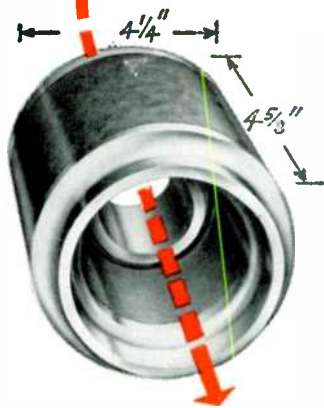




# Largest **MYCALEX** Part Ever Molded



This cross section of a MYCALEX-to-metal molded component part was made for one of the country's leading manufacturers, and is the result of close cooperation between the customer's and our own engineering staffs. It exemplifies a new development in the molding of MYCALEX 410 with metal to form a hermetic seal.

The objective was to take advantage of the low loss factor and other desirable properties of MYCALEX 410 to produce a rugged bushing assembly in a single molding operation.

A difficulty was presented by the extremely long and branched path which the MYCALEX 410 had to follow. Total charge of MYCALEX 410 was 7 pounds, while the metal weighed 6 pounds to make a total weight of 13 pounds.

The MYCALEX and metal were sealed into one closely-bonded integral part, held to extremely close dimensional tolerances.

For more than 27 years MYCALEX has met and surpassed the most exacting needs engineers have been able to devise from year to year. MYCALEX 410, together with our highly perfected methods of molding it, is the greatest advancement in this high frequency low loss insulation to date.

Our technical staff is at your service. What is your problem in low loss insulation?



## MYCALEX CORPORATION OF AMERICA

"Owners of 'MYCALEX' Patents"

Plant and General Offices, CLIFTON, N. J.

Executive Offices, 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.



## THE NC-2-40D

• • • WITH AMATEUR BAND COVERAGE

Every feature the amateur needs is found in the superb NC-2-40D receiver. Special expanded coil ranges for the 10, 20, 40 and 80 meter bands are included in addition to general coverage from 490 Kc. to 30 Mc. Each amateur band is spread over 80% of the dial range and the full vision dial shows your location in the band at a glance. Stability and sensitivity are outstanding. A wide range crystal filter gives optimum selectivity under all conditions. The series-valve noise limiter, the AVC, beat oscillator, tone control and S-meter are among the many auxiliary circuits that contribute toward the all-around excellence of the NC-2-40D. See it at your dealer's.



NATIONAL COMPANY, INC., MALDEN, MASSACHUSETTS

# New FM FREQUENCY MONITORS

*for the new 88-108 mc.  
and 152-162 mc. Bands*

FOR THE  
**BROADCAST**  
88-108 mc.

AND  
**EMERGENCY  
SERVICES**  
152-162 mc.



DIRECT READING

*New Members of  
the famous Monitor Line  
by Doolittle*

## MEET FCC REQUIREMENTS

Now it is possible for you to check the new frequencies with utmost speed, ease and precision. These new FM Frequency Monitors meet the FCC requirements for the new 88-108 mc. Broadcast and 152-162 mc. Emergency Service bands. No charts or complicated adjustments are needed—*reading is direct*. Many other DOOLITTLE features assure consistent accuracy and rugged, long life. Write, wire, or phone RADcliffe 4100 for full information.

*Doolittle*  
**RADIO, INC.**

*Builders of Precision Communication Equipment*

7421 SOUTH LOOMIS BLVD., CHICAGO 36, ILLINOIS



# AND TELEVISION

FORMERLY: FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 6

JULY, 1946

NO. 7

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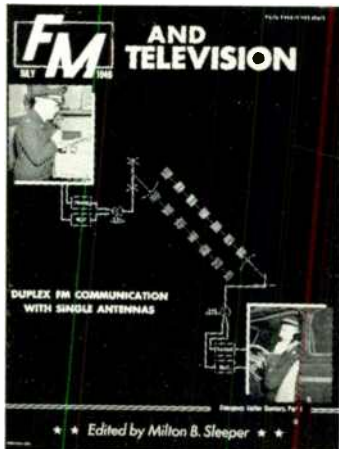
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Chicago: MARIAN FLEISCHMAN, 360 N. Michigan Ave., Tel. STAtE 4822

Pasadena: MILO D. PUGH, 35 S. Raymond Ave., Pasadena 1, Calif. Tel. MadisOn 6272

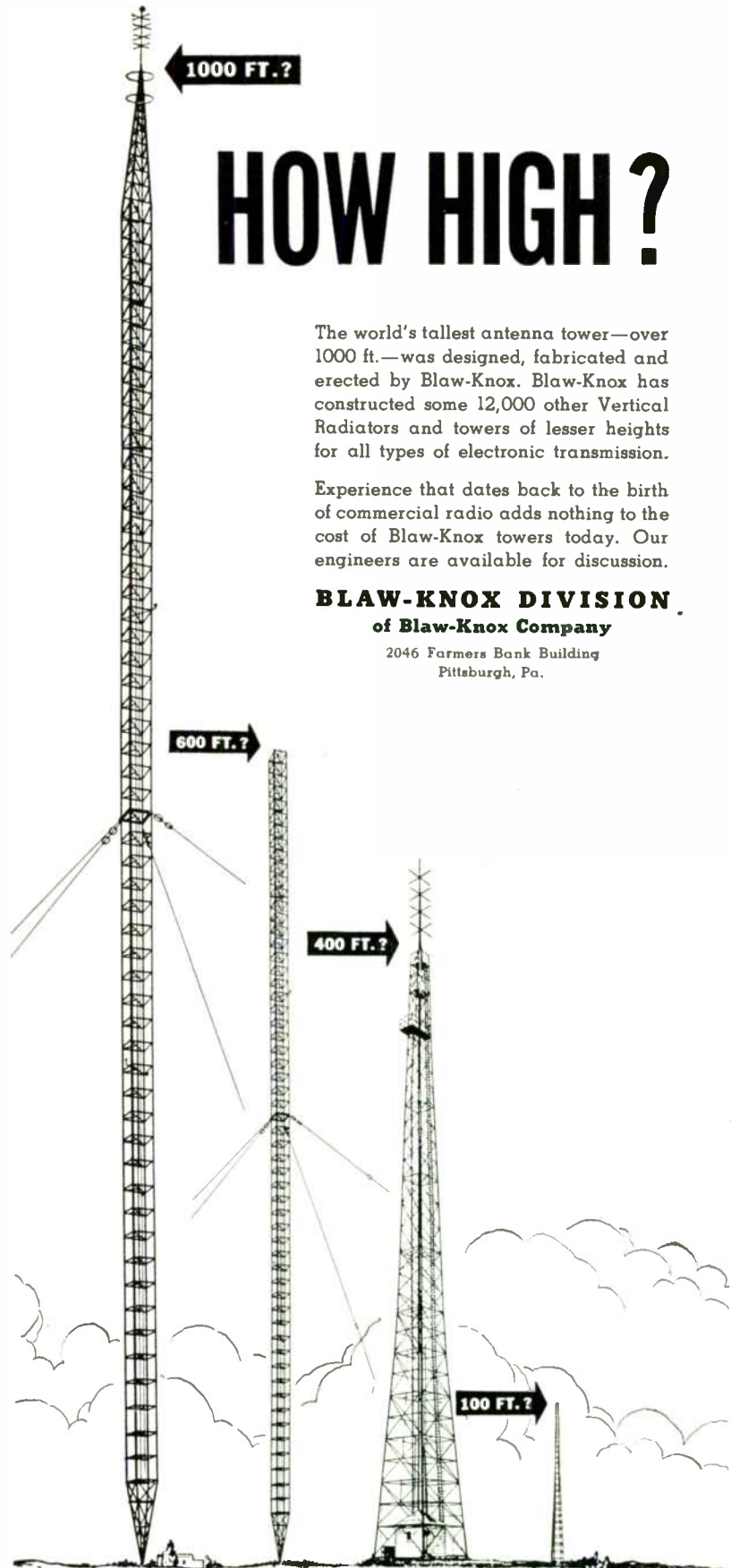
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Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit. Payments are made upon acceptance of final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



### THIS MONTH'S COVER

Up to now, the wire telephone has had one advantage over the radio telephone. With the former, it isn't necessary to use the push-to-talk, one-way-at-a-time switch which radio requires. However, this radio problem will be licked. This month's cover shows a system demonstrated by Federal Telephone & Radio for the Philadelphia police, using 8,000-cycle vacuum tube switch to connect antenna to transmitter and receiver alternately. Supt. Thomas P. Burns, above, and Capt. Charles W. News, below, were surprised that switching was inaudible. In this case, only car had duplex operation, but ultimate intention is to use duplex both ways.



1000 FT. ?

# HOW HIGH ?

The world's tallest antenna tower—over 1000 ft.—was designed, fabricated and erected by Blaw-Knox. Blaw-Knox has constructed some 12,000 other Vertical Radiators and towers of lesser heights for all types of electronic transmission.

Experience that dates back to the birth of commercial radio adds nothing to the cost of Blaw-Knox towers today. Our engineers are available for discussion.

### BLAW-KNOX DIVISION of Blaw-Knox Company

2046 Farmers Bank Building  
Pittsburgh, Pa.

600 FT. ?

400 FT. ?

100 FT. ?

# BLAW-KNOX ANTENNA TOWERS

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.



# WHAT'S NEW THIS MONTH

## OBSERVATIONS FROM THE SIDELINES

IT'S hard to believe that just a year ago we took part in the magazine publishers' bond drive, and had a war bond picture on our front cover. It's equally difficult to realize that nearly a year has passed since the Porter pronouncement that 10-kw. upper-band FM transmitters would be "immediately available."

These two events are significant to recall at this time because they represent important factors in the apparent state of confusion which exists in the radio industry — contrasting sharply with the actual progress that has been made since VJ-Day.

Watching from the sidelines, two things are clear:

Technical progress of twenty normal years, which would have been assimilated step by step, was crowded into the war period. But that progress was withheld from civilian use.

Then, following VJ-Day, it was suddenly released for peacetime applications, as if by the bursting of a dam, at the very time when radio manufacturers were swamped by the multitudinous problems of reconversion. Thus, the industry has had to devote the past ten months to catching up with itself, and restoring a state of balanced activity.

Paul Porter did not realize that the miracles of engineering and production achieved during the war, and paid for by Government-collected taxes, could not be continued in peace. Then, the job came first, and the price was figured later. Now, industry has to pay its own way. Let's take a quick look at what is going on:

**Manufacturing** ★ The only AM designs available for home radio set production are what was left of the cheap AM models of pre-Pearl Harbor vintage. Translated into components at war's-end price levels, the old \$14.95 designs added up to \$29.90 or \$34.50, and that without adding the super-duper features which had been promised in glowing generalities while civilian production was stopped.

FM sets, which had begun to sprout profits just when AM sales had reached the level of dollar-swapping, could not be put into production again because the old 8-mc. tuning band had been widened to 20 mc., and had been moved up to new frequencies which presented entirely new design problems.

At this time of writing, present and

(CONTINUED ON PAGE 33)

## Transformers

*designed with*

**STANDARDIZED** *basic mountings*

*to fit the customer's*

**SPECIALIZED** *requirements*

To achieve economy and speed of production in meeting customers' transformer requirements, Chicago Transformer manufactures and stocks a wide range of sizes in vertical shields and drawn steel cases, which are standardized in construction and appearance, yet are readily adaptable to a variety of special applications. For details on how transformers using these mounting parts will benefit your new product plans, consult Chicago Transformer's sales and engineering staffs.



# CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

3501 ADDISON STREET · CHICAGO, ILL.

## "THIS PIONEERING EFFORT..."

*"The Chicago and North Western Railroad, always interested in technological developments which promise improvement in the efficiency and safety of railway operations, participated in the first regular use of very high frequency railway radio. This installation went into operation in our Proviso Yards in September, 1940, and continued for over a year thereafter.*

*We are happy that the technical and operating information secured from this pioneering effort was subsequently useful to the Army Ordnance Department and to the operators of the large Army Ordnance Plants in making their decision to use railroad radio in connection with the war effort.*

*The case histories provided by the use of radio at Proviso and in the large ordnance plants were later to become an important part of the railroad testimony in the Federal Communications Commission hearing which brought about the present allocation of frequencies for railway use."*



PRESIDENT,  
Chicago and North Western  
Railway System



**W**hen the Chicago and North Western Railway conducted its Proviso Yards pioneering of high frequency radio for communications purposes, some of the present members of the Farnsworth Mobile Communications Division assisted in a technical capacity. These individuals, too, were largely responsible for the Army Ordnance Department's first use of radio in railway operations.

These events occurred more than five years ago, long before the Federal Communications Commission's recent allocation of frequencies for railway use—and at a time when the future of railroad radio was fraught

with doubt, and only one organization was pressing for recognition of the railroads' right to frequencies.

Today, the results of almost a decade of pioneering effort and engineering appear in the new Farnsworth 152-162 megacycle railroad radio equipment—*systematized equipment designed to guarantee maximum availability and flexibility with simplified, low-cost maintenance*—equipment meeting all of the presently-established requirements of the Federal Communications Commission and the Interstate Commerce Commission. Farnsworth Television & Radio Corporation, Dept. FM-7, Fort Wayne 1, Indiana.

# FARNSWORTH TELEVISION & RADIO CORPORATION

Farnsworth Radio and Television Receivers and Transmitters • Aircraft Radio Equipment • Farnsworth Television Tubes • Halstead Mobile Communications and Traffic Control Systems for Rail and Highway • the Farnsworth Phonograph-Radio • the Capehart • the Panamuse by Capehart

July 1946 — formerly FM, and FM RADIO-ELECTRONICS

5

NEW  
**DI-FAN**  
RECEIVING ANTENNA



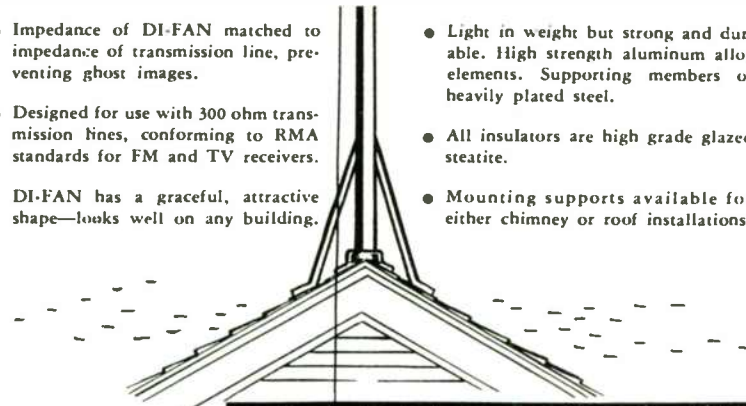
...covers ALL  
television and  
FM frequencies

THE Andrew Co., pioneer specialist in the manufacture of a complete line of antenna equipment, continues its forward pace with the introduction of this new DI-FAN receiving antenna.

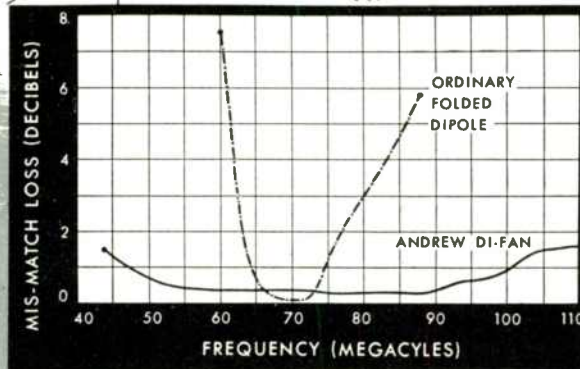
The DI-FAN antenna provides excellent reception on *all* television and FM channels. It thus supersedes ordinary dipole antennas or dipole-reflector arrays which work well over only one or two television channels.

In addition, the following advanced features will recommend the DI-FAN to dealers and receiver manufacturers who want the best possible antenna for use with their FM and TV receivers:

- Impedance of DI-FAN matched to impedance of transmission line, preventing ghost images.
- Designed for use with 300 ohm transmission lines, conforming to RMA standards for FM and TV receivers.
- DI-FAN has a graceful, attractive shape—looks well on any building.
- Light in weight but strong and durable. High strength aluminum alloy elements. Supporting members of heavily plated steel.
- All insulators are high grade glazed stearite.
- Mounting supports available for either chimney or roof installations.



**ANDREW**  
**CO.**  
363 E. 75th St.  
Chicago 19, Ill.



This graph illustrates the superiority of the Andrew DI-FAN over an ordinary folded dipole.

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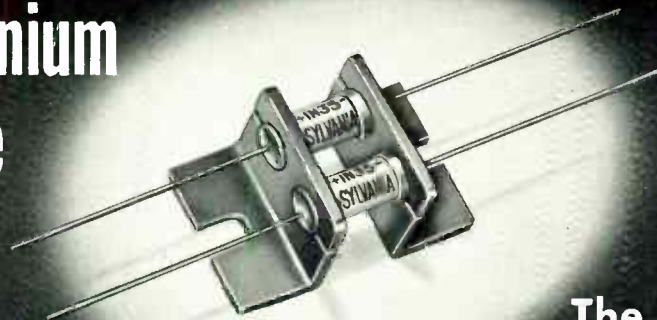
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# Now...a Germanium Crystal Duo-diode



**The Sylvania  
1N35  
(SHOWN ACTUAL SIZE)**

**THE 1N35  
CONSISTS OF TWO MATCHED  
INTEGRALLY MOUNTED CRYSTAL DIODES.**  
The 1N35 is a precision circuit element,  
accurately adjusted, ruggedly constructed.

Germanium crystal is cut from 0.6 mm. sheet, optically ground smooth on one side, and silver-soldered to tip of brass screw.

Whisker is formed from tungsten wire 75 microns in diameter, and soldered to screw. Loop provides spring pressure.

Whisker is adjusted for correct forward and back resistance. Isolantite cartridge is wax-filled to maintain correct adjustment and render moisture-proof.

Pigtails are silver-soldered to precision-formed contact cups, and cups are welded over end caps.

### CONSTRUCTION DETAILS OF THE 1N35

The 1N35 Duo-diode, a new circuit element developed by Sylvania Electric, consists of two Germanium Crystal Diodes mounted in a single assembly that facilitates mounting.

The two crystal diodes are matched for values of forward and back resistance, under conditions typical of those anticipated in actual use. In addition, the 1N35 is tested for R.F. loading on a tuned circuit.

The 1N35 is valuable wherever full-wave rectification, modulation or demodulation is required in a balanced circuit. Potential applications include FM discriminators, bridge rectifiers, ring modulators, demodulators, and variators.

