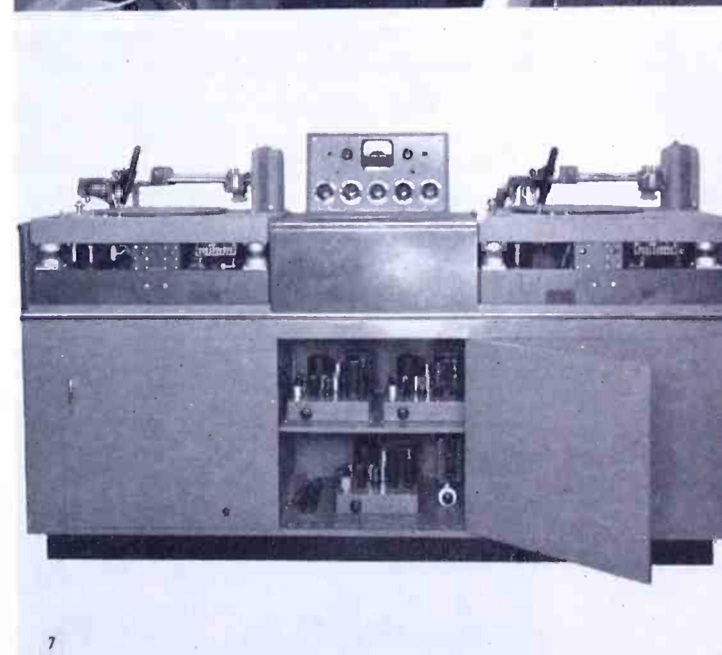
5. Scioto Broadcasting Company has erected this WPAY-FM transmitter on the highest ground between Pittsburgh and Louisville. A 3-kw. RCA transmitter at 104.1 mc. works into a 2-section Pylon antenna on a 173-ft. Truscon tower.

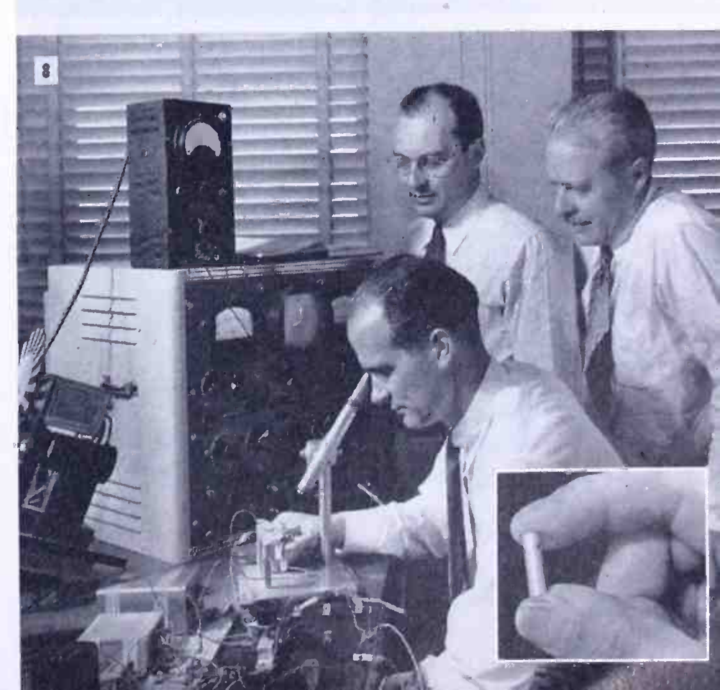
6. First of three giant settling machines installed at RCA's Lancaster tube plant. Handling 144 cathode-ray tubes at a time, this machine handles the application of the luminescent coating to the tube face. Previously, this delicate process was a manual operation.

7. Custom-built dual recorder and control console built by RCA for WKJG and WKJG-FM Fort Wayne. Either recorder can be used by itself, or both operated simultaneously, and either can be monitored during operation.

8. Tiny Transistor, developed at Bell Laboratories, performs functions of an amplifier or oscillator tube, although it has no vacuum, grid, plate, or filament. Instead it has only two thin wires touching a pin-head of semi-conductive material. Participating in Transistor research were, l. to r., Drs. William Shockley, John Bardeen, Walter H. Brattain.







NEW AF AMPLIFIER KIT

EQUIVALENT OF ALTEC LANSING A-323B AMPLIFIER IS AVAILABLE IN LOW-COST KIT—*By* H. S. MORRIS *

FIG. 1. *Appearance of the assembled kit*

FOR the benefit of that select and romantic breed of engineers who are never satisfied unless they can build their own equipment, and who have yearned for what the Altec Lansing A-323B amplifier does for high quality reception, a special kit of parts is now available. The kit consists of output and power transformers, low-pass scratch-equalizer coil, RC board, and a punched steel chassis, complete with schematic and wiring diagram. All other parts, such as sockets, condensers, resistors, and controls, are standard and procurable through any parts jobber.

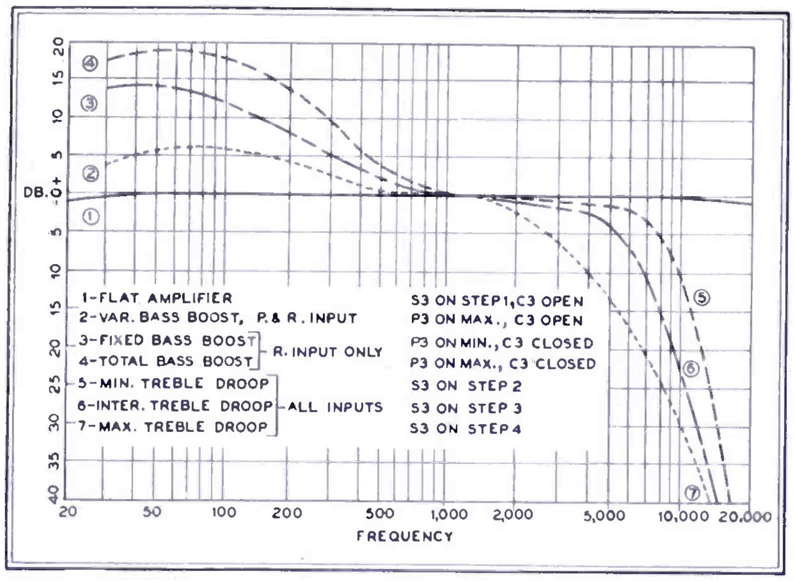
* Altec Lansing Corporation, 161 Sixth Avenue, New York.

The assembled amplifier, Fig. 1, is equivalent to the famous Altec Lansing A-323B, at approximately one-half its normal retail price.

This model, introduced a year ago, is designed as a medium-priced, top-quality amplifier, incorporating several unique features directed specifically to the requirements of home phonograph and radio systems.

Although nominally rated at 15 watts, by means of a well-designed and relatively expensive output transformer, it is designed to deliver full rated power within 1 db from 35 to 12,000 cycles. This power rating should not be confused with frequency response ratings commonly given on commercial amplifiers. It is the ability to deliver power at the very low end and at the very high end of the spectrum that

(*Continued on page 57*)



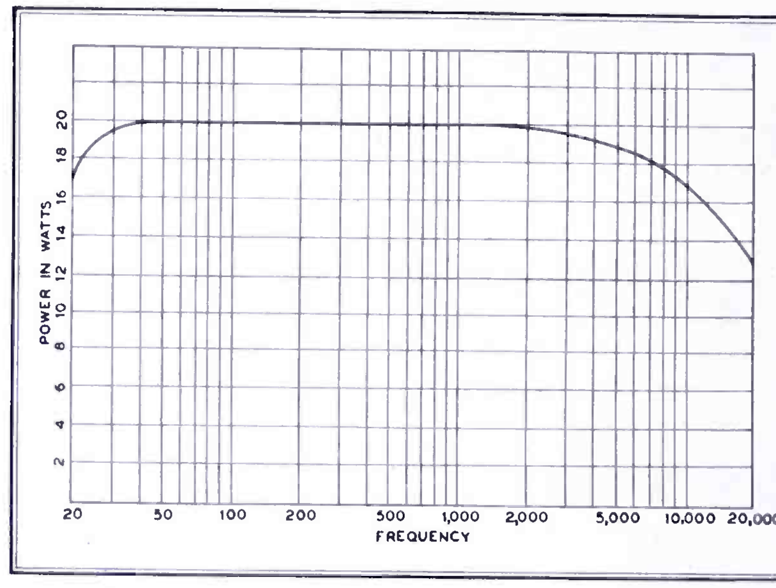


FIG. 2. *Audio characteristics of the four-position equalizer circuit.* FIG. 3. *The power output plotted against frequency*

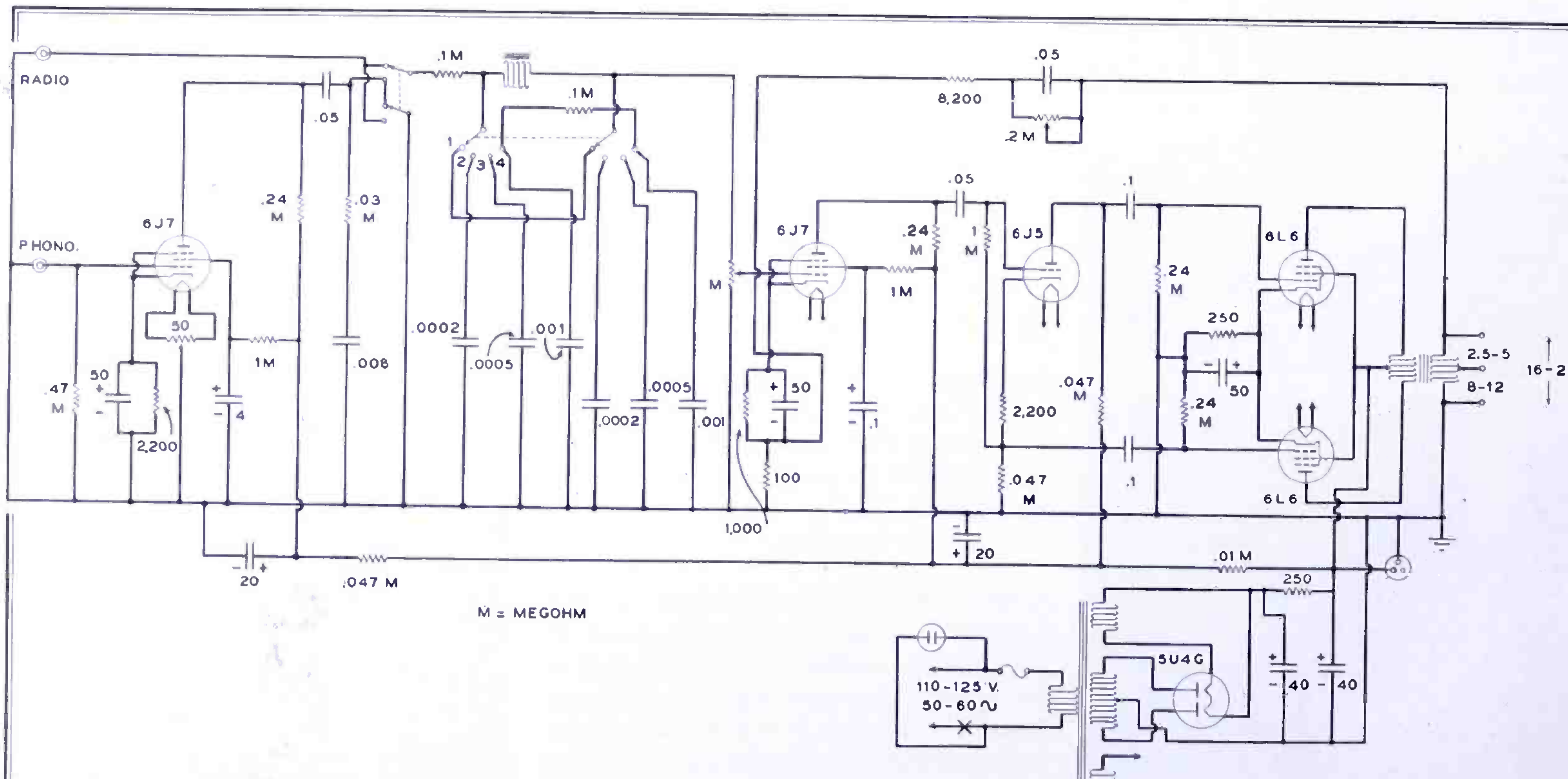


FIG. 4. *Schematic diagram of the Altec Lansing power amplifier. On radio, the radio-phono switch cuts out the first stage*

MICROWAVE HANDBOOK

CHAPTER 4: PRESENTING THE FONDA-FREEDMAN CONCEPT OF OPERATING CONVENTIONAL-TYPE VACUUM TUBES AT MICROWAVE FREQUENCIES—*By* SAMUEL FREEDMAN

4.1 Discussion:

THE normal concept of conventional vacuum tube behavior is that every tube has an upper frequency limit where oscillation stops. Fonda and Freedman have modified this concept by stating that such a limit only holds true with respect to a single period of oscillation. For example, they claim that can be true when the transit time for electrons from cathode to plate is less than the time it takes one cycle to develop at any particular frequency, but more than a certain fraction of that time.

By normal tube circuit concepts, the output frequency increases (wave length decreases) as the lumped and/or distributed inductance and capacitance of any conventional circuit is decreased. A limit is reached when there remains no more inductance or capacitance to be reduced external to the tube itself. This limit is somewhere between 50 and 300 mc. for mass-produced types of conventional vacuum tubes. This is considered to be the "end of the road" for conventional tubes on the higher frequencies. However, since 1944, Fonda and Freedman have advocated a new technique now known as the "Electron Grouping" principle which makes the previously-accepted frequency limit fall just short of the "beginning of a new road." This involves circuit detours, but makes it possible to use conventional tubes a still-undetermined distance through the ultra-high frequency band and into the super-high frequency spectrum. The inductance and capacitance of the circuitry external to the tube can be overcome by using the circuit on its higher harmonics. Fonda and Freedman claim that the circuit stops oscillating because of phase reversal due to transit time. This they solve by making the transit time from cathode to plate correspond to a multiple of periods of oscillation.

Forgetting the electron grouping principle for the moment, and thinking conventionally, a tube of conventional structure such as a common triode or tetrode is not supposed to be capable of generating microwaves largely because of:

1. The amount of capacitance existing between the metallic electrodes within a vacuum tube. This is called inter-electrode capacitance.

2. The time it takes an electron to travel from its source (cathode) to its destination (anode or plate). This transit time causes a phase shift.

3. The condition which causes the grid to develop power dissipation exceeding the plate output is called grid conductance.

4. Radiation and dielectric losses. These are appreciable as the frequency is increased, but are not prohibitive in magnitude.

It has therefore been commonly believed that it is impossible or impractical to generate frequencies higher than the limit indicated by the lead inductances

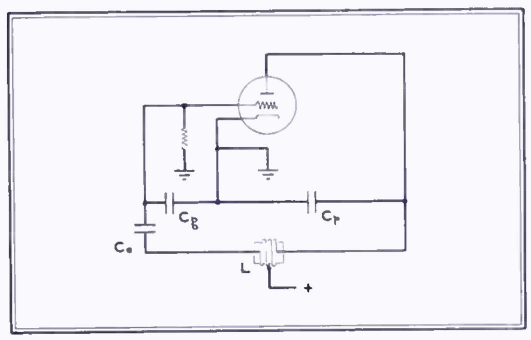


FIG. 26. *Conventional Colpitts circuit for operation on the lower frequencies*

and distributed capacitances of the cathode-grid-anode and any other electrode structures present in conventional tube. The small but appreciable values of inductance and capacitance combine to represent a tuned circuit or circuits that cannot resonate in what is considered to be the true microwave spectrum.

4.2 Inter-Electrode Capacitance:

The simplest triode tube used in radio communications as an oscillator or

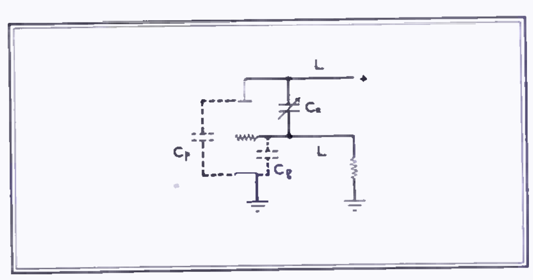


FIG. 27. *Equivalent elements in a circuit designed for microwave frequencies*

amplifier comprises the following electrodes:

1. Cathode (filament), producing electrons.
2. Grid, controlling the electrons.
3. Anode (plate), gathering electrons.

The amount of metal in each electrode determines its inductance. The composition of that metal determines its resistance. The spaces between the electrodes determine the length of the electron path and the inter-electrode capacitances.

In the case of a diode, there is one inter-electrode space which, with the two electrodes, becomes the cathode-plate inter-electrode capacitance.

In the case of a triode, there are three inter-electrode spaces which, similarly, create cathode-grid, cathode-plate and grid-plate capacitances.

The number of inter-electrode capacitances increases as the number of electrodes are increased as follows:

Type of Tube	No. of Elements	No. of Inter-Electrode Spaces
Diode	2	1
Triode	3	3
Tetrode	4	6
Pentode	5	10

For example, a five-element tube may have 10 inter-electrode spaces or inter-electrode capacitances. Considering the cathode A, control grid B, screen grid C, suppressor grid D, and plate E, the following inter-electrode capacitances are developed:

1. A to B
2. A to C
3. A to D
4. A to E
5. B to C
6. B to D
7. B to E
8. C to D
9. C to E
10. D to E

It should be realized, therefore, that every bit of inductance in the form of metallic electrodes and their leads out of the tube will have resistance and reactance, just as is the case with inductances external to the tube. Also, the inter-electrode capacitances and inter-lead capacitances have the same effect as equivalent, separated conductors in any external circuit.

Fig. 26 is a conventional type of Colpitts circuit used for lower frequencies. Fig. 27 is the exact equivalent of that circuit when used for microwaves. In Fig. 26, C_p is lumped, external capacitance provided in the conventional low-frequency circuit, or the inter-electrode capacitance between the cathode and the plate for the microwave oscillator. C_g, instead of being provided externally as lumped capacitance, is provided in the form of inter-electrode capacitance between the cathode and the grid. Lumped Inductance L in Fig. 26 is replaced in Fig. 27 by distributed inductance L in the circuit connections, the plate and grid electrodes, their connections, tube prongs, and socket prongs. The microwave transmitter, operating on higher frequencies, finds those small amounts of capacitance and inductance sufficient for its LC requirements. At lower frequencies, those amounts are negligible, and larger values must be provided externally. Padding condenser C_e may be a tiny trimmer condenser in the case of the microwave oscillator, whereas it must be a condenser of large capacity for the conventional lower-frequency oscillator. In fact, C_e need not even be specifically provided in the microwave oscillator, as it may exist in the form of distributed capacitance represented by the separation between both L sections. The LC can be changed by changing the lateral distance between the L sections or the length of the L sections.

High inter-electrode capacitance means high charging currents and relatively high ohmic losses in the circuit. When these ohmic losses are too high, the tube fails to oscillate. An average inter-electrode capacitance for a conventional tube might be 5 mmf., varying with different tube structures. Such a value of capacitance is equivalent to 31,400,000 electrons per volt.

In general, a low-frequency circuit is clumsier and less efficient than a high-frequency circuit. There is more of everything to provide and energize in order to get similar results. A microwave transmitter of fractional-watt power output can send a stronger signal farther than can any low-frequency transmitter of the same power. The exception is where the size of atmospheric particles in free space is appreciable with respect to the operating wave length.

4.3 Transit Time & Phase Shift:

The real reason why conventional tubes have not been considered practicable for the generation of microwave frequencies has to do with transit time. Inter-electrode capacity is not the limiting factor of many conventional tube types, at least at frequencies at the lower end of the microwave band.

It takes a definite amount of time for an electron released from the cathode by heat to reach the anode or plate. It is in the order of 1/1,000,000,000 second. This is a negligible amount as compared to the time required for one cycle at the lower radio frequencies. However, it may equal or even exceed the time of one cycle at microwave frequencies. The velocity of electron-travel between the tube elements can be anything from above zero to below the velocity of light. It depends upon:

1. The length of the electron transit path from cathode to plate.

2. The amount of acceleration offered when the grid is increasingly positive, or deceleration when the grid is increasingly negative, with respect to the cathode. When the grid bias is made more positive, or less negative, the effect is the same as shortening the electron path, since the electrons travel at greater velocity. When the grid bias is less positive, or more negative, it is equivalent to increasing the electron path, since the electrons then travel at less velocity. If the grid is too highly positive, it usurps the function of the anode, capturing an excessive number of electrons intended for the anode. If the grid is too highly negative, a condition develops where the cathode is more positive, or less negative, than the grid. Electrons will be either stopped, kept at, or returned to the cathode source.

Acceleration by the grid is equivalent to a shorter electron path which, otherwise, could only be obtained by closer inter-electrode spacing. Closer inter-electrode spacing, as in the case of any condenser made up of two metallic plates separated by a dielectric, increases the inter-electrode capacitance. Capacitance increases with increased area of the plates, and the decreased separation between those plates. Capacitance decreases with a decrease of the surface areas and with an increase in the separation between those plates. Those basic principles of condenser design also apply to vacuum tubes.

3. How much more positive, or how much less negative, the anode or plate is with respect to the grid and the cathode. The more highly positive bias maintained on the plate, the greater the equivalence to a shorter electron path so far as transit time is concerned. The less positive, or more highly negative, the plate is with respect to the cathode (also grid), the greater the equivalence to a longer electron path in transit time. An electrode will be positive with respect to another electrode if it has a higher potential of the same polarity than the other, regardless of polarity (positive or negative). It will be negative with respect to another electrode if it has a lower potential of the same polarity. The electrons will be repelled in the latter case and attracted in the former case.

Fig. 28 is a calculated graph showing the electron transit time for electron paths of various lengths and various plate voltages. Transit time in microseconds is plotted against the cathode-plate separation, or length of the electron path, in centimeters. The transit time can be found by projecting horizontally to the left side of the figure from the point of intersection of the diagonal line tagged with the required voltage and the vertical line corresponding to the distance read on the base of the graph. No space charge limitation is presumed to exist for the current in the tube, and each electron is presumed to move under the influence of the plate or anodic field only. It becomes different and difficult to lay out graphs for such a wide range of values if the effects of space charge and grids are present.

However, Fig. 28 clearly indicates that the required voltage increases rapidly if the distance is increased and the transit

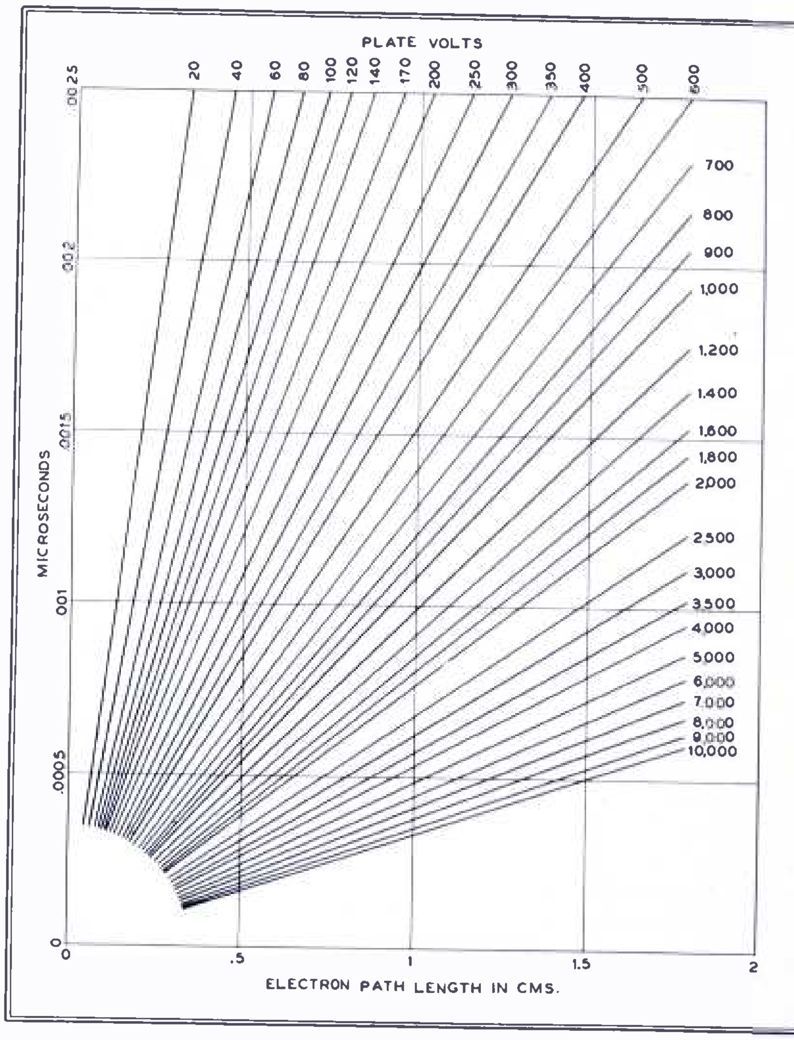


FIG. 28. *Calculated graph of electron transit time against the length of the electron path, at various values of plate voltage*

time held constant, or the transit time decreased without reducing the distance.

Example: For an electron path of .5 cm. (.2 in.), a potential of 300 volts requires a transit time of .001 microsecond. In order to halve this transit time (.005 microsecond), it is necessary to either reduce the electron path to .25 cm. in the case of 300 volts plate potential, or to increase the potential 4 times to 1,200 volts in the case of .5-cm. electron path.

Any value of transit time, plate voltage and electron path can be computed from the following basic equation:

$$\Delta t = D \frac{2}{V} \frac{m}{e}$$

Δt = transit time in seconds.
D = distance in meters between cathode and plate.
V = voltage difference between cathode and plate.
m = mass of 1 electron in kilograms.
e = charge of 1 electron in coulombs.

$\frac{m}{e}$ is a constant equal to .599 × 10–11

The normal condition in any conventional tube, by usual concepts, is for the electron transit time to be too long. Even if it is not long enough to stop the tube from oscillating, it is long enough to cause the electrons to arrive at a time other than during optimum phase. No tube can oscillate if, in the course of electron travel along its electron path from cathode to plate, it arrives at the plate at a time when a RF phase reversal has taken place. Conventional concepts require that the electron leaving the cathode must arrive at the plate in phase *during the same RF alternation.* Fonda and Freedman, with their electron grouping principle, have modified this concept by claiming "the electron leaving the cathode must arrive at the plate in phase during either the same or *any subsequent RF alternation of identical phase.*"

Fig. 29 shows when power can be developed from a conventional tube (on the upper or positive RF alternation) and when power output cannot be developed (on the lower or negative RF alternation). Even during correct phase alternation, the efficiency varies between zero and maximum. For example, at 1 mc., assuming that a conventional tube with normal electrode voltages requires .001 microsecond for an electron to travel from cathode to plate, it will require 1/.001 or a thousandth part of a period of oscillation for an electron to negotiate that distance. This is equivalent to $^{360}/_{1000}$ or .36 degree phase shift. It will arrive at the plate with negligible change in phase. Maximum power output will be obtained. However, this effect begins to change adversely as the frequency is increased. The following are examples for the same amount of transit time and the same tube.

This results in two schools of thought. The majority group, represented by

Frequency Region	Phase Shift
29 mc. Amateur	10.44°
60 mc. Television	21.6 °
108 mc. FM Broadcasting	38.88°
157 mc. Mobile Radio	56.52°
250 mc. ..... Zero Output	90.00°

Wrong Alternation, Zero Performance	
465 mc. Citizens Radio	167.40°
950 mc. Relay Radio	342.00°
3256 mc. Marker Beacons	1172.16°
4000 mc. Microwave Relays	1440.00°
5800 mc. Amateur Band	2088.00°
9375 mc. Marine Radar	3375.00°
31000 mc. Experimental	11160.00°

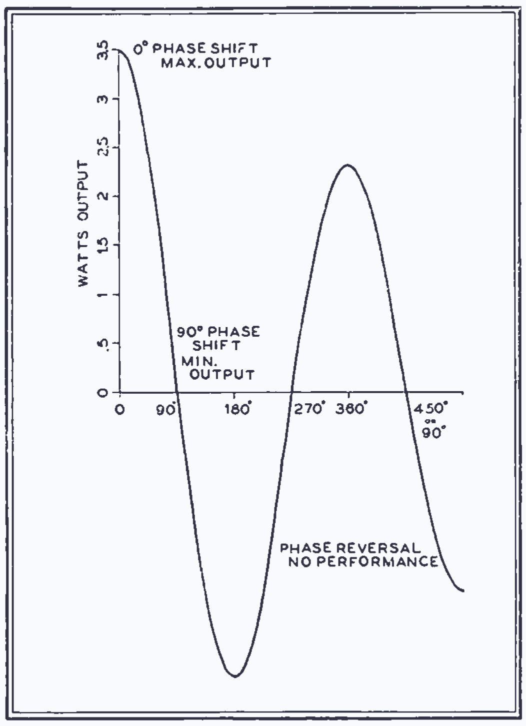


FIG. 29. *Conventional tube develops power on upper or positive RF alternation only*

standard practice to date resulting from initial microwave applications during World War II, claim that conventional tubes cease to function at about the 250-mc. point in the example above. Disk-seal, Klystron and Magnetron tubes have been used for higher frequencies. The new thinking holds that conventional tubes will continue to function under the conditions illustrated in Fig. 29. On the basis of this reasoning, a conventional tube, in the case of the conditions used for the example above, should not only function below 250 mc. but also at such bands as 950 and 1440 mc. It should not function at such bands as 465 and 3,256 ms. In order to function on frequencies with unfavorable phase (465 and 3,256 mc. in the example), it is necessary to produce favorable phase conditions by changing the tube transit time. Fonda and Freedman propose the conventional grid-and-plate-out-of-phase method where functioning is indicated in the example. They propose the grid-and-plate-in-phase method (non-conventional way) where functioning is not indicated. This will make the tube function in the region between 90 and 270° and fail to function for the opposite alternations of Fig. 29.

In June 1947, DeMornay Budd Inc. made their facilities available for developing the necessary simplified cavity and waveguide plumbing to employ this technique. In October 1947, the National Bureau of Standards gave that firm an initial contract to prove or disprove the ability of conventional tubes to generate microwaves in the region between 300 and 3,000 mc. In March 1948, the U. S. Coast Guard awarded a contract to that firm for pilot models of Ramark Beacons on 3,256 mc., employing this principle. The first information on this equipment was released at the time of the 1948 IRE Convention in New York City.

4.4 Other Losses:

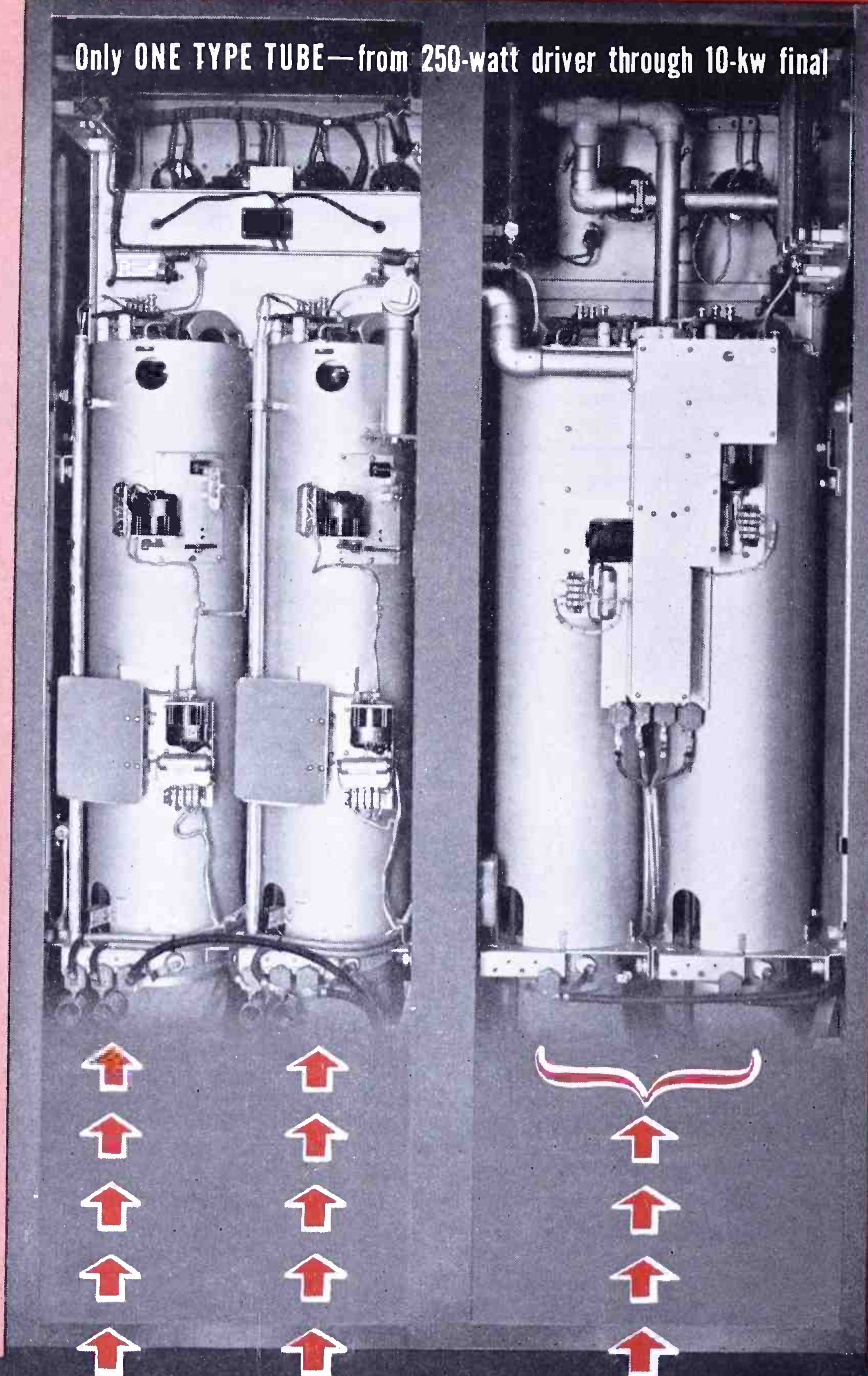
Grid conductance is a very relevant factor in utilizing conventional tubes on microwaves. Such conductance refers to the ratio between current and voltage in the grid circuit. It represents energy dissipation manifested by heating the plate, and depriving the latter of useful amounts of power. It may develop energy dissipation in the grid circuit which actually exceeds the plate output. When this condition is permitted to develop, the circuit ceases to oscillate.

When a conventional tube is operated at low frequency, and then the frequency is increased steadily toward its uppermost limit, the grid conductance increases because:

1. Electrons approaching and leaving the plane of the grid induce in the grid a voltage that may be in phase with the charging current. In this case, the electrons take power from the grid during the first part of their travel and give power back to the grid during the second part. If this travel ends before the completion of a whole period (as the electrons strike the plate), the energy taken in the first part exceeds that given back in the second part. This lost energy appears as heat on the plate.

2. The reactances of the resonant circuit between grid and plate require that voltage and current in this circuit be 90° out of phase. This means that there should be no power in this circuit except that required by the ohmic resistance and the load, if any. But, as has been the case normally, when the current arriving at the plate is *out of phase* with respect to the voltage, then the voltage appearing across the reactances of the circuit as a result of this current will be *in phase* with the current already circulating. This results in a dissipation of power which appears as heat on the plate.

The first approximation of grid input conductance is equal to the product of the mutual conductance of the tube, the signal frequency squared, the transit time from cathode to plate squared, and a constant for a particular tube.



1st Driver
uses one RCA-7C24
power triode

2nd Driver
uses one RCA-7C24
power triode

Power Amplifier
(parallel-connected) uses two
RCA-7C24 power triodes

Power Amplifier and Drivers of the RCA BTF-10B FM Transmitter

Each cylinder is a grounded external conductor for its respective stage. It houses one RCA-7C24 power triode in a grounded-grid circuit . . . provides perfect shielding for its inner conductor. No r-f radiation in transmitter room so no r-f pick-up in adjacent a-f circuits. Second, third, and final stages are motor-tuned. Circuit similarity makes it practical to use identical tubes, blowers, and components . . . saves you substantially in stocking spares.

BROADCAST EQUIPMENT

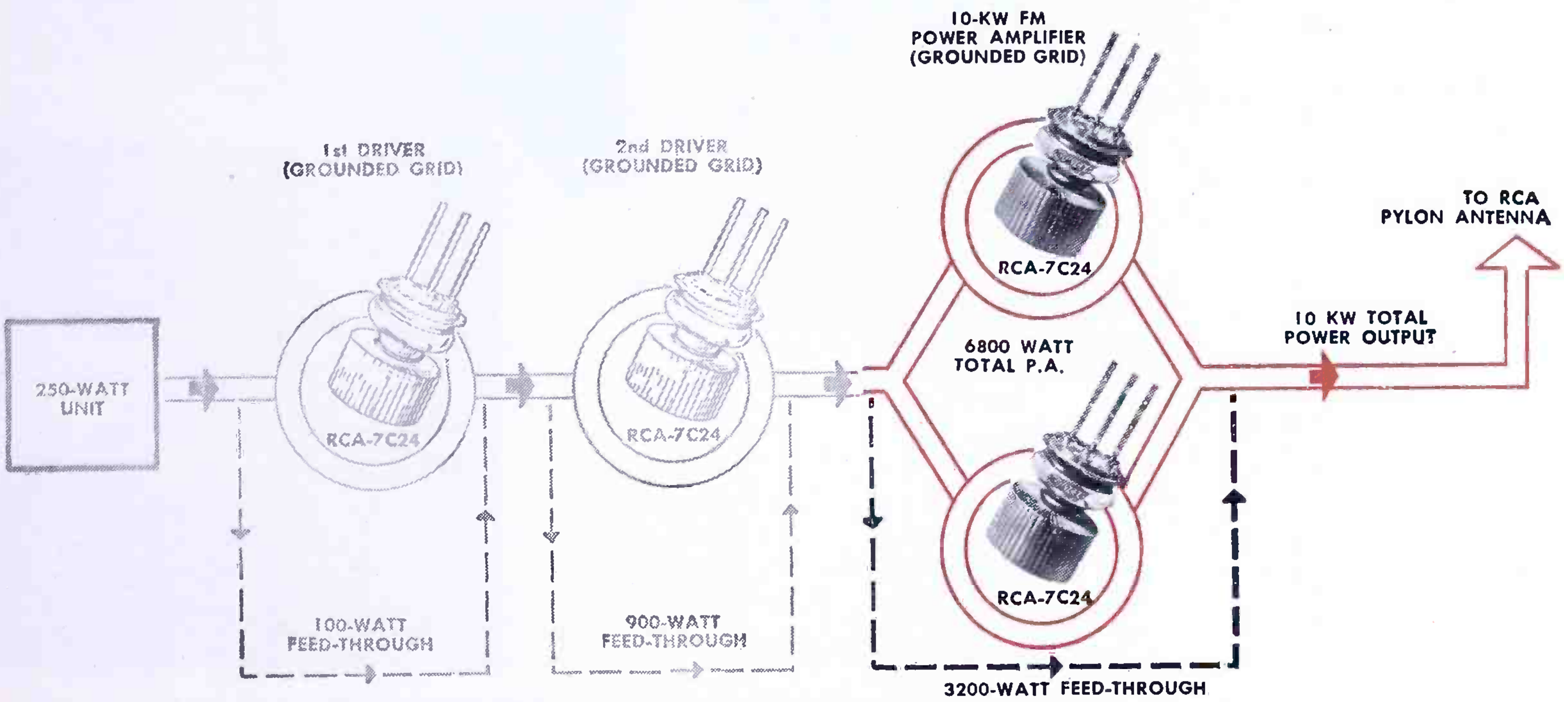
RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

$290.00 buys the two tubes in this 10-KW FM Amplifier

...because it uses high-stability grounded-grid circuits with power feed-through

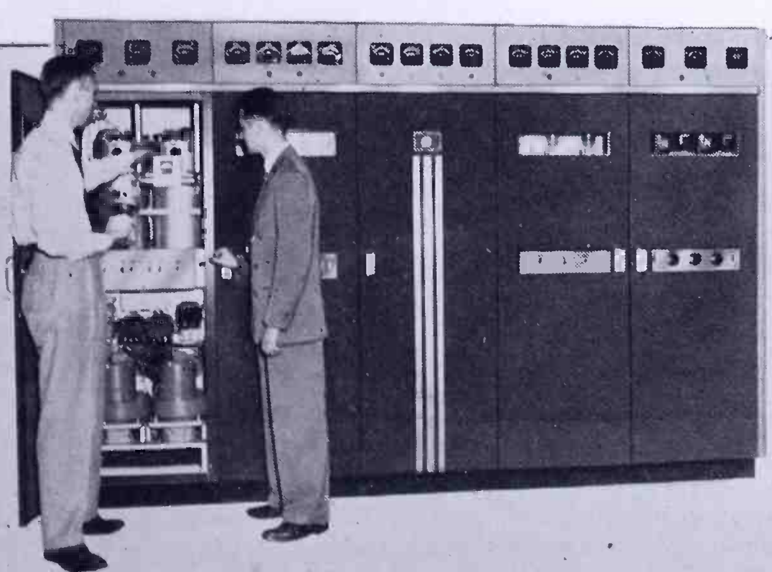


PLENTY OF REASON why RCA's revolutionary new 10-kw FM transmitter costs less to run . . . because this grounded-grid final power amplifier and 2-stage grounded-grid driver *share the load.*

Here, nearly 3200 watts of power from the drivers automatically add to the output of the final power amplifier—because the r-f input and output of each tube is in series . . . and in phase. Consequently, only four 7C24's are used in the entire transmitter.