### TENTATIVE SPECIFICATIONS

Each diode used in the 1N35 has the following tentative characteristics:

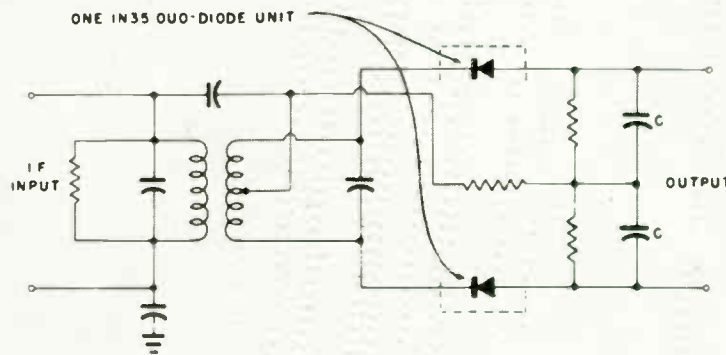
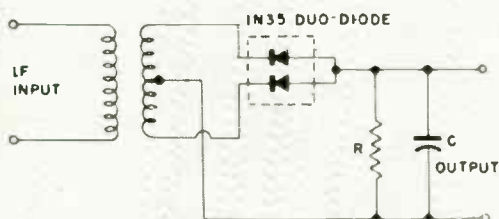
Peak Inverse Anode Voltage	50 volts
Peak Anode Current (sine wave)	60 ma max.
Average Anode Current	22.5 ma max.
Surge Current (transient peak)	200 ma max.
Back Conduction at 50 volts	2 ma max.
Operating Frequency Range	0-100 mc

Inquiries are invited concerning applications of the 1N35.

### TYPICAL CIRCUITS

RIGHT — The 1N35 in frequency discriminator circuit.

BELOW — Full wave rectifier second detector circuit.



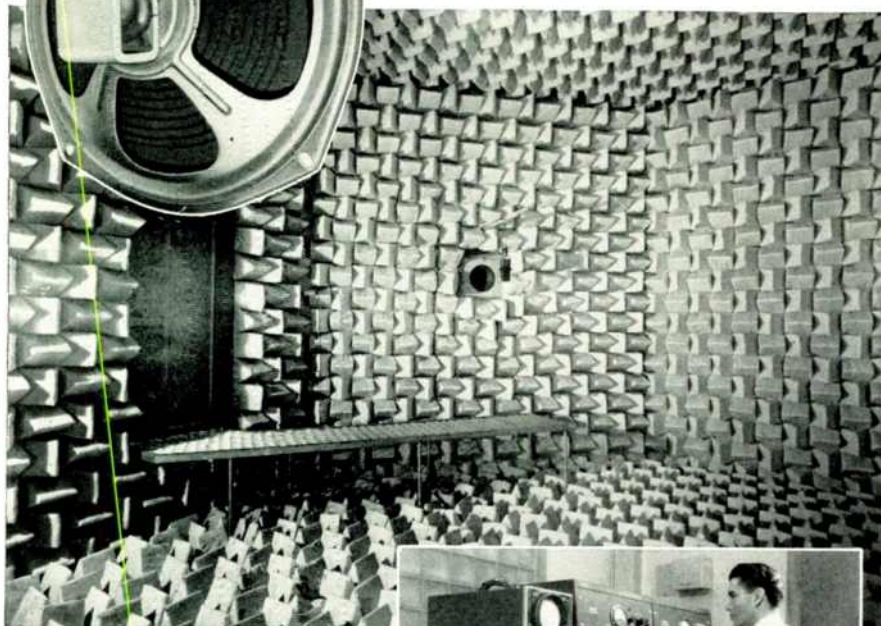
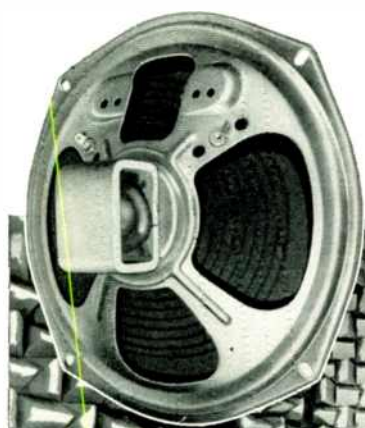
# SYLVANIA ELECTRIC

Electronics Division . . . 500 Fifth Avenue, New York 18, N. Y.

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

July 1946 — formerly FM, and FM RADIO-ELECTRONICS

## The Difference Between "We Think So" and "We KNOW So"



*Permoflux  
Speakers*



### ...are Engineered for Application in this Stalactite Acoustical Chamber

In this completely soundproof room, asymmetrical walls and carefully designed mass-interval baffles effectively reduce troublesome resonant harmonics and reflected sound to an insignificant value. Response curves are plotted which represent true performances so that Permoflux engineers can say "We Know So." Its use at Permoflux is characteristic of the many factors which make it possible to substantiate the fact that Permoflux Speakers provide the finest possible sound reproduction.

TRADE MARK  
**PERMOFLUX**  
PERMOFLUX CORPORATION  
4900 WEST GRAND AVE., CHICAGO 39, ILL.



PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

# ENGINEERING SALES

**RCA:** Only RCA distributors and dealers were admitted to the showing of RCA FM-AM receivers during Chicago convention of the National Association of Music Merchants.

**Westinghouse:** Sales of Westinghouse Broadcast station equipment in the southeastern district will be handled by C. C. Smith, formerly of the Baltimore staff. He will make his headquarters in Atlanta.

**Radio Cruise:** First postwar radio cruise is being organized by D. W. May, 250 Fulton Street, New York, distributors for Farnsworth, Wilcox-Gay, Ken-Rad, and several appliance manufacturers. Winnie May was the originator of this method of extracting commitments from dealers. Trip starts September 28th.

**Electronic Labs:** New representatives are Ronald Bowen, 1886 S. Humboldt Street, Denver, for Rocky Mountain States; J. E. Joyner, of James Millar Associates, now opening offices in Asheville, for the southeastern seaboard; and B. G. Twyman, operating from 6406 N. Fairfield Avenue, Chicago, for St. Louis and eastern Missouri. New offices opened by A. V. Rodman will handle Electronic Laboratories' products in Seattle and Portland.

**Harry Boyd Brown:** Has resigned as Philco's merchandising manager to take over the presidency of the Good House chain of retail stores handling appliances in the Philadelphia area. His headquarters will be at 18 W. Cheltenham Avenue, Philadelphia.

**ERA:** Engineering Research Associates, Inc., comprising some 50 scientists and engineering specialists, have established laboratory facilities in St. Paul, while the Washington offices at 827 14th Street N.W., will handle a consulting practice for AM and FM broadcast and communications stations.

**Schenectady:** New advertising by FM station WBCA features the warning: "If you buy a new radio without FM, you'll obviously have an obsolete radio." Result is that Stromberg, Scott, and Zenith FM sets are moving out at full list prices as fast as dealers get them in.

**TCI:** Technology Instrument Corporation, Waltham, Mass., will be represented in the Chicago area by Ralph P. Glover, 1024 Superior Street, Oak Park, Ill.

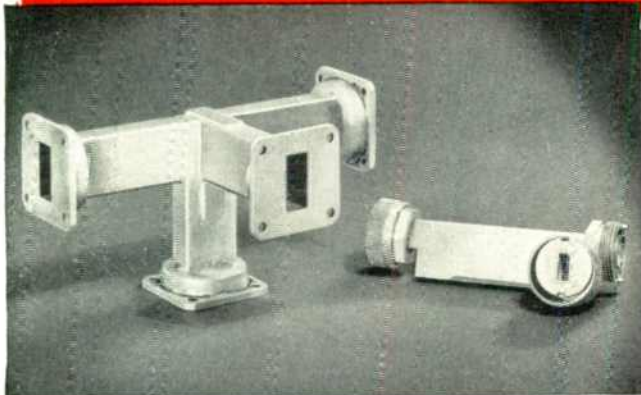
FM AND TELEVISION

# An extensive line of A.R.C. radio and electronic components

Precision Built to Aircraft Standards

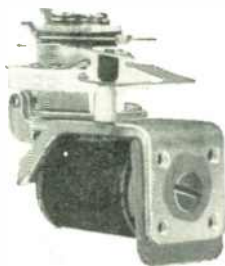


Since 1928 the Aircraft Radio Corporation has devoted its engineering and production facilities to the design and manufacture of high-quality radio equipment for aircraft use. Components similar to those listed here proved their worth in the A.R.C. receivers and transmitters used in nearly all military aircraft during the war.



ARC "Magic Tee" and Microwave Coupler

**MICROWAVE PLUMBING AND ACCESSORIES** — A complete line of Microwave Plumbing and Accessories, engineered to A.R.C. precision standards, is now available. With the increasing emphasis on microwave transmission in modern aircraft navigation and control, A.R.C. has pioneered in the design of equipment for this type of operation. Typical of A.R.C. Microwave Accessories are the "Magic Tee" and Directional Coupler illustrated. Other items, such as the 24,000 megacycle attenuator, use the unique "split plate" construction developed by A.R.C.



Miniaturized D.C.  
Relay by ARC



Precision Built "Music  
Box" Type Switch

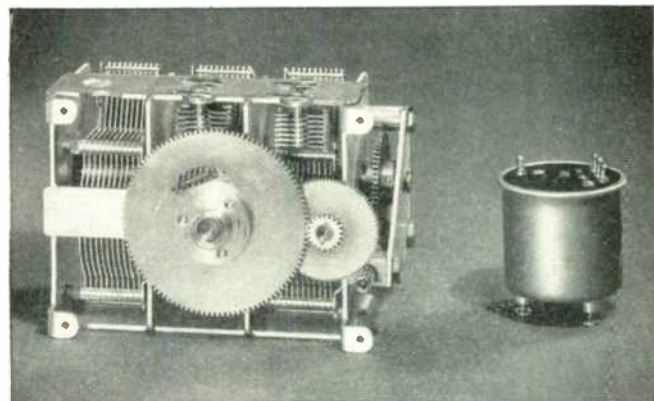
**RELAYS AND SWITCHES** — Compact, lightweight relays designed by A.R.C. have had years of use under the extreme conditions of vibration, humidity and temperature encountered in military aircraft operation. Available in several types and sizes, they meet rigid requirements for reliability and specified performance.

A.R.C. Precision-built Switches are made in Drum-Type, "Music-Box" Type, and special Toggle and Push Types, and are available in various contact combinations. All are designed to stand up under the hardest usage, and are manufactured to the highest standards of the aviation industry.



ARC Multi-contact Connector with Ceramic Inserts

**MULTI-CONTACT CONNECTORS WITH CERAMIC INSERTS** — A.R.C. has developed a line of Ceramic-insulated Multi-Contact Plugs and Receptacles to combat carbon-tracking due to flashover. Floating, self-aligning female contacts and replaceable pin-plugs mean ease of maintenance and assembly as well as efficient service. Completely interchangeable with A.R.C. Bakelite insulated Plugs and Receptacles, the Ceramic type is provided in all types and sizes for use with shielded or unshielded cable, or with open wiring.



ARC Variable Air Condenser and Sealed, Oil Paper Type

**CONDENSERS — VARIABLE, ADJUSTABLE, AND SEALED** — Variable and adjustable air condensers by A.R.C., designed for use in both receivers and transmitters, are available in both single and multiple sections. Features of this equipment include the use of forked springs to provide positive grounding of rotor shafts, a special glass-ball method of stator support which keeps dielectric losses to a minimum, and cadmium plating of rotor and stator assemblies.

A complete line of Sealed Oil Paper and Dry Electrolytic Condensers have been designed by A.R.C. in both cylindrical and rectangular types, sealed in cadmium-plated brass cans. Minimum leakage path to ground is approximately 1/16th inch, good for a breakdown test of 2000 volts D.C.

Sealed Chokes and Transformers are also available in the cylindrical design.

For complete Parts Catalog, or specific information, write

## AIRCRAFT RADIO CORPORATION

BOONTON, NEW JERSEY



# Why

## THIS

## TEAM IS



**1920** Loop antenna for 400-500 meter ship-to-shore radio telephone receivers. Its design enabled earliest measurements of field strength.



**1929** Curtain antennas developed for beaming short-wave radio telephone messages to Europe and South America ... improved commercial service.



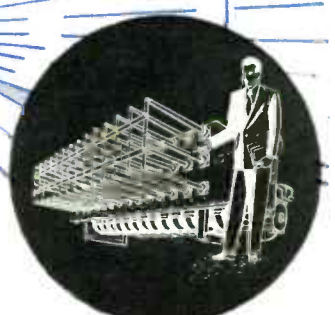
**1930** Half-wave vertical radiator, now in general use, was developed into practical form. It greatly improved signal output of broadcast stations.



**1934** One of the first directional antenna arrays for broadcasting. Designed for WOR to concentrate signals in service area, eliminate radiation over ocean.

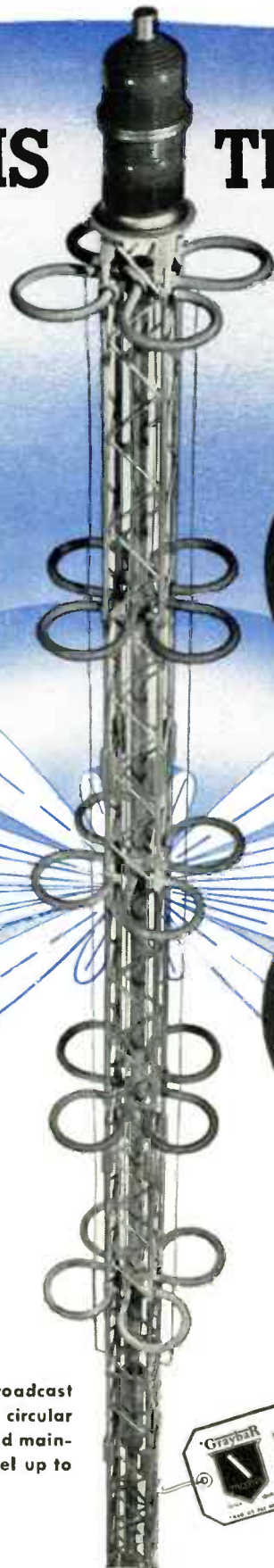


**1938** Coaxial antenna for ultra high frequency communications, designed by Bell Laboratories, gave increased signal strength. Widely used in police radio systems.



**1941** Palyrod radar antenna was an important war contribution ... helped sink many Jap ships. Its exceptionally narrow beam and rapid scanning gave high accuracy to big Navy guns.

**1946** New 54A CLOVER-LEAF FM broadcast antenna has high efficiency and a circular azimuth pattern; is simple to install and maintain. May be used for any power level up to and including 50 KW.



# Up

## ON ANTENNAS

As pioneers and leaders in radio, Bell Telephone Laboratories and Western Electric have been vitally concerned with the development of improved antennas for more than 30 years.

From the long-wave days of radio's youth, right through to today with its microwaves, this team has been responsible for much of the progress in antenna design.

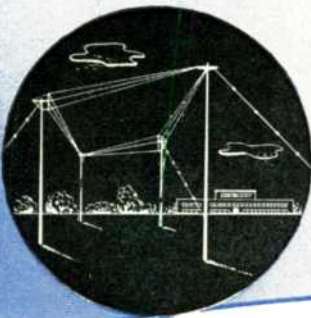
### *Progress based on Research*

Following their long-established method of attack, Bell Laboratories scientists are continually *observing, investigating and measuring* the action of radio waves in space. Their research has covered wave lengths ranging from hundreds of meters to a fraction of a centimeter. In over a quarter-century of intensive study, they have learned how radio waves behave, day and night, under all sorts of weather conditions.

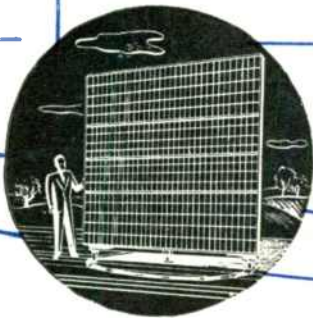
Out of this fundamental research have come such outstanding developments as the rhombic antenna, *musa* antenna, vertical half-wave radiator, curtain antenna, directional array, the polyrod and other improved radar antennas, the metal lens for microwaves and the new CLOVER-LEAF antenna for FM broadcasting.

### *What this means to YOU*

Whether you are interested in AM or FM—equipment for broadcasting, point-to-point, aviation, mobile or marine use—here's the thing to remember. Every item of radio apparatus designed by Bell Laboratories and made by Western Electric is backed by just such thorough scientific research as has been given to antennas. It's designed right and made right to give you years of high quality, efficient, trouble-free service.



**1930** Rhombic (diamond-shaped) antenna for 14-60 meters. It covers wide frequency range without adjustment. Still standard for this band.



**1944** Metal lenses, another Bell Laboratories development, focus microwaves like light. One type has a beam width of only  $0.1^\circ$ —or less than that of a big searchlight.



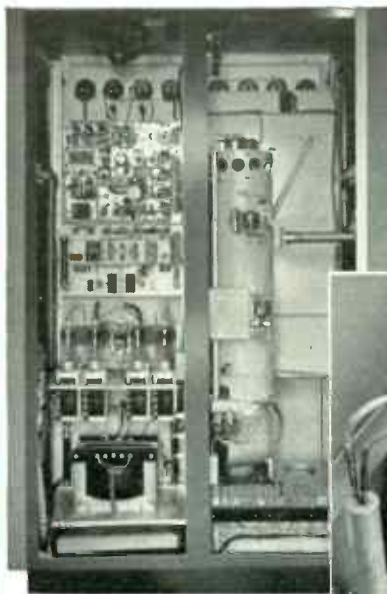
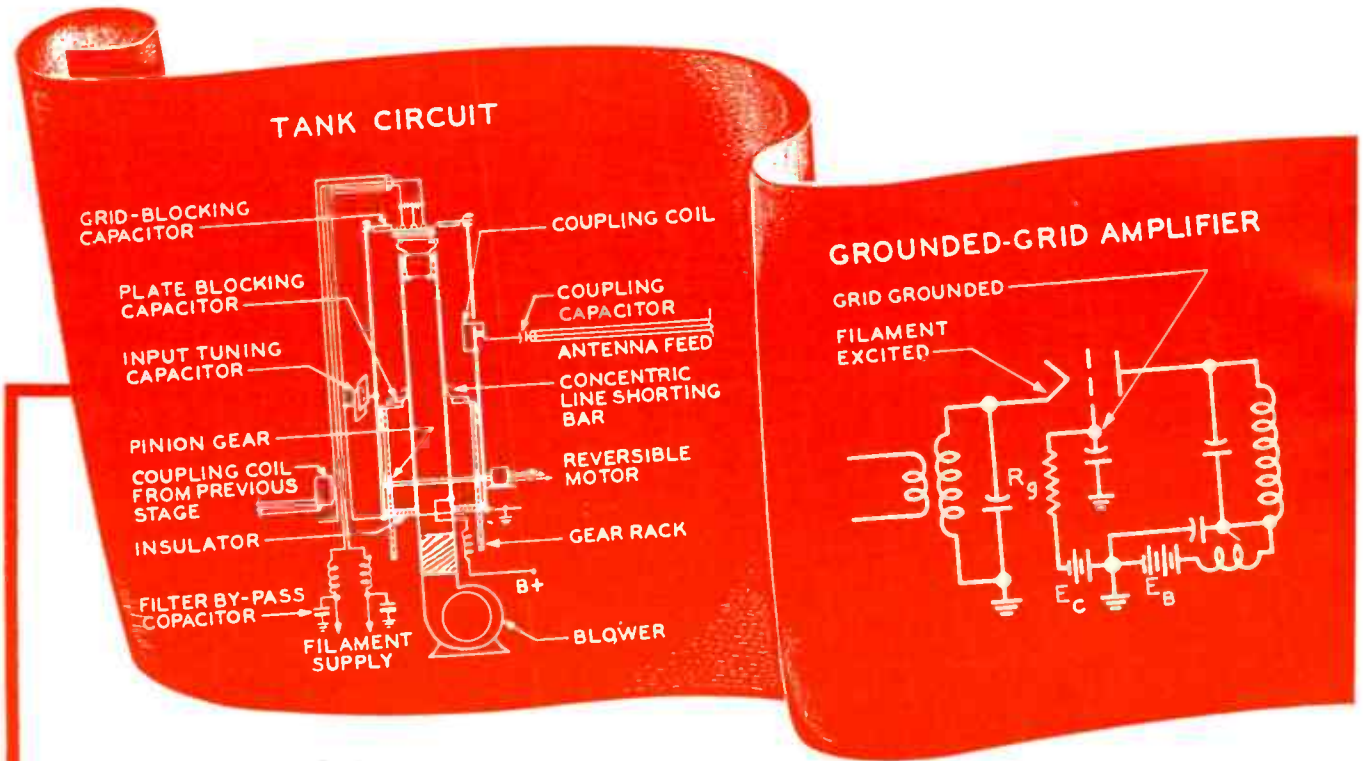
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World's largest organization devoted exclusively to research and development in all phases of electrical communications.

## Western Electric

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

# GROUNDING GRID



**Amplifier tank assembly** (right half of unit at left)—Visible are outer conductor of concentric-line plate tank, cathode transmission line at left, and motors to adjust cathode line, plate tank, and output coupling loop. Close-up below shows the RCA-7C24 in position, grid and filament connections, and air scoop to cool tube seals.

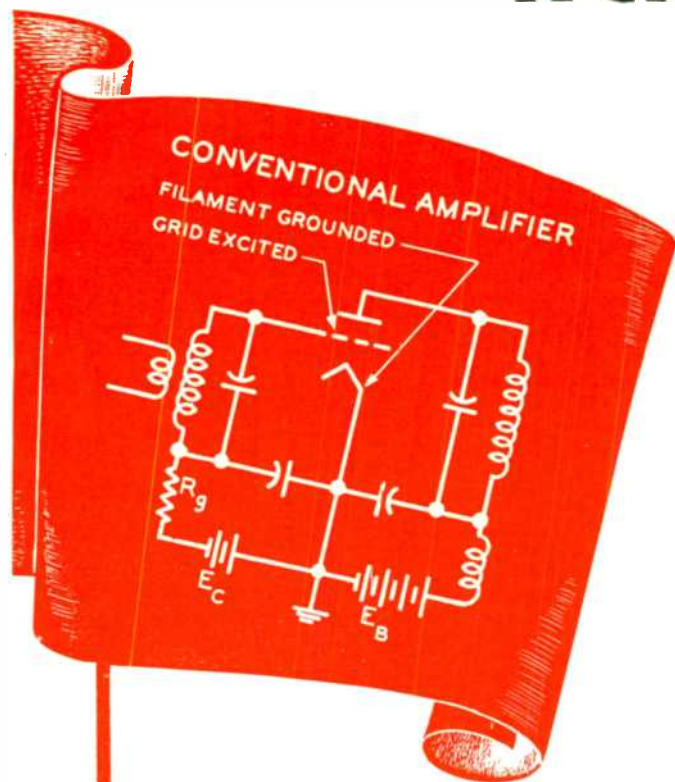


**Tube and grid-clamp assembly**—The new RCA-7C24 (top) is a forced-air-cooled triode especially developed for Grounded-Grid circuits. (Plate dissipation: 2 kw at frequencies up to 110 mc; power output: 4 kw at 110 mc, class C service.) The flange ring at the top of glass envelope is the grid terminal. The grid support is conical in shape and extends well into the tube to provide complete shielding between filament and plate circuits. The circular grid clamp (right) is used to make connection to the disk-seal flange of the grid. With the tube and grid clamp in position (above, left), plate and filament circuits are effectively isolated and a direct, low-inductance path is provided to the grid. No neutralization is needed.

# for greatest stability

... adds these *plus values* to the new

## RCA FM TRANSMITTERS



THE NEW RCA Grounded-Grid amplifier circuits are at once simpler and more stable than any heretofore used. As the name indicates, the grid of the tube is at r-f ground potential (instead of the filament as in conventional amplifiers). Input is applied to grid and filament and output is taken from plate and grid.

Using specially developed triodes (RCA-7C24's), RCA Grounded-Grid circuits are distinguished, principally, by these characteristics:

1. The possibility of self-oscillation has been reduced. Neutralization is seldom required.
2. The driver tube and output tube act in series to supply the load, greatly increasing the over-all efficiency when compared with conventional amplifiers.

- ✓ No neutralization required for low-power transmitter ratings and an easy matter if ever required on high-power units.
- ✓ Simpler circuits with fewer components than conventional amplifiers. Tune easier, introduce less distortion, and assure better program quality.
- ✓ Stability and lack of critical adjustment not previously obtained in 100-mc transmitters.
- ✓ Easier to increase power. You only have to buy the *additional* power required (i.e. a 250-watt transmitter plus a 750-watt amplifier equals a 1000-watt transmitter)—more efficient than adding a 1000-watt unit as is the case with conventional amplifiers.
- ✓ Smaller, less expensive tube types are required since greater output is obtained from the amplifier using a tube of a given size.
- ✓ Fewer spare tubes needed inasmuch as the same tube types are used in the driver and power amplifier of the 1-kw and 3-kw stages.

3. Driving power required in Grounded-Grid circuits is higher than that in conventional amplifier circuits. But this power is not lost—it is merely transferred to the plate circuit and appears as output.
4. Lower output capacitance (approximately 16 mmfd  $C_{GP}$  as contrasted with more than twice this value in capacitance-neutralized amplifiers)—important to assure wide r-f bandwidth and low circulating kva in output circuits.

Add to these advantages the benefits derived from our "Direct FM" exciter circuit, and you will see why we believe an RCA FM Transmitter will mean money in your pocket and true "FM quality." Write Dept. 35-G, Broadcast Equipment Section, Radio Corporation of America, Camden, N. J.



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**RADIO CORPORATION of AMERICA**  
**ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N. J.**

In Canada: RCA VICTOR Company Limited, Montreal

**SOUND EQUIPMENT—precisionized—mechanically and electronically—for finer performance**

*"Alive"  
Response*



Unit 524  
Transcription  
Turntable



**without telltale rumble, noise or wows!**

When we say 'alive' response we mean uncannily 'alive'. You won't hear any signs of artificiality when you listen to the new Unit 524 Fairchild Transcription Turntable. It's completely new. The drive and turntable were designed especially for cabinet installation. They're not portable units set in a console. Study their heavy construction and you'll see why.

Turntable noise, rumble and vibration are practically non-existent because of the unique method of mounting the drive—at the bottom of the cabinet!

A specially designed rubber coupling connects the synchronous motor and drive which are spring-mounted and precision-aligned in a single heavy casting. Special mechanical filters on the hollow drive shaft reduce the transmission of vibration from the drive mechanism to the turntable which is mounted in a heavily webbed cast aluminum panel at the top of the cabinet.

'WOW'—free operation is assured by a carefully maintained evenness of speed. The motor has excellent starting and operating characteristics. The turn-

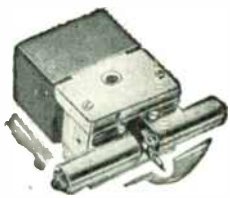
table is perfectly balanced with extra weight in the rim. The turntable clutch permits shifting from 33.3 to 78 rpm in operation and aids in smooth stopping, starting and exact cueing of the record. And the standard broadcast height, solidly built cabinet permits easy operation, easy servicing.

Arrange to see the new Unit 524 Fairchild Transcription Turntable. Examine it closely. Listen to its 'alive' response critically. Address: 88-06 Van Wyck Boulevard, Jamaica 1, New York.

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EQUIPMENT**



**CAMERA AND INSTRUMENT CORPORATION**



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Write for complete information.



UNIT 542  
LATERAL DYNAMIC PICKUP



# MORE *POWER* FOR FM BROADCAST SYSTEMS!

with

## Federal's "Specialized" Triodes

1000 and 3000 Watts at

**88 to 108 MEGACYCLES**  
(MAXIMUM OUTPUT UP TO 150 MC)



7C 26

7C 27

THESE TWO high-performance power triodes have been especially designed in every detail, to provide the best possible combination of operating characteristics for FM transmitters.

Every feature—from electrical characteristics to the most minute detail of mechanical construction—has been "custom tailored" to meet the specific requirements of frequency-modulated transmission service up to 150 megacycles.

Highly efficient forced-air-cooling is assured by the use of pure copper anodes, joined to the cooling fins by a thin solder film of high thermal conductivity. Radial cooling fins provide large surface area and unrestricted airflow path. Federal's vast tube-making facilities, backed by 37 years of experience, give you real assurance of matchless performance, rugged dependability and maximum tube life.

### RATINGS FOR FM BROADCAST SYSTEMS IN THE 88 TO 108 MEGACYCLE BAND (MAXIMUM OUTPUT UP TO 150 MC)

	7C 26	7C 27
Maximum plate dissipation	1000 watts	3000 watts
Filament voltage	9.0 volts	16.0 volts
Filament current	29.0 amp.	28.5 amp
Amplification factor	17	21
Mutual conductance	20,000 Umhos	20,000 Umhos
Cooling air velocity at maximum output	.75 cu ft/min	150-175 cu ft/min
Maximum overall dimensions		
Height	4¼ in.	.8 in
Diameter	2½ in.	3½ in

"Federal tells how to make tubes last longer—"  
Write to Department K326 for this interesting and informative 20-page book which gives helpful hints on how to get the most out of your electronic tubes.



## Federal Telephone and Radio Corporation

In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal  
Export Distributor:—International Standard Electric Corporation

Newark 1, New Jersey



July 1946—formerly FM, and FM RADIO ELECTRONICS



# UTAH POLICE NOW ON THE *Motorola* PARTY LINE

FROM COAST TO COAST IT'S *Motorola*



Typical Motorola transmitting and receiving unit as installed for Miami Police Department.



A standard mobile transmitting and receiving unit in use by Michigan State Police.

HIGHWAY POLICE OF 34 STATES AND  
OVER 1000 COMMUNITIES NOW USE  
*Motorola* 2-WAY F-M RADIOTELEPHONE

● When the Utah Highway Patrol turned to Motorola F-M Radiotelephone, the total of states using Motorola equipment was raised to 34. From coast to coast and beyond, to Hawaii and the Canal Zone, Motorola is overwhelmingly the number one choice for emergency radio communications.

### THERE MUST BE A REASON!

**EASY TO OPERATE**—No technical knowledge of radio-electronics is necessary. Any police officer can use the Motorola Radiotelephone *without special training.*

**EFFICIENT**—The outstanding range and power of Motorola F-M Radiotelephone enables patrols to maintain contact at distances up to fifty miles.

**DEPENDABLE**—The Motorola Radiotelephone is made by the makers of the battle-famous "Handie Talkie" and "Walkie Talkie," your guarantee that your Motorola Radiotelephone will deliver *all* the time under *all* conditions.

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Motorola Radiotelephone has proved itself in thousands of difficult applications. Check with Motorola Engineers and let them show you how Motorola can solve your communications problem. Write today for specific recommendations—no obligation.



A California State Patrolman checks with the station via Motorola Radiotelephone.

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COMMUNICATIONS AND ELECTRONICS DIVISION

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## PLASTIC MOLDED PAPER TUBULAR CAPACITORS

**T**WENTY-THREE years ago Sangamo was first to announce the development of Molded Mica Capacitors. Today Sangamo scores again with another "First": New Paper Tubular Capacitors which are molded in a thermo-setting plastic. Molding in plastic means the same thing in paper tubulars as it does in micas—more stable capacity values. Other advantages of this new molded product are apparent at once: all moisture is permanently kept out—capacity values are sealed in. This means longer life; lower power factor; application at higher temperatures. The molded finish is smooth—less susceptible to catching dust. From a cost standpoint, too, comes good news: Sangamo Plastic Molded Paper Tubulars are priced only slightly higher than ordinary types. Use them in all circuits which call for paper tubular capacitors.



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• Write for new Capacitor Catalog

# SANGAMO

## ELECTRIC COMPANY

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# AND NOW—10 NEW **REL** 1 KW FM TRANSMITTERS IN OPERATION!

**The first  
eight:**

W2XMN (WFMN)—Alpine, N. J.

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WDRC-FM—Hartford, Conn.

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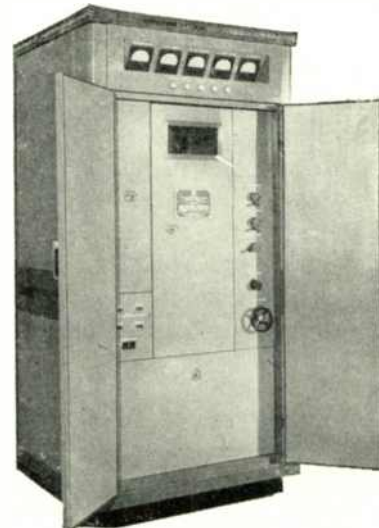
WMIT—Winston Salem, N. C.

**No. 9—**

To WIL (WILFM), owned and operated by the Missouri Broadcasting Company . . . on the air June 20th, 1946. First FM station in St. Louis.

**No. 10—**

To WRCM, owned and operated by Supreme Broadcasting Company. First FM station in New Orleans.



REL is now delivering FM Broadcast Equipment including Transmitters, FM Monitors, Speech Consoles, and a compact turnstile Antenna with Power Gain of 2. Consult us if you have any problems with delivery of your new FM Broadcast Equipment.

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**THE NEW**  
**S-38's**  
**4 Bands—540 kc. to 32 Mc.**

**\$39.50**  
 ADD 3%  
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The Model S-38 meets the demand for a truly competent communications receiver in the low price field. Styled in the post-war Hallicrafters pattern and incorporating many of the features found in more expensive models, the S-38 offers performance and appearance far above anything heretofore available in its class. Four tuning bands, CW pitch control adjustable from the front panel, automatic noise limiter, self-contained PM dynamic speaker and "Airodized" steel grille, all mark the S-38 as the new leader among inexpensive communications receivers.

**FEATURES**

1. Overall frequency range—540 kilocycles to 32 megacycles in 4 bands.  
 Band 1—540 to 1650 kc.  
 Band 2—1.65 to 5 Mc.  
 Band 3—5 to 14.5 Mc.  
 Band 4—13.5 to 32 Mc.  
 Adequate overlap is provided at the ends of all bands.
2. Main tuning dial accurately calibrated.
3. Separate electrical band spread dial.
4. Beat frequency oscillator, pitch adjustable from front panel.
5. AM/CW switch. Also turns on automatic volume control in AM position.
6. Standby/receive switch.
7. Automatic noise limiter.
8. Maximum audio output—1.6 watts.
9. Internal PM dynamic speaker mounted in top.
10. Controls arranged for maximum ease of operation.
11. 105-125 volt AC/DC operation. Resistor line cord for 210-250 volt operation available.
12. Speaker/phones switch.

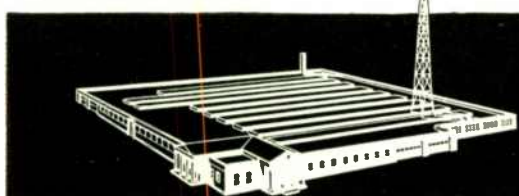
**CONTROLS:** SPEAKER/PHONES, AM/CW, NOISE LIMITER, TUNING, CW PITCH, BAND SELECTOR, VOLUME, BAND SPREAD, RECEIVE/STANDBY.

**EXTERNAL CONNECTIONS:** Antenna terminals for doublet or single wire antenna. Ground terminal. Tip jacks for headphones.

**PHYSICAL CHARACTERISTICS:** Housed in a sturdy steel cabinet. Speaker grille in top is of airodized steel. Chassis cadmium plated.

**SIX TUBES:** 1—12SA7 converter; 1—12SK7 IF amplifier; 1—12SQ7 second detector, AVC, first audio amplifier; 1—12SQ7 beat frequency oscillator, automatic noise limiter; 1—35L6GT second audio amplifier; 1—35Z5GT rectifier.

**OPERATING DATA:** The Model S-38 is designed to operate on 105-125 volts AC or DC. A special external resistance line cord can be supplied for operation on 210 to 250 volts AC or DC. Power consumption on 117 volts is 29 watts.



**hallicrafters RADIO**

THE HALLICTRAFTERS CO., MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

# EXPANSION OF COMMUNICATIONS ON 152-162 MC.

## An Up-to-Date Review of Developments in the Newest and Most Active Band

**WHATEVER** reconversion delays are being experienced by the rest of the radio industry, the field of mobile communications is pushing ahead with great speed. This is particularly true in the band from 152 to 162 mc. which, not more than a year ago, was regarded dubiously by most manufacturers and supervisors of communications systems. Now, applications for CP's on communications systems are literally swamping the FCC, and the largest number are for the 152- to 162-mc. band.

For the benefit of those planning to apply for CP's in this field, this review has been made up from the latest information released by the FCC. The accompanying table of frequency assignments was approved by the Commission on May 16th.

**Police and Fire** ★ The Commission has adopted the policy of permitting maximum utilization of 152- to 162-mc. band in accordance with their propagation characteristics. The frequencies in this band have proved excellent for distances of 15 to 20 miles, using relatively low power. Now that standard equipment is available for this band, all applicants for new municipal police and fire radio systems are being required to operate on frequencies between 152 and 162 mc. unless an adequate technical showing is made of the need to operate on some other frequency. This also applies to any applicant planning to replace an entire existing system or a major part of a system used for police or fire communications.

As the table of allocations shows, the police channels and fire channels are in solid blocks, but they are separated by two experimental channels of 154.49 and 154.57 mc. It should be noted that experimental channel indicated as 154.57 is 100 kc. wide, as it actually extends from 154.52 to 154.62 mc.

There is a growing conviction that all police departments in a state can operate on one frequency, except where objectionable interference might result between two large, adjacent cities. The Indiana Chapter of APCO advocates a universal 5-channel system that would operate in this manner:

Channel C-A — car talkback to station A  
Channel A-C — station A to cars  
Channel P-P — main station point-to-point  
Channel B-C — station B to cars  
Channel C-B — car talkback to station B

For car-to car transmission, the conventional 2-frequency transmitters would

be used, shifting from the normal talkback frequency to the main station frequency.

**General Mobile Service** ★ Three general uses of the urban and highway mobile frequencies are contemplated. They are:

1. Service by telephone companies to the general public at published rates, connecting persons in vehicles to telephone wire lines.
2. Cooperative service on a cost-sharing plan.
3. Individual user systems.

These services will include communications to pick-up and delivery trucks, doctors and nurses, armored cars, express trucks, oil trucks, taxicabs, highway buses and trucks, and boats on adjacent rivers and harbors.

In addition to the urban mobile channels in the band from 152 to 162 mc., there are others provided as follows:

- 12 Channels, 30 to 40 mc. Highway common carrier.
- 4 Channels, 30 to 40 mc. Highway trucks
- 4 Channels, 30 to 40 mc. Highway buses.
- 12 Channels, 40 to 42 mc. Highway common carrier.
- 4 Channels 40 to 42 mc. Highway trucks.
- 4 Channels 40 to 42 mc. Highway buses.