In this 2-tube power amplifier and 2-stage driver, the tanks are concentric lines using RCA-7C24's in grounded-grid circuits. All tanks are similar. Each plate circuit is isolated from its grid circuit by perfect shielding. Benefits: neutralizing is unnecessary. Tuning is easier. Fewer parts are needed. *The tubes and nearly all the components in all four tanks are directly interchangeable.*

For full data on the BTF-10B . . . the 10-kw FM transmitter that requires only 22.5 kw to operate and uses only 14 basic tube types, and just *one* high-voltage power supply, see your RCA Broadcast Sales Engineer, or write Dept. 38-G.



The BTF-10B 10-kw FM Transmitter

Handsome to look at. Sweet to listen to. A genuine satisfaction to supervise. Saves you up to $1500 a year in running costs. The final amplifier is housed in the cubicle at the left. The drivers are housed in the cubicle next to it. Automatic cut-back is available as an accessory.

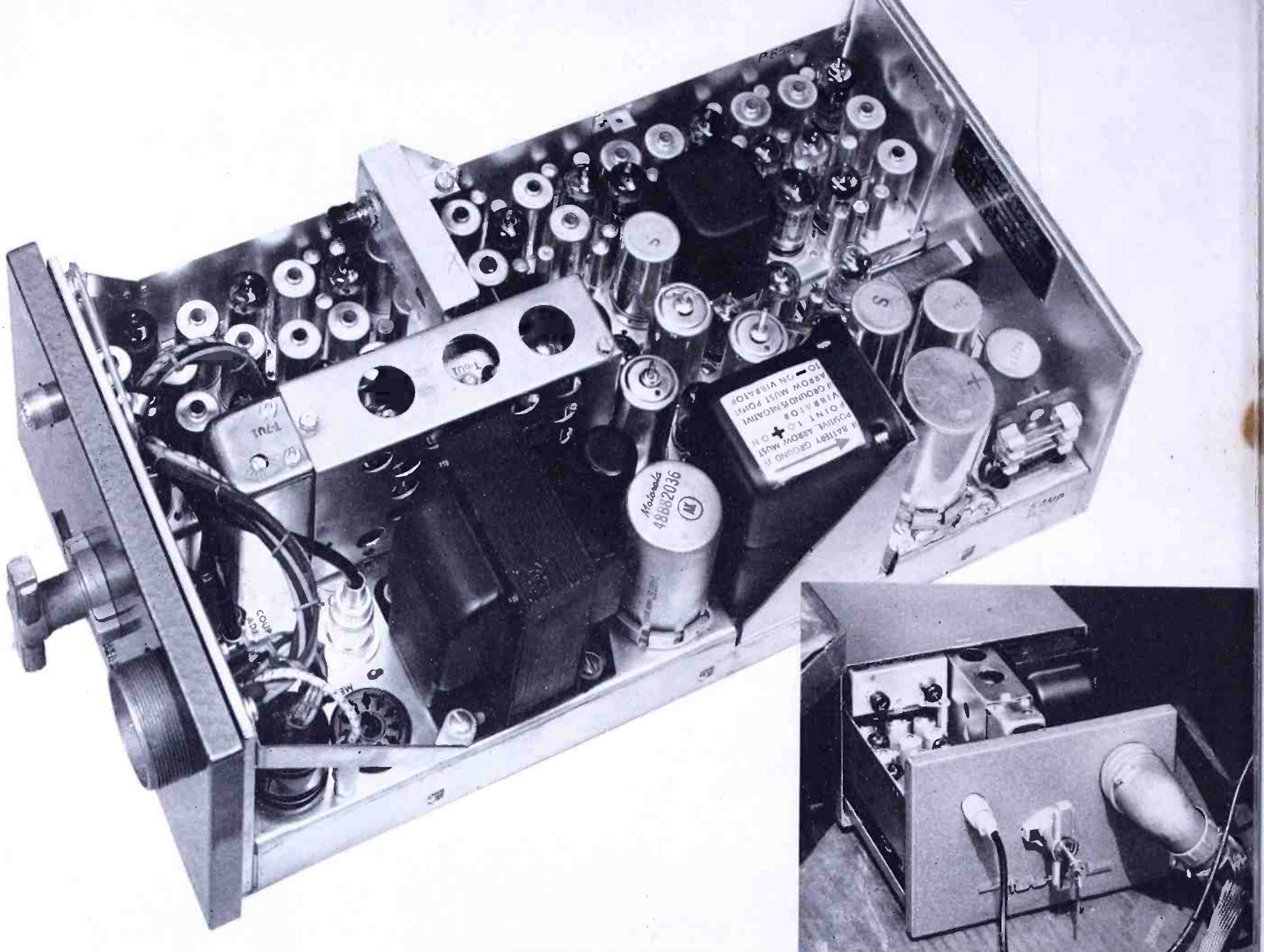


FIG. 1. Separate transmitter and receiver sections are combined in the single case of the Motorola Dispatcher equipment

COMPACT UNIVERSAL MOBILE UNIT

CIRCUIT DETAILS OF MOTOROLA'S DISPATCHER EQUIPMENT, FOR SINGLE- OR DUAL-FREQUENCY USE, WITH OPTIONAL SELECTIVE CALLING: PART 1—*By* L. P. MORRIS *

THE single-unit Dispatcher transmitter and receiver combination to be described is a small, compact, and economical mobile communications installation developed as a part of Motorola's FM communications equipment for the emergency and safety services. This Dispatcher unit is built up on what we call the communication block system, a type of design planned to afford maximum utility and minimum operating and upkeep costs. These standardized building blocks can be assembled into various combinations of multiple-frequency receivers or transmitters, and permit easy and quick conversions from DC to AC supplies. Stock maintenance and servicing procedures in the field are simplified; initial costs are reduced by keeping the number of special major components to a minimum; and delivery to the user is speeded since factory running stocks can be more easily maintained.

In the simplest terms, the Dispatcher is composed of two sections: the receiver, with space provided for a selective calling system; and a 7- to 10-watt transmitter, operating in the 157-mc. band, containing a power supply for the driver and output stages of the transmitter, and a separate dual-purpose power supply for the transmitter oscillator and multiplier stages, and the receiver. Primary power is taken from the 6-volt car battery.

The same transmitter unit can be used for 2-frequency transmission by adding parts contained in a 2-frequency adaptor.

Supplied with the transmitter-receiver unit are the microphone, speaker, control head, and power inter-connector assemblies. The power and cable connections enter the Dispatcher unit through a waterproof AN connector, while the antenna RF connection is made through one UHF connector. A latching handle on the front panel permits withdrawing the complete chassis.

Building Block Sections:

Fig. 1 shows the transmitter-receiver chassis. In the insert, the chassis, connected and ready for operation, has been partly withdrawn from the case. The front and back panels on the chassis protect all components when the unit is turned over for testing or service. The four major components, comprising the front panel, transmitter, receiver, and back panel are illustrated in Fig. 2. It is clear from this view that a new transmitter or receiver can be substituted very quickly when servicing is required. Connectors for power and control circuits

* Communications & Electronics Division, Motorola, Inc., 4545 Augusta Blvd., Chicago, 51.

and for plugging in a test meter are located on the top of the units, to facilitate their use in many combinations where space might not permit side entrance of the plugs.

Fig. 3 is a close-up of the receiver section alone, showing the extremely compact mechanical design. At the top is a selective calling unit, hinged at the rear so it can be raised to permit service checking. A volume control and squelch control bracket is mounted on the chassis if system requirements dictate that these controls be within the case, and inaccessible to the user. Then the main volume control is on this bracket, but final, smaller volume adjustments can be made at the operator's control unit.

The under side of the selective calling unit is illustrated in Fig. 4. It is 3 ins. wide, the same width as the receiver chassis, and about 8 ins. long. Vibrasponders for the different frequencies employed in the selective calling system are plugged in, and are easily removed by snapping out the spring clips across each pair of units.

Fig. 5 indicates another example of the building block system. This is the subassembly of the vibrator power and filter for the receiver and transmitter power supply, located on the transmitter. Fig. 1 shows the unit in place on the transmitter chassis. A block diagram of the complete assembly appears in Fig. 6.

Transmitter Section:

For purpose of explanation, the transmitter circuits of the Dispatcher, Fig. 6, are broken down into sections 1 to 6. These are: 1, oscillator; 2, modulator; 3, multipliers; 4, VHF driver and power output amplifier; 5, receiver power supply; and 6, transmitter vibrator power supply and power relay.

The tube complement of the transmitter comprises:

1 — 6AK5 oscillator
2 — 6BE6 modulators
3 — 6AK5 multipliers
2 — 2E26 RF driver-doubler & RF output
1 — CK1003/OZ4A rectifier
(6X5 can be used if desired)

The transmitter oscillator, Section 1, has a 6AK5 miniature tube oscillating between the first and second grids, crystal controlled with the oscillator output electron coupled to the plate circuit through the oscillator plate tank T1U1. The method of frequency adjustment is unique and different from transmitters in the past, in that a variable inductance is used to shift transmitter frequency for final setting exactly on the desired frequency.

For 2-frequency operation, a 2-crystal adapter is available. This is permanently built and wired into the chassis. The control cables and control head are adapted for the use of a 2-frequency switch. The crystal adapter for 2-frequency operation includes the changeover relay and frequency-determining variable reactance to permit exact setting at the factory and in the field.

The two modulator tubes, section 2, are 6BE6's in a semi-balanced phase-modulator circuit, with the RF center tap for the oscillator plate tank obtained by the use of two fixed plate tank condensers C-5 and C-6. This is necessary because permeability tuning is used instead of condenser tuning.

The RF phase difference for the two modulator tubes is obtained by the use of a 4,700-ohm resistor R-3 and a 14-mmf. condenser across the plate tank coil L-2, Section 1. The upper modulator tube is excited through a 100-mmf. condenser from the plate of the oscillator, while the lower modulator tube, at the proper phase angle, is fed from the tap between the phase shifting resistor and condenser mentioned.

For the purpose of explanation, it may be assumed that the RF phase difference between the grids and the two modulator tubes is 90°, and that the upper modulator is in phase with the oscillator plate. The grid input to the lower modulator tube, V-3, will be assumed 90° out of phase with the upper modulator tube, V-2. The plate circuits of the two modulator tubes are connected in parallel to the modulator output RF tank T2U1, C-17 and L-4, section 3. The instantaneous phase of the two modulator plates, with no modulation, will be the resultant vector of the two 90° vectors appearing in the grid-to-plate circuit of each individual tube, and will be displaced 45° between both tube vectors.

If we consider the instantaneous plate circuit vector of the upper modulator

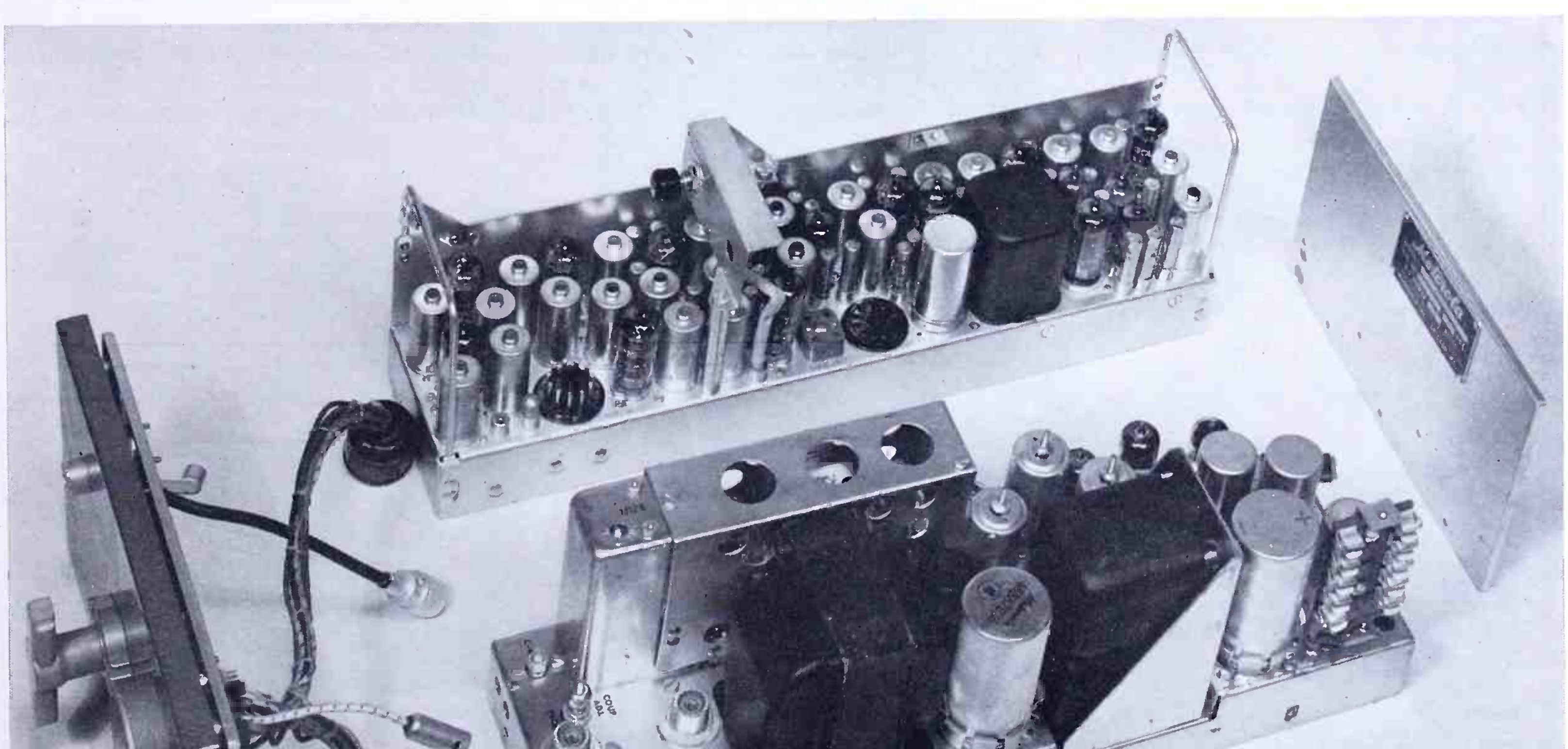


FIG. 2. The Dispatcher can be taken down into these four elements. Transmitter section is in foreground. Note the connectors

tube as being at an angle A, and the instantaneous vector of the lower modulator tube as being at RF phase angle B, then the resultant of the two will be the actual phase angle being fed to the modulation transformer T2U1. Now, if audio modulation is applied in push-pull to the audio grids of the two modulator tubes, it will be noted that when the instantaneous audio grid voltage on the upper tube is plus, the G_m of this tube will be higher. At the same time, the audio grid of the lower modulator tube will be instantaneously more negative, and the G_m of this tube will be lowered. The RF instantaneous plate vector of the upper tube will then be longer, and the vector of the lower tube will be shorter.

The phase angle between the resultant of these two vectors will then shift towards that of V-2, and away from that angle being supplied to the grid of V-3. Thus, the instantaneous shift in the resultant vector applied to T2U1 will be positive, i.e., between 45° and 90° for the duration of that half audio cycle.

For the next half of the audio cycle applied to the modulator audio grids, V-3 will be positive and the upper V-2 will be negative. The instantaneous RF plate vector of V-3 will then be the longer, that of V-2 will be shorter. The resultant vector will then shift towards B at some angle negative with respect to the quiescent condition without modulation. The resultant plate vector applied to T2U1 will then vary at the audio frequency, first toward A as applied to the V-2 modulator tube, and thence to B as applied to the V-3 modulator tube, with the crystal oscillator as the phase and frequency reference. The modulation vector will also change in length because it is the resultant of two right-angle vectors that are shifting in length or amplitude as well as in phase angle.

This instantaneous vector will then shift in accordance with the amplitude of the applied audio frequency from the microphone modulation transformer.

The total biases applied to the two modulator tubes are the resultant of three bias resistors. The biases applied to each tube are the resultant of a combination of screen B+ to cathode bleeder resistor R-8, section 2, common cathode and screen circuit bias resistor R-10, and cathode and audio bias resistor R-9. The audio bias applied to the tube is that bias across the independent cathode resistor connected directly to the cathodes of the modulator tubes, because the center tap of the audio transformer is off ground by the value of the common cathode and screen resistor bias. This condition results in a tendency towards less distortion for over-modulation conditions.

The RF grid bias is a result of bias drop across the audio bias resistor plus the RF bias resistor (in series) next to ground. This modulator is very sensitive at the 10% distortion point, and will permit 100% modulation from a low-level microphone direct. It also permits good intelligibility at higher input levels and therefore does not require complicated level-compressors or critical gain controls.

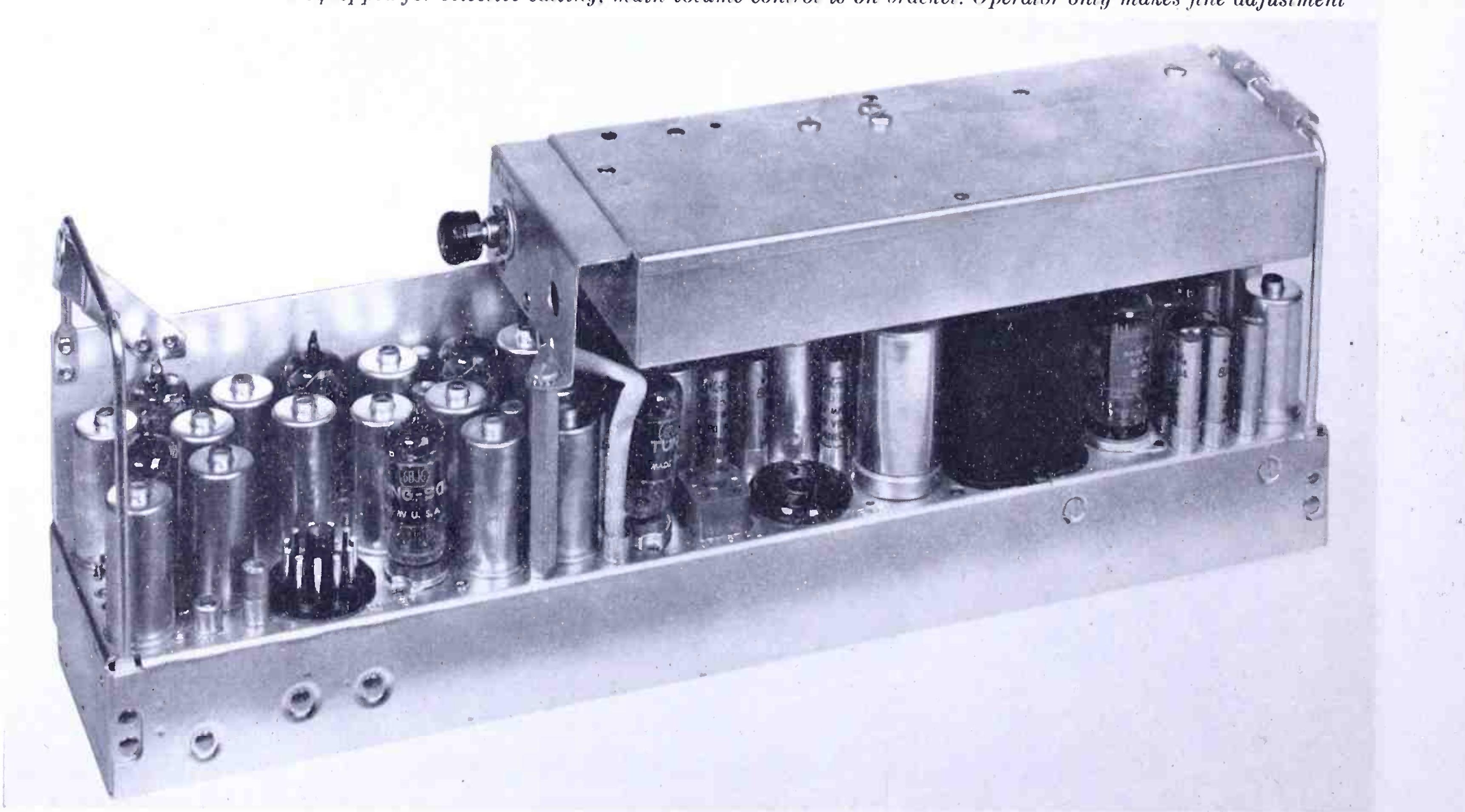
The microphone current is obtained from the common bias of the two modulator tubes and B+ supply. It is, therefore, freer from hum from the A battery supply than has been the case in the past when additional low-voltage filters have not been used. This type of supply is a contributing factor to residual hum reduction because the plate circuit supply is more easily filtered than is the lower-voltage battery supply. Battery supplies with vibrator transformers for the transmitter section are much more difficult to filter for microphone supply than when using dynamotors, because the battery supply is, in effect, keyed from 0 load to full load at approximately 100 cycles by the vibrators.

The microphone circuit runs from the junction of R-9 and R-10 through the primary of the audio transformer and the power connector to the microphone at the driver's position, and back through the connector to ground at the mike transformer primary. This prevents chassis and circuit IR-drop noise pickup.

The audio to the modulators is supplied directly from the microphone transformer through the high audio-frequency discriminating network R-14, R-16 and C-11, C-43. This network causes a falling response above 3,000 cycles.

The modulator output from T2U1 is fed to the grid of the 6AK5 quadrupler. The first quadrupler plate tank, in turn, feeds the 6AK5 tripler. The tripler plate tank and transformer assembly feed a 6AK5 doubler. The doubler plate transformer feeds a 2E26 doubler-driver. Up to this point, the plate circuit supply of the oscillator, modulators and multipliers (all miniature tubes) is obtained

FIG. 3. When receiver is equipped for selective calling, main volume control is on bracket. Operator only makes fine adjustment



from the common medium-low voltage receiver-transmitter vibrator supply. This supply is switched from transmitter to receiver at the coaxial antenna change-over relay.

The B voltage for the doubler-driver and the RF amplifier is obtained from a second vibrator, using a CK1003/OZ4A, or 6X5 rectifier. This non-synchronous B supply is one-half of the identical supply that has been used for several years in many other mobile transmitters. The same vibrator power supply components were originally used in older 15-watt AM transmitters. The components are interchangeable with the other models, as well as certain 15-watt 152- to 162-mc. FM transmitters.

Up to the doubler, transformers with high-permeability iron core tuning are used. The first doubler transformer, however, uses copper-slug tuning in order to save space and make for simplicity. The transformer coupling the doubler-driver to the RF power amplifier is a combination transformer and distributed RF line assembly, using a quarter-wave shielded hairpin in both the plate circuit of the doubler-driver and the grid circuit of the power amplifier.

The power amplifier is coupled to the antenna through a half-wave tank circuit. Tuning is accomplished by tuning the end of the half-wave line opposite the plate of the power amplifier tube with a small variable air condenser. The B supply for the power amplifier tube is coupled into the half-wave line at the center point of low RF potential. This half-wave line is magnetically coupled by means of a loop to the coaxial antenna relay. The variable-coupling antenna tuning link is also series-tuned by C-40, and meets a wide range of antenna resistances and reactances. This method of coupling permits the transmitter to be operated into more widely different loads than would otherwise be possible.

Modulator Circuits:

If modulating audio potential is applied to a phase modulator so that the amplitude is inversely proportional to the frequency, the phase modulator will produce equivalent frequency modulation. If we apply the modulating audio potential to a phase modulator in constant amplitude at all audio frequencies, the modulator will be a pure phase modulator, and the instantaneous frequency deviations will be proportional to frequency, that is, 6 db per octave of the modulating or audio frequency. For phase shift of one radian in the modulator, approximately 57°, the equivalent frequency modulation in cycles per second is equal to the audio modulation frequency in cycles per second. The trans-

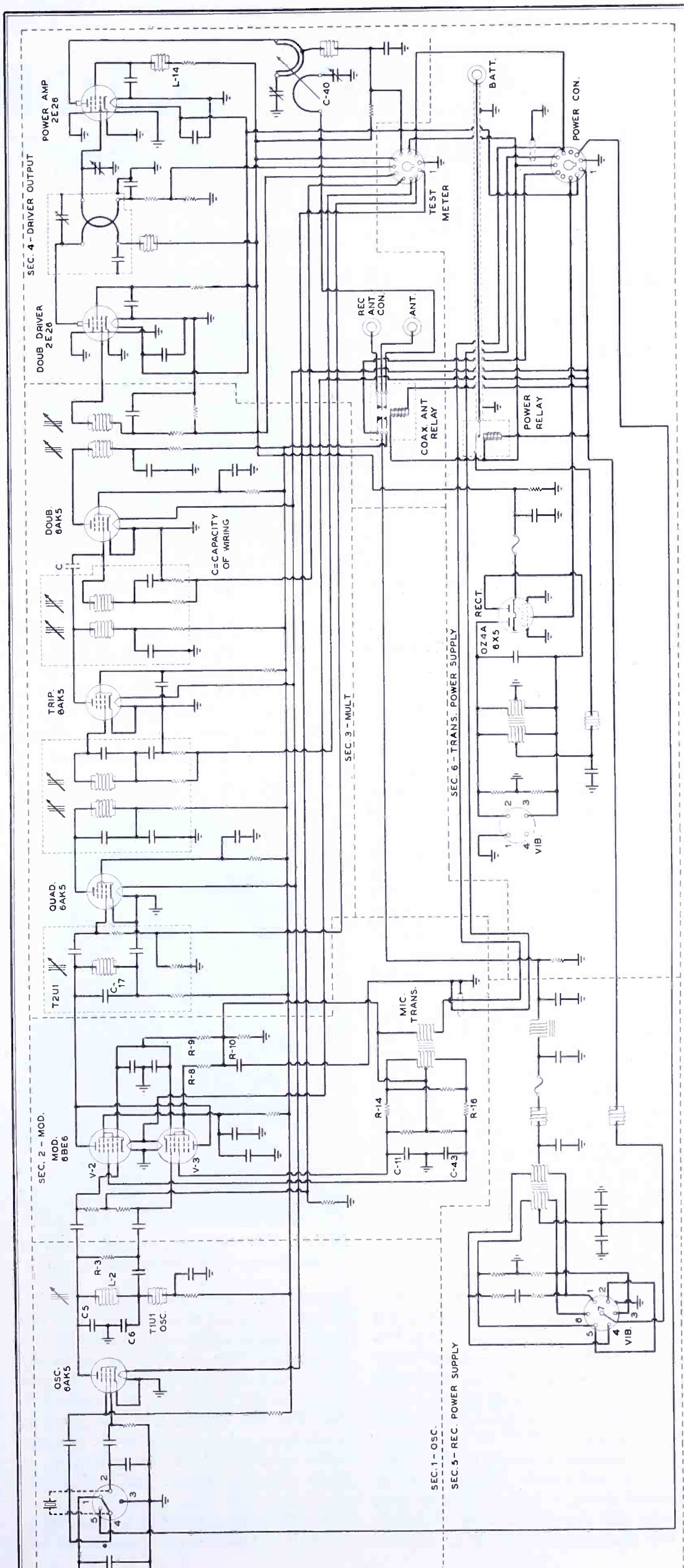


FIG. 6. Schematic of the transmitter section. AC power supply is available for 115 volts, 60 cycles, when it is required

mitter output deviation is the modulator deviation multiplied by the total multiplication of all the multiplier stages.

Several years of experience in initial laboratory and field test work indicated that, to obtain maximum range for a given percentage of intelligibility, a combination of frequency and phase modulation gives best overall results. This does not mean that the greatest fidelity and quality will be secured at these maximum usable ranges but, instead, that the highest possible percentage of intelligibility will be obtained for these maximum ranges. In addition, factors of cost and additional transmitter multipliers were considered in the balance obtained between maximum range *vs.* a high percentage of *intelligibility and audio quality.* The present transmitter represents a balance between cost, number of tubes and parts, quality or fidelity, and *percentage intelligibility at maximum range.* In this type of equipment, maximum range with good fidelity is generally preferred to less range with the higher fidelity.

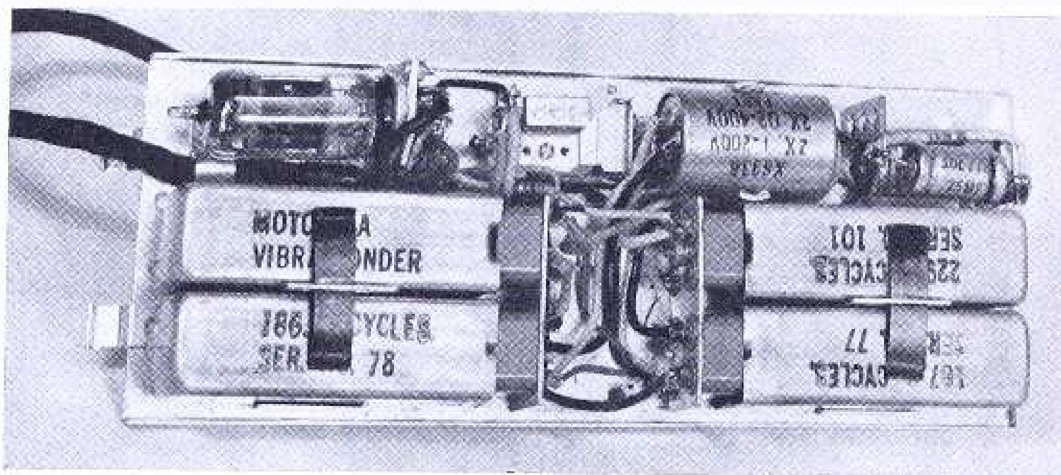


FIG. 4. Under side of the selective calling circuit assembly used with the receiver

The modulator circuit in the Dispatcher approaches phase-modulation characteristics from 300 to 1,500 cycles, and from then on to 3,000 cycles approaches frequency-modulation characteristics. This is determined by the combination of modulator characteristics and the frequency-discriminating network following the microphone transformer.

If the microphone transformer did not have the frequency-discriminating resistance and capacity networks R-14, R-16 and C-11, C-43 following it, the deviation from the modulator and transmitter would increase 6 db per octave, and would operate on phase modulation throughout the audio band. If the frequency discrimination between the transformer and the grids of the modulator tubes were inversely proportional to frequency, that is, the audio output from the network dropped off 6 db per octave, then the modulator would produce pure frequency modulation. This system, as explained above, is intermediate between the two, and gives effective pre-emphasis to the transmitter. This, then, permits the use of a certain amount of de-emphasis in the receiver audio system and, as a result, gives a better signal-to-noise ratio than would be obtained if pure FM were used throughout the audio modulating band.

It is necessary to consider the energy components of the average human voice when discussing a modulator. If we assume that the energy components from an average voice as constant from 300 to 3,000 cycles, then it would be obvious that phase modulation to any degree should not be used. To explain this point, let us assume that 100% modulation is 20 kc. deviation plus and minus about the carrier for 1,000-cycle audio modulation into the modulators. Now, if we had phase modulation, with response increasing 6 db. per octave in the modulator, we would find that the RF output into the antenna would have a deviation of 40 kc. at 2,000 audio cycles, and an RF deviation at 4,000 cycles of 80 kc. plus and minus about the carrier frequency.

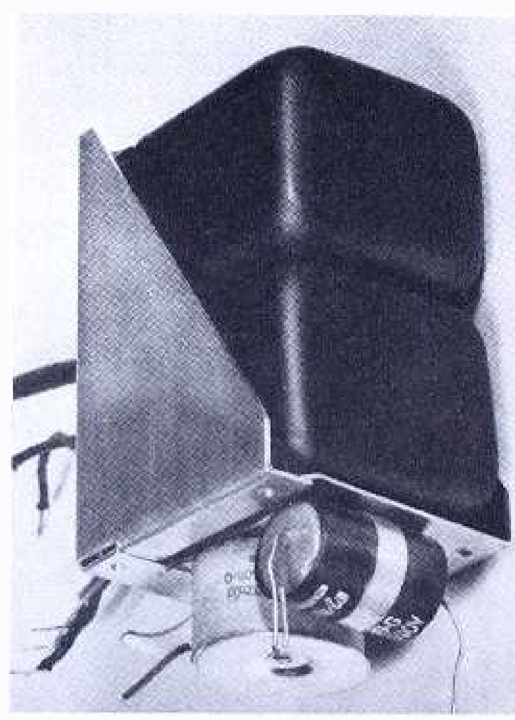


FIG. 5. Vibrator power supply mounts on the chassis of the transmitter section

The RF output deviation for 500 cycles, one-half of 1,000 cycles, would be 10 kc., that is, 6 db down from the 100% at 20 kc. Likewise, at 250 cycles audio, the RF carrier output deviation would be 5 kc., 12 db down from 1,000-cycle modulation, since it is two octaves down. This would mean that, if we assumed 1,000 cycles, which is near the center of the voice spectrum, as 100% modulation, or 20 kc. as permitted by the FCC, we would have greater than 100% modulation of the RF carrier output for any sine wave audio frequency above 1,000 cycles, and of the same audio input amplitude. This condition does not, however, exactly represent the actual condition because of the nature of the human voice.

The reason that such terrific overmodulation does not occur as might be indicated above is due primarily to the fact that the audio amplitude components of the human voice decrease very markedly with increasing frequencies. This means that the instantaneous voice-frequency amplitude components actually decrease above 1,000 cycles, instead of remaining constant as in the case assumed above. As a result, the actual RF instantaneous deviations do not increase 6 db per octave continuously above 1,000 cycles. Under some special conditions of input to the modulator from certain audio circuits (not from the microphone and the ordinary speaking voice) there might be too much deviation at the higher audio frequencies. In such cases, increasing the value of the frequency-discriminating condensers would cut down the audio frequency supplied to the modulator, so that the RF output deviation would not be too great. The greater the value of these two condensers, the nearer the transmitter will come to pure frequency modulation, while the smaller these condensers, the nearer the output will be to pure phase modulation.

These modulators have an appreciable amount of amplitude modulation. This is, in general, limited to a sufficient degree by overdriving the multiplier stages to the extent that they operate also as partial limiters. These modulators are not completely balanced, but do serve quite well in fulfilling the requirements with the least number of tubes and least cost consistent with the *maximum obtainable system range* when considered in conjunction with the receiver characteristics for a good and reasonable percentage of intelligibility.

NOTE: *The second and concluding part of this paper, describing the receiver and methods of installation and servicing will appear next month.*

IN OUR JULY 1944 ISSUE, 6 pages were required to list all the mobile radio systems in the U. S. In this issue, four years later, 11½ pages are devoted to Part 1, covering only police, fire, forestry, and railroads. Part 2, next January, covering all the other mobile services, will probably require 15 pages!