Up to this time, only experimental authorizations have been issued for urban and highway mobile service because, according to the FCC, insufficient data is available to formulate policies and technical plans. For example, it has not been determined whether frequencies will be made available finally for common carrier operation, non-common carrier operation, or both; whether restrictions will be put on the type of communications handled; what frequency stability will be required; and how licensees will maintain the required control over the equipment. During the period of experimental operation, these questions will be studied by the FCC.

In this connection, the Commission points out that fixed repeater, control, and relay stations used in conjunction with general mobile installations will operate at 940 mc. and higher.

Since no conclusions have been reached as to the final uses of the frequencies, the FCC cautions all applicants at this time that investments in connection with present temporary experimental operations will be made at the risk that the experimental frequencies may not be available when final assignments are determined. Further, the granting of an experimental authorization carries no assurance that the FCC will issue a license subsequently on a regular basis.

Detailed information on filing applications for construction permits can be obtained by addressing the Inspector-in-Charge, Federal Communications Commission, at the following field offices:

1. Customhouse, 7th Floor  
Boston 9, Massachusetts
2. 748 Federal Building  
641 Washington Street  
New York 14, N. Y.
3. Room 1200, New U. S. Customhouse  
2nd and Chestnut Streets  
Philadelphia 6, Pennsylvania
4. 508 Old Town Bank Building  
Gay Street and Falsway  
Baltimore 2, Maryland
5. Room 402, New Post Office Building  
Norfolk 10, Virginia
6. All Federal Annex  
Atlanta 3, Georgia
7. P.O. Box 150 (312 Federal Building)  
Miami 1, Florida
8. 400 Audubon Building  
New Orleans 16, Louisiana
9. 404 Post Office Building  
Galveston, Texas
10. P.O. Box 5238  
(500 U. S. Terminal Annex Building)  
Dallas, 2, Texas
11. 539 U. S. Post Office Building  
Temple and Spring Streets  
Los Angeles 12, California
12. 328 Customhouse  
San Francisco 26, California
13. 805 Terminal Sales Building  
Portland 5, Oregon
14. 808 Federal Office Building  
Seattle 4, Washington
15. 504 Customhouse  
Denver 2, Colorado
16. 208 Uptown Post Office Building  
St. Paul 2, Minnesota
17. 838 U. S. Court House  
Kansas City 6, Missouri
18. 246 U. S. Court House  
Chicago 4, Illinois
19. 1029 New Federal Building  
Detroit 26, Michigan
20. 328 Federal Building  
Buffalo 3, New York
21. 609 Stangenwald Building  
Honolulu 1, T. H.
22. P.O. Box 2987  
(322-323 Federal Building)  
San Juan 13, Puerto Rico
23. P.O. Box 1421  
(7-8 Shattuck Building)  
Juneau, Alaska

### SUB-OFFICES

- Address: Radio Inspector  
Federal Communications Commission  
6. P. O. Box 77  
(214-218 Post Office Building)  
Savannah, Georgia

## ASSIGNMENTS IN THE 152- TO 162-MC. BAND

As of May 16, 1946

FIRE—12 Channels	RELAY BROADCAST—12 Channels
MARINE—12 Channels	RELAY PRESS—4 Channels
POLICE—36 Channels	RAILROADS—60 Channels
POWER, PETROLEUM—6 Channels	URBAN—24 Channels
PROVISIONAL, EXPERIMENTAL—4 Channels	

<p><b>URBAN MOBILE</b></p> <p>152.03 152.09 152.15 152.21 152.27 152.33 152.39 152.45 152.51 152.57 152.63 152.69</p> <p><b>MARITIME MOBILE</b></p> <p>152.75 152.81 152.87</p> <p><b>RELAY PRESS<sup>1</sup></b></p> <p>152.93 152.99</p> <p><b>POWER, PETROLEUM</b></p> <p>153.05</p> <p><b>RELAY, BROADCAST<sup>2</sup></b></p> <p>153.11 153.17</p> <p><b>POWER, PETROLEUM</b></p> <p>153.23</p> <p><b>RELAY BROADCAST<sup>2</sup></b></p> <p>153.29 153.35</p> <p><b>POWER, PETROLEUM</b></p> <p>153.41</p> <p><b>RELAY BROADCAST<sup>2</sup></b></p> <p>153.47 153.53</p> <p><b>POWER, PETROLEUM</b></p> <p>153.59</p> <p><b>RELAY PRESS</b></p> <p>153.65 153.71 FIRE 153.77 153.83 153.89 153.95 154.01 154.07 154.13 154.19 154.25 154.31 154.37 154.43</p> <p><b>PROV. &amp; EXP.</b></p> <p>154.49 154.57</p>	<p><b>POLICE</b></p> <p>154.65 154.71 154.77 154.83 154.89 154.95 155.01 155.07 155.13 155.19 155.25 155.31 155.37 155.43 155.49 155.55 155.61 155.67 155.73 155.79 155.85 155.91 155.97 156.03 156.09 156.15 156.21 156.27 156.33 156.39 156.45 156.51 156.57 156.63 156.69 156.75</p> <p><b>POWER, PETROLEUM</b></p> <p>156.81</p> <p><b>RELAY BROADCAST<sup>2</sup></b></p> <p>156.87 156.93 156.99 157.05</p> <p><b>POWER, PETROLEUM</b></p> <p>157.11</p> <p><b>RELAY BROADCAST<sup>3</sup></b></p> <p>157.17 157.23</p> <p><b>URBAN MOBILE</b></p> <p>157.29 157.35 157.41 157.47 157.53 157.59 157.65 157.71 157.77 157.83 157.89 157.95</p> <p><b>MARINE MOBILE</b></p> <p>158.01 158.07 158.13</p>	<p><b>PROV. &amp; EXP.</b></p> <p>158.19</p> <p><b>MARINE MOBILE</b></p> <p>158.25</p> <p><b>PROV. &amp; EXP.</b></p> <p>158.31</p> <p><b>MARINE MOBILE</b></p> <p>158.37</p> <p><b>RAILROADS</b></p> <p>158.43 158.49 158.55 158.61 158.67 158.73 158.79 158.85 158.91 158.97 159.03 159.09 159.15 159.21 159.27 159.33 159.39 159.45 159.51 159.57 159.63 159.69 159.75 159.81 159.87 159.93 159.99 160.05 160.11 160.17 160.23 160.29 160.35 160.41 160.47 160.53 160.59 160.65 160.71 160.77 160.83 160.89 160.95 161.01 161.07 161.13 161.19 161.25 161.31 161.37 161.43 161.49 161.55 161.61 161.67 161.73 161.79 161.85 161.91 161.97</p>
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<sup>1</sup> Shared with Forestry-Conservation, Geophysical.

<sup>2</sup> Shared with Forestry-Conservation, Geophysical, Motion Picture.

7. 409-410 Post Office Building  
Tampa 2, Florida
9. P.O. Box 1527  
(329 Post Office Building)  
Beaumont, Texas
11. U.S. Customhouse Building  
Union and "F" Streets  
San Diego 1, California
19. 541 Old Post Office Building  
Cleveland 14, Ohio

**Operator's License** ★ FCC rules provide that persons holding a Restricted Radiotelephone Operator permit may operate highway mobile installations. Under some circumstances, they may be operated by unlicensed personnel. However, all adjustments and maintenance of equipment must be handled by or under the supervision of a supervisor holding at least a 2nd class operator's license. The supervisor need not be on the payroll of the licensee. He might, therefore, be an independent specialist in radio service work.

The examination for Restricted Radiotelephone Operator permit consists of answering 10 questions selected from a possible 62, dealing with the Federal laws relating to station operation, and FCC regulations. Study material for the examination is furnished in "Study Guide and Reference Material for Commercial Radio Operator Examinations" which can be obtained from the Government Printing Office, Washington 25, D. C. Send 15 cents in coin or money order, but do not send stamps!

Inquiries about taking the examination should be directed to the nearest FCC Field Office listed above.

### FIRST PHILCO FM SETS

Performance of Philco's new model 46-480 FM-AM console, listing at \$144, appears to be on a par with prewar models which started the Better Business Bureau on an investigation to determine if the Company was guilty of misrepresentation in describing their sets as "FM receivers."

Sensitivity is very low because no tuned RF amplification is provided, and there seems to be no effective limiter action to suppress static. The IF selectivity varies with the signal input, so that  $\pm 75$  kc. deviation requires a signal of at least 100 microvolts.

In 20 minutes after the set is turned on, the drift is about  $\pm 40$  kc. Then the circuits continue to drift  $\pm 10$  kc., causing so much distortion that the tuning must be readjusted from time to time.

Maximum undistorted output is 1 watt. Distortion becomes severe when the volume is turned up to 2 watts. The de-emphasis does not meet FCC standards.

Following is the tube list: 7F8 oscillator-mixer, 7H7 1st IF, 7H7 2nd IF, 6H6 ratio detector, 6SQ7 AM detector and 1st AF amplifier, 6V6 output, and 7Z4 rectifier.



# WWV SIGNALS FOR FREQUENCY MEASUREMENTS

## Methods of Making Frequency Measurements by Means of Standard Frequency Transmissions, and Data on the Use of a Newly-Developed Calibrator

BY ARTHUR FONG\*

AS THE USE of the radio spectrum moves to higher and higher frequencies, the degree of accuracy required of frequency measurements approaches that of primary standards. For example an error of .01% at 500 kc. amounts to only 50 cycles, or a small fraction of the 10,000-cycle broadcast channel. However, an error of .01% at 150 mc. is 15,000 cycles, or 50% of the total frequency swing of FM communications transmitters. Actually, FCC regulations require that transmitters in the band from 152 to 162 mc. must be maintained within .005% of their assigned frequencies.

In addition to setting transmitters within such close limits, accurate frequency measurements are essential to the study of frequency drift in FM broadcast and communications transmitters and receivers. There are also various uses for precision-calibrated oscillators at audio frequencies.

Since all secondary frequency standards are subject to drift beyond the limits imposed by laboratory needs and FCC requirements, both manufacturers and operators of radio equipment are confronted with the necessity of acquiring primary frequency standards or else a simple means of checking secondary standards against the standard frequencies transmitted from station WWV. The cost of the former runs into thousands of dollars, while the latter is quite inexpensive, while the degree of precision is about the same in either case.

\*Engineer, Browning Laboratories, Inc., Winchester, Mass.



FIG. 1. THE CALIBRATOR SETUP FOR THE TEST POSITION OF A PRODUCTION LINE

**WWV Services** ★ The National Bureau of Standards provides a 24-hour broadcast service of standard frequencies from its radio station WWV at Beltsville, Md. Standard radio frequencies, standard audio frequencies, standard time intervals, standard musical pitch, and time announcements are available at all times. WWV's frequencies and time intervals are controlled by a 100-ke. standard frequency piezo crystal oscillator. The average frequency value is based upon and agrees with the average United States Naval Observatory time signals. All standards of frequency are ultimately referred to the period of rotation of the earth; this

fundamental source might be referred to as one cycle per day or one cycle per 86,400 seconds.

The accuracy of all frequencies, radio and audio, as transmitted, is better than one part in 10,000,000. Atmospheric conditions may cause slight fluctuations in frequencies as received, but of course the average frequency is as accurate as that transmitted. The time intervals marked by pulses at every second are accurate to 10 microseconds. Time intervals of 5 minutes or longer are accurate to a part in 10,000,000. Following is the complete schedule of WWV transmissions:

- 2.5 mc. — 7:00 P.M. to 9:00 A.M. EST (2400 to 1400 GMT) audio modulation 440 cps.
- 5.0 mc. — Continuous audio modulation only on hours indicated: 440 and 4000 cycles, 7:00 A.M. to 7:00 P.M.; 440 cycles, 7:00 P.M. to 7:00 A.M.
- 10.0 mc. — Continuous audio modulation, 440 and 4000 cycles.
- 15.0 mc. — Continuous audio modulation, 440 and 4000 cycles.

A .005-second pulse can be heard at every second except at the fifty-ninth second of each minute. Audio frequencies are interrupted precisely on the hour and each five minutes thereafter, resuming after an interval of precisely one minute. During



FIG. 2. RADIO CIRCUITS ARE PROVIDED FOR 2.5 AND 5 MC., 5 AND 10 MC., OR 10 AND 15 MC.

the one minute interval, Eastern Standard Time is given in telegraphic code. Voice announcements are made at the hour and half-hour.

**WWV Calibrator** ★ The Browning standard frequency calibrator has been designed to provide in a single package a receiver and associated circuits for making full use of the WWV transmissions. The Calibrator consists of a receiver with two RF inputs, audio filters of 440 and 4,000 cycles, a low pass filter with a cutoff frequency at 400 cycles, and a cathode-ray tuning indicator at the output.

Fig. 1 shows a typical setup for this instrument at the test position of a factory production line, while Figs. 2 and 3 show the construction in detail. Circuit elements are diagrammed in Fig. 4. Three different models are available, with circuits pretuned to WWV frequencies of 2.5 and 5 mc., 5 and 10 mc., or 10 and 15 mc. The instrument is completely self-contained. Frequencies as low as 100 kc. can be inserted directly into the RF input

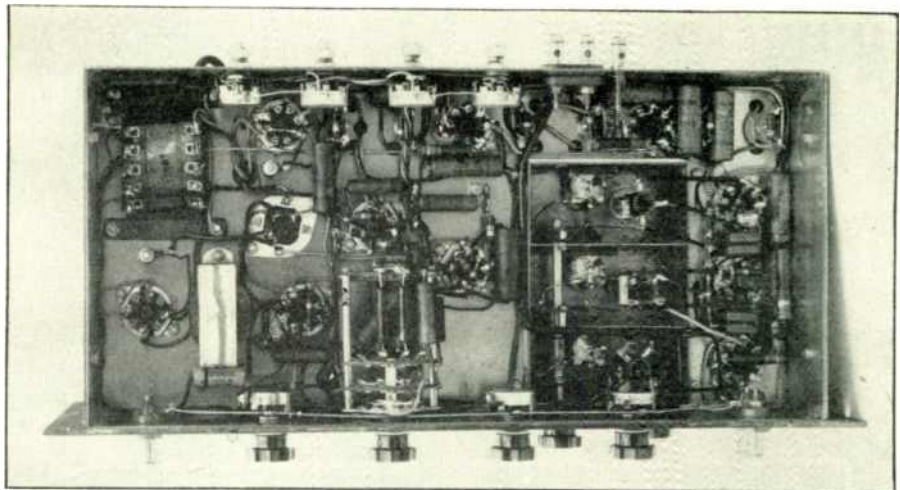


FIG. 3. INTERIOR VIEW OF THE CALIBRATOR, SHOWING UNDER SIDE OF THE CHASSIS

of precision. The method of measurement consists of obtaining a beat note between a harmonic of the signal under test and one of WWV's frequencies. A typical block diagram of the setup is shown in Fig. 5. The dotted lines indicate the

calibrated oscillator is at the same frequency of the beat note. The accuracy of measurement depends very much on the accuracy of the calibrated oscillator and the frequency of the beat note. Standard oscillators are usually made to operate on submultiple frequencies of WWV, for example, 10, 50, 100, 500 kc., etc. These are seldom off in frequency more than 10 or 20 parts per 10,000,000. Beat notes of this range can be determined very accurately by a beat counter, an audio-frequency meter, a frequency bridge, or a calibrated oscillator.

**Use of WWV Audio Frequencies** ★ By utilizing the modulation frequencies of WWV, one can compare or measure audio frequencies which are in fractional harmonic, subharmonic, or harmonic relation. This can be better expressed by the equation:

$$f = \frac{K_1}{K_2} 440 \text{ or } f = \frac{K_1}{K_2} 4000, \text{ where } K_1 \text{ and } K_2 \text{ are integers.}$$

It will be noticed from Fig. 6 that this scheme requires a band pass filter to eliminate the unwanted modulation frequencies. Filtering arrangements consisting of a degenerative type of selective amplifier has proved very satisfactory.

By observing the Lissajou figures<sup>1</sup> produced on the screen, the frequency relations can be determined immediately. A few examples are found in Fig. 7.

<sup>1</sup>The study of Lissajou's figures can be found in "Radio Engineers' Handbook" by F. E. Terman, and other texts.

(CONCLUDED ON PAGE 27)

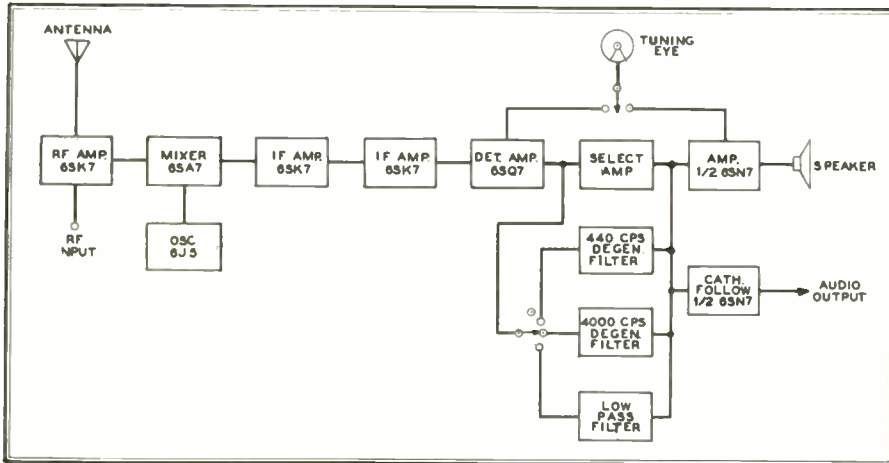


FIG. 4. BLOCK DIAGRAM OF THE CIRCUITS WHICH ARE INCLUDED IN THE INSTRUMENT

without the use of a harmonic generator if the amplitude is 100 microvolts or more. For audio and time interval measurements, the use of an audio oscillator and oscilloscope is necessary.

**Use of WWV Carrier** ★ Signals which are submultiple harmonics of any of WWV's carriers can be measured to a high degree

Browning Calibrator, with the 400-cycle filter cut in.

If the purpose is to set the local signal source to a subharmonic frequency of one of WWV's carrier frequencies, it is only necessary to adjust the local signal for zero beat frequency on the oscilloscope or for no flutter of the eye of the cathode ray tuning indicator. The use of a harmonic generator, Fig. 5, is optional, but the ratio of  $F_w/F_x$  is large and sufficient harmonic amplitude is not generated in the RF amplifier grid. High orders of harmonics can be obtained easily by saturating the grid of a sharp cutoff pentode. Spurious beats caused by modulation frequencies are eliminated by use of the low pass filter in the Calibrator.

In measuring a particular frequency whose harmonics are within 10 kc. of one of WWV's carrier frequencies, the addition of a calibrated audio oscillator is necessary. The calibrated oscillator should be connected to the horizontal plates of the oscilloscope shown in Fig. 5. A Lissajous pattern of an ellipse is seen when the

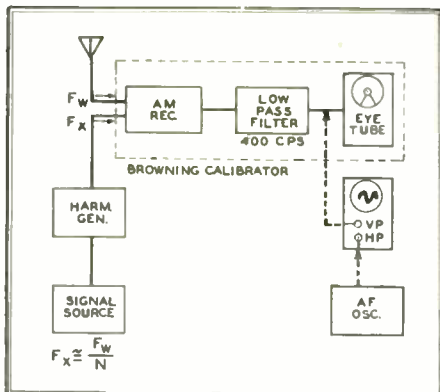


FIG. 5. SETUP FOR RF MEASUREMENTS

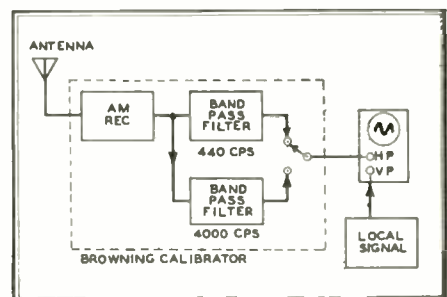
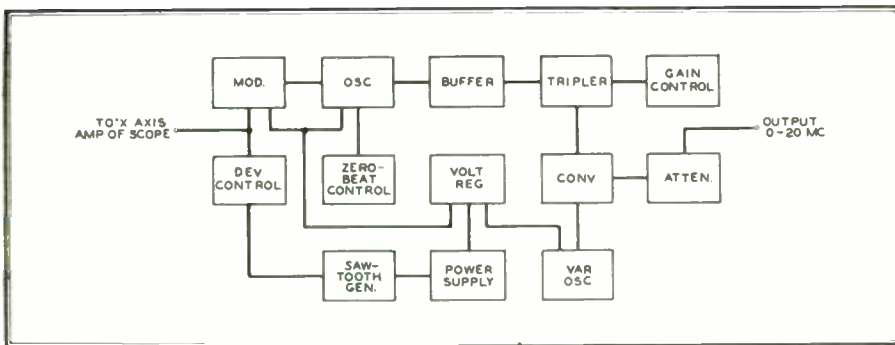
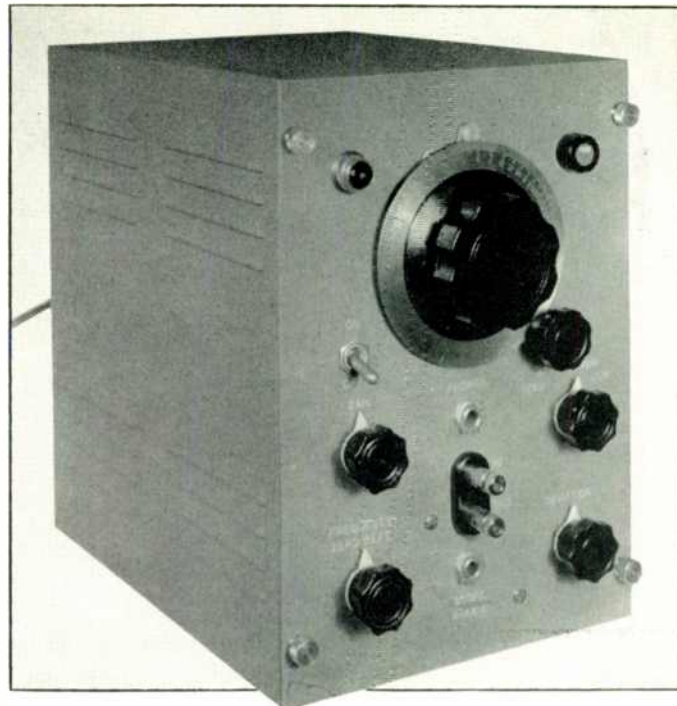


FIG. 6. SETUP FOR AF MEASUREMENTS



ABOVE: FIG. 3. BLOCK DIAGRAM OF THE VISUAL ALIGNMENT FM GENERATOR  
 RIGHT: FIG. 1. THIS SIGNAL GENERATOR IS DESIGNED FOR FM ALIGNMENT



## HOW TO ALIGN FM RECEIVERS

FM Communications and Broadcast Receivers Can Be Aligned with Greater Speed and Accuracy by Visual Method

BY BERNARD J. COSMAN\*

**T**HE most useful tool for the adjustment and alignment of tuned coupling circuits is without doubt the visual alignment FM signal generator, in which the frequency response curve of the circuit under observation is presented on an oscilloscope screen. Changes in circuit adjustments can be evaluated quantitatively in a matter of seconds, whereas the old techniques of tuning for maximum audio output, in the case of receiver alignment, or tuning for maximum VTVM readings in some part of the circuit invariably lead to wholly improper alignment of the IF and discriminator circuits found in any FM receiver.

A visual alignment FM signal generator, designed for aligning both FM broadcast and communications receivers, has been developed by Harvey Radio Laboratories. This instrument is shown in Figs. 1 and 2, with a block diagram of the instrument in Fig. 3.

Several experiments have been conducted to determine the ability of first-class radio laboratory technicians to line up properly a number of FM receivers in various states of misalignment. Two of the receivers, of different manufacture, had IF circuits with band-widths at about 5 mc. In no instance was it possible to get proper alignment of these receivers by the meter and signal generator method. The errors were always characterized by such symptoms as improper band-width, unsymmetrical side-band response, insufficient adjacent-channel selectivity, and reduced gain. Likewise, it was shown to be virtually impossible to get the same gain through both wide- and narrow-band responses. With the visual alignment FM signal generator, however, perfect response was obtained in from 2 to 10 minutes, depending on the nature and amount of the original mistuning. This is to be compared to 4 to 8 hours consumed by the far less accurate meter methods.

\* Chief Engineer, Harvey Radio Laboratories, Inc., Cambridge, Massachusetts.

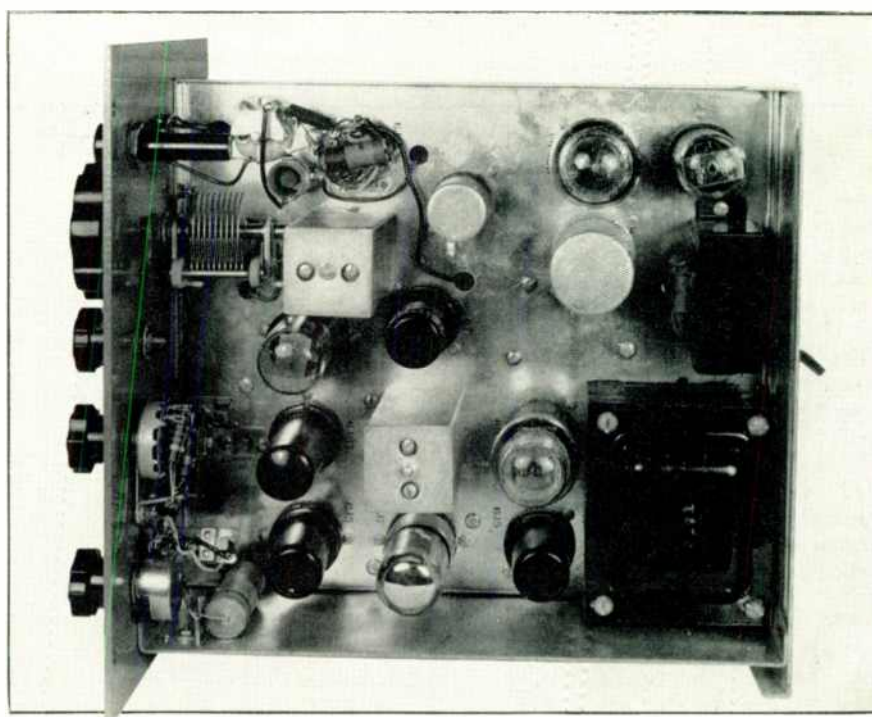
On another receiver, used for communications and equipped with a double superheterodyne circuit and triple-tuned IF stages, the results were similar, although the alignment problem was less complicated. Experienced technicians found it necessary to spend two hours trying to get perfect alignment, and they still fell far short of the results obtained from visual alignment made in 2 to 5 minutes.

In the case of a unit with only two IF stages of the slightly over-critically coupled type, the alignment problem seemed elementary, yet visual alignment cut the time by a factor of more than ten to one, as well as improving the band-pass characteristics of the system.

The conclusion to be drawn, therefore, is that alignment of FM receivers, and

particularly their discriminators, can be accomplished satisfactorily only by a visual alignment technique which presents a linear plot of the transmission characteristics of the circuits under observation on a cathode ray tube screen. This also implies that economical and accurate servicing of FM receivers can only be carried out through the practice of visual alignment. In the case of home receivers when one considers that FM broadcasting can supplant AM only when the general public can appreciate what advantage FM offers, it becomes significant that some of these advantages depend upon maintenance of proper circuit alignment. Because different methods are required for the new sets, many servicemen do not realize that FM circuits can be handled as simply and as quickly as AM. With the proper equip-

FIG. 2. COMPONENTS ARE ASSEMBLED ON A VERTICALLY-MOUNTED CHASSIS



ment, an FM set can be aligned perfectly, and at an absolute minimum expenditure of time and effort.

The visual alignment FM signal generator has been devised to accommodate the needs not only of servicemen but of radio laboratories and factory production. It is stable, easily adjusted and operated, and widely applicable as a source of linearly-swept FM signals. Frequency "wobblers" to date have been characterized mainly by inflexibility and, in some devices, by extreme unreliability and inaccuracy. The function of the visual alignment FM signal generator is to produce frequency-modulated carrier signals for injection into any point in the IF or RF section of a set to be aligned.

This instrument is calibrated from 0 to 20 mc. By using harmonics of this range, it covers both communications and broadcast receivers. The deviations or excursions in the frequency modulation are sufficient to cover 3 to 5 times the bandwidth of receiver circuits. This means that as the carrier frequency is being modulated, the instantaneous frequency is sweeping completely through the entire pass-band of the receiver circuits. A vacuum tube voltmeter, placed on the out-

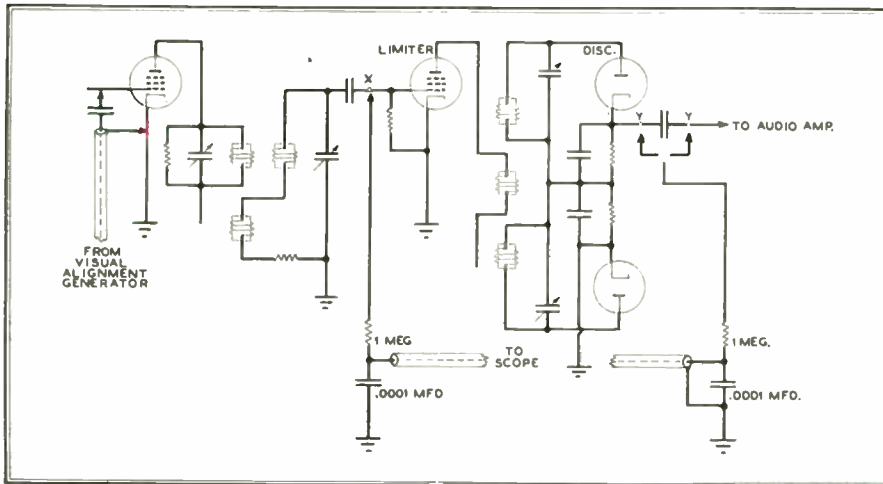


FIG. 5. TEST SETUP FOR OVER-COUPLED IF AND DISCRIMINATOR CIRCUIT ALIGNMENT

put of the circuit being aligned, receives a signal only at such times as the instantaneous carrier frequency passes through the pass-band of the circuit. At all other times, the VTVM output is zero, or very nearly so. If the VTVM output is rectified, the amount of DC voltage developed varies in time exactly proportional to the amount of instantaneous carrier frequency being transmitted through the receiver circuits.

When the carrier is frequency modulated by a saw-tooth wave, the instantaneous carrier frequency is obviously varying at a constant rate from one frequency limit to another, and then flying back to repeat. The DC output of the VTVM thus varies in time exactly according to the transmission curve of the circuit, and is reproduced identically for every sweep of the saw-tooth modulation.

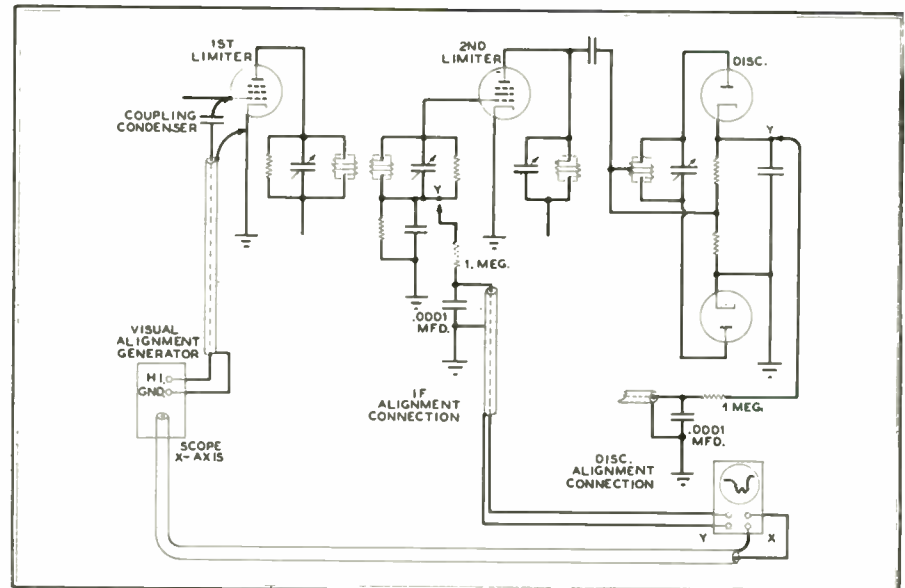


FIG. 4. ARRANGEMENT FOR TYPICAL IF AND DISCRIMINATOR CIRCUIT ALIGNMENT

If the same saw-tooth voltage which is sweeping the carrier frequency through the circuit under observation is also connected to the X-axis plates of an oscilloscope through the X-axis amplifier, then, obviously, the position of the spot on the

mission characteristic of the circuit, the circuit response curve is automatically traced out.

The signal generator is operated essentially as a beat frequency oscillator. A 21-mc. saw-tooth FM signal beats with a variable frequency, 21- to 41-mc. unmodulated oscillator to produce a fundamental output frequency range of 0 to 20 mc., with a controllable frequency swing up to 900 kc., peak-to-peak.

Several features have been incorporated which make for extreme stability and reliability. They make the unit a little more complex than at first seems necessary. For example, the dial calibration indicates a zero frequency which is for zero beat between the two 21-mc. oscillators. This means that sufficient buffering is needed to prevent pulling and locking-in at some super-audible frequency, inasmuch as the unit was meant to be calibrated by merely plugging a pair of phones into the beat detector output and adjusting the fixed-frequency oscillator to zero audio beat. Locking-in occurs between 300 and 2,000 cycles audio beat, but this error is insignificant because the primary frequency range of the instrument is between 500 kc. and 20 mc. Buffering is accomplished primarily, as Fig. 3 shows, by incorporating a tripler stage after a 7-mc. reactance-modulated fixed oscillator. Saw-tooth voltage is generated by an 884 sweep tube, and is fed to the

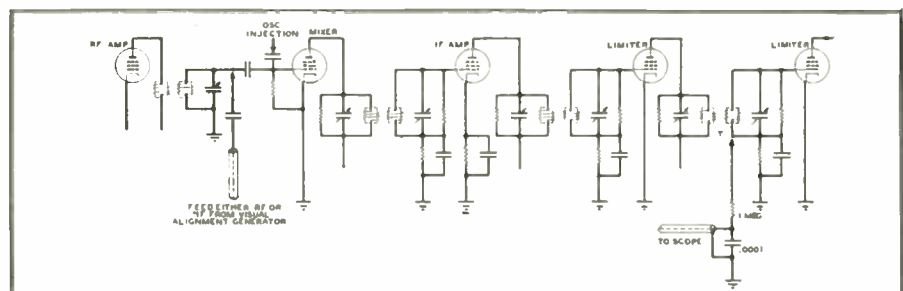


FIG. 6. CIRCUITS PRECEDING LIMITER SHOULD BE ALIGNED BACK TO ANTENNA

reactance tube through a cathode follower stage.

Drift is virtually eliminated by using a voltage-regulated supply to both oscillators and to the reactance tube. The similar thermal characteristics of the two oscillators have proved responsible for a large measure of stability.

Two output gain controls are provided, one acting to change the conductance of the tripler stage, and the other acting to change the load resistance of the BFO output circuit. This output circuit must obviously be resistance coupled in order to pass all frequencies from zero beat to harmonic output frequencies as high as 120 mc. The signal level of the harmonic RF output falls off rather rapidly, but still provides more than enough level to align RF sections of receivers up to 120 mc.

methods, but the simplest is that of utilizing rectified grid current in the limiter circuits to align the IF stages. Once the IF system is aligned, the discriminator can be adjusted merely by taking signals off the audio output connection of the discriminator rectifier, without shifting the RF output connection of the signal generator in the set. Examples of typical connections for visual alignment are shown in Figs. 4, 5, and 6.

Fig. 4 shows typical connections for IF and discriminator alignment. Connections for aligning other types of over-coupled IF and discriminator systems are indicated in Fig. 5. Stages preceding the limiter should be tackled stage by stage, back to the antenna post, as shown in Fig. 6.

Five examples of results, as they appear in the cathode-ray tube, are given in

4, or 5 minutes the accuracy is better than one part in 10,000,000. With appropriate chronograph or oscillographic recording equipment, the second pulses can be used to measure short or long time intervals. Second pulses can also be used to control a frequency source; whether it be an electrical oscillating system or a mechanical vibration system.

Measurements of low frequencies, from 1 to 200 cycles, can be made accurately by using the second pulses. For example, assume that a test frequency of approximately 100 cycles is applied to the horizontal plates of an oscilloscope and the WWV second pulse is applied to the vertical plates. If the pulse travels along the screen and returns to its original position after three hours, or 1,080,000 cycles later, the frequency is shown to be accurate to approximately 1 part in 1,000,000.

In the foregoing operation, it is always desirable to filter out the 400- and 4,000-cycle modulation frequencies by employing a low pass filter in the audio output of the receiver. The cutoff frequency should be 400 cycles or less. Such a filter is provided in the Browning Calibrator.

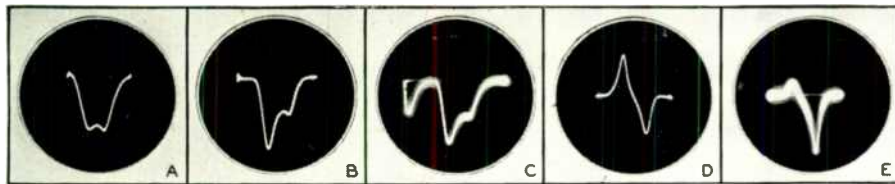


FIG. 7. TYPICAL EXAMPLES OF TRACES RESULTING FROM GOOD AND BAD ALIGNMENT

Use of the instrument is simple, as indicated by Figs. 4, 5, and 6. The RF output of the signal generator is capacity-coupled to the grid of the tube whose plate coupling circuit is to be aligned. Alignment should start with the limiters, working back to the antenna. VTVM signals for the scope can be obtained by a number of

Fig. 7. Perfect alignment of an IF system is shown at A. Trace B resulted from bad alignment. Complete misalignment of cascaded IF stages is indicated at C, with one stage badly aligned as at B. A correctly aligned discriminator produced trace D. Improper tuning of the discriminator resulted in trace E.