U. S. COMMUNICATIONS SYSTEMS: Part 1

Directory of Railroad, Municipal and County Police, State Police, Fire, and Forestry Systems

INFORMATION ABOUT THIS DIRECTORY

1. Compilation of this Directory was made possible by the cooperation and courtesy of the Federal Communications Commission. This revision was completed on June 4, 1948.
2. Parts 1 and 2 are revised and published annually, the former appearing in each July issue of this Magazine, and the latter in each January issue. Part 2 lists public utility, taxicab, truck, and all mobile systems not listed in Part 1.
3. Addresses are given for the control points, not transmitter locations. Municipal systems should be addressed "Police Headquarters"; county systems, indicated by C after the city or town, should be addressed "County Sheriff's Office"; state police systems, "State Police Barracks."
4. The number preceding the call letters indicates the number of mobile units. Call letters are for the headquarters transmitters.
5. The following letters are used after the city or town in the listing of experimental stations: M Municipal; N Control Point; R Repeater Station.
6. Frequency is indicated in megacycles where a decimal point appears. Otherwise, the frequency is in kilocycles. The letter following the frequency indicates Amplitude or Frequency modulation.
7. The last letter or letters show the make of the principal equipment in the system. These are:

A Aireon	DF Doolittle & Falkner	K Kaar	Ry Raytheon
B Bendix	F Federal	L Link	S Sound Products
BA Bassett	Fa Farnsworth	M Motorola	Sp Sperry
BD B & D Radio	GE General Electric	P Pierson DeLane	St Stancor
C Composite	Gr Gen Railway Signal	Ph Philco	T Temco
CC Communications	H Hallicrafters	R RCA	TS Radio Tel & Signals
Cn Collins	Hv Harvey	RR Railway Radio Tel	W Western Electric
D Doolittle			We Westinghouse

MUNICIPAL & COUNTY POLICE

ALABAMA

Anniston	7	WRBD	33.1	A W
Baldwin C	2	WKUV	37.5	F M
Bessemer	45	WKIU	155.13	F M
Birmingham	93	WPFM	30.58	F M
	1	WJGZ	2382	AGE
Blount C	2	WAQR	37.5	F M
Calhoun	4	WCTM	37.5	F M
Clay C	3	WKSF	37.5	F M
Cleburne	2	WCML	37.5	F M
Colbert C	3	WKSF	37.5	F M
Decatur	5	WADN	35.9	F M
DeKalb C	2	WRLT	37.5	F M
Dothan	3	WAKD	35.5	FGE
Elmore C	2	WXAI	37.5	F M
Escambia C	2	WFGB	37.5	F M
Etowah	3	WIYU	37.5	F M
Florence	4	WKUH	35.9	F M
Gadsden	15	WQIG	37.02	A M
Greene C	2	WRTW	37.5	F M
Houston C	3	WNME	37.5	F M
Huntsville	4	WMHA	35.9	F M
Jackson C	2	WUAZ	37.5	F M
Jasper	5	WKDF	155.01	F M
Jefferson C	6	WQFR	37.5	F M
Lauderdale C	2	WDPM	37.5	F M
Lee C	2	WCVE	37.5	F M
Limestone C	2	WDRP	37.5	F M
Macon C	2	WIJF	37.5	F M
Marshall C	2	WMDO	37.5	F M
Mobile	26	WPGW	3058	A M
Montgomery	50	WMPM	155.01	F K
Morgan C	2	WEHY	37.5	F M
Muscle Shoals	1	WVJR	33.5	F L
Northport	1	WDBZ	35.9	F
St Clair C	2	WXAE	37.5	F M
Selma		WASP	2382	A W
Sheffield	27	WKIM	33.5	F L
Shelby C	2	WSFD	37.5	F M
Sylacauga	2	WBVS	33.5	A R
Tuscaloosa	5	WQLH	35.9	F M
Tuscaloosa C	3	WJWN	37.5	F M
Walker C	2	WRSN	37.5	F M

ARIZONA

Bisbee	10	KRHS	39.18	F R
Casa Grande	1	KRQN	35.1	A S
Douglas	2	KBQM	39.18	F K
Flagstaff	4	KQOJ	39.18	F R
	2	KFPX	39.9	F R
Florence	21	KRAC	39.18	F R
Holbrook	8	KICG	39.18	F R
Kingman	7	KSPW	39.18	F R
Maricopa C	22	KQXU	39.18	F R
Mesa	4	KRIZ	39.18	F R
Nogales	1	KAMG	39.18	F K
Phoenix	35	KGZJ	30.58	A M
Prescott	3	KNHG	39.18	F R
	20	KQHM	39.18	A R
Safford C	3	KRJA	35.1	A M
South Tucson	1	KEVZ	35.1	A T
Tempe	1	KEYU	35.1	A M
Tucson	25	KQEP	155.01	F K
	150	KQPW	39.18	F K
Wickenburg	1	KSMG	39.18	F R
Williams	1	KBPQ	39.18	F R
Winslow	3	KRDW	35.1	A M
Yuma C	22	KADF	39.18	F R
Yuma	10	KVNR	39.9	F R

EXPERIMENTAL

Tucson M		W6XEH	73.54	A C

ARKANSAS

Arkansas City	3	KSDC	31.5	A K
Blytheville	1	KPBA	30.58	F R
Camden	2	WJXY	31.5	F M
Dumas		KSDD	31.5	ABA
Fayetteville	1	KRNQ	30.58	A C
Ft Smith	4	KNHA	30.58	A M
	10	KPWE	156.69	F M
El Dorado	6	KWXI	37.10	F M
Garland C		KQMC	2406	A K
Helena	2	KIKS	30.7	F M
Hope	1	KHSK	35.78	F M
Hot Springs Nat'l Pk	8	KQEH	30.58	A R
Jonesboro	10	KIHR	156.69	F M
Little Rock	22	KGHZ	31.78	F M
McGehee C		(0$3		
Marion	6	KIOC	37.1	F M
McGehee C		KSDE	31.5	ABA
Mississippi C	14	KPMA	33.5	A M
Newport	16	KRKI	155.01	A
N Little Rock	10	KRAE	156.69	A M
Ouachita	2	KSGO	31.5	F M
Paragould	10	KKNM	155.01	A B
Pine Bluff	2	KDBR	37.5	F M
Pulaski C	8	KRGI	31.78	A M
Texarkana	11	KTAP	33.22	A M
Van Buren	5	KIDN	155.25	F M
West Helena	1	KUHE	30.7	F M

CALIFORNIA

Alameda C	1	KAKQ	1658	A H
	55	KQBR	154.65	A L
Albany	5	KGWC	37.78	A M
Alhambra	16	KRBQ	31.5	A C
Alturas	1	KSYH	39.38	F M
Anaheim	4	KQCL	37.34	A C
Antioch	5	KSNW	37.02	A L
Arcadia	10	KQAP	33.5	A C
Arcata	1	KCLN	39.78	F M
Atherton	2	KQXC	33.78	A K
Auburn	5	KRQP	154.65	FGE
Azusa	3	KIBR	155.49	F M
Bakersfield	3	KGPS	30.58	A M
	56	KACS	156.21	AWe
Banning	2	KQLY	30.58	A M
		KQHL	2442	A M
Barstow C	1	KIHM	33.22	A M
		KSBB	1714	A C
Beaumont	5	KQJH	30.58	A C
Bell	1	KPBC	35.5	A M
Benicia	5	KQSN	30.58	A C
Berkeley	73	KSW	37.78	A C
	1	KGIH	37.78	A C
Beverly Hills	28	KQAI	37.1	A M
Blythe	2	KAPY	30.58	A C
		KIOD	2442	A M
Brawley	6	KBMP	155.01	F M
Brea	3	KADQ	37.34	A C
Burbank	18	KQBE	33.5	A C
Burlingame	9	KQCM	37.22	A C
Butte C	13	KBYQ	39.38	F M
Calexico	2	KVRJ	155.25	F M
Carmel-by-the Sea	5	KQFI	35.22	A C
Chico	1	KQEO	31.5	A R
Chino	5	KQKN	33.22	A C
Chula Vista	15	KQJG	37.34	A C
Claremont	2	KQRY	33.22	A M
Coachella	4	WCJO	30.58	A C
Coalinga	2	KOFK	33.5	F M
	1	KIHW	35.22	F M
Colton	4	KQVO	33.22	A C
Colusa	6	KQRO	39.38	F M
Compton	6	KQAO	31.78	A C
Corcoran	3	KKNE	37.5	F M
	1	KKNJ	37.78	F M
Corona	5	KRIV	30.58	A C
Coronado	15	KQKV	37.34	A C
Corte Madera	1	KPCM	33.22	F R
Covina	1	KIQH	155.49	F M
Culver City	5	KPDC	37.5	A C
Daly City	5	KILZ	35.9	F L
Davis	2	KGOG	35.1	A K
Delano	2	KEYG	35.9	A M
Dinuba	4	KAAT	35.1	F R
El Cajon	1	KEIJ	33.7	A M
El Centro	2	KNGJ	35.1	F M
	1	KQVN	2490	A C
El Cerrito	4	KAMM	37.78	A M
El Dorado C	4	KRZY	39.78	F M
El Monte	1	KROR	39.5	A M
El Paso de Robles	3	KAGT	39.1	F M
El Segundo	5	KQJL	37.9	A M
Elsinore	1	KGTS	30.58	A C
Escondido	4	KQHX	33.78	A M
Eureka	5	KQRM	30.7	A K
Fairfax	2	KDIC	33.22	F R
Fairfield	10	KAGR	30.98	A L
Fairmont	137	KPDA	73.9	F L
Fresno	68	KGZA	35.22	F L
Fullerton	6	KQBN	37.34	A M
Gardena	3	KQEG	39.1	A M
Gilroy		KROB	1674	A K
Glendale	48	KQCI	33.22	APM
		KQZL	33.94	A P
Glendora	1	KBPA	155.49	F M
Glenn C	5	KQVE	39.38	F M
Grass Valley	1	KGVC	35.22	FGE
Hawthorne	1	KAGS	39.1	A K
Hayward		KCTK	73.9	F L
Hemet	1	KBJT	30.58	A C
Hermosa Beach	4	KRMZ	155.61	F M
Hillsborough	1	KANQ	1674	A C
	7	KSPH	33.22	A C
Humboldt C	7	KHCP	39.78	FGE
Huntington Bch	4	KQAL	37.34	A M
Huntington Park	16	KHPM	39.9	F M
Imperial C	16	KEZQ	35.1	F M
Indio	2	KQHJ	30.58	A C
		KQAD	2442	A C
Inglewood	25	KQXL	39.5	F R
Kensington Pk	3	KKFD	35.22	A C
Kern C	1	KRVU	2414	A
Kings C	5	KEWB	2414	A M
Laguna Bch	5	KQEN	37.34	A M
Lakeport C	4	KAVL	33.22	F M
La Mesa	2	KEZT	33.78	A M
Larkspur	1	KDII	33.22	F R
La Verne	2	KQPZ	33.22	A M
Lindsay	2	KRIM	37.1	A M
Lodi	10	KNGY	39.5	F L
Long Beach	52	KQAO	31.78	A R
	1	KQST	33.1	A C
	1	KBQW	33.1	ACC
		KQXI	33.1	A C
Los Angeles	265	KGPL	155.37	A M
	466	KGPL	155.37	F
	1	KNGX	1730	A C
	1	KQEF	37.5	A C
		KQJN	1730	A C
		KQJO	1730	A C
		KQJP	1730	A C
Los Angeles C	6	KQBV	31.9	A C
Lancaster		KQDD	31.9	A C
Los Banos	3	KERL	37.78	A K
Lynwood	8	KQHK	35.5	A P
Madera C	14	KFWH	37.78	FML
Manhattan Bch	3	KRIB	37.9	A M
Marin C	27	KSRC	33.22	FGE
	1	KEZB	1610	A C
Mariposa C	2	KOBD	37.22	A R
Martinez	8	KQKA	35.22	A L
Martinez C	109	KQCE	35.22	F L
		KRBS	1658	A C
		KHNI	1658	A H
Marysville	4	KADS	39.38	F M
Maywood	6	KHNJ	35.5	A M
Menlo Pk	11	KQXV	33.78	A K
Merced	3	KQDP	37.22	A C
	20	KSOM	37.22	AKM
Mill Valley	2	KDIO	33.22	FGE
Modesto	11	KQDQ	39.38	A K
Modesto C	25	KASE	39.38	A K
Modoc	5	KSYJ	39.38	F M
Monrovia	7	KQAG	33.5	A C
Montebello	6	KQFE	37.9	A M
Monterey	5	KRLF	35.22	A M
Monterey Pk	5	KGKR	31.5	A M
Napa	9	KNCO	33.22	F L
	15	KPNC	155.49	F M
National City	8	KQBF	33.1	F M
Needles	4	KNCF	33.22	A M
		KMXN	1714	A C
Nevada City	2	KQRN	35.22	F M
Nevada C	8	KPLN	39.78	F M
Newport Bch	8	KQAF	37.34	A C
N Inyokern C		KEVE	24.14	AWe
N Sacramento	2	KQRV	35.22	A C
Niles		KCTP	73.9	F L
Oakland	278	KALT	31.78	FMGE
		KCTT	73.9	F L
Oceanside	4	KADI	37.34	A M
Ontario	14	KQKT	33.22	A C
Orange	4	KQBI	37.34	A C
Orange C		KOCM	2490	A H
Oroville	1	KSPQ	39.38	F M
Oxnard	6	KOXC	30.58	A K
Pacific Grove	1	KAZI	30.58	FGE
Palm Springs	3	KQAS	37.1	A P
Palo Alto	17	KGHK	33.78	A K
Palos Verdes Estates	1	KQXK	37.9	A C
Pasadena	61	KGJX	33.22	A C
Perris	1	KIDW	30.58	A C
Petaluma	2	KQCY	37.1	A C
Piedmont	16	KQCP	37.22	A C
Pittsburgh	5	KQBT	30.58	F L
Pomona	23	KNFJ	33.22	A M
		KALM	17.14	A C
Porterville	3	KQAU	37.1	F M
	1	KQAX	35.1	F M
Quincy C	5	KBSV	39.38	F M
Redding	4	KRTM	156.69	F L
Redlands	11	KQFT	33.22	A M
Redondo Bch	3	KTEQ	155.61	F M
Redwood City	19	KRAZ	33.78	A M
	58	KRGX	39.26	F M
		KDAX	154.65	F L
	16	KEKN	154.65	F L
Reedley	2	KRCP	33.5	ARCA
Rialto	3	KROG	33.22	A M
Richmond	47	KRLW	33.78	F L
		KEYZ	31.5	F L
Riverside	69	KQJE	30.58	A C
Riverside C	58	KQSG	30.58	A C
		KERC	24.42	A C
	1	KEZE	24.42	A C
Roseville	1	KRPD	35.22	F M
Ross	1	KRPC	33.22	F R
Sacramento C	20	KFPN	35.22	A C
Sacramento	62	KNGF	35.22	A L
	1	KSPD	17.22	A C
	1	KGSC	17.22	A C
Salinas	5	KQHY	35.22	A C
	11	KQCO	35.22	A M
San Anselmo	5	KQBP	33.22	FGE
San Bernardino	33	KQAC	33.22	A M
San Bernardino C	49	KSBC	33.22	A C
San Benita C	8	KDHB	35.1	A M
San Buenaventura	14	KACN	30.58	A S
San Carlos	8	KRGK	33.78	A M
San Diego	252	KGZD	155.37	A C
		KFWL	24.90	A H
	1	KHKF	2490	A
San Diego C	55	KQOV	37.34	A C
San Fernando	3	KRMQ	39.5	A M
San Francisco	84	KGPD	39.38	F L
San Gabriel	6	KQBL	31.5	A M
San Jacinto	1	KQHV	30.58	A C
San Jose	132	KGPM	155.13	F M
	100	KTEH	156.21	F M
San Luis Obispo	2	KRAW	30.58	A R
	8	KQXA	39.78	F M
San Marino	8	KQDW	35.9	A P
San Mateo	10	KQDA	37.22	A K
San Rafael	7	KSRP	33.22	F R
Santa Ana	17	KQAK	37.34	A M
Santa Ana C	49	KGHX	37.34	A C
Santa Barbara	30	KGZO	30.58	A S
		KSBP	24.14	ACn
Santa Barbara C	34	KQIR	30.58	A C
Santa Cruz	35	KGZT	154.77	F K
Santa Cruz C	15	KUOT	37.38	F K
Santa Maria	8	KSMP	30.58	A K
Santa Monica	44	KQDF	33.5	A C
Santa Paula	2	KVSL	30.58	A M
Santa Rosa	9	KQDG	154.89	F M
Santa Rita		KCTO	73.9	F L
Santa Rosa	9	KQDG	154.89	F M
	15	KSRM	33.22	F M
Sausalito	2	KCOS	33.22	F L
Seal Beach	1	KQGX	31.78	A M
Shafter	2	KDCZ	33.5	F M
Sierra C	4	KPRI	39.78	F M
Sierra Madre	10	KRUA	156.69	FGE
Signal Hill	2	KQFU	33.1	A M
Solano C	25	KBRV	37.02	A L

South Gate	28	KQPY	35.5	A M
S Pasadena	9	KBSP	33.22	A M
S San Francisco	10	KGIA	30.98	F L
Stanislaus C	25	KASE	39.38	A M
Stockton	80	KQCR	37.78	A M
Stockton	20	KAPH	37.22	FGE
Susanville	4	KAEX	39.38	A M
Sutter C	4	KBQF	39.38	F M
Torrance	7	KRMF	39.1	A M
Tracy	4	KACO	39.38	A C
Tulare	2	WPDA	30.58	A M
Turlock	2	KQCG	39.38	A K
Tustin	1	KQJA	33.78	A C
Ukiah	12	KBKH	39.78	F L
	1	KHGV	39.5	F M
Upland	7	KQKU	33.22	A M
Vallejo	50	KGPG	155.49	F L
Ventura C		KCFQ	2414	A H
	38	KFOJ	30.58	A M
Visalia	10	KQBQ	155.49	A M
Visalia C	77	KAZF	35.1	F M
Watsonville	3	KWCP	35.22	A M
West Covina	1	KREQ	31.1	F M
Westwood		KSDH	1722	A H
Whittier	8	KGHY	155.73	F M
Woodland		KAGD	17.22	A C
Yreka	1	KQGZ	30.58	A M
Yuba City	2	KBQY	30.58	F M
Yuba C	6	KBQZ	39.38	F M

EXPERIMENTAL

Contra Costa C R	W6XCD	73.54	F L
Fresno R	W6XHU	74.14	F L
	W6XHV	75.98	F L
Glendale N	W6XWC	75.56	FCn
Grapevine M	W6XGL	75.98	A C
KettlemanR	W6XIA	73.22	F M
Long Beach N	W6XWD	74.58	A B
Los Angeles N	W6XWA	74.58	A C
Los Angeles R	W6XKM	72.04	F M
Mt Tamalpais M	W6XGX	75.98	F L
Monterey R	W6XHG	74.58	A C
Orange C M	W6XIJ	75.98	A C
Orange C R	W6XIL	75.98	A C
Orange C M	W6XVJ	73.18	A C
Pasadena N	W6XWF	74.58	A B
Pomona N	W6XWG	74.58	A B
Richmond R	W6XWU	73.54	F L
Riverside R	W6XEI	73.62	A P
Riverside N	W6XWH	74.58	A B
San Bernardino CM	W6XVY	74.58	A B
San Diego M	W6XHA	75.98	A C
San Diego N	W6XVN	74.58	A B
San Jose R	W6XHW	73.14	F C
San Mateo R	W6XHO	73.62	F M
San Mateo M	W6XVQ	74.38	F M
Santa Ana M	W6XVI	74.58	A B
Ventura C R	W6XIB	73.62	F M
Williams Hill R	W6XOW	74.02	A C

COLORADO

Boulder	7	KQGA	33.78	A M
Colorado Spgs	15	KPCS	31.5	A W
Denver	151	KGPX	33.78	A M
Durango	5	KXJI	155.01	A B
El Paso C	5	KFHR	31.5	A M
Englewood	2	KIUE	33.78	A M
Fort Collins	2	KQFW	33.78	A M
Golden C	36	KRSU	39.5	FGE
Grand Junction	6	KQXT	33.78	A M
Greeley	8	KPDG	33.78	A M
La Junta		KPLJ	24.42	A R
Larimer C	3	KAEU	33.78	A M
Longmont	3	KPDL	33.78	ACn
Pueblo	15	KQCX	30.98	A C
		KRHY	24.42	A R
Sterling	1	KESY	33.78	A K
Trinidad	2	KHRI	30.58	A M
Trinidad C	2	KEHM	30.58	A M

CONNECTICUT

Ansonia	2	WKSS	33.1	F L
Bethel	1	WHNK	35.9	A L
Bloomfield	1	WLST	33.9	A M
Branford	2	WMVO	31.1	F L
Bridgeport	23	WPFW	30.58	FGE
Bristol	6	WJVO	31.1	FGE
Danbury	3	WSRE	35.9	A L
Darien	4	WQYB	33.78	FGE
Derby	1	WDPP	155.49	F R
Easton	1	WIVR	30.58	FGE
E Hartford	8	WBXC	33.1	AGE
Enfield	1	WBMW	39.1	A L
Fairfield	10	WKGF	31.78	FGE
Glastonbury	2	WKVQ	33.1	AGEM
Greenwich	20	WQLE	39.9	FGE
		WWEF	39.9	FGE
Groton	1	WIZY	31.9	FGE
Hamden	9	WHPD	37.9	F L
Hartford	46	WQRC	33.1	AGEM
Manchester	3	WRZP	33.94	A R
Meriden	5	WKSM	35.1	FGE
Middletown	2	WSKV	37.9	A W
Milford	6	WBLB	31.9	A R
New Britain	9	WRAF	37.1	A R
New Canaan	2	WJPY	37.9	F L
New Haven	29	WQFA	37.1	F L
Newington	2	WPLZ	33.1	A M
New London	6	WAKB	31.9	FGE
N Haven	1	WKKD	37.78	F L
Norwalk	7	WEIS	35.5	F L
Norwich	3	WBXY	39.9	F L
Plymouth	1	WHHL	31.1	FGE
Seymour	6	WMYN	31.5	F L
Southington	5	WOQW	155.01	F M
Stamford	8	WPHH	37.5	A L
	7	WSVL	37.5	A L
Stratford	7	WCBH	30.98	FGE
	2	WKSC	30.98	FGE
		WKEQ	30.7	FGE
Suffield	1	WCSO	30.7	AHv
Torrington	4	WKPJ	39.9	F L
Trumbull	3	WJUY	30.98	FGE
Wallingford	7	WMIR	39.9	FGE
Waterbury	37	WMPW	39.1	F L
Watertown	1	WJYX	39.1	F L
W Hartford	13	WQJI	31.5	A R
W Haven	4	WBLB	155.25	F M
Westport	4	WBLT	33.94	FGE
Wethersfield	3	WABT	33.1	A R
Willimantic	1	WEGJ	31.1	FGE
Winsted	1	WHUO	30.7	F M
Windsor	2	WLSY	33.1	A M
Woodbridge	2	WAQX	37.1	F L

DELAWARE

Bridgeville	2	WIHO	39.78	F L
Dover	5	WAZP	33.5	A M
Milford	1	WMDM	37.50	A M
New Castle	2	WBKW	39.78	F L
New Castle C	2	WTOS	39.78	F L
Newark	2	WNBA	39.5	F L
Seaford	2	WXAK	39.78	F L
Smyrna	2	WKBL	39.78	F L
Wilmington	64	WWPD	30.58	A C
		WRPF	31.5	AHv

DISTRICT OF COLUMBIA

Washington	113	WPDW	37.22	F L
Washington	40	WDCS	39.5	F L
	1	WJHJ	39.5	F L
Washington D C Jail	4	WDPG	39.02	F L
Lorton Va Reformatory	11	WLOV	39.5	F L

FLORIDA

Bartow	8	WBPF	155.31	F M
Belleair	1	WAJT	30.58	A M
Boca Raton	1	WHPZ	35.9	F M
Bradenton	4	WRMO	37.1	F R
Clearwater	3	WQOI	30.58	A L
	2	WQOI	30.58	F L
Clearwater C	8	WAKG	33.78	F M
Coral Gables	7	WOCG	155.31	FCC
Dade City	3	WQHE	30.7	F M
Dania	2	WQXM	37.1	A M
Daytona Bch	10	WRHQ	155.67	F R
DeLand	25	WJQD	154.95	F M
Delray Bch	3	WAFD	35.9	F M
Dixie C	2	WDKX	31.1	F M
Dunedin	1	WBLE	30.58	F M
Escambia C	7	WPFR	31.1	F M
Ft Lauderdale	14	WAKO	30.58	A C
Fernandina	3	WMUW	31.1	F M
Ft Myers	2	WFLM	37.1	A M
Ft Pierce	3	WFPF	35.5	F M
Gainesville	15	WQFC	156.03	F M
Gulfport	1	WQUT	33.5	A M
Haines City	1	WITW	35.9	F M
Hallandale	2	WSVE	37.1	A M
Holly Hill	2	WBJE	155.67	A R
Hollywood	7	WQNL	37.1	A L
Jacksonville	83	WPFG	155.67	A M
Jacksonville Bch	7	WJBH	30.7	F M
Lakeland	17	WPFT	31.5	A M
Lake Worth	12	WLWP	156.51	F F
Leesburg	3	WGPD	37.5	F R
Leon C	2	WCGV	33.1	F M
Manalapan	2	WMAF	156.51	F F
Marianna C	2	WJQR	39.5	F M
Miami	60	WPFZ	155.67	F M
	42	WDHI	31.5	F M
Miami Bch	72	WQMA	156.03	F M
Ocala	6	WBTW	35.9	F M
Orlando	25	WPHM	37.26	A R
Ormond	3	WMJI	37.1	A R
Pahokee	3	WBNO	155.31	F M
Palm Bch	11	WPFX	30.58	A R
Palm Bch C	3	WSSR	31.1	F M
Panama City	4	WAZU	37.1	F M
	5	WKRE	31.1	F M
Pensacola	8	WRGP	30.58	A C
Pinellas	2	WBUW	33.5	A M
Plant City	3	WRFP	35.5	FGE
Putnam C	3	WKGH	31.1	F M
Riviera Bch	4	WLRG	155.01	F M
Quincy	5	WYNB	156.57	F M
Sanford	5	WQRA	33.1	A R
St Augustine	4	WQSU	33.1	F R
	4	WFLI	39.5	F R
St Lucie C	3	WMQP	35.5	F M
St Petersburg	26	WQMZ	33.5	A M
Sarasota	6	WEAG	31.5	F R
	4	WBYI	30.7	A R
Stuart	8	WRWL	155.01	F M
Tallahassee	16	WQSX	33.1	F M
Tampa	35	WHDM	35.5	FGE
		WFPT	37.9	F M
	32	WPHN	37.78	F M
Tavaree	10	WMQJ	39.82	F R
Vero Bch	4	WOGA	155.67	F R
W Palm Bch	18	WRZY	35.5	F M
Winter Haven	3	WQFN	35.9	F M

GEORGIA

Albany	20	WIVJ	155.01	F M
Americus		WRJW	2414	A M
Athens	3	WMUO	39.5	F L
Atlanta	205	WPDY	156.21	F C
Augusta	22	WQFV	31.78	F M
Bibb C	8	WLAF	30.58	F L
Bullock C	7	WFHT	155.01	F R
Brunswick	12	WQTC	155.61	F M
Columbus		WBLV	2414	A S
Dalton	6	WBPJ	37.9	FGE
Decatur	20	WQSJ	37.50	F R
	15	WLAS	155.01	FRy
Dougherty C	4	WDKK	30.98	F M
East Point	10	WBFF	35.5	F L
Elberton	5	WKIY	155.73	F M
Floyd C	6	WNPQ	35.9	F M
Gainesville	2	WHNX	35.5	FGE
Glynn C	8	WQGI	155.61	F M
Griffin	10	WUET	155.73	F M
LaGrange	2	WQTZ	37.1	A M
Macon	11	WQFB	30.58	F L
Marietta	2	WANT	33.94	FGE
Richmond C	9	WGMA	35.9	F M
Rome	8	WQNQ	35.9	F M
Savannah	27	WQTR	33.1	F M
	15	WJPE	155.13	F M
Statesboro	5	WFNP	155.01	FRy
Thomasville	2	WROH	37.1	A M
Toccoa	2	WHVT	39.5	F R
Valdosta	2	WBYB	33.5	A M
Waycross	3	WMPF	35.9	F M

TERRITORY OF HAWAII

Hilo C	40	KADK	35.1	A M
Honokaa	1	KAFR	1714	A M
Honolulu	1	KFJD	37.1	F M
	303	KGPQ	35.1	A M
Kakaako Fire Sta		KFJJ	37.1	F M
Kalihi Fire Sta	1	KFJP	37.1	F M
Kaneohe		KHAB	1714	A C
Kaunakakai C	10	KRLB	30.58	A M
Kealakakua Kona		KIRU	1714	A M
Lahaina		KENW	1722	ASt
Lanai City		KBSN	1722	A C
Lihue C	55	KCKT	37.9	F M
Oahu		KHAC	1714	A C
Wahiawa		KHAA	1714	A C
Wailuku	52	KAPM	39.58	ASt
Waimea C	1	KCKU	37.9	F M

IDAHO

Ada C	5	KAHP	37.22	F M
Bannock C	3	KAAL	37.22	F M
Boise	10	KQBD	37.22	F M
Bonneville	2	KOAD	37.22	F M
Burley	2	KREV	37.22	F M
Caldwell	5	KEHK	37.22	A M
	2	KEHK	37.22	F M
Burley C	2	KREU	37.22	F M
Coeur d'Alene	2	KXIR	30.58	A M
	3	KQGE	30.58	A
Elmore C	2	KECO	37.22	F M
Gem C	1	KFEM	37.22	F M
Gooding C	1	KCJZ	37.22	F M
Idaho Falls	3	KNFB	30.58	F M
Jefferson C	1	KCUK	37.22	F M
Jerome C	2	KAHA	37.22	F M
Jerome	1	KCKK	37.22	F M
Kellogg	3	KHFZ	39.5	FGE
Moscow	5	KQJF	39.42	FGE
Lewiston	3	KSTD	30.58	A
	3	KRLG	30.58	A
Minidoka C	1	KRET	37.22	F M
Moscow	6	KKMT	39.42	FGE
Nampa	4	KQZS	155.01	F K
Payette	1	KXRY	32.22	F M
Pocatello	5	KRBL	30.58	A M
Power C	1	KRZH	37.22	F M
Twin Falls	6	KRDZ	37.22	F M
Wallace	8	KHIW	39.42	FGE
	3	KHFY	39.42	FGE

ILLINOIS

Alexander C	1	WKXZ	39.5	F M
Aledo C	4	WTWU	39.5	F M
Alton	6	WQSR	30.7	A C
Arlington Hgts	3	WBNQ	155.13	F M
Aurora	4	WQRM	155.61	F M
Bartonville	1	WBOF	33.5	A R
Batavia	2	WKDV	35.5	A M
Bedford Park	9	WJVI	39.1	F M
		WSKE	39.1	A D
Belleville	8	WQTG	155.49	F M
Belvidere C	2	WSKO	31.05	A M
Bellwood	2	WKGO	31.5	F M
Bensenville	1	WJHG	37.22	F L
Berwyn	5	WSVH	33.5	A M
Bloomington	10	WQRX	155.13	A M
	5	WSGQ	39.5	F R
Broadview	1	WDBL	31.5	FGE
Brookfield	2	WEUC	31.5	F M
Cairo	1	WIPC	30.98	A M
Calumet	2	WKJN	39.1	F M
Calumet Park	1	WBWG	33.78	A M
Cambridge	4	WIKD	39.5	F M
Canton	2	WHNB	37.1	F M
Carlyle C	2	WKNW	33.94	F L
Carbondala	1	WRLI	39.5	F M
Cary	1	WCVP	39.5	F M
Carthage	2	WAFA	33.94	F M
Centralia	2	WSKZ	33.94	F M
Centerville Tn	2	WGRX	33.1	F M
Champaign	4	WQIB	155.61	F M
Chicago		WPDB	1714	A W
	201	WPDC	35.22	F
		WPDD	1714	AWe
	103	WQJF	31.1	A R
Chicago Hgts	3	WQXZ	33.22	FHv
Cicero	8	WRHC	33.5	A
Collinsville	1	WBEP	39.1	F M
Creve Coeur	1	WNGG	155.73	F M
Crystal Lake	1	WCLV	39.5	F M
Danville	4	WRGQ	30.58	AWe
	12	WBWJ	39.5	F M
Decatur	10	WQTF	33.1	A R
	3	WASB	39.5	F M
Decatur Pk Dist	1	WAAO	33.1	A M
Des Plaines	3	WRIJ	37.1	A D
Clinton	6	WMPJ	39.5	F R
Dixon	3	WAGW	39.5	F M
	7	WAGX	39.5	F M
Dolton		WBVY	33.78	A M
Downers Grove	3	WRIW	37.22	D
E.Moline	4	WEMY	156.21	F M
E.Peoria	3	WJVM	155.01	A M
E.St.Louis	19	WSTX	33.1	F M
Edwardsville	1	WKIJ	33.94	F M
	3	WQRY	33.94	A M
Elgin	6	WQNO	154.89	F M
Elmhurst	5	WQJX	37.22	A M
Elmwood Park	3	WIEG	31.5	F M
Evanston	11	WQLO	30.7	F M
Eureka C	2	WBFG	39.5	F M
Evergreen Park	1	WBKL	33.78	A M
Flora	3	WJLA	33.94	F M
Flossmoor	1	WEKB	33.78	A M
Forest Park	2	WBXG	37.1	A M
Fox River Grove	1	WJUR	33.94	F M
Franklin Park	1	WJWT	31.5	F M
Freeport C	4	WKGI	33.94	F M
Galesburg	3	WBYF	37.1	F M
Geneva	1	WKBP	35.5	A M
	5	WDAA	35.5	AWe
Glencoe	4	WQLN	35.5	AMWe
Glen Ellyn	3	WAEX	154.89	F M
Glen View	2	WGLI	37.1	A
Granite City	2	WQYC	39.1	F M
Harrisburg	1	WALG	39.50	F M
Harvard	1	WHPK	39.5	F M
Harvey	3	WSOK	37.9	A M
Havana	6	WVFZ	39.5	F M
Henderson C	1	WMQD	39.5	F M
Herrin	1	WDKY	39.5	F M
Hennepin	1	WLNY	39.50	F M
Highland Park	5	WQRE	35.9	A M
Highwood	1	WKMB	35.9	A M
Hillside	1	WBRQ	31.5	FGE
Hinsdale	3	WROG	37.22	F M
Homewood	1	WBHY	33.78	A M
		WSKD	31.9	A D
Jacksonville	2	WNRN	39.5	F M
	3	WCUN	39.5	F M
Joliet	5	WQLW	33.1	F M
Kankakee	4	WSTU	30.58	A D
Kenilworth	2	WKPD	35.9	A D
Kewanee	2	WWHO	154.89	F M
LaGrange	2	WAFC	31.5	F M
LaGrange Park	2	WMHZ	31.5	F M
Lacon	4	WKOS	39.5	F M
Lake Forest	7	WQLK	155.85	F M
Lansing		WBMG	33.78	A M
LaSalle	2	WQKR	39.70	F M
Lawrenceville	1	WQGV	33.94	F M
Lewiston	3	WLIS	39.5	F M
Lawrence C	1	WETW	39.5	F M
Libertyville	7	WSYW	33.22	F M
Lincoln	4	WDBT	31.9	A R
	5	WDBU	39.5	F R
Lincolnwood	2	WSKR	37.1	A D
Lockport	1	WLIJ	39.5	F M
Lombard	2	WTSA	154.89	F M
Lyons	2	WDCV	31.5	F M
Madison	2	WMQK	39.1	F M
Maine	37	WSCI	31.9	A D
Marengo	1	WUAV	39.5	F M
Marion	1	WQHX	33.94	F M
	6	WUEI	39.5	F M
Markham	1	WVKD	33.78	F M
Mattoon	3	WBCX	39.5	F M
Maywood	4	WBZD	31.5	FGE
Midlothian	1	WJXF	33.78	AB&D
Moline	4	WAON	33.5	A M
Monmouth	2	WMQS	39.66	F M
Monmouth C	2	WMHI	39.66	F M
Monticello	5	WUFD	39.5	F M
Morton Grove	1	WSKJ	33.78	ADF
Morrisson	5	WKPC	39.5	F M
Mt Carmel	2	WMMO	33.94	F M
Mt Vernon	2	WMTV	39.5	F R
	3	WLEB	39.5	F M
Mundelein	1	WAJS	33.22	A M
	1	WAJS	33.22	F M
Murphysboro	2	WUEP	39.5	FML
Nameoki	1	WMKU	39.1	F M
Naperville	1	WROA	37.5	A R
Normal	1	WQJR	155.13	F R
Northbrook	1	WOQH	35.9	A M
N Chicago	2	WRLN	33.22	A D
Oak Lawn	2	WIWZ	33.78	A D
Oak Park	14	WQFL	37.02	ADF
Oglesby	1	WSRZ	39.5	F M
Olney	4	WXPZ	39.5	F M
	6	WGUZ	39.5	F M
Ottawa	6	WQFZ	39.5	F M
	3	WQKN	37.1	A M
Park Ridge	2	WBZD	30.7	FGE
Paxton C	1	WQWT	39.5	F M
Pekin	2	WSTO	33.5	A R
	2	WANU	39.5	F M
Peoria	30	WASE	155.91	F M
	16	WASE	155.91	A R
		WRIM	33.5	ARCA

Peoria C	10	WRNK	155.01	F M
Peoria Hgts	5	WMWZ	155.01	F M
Peru	1	WQKM	37.1	A M
Pontiac	6	WLCI	39.5	F D
Posen	1	WRTY	33.78	A M
Princeton	8	WKPS	39.5	F M
Quincy	5	WBHZ	155.85	F M
Riverdale		WBMQ	33.78	A M
River Forest	3	WQIN	37.9	A C
		WRIX	37.9	A C
River Grove	1	WJWS	31.5	F M
Riverside	2	WCEV	31.5	FGE
Rock Falls	6	WOJQ	155.61	F M
Rockford	12	WPGD	155.85	A R
	25	WPGD	155.85	F R
	5	WPWC	33.94	F M
Rock Island	6	WBDI	155.61	F M
St Charles	2	WSTY	35.5	A W
St Clair C	10	WRMH	39.5	F M
Salem	1	WAQL	33.94	F M
	3	WBXM	39.5	F M
Saline	3	WMQW	39.5	F M
Sangamon C	4	WRSC	39.5	F M
Scott C	1	WSPK	39.5	F M
Skokie	2	WQXL	155.13	A L
	3	WQXL	155.13	F L
Springfield	10	WQXJ	156.33	F L
Sullivan	4	WHIV	39.5	F M
Stickney	1	WJKW	33.78	A M
Streator	4	WQKE	155.61	F M
	1	WQKE	37.1	A M
Sullivan	1	WGDY	39.5	F M
Taylorville	1	WPTM	33.78	A M
	3	WJYF	33.78	F M
Urbana	4	WAGR	155.73	F M
	10	WYNJ	39.50	F M
Vandalia	1	WFVI	33.94	F M
Venice	1	WJAA	39.1	F M
Villa Park	1	WBLS	37.22	A M
Washington C	2	WSVI	39.5	F M
Watseka	5	WUED	39.5	F M
Wauconda	1	WNVF	33.22	F M
Waukegan	4	WQLM	33.22	F M
Waukegan C	31	WQFX	33.22	F M
	5	WQFX	33.22	A D
Westchester	1	WCUU	31.5	FGE
West Chicago	1	WDCR	39.66	F M
Western Springs	3	WKYZ	31.5	FGE
West Frankfort	1	WDVQ	39.5	F M
Wheaton	3	WQJV	39.5	F L
Wheaton C	20	WQJW	37.22	F M
Wilmette	4	WDEY	39.7	F M
Winnetka	5	WQTO	35.9	A R
Woodstock	2	WPID	39.5	F M
	1	WWPI	39.5	F M
Zeigler	1	WWEV	39.5	F M

INDIANA

Alexandria	2	WEDX	154.89	F M
Allen C	4	WSKG	30.58	A R
	10	WSKG	155.85	F M
Anderson	42	WMPI	155.61	F M
	4	WBMK	154.89	F M
Angola		WIUM	2490	A C
Arkansas City	10	KIHC	39.58	FGE
Auburn	1	WAXT	155.13	F M
Bartholomew C	1	WBBU	155.13	F M
Bedford	2	WBIP	30.58	A M
Beech Grove	1	WKBA	154.71	F M
Bloomington	2	WBPD	155.13	F M
Bluffton	1	WAMI	154.89	F M
Cass C	3	WSLH	154.89	F M
Churubusco C	1	WDNF	154.89	F M
Clinton C	2	WBTJ	154.89	F M
Columbia City	1	WGHQ	154.89	F M
	2	WBJH	155.13	F M
Columbus	3	WRJF	155.13	F M
Connersville	3	WAMB	154.89	F M
Crawfordsville	3	WCIP	154.89	F M
Crown Point	1	WCPP	37.1	F M
	5	WAGT	37.1	F M
Crow's Nest	1	WETZ	154.89	F M
DeKalb C	2	WAXU	155.13	F M
East Chicago	11	WRQT	33.94	F D
		WSGP	33.94	ADF
Edinburg	1	WGGN	155.13	F M
Elkhart	20	WBVH	155.85	F M
Elwood	2	WASF	154.89	F M
Evansville	67	WQKB	154.89	AML
		WETS	30.7	A L
Fort Wayne	100	WPDZ	155.85	F M
	54	WPDZ	30.58	A R
		WBST	2490	A C
Franklin	1	WCQO	154.89	F M
Frankfort	8	WAKK	154.89	F M
Gary	23	WAEE	39.1	FGE
Gibson C	3	WGFA	155.85	F M
Goshen C	5	WSRY	155.85	F M
Goshen	5	WGON	155.85	F M
Hamilton C	4	WSVP	154.89	F M
Hammond	15	WQYK	155.61	F M
		WRGW	30.7	A C
Henry C	3	WUEB	155.13	F L
Howard C	2	WBXD	30.58	A M
	3	WBXD	154.89	F M
Huntington	3	WAKA	30.58	A M
Huntington C	2	WSTA	30.58	A M
Indianapolis		WLSM	2442	A C
	75	WMDZ	35.22	A C
	31	WMDZ	154.71	F M
Jasper	1	WJAI	30.7	A L
Jeffersonville	4	WMHV	39.1	F M
Kokomo	15	WPDT	154.89	F M
Lafayette	10	WQFQ	154.89	F M
LaPorte	8	WMPL	154.89	F M
Logansport	4	WMPQ	154.89	F M
Marion	4	WRAY	30.58	A M
	12	WSIF	154.71	F M
Marshall	1	WMCJ	155.13	F M
Michigan	11	WSVF	155.61	F M
Mishawaka	6	WSKP	154.71	F M
Monroe C	1	WBJK	155.13	F M
Montgomery C	2	WBVG	154.89	F M
Mt Vernon	2	WBTY	30.7	A L
Muncie	25	WPGP	155.97	F L
New Albany	3	WBWX	39.1	F M
New Castle	3	WBNC	154.89	A M
	5	WBNC	155.13	F L
Noblesville	5	WKUO	154.89	F M
N Manchester	1	WNMD	154.89	F M
Peru	6	WASC	30.58	A C
Plymouth	1	WPAC	155.13	F M
Porter C	1	WBVT	30.58	ABA
Putnam C		WHHB	35.1	A M
Richmond	14	WPDH	33.5	F L
Rush C	1	WJAD	154.89	F M
Rushville	2	WJAF	154.89	F M
St Joseph C	6	WXAJ	155.89	F M
Shelby C	2	WSTL	154.89	F M
Shelbyville	2	WDPS	154.89	F L
S Bend		WPGN	154.89	A C
Terre Haute	10	WQOF	33.1	F L
Terre Haute C	3	WNUZ	155.13	F M
Tippecanoe C	2	WJNU	154.89	F M
Tipton C	2	WMQI	154.89	F M
Valparaiso	1	WMPV	30.58	AHv
Vanderburgh C	6	WBXF	30.7	A L
Vincennes	3	WQKT	155.13	F M
Wabash	2	WBIE	30.58	A M
Wabash C	2	WBIH	30.58	A M
Warsaw	2	WHCR	154.89	F M
	2	WJKM	30.58	A M
Washington	1	WNKO	154.89	F K
Wayne C	2	WRIP	33.5	FLGE
Wells C	2	WJAK	154.89	F M
West Lafayette	2	WRMW	154.89	F M
Whiting	2	WQKD	37.1	F M