**Standard Musical Pitch** ★ The modulation frequency of 440 cycles corresponds to pitch A above middle C (or A4) in the Equal Tempered Chromatic Scale as adopted by the American Standards Association in 1936.

To utilize the pitch A4 to its fullest extent, it would be advisable to filter out the second pulses, 4,000-cycle modulation frequency, and noise by employing the selective amplifier at 440 cps.

## FREQUENCY MEASUREMENTS

(CONTINUED FROM PAGE 24)

When the resulting pattern remains stationary, the ratio relations are exact. If the pattern drifts slowly, the ratio relation is not exact, but slightly higher or lower. By measuring the time required for a particular point on the pattern to travel one complete cycle along the horizontal axis, the exact ratio can be determined. The test frequency is as follows:

$$f = R \left[ F_m \pm \frac{F_m}{t F_m \mp 1} \right] \approx R \left[ F_m \pm \frac{1}{t} \right]$$

Approximately

$$f = \text{test audio frequency}$$

where  $F_m$  = WWV's modulation frequency  
 $t$  = time in seconds for a particular point to complete one cycle along the horizontal axis.

$R$  = Ratio relation

To determine whether the local signal frequency is higher or lower than WWV's modulation frequency, the test frequency or its phase can be shifted slightly to note the direction of drift. A typical phase shift network is shown in Fig. 8. When  $R$  is increased, the direction of travel taken by the pattern on the cathode-ray tube

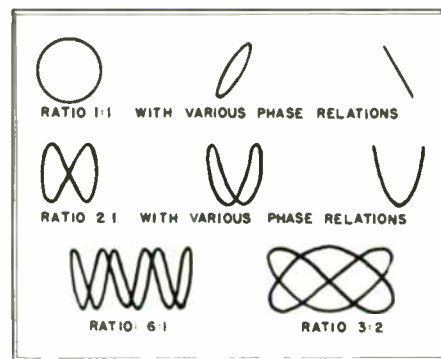


FIG. 7. TYPICAL LISSAJOUS FIGURES

will be that of a local signal frequency higher than WWV's modulation frequency.

**Time Interval Measurements** ★ The accuracy of the time interval marked by a pulse every second as transmitted by WWV is better than 10 microseconds. For intervals of 1,

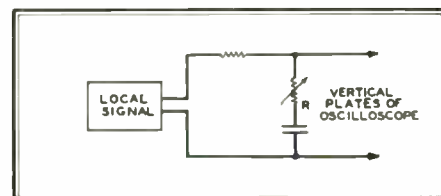


FIG. 8. SIMPLE PHASE SHIFT NETWORK

**Specifications** ★ Following is a summary of the specifications of the Calibrator:

All circuits, including the power supply, that are necessary for making WWV frequency measurements are provided.

Power Supply: 100 to 125 volts, single phase, 50/60 cycles.

Power Consumption: Approximately 85 volt-amperes.

RF Input Signal: Pretuned for 2.5 and 5 mc., or 5 and 10 mc., or 10 and 15 mc., with a sensitivity better than .5 micro-volt. Panel provision is made for test frequency input.

Selectivity: 10 db down at 5 kc. off resonance. Image rejection ratio and IF rejection ratio at least 50 db.

Cathode Ray Tuning Indicator: Audio indicator permits comparison between RF source and WWV transmission using zero beat method.

Audio Filters: Filter system allows selection of sharp band pass filter at 440 or 4,000 cycles, or low-pass filter with cutoff frequency at 400 cycles.

Dimensions: 9 ins. wide, 11 ins. deep, weight about 30 lbs.

The unit is supplied for rack mounting or in separate steel cabinet.

# SPOT NEWS NOTES

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

**James Lawrence Fly:** Former FCC chairman has been joined by William C. Fitts, Jr. and Peter Shuebruk in forming the law firm of Fly, Fitts and Shuebruk, at 30 Rockefeller Plaza, New York 20. Mr. Fitts served as general counsel of the Tennessee Valley Authority, while Mr. Shuebruk was assistant to the general counsel of the FCC.

**FM Set Production:** Scott Radio is setting an all-time record of dollar-volume sales on FM-AM receivers, despite the high prices of their models. Zenith is in full production on moderately-priced sets of excellent performance. Freed Radio will probably be next to schedule deliveries. Chassis are coming off their lines, but shipments have been held up for cabinets. G.E.'s Bridgeport plant promises FM-AM sets in August, and RCA has announced that a full range of models will be available in September. Sears, Roebuck will be among the leaders.

**Dr. Bennett S. Ellefson:** A member of the Sylvania research organization since 1937, has been appointed director of Sylvania's central engineering laboratories.

**Milwaukee:** *The Milwaukee Journal* has been granted a construction permit to erect an experimental television station, operating in the 540- to 920-mc. band. Plan is to conduct research into the performance of the latest standard, commercial television equipment. Construction and field studies will be directed by Phillip B. Laeser, FM and television engineering supervisor, and Edwin L. Cordes, chief construction engineer.

**Tube Count:** RMA has called upon its members to observe strictly the FTC ruling of July 22, 1939, which required discontinuance of advertising which specified the number of tubes including rectifiers, and the substitution of such phraseology as "8 tubes and rectifier tube".

**Dr. Felix L. Yezley:** Appointed director of research and engineering at Mycalex Corporation, Clifton, N. J. A specialist in insulation research, he has been connected previously with Western Electric, Bendix Aviation, Weston, and DuPont.

**Fitting:** From the newly-revised Directory of municipal radio stations in this issue, we learned that the police radio system in Brooklyn Center, Minn., is licensed under the call letters KANN, while that at Hazel Park, Mich., has been assigned the significant call WJUG.

**FM Lines:** AT&T is cooperating very effectively, and at great expense, with the television stations in the preliminaries of

coaxial cable networks. Now, we'd like to have a chance to hear what can be done by way of high-fidelity FM programming over telephone lines which are available for 15,000 cycles. If live talent cannot be used for such a demonstration, some of the new high-fidelity recordings would make suitable program material. And some of those wood-sawing, nail-driving demonstrations would add interest. Or how about a bit of good old melodrama, with screams and pistol shots?

**Chicago:** Plans for FM and television studios projected by Balaban & Katz call for a 600-ft. tubular steel tower to be erected on the State-Lake Building. The tower, 15 ft. in diameter at the base and 3 ft. at the top, and extending 90 ft. into bed rock, will enclose an elevator and the lines to the antennas. The latter will be mounted on an 85-ft. mast above the tower. An exterior spiral staircase will be used for tower maintenance work. B. & K. have retained Milton Searle Carstens as architect and designer of the tower and FM installation.

**Railroad Radio:** Manufacturers are beginning to complain that it's time for some of the railroads to spend a little of their own money on radio equipment and development. Practically all the work done so far has been at manufacturers' expense, with the railroads contributing nothing but the loan of some rolling stock.

**FM Monitor:** FCC approval has been issued on the REL monitor for FM broadcast stations. This instrument provides direct reading of frequency deviation on a zero-center meter, and of modulation up to 140%, with plus-or-minus 75 kc. swing as 100%. Also provided are an over-modulation alarm and an audio monitoring circuit. Deviation, modulation, and the over-modulation alarm can be indicated remotely.

**RMA Officers:** The 1946-47 officers of RMA, elected on June 13th, are: president, R. C. Cosgrove; vice president and chairman of the set division, Henry C. Bonfig; vice president and chairman of the tube division, M. F. Balcom; vice president, Fred R. Laek; vice president and chairman of the parts division, J. J. Kahn; vice president, Allen Shoup; treasurer, Leslie Muter; executive vice president, general manager, and secretary, Bond Geddes. RMA membership is now at a record high of 337 companies.

**Record Crystal:** A quartz mother formation weighing 115 lbs. has been received from Brazil by James Knights Company. While this formation, valued at \$5,000, is not

the largest ever found, it is said that none of comparable size has been so free of checks and flaws.

**FCC Chairman:** Contrary to the impressions of some of our readers, *FM AND TELEVISION* did not at any time oppose the shifting of FM broadcast frequencies, per se. We have, however, opposed those who advocated the change, under the guise of trumped-up technical arguments, in the hope of protecting their AM interests. We objected strenuously to the manner in which the FM hearings were conducted, for Mr. Porter's selective acceptance and rejection of testimony gave the appearance of bringing out support of a decision reached before the proceedings started. Also, we objected to what appeared to be an effort to sell the final decision to the industry, since it was obvious to any well-informed observer that so much of the testimony favoring the change came from those who were not concerned with public interest, but with their own.

We could have been wrong, but Mr. Porter's handling of OPA, and the type of propaganda which has issued from his office, particularly since July 1st, encourages us to favor Mr. Denny as permanent FCC Chairman.

**Facsimile:** Chicago Tribune's daily demonstrations of FM facsimile transmission included four-column rush pictures of the tragic La Salle Hotel fire. Special demonstrations have been given for students at Medill School of Journalism, Evanston, and for the Illinois Press Association at St. Charles. Transmission is from WGNB.

**Ronald P. Evans:** Elected president of The Turner Company, microphone manufacturers at Cedar Rapids, Ia. He has served as general manager for the past 3 years. David Turner, founder of the Company, is now board chairman, and John B. Turner the executive vice president.

**FM Transmitters:** First FM transmitter shipped by Federal Telephone & Radio Corporation was a 1-kw. installation, complete with square loop antenna, for the Omaha World Herald. Temporary location of the station is a farm house moved to the transmitter site. Special building will be erected when restrictions on new construction are lifted.

**John Logie Baird:** One of the pioneer television inventors has passed away in London at the age of 58.

**Television Construction:** Farnsworth is completing a radio center at Fort Wayne where it is planned to demonstrate the feasibility of television in cities of middle

(CONTINUED ON PAGE 59)



## NEWS PICTURE

**S**OME of the most important news of FM applications will be made by installations employing towers of this general appearance. We can recall, and it was not so long ago, that some engineers predicted that there would be no use for FM above 100 or 150 mc., because no

static exists above those frequencies. Subsequent experience with highly sensitive receivers indicates 1) that there is static all the way up the spectrum, and 2) that FM's contribution to relay and control circuits will expand their use enormously, and make possible better service at lower cost than can be obtained from wire lines. This photograph shows an RCA relay station operated in cooperation with Western Union between New York City

and Camden. It is expected that installations of this sort may ultimately replace thousands of miles of telephone and telegraph wires. Such systems may also carry FM broadcast and facsimile networks. With a further increase in transmitter bandwidth, such relays can handle television programs also. Still another use of microwave circuits is to control electrical or mechanical devices which are located in remote, inaccessible places.

# TRANSMISSION LINES FOR FM STATIONS

## Characteristics of Coaxial Lines, and Methods of Installation—Part 2

BY C. RUSSELL COX\*

**Overall Expansion** ★ Normal variations in temperature due to weather cause expansion and contraction in copper transmission lines, affecting the inner and outer conductors equally. For the extreme temperature range from winter cold to summer heat, the magnitude of this expansion is about  $1\frac{1}{4}$  ins. per 100 ft. On a 400 ft. run, the total expansion is thus about 5 ins.

Although there are many successful installations in which soft-temper  $\frac{7}{8}$ -in. coaxial cables have been attached to vertical towers with no provision for expansion, the flexibility of these lines is entirely lacking in the rigid lines designed for FM, and the user is cautioned against installing such rigid lines with inflexible mechanical supports. The basic difficulty with inflexible supports is that the expansion coefficient of copper is approximately 50% greater than that of steel, and enormous forces (several tons) may be developed in a structure if the two metals are held inflexibly together. Unless some form of stress relief is provided, these forces will inevitably cause failure of the supports, of the transmission line couplings, or possibly even of the tower itself.

Two methods of providing for expansion on vertical towers are illustrated in Fig. 21. The expansion joints in Fig. 21A are installed at 200-ft. intervals, and the

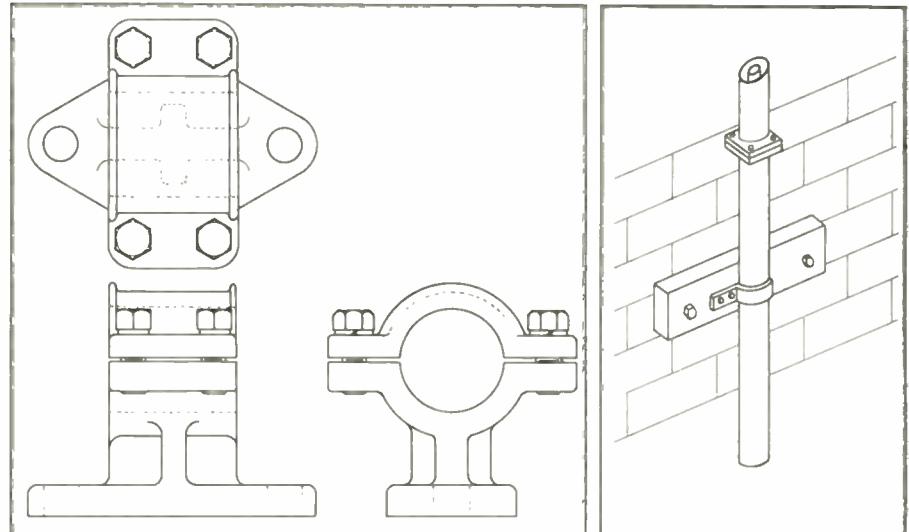


FIG. 18, LEFT. DETAIL OF RIGID SUPPORT TO CLAMP COAXIAL LINE. FIG. 19, RIGHT. PIPE STRAPS OR CONDUIT CLAMPS PERMIT LONGITUDINAL MOTION

bottom ends of each 200-ft. run are supported by brackets which anchor the line firmly to the tower. The remaining supports should be of a type which permit vertical motion (as from expansion or contraction) but prevent lateral motion. In making such an installation, the bottom section of transmission line should be installed first and subsequent sections added

to it so that all sections are supported by the bottom one and all couplings are in compression, rather than tension. In connecting the expansion joint between the last section of the line and the antenna, it should be compressed slightly below its normal length for the temperature at the time of installation, to permit inserting the inner connector.

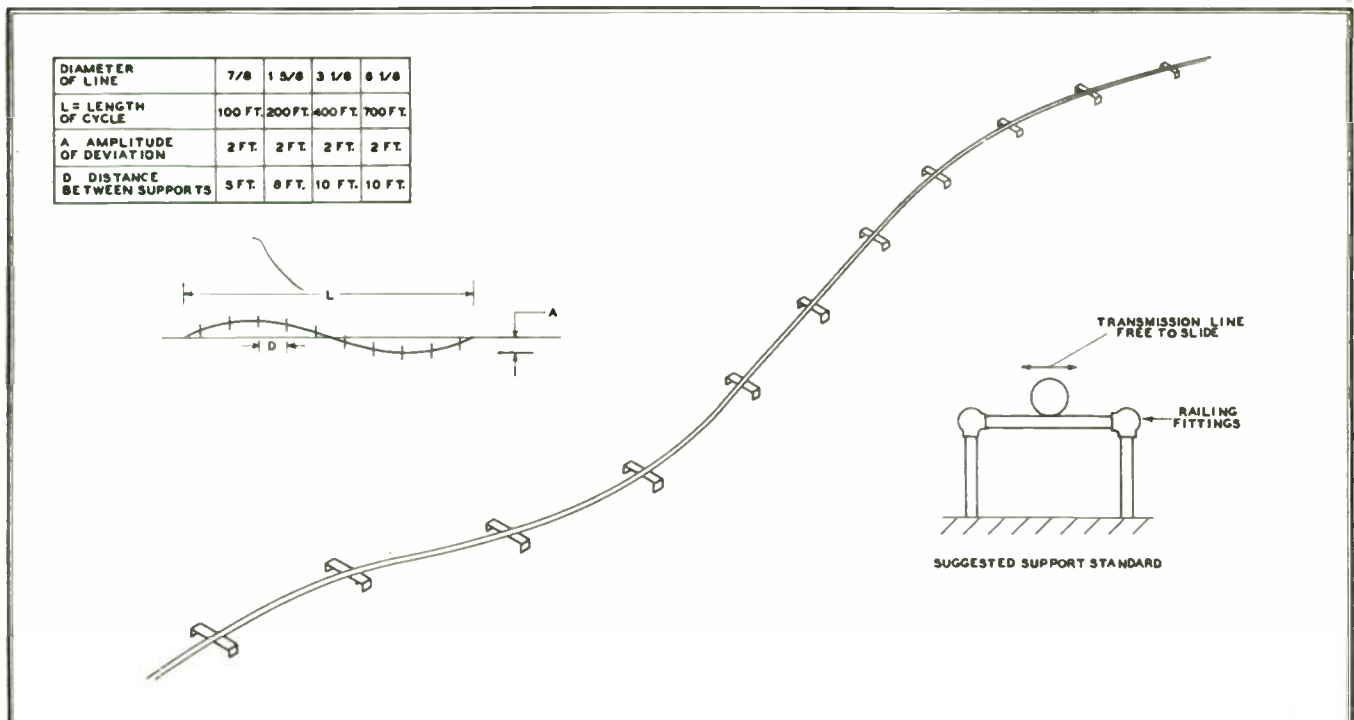


FIG. 20. IF THE LINE IS LAID IN A SINUOUS FASHION, AS SHOWN, EXPANSION FITTINGS ARE NOT NEEDED ON HORIZONTAL RUNS



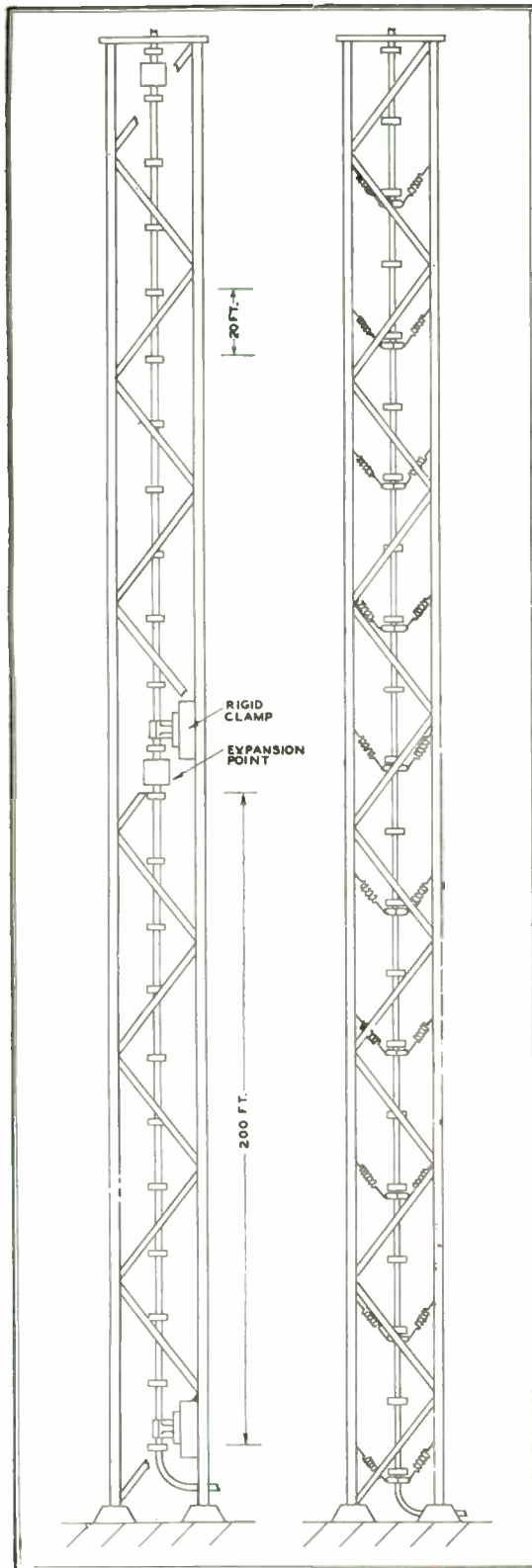


FIG. 21A, LEFT. RIGID LINE MOUNTING. FIG. 21B, RIGHT. SPRING SUSPENSION FOR VERTICAL RUN

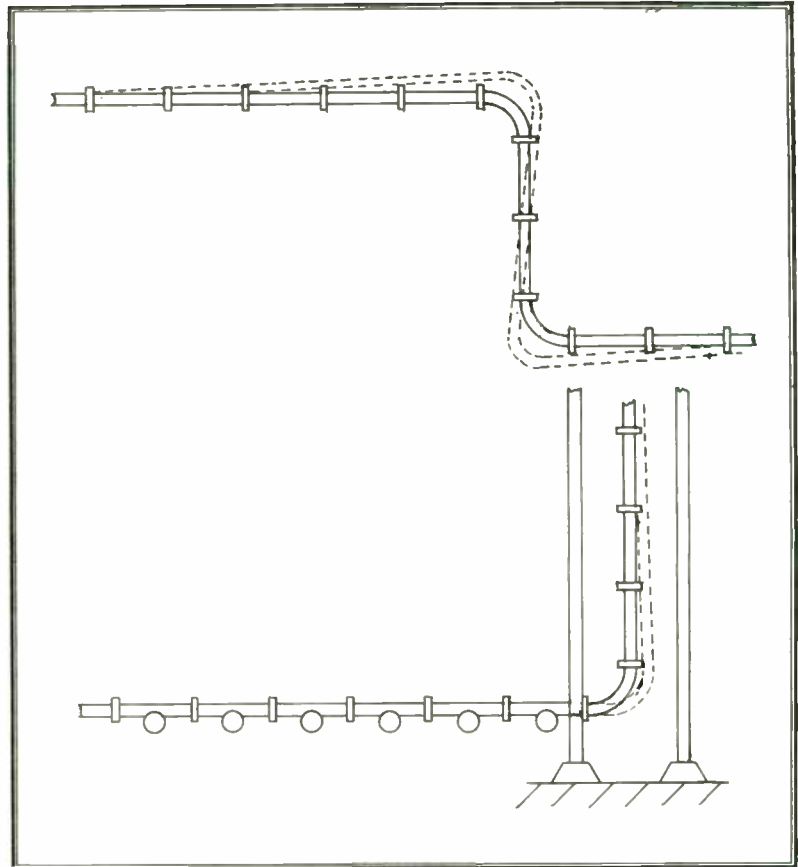


FIG. 22. PROPOSED ARRANGEMENT FOR A LONG HORIZONTAL RUN

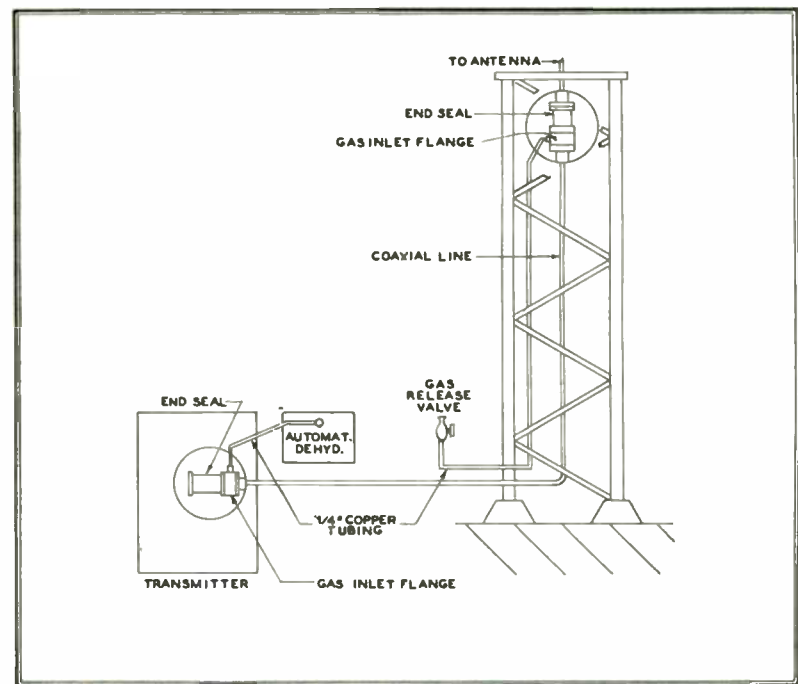


FIG. 24. DETAILS OF A PREFERRED METHOD FOR PROVIDING GAS CONNECTIONS ON TYPICAL FM LINE INSTALLATION

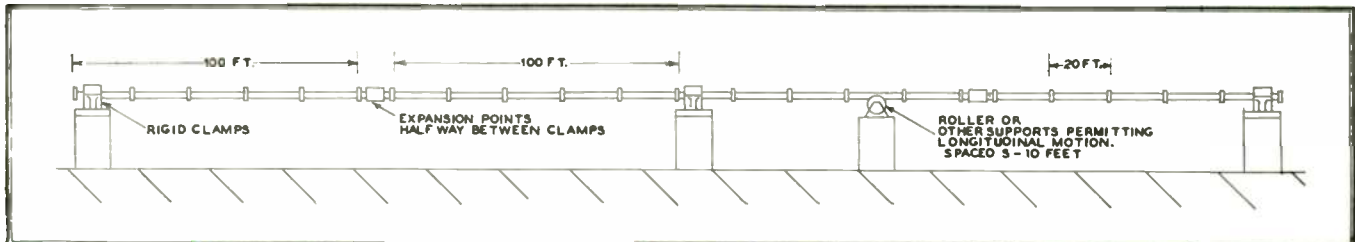


FIG. 23. PROPOSED CONSTRUCTION FOR A LONG LINE COMBINES RIGID AND ROLLER MOUNTS, AND EXPANSION JOINTS



FIG. 25A. MOTOR-DRIVEN DRY AIR PUMP

In Fig. 21B, spring supports allow expansion and contraction to occur freely, and expansion joints are not needed. Whereas the installation of Fig. 21A is made from the bottom up, this one is made from the top down. The spring supports should be added as the work progresses, so that tension on any one flanged connector is never greater than that due to the weight of three or four lengths of line.

**Horizontal Runs** ★ Fig. 20 illustrates a horizontal run in which no provision for expansion is required because of the sinuous fashion in which the line is laid. Fig. 22 shows two other horizontal runs in which expansion joints are not needed. In both figures, the dotted lines indicate with some exaggeration the position of the line after

expansion has occurred. Fig. 23 shows a long horizontal run with expansion joints.

If it becomes necessary to cut a 20-ft. length of line, the cut should be made only at the mid-point between insulators, to avoid disturbing the characteristic impedance of the line. The mid-points are marked on the outside of the outer conductor by means of yellow bands. In FM, one or two exceptions to this rule may be tolerated, especially if they occur near the transmitter rather than near the antenna. In television, however, if a cut is made any place other than at the mid-point, it becomes necessary to install a special section of inner conductor to introduce reflections compensating those due to the improper cut.

**Pressurization** ★ Pressurization with a dry inert gas is necessary if reliable operation is to be obtained. Although nitrogen was frequently used for this purpose before the war, dehydrated air is considered preferable because of its ready availability. So far as performance is concerned, there is no preference between the two gasses. Fig. 25 shows two suitable sources of dry air, one manually operated and recommended for short lengths of line, the other motor driven, self-reactivating, and fully automatic.

The antenna end of a transmission line should be fitted with a valve to permit flushing the line with gas, a procedure especially recommended on new lines or after a line has been opened for repairs. Since the antenna end of the line is usually inaccessible, a length of copper tubing may be routed from a gas inlet coupling to

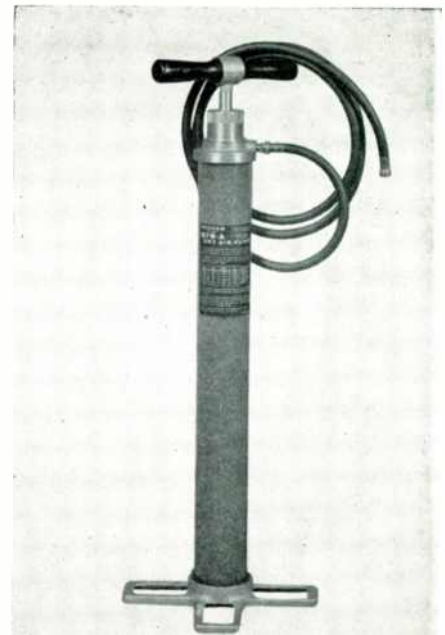


FIG. 25B. MANUALLY-OPERATED DRY AIR PUMP FOR COAXIAL LINES

some more convenient spot where the valve is located. Rubber hose may be used in place of copper tubing to by-pass the base insulator on insulated vertical towers. Fig. 24 shows typical gas connections.

**Isolation from AM Towers** ★ For owners of standard broadcast stations who are adding FM, it is often economical to use existing vertical tower radiators for support of the FM antenna. Two schemes for doing this without detuning the AM tower are illustrated in Figs. 26 and 27. Both methods attempt to provide a very high impedance between the base of the tower and the outside surface of the FM transmission line, by means of quarter wave resonant sections. In Fig. 26, the resonant section is on the tower and the tower itself forms the outer conductor. The transmission line must be insulated from the tower for a vertical distance of one-quarter wave up from the base. Fig. 27 shows an alternate scheme in which the resonant section is laid horizontally above ground.

In both methods described above it is possible to provide an exact adjustment to resonance by making the line slightly shorter than a quarter wave in length and connecting a variable condenser across the open end.

**Spare Lines** ★ The FCC engineering standards for FM require either an emergency antenna or an auxiliary coaxial transmission line to the main antenna. In most cases, it is cheaper to install an emergency antenna, as this may be an inexpensive device located on top of the transmitter building or at an intermediate level on a tower. Under emergency conditions operation at reduced power would then be necessary. Duplicate coaxial lines will undoubtedly be used in the larger stations.

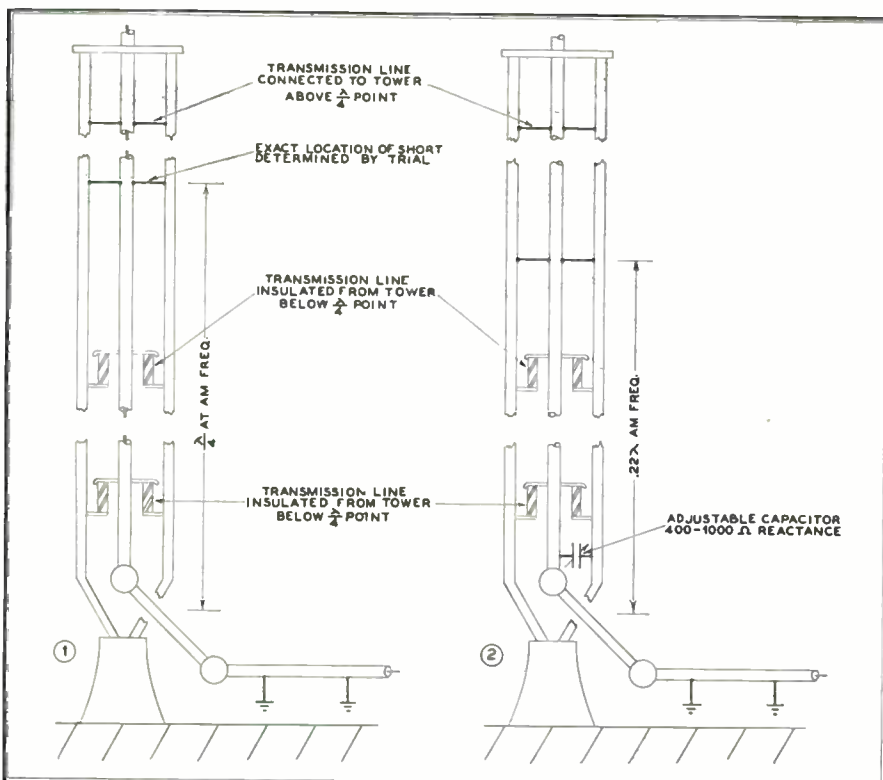


FIG. 26. TWO METHODS FOR ISOLATING FM LINE FROM AM RADIO TOWER

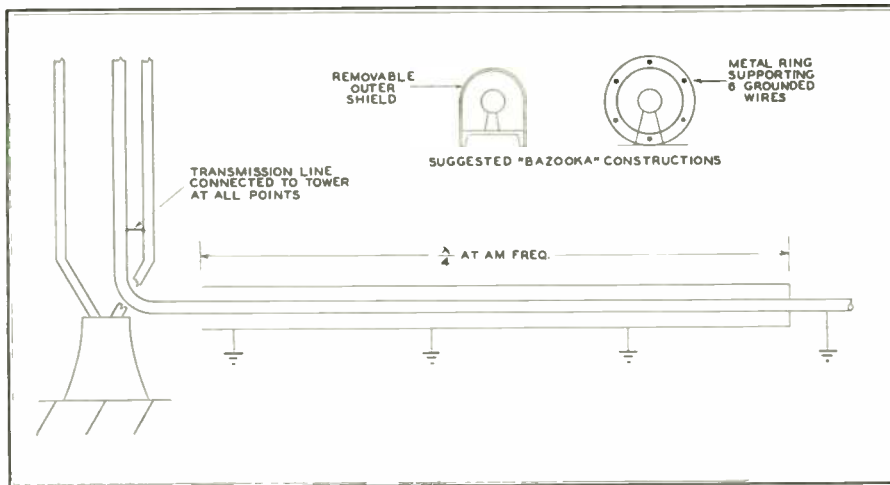


FIG. 27. RESONANT SHIELD USED TO ISOLATE FM LINE FROM AM TOWER

where the loss of revenue due to emergency operation with greatly reduced power is a more serious consideration than the cost of a duplicate line.

**Costs** ★ Fig. 28 shows the initial investment in transmission line materials only, exclusive of installation costs. Where steeplejacks are employed to work on towers, the installation labor may cost several times as much as the transmission line itself.

**Summary** ★ The data presented on specific antenna design problems has been drawn from such practices as have been adopted as standard, and from the author's very extensive experience in the installation of coaxial lines for FM and television antennas. In the former case, the organizations responsible for the adoption of standards were identified. Curves and data on line characteristics have been checked against actual practice, and afford a dependable basis for the design of new in-

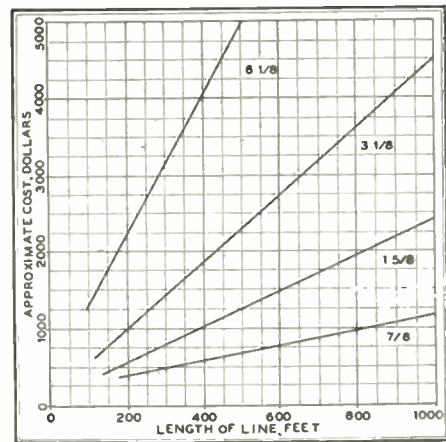


FIG. 28. THE APPROXIMATE COST OF LINE INSTALLATION, EXCLUSIVE OF THE LABOR, AS A FUNCTION OF LENGTH

stallations.

Correct design of antenna structures is emphasized not only because the cost is a substantial part of the total investment in any FM or television station, but because the efficiency of an antenna is directly related to coverage and, therefore, to the potential revenue to be derived from the station. Experiences which AM broadcasters have had with antenna problems shows the wisdom of thorough planning as a means of avoiding subsequent changes.

## WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

potential FM broadcasters seem worried about the failure of manufacturers to deliver FM receivers in quantity. Some individuals have accused set manufacturers of deliberately stalling and, in one instance, a Congressional investigation was suggested.

If the manufacturers had time to worry over such things, they would probably say: "You should be a manufacturer yourself!" The only set producers that aren't actively engaged in completing FM designs, or preparing to start production, are those whose facilities are limited to building little AM table models. Judging from the shipments being made now, the competitive situation will penalize any major concern that cannot start regular deliveries by September 1st.

In this respect, it is quite possible that Sears, Roebuck will steal a march on the rest of the industry. Colonial Radio, now a Sylvania subsidiary, is chief supplier of Sears Silvertone sets. The Colonial plant at Buffalo ranks with the leaders of the industry in engineering and production facilities. This was evident in the equipment produced there during the war.

Now, Colonial has a new plant at Riverside, Calif., and another at Bloomington, Ill., where Sylvania made VT fuse tubes. In some of the 500 cities where Sears stores sell radios, it is quite likely that the first FM sets offered will be

Silvertone models. And it is safe to say that they will deliver full FM performance as to tone and static elimination.

Manufacturers of AM broadcast station equipment are fairly well situated. At least, enough C.P.'s for new AM stations are being issued to use up whatever materials and components were carried over from before the war, and the old AM designs are still the best to be had.

But the production of FM broadcast equipment, on which many had counted heavily, was knocked into a cocked hat by the necessity of developing entirely new designs and tubes for the new frequencies. Deliveries of 1-kw. FM transmitters are beginning to roll at last, but nearly a year after Paul Porter assured the industry that 10-kw. transmitters would be "immediately available," we are still waiting to hear that the first one has been shipped.

**Communications** ★ Principal engineering salvaged from the war was what had been done on FM communications equipment. In fact, although it may not be realized generally, the most active section of the whole industry is that devoted to FM communications. This applies not only to installations for the old 30- to 40-mc. band, but to the new bands opened up by the FCC, because suitable transmitting tubes of sufficient power for these services were already available.

The present status of radio telephone communications over relatively short distances (up to 100 miles) or by relays

spaced at line-of-sight intervals is approximately comparable to the status of broadcasting after World War I. The chief difference was that the use of 2-way FM by police services was off to a convincing start before Pearl Harbor. During the war years, except where its use was precluded by our standardizing on existing British AM equipment, FM won its way on the sheer superiority of its performance for short-distance and relay communications.

Thus, after VJ-Day, 2-way equipment, giving a degree of dependability comparable to the wire-connected telephone, was available for civilian applications. Chief advantages of FM are lower installation and maintenance, and the ability to communicate with automobiles, trucks, buses, and trains while they are in motion.