IOWA

Adams C		KBIE	35.22	F M
Ames	3	KQFW	31.78	A C
Appanoose C	3	KOFI	37.1	FGE
Boone	3	KCBI	37.1	F R
Burlington	6	KQAR	37.1	F M
Calhoun C	1	KKLJ	37.1	F M
Carroll C	1	KCUA	37.1	F M
Cass C	1	KHQD	37.1	F M
Cedar C	1	KFRA	37.1	F M
Cedar Falls	6	KESN	37.1	F L
Cedar Rapids	22	KGPZ	37.1	F M
		KFLZ	33.22	ACn
Centerville	1	KKNK	37.1	F L
Cerro Gordo C	1	KQNY	37.10	F L
Clinton	7	KRIX	31.78	A M
Clarinda	3	KCJJ	37.1	F M
Council Bluffs	7	KPCB	33.78	F M
Dallas C	1	KXRQ	37.1	F M
Davenport	17	KGPN	31.78	A M
Davis C	2	KRPS	37.1	F L
Denison	13	KAIS	37.1	F L
Des Moines C	1	KHGX	37.1	F M
Des Moines	50	KGZG	156.69	F M
Dubuque	5	KQDT	31.78	ACn
Fairfield	1	KAMJ	37.1	F L
Fort Dodge	5	KWZF	37.1	F R
Fort Madison	6	KBYS	33.5	A M
Green C	1	KGHC	37.1	F M
Guthrie C	1	WRKL	37.1	F M
Iowa City	4	KAWP	37.1	F R
Jackson C	1	KWGP	37.1	F M
Keokuk	7	KRAT	37.1	F L
Knoxville	3	KANF	37.1	FGE
Marshalltown	2	KRHL	37.1	F M
Mason City	7	KQAE	31.78	F M
Mt Pleasant	1	KHOR	37.1	F L
Muscatine	3	KCHR	39.9	F M
Newton	5	KJXH	37.1	F M
Oskaloosa	8	KQJI	30.58	A M
Pocahontas C	1	KWIV	37.1	F M
Polk	6	KIGR	35.22	F M
Red Oak	3	KCFK	37.1	F M
Shenandoah	1	KDEN	37.1	F M
Sioux City	13	KGPK	31.78	A M
Tama C	2	KCJN	37.1	FGE
Waterloo	10	KRMJ	37.9	F M
Woodbury C	4	KPMF	37.1	F M

KANSAS

Allen C	2	KAKP	31.5	F M
Arkansas City	10	KIHC	39.5	FGE
Atchison	4	KACA	30.98	A M
Chanute	2	KGZF	33.22	A M
Coffeyville	3	KGZP	30.98	A M
		KMKE	31.5	F M
Cowley C	2	KCFJ	39.58	FGE
Crawford C	3	KRHU	31.5	A M
Dodge City	1	KNGH	33.22	A R
Douglas C	6	KAEQ	31.5	F M
Eldorado	2	KAPD	31.5	F M
Emporia	3	KQUJ	30.98	A M
Garden City	5	KNFH	39.58	F M
Geary C	1	KBXW	31.5	F M
Great Bend	2	KBQN	30.58	A M
Hutchinson	12	KGHN	35.1	F L
Independence	6	KBPL	31.5	F M
Iola	1	KAPG	31.5	F M
Junction City	4	KBNG	31.5	F M
Kansas City	35	KQBH	35.1	A L
		KROK	33.1	A R
Labette C	3	KANH	35.22	F M
Lawrence	3	KQBM	31.5	FGE
Leavenworth	10	KNFF	155.97	F M
Manhattan	7	KRJC	30.58	A M
Mission	10	KBNW	37.5	F M
McPherson	10	KWDG	39.58	FGE
Newton	15	KAMH	39.58	F M
		KAHZ	31.5	F M
Ottawa	7	KXYO	39.58	FGE
Parsons	3	KGKD	35.22	F M
Pittsburgh	5	KPGK	31.5	A M
Salina	18	KNGV	39.58	FGE
Summer C	5	KTKP	39.58	FGE
Topeka	15	KGZC	30.58	A M
	16	KGZC	30.58	A C
Wellington	10	KUHG	39.58	FGE
Winfield	3	KWCL	39.58	F M
Witchita	31	KGPZ	39.58	A R
	40	KGPZ	39.58	A R
	15	KWUH	37.10	FGE
Wyandotte C	3	KQJK	35.1	A R

KENTUCKY

Anchorage		WMHD	30.7	A M
Ashland	3	WSAG	35.1	A M
Bowling Green	4	WRNM	30.7	A W
Covington	10	WKXC	156.69	F M
Fort Thomas	8	WKNU	156.57	FGE
Hazard	1	WMHK	39.5	FGE
Henderson	2	WQTT	30.7	A L
Henderson C	9	WKKZ	30.7	A L
Hopkins C	2	WKYP	30.7	ALM
Hopkinsville	1	WRPE	30.7	A L
Louisville	24	WRGJ	30.7	A R
	100	WPDE	37.1	F M
Laurel C	1	WUEW	39.9	A M
Lexington	17	WPET	39.5	F L
Madisonville	1	WMKY	30.7	A L
Maysville	2	WRPG	31.5	A M
Owensboro	13	WRPJ	30.7	ARLM
Paducah	5	WANP	30.7	A M
Shively	1	WSYK	30.7	F R
Winchester	10	WLHG	155.01	F K

LOUISIANA

Alexandria	29	KPAL	33.22	A M
Baton Rouge	11	WAME	39.5	F M
Bogalusa	3	WFKK	39.55	F M
Calcasieu Parish	4	KIHT	39.5	F M
Coushatta	2	KAJO	39.5	F M
Crowley	4	KISP	155.01	F M
Frankinton C	2	WKKO	39.5	F M
Houma C	8	KANX	39.5	F M
Lafayette	8	KRRA	39.5	F M
Lafayette C	3	KLFN	39.5	F M
Lake Charles	3	KRKP	37.22	ASt
Leesville	3	KHOX	39.5	F M
Mansfield	3	KSGP	39.5	F M
Monroe	5	KPML	33.22	A R
Natchitoches C	3	WNPD	39.5	F L
New Iberia	2	KRAV	155.13	F M
New Orleans	4	WPEK	31.78	A M
Opelousas	2	KVOK	37.1	FGE
Rapides Parish	5	KHML	39.5	F M
Shreveport		KNGO	2430	A C
	18	KNGP	33.22	A C
	16	KVVW	39.50	F K
St Martinville	1	KHBM	39.5	F M
West Monroe	2	KIOQ	155.25	F L

MAINE

Auburn	4	WSAH	30.7	AHv
Augusta	1	WALR	39.1	F M
Bangor	6	WJTM	39.1	F L
Bath	2	WLBM	39.1	F L
Brewer	1	WAQT	39.1	F L
Brunswick	4	WECT	39.1	F M
Houlton	4	WLDU	39.1	FGE
Lewiston	7	WRQH	33.5	A R
Portland	11	WPFU	37.78	A M
		WKJD	39.58	A M
Presque Isle	1	WPIN	39.1	FGE
Rockland	5	WJLL	155.25	F M
Saco	1	WMQT	39.5	F M
Sanford	10	WMHB	39.5	F M
South Portland	11	WCAD	39.5	FMGE
Waterville	2	WJYE	39.1	F M
Westbrook	2	WASL	39.5	FGE
Winslow	1	WBAG	39.1	F M

MARYLAND

Annapolis	2	WAMD	39.18	F L
Baltimore	139	WPFH	33.22	A C
Bel Air C	6	WMHF	35.9	F L
Catonsville C		WMPY	37.5	F L
Charles C	3	WCAI	39.1	F L
Cheverly C		WJLW	39.9	F L
Cockeysville	2	WBZY	37.5	F L
Cumberland	5	WMEY	39.5	F L
Dorchester C	2	WJYN	39.1	F L
Dundalk C		WMQG	37.5	F L
Eastport	1	WHRP	39.58	F R
Edgemere C		WMHE	37.5	F L
Essex		WMPT	37.5	F L
Ferndale	16	WJHS	39.58	F R
Frederick	5	WAUM	35.5	F L
Frederick C	1	WFMQ	39.1	F L
Fullerton C		WMPU	37.5	F L
Galesville	1	WHRO	39.5	F R
Greenbelt	2	WABV	39.9	F L
Hagerstown	4	WHMD	31.1	FGE
Halethorpe		WMQE	37.5	F L
Hyattsville	2	WAOL	39.9	F L
Laurel		WGPH	39.1	F L
Pikesville C		WMPP	37.5	F L
Reisterton C		WMQA	37.5	F L
Rockville	69	WKYX	37.9	F L
St Mary's C	1	WXKE	39.1	F L
Salisbury	2	WBVQ	35.5	FGE
Silver Spring C	38	WHMM	37.9	F L
Towson	41	WPFL	37.5	F L
Upper Marlboro C	25	WJLU	39.9	F L
Washington C	2	WRHO	39.1	F L
Woodlawn C		WMPX	37.5	F L

MASSACHUSETTS

Abington	1	WLIH	155.73	FGE
Acton	1	WITY	155.25	F M
Agawam	2	WMKZ	39.38	F M
Andover	3	WBRJ	39.1	A M
Arlington	12	WPED	30.7	F L
Ashland	1	WRPI	35.90	F L
Athol	3	WBJA	31.9	FGEL
Attleboro	11	WBVC	33.5	FGEL
Auburn	1	WBHC	33.78	A L
Barnstable C	1	WBPW	39.9	A C
Barnstable	15	WRAQ	39.9	AHv
Barre		WAMO	37.5	AGE
Bellingham	1	WBBA	37.9	F L
Belmont	5	WRJZ	33.94	A R
Beverly	10	WBMP	154.77	F L
Bolton	3	WKTJ	37.1	FGE
Boston		WQIP	35.5	AGE
	110	WRAS	30.98	AGE
	125	WRAS	154.89	F M
	1	WAGJ	35.5	AGE
	2	WQRF	35.22	F L
	1	WQRG	37.5	F L
	1	WQRH	37.5	F L
	34	WQRT	35.22	F L
Braintree	5	WBUA	37.9	ASt
Brockton	6	WMPB	30.98	A C
Brookline	32	WQKK	33.5	FGEL
Burlington	3	WCAW	31.5	AMLC
Bourne	10	WRAG	39.9	AMHv
Cambridge		WKWU	33.1	F L
	17	WQLF	39.38	F L
Carver	1	WDOF	39.58	FGE
Chatham	2	WEWE	39.9	A M
Chelmsford	2	WSTI	37.1	A W
Chelsea	5	WAFL	31.1	F L
Chicopee	5	WBMT	30.58	A
Clinton	3	WQKY	37.1	F L
Cohasset	3	WPGU	37.78	A C
Concord	4	WRAC	155.25	F M
Danvers	2	WRAU	39.98	A M
Dartmouth	6	WRJT	154.77	FHv
Dedham	4	WRNU	30.7	A W
Dracut	1	WKTK	37.1	A W
Duxbury	1	WDBI	31.9	F L
E Bridgewater	1	WOJN	155.73	FGE
Easthampton	3	WAMT	31.78	F M
Everett	9	WAKF	37.78	A M
	25	WAKF	155.85	F M
Fairhaven	2	WFMP	30.7	FGE
Fall River	9	WAKV	33.1	FGE
Falmouth	1	WQTL	39.9	A M
Gardner	2	WBWZ	33.94	A W
Gloucester	6	WGMP	31.78	A
Greenfield	6	WKQT	39.90	FGE
Groton	4	WJQN	37.9	F L
Hanson	1	WBGF	155.73	FGE
Harvard	1	WMYK	37.1	F L
Harwich	1	WQTM	39.9	A M
Haverhill	8	WHGF	155.85	F M
Hingham	5	WQTI	37.1	A C
Holliston	1	WDMN	35.1	F L
Holyoke	15	WQIF	156.57	FGE
Hudson	8	WEHB	155.13	FGE
Hull	6	WQYD	37.1	AMC
		WQYE	37.1	A C
Hyannis		WRJH	39.9	AHv
Ipswich	2	WMJQ	37.9	A M
Kingston		WKDX	31.9	F L
Lancaster	2	WKHS	37.1	F L
Lawrence	7	WBLC	39.9	ARM
Leominster	3	WBND	33.5	A W
Lexington	2	WBTZ	39.9	ARM
Lincoln	1	WBOQ	155.25	F M
Longmeadow	4	WBUI	37.22	A
Lowell	14	WQNR	37.1	A W
Lynn	9	WKLM	33.22	FGE
Lynnfield	2	WLDP	35.9	F L
Malden	16	WSVC	33.22	AMC
Manchester	1	WBRT	33.94	A R
Mansfield	3	WAQO	33.78	A M
Marblehead	5	WBVZ	33.5	ARLM
Marion		WKWS	37.9	A C
Marlborough	1	WRTX	39.1	F L
Marshfield	2	WJHU	31.9	F M
Mattapoisett C	1	WLDG	30.7	F M
Maynard	1	WMUL	155.01	F M
Medford	8	WPHG	31.78	AWHv
Medway	1	WBBN	37.9	F L
Melrose	7	WMEJ	39.9	F L
Methuen	5	WBGA	30.7	F L
Middleborough	4	WMAH	30.58	F L
Milton	6	WRBA	35.1	AFM
Nantucket	1	WBYJ	39.9	A M
Natick	2	WQJH	37.78	F L
Needham	9	WMPN	33.22	AHv
New Bedford	7	WPFN	31.1	F M
Newburyport	1	WBMF	37.9	F L
Newton		WBSW	1714	A C
	23	WPFA	31.78	AWGE
Norfolk	1	WFZL	37.9	F L
North Adams	2	WQOV	37.1	A R
Northampton	3	WBMB	31.78	F M
North Andover	3	WEIL	31.1	A M
N Attleborough	6	WIEN	33.5	F L
Norwood	3	WCET	31.1	F L

Osterville		WMUV	39.9	AHv
Pembroke C	1	WAVN	31.90	F L
Pepperell C	1	WFRV	37.9	F L
Phillipston	1	WEIW	31.78	A
Pittsfield	10	WJKH	30.58	FGE
Plymouth	4	WQYJ	31.9	F L
Provincetown	1	WMUZ	39.9	A M
Quincy	30	WQRP	37.22	A C
Reading	3	WQID	37.9	ARM
Revere	5	WMPR	33.78	AWe
Rochester	1	WRMT	37.9	A C
Rockport	1	WQYI	155.01	F M
Salem	4	WRCG	39.38	A M
Salisbury	2	WHNS	37.9	F L
Saugus	3	WAYU	35.1	AHv
Scituate	2	WQOJ	37.1	FGE
Sharon	5	WQSO	33.1	AHvL
Somerset	4	WRKM	33.1	FGE
Somerville	17	WPEH	35.1	FHvM
Southbridge	6	WBTV	31.1	AHv
Southborough		WAMX	37.5	AGE
Springfield	33	WQMD	39.38	F M
Sterling C	2	WKMD	37.1	FGE
Stoneham	2	WRHB	31.1	A R
Taunton	6	WKTB	37.22	FGE
Tewksbury C	2	WQTY	37.1	A W
Wakefield	7	WKWM	30.58	F L
Walpole	4	WHNQ	31.1	F L
Waltham	8	WRNA	37.78	A
Wareham	2	WSTW	37.9	AHv
Ware	9	WAGL	37.5	AGE
Watertown	8	WBNE	31.9	FMGE
Wayland	1	WWPE	37.78	F L
Webster	3	WMKW	33.22	AHv
Wellesley	5	WQJG	33.78	A L
W Bridgewater	1	WWBM	155.73	FGE
Westfield	3	WAKW	37.9	A M
Westford	2	WBVI	37.1	A W
Westport	2	WMWP	155.37	FGE
W Springfield	5	WFLL	39.38	F M
Weston	8	WHTE	33.94	F L
Westwood	3	WKYA	31.1	FGE
Weymouth	5	WBVN	39.9	ARM
Whitman	1	WODT	155.73	FGE
Wilmington		WJYI	37.9	A M
Winchendon	2	WJHQ	31.9	F L
Winchester	6	WQSV	37.22	FGE
Woburn	3	WAKZ	33.78	A M
Worcester	20	WPGX	33.78	A L
Wrentham		WMGT	37.9	F L

MICHIGAN

Adrian	2	WWEJ	33.1	F M
	5	WGIU	33.1	F M
Albion	1	WARZ	33.1	F M
Algonac	1	WNQT	37.38	F M
Allegan C	4	WQGJ	33.1	F M
Allen Park	2	WSKH	31.5	FGE
Alpena	2	WQKV	31.5	F
Ann Arbor	11	WQRK	35.1	F M
Bad Axe	2	WQGS	33.1	F M
Battle Creek	17	WRLM	33.1	F L
	1	WMLU	33.1	F M
Bay City C	3	WEKA	39.5	F M
Benton Harbor	8	WSVO	33.1	F M
Berkley	2	WRIZ	39.38	A M
Beulah	30	WKUZ	155.85	F M
Birmingham	10	WRIY	155.73	F M
Bloomfield Hills	6	WQOG	155.73	F M
Bloomfield	5	WBBJ	155.97	F M
Buchanan	1	WKWW	33.1	F M
Cassopolis	8	WUEJ	155.61	F M
Center Line		WGBX	39.9	A M
Charlotte C	4	WHNA	33.1	F M
Clawson		WRJA	39.38	A C
Dearborn	97	WQND	154.77	F D
Detroit	306	WCK	155.85	FLM
		WDMI	39.1	F R
Dowagiac	1	WJHK	33.1	F M
East Detroit	4	WAEZ	39.9	A M
Ecorse	6	WQMH	35.9	F M
Escanaba	2	WAYA	35.9	F M
Ferndale	4	WRJB	35.5	A C
Flat Rock C		WQZY	37.38	F M
Flint	50	WPDF	154.77	F R
	30	WMEZ	155.85	F M
Grand Haven	2	WSOJ	33.78	ABA
Grand Haven C	3	WOMN	33.1	F M
Grand Rapids	25	WPEB	33.22	A C
	61	WPEB	33.78	F L
	1	WCPX	2442	A C
Grosse Pointe	4	WQMT	37.1	A W
Grosse Pte Woods	17	WRDR	30.58	A C
Hamtramck	7	WQTD	37.9	F M
Hart C	2	WHUJ	33.1	F M
Hastings	1	WAVQ	33.1	F M
Hastings C	2	WAVO	33.1	F M
Hazel Park	3	WJUG	39.38	A C
Highland Park	10	WMO	33.22	A M
Holland	3	WHBM	33.1	F M
Huntington Woods	2	WRJC	39.38	A M
Ironwood	5	WLVA	155.85	F M
Kalamazoo	10	WAMG	33.22	A M
	7	WAMG	33.1	F L
		WJVE	33.22	A C
	6	WBVU	33.1	F M
Lake Orion C	2	WKXA	155.73	F M
Lansing	34	WPDL	33.1	F M
		WKWQ	2442	A C
Ludington	2	WLRB	33.1	F M
	2	WCSV	33.1	F M
Marshall C	8	WBPK	33.1	F M
Marine	1	WQXA	37.38	F M
Marquette	7	WSLJ	30.7	A M
Marysville	2	WDBM	33.1	F M
Mason		WMLF	33.1	F M
Mecosta	1	WLCV	37.38	F M
Menominee	2	WRZQ	33.5	A M
Midland	7	WBLA	31.5	A M
	12	WBLA	155.85	F M
Monroe	4	WEIG	33.22	F M
	3	WQTB	33.22	F M
Mt Morris	1	WHRD	37.38	F M
Mt Pleasant	1	WLEF	37.38	F M
Muskegon	6	WPFC	39.38	A M
	20	WPFC	30.58	F M
Muskegon C	5	WBSU	39.38	F M
Muskegon Hgts	5	WBKD	39.38	A M
	1	WBKD	30.58	F M
Mt Clemens	3	WSRQ	39.9	A M
New Baltimore	1	WBTE	39.9	F M
New Haven	1	WBHW	39.9	F M
New Muskegon	1	WKVJ	39.38	F M
Niles	6	WRQF	30.58	ABA
Oakland C	20	WQRZ	155.97	F M
Oak Park		WDBK	35.5	A M
Orchard Lake	1	WOLX	155.97	F M
Osceola C	1	WLDB	37.38	F M
Ovid	1	WAQN	33.1	F M
Owosso	6	WDDI	33.1	F M
Parchment	1	WBXO	33.22	A M
Paw Paw	1	WCJI	33.1	F M
Pleasant Ridge	2	WRJD	39.38	A C
Pontiac	27	WQMG	155.73	F M
Port Huron	8	WPGB	33.1	F M
River Rouge	5	WROQ	155.49	F M
Roseville	5	WRIR	39.9	AFM
Royal Oak	7	WQMB	39.38	A C
		WBWM	35.5	A M
	3	WQVX	39.38	A M
Saginaw	28	WPES	31.78	A C
	1	WPES	31.78	A L
	7	WRNH	31.78	A C
St Clair	5	WSPV	33.1	F M
	1	WNGF	37.38	F M
St Clair Shores	3	WAGP	39.9	ARM
	4	WAGP	39.9	A M
St Joseph C	9	WSTJ	33.1	F M
St Joseph	4	WSQM	33.1	F M
Sault Ste Marie	2	WCBQ	37.9	F M
Southfield	1	WTSW	39.38	A M
South Haven	7	WOGC	155.61	F M
South Lyon	1	WHVI	37.38	F M
Spring Lake	1	WMVF	37.38	F M
Sturgis	5	WWEY	155.85	R R
Spring Lake	1	WMVF	37.38	F M
Sturgis	5	WWEY	155.85	F R
Sylvan Lake	1	WNVE	155.97	F M
Traverse City	2	WRMB	37.22	A C
Trenton	2	WQWN	31.9	FGE
Van Dyke	1	WBNR	39.9	A C
	4	WBNR	39.9	F M
Washtenaw C	29	WBJG	35.1	F M
Wayne	48	WQMF	30.98	F
W Bloomfield	5	WBOL	155.97	F M
Wyandotte	5	WRHV	39.5	FGE
Ypsilanti	3	WQOK	31.78	AMC

MINNESOTA

Albert Lea	15	KQEZ	155.01	F M
Austin	2	KQBG	37.1	A M
Brainerd	1	WRJP	30.98	A M
Cloquet	4	WFJC	37.1	A M
Dakota	2	KPDW	33.94	A R
Duluth	23	KNFE	30.58	A W
	10	KNFE	30.58	F M
		KQRK	2382	A C
Faribault	1	KQED	37.78	A
Hibbing	3	WJUI	33.5	A M
Int'national Fls	3	KSOZ	155.25	FGE
Mankato	5	KQAA	39.38	A
Minneapolis C	15	KANN	39.9	F M
Minneapolis	83	KGPB	30.98	F M
Moorhead	2	KRSG	39.9	F M
New Ulm	10	KPFJ	155.01	F R
Owatonna	4	KOGC	154.77	F M
Ramsey	3	KQKW	33.94	ARM
Red Wing	1	KQDB	33.5	A M
Rochester	4	KQAM	37.1	F M
St Cloud	2	KQFY	154.65	F R
St Louis C		KKNF	30.58	A W
St Paul	47	WPDS	33.94	A R
South St Paul	3	KQGR	33.94	A R
West St Paul	1	WMRV	33.94	A M
Willmar C	15	KRIN	31.5	A C
Winona	3	KBZB	35.9	F R
Virginia	2	WDCX	31.5	A M

MISSISSIPPI

Adams C	3	WAUA	31.78	F M
Biloxi	3	WJJN	35.9	F M
Columbus	20	WUEL	155.13	F M
Greenville	6	WMPG	35.9	F M
Greenwood	25	WSRW	155.25	F L
Gulfport	5	WGPP	33.5	F M
Harrison	3	WJYG	33.5	F M
Hattiesburg	3	WBJC	33.5	A R
Hinds C	1	WJEU	31.78	A M
Jackson	37	WAMK	39.18	F K
Laurel	3	WLCP	30.98	F M
Meridian	12	WJUA	35.9	F M
Natchez	15	WAMJ	155.31	F M
McComb	10	WKNV	155.25	F K
Pascagoula	15	WDVH	155.01	F M
Vicksburg	4	WRNC	35.1	FGE

MISSOURI

Cape Girardeau	1	KQBS	30.98	A M
Carthage	6	KCMU	155.61	F M
Caruthersville	10	KRSK	39.9	FGE
Clayton	2	KSLC	35.5	F L
Colombia	16	KQDE	155.13	F M
Excelsior Spgs	2	KGTE	155.37	A B
Hannibal	4	KQRU	155.13	F M
Independence	3	KRLK	35.9	FGE
Jackson C	14	KRHW	155.61	F M
Joplin	5	KQAJ	30.58	A D
Kansas City	125	KGPE	155.61	F M
Kirkwood	6	KXYU	155.25	F M
Ladue	5	KQOU	33.5	A M
Moberly	6	KXRS	155.61	F M
Nevada	10	KSTF	155.25	F M
N Kansas City	6	KFIV	155.85	F M
Sedalia	2	KAME	30.98	A M
Springfield	14	KQBO	33.1	A M
St Charles	1	KQCD	31.9	F M
St Charles C	2	KBMB	39.78	F M
St Joseph	16	KQBW	39.1	F M
St Louis	150	KGPC	155.85	F M

MONTANA

Anaconda	2	KQHU	39.38	A R
Billings	5	KQIZ	39.38	A R
Bozeman	1	KBSO	39.38	A D
Butte	5	KBPD	38.5	AWM
	10	KBPD	38.5	F M
Custer C	2	KGRC	39.38	AMD
Gallatin C	3	KROI	39.38	AMD
Great Falls	6	KPGF	39.38	AMHv
Helena	3	KHMP	39.38	A K
Kalispell	15	KGKC	39.38	A M
Lewis & Clark C	1	KTNQ	39.38	A K
Livingston	3	KVRI	39.5	F M
Miles City	2	KFMW	39.38	ATD
Miles City C	2	KGRC	39.38	A
Missoula	2	KQKD	39.38	AKCn
Park C	2	KVRD	39.5	F M
Silver Bow	3	KTMH	39.5	F M

NEBRASKA

Alliance	2	KANB	33.94	FGE
Beatrice	4	KSJV	39.9	FHv
Cass C	1	KSKU	39.9	F M
Chase C	1	KVTX	39.9	F M
Colfax	2	KRLT	39.9	F M
Columbus	5	KQHF	39.9	F M
Dodge C	2	KXCU	39.90	F M
Falls City	2	KRAF	30.58	F M
Fremont	2	KCVB	39.9	F M
Grand Island	3	KQAV	33.1	A M
Hastings	8	KRLX	39.9	F M
Lancaster	10	KCGB	39.9	F M
Lincoln C	1	KPIJ	39.9	F M
Lincoln	17	KGZU	30.58	A M
Norfolk		KNGN	2490	A C
N Platte	3	KRGW	33.5	A M
Omaha	48	KGPI	33.78	F M
		KSDZ	33.94	F M
Omaha C		KRNY	37.1	FGE
	7	KRNX	37.1	FGE
Saline C	1	KUWX	39.9	F M
Saunders C	2	KDBX	39.9	F M
Scottsbluff	3	KRKV	33.5	A M
Scotts Bluff	1	KXDP	39.9	FHv
S Sioux City	1	KQWD	31.78	A M

NEVADA

Carson City	2	KXRL	39.38	F L
Elko	10	KIXN	39.38	F K
	10	KQNZ	39.38	F K
Ely C	20	KSML	39.38	F M
Fallon C	10	KHFS	39.38	F M
Las Vegas	16	KGHG	155.73	F M
	8	KNER	39.38	F M
Lovelock	4	KVWD	39.38	F L
Pioche	6	KFLV	39.38	FGE
Reno	19	KGHH	39.38	FML
Sparks	5	KGHC	39.38	FML
Washoe C	9	KKWC	39.38	F M

NEW HAMPSHIRE

Berlin	10	WUBK	37.5	F M
Claremont	6	WKTX	33.5	F M
Concord	7	WRJV	37.9	A M
Dover	1	WMYQ	30.7	F M
Farmington	8	WVEZ	155.25	A B
Hudson C	1	WLHB	39.5	A M
Keene	2	WJLR	33.5	F M
Laconia	2	WCOT	30.7	F M
Manchester	25	WQLQ	155.97	F M
Nashua	10	WPHB	154.77	F M
Portsmouth	2	WKSA	33.5	F M
Rochester	5	WHIL	39.5	F M

NEW JERSEY

Allenhurst	2	WMQZ	39.9	F L
Alpine	7	WQRO	37.78	A L
	9	WSOE	31.78	F L
Asbury Park	4	WABM	31.1	A L
Atlantic City	20	WQIY	156.57	A L
	1	WQIY	156.57	F L
		WLDN	33.1	A C
	1	WIBY	33.1	A C
Atlantic Hghlnds	1	WJZB	37.38	F L
Audubon	6	WETQ	155.37	F R
Avon by the Sea	1	WBSK	39.9	F L
Bay Head	1	WIZN	33.5	F M
Bayonne	20	WQXN	155.49	F L
Beach Haven	1	WJXE	33.5	F M
Beachwood	1	WKBX	33.5	F L
Belmar	2	WQNT	37.1	A L
Belmawr	6	WKWN	155.37	F R
Belleville	9	WRQX	33.1	F M
Bergenfield	3	WRJU	35.9	A L
Bloomfield	9	WAKH	37.22	A L
Bloomingdale	1	WAKD	37.1	A
Bogota	3	WIUA	39.5	A L
Boonton	1	WFUA	37.9	F L
Bound Brook	1	WQKA	37.9	A L
Bradley Beach	2	WQHW	39.9	F L
Brant Beach	2	WKTS	33.5	F M
Bridgeton	1	WSKA	31.1	A R
	1	WSKA	31.1	F L
Brielle	1	WDBX	37.78	F L
Brigantine	1	WJVN	33.1	A L
Brooklawn	1	WRWK	155.37	F R
Budd Lake	1	WQNA	33.1	A L
Burlington	2	WBSX	37.9	ARM
Butler	1	WANZ	37.1	A
Caldwell	1	WAFP	37.9	F L
Camden	25	WQNI	155.73	F R
Camden C	3	WFZG	156.21	F R
Cape May	3	WFUM	156.69	F L
Carlstadt	1	WKVZ	37.38	A L
Carteret	3	WANV	33.1	F L
Cedar Grove	2	WAWX	33.1	F L
Cinnaminson	1	WKTH	156.69	F R
Clark	2	WFZO	156.31	F L
Cliffside	2	WBVX	35.5	A M
Clifton	10	WSQO	31.1	A L
Closter	3	WRLZ	155.61	F L
Collingswood	5	WQNG	156.21	F R
Cranford	3	WQMC	155.25	F L
Cresskill	1	WRPR	39.9	A L
Deal	4	WQOQ	33.1	A
Denville	2	WEDE	33.5	F L
Dover	4	WDHM	33.5	F L
	2	WECV	33.5	F M
Dumont	1	WBNW	37.5	A M
E Hanover		WETX	35.9	A M
E Orange	12	WQKI	39.5	A W
Eatontown	1	WFJV	37.78	F L
Edgewater	4	WBOO	39.1	F L
Elizabeth	13	WRAD	39.1	A
Emerson	1	WHBA	37.9	A L
Englewood	7	WQIK	33.5	A L
	1	WBMC	37.78	A L
Englishtown	1	WJJE	37.78	F L
Essex Falls	3	WIHC	155.37	F R
Ewing	1	WRKY	37.26	F R
Fair Haven	1	WRXN	37.78	F L
Fanwood	2	WQYZ	156.45	F L
Fair Lawn	3	WCAK	37.9	F L
Florham Park	1	WSRL	35.5	A L
Franklin Lakes	2	WNKR	156.45	F R
Fort Lee	2	WBKN	35.5	A M
Freehold	2	WAII	37.78	F L
Freehold C	45	WAKC	37.78	F L
Garfield	4	WRQE	39.1	A L
Garwood	1	WGIP	155.25	F L
Glassboro	1	WHNU	155.25	F R
Glen Ridge	3	WBYY	37.22	A L
Glen Rock	2	WSFB	155.73	F L
Gloucester	4	WXAH	155.37	F R
Guttenburg	1	WAVK	39.9	F L
Hackensack	15	WPFK	37.78	A L
	20	WPFK	37.1	F L
	9	WQIJ	37.5	A L
Haddon Twp	2	WBKH	156.21	F M
Haddon Heights	4	WRAN	155.37	F R
Haddonfield	3	WRBJ	155.49	F R
Haledon	1	WBTK	35.5	A L
Hamilton Twp	6	WQJM	37.26	F R
Hanover Twp	1	WLSH	35.9	A M
Harrington Park	1	WFQE	155.61	F L
Harrison Twp	10	WXAG	156.21	F M
Hasbrouck Hgts	2	WBYX	33.1	F L
Hawthorne	2	WRGN	39.9	A L
Highland Park	2	WBXL	33.95	FGE
Highlands	1	WJSR	37.78	F L
Hightstown	1	WBGG	37.78	F L
Hillsdale	1	WHNG	37.9	A L
Hillside Twp	6	WSYZ	35.5	A L
Hoboken	7	WMFH	35.9	F M
Hohokus	1	WSRP	37.78	A L
Interlaken	1	WAAG	37.78	F L
Irvington	10	WLSN	35.9	F L
Jersey City	46	WQRS	31.9	A L
	1	WRMJ	31.9	A L
Kearny Twp	30	WUAM	156.69	F M
	11	WRPH	39.9	A W
Keyport	1	WQCM	37.78	F L
Lakewood	2	WRBT	37.9	A L
Lawrence	2	WQJN	37.26	F R
Leonia	5	WSTB	35.9	A L
Lincoln Park	1	WRBO	3.15	A L
Linden	13	WAJQ	31.1	A W
Little Falls	1	WJKI	33.1	F L
Little Silver	1	WFAB	37.78	F L
Livingston Twp	4	WQMK	35.9	A R
Long Branch	6	WQNF	37.1	A L
Longport	4	WQMP	37.1	A M
Lower Penns Neck	1	WBTT	35.5	F M
Lyndhurst Twp	3	WSOM	37.5	A L
Madison	2	WQJU	35.5	A L
Madison Twp	1	WJSH	37.78	F L
Mahwah Twp	1	WCBB	31.1	A
Manasquan	1	WMNJ	37.78	F M
Manville	1	WBYR	31.9	A M
Maplewood	6	WAPK	37.5	F L
Margate City	3	WRLY	37.1	A
Matawan	1	WCBL	37.78	F L
Matawan Twp	1	WKZB	37.78	F L
Maywood	2	WQMX	39.1	A L
Metuchen	2	WQLT	37.1	ALW
Middlesex	1	WFZD	37.9	A L
Middletown	2	WBXZ	37.78	F L
Midland Park	1	WRBX	33.5	A L
Millburn	8	WQKJ	37.1	F L


inside
U.S.A.
LINK RADIO
Communication Equipment
is preferred
LINK RADIO CORPORATION
125 W. 17th STREET
NEW YORK 11, N. Y.
DESIGNERS AND MANUFACTURERS OF ELECTRONIC COMMUNICATIONS EQUIPMENT SINCE 1932

Milltown	1	WMNS	33.94	FGE
Millville	1	WRHR	33.94	F L
Monmouth Beach	1	WMNF	37.78	F L
Monroe Twp	1	WKJE	155.25	F R
Montclair	12	WQMO	156.57	F L
Montvale	3	WKQL	156.21	F M
Montville Twp	1	WKPM	37.1	A L
Moorestown	3	WGNQ	37.5	A R
Morristown	2	WQXK	39.1	A W
Morris Twp	9	WFRR	155.01	F L
Mt Ephraim	5	WXQA	155.37	F R
Mt Holly	1	WBOD	30.7	A R
Mountainside	1	WBXE	33.5	F L
Neptune	3	WBYD	31.9	F L
Neptune City	1	WKKG	37.78	F L
Newark	100	WQIE	156.21	F M
New Brunswick	5	WQHV	39.38	A
New Milford	1	WGCS	37.9	A L
New Providence	2	WGXZ	33.5	F L
North Arlington	2	WBRZ	31.78	A L
North Bergen	12	WAHG	31.1	F L
North Caldwell	1	WAMM	39.1	F L
Northfield	1	WKGE	37.1	A R
North Haledon	1	WBVF	35.5	A L
North Plainfield	2	WQJS	155.73	F L
North Wildwood	3	WNTO	156.21	F R
Nutley	3	WRHQ	155.85	F F
Oakland	1	WBGU	37.1	A
Oaklyn	1	WRMG	156.21	F R
Ocean City	4	WHTV	39.1	F M
Oceanport	2	WCBU	37.78	F L
Oradell	1	WGMU	37.9	A L
Orange	6	WQTS	154.65	F L
Palisades Park	1	WPPP	37.1	A M
	1	WPPP	37.1	F L
Palmyra	8	WKPF	155.01	F R
Paramus	2	WBKE	37.78	A L
Park Ridge	6	WKQJ	156.21	F M
Passaic	8	WQKH	35.9	A L
Paterson	15	WRGO	35.5	A L
Paulsboro	5	WWRS	155.25	F R
Pennsauken Twp	3	WSPT	39.1	A R
	10	WSPT	155.61	F R
Penns Grove	1	WBSL	35.5	F M
Pequannock Twp	1	WANX	37.1	A B
Perth Amboy	5	WFTK	37.9	F L
Phillipsburg	2	WENX	156.09	F L
Piscataway	3	WQJY	39.9	A L
Pitman	7	WAOW	155.25	F R
Plainfield	10	WQKG	156.45	F L
Pleasantville	12	WQMQ	155.73	F R
Point Pleasant	1	WAXV	37.78	F L
Pompton Lakes	3	WSWI	37.1	A L
Princeton	2	WQTA	37.1	A L
Princeton Twp	2	WRBI	37.1	A L
Prospect Park	1	WBTL	35.5	A L
Rahway	8	WQYG	156.33	F L
Raritan	8	WQJC	39.98	F L
	1	WBWI	37.78	F L
Red Bank	6	WIEJ	39.38	F L
Ridgefield	2	WBKP	37.5	A M
Ridgeport Park	3	WSKM	39.5	A L
Ridgewood	9	WQYF	33.5	A L
Ringwood	1	WAKJ	37.1	A
Riverdale	1	WBZJ	37.1	A L
River Edge	3	WDYV	156.09	F L
Riverton	1	WIVS	155.01	F R
Rockaway Twp	1	WTVY	33.5	F L
Rockaway	1	WEDQ	33.5	F L
Roseland	1	WIZM	35.9	A L
Roselle	3	WQMY	35.5	A L
Roselle Park	2	WQJQ	37.5	A L
Rumson	4	WQKQ	35.9	ARL
Saddle River	1	WMHT	37.78	A L
Salem	1	WSQK	35.5	F R
Scotch Plains	2	WSPP	33.5	F L
Sea Bright	1	WMQC	37.78	FL
Sea Girt	1	WFUO	37.78	F L
Seaside Hgts	2	WBBF	33.5	F M
Seaside Park	1	WCYC	33.5	F M
Secaucus	3	WQIL	37.1	A L
Shrewsbury	1	WMQF	37.78	F L
Ship Bottom	1	WKQV	33.5	F M
Somerville	2	WRSO	31.1	F M
S Bound Brook	1	WBXJ	37.9	A L
South Belmar	1	WBJD	38.78	F L
South Orange	4	WKVR	31.9	F L
South Plainfield	2	WABU	39.9	A M
South River	2	WNRF	155.97	F M
Sparta Twp	2	WSLG	31.5	A L
Springfield	3	WBHG	39.1	F L
Spring Lake Hgts		WSLL	37.78	F L
Spring Lake	2	WRAZ	35.5	A
Summit	5	WQRX	39.9	ARL
Surf City	1	WBMX	33.5	F M
Teaneck	7	WQJO	154.77	F L
Tenafly	3	WRGI	39.9	A L
Totowa	1	WJKC	31.5	A L
Trenton	30	WQIZ	37.26	F R
Toms River C	9	WBAK	33.5	F M
Union Beach	1	WDJQ	37.78	F L
Union City	12	WQNY	155.61	F L
Union Twp	7	WQJB	37.9	A L
Upper Penns Neck	1	WAYE	35.5	F M
Ventnor	4	WQKX	37.1	A C
Verona	2	WQYH	37.9	F L
Vineland	5	WJED	39.1	F R
	4	WLPH	156.21	F R
Wall	1	WPHL	37.78	F L
Wanaque	1	WAKM	37.1	A
Washington	1	WCWD	37.9	A L
Watchung	1	WSPE	156.57	F L
Wayne Twp	3	WSLC	31.5	A L
Weehawken Twp	7	WKGL	31.5	F M
West Caldwell	1	WSQN	35.9	A R
Westfield	3	WQOM	33.1	A W
W Long Branch	1	WFOV	37.78	F L
W Milford Twp	1	WBNG	37.1	A
W New York	7	WQRN	37.9	A L
West Orange	5	WSKN	39.5	A L
W Patterson	1	WIUO	31.5	A L
Westwood	3	WRMZ	37.9	A L
Wharton	1	WEDH	33.5	F L
Wildwood	2	WBOJ	31.5	A L
Wildwood Crest	1	WESD	155.25	F R
Woodbridge	7	WQJE	37.5	A L
Woodbury	1	WRLV	31.9	F R
Woodcliff Lake	3	WKRH	155.37	F M
Woodlynne	2	WPYV	156.21	F R
Wyckoff Twp	6	WKJZ	156.45	F R

EXPERIMENTAL

Boonton	W2XVE	72.76	F L
Dover	W2SVF	72.76	F L

NEW MEXICO

Albuquerque	7	KGZX	39.1	FGE
Albuquerque C	4	KSTH	37.1	FGE
Artesia	4	KTHZ	39.9	F M
Carlsbad	4	KTIH	39.9	F M
	7	KTHR	39.9	F M
Chaves C	2	KRHQ	33.22	F R
Clovis	8	KNFA	39.9	F K
Hobbs	6	KHMQ	39.9	FRK
Lovington	12	KSLY	39.90	F M
Roswell	2	KRNM	33.22	A R
Santa Fe	3	KGPF	39.5	FGE

NEW YORK

Albany	31	WPFD	155.01	F M
Amityville	2	WHDI	35.9	A
Amsterdam	4	WKNI	37.9	FGE
Arcade	1	WMLG	37.9	F M
Ashsroken	1	WTXK	39.38	F L
Auburn	5	WPDN	39.5	F L
Albion C	3	WAZN	39.5	F M
Armonk	3	WAUF	35.9	F L
Babylon	3	WROI	35.9	A
Bath	14	WEJZ	37.9	F M
Batavia	2	WRGS	33.5	FGE
Bear Mountain	7	WJXL	31.78	F L
Bedford Hills	10	WTUR	155.37	F L
Binghamton	14	WHTZ	37.9	F L
Brooklyn	150	WRQP	37.22	F R
Blasdell	1	WEQF	2422	A C
Broome C	8	WBZN	37.9	F L
Briarcliff Manor	2	WBDN	37.1	A
Bronxville	3	WQOY	155.49	F L
Buffalo	50	WMJ	30.58	ACMR
	30	WMJ	30.58	F M
Caledonia	1	WCNF	37.9	F M
Canandaigua	1	WAIJI	37.9	F M
Canton	7	WKJX	2414	A L
Celeron	1	WRAX	37.9	F M
Cheektowaga	12	WKQZ	156.57	FGE
Clarkstown	2	WBLF	31.1	A M
Corning	3	WKPI	37.9	F M
Cortland	2	WBID	35.1	FGE
Croton on Hudson	2	WRLB	37.1	A
Chappaqua	2	WEKU	39.1	F M
Depew	2	WDPB	37.9	FGE
Dobbs Ferry	2	WVEP	155.85	F M
Dunkirk	3	WALK	37.9	F M
Eastchester	6	WQLC	33.1	FGE
East Hampton	1	WKVI	155.13	F L
Easthampton	1	WHTU	31.9	F L
Elmira	14	WBLL	37.9	F M
Endicott	9	WIKE	155.13	A L
	20	WIKE	155.13	F L
Elliott C	45	WAXK	31.5	F M
Erie	6	WBTQ	37.22	F M
Floral Park	5	WBDO	31.5	A L
Fonda C	2	WHOH	37.9	F M
Freeport	6	WAFR	37.9	A
Fulton	2	WBIC	33.5	A M
Garden City	8	WQKO	37.1	A
Geneseo C	4	WAZS	37.9	F M
Geneva	2	WQOU	31.5	F M
Glen Cove	6	WRJG	33.78	A
Glens Falls		WQQR		
Glenville	1	WTKZ	39.5	FGE
Gloversville	2	WJQL	33.1	F L
Goshen C	5	WQHS	37.9	F M
Grand View on Hudson	1	WBVK	31.1	A
Greenburgh	4	WQKZ	33.1	F M
Hanover	1	WSRX	37.9	F M
Harrison	15	WQLX	156.33	FGE
Hastings on Hudson	3	WKIQ	155.73	F L
Haverstraw	1	WBLG	31.1	A
	1	WQTK	31.1	A
Hempstead	10	WQKP	39.5	A
Herkimer	1	WAKN	2414	A C
Hillburn	1	WBOY	31.1	A
Hornell	4	WRAP	37.9	FGE
Huntington	10	WPGO	39.38	F L
Ilion	10	WXCK	155.61	F M
Islip	4	WHTI	31.9	F L
Ithaca	2	WQNS	31.5	AGE
Jamestown	11	WJNY	37.9	F M
Johnston C	2	WNKU	37.9	F L
Johnson	11	WMOJ	37.9	F L
Kenmore	12	WGSY	155.13	FGE
	12	WKAS	155.13	FGE
Kings Point	3	WIHJ	39.9	F M
Kingston	7	WQXP	155.61	F M
Lakewood	1	WDCT	37.9	F M
Lake Success	2	WMQO	35.1	F L
Lancaster	5	WBAW	37.9	FGE
	6	WLSB	37.9	FGE
Larchmont	3	WQJT	33.1	A W
Lindenhurst	4	WROJ	35.9	A
Little Valley	10	WAXZ	37.9	F M
Lockport	10	WLOC	39.5	F L
	1	WLOD	39.5	F L
Lockport C	6	WKHR	37.9	F M
Long Beach	5	WLBP	155.37	FGE
Lynbrook	5	WBDK	35.1	F L
Malvern	4	WGSW	155.13	A
Mahopac C	3	WQEZ	39.9	F L
Mamaroneck	10	WSNK	155.25	F L
Massena	2	WMJX	37.9	F M
Middletown	4	WSRN	155.73	F M
Mineola	169	WPGS	37.34	F L
Mt Vernon		WQLV	35.5	A W
Newtonville	10	WKDE	39.42	FGE
Newburgh	3	WEUA	39.9	F L
New Rochelle	7	WQKC	31.5	A W
New York (Bronx)	88	WEYW	39.82	F R
" (Jamaica)	100	WJIJ	39.9	F L
"	1	WNAJ	33.94	F L
"	11	WNYM	30.98	ALR
" (Kings)		WPEE	33.94	AWR
" (Bronx)		WPEF	33.94	AWC
"	61	WPEG	30.98	ALRW
" (Richmond)	29	WRFN	33.94	F L
New City		WQIN	31.1	A
Niagara Falls	15	WNFP	37.1	F M
Nissequogue	1	WETY	31.9	A M
North Pelham	3	WQLD	37.1	A
Northport	1	WRKD	31.5	F L
N Tarrytown	1	WBXN	37.1	A
N Tonawanda	14	WBTI	35.9	F M
Nyack	2	WRGM	31.1	A
Ogdensburg	5	WHJC	155.55	FGE
Olean	2	WQMV	37.9	F M
Old Westbury	3	WDQK	35.1	F L
Oneida	4	WJAM	35.1	ASt
Oneonta	3	WQFJ	30.58	AHvM
Onondaga C	9	WBVJ	37.78	AFM
Ossining Twp	1	WMVE	37.1	A
Oswego C	14	WJZX	37.9	F M
Patchogue	16	WRNE	155.49	F M
Peconic	6	WHTT	31.9	F L
Peekskill	2	WBZW	31.5	A R
Pelham	2	WQOT	37.1	A
	1	WDAG	37.1	A
Pelham Manor		WFJU	37.1	A L
	4	WQOS	37.1	A L
Plattsburg C	1	WIKG	37.9	FGE
Pleasantville	3	WHBP	155.37	F L
Piermont	1	WHHE	31.1	A
Plattsburg	1	WDGS	37.1	FGE
Port Chester	6	WRSY	156.45	A M
Port Jervis	2	WQXY	33.1	A L
Port Washington	3	WABN	35.22	A
Poughkeepsie	8	WRCV	30.7	A R
Putnam Vly Twp	1	WIKI	31.5	A R
Ramapo Twp	3	WBLH	31.1	A M
Rensselaer	2	WVSM	155.01	F M
Riverhead Twp	2	WAYT	31.9	F L
Rochester	1	WPDR	30.58	A
Riverhead C	12	WJPV	31.9	F L
Riverhead Twp	2	WAYT	31.9	F L
Rochester	74	WPDR	30.58	ALM
Rotterdam	3	WRTK	35.5	FGE
Rye	6	WQKU	31.9	A
Salamanca	2	WBSB	37.9	FGE
Sands Point	2	WQHZ	35.9	A
Saratoga Spgs	2	WJGB	35.9	FGE
Scarsdale	5	WQKL	33.1	A
Schenectady	13	WQRB	37.1	FGE
	2	WBGJ	39.5	FGE
Scotia	1	WTMZ	39.5	FGE
Sloatsburg	1	WCUJ	31.1	A
Smithtown Branch	3	WAFV	31.9	A M
Solvay	3	WCQY	35.9	FGE
Southampton	4	WHTS	31.9	F L
	2	WKPH	155.73	F L
Sparkill	3	WSWJ	31.1	A
Spring Valley	2	WBLI	31.1	A L
Suffern		WBLM	31.1	A
Syracuse	37	WPEA	37.78	FGEM
	4	WPEA	30.98	AGE
Tarrytown	3	WBLN	35.5	F M
Troy	25	WRCD	155.61	FGE
Tuckahoe	2	WQJD	33.1	A
Upper Nyack	1	WBLO	31.1	A
Utica	23	WPGJ	31.5	FGE
Warsaw	1	WMLJ	37.9	F M
Watertown	4	WCDX	37.1	FGE
Watervliet	1	WMJN	37.9	F M
Warsaw C	6	WBPE	37.9	F M
Westfield	1	WEQK	37.9	F M
West Seneca	12	WSEN	155.01	FGE
White Plains C	27	WJKS	30.58	F M
White Plains	22	WQKS	37.1	A W
Williamsville	5	WRNJ	31.5	F L
Yonkers	9	WPFY	37.22	F L
Yorktown	2	WNHO	31.5	ARM

EXPERIMENTAL

Brookhaven	W2XML	74.60	F M
Patchogue	W2XMK	73.22	F M

NORTH CAROLINA

Albemarle	3	WFAO	155.13	F R
Asheboro	5	WKRD	155.13	F M
Asheville	10	WQMJ	30.58	A C
Asheville C	20	WPFS	30.58	A C
Beaufort	10	WEHV	35.9	F L
Burlington	3	WRJE	33.5	A L
Canton	5	WBKG	37.1	F L
Charlotte	10	WSLF	37.9	F L
Concord	3	WQNE	33.1	A L
Durham	25	WDMP	39.1	F L
Durham C	10	WUEV	39.1	F L
Edentown	4	WQZE	35.9	F L
Elizabeth	5	WBIV	39.5	F L
Fayetteville	11	WROS	33.5	F L
Forsyth C	3	WRPU	33.5	A R
Gaston C	12	WMHY	37.1	F L
Gastonia	4	WQNZ	37.1	F L
Goldsboro	4	WABQ	35.9	F L
Granite Falls	1	WEVQ	37.5	A R
Greensboro	22	WQMR	37.1	A L
Greenville	4	WJPT	35.9	F L
Guilford C	14	WLSG	39.5	F L
Henderson	6	WSQP	39.5	F L
	10	WSQR	39.5	F L
Hendersonville	6	WHSD	39.1	F R
Hickory	5	WRGY	37.5	A L
High Point	6	WHPP	39.5	F L
Iredell C	3	WDBR	33.94	F R
Jacksonville	5	WMHU	39.1	F L
Kings Mountain	2	WIUD	37.5	A L
Kinston	6	WQLR	35.9	F L
Leaksville	6	WGNJ	37.5	A L
	8	WBJF	37.5	A L
Lenoir	11	WBNL	37.5	ARM
Lexington	2	WRNT	33.1	F L
Lumberton	15	WKQM	39.5	F L
Monroe	2	WKZM	39.5	FGE
Mooresville	6	WKWO	155.13	F L
Morganton C	8	WBXT	37.5	A M
Mt Airy	2	WQME	35.9	F L
New Bern	3	WADX	35.9	FGE
Newton	2	WBTX	37.5	AL M
Oxford	5	WEKH	39.38	F L
Pitt C	5	WTJE	35.9	F L
Raleigh	10	WQLY	31.5	F L
Reidsville	2	WRPW	37.5	A L
Roanoke Rapids	10	WPXC	35.9	F L
Rocky Mount	3	WQLI	33.5	F L
Rutherfordton	9	WATU	33.5	F L
Salisbury	5	WQLU	33.1	F L
Shelby	3	WANY	37.5	A L
Statesville	2	WDBS	33.94	F R
Thomasville	2	WETO	39.5	F L
Washington	6	WDPJ	35.9	F L
Wayne C	1	WJDZ	35.9	F L
Wilmington	15	WDPW	39.5	FLM
Wilson	10	WQNU	155.13	F M
Winston Salem	17	WQMS	33.5	ARL

NORTH DAKOTA

Bismarck	1	KQRL	33.5	A R
Cass C	4	KXYX	39.9	F M
Fargo	5	KNHM	39.9	F M
Grand Forks	5	KQSO	39.9	F M
Minot	10	KSMB	39.9	F M

OHIO

Adams Twp	2	WJQB	30.7	FGE
Akron	21	WPDO	37.9	ARM
	10	WPDO	156.21	FRGE
	10	WCAY	39.58	F R
Akron C	5	WCAY	30.7	A
Allen C	2	WAAL	37.9	F M
Alliance	4	WJUK	33.94	F L
Amberly	2	WBIU	31.5	A R
Ashland	2	WAXC	37.9	F R
Ashtabula	3	WSTK	37.1	A R
Athens	1	WMPZ	37.9	F M
Barberton	3	WJGD	31.9	A L
Beachwood	1	WANW	37.9	F M
Bedford	6	WBQF	155.61	F M
Bellevue	1	WBAU	39.78	FGE
Berea	10	WTNE	155.61	F R
Bryan	10	WLHD	155.61	F M
Brecksville	2	WMLB	37.9	F R
Bucyrus	2	WQTQ	30.98	A M
Canal Winchester	4	WJZA	39.58	F M
Canton	25	WQKW	156.57	F M
Canton C	10	WBYZ	39.38	F L
Campbell	2	WNKQ	37.22	A L
Chagrin Falls	2	WJZN	37.9	F M
Champion C		WJWO	37.9	F M
Chardon C	1	WNZE	37.9	F M
	4	WJJO	37.9	F M
Chillicothe	3	WRIC	33.22	A
Cincinnati	45	WKDU	30.58	ARM
	36	WKDU	35.22	F M
Cleveland		WEND	33.1	AGE
	69	WRBH	30.98	ARM
	122	WRBH	37.34	FGEM
		WRPD	33.5	A R
Cleveland Hgts	11	WSXO	37.5	FGE
Clyde		WLDO	30.58	FGE
Columbus	80	WPDI	154.65	F M
	20	WJKB	39.66	F M
Colerain Twp	24	WLOZ	37.9	F M
Coshocton	5	WDQH	155.85	F M
Cuyahoga Falls	8	WBUJ	35.9	F M
Dayton	75	WPDM	156.33	F F
Defiance C	2	WJES	39.78	F M
Delaware	1	WHIV	39.66	F M
Delaware C	2	WHNL	39.66	F M
East Cleveland	15	WMSZ	31.1	A R
East Liverpool	4	WMLC	37.9	F M
Elyria	12	WRNS	31.5	A R
Elyria C	4	WBYO	37.9	F M
Erie	5	WALU	30.98	FGE
Euclid	11	WLSD	39.9	F L
Fairfield C	3	WFPV	33.22	F M
Forestville C	1	WKOI	37.9	F M
Gallon	1	WRQM	30.98	F L
Garfield Hgts	3	WBHA	37.9	F M

Gates Mill	2	WKWB	37.9	F M
Gibsonburg	1	WGBY	39.78	FGE
Girard	1	WJSD	37.22	A L
Grand River	1	WNZW	31.5	A R
Grandview Hgts	8	WKTI	154.65	F M
Greenville	1	WQZE	37.9	F M
Hamilton	7	WQOX	37.1	AGE
Hamilton Twp	6	WUEO	39.58	F M
Hardin C	1	WHCO	37.9	F M
Hilliards	2	WJZJ	39.58	F M
Hills & Dales	1	WRSI	156.57	F M
Hunting Valley	4	WKUW	37.9	F M
Indian Hill	8	WQST	155.85	F M
Ironton	2	WBVL	31.5	A M
Jackson		WSPX	2430	A C
Jefferson C	8	WSIG	37.5	A L
Kenton	2	WKMP	37.9	F M
Kirtland Hills	2	WKWX	31.5	A M
Knox C	4	WAWI	37.9	FMK
Lakewood	11	WHTL	37.9	F M
Lancaster	4	WQFO	33.22	F M
Licking	6	WHHA	37.9	F M
Lima	7	WAFU	37.90	F M
Lockland	3	WBMZ	37.9	F M
Logan	1	WBOH	31.5	A R
Lorian	8	WLOP	37.1	F M
Lyndhurst	2	WKVE	37.9	F M
Madison Twp	4	WJZE	37.9	F M
Mahoning C	7	WHMY	37.22	A L
Mansfield C	3	WJMH	37.5	F L
Mansfield	5	WQFY	37.9	F M
Maple Heights	3	WMVH	37.9	F M
Marietta	2	WRGL	31.5	F R
Marion	2	WJJI	37.9	F M
Marion Twp	1	WKUI	154.65	F M
Marysville	6	WBBP	39.58	F R
Massillon	6	WBGT	37.1	A L
Maumee	3	WMFS	30.7	FGE
Mayfield Hgts	3	WKVF	37.9	F M
Mentor		WMOP	31.5	A R
Mentor on the Lake	1	WAIS	31.5	A M
Middletown	11	WBVB	35.9	A M
Millersburg C	5	WKNC	39.9	F M
Mingo Junction		WEMX	33.1	A R
Montgomery C	9	WBAV	31.78	A M
Moreland Hills	2	WKVH	37.9	F M
Morrow C	1	WKTH	39.78	F M
Mt Vernon	2	WMVK	37.9	F M
Nelsonville	4	WKAU	155.61	F M
New Philadelphia	5	WBPH	39.66	F K
Niles	1	WRQL	37.5	A L
North Newark	5	WQRW	37.9	F M
Norwalk	2	WJUM	37.9	F M
Norwood	10	WBYG	39.5	F M
Oakwood	4	WBKC	33.5	A M
Orange	2	WJZL	37.9	F M
Osborn	3	WEQS	156.33	F M
Ottawa C	4	WDHW	39.66	FGE
Ottawa Hills	3	WQOL	31.5	FGE
Painesville	3	WKHL	37.9	F M
Painesville C	4	WBOK	31.5	A R
Parma	8	WTAK	35.9	FGEM
Pepper Lake	2	WKVK	37.9	F M
Perrysburg	4	WKYF	37.9	F M
Piqua	5	WQTP	155.13	F M
Port Clinton	4	WSTM	39.66	FGE
Portsmouth	9	WPGI	30.58	A C
Ravena	1	WRAA	37.9	F M
Ravena C	4	WFRK	37.9	F L
Reading	2	WCDE	37.9	A M
Rocky River	8	WAFX	39.5	F L
St Bernard	3	WJSB	37.5	A M
St Clairsville C	4	WAKL	33.1	A M
Salem	1	WBGW	37.1	F L
Sandusky	4	WAKI	30.98	FGE
	2	WBTU	30.58	FGE
Sandusky C	5	WALU	30.98	F
Seneca C	4	WBNA	39.66	FGE
Shaker Hgts	13	WQHN	37.9	F M
Shelby	1	WAMH	155.13	F M
Sidney	1	WSGO	31.5	A R
Silver Lake	1	WKUJ	35.9	F M
Solon	1	WBUG	37.9	F M
South Euclid	2	WKTW	37.5	F M
Springfield	15	WQMI	33.1	ALM
Steubenville	3	WPHD	33.1	A R
	5	WPHD	154.85	F R
Steubenville C	5	WWRV	33.1	A R
Sylvania	1	WSFI	30.7	FGE
Tallmadge	1	WTAJ	39.66	F D
Terrace Park	1	WNAZ	37.9	F M
Tiffin	4	WKTP	39.66	FGE
Toledo C	7	WMFO	30.7	FGE
Toledo	33	WRDQ	35.22	FGE
Toronto	1	WRIL	33.1	A R
Troy	3	WQTX	37.9	F M
Trumbull C	4	WAFE	37.78	F L
University Hgts	1	WKIK	37.9	F M
Upper Arlington	5	WUAP	154.65	F M
Urbana	2	WJVQ	37.9	F M
Van Wert C	2	WBPG	39.78	F M
Van Wert	5	WGEB	155.85	F M
Waite Hill	2	WKKU	31.5	AMR
Warren	9	WCBK	39.66	F L
Warrensville Hgts	1	WMYP	37.9	F M
Wellsville	2	WMPO	33.1	A L
Westlake	1	WKMZ	39.38	A K
Wickliffe	3	WJZV	31.5	AMR
Willoughby	3	WQHM	31.5	A M
Willowwick	2	WQWO	31.5	A M
Wooster	8	WJST	155.61	F M
Wooster C	4	WNEG	39.9	F L
Wyoming	3	WBYA	33.5	FGEM
Xenia	1	WEGH	33.94	FGE
Youngstown	32	WPDG	37.22	A L
Zanesville	6	WPHO	33.22	A C

OKLAHOMA

Ada	6	KNHC	156.69	F M
Altus	2	KACL	30.58	A
Ardmore	5	KTQW	156.69	F M
Bartlesville	5	KQFM	156.69	F L
Blackwell	3	KEZY	33.22	A C
Bristow		KOKB	2450	A C
Canadian C	2	KBYH	31.5	F M
Chickasha	4	KACF	31.5	FGE
Cushing		KAPB	2450	A C
Duncan	2	KNGK	33.22	A M
Durant	5	KRBK	33.22	ARM
Edmond	2	KRHT	30.58	A M
El Reno	3	KQAB	31.5	F M
Enid	6	KAPK	33.22	AMSt
Guthrie	1	KGOP	31.5	F M
Henryeta	6	KCJM	156.69	F M
Hugo C	5	KPMZ	31.5	F M
Kay C	2	KQTV	33.22	A M
Lawton	2	KGHP	33.22	A K
Logan C	2	KHUO	31.5	F M
Miami	5	KNCE	31.5	F M
Muskogee	10	KNGT	31.5	F M
Norman	3	KRAY	33.22	A C
Norman C		KAPE	2450	A C
Nowata C	2	KHOC	31.5	FMK
Oklahoma City	15	KQDS	33.5	FGE
Oklahoma City C	22	KGPH	33.5	FGEM
Okmulgee	10	KAPF	156.69	F M
Pawhuska	5	KOPM	31.5	F M
Ponca City		KACP	2450	A R
Pryor	2	KCNO	31.5	F M
Sapulpa	8	KPDS	30.58	F
Seminole	3	KACR	30.58	A R
Shawnee	2	KWCM	33.22	A C
Stillwater	6	KSWP	30.58	AMR
Tulsa	75	KQEI	30.58	AMR
	101	KQEI	156.69	F M
Wewoka	8	KWMP	156.69	F M

OREGON

Albany	3	KIOA	33.5	F M
Astoria	5	KQKX	30.98	A M
Baker	10	KSYG	156.57	F M
Beaver Creek		KSAD	33.5	F M
Bend	2	KQIN	35.22	A M
Canby	1	KSAB	33.5	F M
Clackamas C	8	KBSX	33.5	F M
Coos Bay	10	KHFX	155.01	F M
Corvallis		KFZO	33.5	F M
Dallas	4	KPJC	155.73	F M
The Dalles	4	KHNX	33.5	F M
		KRWF	33.5	F M
Estacada	3	KEVU	33.5	F M
Eugene	9	KADV	39.82	F K
Gladstone	2	KSAG	33.5	F M
Klamath Falls	20	KGZH	156.57	F M
La Grande	4	KQXP	156.57	F M
Lane C	3	KCSK	39.82	F K
Marion C	5	KORM	155.73	F M
McMinnville	12	KRLA	33.5	FGE
		KWGK	33.5	FGE
Medford	2	KRIQ	35.1	ASt
Milwaukee	7	KSAK	33.5	F M
Molalla	1	KEHJ	33.5	F M
Mominnville	1	KRLA	30.98	A
Mount Angel	4	KVWM	155.73	F M
Multnomah C	100	KQJR	30.98	AMRK
Newberg	3	KIYX	156.33	F F
Oak Lodge	1	KSAH	33.5	F M
Oregon City	5	KGOQ	33.5	F M
Oswego	1	KIAD	33.5	F M
Pendleton	4	KPOL	33.5	F M
Portland	35	KBQS	155.61	F M
	155	KGPP	30.58	AMKC
Polk C	1	KPYN	155.73	F M
Salem	30	KGZR	155.73	F M
Salem C	1	KORM	30.98	A
Sandy		KSAJ	33.5	F M
Sheridan	4	KNHL	33.5	FGE
Silverton	4	KSYN	155.73	F M
Springfield	1	KJML	39.82	F K
Tillamook C	3	KIKO	33.5	F K
Washington C	3	KRJB	30.98	AMK
West Linn	4	KHWL	33.5	F M
West Salem	4	KSYD	155.73	F M
Willamina	4	KNHK	33.5	FGE
Woodburn	4	KSYQ	155.73	F M

EXPERIMENTAL

Portland	2	W7XJM	73.30	F L
Rocky Butte		W7SJK	74.58	F L
Troutdale		W7SJL	73.30	F L

PENNSYLVANIA

Abington	10	WQNW	33.94	F L
Aldan	1	WJZP	39.5	F R
Allentown	25	WQJZ	156.57	F R
Aliquippa	4	WRIK	33.5	F R
Altoona	5	WSRD	35.9	F L
Ambridge	3	WRHZ	35.5	F L
Ardmore	22	WQNX	156.33	F M
Aspinwall	1	WOBZ	39.38	F L
Baldwin Twp	5	WNBX	39.38	F L
Beaver	1	WQQR	37.1	A L
Beaver C	2	WJVY	30.7	A R
Beaver Falls	4	WRHA	37.1	A L
Ben Avon	1	WNIB	39.38	F L
Berwick	2	WKJH	37.5	FGE
Bethel	1	WAEU	39.38	F L
Bethlehem	4	WQJJ	33.5	A
Bethlehem	8	WPEZ	31.9	A R
Bradford	5	WBRA	37.9	F M
Brentwood	1	WDED	39.38	F L
Bristol	3	WHRL	155.25	F M
Brookline	5	WQOR	31.1	F R
Brownsville	1	WDAH	39.1	F L
Butler	2	WMBT	35.9	FGE
Castle Shannon	1	WKKB	39.38	F L
Chambersburg	3	WMCB	39.5	A M
Charleroi	4	WKWY	39.5	F L
Chester	18	WKLC	37.5	FGE
Clairton	4	WQRD	155.49	F M
Clifton Hgts	1	WBRS	39.5	F M
Coatesville	2	WBRV	33.1	A M
Collingdale	1	WBEV	31.5	F M
Colwyn	1	WXAN	37.9	A M
Connellsville	5	WRFB	155.13	F M
Coraopolis	2	WSRC	33.5	F R
Crafton	1	WPMG	39.58	F L
Darby	1	WKEF	31.5	F M
Dormont	1	WDSN	39.38	F L
Dunmore	2	WLHK	156.45	F M
East Lansdowne	1	WKDQ	39.5	F R
Easton	10	WKWQ	156.69	F M
	2	WIJQ	155.13	F
Elkins Park	9	WQON	31.1	F M
Ellwood City	2	WKMG	33.94	FGE
Ephrata	1	WBHV	31.5	F M
Erie	17	WQLS	37.1	A R
Etna	1	WPWR	39.38	F M
Farrell	3	WBGH	37.1	F L
Folcroft	1	WKKX	37.9	A R
Forest Hills	1	WPWZ	39.38	F M
Fox Chapel	2	WQGD	39.38	F L
Franklin	1	WBPT	37.9	F M
Glenolden	1	WRJX	37.9	AGE
Greensburg	3	WGRH	155.25	F M
Hanover	3	WQHP	35.9	F L
Hanover Twp	3	WFDV	155.01	F M
Harrisburg	10	WQOD	156.45	F M
Hazelton	5	WUEQ	156.21	F M
Indiana Twp	1	WCMF	39.38	F L
Ingram	1	WREZ	39.58	F L
Jeannette	2	WRMA	33.5	A R
Jefferson Twp	1	WCPE	39.38	F L
Jenkintown	1	WBKO	33.94	F L
Johnstown	3	WIED	35.5	F L
Kingston	2	WRHW	31.1	A R
Lancaster	4	WQTW	37.1	F M
Landsdowne	2	WQNB	39.5	F R
Latrobe	2	WRLH	35.9	F L
Lebanon	5	WBMV	156.57	F M
Lewistown	2	WBXR	33.5	F L
Lock Haven	1	WBSN	33.5	A M
Lower Chichester	1	WKYV	37.9	F R
Lower Moreland T	1	WBWA	33.94	F L
Marcus Hook	5	WLDF	155.61	F R
Marple Twp	1	WBRH	31.78	A M
McKeesport	25	WQIC	156.33	F L
McKees Rocks	1	WEAY	39.38	F L
Meadville	4	WRGZ	37.9	F M
Media	2	WBRX	31.78	A M
		WDPK	37.9	F R
Midland	2	WKJQ	33.5	F R
Millbourne	1	WFIF	39.5	F R
Millvale	1	WPWM	39.38	F L
Milton	1	WCVD	35.5	FGE
Monaca	2	WWCC	33.5	F R
Monessen	2	WQFF	39.5	F L
Monongahela	1	WIEQ	39.5	F L
Morrisville	1	WRMC	37.26	F R
Morton	1	WMGP	31.78	A M
Mt Oliver	1	WMOV	39.38	F L
Nanticoke	4	WRWT	155.49	F M
Nether Providence Twp	2	WNPP	31.78	A M
New Castle	3	WPGT	37.78	F L
New Kensington	3	WLDI	31.9	FGE
Norristown	4	WQMU	33.5	F R
	2	WMJE	30.58	F R
Norristown C	39	WMCN	30.58	FRLM
Northampton	5	WKHN	155.49	F M
Norwood	1	WRHY	37.9	A
O'Hara Twp	1	WCRQ	39.38	F L
Oil City	2	WPHZ	37.9	F M
Parkside	1	WBJI	31.78	A M
Philadelphia	131	WPDP	30.98	F M
	300	WIYP	155.97	F M
Phoenixville	1	WQNJ	30.7	F R
Pittsburgh	1	WPDU	1714	A
	68	WPIM	39.38	F L
	3	WMLK	37.5	F L
Pleasant Hills	2	WVKG	39.38	F L
Plymouth	4	WPPD	155.25	F R
Pottsville	10	WJPP	156.45	F M
Prospect Park	1	WSTQ	37.9	AGE
Punxsutawney	2	WXAM	155.13	F M
Reading	10	WPFE	33.22	A W
Reserve Twp	1	WBQD	39.38	F L
Ridley Twp	2	WBKV	31.78	A M
Ridley Park	1	WABH	37.9	A M
Rose Valley	1	WBHE	31.78	A M
Ross Twp	1	WOQG	39.38	F M
Scranton	12	WQTV	156.45	F M
Sewickley	2	WBXP	31.1	A W
Sewickley Hgts	3	WQIA	33.1	A W
Shaler Twp	1	WRFY	39.38	F L
Shamokin	2	WKXU	155.61	F M
Sharon	5	WQFU	39.42	F L
Sharon Hill	2	WQOC	37.9	A
Sharpsburg	1	WBFH	39.38	F L
Spring City		WFUQ	30.58	F L
Springfield Twp	2	WSRT	31.78	A
Spring Garden	2	WKVS	156.57	F L
State College	1	WJZD	37.9	F M
Steelton	5	WSPI	155.49	F M
Stowe Twp	1	WCHX	39.38	F L
Swarthmore	2	WPFQ	31.78	A
Tinicum Twp	1	WBOI	31.78	A M
Trainer	1	WDLC	37.9	F R
Uniontown	2	WQTN	39.1	F L
Upper Chichester	1	WKYU	37.9	F R
Upper Dublin		WSVN	33.94	F L
Upper Moreland	1	WSVB	33.94	F L
Upper Providence	1	WBLP	31.78	A M
Upper Southampton	1	WHMU	30.58	F L
Warminster Twp	1	WIKJ	30.58	F L
Warren	1	WENZ	31.1	F L
Washington	2	WKYR	39.5	F L
Wayne	6	WCPV	73.74	F L
Waynesboro	2	WIUY	33.5	A M
West Chester	4	WQNV	33.1	F R
West Deer Twp	1	WDKV	39.38	F L
W Goshen Twp	1	WBQE	33.1	F R
West Mifflin	2	WMII	37.58	F L
West View	1	WTQD	39.38	F L
Whitehall	2	WBWT	39.38	F L
Wilkes Barre	1	WQFM	2442	A W
Wilkinsburg	5	WKSY	156.57	F M
Williamsport	3	WQOH	33.1	A M
Yeadon	5	WRLO	31.5	F M
York	6	WAKX	156.33	F L

PUERTO RICO

Aguadilla	1	WSJP	155.13	F M
Arecibo	1	WSJH	155.13	F M
Bayamon	1	WSJI	155.13	F M
Caguas	1	WSJK	155.13	F M
Culebra		WSJE	155.13	F M
Guyama	1	WSJG	155.13	F M
Humacao	1	WSJF	155.13	F M
Mayaguez		WLHP	155.13	F M
		WSJL	155.13	F M
Ponce		WSJB	155.13	F M
San Juan	1	WSJO	155.13	F M
		WSJC	155.13	F M
Vieques		WSJD	155.13	F M

RHODE ISLAND

Central Falls	3	WKAA	39.38	A M
Cranston	14	WPGK	31.78	F L
E Providence	16	WPEI	33.22	AHvM
Middletown	1	WVFX	155.73	FGE
Newport	8	WMPH	155.73	FGE
N Kingston	8	WNHZ	37.1	F L
N Providence	3	WRKF	155.85	F M
Pawtucket	9	WPFV	39.38	A L
Providence	30	WPGF	30.58	A R
Wakefield	12	WBTF	37.1	F L
Warren Twp		WPIA	1714	A C
Warwick	35	WSYV	154.89	F L
Washington	12	WKZA	39.1	FHv
Woonsocket	6	WPEM	35.1	F M

EXPERIMENTAL

Providence	45	W1XVI	154.57	A

SOUTH CAROLINA

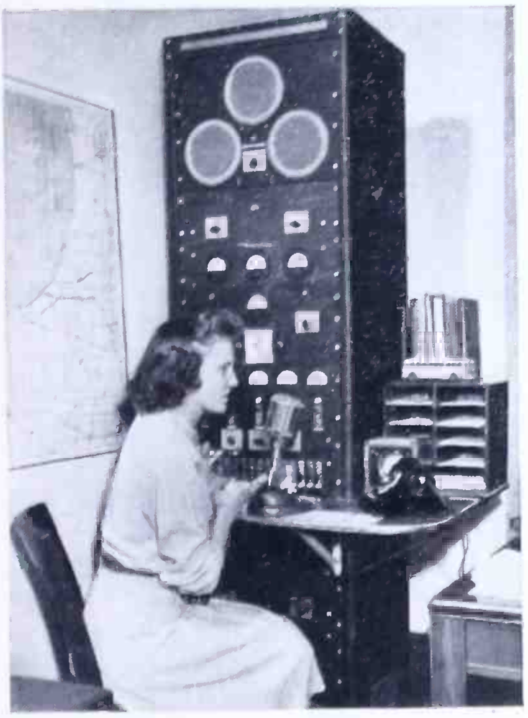
Aiken	3	WRXP	39.5	F L
Anderson	3	WRJQ	37.5	A L
Charleston		WCPD	2430	A W
Chester	5	WJSU	155.25	F M
Chester C	10	WJVF	155.25	F M
Clinton	4	WCQW	155.73	F M
Columbia C	14	WMGU	37.5	FRL
Columbia	14	WCMP	39.38	F L
Florence	7	WMYR	37.5	F L
Greenville	6	WQLG	33.1	ARM
Greenville	16	WPGR	37.1	F R
Greenwood	4	WSVQ	33.5	A M
Lancaster	6	WIAT	35.5	F D
Laurens	2	WOMU	31.5	F M
Laurens C	6	WONH	31.5	F M
Orangeburg	10	WJQC	155.13	F L
Rock Hill	10	WPRH	39.1	F M
Spartanburg C	20	WBPB	35.9	F M
Spartanburg	10	WSSC	35.9	F M
Sumter	3	WLAH	33.1	F L
Union	15	WKQW	155.01	F M
York C	6	WJKE	39.1	F M

SOUTH DAKOTA

Aberdeen	2	KAWC	39.1	F M
Armour	3	KXRW	39.18	F M
Belle Fourche	2	KXYM	39.1	F M
	2	KXYL	39.1	F M
Beresford	2	KAOW	39.18	F L
Brookings	2	KQEJ	39.10	F M
Brookings C	3	KUMD	39.18	F M
Brown C	2	KRQA	39.1	F M
Charles Mix C	2	KVWI	39.18	F L
Clay C	1	KVML	39.18	F L
Codington C	4	KJXP	39.18	F L
Custer	2	KTLQ	39.18	F L
Davison C	1	KGLK	39.18	F L
Day C	2	KRID	39.18	F L
Deadwood	1	KBPR	39.18	F L
Elk Point	3	KDCQ	39.1	F M
Fall River	2	KXQK	39.18	F M
Faulkton	2	KXOY	39.1	F M
Grant C	2	KAVY	39.18	F M
Hanson C	1	KAMW	39.1	F L
Hot Springs	1	KWAR	39.1	F L
Huron	2	KVPB	39.1	F L
Kingsbury	1	KCIA	39.1	F L
Lake Andes	2	KVUF	39.18	F L
Madison	2	KHFT	39.18	F L
McIntosh	2	KUOR	39.18	F M
Minnehaha	2	KXAB	39.18	F M

Greyhound Bus improves service, saves mileage, reduces delays with *Motorola* sets . . . .

and Sylvania Lock-In Tubes . . . . .



Dispatchers communicate directly with drivers to adjust schedules to changing load conditions.

BY MAINTAINING 2-WAY RADIO COMMUNICATION between dispatchers and buses on the road in the Chicago area, Greyhound has effected substantial operating economies — and *at the same time* has improved quality of its service to riders! Schedules are quickly readjusted, extra sections added, runs combined — as the dispatcher works with the up-to-the-minute reports coming in from drivers.

The 2-way communication is maintained by FM equipment built by Motorola, Inc., Chicago — using Sylvania Lock-In Tubes in the mobile units. These famous tubes stay put in their sockets, no matter how rough the road. They have no soldered joints, few welded ones. Short, direct connections reduce losses. Getter is located on top; separation of getter material from leads cuts down leakage.

This electrical and mechanical superiority makes the Lock-In the ideal choice for equipment on the road, in the air, on the rails . . . for marine radar, FM, television. See Sylvania Distributors, or write Radio Tube Division, Emporium, Pa.

SYLVANIA ELECTRIC

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

Driver can quickly report overloading or underloading, traffic conditions, weather hazards.

Mitchell	1	KQSP	39.1	F L
Pennington C	2	KRTX	39.18	F M
Pierre	2	KBKV	39.1	F L
Rapid City	10	KNGM	39.5	F M
Redfield	1	KHQR	39.1	F M
Salem	2	KXIV	39.18	F L
Selby	3	KAZM	39.18	F L
Sioux Falls	5	KBTY	39.1	F M
Spink C	1	KSCD	39.1	F M
Sturgis	2	KTIA	39.18	F L
	2	KTHV	39.18	F L
Tyndall	3	KAFV	39.18	F L
Vermillion	1	KROE	39.1	F L
Watertown	1	KQJM	39.18	F L
Winner	1	KBVU	39.1	F L
Yankton	3	KQXR	39.18	F M
Yankton C	2	KUQG	39.18	F M

TENNESSEE

Alcoa	2	WNLF	33.5	FGE
Bristol	1	WHTW	37.9	F M
Chattanooga	19	WRCK	33.1	A R
Clarksville	3	WGTQ	155.01	F M
Cleveland	2	WNOS	33.5	FGE
Columbia	4	WDDV	37.26	F L
Dyer C	1	WKXI	39.38	F L
Dyersburg	4	WBSV	39.38	F L
Gallatin	10	WEBG	37.26	F L
Greenville	5	WNTH	37.26	F L
Jackson	7	WRSJ	31.5	F L
Johnson City	3	WPGZ	35.1	FGE
Knoxville	15	WKHJ	155.01	F M
	14	WPFO	37.26	F L
Maryville	2	WNPO	33.5	FGE
Maury C	10	WEAA	37.26	F K
Memphis	75	WPEC	30.58	AMRL
Murfreesboro	7	WEBT	37.26	F L
Nashville	15	WRHT	155.01	F M
	31	WBYH	37.1	FGE
Paris	2	WBTB	37.1	A M
Springfield	6	WTWR	155.25	F K
Union City	1	WRLX	37.9	A R
Washington C	5	WMLA	155.61	F M

TEXAS

Abilene	14	KADR	30.98	A M
Alamo Hgts	1	KQZW	33.22	A M
Amarillo	4	KQDH	30.58	A C
Angleton	8	KBMI	35.5	F M
Anahuac C	2	KFTX	37.22	A L
Austin	100	KGHU	155.61	F M
Beaumont	50	KGPJ	37.22	F L
	35	KGPJ	37.22	A L
Bell C	1	KFEB	30.58	A K
Bexar C	24	KPBT	33.22	A M
Big Spring	2	KACM	33.22	A K
Borger	3	KGCV	30.58	A M
Brazos C	4	KCFV	37.10	F K
Brown C	5	KAGJ	24.58A	C
Brownwood	4	KNGW	30.58	A C
Brownsville	7	KGHT	35.1	A C
Bryan	20	KPBR	37.10	F K
Cameron C	3	KOGA	35.1	A M
Carthage	1	KHIU	35.5	F M
Cleburne	4	KNGE	35.1	A M
Center	5	KRVX	39.38	F K
Conroe	6	KCOP	35.5	FGE
Corpus Christi	18	KGHV	33.22	A M
Corsicana	5	KRGA	30.98	A C
Cuero	3	KLFQ	35.5	FGE
Dallas	72	KVP	33.22	A M
		KVPA	1714	A C
Dallas C	11	KRMB	33.22	A M
Denison	10	KQAT	31.5	A M
Denton	4	KNHF	37.1	AMK
Electra	2	KPDE	30.58	A C
El Paso	5	KGZM	33.1	A C
El Paso C	8	KRHV	33.1	A C
Ennis	1	KAAV	35.1	F M
Fort Worth	113	KQAN	33.1	AKC
		KRLJ	33.1	A C
Freeport	5	KSME	37.26	A M
Gainesville	12	KADM	30.58	A M
Galena Park	2	KBZQ	35.5	FGE
Galveston	18	KRPW	33.22	ALR
	5	KGCT	33.22	A L
Gladewater	1	KBYN	33.22	A C
Grand Prairie		KISE	39.1	F L
Grayson	5	KFXL	39.1	FGE
Greenville	15	KIFH	39.5	FGE
Harlingen	10	KXDJ	155.61	F L
Harrison C	6	KSVH	39.38	F F
Hempstead	15	KRLS	37.26	FHv
Henderson	6	KDLV	35.1	F K
Highland Park	7	KQGS	37.1	A R
Houston	73	KHTP	155.37	FMHv
	90	KHTP	33.1	ARCL
	19	KHCZ	35.5	FGE
		KHPR	1714	A R
	1	KHRC	1714	A H
Howard C		KFEA	33.22	A C
Kilgore	4	KKPD	33.22	A
Kountze	2	KSYO	35.5	F C
Lamar C	6	KTUY	155.25	F M
Laredo	25	KYNL	39.1	F M
Liberty	10	KRVT	37.18	F M
Longview	8	KACU	31.78	A C
Lubbock	9	KGZW	33.22	A M
Lufkin	5	KQDN	37.22	A M
Marshall	12	KADT	39.38	F F
	2	KADT	39.38	A
McAllen	13	KBQI	155.13	F L
McKinney	8	KTWP	37.22	A M
McLennan C	10	KRVH	39.42	F M
Mexia	3	KOXW	33.22	A M
Midland	3	KRLE	33.22	A K
Midlothian	1	KRPJ	35.1	F M
Nacogdoches	1	KRAN	37.22	A R
Nueces C	2	KPKT	33.22	AMK
Odessa	5	KBGC	35.1	A K
Olmos Park		KOTP	33.22	A C
Orange	7	KEZU	37.22	AKL
Palestine	5	KXGJ	155.25	F M
Panola C	2	KRSY	35.5	F M
Pampa	3	KPAM	30.58	A M
Paris	6	KQKM	155.25	F M
Pasadena	3	KPPD	33.22	A C
Plainview	1	KRKQ	2458	A C
Port Arthur	8	KPAT	37.22	A L
Richmond	15	KSRT	37.26	FHv
Rosenburg	15	KRTP	37.26	FHv
San Angelo	4	KASD	33.22	A C
San Antonio	70	KGZE	33.22	ARM
Sherman	6	KVUW	39.1	FGE
Sweetwater	5	KAPJ	39.1	F F
Temple	4	KRKW	30.58	A C
Terrell Hills	1	KQJB	33.22	A M
Texas City	3	KTWL	33.22	A C
Tyler	6	KQCF	31.9	F M
University Park	13	KQZI	31.5	AGE
Vernon	4	KHGZ	30.58	A C
	4	KBLB	2458	A C
Victoria	6	KDJD	33.5	F K
	15	KEPL	33.5	F K
Waco	35	KGZQ	39.42	F C
Waxahachie	5	KRKC	35.1	F M
		KQIH	35.1	F M
Westover Hills		KRIW	33.1	A C
West Univ Place	2	KHQK	33.22	A C
Wharton	9	KWSO	37.26	A L
	1	KWSO	37.26	F M
Wichita	15	KGZI	30.58	A C
Yoakum	1	KPRQ	33.50	FGE

UTAH

Helper City	1	KHGB	35.9	F M
Ogden	8	KQCH	30.58	F M
Price	2	KCBJ	35.9	F M
		KPGB	35.9	F M
Provo	5	KPMU	33.5	F M
Springville	1	KRWA	35.78	FGE

VERMONT

Brattleboro	5	WBQG	33.5	F M
Burlington	3	WRCW	35.9	A R
Rutland	2	WBMI	39.1	FGE
Springfield	4	WIUF	39.1	FGE

VIRGINIA

Alexandria	16	WAVA	31.1	F L
Appomattox C	1	WNKV	47.2	F L
Arlington	10	WPAV	33.5	FGE
Augusta C	2	WKUG	37.9	F M
Bedford C	2	WBCL	42.7	A L
Bristol	2	WPHV	37.9	F M
Caroline C	2	WDVL	42.7	F L
Charlotte C		WEKC	39.38	F L
Charlottesville	4	WQTE	33.94	F L
Chesterfield	13	WMSO	39.1	F L
Colonial Hgts	1	WAVP	37.9	F L
Danville	6	WRGU	33.1	F L
Dinwiddie C	3	WMWJ	42.7	F L
Fairfax	7	WMFC	35.9	FGE
Franklin	10	WENW	155.13	F M
Falls Church	2	WHCN	35.9	FGE
Frederick C	1	WAPT	37.9	F M
Fredericksburg	2	WRQG	39.82	F F
Hampton	4	WTPH	37.5	F L
	2	WELH	33.1	A R
Hanover	5	WCAQ	42.7	F L
Henrico	30	WEUG	156.09	F R
Hopewell	2	WQOZ	37.1	A L
James City	1	WAQJ	33.1	F L
Lexington	8	WMKO	39.5	F M
Lynchburg	12	WQFH	35.1	FGE
Marion	2	WKME	39.5	F L
Martinsville	4	WHTJ	39.1	FGE
Nansemond	2	WFRU	39.5	F L
New Kent C	1	WTNF	35.78	F L
Newport News	12	WRIV	35.9	A W
Norfolk	46	WQNK	37.1	A K
Orange C	2	WBSJ	42.7	F L
Petersburg	7	WQFI	39.5	F M
Portsmouth	26	WPVL	37.9	F L
Portsmouth C	7	WKNR	39.9	F L
Pulaski	2	WDGL	39.5	F L
Radford	4	WTMY	39.5	F L
Richmond	126	WPHF	156.09	F R
Roanoke	45	WQFG	155.13	F M
Rockingham	3	WMMG	37.9	F M
Salem	20	WCTG	39.5	F L
	5	WSQF	39.5	F L
S Norfolk	2	WHTG	155.13	F L
Stafford C	1	WHNJ	33.1	F L
Staunton	7	WRID	37.9	F M
Suffolk	5	WRGV	39.5	F L
Virginia Beach	9	WADB	33.94	F L
Waynesboro	2	WIGV	37.9	F M
Williamsburg	2	WKYT	33.1	F L
Winchester	2	WSKQ	37.9	F M
York C	1	WRWJ	42.70	F L

WASHINGTON

Aberdeen	20	KGZV	155.73	F M
Anacortes	5	KAEB	35.5	F M
Asotin	1	KBSM	30.58	A
Bellingham	28	KACK	39.9	F R
Bremerton	30	KASF	33.5	F M
Burlington	.2	KTFJ	35.5	F M
Camas	4	KREB	30.98	A M
Centralia	4	KGHW	35.5	F M
Clark C	8	KRDL	30.58	A M
Clarkston		KHBX	30.58	A
Colfax	1	KQKC	30.58	A M
Davenport	3	KAEV	39.42	FGE
Ellensburg	3	KBRG	35.5	F M
	6	KCNQ	35.5	F M
Everett	22	KNFP	37.1	F M
Ephrata	10	KABI	156.57	F M
Hoquiam	4	KAPL	30.58	A M
King C	34	KAXT	37.78	F M
Kelso	15	KBJA	156.21	F M
	20	KQEQ	156.21	F M
Lewis C	12	KQWA	35.5	F M
Longview	20	KSLB	156.21	F M
Montesano	13	KRQB	35.5	F D
Morse Creek		KRXY	39.74	FGE
Mount Vernon	5	KCNR	35.5	F M
	3	KNFI	35.5	F M
Oak Harbor	1	KOGX	37.5	F D
Olympia	5	KACE	35.5	F M
Pasco	2	KIBS	35.5	F M
Port Angeles	18	KPAP	39.74	FGE
Port Orchard	14	KADL	33.5	F M
Port Townsend	1	KQEC	30.58	A K
Pullman	3	KQVP	39.42	FGE
Puyallup	2	KPWP	35.9	F M
Ritzville	2	KRAU	30.58	A M
Renton	12	KGLB	35.5	F M
Seattle	15	KAFO	37.78	FGE
	54	KATH	37.78	FMGE
Shelton	2	KHKE	35.5	F M
	2	KHLD	35.5	F M
Snohomish C	11	KSCP	37.10	F M
Spokane	25	KBTO	39.42	F M
	46	KGHS	39.42	FGE
	25	KGHS	30.58	AMC
		KRLI	2414	A C
Tacoma	25	KQBA	35.90	F M
	154	KGZN	156.57	F M
Thurston C	4	KRHM	35.5	F M
Vancouver	30	KRDM	156.57	F M
Walla Walla	4	KWWX	35.5	F M
Wenatchee	7	KHGW	39.42	F M
Whatcom C	4	KAJS	39.9	F R
Yakima	8	KRSI	35.5	F M

WEST VIRGINIA

Beckley	2	WKHK	35.5	FGE
Bluefield	3	WBWV	33.1	FGE
Charleston	6	WPHI	37.9	F M
Clarksburg	3	WPFP	30.58	A M
Dunbar	1	WJOA	37.9	F M
Fairmont	3	WPHJ	35.1	A M
Follansbee	1	WSLE	33.1	A C
Hancock C	6	WEIR	39.98	F R
Hollidays Cove	4	WRHF	37.1	A L
Huntington		WQOW	33.1	F L
Keyser	6	WAEF	37.90	F L
Martinsburg	3	WCHD	37.9	F M
Morgantown	7	WJWZ	35.9	FGEL
New Cumberland		WKWI	39.98	F R
Parkersburg	2	WPHQ	37.9	F M
Princeton	1	WSTH	31.5	A M
South Charleston	8	WUFS	155.13	F M
Weirton	4	WFGG	39.98	F R
Wellsburg	1	WRIN	33.1	A R
	6	WRGH	39.98	F R
Wheeling	7	WQTU	33.1	A W
Williamson	1	WCWF	37.9	F M

WISCONSIN

Antigo	7	WQWS	37.9	F M
Appleton	14	WBIQ	37.78	A M
	1	WBIQ	37.78	FGE
Balsam Lake	5	WVCM	39.42	F M
Baraboo	1	WKLG	31.5	A M
Baraboo C	15	WJUP	31.5	A M
Barron	3	WKIV	37.9	F M
Beaver Dam	2	WSTG	31.5	A M
Beloit	12	WRNI	37.26	A M
Blooming Grove	1	WBVE	37.78	F R
Brodhead	1	WNKS	39.58	F R
Burlington	1	WTYV	37.9	F M
Cedarburg	1	WJAQ	37.78	F M
Chilton	7	WKLU	33.5	A M
Chippewa Falls	4	WNGX	37.9	F M
Chenequa	3	WGUX	154.89	F M
Columbia C		WHIX	31.5	A C
Dane C	13	WTNR	39.58	F R
De Pere	3	WHNP	37.9	FGE
Dodgeville	8	WKPY	39.66	F R
Douglas	6	WDTO	30.58	F M
Eagle River	4	WOAZ	37.9	F M
Eau Claire	10	WBHT	39.34	F R
	10	WBHU	39.42	F R
Edgerton	2	WFXQ	39.42	F R
Elkhorn	12	WMPE	30.58	A M
	6	WMPE	37.78	F M
Evansville		WSUB	31.5	A M
Fond Du Lac	30	WFDW	39.34	F R
Forest	3	WKMX	37.9	F M
Fort Atkinson	1	WRLP	39.42	F R
Grafton	1	WKIW	37.78	F M
Green Bay	18	WHNO	37.9	FGE
	5	KNHB	33.22	A C
Green Lake	2	WJLH	39.66	F M
Janesville	6	WRNQ	39.42	F R
	21	WRIT	39.42	F R
Jefferson	3	WRAJ	37.78	F R
Juneau	20	WQXO	39.42	F R
Kenosha	24	WPEP	31.5	AMC
Kohler	3	WQZJ	33.5	A M
LaCrosse		WSLM	31.5	A M
	23	WQTH	155.85	F M
	7	WQTH	37.1	ABR
Lake Geneva		WQRJ	30.38	A M
Lancaster	8	WFRI	39.42	F M
Madison	20	WASD	39.26	F R
	1	WSVY	37.78	F R
	1	WBQC	37.78	F R
Manitowoc	8	WBSY	33.5	A R
Maple Bluff	1	WRNF	37.78	F M
Marshfield	3	WBGN	31.9	A M
Marinette	2	WALF	37.1	A M
	10	WBAJ	37.9	F M
Mauston	3	WJUL	37.9	F M
Medford	10	WJHF	39.58	F M
Menomonie	2	WEKD	37.9	F M
	1	WDBH	37.9	F M
Milwaukee	186	WPDK	33.78	F M
Minocqua Twp	1	WPQF	37.9	F M
Monona	1	WSWH	37.78	F R
Montello	2	WMVS	37.9	F M
Mosinee	1	WNJE	31.9	A M
Neillsville	6	WJWR	37.9	F M
Oconto	9	WPEV	37.9	F M
Oshkosh	5	WCJR	30.58	A M
	14	WAKE	37.78	AFM
Peshtigo	1	WPWL	37.9	F M
Phillips	7	WQSM	39.66	F M
Plymouth	1	WKOL	33.5	A M
Portage	16	WSOR	39.66	F R
	1	WAGH	39.66	F R
	6	WELA	31.5	A M
Port Washington	5	WDAW	37.78	F M
	2	WRJL	37.78	F M
Racine	15	WQLJ	37.78	F M
Racine C	6	WRNP	39.66	F M
Rhinelander	6	WITL	37.9	F M
	1	WKSE	37.9	F M
Shawano C	12	WGNF	39.42	F M
Sheboygan	5	WQMW	33.5	A R
Sheboygan C	6	WBOA	33.5	A M
Shorewood Hills	1	WCKO	37.78	F M
Stevens	3	WRNG	31.5	A M
Sturgeon Bay	10	WKZQ	37.9	A M
	1	WKZQ	37.9	F M
Stoughton	1	WDBD	37.9	F R
Sparta	6	WMRQ	39.42	F M
Superior	6	WSWE	30.58	A W
Tomahawk	1	WTAV	37.9	F M
Two Rivers	2	WDCJ	33.5	A D
Viroqua	16	WBWL	39.34	F M
Waukesha	8	WQML	155.13	F M
	25	WMPD	155.13	A M
Wausau	19	WBDX	31.9	A M
Watertown	9	WRHX	39.42	F R
Waupaca	18	WFQF	39.34	F M
Waushara C	2	WCKT	39.66	F M
West Allis	11	WGSO	155.61	F M
West Bend	10	WRPQ	39.66	F M
	2	WJAJ	37.78	F M
West Kewaunee	18	WEBY	39.66	F M
Whitewater	3	WHPH	39.42	F M
Wisconsin Rapids	2	WNRG	31.9	A M
	8	WJZH	31.9	A M

EXPERIMENTAL

Cedarville		W9XXJ	73.22	F M

WYOMING

Casper	4	KGAC	33.22	A M
Cheyenne	11	KQOI	33.22	A M
Laramie C	3	KQRZ	33.22	A M
Laramie	3	KRTQ	33.22	A M
Rawlins		KEYH	33.22	A M
Rock Springs	1	KEYI	33.22	A M
Sheridan	2	KEYJ	33.22	A M

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
	4	WQXB	37.5	F M
Florence		WQXF	37.5	F M
Tuscaloosa		WHTX	37.5	F M
Grove Hill		WSQY	37.5	F M
Decatur		WKSD	37.5	F M
Cadsden		WKSG	37.5	F M
Selma		WKSJ	37.5	F M
Demopolis		WKSK	37.5	F M
Huntsville		WKSP	37.5	F M
Blakely Island		WKSQ	37.5	F M
Anniston		WKVG	37.5	F M
Dothan		WKXR	37.5	F M
Birmingham		WLBA	37.5	F M
Evergreen		WQXE	37.5	F M
Opelika		WQXG	37.5	F M
Montgomery		WRBU	37.5	F M

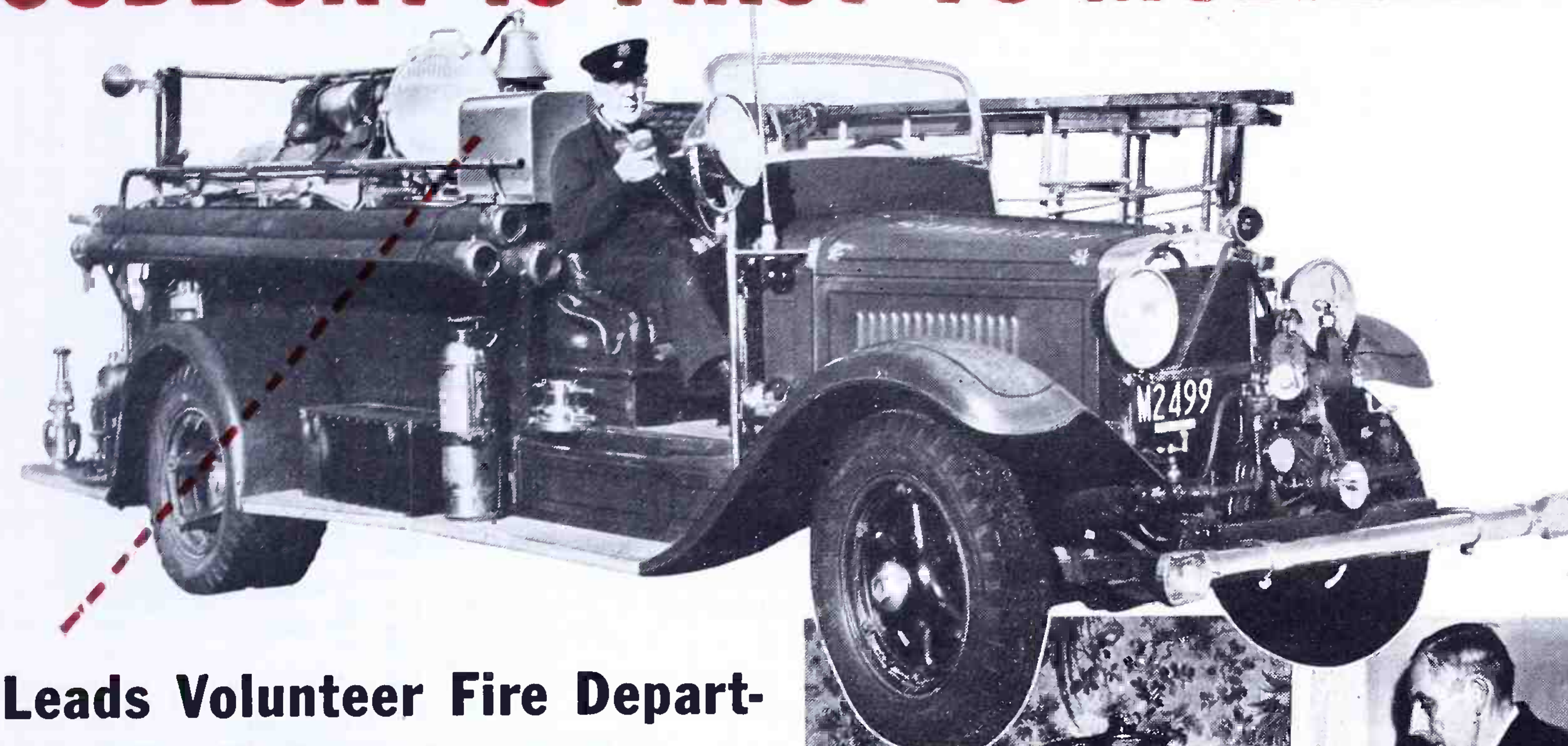
EXPERIMENTAL

Dothan		W4XWM	74.50	F M
Newton		W4XWO	73.22	F M

ARIZONA

Phoenix Hq		KIEE	39.18	F M
		KNGG	1698	ATCn
	102	KAXR	39.18	F A
				M R
				K F
Ehrenberg		KFHA	39.18	F R

SUDBURY IS FIRST TO MOBILIZE!



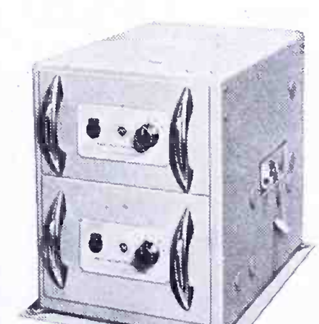
Leads Volunteer Fire Departments with Split-Second Alarms by Federal Mobile Radio

This model volunteer fire department—the first of its kind—is the pride of Sudbury, Massachusetts. It's mobilized! With Federal "Selecto-Call" Mobile Radio equipment. So quickly do civilian firemen now respond to an alarm that they rival professionals in efficiency and can give quick aid to neighboring towns.

Mobilization of the entire fire-fighting force takes only a matter of minutes. "Selecto-Call"—an exclusive Federal feature—contacts any specific group of mobile units to the exclusion of all other receivers tuned to the same frequency. A telephoned alarm automatically sets off a large bell in the Fire Station. The call is transmitted by firemen on duty to ten strategically-located house receivers, and relayed by telephone to ten alternates. The Fire Chief is notified over his own channel. The Police Chief, too, is alerted over his channel.

Not only has this ultra-modern system solved the problem of immediate alarm, but it takes care of false alarms, too. Volunteers can be recalled *before leaving their work* or *homes*. The two fire trucks can keep in touch with each other, for closer cooperation while operating over a large area. Fire and Police Chiefs can contact each other as well as the fire trucks. If another fire breaks out, equipment can be dispatched directly without delay.

Federal offers complete mobile radio equipment for fire and police departments, for service cars, for "anything that moves." For complete information, write to Department I-420.



Federal's Mobile Transmitter-Receiver Unit

Federal's mobile equipment is available in weather-proof housing for outdoor installations.

FTR An IT&T Associate

Federal Telephone and Radio Corporation

100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

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.

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EXPERIMENTAL

Phoenix		W7XIS	75.98	F M
Yavapai C		W7XEF	73.62	F M

ARKANSAS

Little Rock Hq		KASP	1722	A R
		KAOB	35.78	FRM
	1	KHAD	1722	A R
Newport		KBSL	1722	A C
Hope		KEZX	1722	A R
Forrest City		KFDK	1722	A R
Clarksville		KFDL	1722	A R
Warren		KFDO	1722	A R
El Dorado		KQSR	1722	A R
Harrison		KWBQ	1722	A R

CALIFORNIA

Sacramento Hq		KAAS	1690	A C
		KADJ	1690	A C
	685	KAPA	39.78	FGE M R
	2	KGNW	1690	A M
Bakersfield		KADC	1682	A
Nevada City		KAPI	1690	A C
Los Angeles		KAWF	1682	A M
Oak Glen		KFPE	1682	A M
Yerba Buena Island	14	KKJW	156.69	F M
Willows		KASG	1690	A C
Alturas		KHNW	1690	A C
Vallejo		KHNY	1690	A C
Ventura		KIUF	1682	A C
Oroville		KPDF	1690	A C
San Luis Obispo		KQDO	1682	A C
Pomona		KQUG	1682	A C
Newhall		KQUI	1682	A C
Oakland		KRBU	1690	A M
Chino		KSCC	39.9	F M
Yreka		KSCY	1690	A C
Redding		KSPR	1690	A C
San Quentin		KSQP	39.9	F M
Represa		KSRF	39.9	F M

EXPERIMENTAL

Corona		W6XAR	72.26	F M
Santa Clara C		W6XFY	74.5	F M
Blue Canyon		W6XH	73.22	F M
Santa Paula Twp		W6XHI	74.14	F M
State Park		W6XHJ	74.14	F L
Strawberry Peak		W6XHK	74.14	F M
Lyons Peak		W6XHL	74.14	F M
San Marcos Pass		W6XHM	74.14	F M
Twp 27 nr Klaus Mine San Luis Obispo Co		W6XIC	74.14	F M
Kern		W6XIE	74.14	F M
Sacred Oak Peak		W6XIK	74.14	F M
Mt Pierce		W6XJB	74.14	F M
Bloomer Mt		W6XJC	74.14	F M
S Fork Mt		W6XXD	74.14	F M

COLORADO

Denver Hq		KDPY	156.69	FPh
	1	KRAR	33.78	A M
		KGSP	42.46	FPh
	191	KQKY	42.46	APh M K
Idaho Springs		KDQE	154.77	FPh

CONNECTICUT

Hartford Hq	345	WCSE	39.50	F L
	3	WQUB	39.5	F L
Canaan		WJTB	39.5	F L
Stafford Springs		WJTC	39.5	F L
Danielson		WJTD	39.5	F L
Croton		WJTE	39.5	F L
Ridgefield		WJTA	39.5	F L
Westbrook		WJTF	39.5	F L
Westport		WJTG	39.5	F L
Hartford		WJTH	39.5	FLM
Bethany		WJTI	39.5	F L
Litchfield		WJTJ	39.5	F L
Colchester		WJTK	39.5	F L

DELAWARE

Dover Hq		WJRF	39.5	F L
	50	WJIH	39.78	F L
Bellefonte		WAFE	39.5	F L
Georgetown		WAYY	39.5	F L
Bridgeville		WAYZ	39.5	F L
New Castle		WDSP	39.5	F L

FLORIDA

Tallahasee Hq		WKTF	31.1	F M
	3	WKGJ	31.1	F M
	182	WJXD	31.1	F M
Bartow		WKSO	31.1	F M
Deland		WJJX	31.1	F M
Cross City		WJSK	31.1	F M
Jacksonville		WJXJ	31.1	F M
Ocala		WJXI	31.1	F M
Lake City		WKDR	31.1	F C
Tampa		WKGZ	31.1	F M
Chipley		WLIU	31.1	F M
Pahokee		WRSF	31.1	F M
Fort Myers		WSPF	31.1	F M
Pensacola		WSWR	31.1	F M
Palatka		WSWY	31.1	F M
Miami		WSWP	41.1	F M
West Palm Beach		WSYU	31.1	F M

GEORGIA

Atlanta Hq	15	WGSP	1666	A C
Gainesville		WGRN	1666	A C
Newman	1	WVCZ	42.02	F R
Perry		WKPG	1666	A
Reidsville		WSIJ	1666	A W
Albany		WSIK	1666	A C
Griffin		WSIN	1666	A C
Villa Rica	1	WVRA	41.02	F R
Thomaston	1	WWWM	42.02	F R
Washington		WSIO	1666	A C

IDAHO

Boise Hq	50	KFEO	37.22	F M

ILLINOIS

Springfield Hq		WQPS	1610	A W
	1	WQPY	1610	A C
	1	WQPX	1610	A C
	1	WQPZ	1610	A T
	1	WQPQ	1610	A H
	1	WQPV	1610	A H
	1	WQPI	1610	A C
	488	WSTE	42.5	FMD
Blue Island		WQPB	42.5	F M
Chicago		WQPC	155.37	A M
DuQuoin		WQPD	1610	A W
Elgin		WQPE	42.5	F M
Effingham		WQPF	1610	A W
Sterling		WQPG	1610	A W
Urbana		WQPH	42.5	F M
East St Louis		WQPJ	1610	A C
Peoria		WQPL	1610	A C
Macomb		WQPM	1610	A W
Joliet		WQPO	42.5	F M
Pontiac		WQPP	1610	A W
Rock Island		WQPR	42.5	F M

EXPERIMENTAL

Warrensburg R		W9XAW	74.14	F
Fairmount R		W9XFM	74.14	F
Beverly R		W9XJK	74.14	F
Woodstock R		W9XNR	74.14	F
Marseilles R		W9XNS	74.14	F
Seward R		W9XNT	74.14	F
Mt Olive R		W9XNU	74.14	F
Mill Shoals R		W9XPL	74.14	F
Goreville R		W9XPM	74.14	F
Springfield		W9XSW	42.5	F L

INDIANA

Indianapolis Hq		WPHE	1634	A
	1	WAHO	1634	A C
	1	WAHQ	1634	A C
	1	WAHR	1634	A C
	1	WAHP	1634	A C
	1	WRSH	1634	A C
	358	WSPC	42.26	F M
Connorsville		WBII	1634	A C
Charleston		WBMO	1634	A H
Indianapolis		WPHE	1634	A C
Chesterton		WPHS	1634	A C
Jasper		WPHU	1634	A C
Seymour		WQFE	1634	A C
Ligonier		WQFW	155.37	F M
Putnamville		WQGB	1634	A C
Pendleton		WRNR	1634	A C
West Lafayette		WROR	1634	A C

EXPERIMENTAL

Hartford City		W9XQG	74.58	F M

IOWA

Des Moines Hq	171	KADW	35.78	FMGE
	1	KADW	1682	ACn
		KGHO	1682	ACn
	4	KRPA	35.78	A C
Fairfield		KACC	1682	ACn
Atlantic		KACD	1682	ACn
Maquoketa		KCMW	35.9	FGE
Cedar Falls		KNFN	1682	A W
Storm Lake		KNFO	1682	A W
Ladora		KNGI	73.42	F L
Belmond		KODA	73.42	F L
Essex		KRPE	73.42	F L

KANSAS

Topeka Hq		KAZZ	1698	A C
	1	KANI	42.46	F M
	115	KRXE	42.46	F M
		KBGE	42.46	F M
		KBGF	42.46	F M
Hutchinson		KAHR	42.46	F M
		KCJI	42.46	F M
Chanute		KAQB	42.46	F M
Wheaton		KBGD	42.46	F M
Salina		KHNS	42.46	F M
Garden City		KHSN	42.46	F M
Norton		KJAD	42.46	F M
		KJPR	42.46	F M
Garnett		KHAF	42.46	F M

EXPERIMENTAL

Council Grove		W9XIB	75.98	F M
McLouth		W9XIC	75.98	F M
Wheaton		W9XIE	75.98	F M
Topeka		WXCE	73.98	F M
Hutchinson N		WXDC	74.58	F M
Garnett R		WXDI	73.30	F M
Colby R		WXDJ	73.30	F M
Pratt R		WXDK	73.30	F M
Great Bend R		WXDL	73.30	F M
Norton N		WXDM	74.58	F M
Stockton R		WXDN	73.30	F M
Wichita R		WXDO	73.30	F M

KENTUCKY

Frankfort Hq	21	WMLI	39.90	F M
		WQWY	39.9	F M
Bowling Green		WIHE	39.9	F M
Mayfield		WIHG	39.9	F M
Elizabethtown		WKBE	39.9	F M
London		WKBF	39.9	F M
Hazard		WKBG	39.9	F M
Morehead		WKPE	39.9	F M
Madisonville		WKYM	39.9	F M

LOUISIANA

Baton Rouge Hq		WLSP	1682	A R
		WLSP	39.5	F M
	68	KBLJ	39.5	F M
Alexandria		KRAD	1682	A R
		KRAD	39.5	F M
New Orleans		WNHI	1682	A R
		WNHI	39.5	F M
Lake Charles		KSPB	1682	A R
		KSPB	39.5	F M
Franklin		KSPF	1682	A R
		KSPF	39.5	F M
Shreveport		KSPS	1682	A R
		KSPS	39.5	F M
Monroe		KSPC	1682	A R
		KSPC	39.5	F M
Leesville		KSPL	1682	A R
		KSPL	39.5	F M
Ruston		KIHL	39.5	F M
Hammond		WEKK	39.5	F M
La Place		WNJB	39.5	F M

MAINE

Augusta Hq		WBNV	39.9	F M
	106	WSYD	39.9	F M
Houlton		WGSL	39.9	F M
		WLDQ	39.9	F M
Skowhegan		WGIO	39.9	F M
Thomaston		WSTR	39.9	F M

EXPERIMENTAL

Waterboro		W1XDR	73.3	F M
Wells		W1XDT	74.58	F M
West Scarboro		W1XDU	74.58	F M
Castle Hill R		W1XIF	73.30	F M
Houlton N		W1XJF	74.58	F M

MARYLAND

Annapolis Hq	257	WMSI	39.18	F L
Belair		WEVN	39.1	F L
Cumberland		WMEV	39.1	F L
College Park		WWCP	39.1	F L
Waterloo		WHWN	39.1	F L
Easton		WMSE	39.1	F L
Hagerstown	1	WMQU	39.10	F L
High Knob		WMSF	39.1	F L
Conowingo		WMSH	39.1	F L
Randallstown		WMSR	39.10	F L
Salisbury		WWSG	39.1	F L

MASSACHUSETTS

Boston Hq	208	WEGI	35.9	F L
		WKFA	35.9	F L
Northampton		WKFI	35.9	F L
		WPEW	35.9	F L
Bridgewater		WKGC	35.9	F L
		WPEL	35.9	F L
Framingham		WMP	35.9	F L
Nantucket		WSPN	35.9	F L
Pt Holden		WSQL	35.9	F L

EXPERIMENTAL

Adams R		WAWT	154.65	F L
Holden N		WBUN	154.65	F L
Princeton R		WBVW	156.69	F L

MICHIGAN

Lansing Hq	538	WBLU	37.38	F M
		WBMU	37.5	F M
Brighton		WAOD	37.5	F M
Ypsilanti		WAOG	37.5	F M
Flat Rock		WAPW	37.5	F M
Detroit		WAPU	37.5	F M
Mio		WBKZ	37.5	F M
Jonesville		WBNF	37.5	F M
Alpena		WBQJ	37.5	F M
New Buffalo		WBQI	37.5	F M
Manistee		WBQK	37.5	F M
East Tawas		WBQL	37.5	F M
Newberry		WBQP	37.5	F M
West Branch		WBQQ	37.5	F M
Baraga		WBQR	37.5	F M
Cadillac		WBQS	37.5	F M
Bad Axe		WBQT	37.5	F M
Gladstone		WBQU	37.5	F M
Wakefield		WBQV	37.5	F M
Atlanta		WBRD	37.5	F M
Palmer		WBRF	37.5	F M
Iron Mountain		WBSI	37.5	F M
Centerline		WBTO	37.5	F M
Manistique		WBTP	37.5	F M
Gladwin		WBXA	37.5	F M
Muskegon		WBYK	37.5	F M
Baldwin		WDAI	37.5	F M
Boyne City		WDAQ	37.5	F M
Ewen		WDSO	37.5	F M
Jackson		WITN	37.5	F M
Keego Harbor		WITP	37.5	F M
Flint		WITQ	37.5	F M
Bay City		WITR	37.5	F M
Roscommon		WIVA	37.5	F M
Battle Creek		WIWG	37.5	F M
Allegan		WIXD	37.5	F M
Sandusky		WJAT	37.5	F M
White Pigeon		WJAW	37.5	F M
St Clair		WJBI	37.5	F M
Romeo		WJBL	37.5	F M
Erie		WJBP	37.5	F M
Clinton		WJBR	37.5	F M
Blissfield		WJBS	37.5	F M
South Haven		WJBT	37.5	F M
Traverse City		WKJK	37.5	F M
Mount Pleasant		WKJM	37.5	F M
Gaylord		WKJR	37.5	F M
Cheboygan		WKJU	37.5	F M
Sault Ste Marie		WMIC	37.5	F M
Rockford		WMSP	37.5	F M
St Ignace		WQSY	37.5	F M
Houghton Lake		WRDH	37.5	AFRM
Paw Paw		WRDP	37.5	AFRM
East Lansing		WRDS	37.5	AFRM
Reed City		WRLE	37.5	F M
Grand Haven		WRLS	37.5	F M
Escanaba		WRRC	37.5	F M
Imlay City		WRXY	37.5	F M
Niles		WSWF	37.5	F M
Crystal Falls		WSWK	37.5	F M
Plainwell		WIXD	37.5	F M

EXPERIMENTAL

Palmer		W8XFR	75.98	F M
Marquette N		W8XFS	73.14	F M

MINNESOTA

Redwood Falls		KNHD	42.82	A W FGE
St Paul		WAMV	42.82	FGE

MISSISSIPPI

Jackson Hq		WRJI	42.02	F L
	151	WJBE	42.02	F L
Greenwood		WJBD	42.02	F L
Batesville		WJBF	42.02	F L
Gulfport		WJBG	42.02	F L
Starkville		WJBJ	42.02	F L
New Albany		WJBN	42.02	F L
Brookhaven		WKGK	42.02	F L
Hattiesburg		WMHP	42.02	F L
Meridian		WNRJ	42.02	F L

EXPERIMENTAL

Meadville R		W5XLM	73.30	F L
Brookhaven N		W5XLN	74.58	F L

MISSOURI

Jefferson City Hq		KHPF	42.06	ACn F M
	363	KHPJ	42.22	F M
Lee's Summit		KHPA	42.06	ACn F M
Macon		KHPB	42.06	ACn F M
Kirkwood		KHPC	42.06	ACn F M
Springfield		KHPD	42.06	ACn F M
Poplar Bluff		KHPE	42.06	ACn F M
St Joseph		KHPH	42.06	F M
Willow Springs		KAXC	42.06	F L
		KHPG	42.06	F M

EXPERIMENTAL

Ft Leonard Wood R		W9XGD	75.98	F L
Potosi R		W9XGE	75.98	F M
Carthage R		W9XGL	75.98	F M
Hannibal R		W9XHU	74.58	F M
Jefferson City R		WXAN	42.06	F L
Willow Springs N		WXJK	73.14	F L

MONTANA

Helena Hq	24	KRNW	39.38	A

NEBRASKA

Lincoln		KAXD	42.46	F M
	105	KREP	42.46	F M
Omaha		KBJY	42.46	F M
Grand Island		KHIK	42.46	F M
Norfolk		KHIS	42.46	F M
North Platte		KHNB	42.46	F M
McCook		KHNN	42.46	F M
Holdrege		KHNP	42.46	F M
Oshkosh		KRXN	42.46	F M
Gering		KRXW	42.46	F M

NEVADA

Carson City Hq		KODH	1634	A H
	2	KRGL	39.38	AMC
	12	KRGL	39.78	F M
Reno		KRNP	1634	A C

NEW HAMPSHIRE

Concord Hq		WMOE	33.5	F C
		WRPT	1682	A W
		WAJA	1682	A C
	92	WJJF	37.38	F M

EXPERIMENTAL

Sargent's Purchase		W1XCD	75.98	F M
Warner R		W1XUD	75.98	F M

BROWNING FREQUENCY METERS

Hand-Calibrated Precision Types for the Communications Services

Model S-6: Continuous Coverage for All Measurements, 100 Kc. to 50 Mc.

A general-coverage, crystal-controlled meter for measuring the frequency of any signals between 100 kc. and 50 mc. By the use of harmonic amplifiers, the 5-band fundamental range of 1 to 2 mc. is extended to 50 mc. Accuracy is plus or minus. 025%. Provisions are made for precision calibration against WWV signals as a primary standard. Zero beat is indicated by the tuning eye or headphones. Machine-engraved scale and vernier give a readable accuracy to plus or minus .01%. The voltage-regulated power supply operates from 110–115 volts AC.

Model S-4: Calibrated at Any 1 to 5 points from 1.5 to 70 Mc.

For checking specific frequencies of communications systems. So accurate and convenient is this highly perfected design that you can check the frequency of any transmitter in 60 seconds. Accuracy of plus or minus .0025% meets FCC requirements in this range. Circuit uses crystal control, electron-coupled oscillator, and line-voltage regulator. Rugged construction will withstand years of use in the field. Each dial division represents 25 cycles at the lower frequencies. Operates on 110–115 volts, AC or DC. A standard instrument in the communications field since 1939.

Model S-7: 1 or 2 Points between 72 to 76 and/or 152 to 162 Mc.

For communications systems operating in either or both bands between 72 to 76 or 152 to 162 mc. Hand-calibrated and crystal-controlled at any one or two specified frequencies in these bands. Similar in appearance to the famous model S-4, it can be used with the same speed and precision for checking mobile and headquarters transmitters. Accuracy of plus or minus .005% meets FCC requirements in these two communications bands. At the lower frequencies, each dial division represents about 1,000 cycles. Voltage-regulated power supply operates on 110–115 volts, AC or DC.

Model S-8: Calibrated at the Three Diathermy Frequencies

This new addition to the line of BROWNING Frequency Meters is intended for checking interfering signals from diathermy equipment. It is calibrated at 13.66, 27.32, and 40.98 mc., to show the extent of frequency deviation from FCC assignments at any of these points.

Thus it is of great value to manufacturers and users of diathermy equipment, and to operators of other services with which such apparatus may cause interference. Accuracy is assured by hand calibration and crystal control. Voltage-regulated power supply operates from 110–115 volts, AC or DC.

MODEL S-5: Hand Calibrated at any 1, 2, or 3 Frequencies between 30 and 500 Mc.

The BROWNING S-5 meter, accurate to ±.0025%, is suitable for all standard and special services on 30 to 500 mc. The crystal, contained in a temperature-controlled oven, is accurate to ±.001%. The electron-coupled oscillator is temperature compensated, and a line-voltage regulator is built into the meter.

If desired, the panel, 8¾ by 19 ins., can be rack mounted. It is not necessary to bring the mobile transmitters to the location of the meter. Signals can be picked up on a receiver to which the meter is coupled. The meter is then tuned for zero beat. An easy-reading scale of 5,000 divisions is operated with a precision worm drive. At 30 mc., one division represents about 24 cycles.

Operates on 105–115 volts AC. Weight 35 lbs. Eight tubes and a voltage regulator are supplied.

IMPORTANT: Every communications system should have a BROWNING model RH-10 calibrator, to check any make of frequency meter against Bureau of Standards WWV signals. The RH-10 is standard for this purpose.

BROWNING LABORATORIES, INC.
750 Main Street, Winchester, Mass.

In Canada, Address:
MEASUREMENT ENGINEERING, Ltd.
Arnprior, Ontario

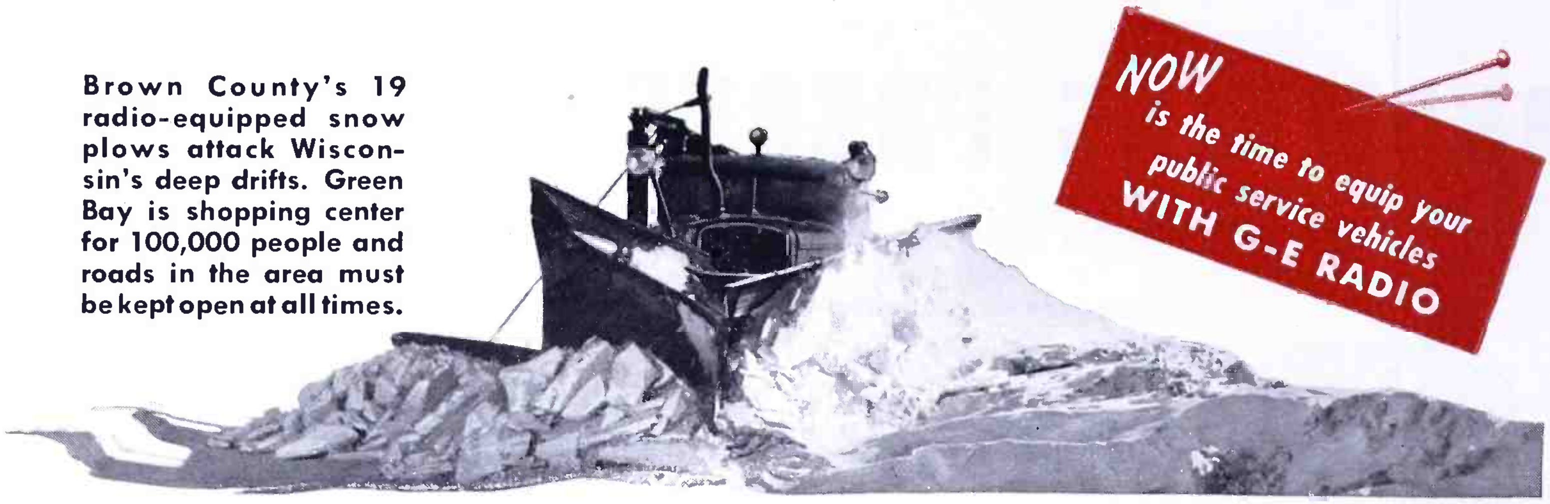
BROWNING LABORATORIES, Inc.
750 Main St., Winchester, Mass.

Please send me technical details and prices on the following Browning precision products:

- ☐ S-4 Frequency Meter
- ☐ S-7 Frequency Meter
- ☐ S-5 Frequency Meter
- ☐ WWV Frequency Calibrator
- ☐ S-6 Frequency Meter
- ☐ S-8 Frequency Meter

Name . . . .
Address . . . .
Company Connection . . . .

Brown County's 19 radio-equipped snow plows attack Wisconsin's deep drifts. Green Bay is shopping center for 100,000 people and roads in the area must be kept open at all times.



BROWN COUNTY, WISCONSIN, USES G-E 2-WAY RADIO

For Traffic Police • Sheriff's Patrol Cars • Highway Department!

● Once again a tough job is being licked by dependable G-E 2-way radio equipment!

Here's an ideal communication system combining police patrol and highway maintenance. Does an efficient job under difficult conditions and saves taxpayers' money. How?

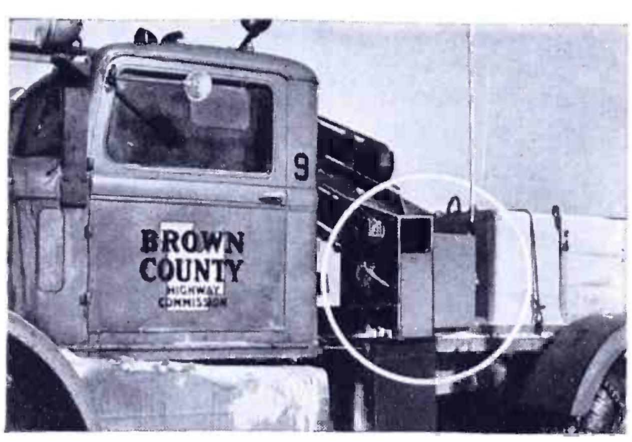
General Electric 2-way radio serves Brown County police and sheriff's vehicles which patrol 500 miles of county and state highways. Use of these radio communication sets on snow plows, for example, enables these snow fighters to combat storms with maximum efficiency *in less than half the usual time*, say highway officials.

Alert public officials everywhere are asking about the new General Electric radio equipment designed to provide better communication among such departments as:

Police	Highway Patrol	Highway Maintenance
Fire	Snow Clearance	Ambulance
Sheriff	Electric, Gas, & Water Utilities	

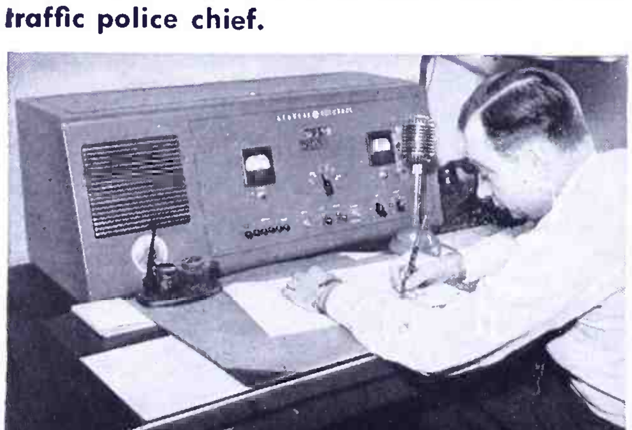
Want to hear more?

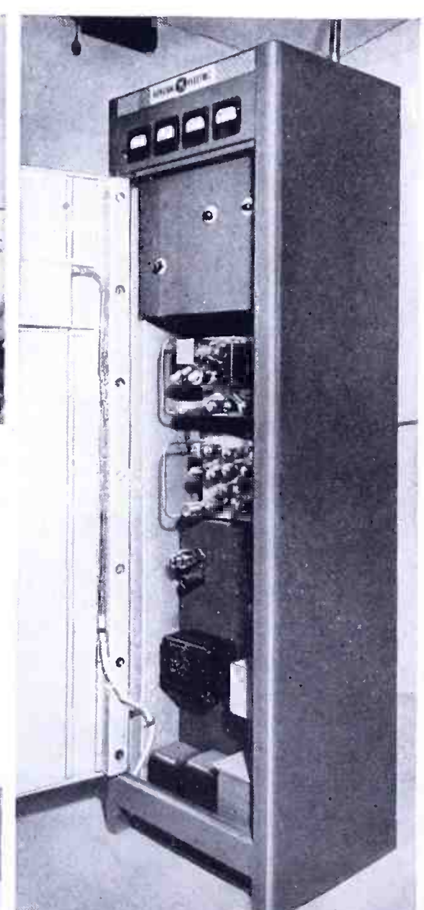
You can reach a radio communication representative through the G-E office nearest you. Call there, or write: *General Electric Company, Transmitter Division, Electronics Park, Syracuse, New York.*



Sturdy G-E equipment is conveniently mounted behind boom gear. Coldest weather or stiff winter winds do not affect radio efficiency. Note strong buggy-whip antenna.

Two G-E remote control consoles are used in the system. This one is in the office of the traffic police chief.





County police and sheriff's patrol cars carry G-E 2-way radio. Highway vehicles are on same net, enabling officials to coordinate snow clearance, flood control, other emergencies.

Neat, efficient 250-watt G-E FM transmitter is heart of 3-way Brown County radio system.

LEADER IN RADIO, TELEVISION AND ELECTRONICS

GENERAL ELECTRIC

163-G2M-6918

STATE POLICE

NEW JERSEY

Trenton Hq	220	WBPR	37.1	F L
		WBPR	39.78	A R

EXPERIMENTAL

Mantua		W2XAH	27.925	F L
Trenton Hq	1	W2XCK	27.925	F L
Mays Landing		W2XIU	27.925	F L
Tuckerton		W2XZP	27.925	F L
Ramsey		W2XZQ	27.925	F L
Scotch Plains		W2XZR	27.925	F L
Freehold		W2XZS	27.925	F L
Toms River		W2XZT	27.925	F L
Keyport		W2XZU	27.925	F L
Cape May CH		W3XTG	27.925	F L
Port Norris		W3XTH	27.925	F L
Absecon		W3XTI	27.925	F L
Elwood		W3XTJ	27.925	F L
Berlin		W3XTK	27.925	F L
Malaga		W3XTL	27.925	F L
Woodstown		W3XTM	27.925	F L
Andover Twp		W3XTN	27.925	F L
Flanders		W3XTO	27.925	F L
Morristown		W3XTQ	27.925	F L
Somerville		W3XTR	27.925	F L
Washington		W3XTP	27.925	F L
Flemington		W3XTS	27.925	F L
Springfield Twp		W3XTU	27.925	F L
Trenton		W3XTV	27.925	F L
Riverton		W3XTW	27.925	F L
New Brunswick		W3XTX	27.925	F L

NEW MEXICO

Santa Fe Hq		KCQA	39.9	F M
	40	KCQB	39.9	F M
Albuquerque		KMXR	39.9	F M

EXPERIMENTAL

Albuquerque		W5XHY	79.00	F M
Santa Fe		W5XHZ	81.00	F M

NEW YORK

Albany Hq	30	WFLJ	42.30	F L
	417	WNEH	42.14	FGE L M
Allegany		WNHV	42.14	FGE
Babylon		WKRI	42.14	F L
Jones Beach		WKRL	42.14	F L
East Islip		WKRN	42.14	F L
Lathams		WJSC	42.14	FGE
Highland		WNBO	42.14	FGE
Hawthorne		WNDV	42.14	FGE
Athol Springs		WNGU	42.14	FGE
Homer		WNGW	42.14	FGE
Solvay		WNHA	42.14	FGE
Malone	2	WNHE	42.14	FGE
Saranac Lake		WNHG	42.14	FGE
Port Henry		WNHL	42.14	FGE
Duanesburg		WNHM	42.14	FGE
Herring		WNHP	42.14	FGE
Auburn		WNHR	42.14	FGE
Painted Post		WNHU	42.14	FGE
Westfield		WNHW	42.14	FGE
Ferndale		WAHU	42.14	FGE
Horseheads		WNHY	42.14	FGE
East Avon		WNIO	42.14	FGE
Keeseville	2	WNJA	42.14	FGE
Monroe		WNJP	42.14	FGE
Lewiston		WNJT	42.14	FGE
Fonda		WNJW	42.14	FGE
Ferndale		WNJX	42.14	FGE
Fishkill	1	WNKH	42.14	FGE
Wellsville		WNQF	42.14	FGE
Batavia		WNQG	42.14	FGE
Canandaigua		WNQK	42.14	FGE
S Glen Falls	2	WNQM	42.14	FGE
Tupper Lake	2	WNQX	42.14	FGE
Alder Creek		WNQY	42.14	FGE
Canton	1	WNRC	42.14	FGE
Riverhead		WNWC	42.14	F L
Troy		WNWG	42.14	FGE
		WGFW	42.14	FGE
Brightwaters		WNWO	42.14	F L
Catskill		WNWS	42.14	FGE
Oneonta		WNWV	42.14	FGE
Sidney	2	WNHX	42.14	FGE
Vestal		WNPM	42.14	FGE

EXPERIMENTAL

Albany Hq	42	W2XPG	42.14	F M

NORTH CAROLINA

Raleigh Hq		WANH	42.62	F L
	615	WIUK	42.78	F L
Kernersville		WKJT	42.62	F L
Swannanoa		WANJ	42.62	F L
		WKVL	42.62	F L
Williamston		WANI	42.62	F L
Salisbury		WANK	42.62	F L
Elizabeth		WANL	42.62	F L
Elizabeth City		WFGX	42.62	F L

EXPERIMENTAL

Asheville R		W4XTK	74.50	F L
		W4XWX	74.58	F L
Swannanoa N	2	W4XTN	73.34	F L
Waynesville R		W4XTO	74.50	F L

NORTH DAKOTA

Bismarck Hq		KAZB	1674	A

OHIO

Columbus Hq		WPGQ	39.1	AFRM
	1	WDCW	1730	ACn
	6	WFHO	39.1	F L
	300	WDQR	39.78	FMLR
Springfield		WAGB	39.1	F M
Warren		WBGQ	39.1	F L
Marietta		WCGN	39.1	F M
Hebron		WCIU	39.1	F M
Georgetown		WCIV	39.1	F M
Gallipolis		WCIX	39.1	F M
Portsmouth		WHNT	39.1	F M
Lancaster		WJAH	39.1	F M
Defiance		WJAV	39.1	F M
Wooster		WJEE	39.1	F M
Mt Vernon		WKFO	39.1	F M
Mansfield		WLSV	39.1	F M
Geneva		WLSW	39.1	F M
Bridgeport		WLSZ	39.1	F M
Dayton		WODH	39.1	F M
Perrysburg		WODX	39.1	F M
Salem		WOEX	39.1	F M
Marion		WOGN	39.1	F M
Bellevue		WOHO	39.1	F M
Middletown		WOUB	39.1	F M
Lorain		WOUG	39.1	F M
Athens		WOZY	39.1	F M
Van Wert		WPFF	39.1	F M
Findlay		WPGG	39.1	AFM WCn
Columbus		WPGQ	39.1	AFRM
Massillon		WPHC	39.1	AFM WCn
Wilmington		WPHK	39.1	AFM WCn
Cambridge		WPHT	39.1	AFM WCn
Bellefontaine		WPIJ	39.1	F M
Troy		WTOH	39.1	F L
Medina		WWCJ	39.1	F M
Kent		WWCI	39.1	F M
New Philadelphia		WWCK	39.1	F M
Chillicothe		WWCL	39.1	F M
Steubenville		WWCM	39.1	F M
Lima		WWCN	39.1	F M

OKLAHOMA

Oklahoma City Hq		KOSO	1626	A R
	1	KOSR	1626	A R
	129	KONJ	35.78	AFM
Pawnee		KOSP	1626	A R
Claremore		KOSU	1626	A R
McAlester		KOSW	1626	A R
Clinton		KOSX	1626	A R
Lawton		KOSY	1626	A R
Coalgate		KOSC	1626	A C
Tulsa		KOSE	1626	A C

OREGON

Salem Hq		KOHS	1706	ACn
	1	KOHH	1706	A C
	43	KOHF	30.98	ACn
Bend		KOHN	1706	ACn
Roseburg		KOHR	1706	ACn
Astoria		KOHA	1706	ACn
Baker		KOHB	1706	A C
CoQuille		KOHC	1706	ACn
The Dalles		KOHD	1706	ACn
Eugene		KOHE	1706	ACn
Grants Pass		KOHG	1706	ACn
Gov Camp		KOHI	1706	A C
Santiam		KOHJ	1706	A C
Klamath Falls		KOHK	1706	ACn
La Grande		KOHL	1706	ACn
Ontario		KOHZ	1706	A C
Portland		KOHM	1706	ACn
John Day		KOHO	1706	ACn
Pendleton		KOHP	1706	ACn
Medford		KOHQ	1706	AGE
Burns		KOHU	1706	ACn
Odell Lake		KOHY	1706	A C

PENNSYLVANIA

Harrisburg Hq	266	WPAZ	42.78	F M
		WPSP	42.62	F M
Greensburg		WHNI	42.62	F M
Lebannon		WDLL	42.62	F M
Reading		WKPP	42.62	F M
Hollidaysburg		WNTK	42.62	F M
Lancaster		WNRZ	42.62	F M
Bedford		WNSH	42.62	F M
Blakely		WNSG	42.62	F M
Punxsutawney		WNSI	42.62	F M
Chamberburgh		WNSL	42.62	F M
Warren		WNSY	42.62	F M
Milton		WNTA	42.62	F M
Washington		WNTE	42.62	F M
Pleasant Gap		WNTF	42.62	F M
Philadelphia		WNTN	42.62	F M
Montoursville		WNTZ	42.62	F M
Hamburg		WOVK	42.62	F M
Milford		WOVM	42.62	F M
Pine Grove		WOVS	42.62	F M
Wyoming		WPAJ	42.62	F M
Clearfield		WPJR	42.62	F M
New Milford		WPJT	42.62	F M
Ebensburg		WPJX	42.62	F M
Schuylkill		WPKX	42.62	F M
Clarion		WPLR	42.62	F M
Corry		WPLS	42.62	F M
Indiana		WPML	42.62	F M
Franklin		WPMU	42.62	F M
Huntingdon		WPMW	42.62	F M
Erie		WPNA	42.62	F M
McConnellsburg		WPNT	42.62	F M
Ridgway		WPNU	42.62	F M
Lewiston		WPNX	42.62	F M
Imperial		WPOA	42.62	F M
Coatesville		WPQE	42.62	F M
Butler		WPVK	42.62	F M
Lykens		WQSA	42.62	F M
York		WQSB	42.62	F M
Bloomsburg		WQSC	42.62	F M
Coudersport		WQSD	42.62	F M
Emporium		WQSE	42.62	F M
Carlisle		WQSF	42.62	F M
Gettysburg		WQSG	42.62	F M
Dalesville		WQSH	42.62	F M
Lock Haven		WQSI	42.62	F M
Kane		WTIQ	42.62	F M
Kittanning		WTIX	42.62	F M
Rochester		WTJJ	42.62	F M
Uniontown		WTJP	42.62	F M
Mansfield		WTJQ	42.62	F M
Somerset		WTJZ	42.62	F M
Towanda		WTKF	42.62	F M
Indiantown Gap Military Res		WTKK	42.62	F M
Easton		WTLT	42.62	F M
Quakertown		WTLU	42.62	F M
Mt Pocono		WTNH	42.62	F M
Hazelton		WTNL	42.62	F M
Lehighton		WTNW	42.62	F M
New Castle		WTPB	42.62	F M
Brodheadsville		WTPI	42.62	F M
Waynesburg		WTPJ	42.62	F M
Belle Vernon		WTQB	42.62	F M
Mercer		WTQT	42.62	F M
Athens		WTQV	42.62	F M
Tunkhannock		WTRL	42.62	F M
Shickshinny		WTRO	42.62	F M
Dushore		WTSS	42.62	F M
Honesdale		WTTA	42.62	F M
W Springfield		WTTB	42.62	F M
Stroudsburg		WTTC	42.62	F M
Avondale		WTTD	42.62	F M

RHODE ISLAND

Providence Hq	50	WKXW	39.78	F M
North Scituate		WRSA	42.62	F M
Richmond		WKQI	42.62	F M

SOUTH CAROLINA

Columbia Hq	2	WKLD	42.1	F D
	500	WKBY	42.26	FRMF
Greenville		WCQF	42.1	F D
Walterboro	1	WDYQ	42.10	F D

SOUTH DAKOTA

Pierre Hq		KAVX	39.1	F M
	135	KSDK	39.1	FLM
Rapid City		KRBD	39.1	F M
Kimball		KRBE	39.1	F L
Huron		KRBW	39.1	F M
Parker		KSDA	39.1	F M
Pierre		KRCE	39.1	F M
Huron		KSDH	39.1	F M
Webster		KSDW	39.1	F M
Rapid City		KSDG	39.1	F M
		KSDL	39.1	F M
	1	KSLL	39.1	F K

EXPERIMENTAL

Rapid City N		W9XSI	81	F M
Deadwood R		W9XSJ	79	F M
Custer R		W9XSL	79	F M
Arlington R		WXCW	73.22	F L
Pierre R		WXCX	73.22	F L
Rapid City N		WXCY	74.50	F L
Gettysburg R		WXCZ	73.22	F L
Huron N		WXDA	74.50	F L
Faith R		WXDB	73.22	F L
Pierre N		WXFR	74.50	F L
Rapid City N		WXOH	81.06	F M

TENNESSEE

Nashville Hq	85	WAMW	35.78	A C
Jordonia		WBVM	1618	A C
Memphis		WDBW	1618	A C
Huntington		WEBD	1618	A C
Kingsport		WEOM	42.42	F L
Chattanooga		WJBV	1618	A C
Knoxville		WKVT	1618	A C

EXPERIMENTAL

Columbia		W4XTB	73.98	F L
Rockwood		W4XTH	73.98	F L
Humboldt R	1	W4XTL	73.98	F L
St Andrews		W4XTM	73.98	F L

TEXAS

Austin Hq		KTXA	1658	AWe
	1	KTXB	1658	A C
	1	KTXH	1658	A K
	1	KTXR	1658	A K
	227	KRXJ	42.9	A F KMGE
Arlington		KTXF	1658	A C
Houston		KTXU	1658	A C
Harlingen	1	KTXK	1658	A
Pecos	1	KTXP	1658	A

UTAH

Salt Lake City Hq		KUHP	1674	A C
	281	KXYG	42.94	FGE M K
Brigham City	1	KBUO	42.94	F M
Logan	1	KHQW	42.94	F M
Provo		KPRV	1674	A C
		KPRV	35.9	F M
Ogden	1	KUSH	1674	A C
	1	KUSH	42.94	F M

VIRGINIA

Richmond	477	WRJJ	42.86	FGE L M
	1	WPXE	42.86	F M
Norfolk		WAEY	42.86	F L
Culpeper C		WRIG	42.86	F L
Wytheville		WBXQ	42.86	F L
Roanoke		WBXQ	42.86	F L
Norton		WBXQ	42.86	F L
Appomattox		WRIF	42.86	F L
Chesterfield C		WSPH	42.86	F L

EXPERIMENTAL

Montgomery C		W3XVY	73.22	F L
Wytheville		W3XZJ	74.50	F L
		W3XZK	74.50	F L
Culpeper N		W3XZL	74.50	F L
Wise C		W4XAB	73.22	F L
Rappahannock C		W4XAC	73.22	F L
Norfolk		W4XQA	74.50	F L
Warwick C		W4XQB	73.22	F L

WASHINGTON

Tacoma Hq		KQJY	37.5	F M
		KQJY	2490	A
	108	KHMZ	37.5	F M
	123	KHMZ	2490	A
	5	KQAW	2490	A
	5	KQBX	2490	A
Chinook Pass		KGHQ	2490	A
Okanogan		KACB	2490	A
Bellingham		KNFK	2490	A
		KNFK	37.5	F M
Colville		KAXV	2490	A C
Kelso		KBKK	37.5	F M
Hoquiam		KBPY	37.5	F M
Mt Vernon		KLEZ	37.5	F M
Yakima		KNGB	2490	A
		KNGB	37.5	F M
Everett		KFGD	37.5	F M
Mercer Island		KGHD	2490	A
		KGHD	37.5	F M
Snoqualmie		KGHE	2490	A
		KGHE	37.5	F M
Shuksan		KNFL	2490	A
Chehalis		KLFE	37.5	F M
Olympia		KNFG	2490	A
		KNFG	37.5	F M
Ellensburg		KNFX	37.5	F M
Ilwaco		KNFY	2490	A
Lodge Pole Camp		KNFZ	2490	A
Vancouver		KNGC	2490	A
		KNGC	37.5	F M
Wenatchee		KNGQ	37.5	F R
Spokane		KNGR	2490	A
		KNGR	37.5	F M
Colfax		KQCS	2490	A C
Mason City		KQDY	2490	A
Pasco		KQEK	2490	A C
K-M Hill		KQGF	2490	A
Bremerton		KQZT	37.5	F M
Port Angeles		KRGS	37.5	F M
Tacoma		KQJY	2490	A
		KQJY	37.5	F M
South Bend		KWSE	2490	A
Davenport		KWSF	2490	A

WEST VIRGINIA

Charleston Hq	142	WBSQ	42.26	FMR GEL
Beckley		WBSP	42.1	F M
Barboursville		WKQS	42.1	F M
Stollings		WDKE	39.9	F M
		WSLT	39.9	F M
Romney		WRMP	1626	A R
		WRMP	42.1	F R
Parkersburg		WSJA	39.9	F M
Elkins		WSPL	39.9	F M
Moundsville		WMWV	42.1	F R
Weirton	1	WDSF	42.10	F M
South Charleston		WPWV	1626	A R
		WPWV	39.9	F M
Shinnston		WSWV	1626	A R
		WSWV	39.9	F M

EXPERIMENTAL

Blair Mountain		W8XCP	73.62	F M
Stollings		W8XCQ	74.58	F M
Kanawha C		W8XDD	73.62	F M
South Charleston		W8XDE	74.58	F M
Mountain View		W8XDF	73.62	F M
Middle Point		W8XPV	73.62	F M
Beckley		W8XFW	75.98	F M
Keeney Mountain		W8XFX	73.62	F M
Elkins		W8XFY	75.98	F M
Moundsville R		W8XO	73.62	F R
Moundsville N		W8XOD	75.98	F R
Romney R		W8XSH	73.62	F R
Romney N		W8XSI	75.98	F R

WISCONSIN

Madison Hq		WIZR	42.38	F M
	121	WDAU	42.38	F M
	2	WDAU	31.5	ARCn
Greenfield	1	WCJA	42.38	F M
Hayward		WDAZ	42.38	F M
Tomahawk		WEBH	42.38	F M

WYOMING

Cheyenne Hq KWHC 1642 A F
36 KWHZ 1642 A R
Rock Springs KWHA 1642 A R
Rawlings KWHD 1642 A R
Sheridan KWHE 1642 A R
Casper KWHF 1642 A R
Lander KWHG 1642 A C
Basin KWHH 1642 A H
Laramie KWHQ 1642 A T

MUNICIPAL FIRE

Akron Ohio 158 S High
19 WMUI 35.58FMRL
Alameda Calif 20 KSUJ 154.07 F L
Bakersfield Calif 2101 H St
20 KVWG 154.07 F R
Berkeley Calif 2120 Grove St
40 KBKY 154.19 F L
Bellaire Texas 400 S Rice Street
12 KIRW 154.19 A B
Bernardsville N J 35 Mill St
10 WNQL 154.43 F L
Boston Mass 59 Fenway
172 WEY 33.74 FML HvGE
Bridgeport Conn 274 Middle St
10 WMQR 154.19 F L
Cleveland Ohio 310 Carnegie Ave & 2001 Payne Ave
26 WFDC 37.74 F L
Columbus Ohio 50 W Broad St
50 WBFM 154.19 F M
Contra Costa Co Calif
57 KXIZ 33.9 ALK
Denver Colo 9th & Columbine
40 KFWT 154.31 F D
Detroit Mich 697 Macomb
WKDT 1630 A C
Washington D C 4th & Douglas N W
104 WAKY 154.13 F L
Eau Clair Wis 216 S Dewey
15 WECP 154.31 A B
Hamilton Twp E State St & Adela
3 WNWR 154.43 F M
Haverhill Mass 17 Hamilton
10 WTYH 153.95 F M
Hingham Mass 339 Main St
2 WHRH 154.19 FGE
Honolulu T H City Hall Bldg
KFJY 37.74 F M
KFJO 37.74 F M
50 KFJC 37.74 F M
KFJR 37.74 F M
3 KFJA 37.74 F M
Jacksonville Fla 1066 Laura St
35 WBVR 154.31 F M
Long Beach Calif 1417 Peterson
21 KCJA 37.74 ACC R T
Los Angeles Calif 2228 W 6th St
2 KCJD 35.58 F M
210 KCJE 35.58 F M
14415 Sylvan St & 1624 Purdue Av
2 KCUG 35.58 F M
Oakland Calif 1310 Oak St
50 KXDE 154.31 F L
Madison Wis 18 S Webster
25 WJVD 153.89 FGE
Miami Fla Rear of 74 W Flagler
35 WJRV 154.31 F M
Minneapolis Minn City Hall
62 KCNX 37.74 F M
New Haven 152 Court St
23 WMUJ 33.82 AFL
New Orleans La Fireboat Samson
1 WSKK 1630 A
2 Canal St 1 WSKW 154.25 F L
New York N Y Manhattan Fire Alarm Central Off 79 St Transverse Rd
50 WNYF 37.74AGEL
(Kings Co) WNYQ 1630 A W
St George N Y Richmond Borough Hall No 2 Richmond Terrace
WHGH 35.58 A L
Okmulgee Okla 123 E 4th St
8 KCJL 154.31 F M
Oklahoma City Okla 428 W Calif
11 KIGE 153.89 F L
Orlando Fla 19 N Main
8 WOMC 33.94 F M
Purtland Ore NE 21st Av & Pacific St
45 KPFD 33.98 ACM
Purtland Me 118 Federal
7 WDBE 35.58 A F MHv
Rehoboth Mass Winthrop St
4 WTSG 154.43 FHv
Rockford Ill 204 S 1st St
30 WROF 154.19FRGE
San Pedro Calif 638 S Beacon
KCJB 35.58 F M
Seattle Wash 223 4th Ave N
67 KRMO 35.58 F M
40 KVLW 154.19 F M
Sherman Texas 315-19 S Travis
4 KQIS 33.5 A W
Stockton Calif City Hall
25 KTSH 153.83 F M
St Petersburg Fla 3rd St & 2nd Ave
20 WKRQ 154.07 F F
Sudbury Mass Town Hall
6 WDGI 37.74 F F
Tampa Fla Fire Sta Zack & Jefferson Sts
45 WLDH 154.43 F M
Teaneck N J 1217 Teaneck Rd
8 WGVZ 35.58 A L
Toledo Ohio 550 Erie St
25 WWGF 153.95 F R
Tulsa Okla 1010 E 8th
20 KBPF 153.89 F M
Houston Texas 3800 University Blv City Hall W University Pl
12 KWPJ 154.43 A B
Ventnor City N J New Haven & Winchester Aves 2 WLDR 37.74 A R
Warren Ohio 201 S Park Ave
7 WLDV 154.19 F L
Upper Darby Pa Garret Rd & Long Lane 4 WKBQ 72.9 F M
Worcester Mass 230 Park Ave
6 WQWV 35.58FLGE

EXPERIMENTAL

Summit Calif Mt Diablo
W6XTY 72.94 F L

RAILROADS

Alton & Southern 3105 Missouri Ave St Louis Mo
WFKS 158.79 F M
6 WFKV 158.79 FCC
Atchison Topeka & Santa Fe 80 East Jackson St Chicago 4 Ill
30 & Powell Argentine Kans
KAWN 160.95 F A
KCDC 159.45 FTS
KCKE 159.45 FTS
KSVU 160.65 FFa
Santa Fe Yards Argentine Kans
KAWO 158.85 F A
2nd & Santa Fe Los Angeles Calif
KCKB 161.37 F B
2154 Archer Ave Chicago Ill
WIJL 160.65 F B
38 & Central Park Ave Chicago
WRPK 160.65 F B
Mobile 97 KCKF 160.65 F B
106 WRQI 160.65 FBFaA
Port 10 WLBD 160.65 FTS
Exp 4 W10XQD 160.65 F B
Baltimore & Ohio Balt & Charles Baltimore Md
23 WTUK 160.89 F B
WBWC 159.93 FGr
New Castle Pa
WBOR 159.27 F B
Locust Pt Baltimore Md
WRTO 160.41 F B
Bangor & Aroostook Bangor Maine
Port 2 WIHA 158.97 F B
Bessemer & Lake Erie 700 Union Trust Bldg Pittsburgh Pa
2 WBRR 158.67 F B
1 WRYK 158.43 F B
2 WRYL 158.43 F B
WBWC 159.93 FGr
WEUO 158.67 F B
Boston & Maine 150 Causeway St Boston Mass
5 WRIQ 160.11 FGr
Mechanicsville N Y
WRKC 160.11 FGr
Central of Georgia 233 W Broad St Savannah Ga
East Point Ga
2 WCAG 161.19 F B
Jersey City Term Jersey City N J
WBYV 160.89 FGr
Allentown Pa
WKQB 169.89 FGr
Mobile 8 WCAS 161.19 F B
7 WBYM 160.89 FGr
WKQC 160.89 FGr
Chesapeake & Ohio 3044 W Grand Blv Detroit 2 Mich
Wyoming Yard Grand Rapids Mich
WBBT 161.49 FFa
Pier No 9 Newport News Va
WCRR 158.55 F B
Hump Office Walbridge Ohio
WHGN 161.37 FWe
Pere Marquette Dock Office Ludington Mich
WRKN 160.11 F B
Railway Dock Office Manitowoc Wisc WRLU 160.11 F B
Railway Dock Office Milwaukee Wisc WRMD 160.11 F B
Rougemere Yd Office Industrial Ave & Vernor Hway Detroit Mich
WRRE 159.33 FFa
Mobile 27 WCSK 158.55 F B
13 WPMQ 159.33 FFa
Port WRRD 160.11 F B
Chesapeake Western 141 Bruce St Harrisonburg Va
WJYT 158.79 F M
Elkton Va WJYV 158.79 F M
Bridgewater Va
WJYW 158.79 F M
Staunton Va
WJYY 158.79 F M
Mobile 4 WJYZ 158.79 F M
Chicago Burlington & Quincy 547 W Jackson Blvd Chicago 6 Ill
WIAE 159.69 F B
N Kansas City Mo
WTQY 159.69 F B
Galesburg Ill
WCYA 160.23 F B
WCYR 160.23 F B
WCZK 161.85 F B
Mobile 58 WIAF 161.85 F B
Chicago & Eastern Illinois 332 S Mich Ave Chicago 4 Ill
Morgan Ave Evanston Ind
WLCL 161.61 FFa
Mobile 4 WLCB 161.61 FFa
Chicago Milwaukee St Paul & Pacific Union Station Chicago 6 Ill
Mobile 25 KCMS 158.73 F B
Chicago Rock Island & Pacific 133 LaSalle St Station Chicago 5 Ill
Inver Grove Yards Minneapolis
KCOA 161.61 F M
Rock Island Yards Des Moines Ia
KCOJ 161.61 F M
Armourdale Yds Kansas City Kans
KCPT 161.61 F M
805 W Chicago Av Hinsdale Ill
WCHU 161.61 F M
LaSalle & Van Buren Chicago Ill
WCHZ 161.61 F M
Silvis Ill
WCIY 161.61 F M
Burr Oak Yds Blue Island Ill
WCJK 161.61 F M
Bureau Ill
WCJL 161.61 F M
Mobile 47 WHUF 161.61 FSp
Delaware Lackawanna & Western 140 Cedar St New York 6 N Y
Pier 6 North River Hoboken N J
WIEB 160.29 F B
Mobile 10 WIEC 160.29 F B
Denver & Rio Grande Western 1531 Stout St Denver Colo
4th Ave Yard Office Denver Colo
KAEF 160.83 F B
6th & State Alamosa Colo
KCOE 160.83 F B
8th & Osage Denver Colo
KDSC 160.83 F B
KDEX 159.81 F A
Mobile 60 KRCU 159.81 F A
8 KAEJ 160.83 F B
Exp 4 W10XIR 159.57 FBMA
Detroit Toledo & Ironton 4921 Calhoun Dearborn Mich
24002 Vreeland Rd Flat Rock Mich
WDTJ 161.85 FFa
Mobile 6 WFTW 161.85 FFa
Duluth Missabe & Iron Range 500 Wolvin Bldg Duluth Minn
Proctor Yd Office Proctor Minn
WMBA 158.61 FRR
Mobile 10 WMBZ 158.61 FRR
Elgin Joliet & Eastern 208 South LaSalle St Chicago 4 Ill
Standard Oil Yard Whiting Ind
WELJ 159.12 F B
Mobile 7 WLOQ 159.21 F B
Erie RR Co 101 Prospect Ave NW Cleveland Ohio
Erie DV Tower Falconer N Y
WJZK 159.33 FFa
Pier 4 Jersey City N J
WJRP 158.85 FWe
Erie WB Yd Office Marion Ohio
WWCB 159.09 FFa
Erie MD Tower Mansfield Ohio
WMOV 159.09 FFa
Erie SC Tower Silver Creek O
WWBA 159.09 FFa
Erie KE Yd Office Talmadge O
WWGE 159.09 FFa
Erie SN Tower Leavittsburg O
WSND 159.09 FFa
Erie SE Tower Creston Ohio
WROE 159.09 FFa
Mobile 20 WERL 158.85 AWe
5 WERL 159.33 FFa
57 WSVD 160.05 FFa
Florida East Coast St Augustine Fla
Yardmaster's Office NE 29th St Miami Fla WRRG 160.11 FCC
Mobile 16 WRRH 160.11 FCC
General Railway Signal Co Box 600 Rochester N Y
Mobile 15 W10XDL 158.31 AFGr
Great Northern Railway Co 4th & Jackson St Paul Minn
KVYA 159.93 F B
Port 5 KVYJ 159.93 F B
Mobile 25 KVYK 159.93 F B
5 KVYN 159.93 F B
Gulf Mobile & Ohio 104 St Francis Mobile Ala
RR Yard Meridan Miss
WTYF 159.03 F B
Mobile 2 WNDN 160.11 F B
2 WWGM 159.03 F B
Illinois Bell Telephone Co 135 E 11th Pl Chicago 5 Ill
W9XOK 154.57 F W
Mobile 39 W9XOL 154.57 F W
Illinois Central RR Co 135 E 11th Chicago 5 Ill
171st & Ashland Av Hazel Crest Ill WMWK 161.85 FFa
Mobile 15 WEHM 161.37 FFa
Jacksonville Terminal Co 1000 W Bay St Jacksonville Fla
Myrtle Ave Tower JacksonvilleFla
WTVF 161.25 FCC
Lee St Tower Jacksonville Fla
WTVG 161.97 FCC
Mobile 12 WTVH 161.97 FCC
Lehigh Valley RR 143 Liberty St New York 6 N Y
Foot of Johnson Av Jersey City N J WAHW 158.43 FGr
Mobile WAHY 158.43 FGr
Los Angeles Junction Ry Co 80 E Jackson Blvd Chicago 4 Ill
3420 Exchange Av Los Angeles Cal
KUDL 161.13 F B
Mobile 4 KUDM 161.13 F B
Missouri Kans Texas RR Ry Exchange Bldg St Louis Mo
McKinney Ave & Houston Dallas Tex
KPWY 159.93 F B
Mobile 16 KMFR 159.21 F B
7 KPFE 159.93 F B
Missouri Pacific RR 310 N 13th St St Louis 3 Mo
Mobile 32 KMPQ 160.41 FGr
The New York Central 466 Lexington Ave New York 17 N Y
Weehawken N J
WDHC 161.67 FGr
5339 Hump Rd Hammond Ind
WNKW 158.49 FGr
Gardenville Yd Union & Losson Rds Cheektowaga Tn N Y
WNYH 160.41 FGr
Selkirk Yd N Y Central RR Bethelem Tn N Y
WNYJ 158.79 FGr
Dewitt Yd N Y Central RR Manlius Tn N Y WNYP 158.79 FGr
WNYX 161.61 FGr
Mobile 65 WNKX 158.49 FGr
The New York Chicago & St Louis RR 50 Public Sq Cleveland 1 Ohio
970 S Park Ave Buffalo N Y
WMHG 161.25 F B
Mobile 13 WMHS 161.25 F B
WNRL 161.25 F B
The New York New Haven & Hartford 71 Meadow New Haven Conn
132nd St & Willis Av New York N Y
WRTJ 161.49 FGr
Mobile 14 WEQJ 161.49 FGr
Northern Pacific Ry 176 E 5th St St Paul 1 Minn
Mississippi St Yd Office St Paul
KNCM 161.25 F B
2266 E Marginal Way Seattle Wash
KTQX 161.13 F B
Mobile 4 KNCQ 161.25 F B
15 KTQV 161.13 F B
The Pittsburgh & Lake Erie Terminal Bldg Pittsburgh 19 Pa
E Youngstown Yds Youngstown Ohio
WPIU 159.69 FWe
Mobile 33 WSFF 159.69 F B
Richmond Fredericksburg & Potomac Broad St Sta Richmond 20 Va
Potomac Yd Alexandria Va
WFSB 161.49 FFa
WFXN 161.49 FFa
Mobile 18 WFXF 161.49 FFa
River Terminal Ry 3100 E 45th St Cleveland Ohio
Bldg 1 Blast Furn 2 Steel Plt E Strip Mill Cleveland
WBZX 161.61 FWe
Mobile 6 WBUV 161.61 FWe
St Louis San Francisco Ry 906 Olive St St Louis 1 Mo
537 E Commercial Springfield Mo
KRRM 161.97 F B
Mobile 15 KRRO 161.97 F B
Seaboard Air Line RR 211 SAL Bldg Norfolk 10 Va
Lafayette & Meridian Av Tampa Fla WRCL 160.17 FCC
SAL Yeoman Yd Office Tampa Fla
WRGS 160.17 FCC
Howells Yd Office Chattahoochee Av Atlanta Ga
WRGT 160.17 FCC
N Spot House Hamlet(Richmond)NC
WSNA 160.17 FCC
SAL Yd Office Hamlet(Richmond)NC
WSRR 160.17 FCC
SAL Yd Office Richmond Va
WWSF 160.17 FTS
SAL Yd Office Savannah Ga
WWSH 160.17 FTS
SAL Yd Office Brown St Richmond Va WWSI 160.17 FTS
Southern Railway Co Box 1808 Washington 13 D C
Inman Yard Atlanta Ga
2 WKXT 158.97 FGr
J Sevier Yd Knoxville Tenn
WSKT 160.65 FGr
WSKU 160.65 FGr
Mobile 24 WSLK 158.97 FGr

Union Pacific RR Co 1416 Dodge St Omaha Neb
UP Yd Office Los Angeles Calif KAUC 160.17 F M
UP Depot Riverside Calif KAUF 160.17 F M
UP Depot Pomona Calif KAUY 160.17 F M
Hump Tower N Platte Neb KBVH 160.41 F M
Yardmaster's Off N Platte Neb KBVI 160.29 F M
UP Depot Lawrence Kans KRBG 160.17 F M
UP Depot Menoken Kans KRBN 160.17 F M
UP Depot Emmett Kans KRBT 160.17 F M
UP Depot Onaga Kans KRBV 160.17 F M
UP Depot Frankfort Kans KRCR 160.17 F M
UP Depot Marysville Kans KRDA 160.17 F M
36th St Yd Office Denver Colo KRDB 160.29 F M
23rd St Yd Office Denver Colo KRDB 160.29 F M
North Yard Salt Lake City Utah KRDC 160.29 F M
East Yard Los Angeles Calif KRDD 160.29 F M
9th & Jones and 8th & Davenport Omaha Neb KTDE 160.29 F M
7th St & RR Yard Kansas Cty Kans KRUP 160.29 F M
Retarder Yd Office Pocatello Idaho KUCA 160.41 F M
Pocatello Yardmaster's office Pocatello Idaho KUCC 160.29 F M
Argo Yard Seattle Wash KWBI 160.29 F M
Albina Yard Office Portland Ore KWBV 160.29 F M
7th St Yardmaster's Office Kansas City Kans KWLN 159.93 F M
Union Railroad Co 700 Union Trust Bldg Pittsburgh Pa
Carrie Furnaces Rankin Pa WNLT 159.87 FWe
Mobile 3 WNLE 159.87 FWe
Washington Terminal Co Union Sta Washington D C
100 Mass Av NE Washington D C 2 WWNT 159.45 F B
Mobile 30 WWNV 159.45 F B
Western Maryland Ry Co Standard Oil Bldg Baltimore 2 Md
Port Covington Yd Office Baltimore Md WWNB 158.67 F B
Mobile 6 WWND 158.67 F B
Westinghouse Radio Stations(for use on N Y N H & Hartford RR
Exp W1OXSK 154.57 AFWe
Port W1OXSL 154.57 AFWe
Mobile W1OXSN 154.57 AFWe

FORESTRY

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

ALABAMA

Montgomery Hq WTTW 152.99 F M
693 WRXU 152.99 FML
Hacoda WEVI 152.99 F M
Grove Hill WJOH 152.99 F M
Birmingham WELZ 152.99 F M
Brewton WOLM 152.99 F M
Vredenburg WOMF 152.99 F M
Chapman WRBG 152.99 F M
Stapleton WRXT 152.99 F M

ARKANSAS

Little Rock Hq KAVZ 31.94 F L
17 KAHU 31.94 A
303 KAHU 31.94 F L
Dierks KCJK 37.66 A
Malvern KSWC 31.94 F L
Bismark KSWD 31.94 F L
Fordyce KSWE 31.94 F L
Hampton KSWF 31.94 F L
Stamps KUHK 31.94 F L
Dorado KYND 31.94 F L
Paron KYNE 31.94 F L
Crosset KYNJ 31.94 F L
KYNS 31.94 F L
Sheridan KYNU 31.94 F L
Prescott KYNW 31.94 F L
Graysonia KYNX 31.94 F L
Perryville KYNY 31.94 F L
Star City KYOC 31.94 F L
Hermitage KYOD 31.94 F L
West Camden KYOF 31.94 F L

CALIFORNIA

Sacramento Hq KALJ 2226 A M
496 KCMV FML
307 KCMV AMK
6 KQNJ 35.94 A
55 KRSF 31.58 A M
Perris KAIV 2226 A M
Fresno KAYP 2226 A L
Fortuna KBGG 2226 A L
Howard Forest Forestry Sta KBGJ 2226 A
Oreville KBGK 2226 A
Yreka KBGL 2226 A
Sonora KBCM 2226 A
San Andreas KBGN 2226 A
Madera KBII 2226 A
King City KBIQ 2226 A
Santa Rosa KBJX 2226 A L
Crescent City KBXR 2226 A
La Mesa KGSC 2226 A M
Visalia KRDS 2244 A
KRVH 2226 A
Monterey 2226 A L
Redding KRRE 2226 A M
San Luis Obispo KRRF 2226 A
Alma KRRG 2226 A
Camino KRVO 2226 A
Middletown KRWV 2226 A
Susanville KRWW 2226 A
Mariposa KRWY 2226 A
Auburn KRWZ 2226 A
Indio KXYR 2226 A
Bakersfield KRBJ 2226 A
La Canada KFRW 2212 A M
Los Angeles KQXB 2212 A
Newhall KRJO 2212 A M
San Bernardino 47 KLYG 2226 A M
KQRW 2226 A
Yucaipa KQRX 31.58 A
Twenty-Nine Palms KBIA 2226 A

EXPERIMENTAL

Calistoga W6XBT 72.34 F L
Perris W6XGK 75.90 A
Oreville W6XMH 73.98 F L
Redding W6XMI 72.34 F L
Palomar W6XNI 72.66 F M
Colfax W6XSY 72.02 F M
Berryessa Peak W6XUE 72.14 F M
Coalinga W6XUF 72.14 F M
Los Gatos W6XUO 72.50 F M
Mariposa W6XUH 72.62 F M
Lyons Peak W6XVK 72.38 F M
Pine Grove W6XVP 72.14 F M
Exeter Rocky Hill W6XVS 72.02 F M
Angels W6XVT 72.14 F M
Laytonville W6XWQ 72.02 F M
Scotia W6XWR 72.62 F M
Tollhouse W6XWS 72.14 F M
Orick W6XWT 72.62 F M
Grapevine W6XAF 73.98 F M
San Bernardino W6XEK 73.02 A

CONNECTICUT

Hartford Hq WSPQ 35.74 F L
25 WIOQ 35.74 A L
2 WIOQ 35.74 A L
Sterling WROY 35.74 F L
Storrs WROZ 35.74 F L
Oxford WZPZ 35.74 F L

DELAWARE

Dover Hq 5 WAPL 37.66 A

FLORIDA

Tallahassee Hq 63 WAWP 2226 AF
153.11
Shamrock WAGI 2226 A C
Lake City WAGU 2226 A C
Munson WBWY 2212 A C
Madison WFGL 153.11 F M
Secotan WGWW 2226 A C
Bakersfield WJQX 153.35 F M
Blountsville WJQY 153.35 F M
Dinsmore WJRT 153.35 F M
Valrico WRQO 153.35 A C
Joe WSRM 153.35 A C
Molino WSXR 153.35 F M
Southport WSTD 2226 A C
St James Island WKTK 153.11 F M

GEORGIA

Homerville WANA 2226 A C
Eulonia WEGK 2226 A
Townsend WGDH 2226 A
Ludowici WGRR 2226 A
Brunswick WGSF 2226 A C
Waycross WJKR 2226 A
Jesup WKWD 2226 A
Nahunta WKWJ 2226 A
Valdosta WKWL 2226 A
Colesburg WMVQ 2226 A K
Macon WNES 2226 A C

IDAHO

Boise Hq 10 KRFO 2212 A K
98 KBTK 31.5 F L
KRFS 2212 A K
Orofino KRFP 2212 A K
Elk River KRFW 2212 A K

LOUISIANA

Hammond KBRK 39.94 F L
Oberlin 1 KBRW 31.50 F L
Pine Grove KBSH 39.94 F L
Springville KBSI 39.94 F L
Robert KBSS 39.94 F L
Mandeville KBSY 39.94 F L
Franklinton KBSZ 39.94 F L
Belah KSVJ 31.38 F L

MAINE

Augusta Hq 14 WMML 35.94 A L

MARYLAND

Cumberland 100 WMAU 31.58 F L
WKXD 31.58 F L
Belair WBPL 31.58 F L
Mountain Lake Park WBUQ 31.34 F L
Thayerville WETH 31.58 F L
Green Hill WETJ 31.58 F L
Stoeny Forest WMAI 31.58 F L
Cub Hill WMAY 31.58 F L
Madonna WMBE 31.58 F L
Woodlawn WMBJ 31.58 F L
Avalon WMBK 31.58 F L
Welcome WMBQ 31.58 F L
Brandywine WMBU 31.58 F L
Long Hill WMBX 31.58 F L
Laurel WMCL 31.58 F L
Hillmeade WMCR 31.58 F L
Hollofield WMDK 31.58 F L
Burtonsville WMEQ 31.58 F L
Great Mills WMES 31.58 F L
New Germany WMFQ 31.58 F L
High Knob WMSY 31.58 F L
Nassawango WQWB 31.58 F L
Church Creek WQWF 31.58 F L

MASSACHUSETTS

Boston WRNB 31.34 FHv
21 WEQW 31.34FHvL
Stow WBGD 31.34 FHv
Agawam WCXB 31.34 FHv
Shelburne WCXP 31.34 FHv
Sunderland WFGQ 31.34 FHv
Manchester WMHL 31.34 FHv
Chelmsford WMHO 31.34 FHv
Acushnet WMHQ 31.34 FHv
Rehoboth WMHW 31.34 FHv
North Reading WMNR 31.34 FGE
Wellfleet WMZH 31.34 F L
Holbrook WMZI 31.34 FHv
Harvard WQWG 31.34 FHv
Princeton WQWH 31.34 FHv
Bourne WQWJ 31.34 FHv
Harwich WQYA 31.34 F L
Middleborough WQYQ 31.34 F L
Carver WQYR 31.34 F L
Plymouth WQYS 31.34 F L
Hanson WQYU 31.34 F L
Falmouth WQYV 31.34 F L
Barnstable WQYW 31.34 F L
Sharon WRKO 31.34 FHv
Mendon WRKP 31.34 FHv
Fall River WRKQ 31.34 F L
Petersham WRKR 31.34 FHv
Brimfield WRKT 31.34 F M
Oxford WRKU 31.34 F M
Andover WRML 31.34 FHv
3 WBMR 31.34 FHv
Ashland 4 WIVQ 31.34 F M
Osterville 5 WRKW 31.34 F M
Billerica 1 WBIQ 31.34 FHv
Buzzards Bay 4 WQWL 31.34 F M
Carlisle 1 WAJP 31.34 F C
Carver 1 WAPE 31.34 FGE
Chelmsford WKWV 31.34 FHv
Dennis 1 WDNN 31.34 F M
Duxbury 2 WSVG 31.34FMGE
North Easton 1 WLDK 31.34 FGE
Falmouth 6 WQYK 31.34 F M
Harwich 1 WTYG 31.34 F M
Kingston 3 WRMI 31.34 F M
Lakeville 1 WEHD 31.34 FGE
Marion 2 WCLG 31.34 FGE
Middleboro 3 WAAN 31.34 FGE
North Andover 2 WHBH 31.34 FHv
Palmer 1 WRQJ 31.34 F L
Plymouth 2 WRGE 31.34 F L
Plympton 2 WEHE 31.34 FGE
Sterling WBPP 31.34 FGE
Stoughton 1 WBKW 31.34 F L
Uxbridge 2 WTOQ 31.34 F L
West Wareham 4 WRKV 31.34 FGE
Wareham 2 WWEU 31.34 FGE

MICHIGAN

Marquette Hq WBHX 35.74 A C
146 WIXA 35.74 AML
Mio WBKZ 35.74 A R
Atlanta WBRD 35.74 A R
Gladwin WBXA 35.75 A R
Baldwin WDAI 35.74 A R
Traverse City WDAP 35.74 A R
Boyne City WDAQ 35.74 A C
Ewen WDSO 35.74 A R
Newberry WEDM 35.74 A R
Roscommon WIVA 35.74 A C
Marie WMIC 35.74 A
Escanaba WRRC 35.74 A M
Baraga WSWB 35.74 A M
Crystal Falls WSWK 35.74 A M

MINNESOTA

St Paul 25 KQEY 39.74 A

MISSISSIPPI

Jackson Hq 140 WCPY 31.22 F M
8 WIGF 37.66 F K
10 WJPZ 31.42 F L
DeKalb WPMZ 31.22 F M
Canton WIGE 37.66 F K
Rankin C WVBL 37.66 F K
Carthage WVBM 37.66 F K
Electric Mills WBGK 37.66 F M
Perkinston WJNV 31.42 F L

MISSOURI

Eminence 1 KOAJ 31.42 FGE
147 KQGH 31.30 AF
Camdenton 1 KCTL 31.42 FGE
Sullivan 1 KSHG 31.42 FGE
Piedmont 1 KOAP 31.42 FGE
Warrenton 1 KWFG 31.42 FGE
Pineville 1 KWFH 31.30 FGE

NEW HAMPSHIRE

Concord WKJY 39.42 A M
WNHF 39.42 A M
WKML 39.42 A M
236 WQZM 39.42 A M
Loudon WLOM 39.42 A C
Nashua WNWQ 39.42 A M
Franklin WSRE 39.42 A M

NEW JERSEY

Trenton WQVA 39.94 A
33 WHCL 39.94 A
Lebanon St Forest WBPN 35.74 A
Butler WQVB 35.74 A
Blue Anchor WQVC 37.46 A
Union Hill WQVD 35.94 A
Budd Lake WQVE 39.94 A
Culver Lake WQVF 39.94 A
Catfish WQVG 39.94 A
Windbeam WQVH 39.94 A
Beaufort WQVI 39.94 A
Milton WQVJ 39.94 A
Toms River WQVX 39.94 A
May's Landing WQVL 39.94 A
Farmingdale WQVM 39.74 A
Bass River WQVN 39.74 A
Retreat WQVO 39.74 A
Cedar Bridge WQVP 39.74 A
Lakewood WQVQ 39.74 A
Batsto WQVR 39.74 A
Belle Plain WQVS 39.42 A
Millville WQVT 39.74 A
McKeetown WQVU 39.42 A
Mizpah WQVW 39.42 A

NEW YORK

Albany 40 WSAE 31.98 A

NORTH CAROLINA

Raleigh 400 WRVO 31.46 F M

OKLAHOMA

Oklahoma City 26 KOEA 35.74 AMR

OREGON

Salem 124 KRLZ 31.94 A
284 KQSM 31.94 A
Kinzua KAMV 31.58 A
Mollala KGLK 2236 A
Coos Bay KGLM 31.58 A
Roseburn KGLP 31.94 A
Sisters KGLS 31.58 A
Wallowa KOFD 31.58 A
Tillamook KOIA 31.58 A
Klamath Falls KOIB 30.94 A
Sweet Home KORI 30.94 A
Monument KQFP 2236 A
Pittsburg KQGP 31.58 A
Gold Beach KQHN 31.58 A
Salem KQHQ 31.58 A
Springfield KQJS 31.58 A
Grants Pass KQSC 31.58 A
Dallas KQSD 31.58 A
Veneta KQSE 31.82 A
Medford KRDP 31.94 A
La Grande KRDQ 31.58 A
Toledo KRLY 31.94 A
Forest Grove KRNI 31.58 A
Jewell KRNJ 31.58 A

EXPERIMENTAL

Portland 7 W7XPR 30.94 A

PENNSYLVANIA

Harrisburg WIRT 30.94 A R
245 WPFJ 39.94 A R
163 WTYB 39.94 A R
8 W3XIY 153.17 F R
New Cumberland WJAB 35.84 A R
Peters Mountain W3XPT 39.94 A R
Shaffers Path W8XUN 37.46 A R
Lee Fire Tower W8XUT 39.94 A R
Kellogg Mt W8XVE 39.94 A R
Knobs Fire Tower W8XVF 39.94 A R
Loop Fire Tower W8XVL 39.94 A R

RHODE ISLAND

Providence Hq 26 WFMU 35.94 A
1 WXAO 37.66 A L
Scituate WAWR 35.94 A
South Kingstown 1 WKGM 37.66 A

SOUTH CAROLINA

Columbia WCNA 31.9 F M
150 WCNI 31.78 F M
WJHJ 31.9 F M
Lexington WCNE 31.9 F M
St Matthews WGJC 31.9 F M
Walterboro WJGE 31.9 F M
Ridgeland WJGG 31.9 F M
Ridgeville WJGH 31.9 F M
Bonneau WJGI 31.9 F M

AF AMPLIFIER KIT

(*Continued from page 28*)

assures clean reproduction, free of intermodulation. Frequency-wise, the amplifier carries a rating of within 1 db from 20 to 20,000 cycles which condition will hold throughout a power range of 60 db, thus assuring a flat frequency characteristic when operated even at the lowest volume levels. Power and frequency characteristics are shown in Figs. 2 and 3.

Referring to the schematic circuit, Fig. 4, the first stage of the amplifier is a high-gain stage to provide a total amplifier gain of 115 db for phono input. This stage has built-in equalization to permit operation direct from any of the new magnetic pickups, such as the General Electric variable reluctance type, the Pickering, or the Clarkston, without having to resort to an external preamplifier.

This equalization consists primarily of a 14-db boost at the low end, necessary because all phonograph recordings are made on a constant-amplitude basis below approximately 500 cycles. This results in a droop of 14 db at 50 cycles. Accordingly, a similar compensation is required in the reproducing system, in the form of equalization, when using a pickup such as the new magnetic cartridges which are essentially flat in that region.

The built-in equalization in the first stage can be cut out and the frequency response of the amplifier made flat by opening the series resistor-condenser circuit to ground.

Another feature which shows up in the first stage of this amplifier is the potentiometer across the heater of the 6J7 vacuum tube, to permit adjustment for minimum hum. This potentiometer, located at the top of the chassis, has a shaft slotted for screwdriver adjustment. It permits adjusting for minimum noise with any set of vacuum tubes, thus reducing the need of selecting tubes for quiet operation. This feature is usually found only on the most costly recording and laboratory amplifiers. Adjustment of the potentiometer will often reduce the residual hum in the output of the amplifier by as much as 15 db.

Switch control is provided to connect either the phono or the radio input to the amplifier. When in the RADIO position, the first phono stage of the amplifier is cut out, as the diagram shows.

A third feature, unique with this amplifier, is an adjustable low-pass filter, primarily for record-scratch elimination. It is designed to give a very sharp cut-off, so that the maximum usable recorded signal can be reproduced, and the higher noise-frequencies eliminated. Four positions are provided, the characteristics of which are indicated in Fig. 2. The first gives a flat frequency characteristic up to 20,000 cycles; position No. 2 provides

(*Concluded on page 58*)

Location		Call	Freq.	Type
Conway		WJGL	31.9	F M
Sumter		WJGM	31.9	F M
Johns Island		WJGP	31.9	F M
Sheldon		WJGQ	31.9	F M
Georgetown		WJGS	31.9	F M
Sumter		WJHR	31.9	F M
Summerton		WMJK	31.9	F M
Aiken		WMJL	31.9	F M
Marion		WMJR	31.78	F M
Olanta		WMJU	31.78	F M
Bennettsville		WMJY	31.78	F M
Rowesville		WMJZ	31.78	F M
Greenville		WMKV	31.78	F M
Barton		WMJW	31.78	F M
Dillon		WMKX	31.78	F M
Camden		WMLD	31.78	F M
TEXAS				
Jefferson		KBWO	2226	A C
		KBWP	2226	A C
	60	KHTM	31.42	FGE
Lufkin		KBXT	31.3	FGE
Woodville		KSGX	31.3	FGE
Kirbyville		KSGY	31.3	FGE
Conroe		KSGZ	31.3	FGE
WASHINGTON				
Olympia		KGMD	2244	A
	287	KPKX	31.34	A
	26	KETR	31.34	A
Thurston C		KEYM	31.34	A
Weyerhaeuser Timber Co	16	KETS	31.94	A R
	5	KRWE	31.94	A
		KWTF	31.34	A R
WEST VIRGINIA				
Charleston		WBLZ	35.74	F M
	42	WMGX	35.74	F M
Logan		WBLY	35.74	F M
Beckley		WKQQ	35.74	F M
EXPERIMENTAL				
Charleston		W8XCY	75.98	F M
		W8XEM	72.14	F M
Logan		W8XEK	75.98	F M
		W8XEL	72.14	F M
Charmco		W8XGU	72.14	F M
Beckeley		W8XGV	75.98	F M
		W8XGW	72.15	F M
WISCONSIN				
Adams		WDYI	31.54	F M
Wausaukee		WDYS	31.54	F M
Black River Falls		WGPQ	31.54	F M
	133	WHTA	31.54	AF

ZONE POLICE

Location		Call	Freq.	Type
ALABAMA				
Birmingham		WNJO	5195	A C
	1	WHQR	5195	A C
ARKANSAS				
Little Rock		KASP	5195	A R
Fort Smith		KNHA	5195	A C
CALIFORNIA				
Los Angeles	3	KGPL	5195	A
San Diego		KFWL	5140	A
GEORGIA				
Columbus		WPFI	5195	A C
ILLINOIS				
Chicago		WQPC	5195	A
Springfield		WQPI	5195	A C
		WQPX	5195	A C
		WQPZ	5140	A T
		WQPQ	5195	A
		WQPV	5195	A
DuQuoin		WQPD	5195	A C
Effingham		WQPF	5195	A C
Sterling		WQPG	5195	A C
East St Louis		WQPJ	5195	A C
Macomb		WQPM	5195	A C
Pontiac		WQPP	5195	A C
Peoria		WASE	5195	A C
Rockford		WPGD	5195	A
INDIANA				
Indianapolis		WMDZ	5195	ACn
		WLSM	2812	A C
		WRSH	5195	A C
		WAHO	5195	A C
		WAHP	5195	A C
		WAHQ	5195	A C
		WAHR	5195	A C
Connersville		WBII	2812	A C
Charlestown		WBMO	2812	A C
Chesterton		WPHS	5195	A C
Jasper		WPHU	5195	A C
Seymour		WQFE	5195	A C
Ligonier		WQFW	5195	A C
Putnamville		WQBG	2812	A C
Pendleton		WRNR	2812	A C
West Lafayette		WROR	5195	A C
KANSAS				
Topeka		KAZZ	5195	A C
Chanute		KAQB	5195	A C
Norton		KAQF	5195	A C
Garden City		KAQH	5195	A C
Hutchinson		KAHR	5195	A C
Salina		KHNS	5195	A C
Wichita		KGPZ	5195	A R
LOUISIANA				
Baton Rouge		WBRP	2812	A
MICHIGAN				
Grand Rapids		WPEB	5195	A C
Duluth		KNFE	5195	A C
		WBMU	5140	A C
MISSOURI				
North Springfield		KDGW	5195	ACn
Lee's Summit		KHPA	5195	ACn
Macon		KHBP	5195	ACn
Kirkwood		KHPC	5195	ACn
Springfield		KHPD	5195	ACn
Poplar Bluff		KHPE	5195	ACn
Jefferson City		KHPF	5195	ACn
Willow Springs		KHPG	5195	ACn
St Joseph		KHPH	5195	ACn
OHIO				
Akron		WPDO	5195	A C
Findlay		WPGG	5195	ACn
Massilon		WPHC	5195	ACn
Wilmington		WPHK	5195	ACn
Cambridge		WPHT	5195	ACn
Cincinnati		WKDU	5195	A R
Cleveland		WENB	5195	A B
Toledo		WRDQ	5195	ACn
Youngstown		WPDQ	2812	A C
OKLAHOMA				
Oklahoma City		KOSO	5195	A C
		KTQO	5195	A C
Tulsa		KQEI	5195	A C
OREGON				
La Grande		KOHL	5195	A C
Salem		KOHS	5195	A C
TEXAS				
Beaumont		KGPJ	5140	A C
Austin		KTXA	5195	A C
Denton		KNHF	5195	A C
Longview		KACU	5195	A C
Gainesville		KADM	5195	A C
Wharton C		KWSO	5195	A C
WASHINGTON				
Mercer Island		KGHD	5140	A
Snoqualmis Pass		KGHE	5140	A
Bellingham		KNKF	5140	A
Yakima		KNGB	5140	A
Vancouver		KNGC	5140	A
Wenatchee		KNGQ	5140	A

INTERZONE POLICE

Location		Call	Freq.	Type
Spokane		KNGR	5140	A
	1	KQBX	2808	A
WEST VIRGINIA				
Romney		WRMP	5195	A R
		WRPC	5195	A R
WISCONSIN				
Racine		WQLJ	2812	A C
Greenfield		WIZR	5195	A C

INTERZONE POLICE

Location	Address	Call	Freq.	Type
Montgomery Ala	711 High St	WCLB	5195	A C
Phoenix Ariz	1739 W Jackson St	KNGG	5195	ACn
Santa Ana Calif	615 N Sycamore St	KGHX	5195	ACn
Denver Colo	9th & Columbine Sts	KGPX	5195	ACn
Tampa Fla	Fla Ave & Jackson St	WPHN	5195	A C
Atlanta Ga		WPDY	5195	A C
Springfield Ill		WQPS	5195	A
Indianapolis Ind	State Fairgrounds	WPHE	5195	A C
Des Moines Ia		KGHO	5195	ACn
Topeka Kans	204 W 5th St	KGZC	5195	A C
Louisville Ky	1306 Bardstown Rd	WPDE	5195	A
New Orleans La	2700 Tulane Ave	WPEK	5195	A F
Lansing Mich	S Harrison Rd	WRDS	2812	AWe
Detroit Mich		WCK	5195	A C
Jackson Miss	2550 N State St	WRJI	5195	A C
Kansas City Mo	1125 Locust St	KGPE	5195	AWe
St Louis Mo	1200 Clark Ave	KGPC	5195	AWe
Buffalo N Y		WMJ	5195	A R
Columbus Ohio		WPGQ	5195	A C
Oklahoma City		KGPH	5195	A C
Portland Ore		KOHM	5195	ACn
Memphis Tenn	179 S Barksdale	WPEC	5195	A R
Houston Tex	401 Caroline St	KHTP	5195	A C
Olympia Wash	Transportation Bldg	KNFG	5195	A
S Charleston W Va		WPWV	2812	A R
Milwaukee Wisc	4715 W Vliet St	WPDK	5195	A C

AF AMPLIFIER KIT

(Continued from page 57)

a sharp cut-off becoming effective around 8,000 cycles; position No. 3 gives a sharp cut-off beginning at 6,000 cycles; and position No. 4, a smooth roll-off effective at around 4,000 cycles. This low-pass scratch filter is quite different from the ordinary treble tone control, consisting of a simple condenser and resistor combination. Note that this circuit consists of an inductance, resistor, and 8 condenser combinations, such as are used on professional amplifiers.

The second 6J7 tube serves purely as a voltage amplification stage. It operates into the 6J5 triode phase-inverter, for driving the 6L6 push-pull power stage.

Beam power tubes were selected for the output stage, rather than triodes, in order to take advantage of the high power sensitivity, high efficiency and lower cost of the 6L6 type tube as compared to equivalent triodes such as the 2A3. However, decision to use beam power tubes was made only after exhaustive intermodulation and listening tests by a large group of sound technicians from the Hollywood film studios who were well qualified as critical listeners.

The high point of their conclusions was that when properly designed output transformers are used, beam power tubes can deliver the same audio power as triodes with no more or with less distortion. At the same time, the signal-to-noise ratio is improved as much as 10 db.

Recent tests by intermodulation methods on triode amplifiers show that, in order to achieve low intermodulation, it is necessary to provide elaborate high-power driver stages which are necessarily more expensive than beam power circuits.

The output transformer provides three ranges of load impedances, 2.5 to 5 ohms, 8 to 12 ohms and 16 to 24 ohms. Since the output transformer is the most serious bottleneck in the audio amplifier, the transformer for this position has a liberal amount of iron and copper, and is designed to assure low leakage and low distributed capacity. These are important considerations to the application of the proper amount of feedback. The use of negative feedback in amplifiers requires that the frequency range of the output transformer be made much broader than the actual amplification characteristic needed. The frequency range over which the transmission characteristics of the feedback loop must be controlled is surprisingly high, and represents the price that must be paid to obtain the benefits of negative feedback.

In assembling the amplifier kit, the first step is to mount the transformers, sockets, RC board, controls, and terminal strip on the chassis, utilizing the punched holes provided. Condensers and resistors are mounted on the RC board. Then the transformers should be wired in, followed progressively by the remainder of the circuit. It is of great importance that the condensers and resistors be positioned exactly as shown in the layout provided, since changes may lead to excessive hum.

FM–TV STATION SCORE

At the end of June, progress in FM and TV broadcasting stood as follows:

	TV	FM
On the air	28	564
CP's issued	83	463
Pending	281	91
Total	392	1,118

In addition to the commercial FM stations listed above, there are 21 educational FM stations now operating.

Meanwhile, with the upper-band TV hearing scheduled to start at the FCC on September 20, applicants for television stations are asking that consideration of their applications be postponed until such time as the proposed changes in the low-band assignments are settled, and future plans for the upper band have been made known by the Commission.

Special Issues Coming:

AUGUST: A collection of articles on television, including a review of coming developments of such importance that it is a must for every member of the radio industry.

SEPTEMBER: The FMA Convention issue, presenting the new plans of broadcasters and manufacturers, and a 3-part analysis of the Rural Network's operation.

JANUARY: Containing the revised Communications Directory of systems operated by taxicabs, public utilities, trucks, buses, geophysical and all other special services.

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FM-TV CONTROVERSIES

(*Continued from Page 25*)

During the early Autumn of 1926, Franklin beam stations had been set up in England and in the vicinity of Montreal, Canada, and were completing their testing and were about to start commercial operation. During this interval, I happened to drop into the Riverhead laboratories of RCA Communications and was informed of that fact. The engineers there reported to me that signals were being transmitted on the beam system at very high speed — 100 words a minute — but that the signals as received at Riverhead were not significantly better than other foreign signals, and that they looked upon these high speed transmissions as a sort of propaganda stunt, because every so often they had observed that important messages over the system were sent by hand at a speed of about twenty words a minute, twice repeated.

However, they said that they had been invited to go up to Montreal the following week and look over the operation, and would know more about it then. They went, and the story of what they saw was related to me by William A. Winterbottom, then head of RCA Communications. He reported to me the experience of Dr. Beverage at the demonstration — a demonstration so wonderful in its results that Beverage and his associates could hardly believe it.

Not until Dr. Beverage had set up an ordinary simple receiver, hooked it onto an antenna located well out of the field of the beam antenna and listened to the signals of a French short wave station (St. Assise, if I recall it correctly) and found that the signals were substantially like the signals of that station as received at Riverhead, could he believe that he had not been witnessing some extraordinarily favorable period of transmission over the England-to-Canada path. The fact, of course, is that Dr. Beverage had not been able to observe at Riverhead the true effectiveness of the Franklin system because Riverhead was out of the beam and he did not have the benefit of the highly effective receiving array developed by Franklin.

Winterbottom is no longer with us, but I am quite sure that Dr. Beverage will recall the episode. But in any event, it is not necessary to rely on my recollection, or on that of any other living person. One single fact, a matter of historical record, tells the whole story. Winterbottom, charged with the responsibility of maintaining the place of RCA in the field of world communications, acted immediately and insisted, in the face of opposition, upon buying one of the beam systems from British Marconi for use of his company. This equipment was duly installed and operated at Riverhead and Rocky Point, Long Island, the receiving and

(*Concluded on Page 62*)

transmitting centers of RCA Communications.

It will be no answer to this set of facts to reply that RCAC's engineering department subsequently developed and set up most excellent, or perhaps superior equipment to the original Franklin beam and published some very comprehensive papers on the subject of world wide communication. The point is that the genius and the insight rested with two men — Marconi and Franklin — backed by far less resources than were then behind the Radio Corporation of America. Theirs were the discoveries and theirs the work that produced the obsolescence of the alternator and the scramble that came in 1927 when the special reserve of four and a half million dollars referred to in the last sentence of the quoted Jolliffe report was set up.

Whether Dr. Jolliffe knew the facts about this situation when he read his statement is for him to say, but since they are now fully available to him, he owes an apology to the memory of Marconi and an acknowledgment of the work of Franklin.

It would be much better if Dr. Jolliffe would stop taking his facts from the lawyers, who are engaged in rewriting radio history in an attempt to prove a case. Dr. Beverage, for example, knows the facts and would be the first to recognize the work of Marconi and Franklin.

E. H. Armstrong

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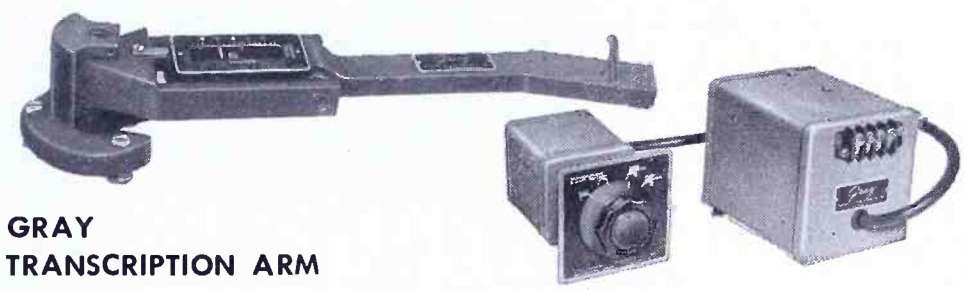

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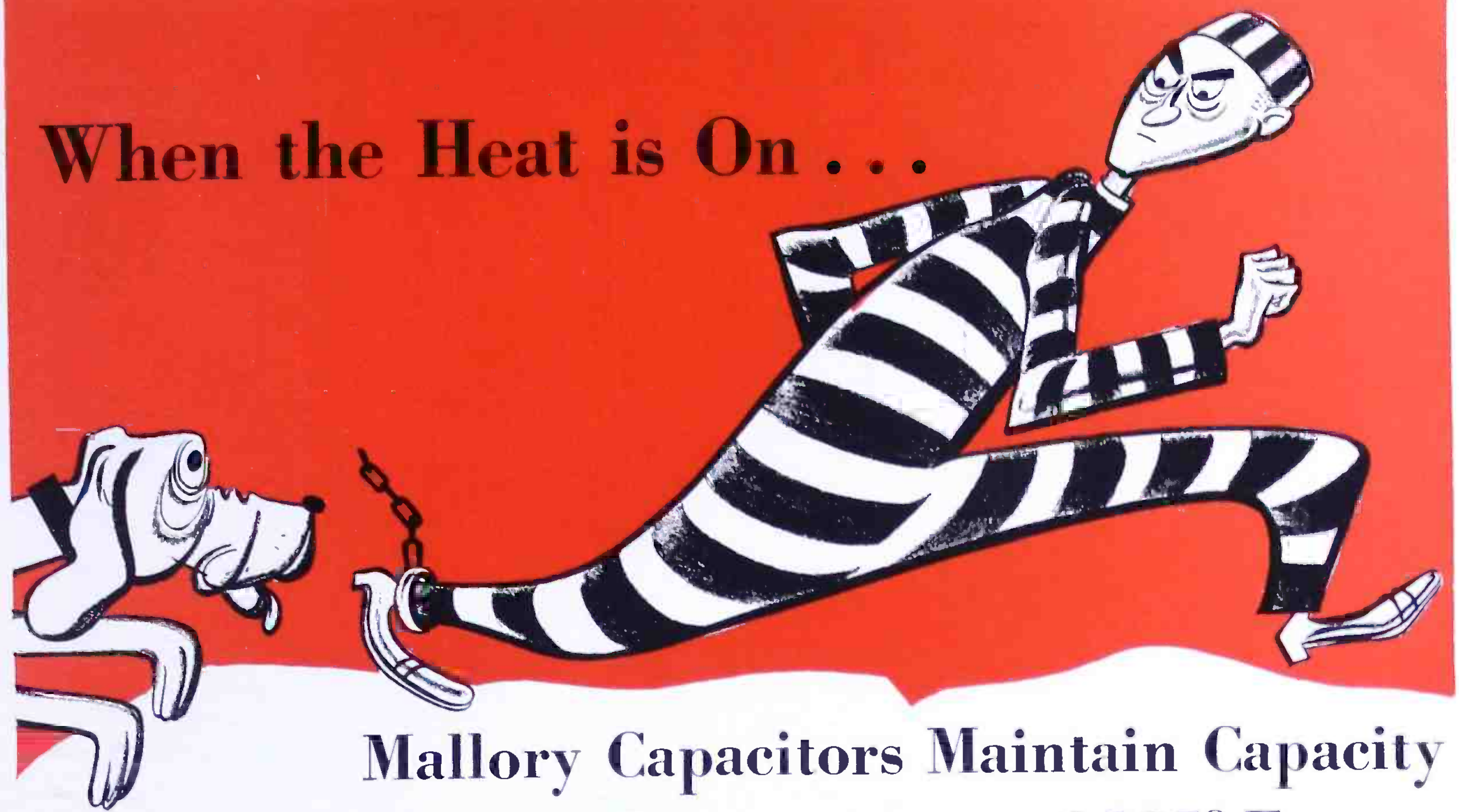

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