Already, prewar AM municipal and state police equipment is being replaced by FM installations, and practically no AM equipment is being built for the emergency and mobile services except to maintain prewar systems. All railroad radio equipment is FM. One of the largest manufacturers of military radio apparatus spent a sum reported to exceed a quarter-million dollars on AM railroad radio development only to abandon the project and shift to FM.

Innumerable uses for FM have come about since the war, as individuals and businesses have come to realize the dependability of the FM telephone, and the ease with which the equipment can

(CONTINUED ON PAGE 58)

# EXAMINING FM TRANSMITTER PERFORMANCE

## Use of the Panalyzer for Analyzing the Characteristics of FM Circuits—Part 2

BY J. R. POPKIN-CLURMAN

**C. PARASITIC AM ON FM**—To check for parasitics, it is desirable that a modulation frequency greater than 8 kc. be used. If AM is present, then the  $J_1(\beta)$  Bessel function sidebands will fall to zero in an unsymmetrical manner as the deviation is changed. Generally, the lower sideband will fall to zero before the upper sideband. This is due to the fact that the AM is a sine function and the FM is a co-sine

tude than would be predicted for pure FM. This condition may be caused by insufficient excitation of the final amplifier stages. It is shown in 9C.

**D. COMBINATION FM, AM AND PM**—When spurious phase modulation is present in addition to AM on FM, it will be observed that some of the side frequencies never go to zero, and of course the theo-

If the audio modulation frequency is known, then the deviation when the carrier  $[J_0(\beta)]$  goes to zero for the first time, will be 2.4 times the modulation frequency; 5.52 times the modulation frequency the second time the  $[J_0(\beta)]$  goes to zero; or when the  $[J_1(\beta)]$  sidebands go to zero for the first time, will be 3.8; and approximately 7 for the second zero. The exact values can be taken from a table of

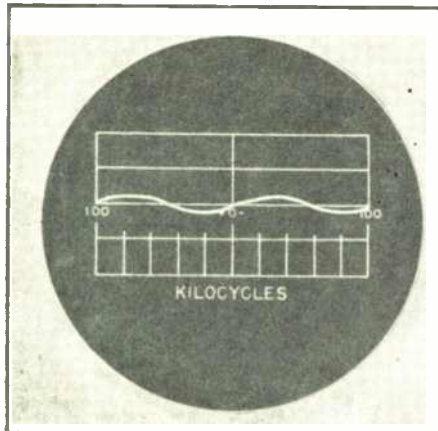


FIG. 8A. 60-CYCLE AM OR FM HUM ON UNMODULATED CARRIER

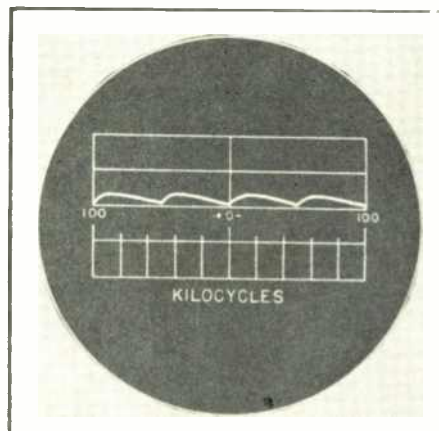


FIG. 8B. 120-CYCLE RIPPLE ON CARRIER. SWEEP AT 0. SWEEP RATE 30 CYCLES

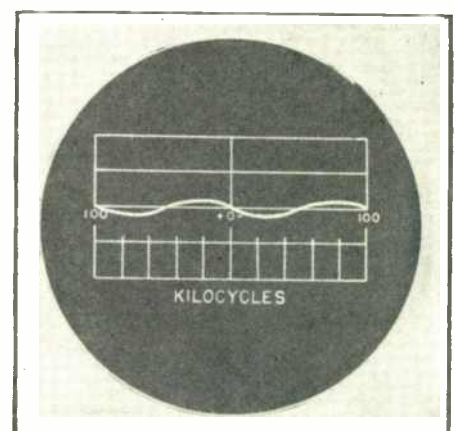


FIG. 8C. 60-CYCLE HUM ON UNMODULATED CARRIER PHASE OPPOSITE FIG. 8A

function for the first pair of sidebands, so that the AM subtracts from the lower sideband and adds to the upper sideband. When AM is present, most of the sidebands will be unsymmetrical, and as the modulation is increased, the sidebands will reverse their amplitudes after passing through zero, Figs. 9A and 9B. The greater the modulation index the less effect the AM has on FM.

For heavy AM on FM, it is possible to cancel one of the sidebands completely while leaving the other a greater ampli-

retical distribution for sine wave, as predicted by the Bessel function, can never be realized.

**E. DEVIATION CALIBRATION OF THE FM TRANSMITTER, AND CALIBRATION OF THE PANALYZOR**—Assuming that no AM or PM is present in the transmitter, the modulation deviation of the transmitter can be determined experimentally by watching when the carrier, or first, second, third, and additional sidebands pass through zero as the deviation is increased.

Bessel functions. Figs. 10A through 10E illustrate typical patterns received under such conditions.

If a known frequency, such as 15 or 20 kc., modulates the FM transmitter, then the side frequencies act as calibrated markers for the Panalyzer, since the sidebands of the FM transmitter occur at regular intervals spaced by the amount of the modulation frequency. The limits for  $\pm 75$  kc., may be set by modulating the transmitter with 13.6 kc. and watching when the  $J_0(\beta)$  goes to zero for the

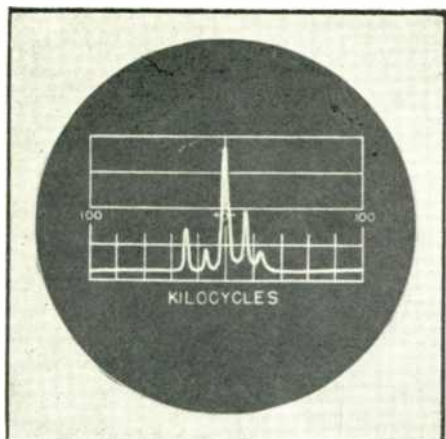


FIG. 9A. LIGHT AM ON FM, 15-KC. SWEEP  $\beta = .5$ , DEVIATION  $\pm 7.5$  KC.

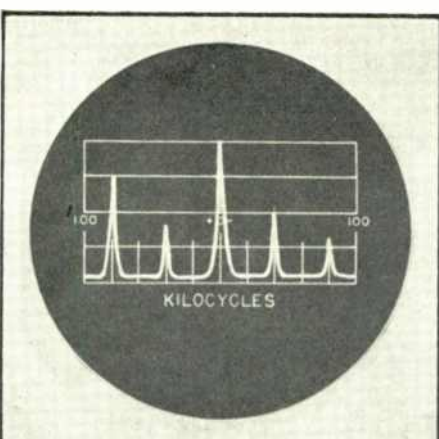


FIG. 9B. FM SIGNAL WITH 40-KC. MODULATION, WITH AM SUPERIMPOSED

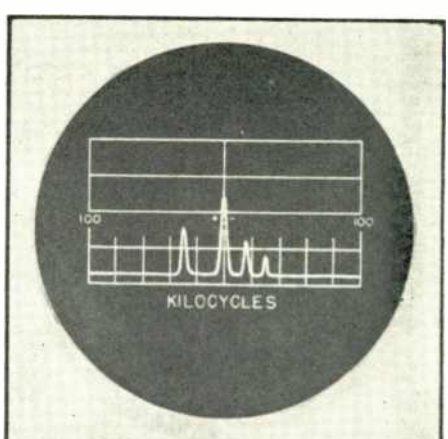


FIG. 9C. HEAVY AM ON FM, 15 KC. MOD. ONE  $J_1(\beta)$  SIDE BAND MISSING

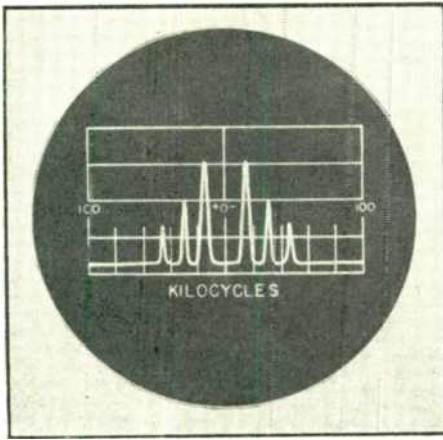


FIG. 10A. 15 KC. MOD.  $J_0(\beta) = 0$ , ( $\beta = 2.4$ ), DEVIATION  $\approx 36$  KC.

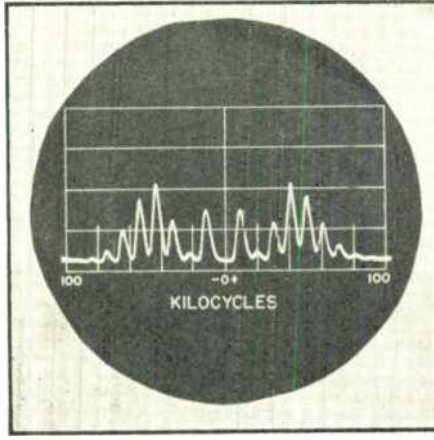


FIG. 10B. FM SIGNAL, 11-KC. MODULATION,  $J_0(\beta) = 0$ , DEV.  $\approx 60.7$  KC.

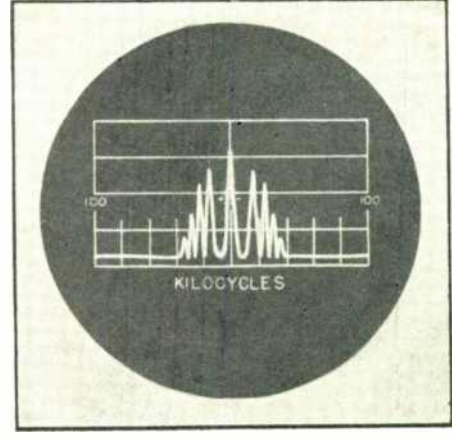


FIG. 10C. FM SIGNAL, 7-KC. MODULATION,  $J_1(\beta) = 0$ , DEV.  $\approx 26.6$  KC.

second time. This will establish the  $\pm 75$  kc. deviation. To get the limits for narrow band FM, if  $\pm 15$  kc. determine the total limits of swing, it is only necessary to modulate the narrow band transmitter with 15 kc. and the first sidebands will be 15 kc. on either side of the carrier and determine the limits of modulation. A secondary standard can also be used in conjunction with multi-vibrators to calibrate the Panalyzer directly.

**F. PRE-EMPHASIS CALIBRATION** — To check the pre-emphasis network versus frequency, the bandwidth is noted as shown on the Panalyzer as a function of audio frequency, maintaining the input modulation audio level constant. A plot will then show whether the deviation ratio coincides with the pre-distortion curve.

**3. Square-Wave Response** ★ The distribution of side frequencies for a square-wave input is not as predictable, since square waves may be considered as made up of odd cosine functions. In most cases the significant sideband components extend much further away from the carrier than for equivalent voltage sine wave modulation, and in some instances the sidebands never go to zero. Figs. 11A and 11B compare an FM signals for sine wave and square wave modulation of equal peak voltages.

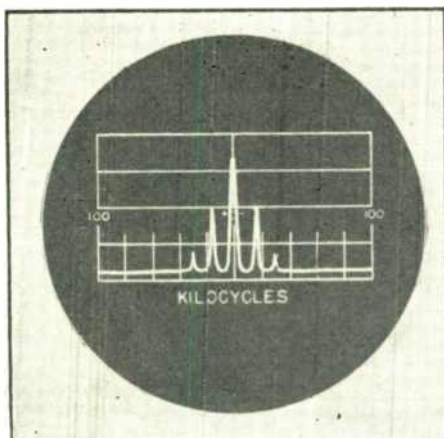


FIG. 11A. 15-KC. MOD. WITH SINUSOIDAL WAVE,  $\beta = .5$ , DEV.  $\approx 7.5$  KC.

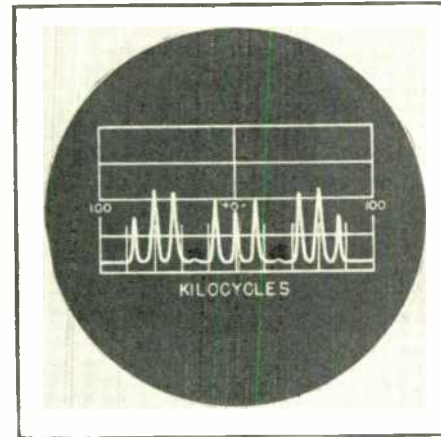


FIG. 10D. FM SIGNAL, 15-KC. MODULATION,  $J_2(\beta) = 0$ , DEV.  $\approx 75$  KC.

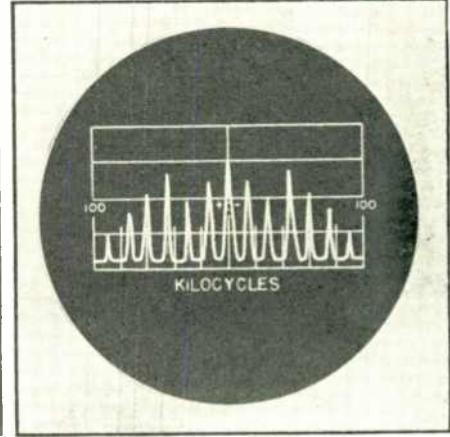


FIG. 10E. FM SIGNAL, 15 KC. MODULATION,  $\beta = 5$ , DEVIATION  $\approx 75$  KC.

distribution of the FM energy band. Therefore, carrier shifts under modulation are readily apparent as well as non-symmetrical modulation. A large carrier shift under complex modulation is shown in Fig. 12. There being no time delay in

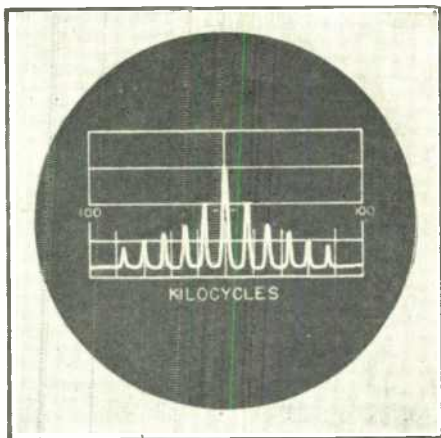


FIG. 11B. 15-KC. MOD. WITH SQUARE WAVE, SAME PEAK AMPLITUDE AS FIG. 11A

**4. Complex Waves** ★ Despite the fact that audio program material does not possess constant frequencies or amplitudes, it is, nevertheless, possible to check the carrier shift and non-symmetrical modulation, as the program material can be seen instantaneously, and the eye can weigh the

observing transient conditions, it is possible to watch the center frequency control circuits functioning as soon as modulation ceases. Noisy circuits are shown in Fig. 13. Thus the overall behavior of an FM transmitter can be checked continuously by means of the Panalyzer.

**5. General Frequency Measurement** ★ Because the Panalyzer has direct-coupled amplifiers, it will measure frequencies down to and including zero beat. This property, together with the ability to show large amounts of the spectrum at once, make it invaluable for checking the proper operation of doublers, quadruplers, frequency dividers, and otherwise general alignment of the stages of the transmitter. It can also be used for checking AM modulation, Fig. 14, and carrier shift of AM transmitters.

A suggested arrangement of the Panalyzer for FM stations would consist of a stable, crystal-controlled beating oscillator with the necessary multipliers, Fig. 15, as the local oscillator. An auxiliary crystal oscillator (500 kc.) should be used for checking the center frequency of the Panalyzer. This crystal oscillator could be modulated by any audio frequency to which it is desired to set the modulation limits. This would result in a pip appearing at the center of the screen, and two

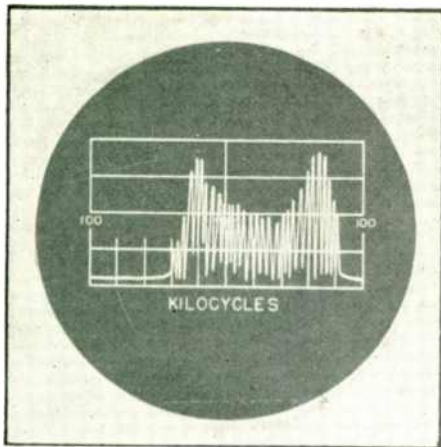


FIG. 12. HEAVY CARRIER SHIFT UNDER COMPLEX MODULATION

pip markers appearing at the deviation desired.

Personnel using the Panalyzer for FM monitoring and checking have found it invaluable because of its ability to sum up the performance picture instantaneously. Their comments have led to suggestions for a possible FM modulation monitor and FM frequency meter.

The FM transmitter is fed into the Panalyzer in the usual manner. A temperature-controlled crystal oscillator equal to the transmitter frequency plus or minus 500 kc. divided by 16 is fed to two quad-

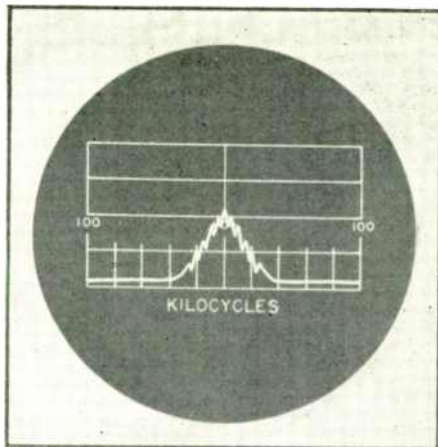


FIG. 13. HEAVY RANDOM NOISE ON FM CARRIER, SWEEP REDUCED

ruplers. This provides a stable heterodyning oscillator which produces a 500 kc. beat with the FM transmitter center frequency. Both these signals are then fed into the Panalyzer. A 500 kc. crystal of low-drift characteristics is also fed into the Panalyzer. The 500 kc. crystal is amplitude modulated by a 75 kc. or other limit oscillator. The markers which then appear on the Panalyzer screen correspond to the center frequency of the FM transmitter and the limits set for 100% modulation are shown by markers set up  $\pm 75$  kc. of the center frequency. The

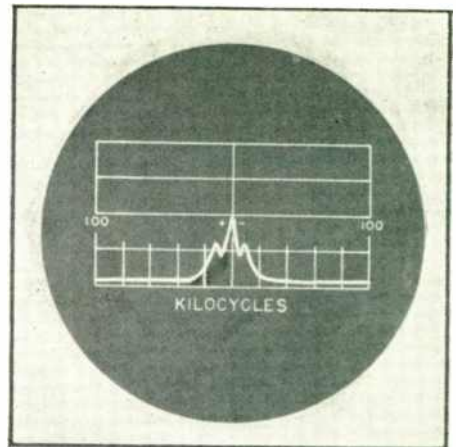


FIG. 14. AM SIGNAL, 100% MODULATION WITH 10 KC. OF AUDIO

75 kc. oscillator may be made variable to set other modulation limits. When there is no FM modulation present, the FM carrier will beat with the 500-kc. center mark. A part of the 500-kc. beat energy is fed to a limiter which may operate at 500 kc. or a multiple thereof and thence to a piezo electric or usual discriminator which feeds a meter indicating cycles deviation from the standard. An alternative center frequency meter would consist of a crystal discriminator and limiter fed by frequency dividers. A possible arrangement is shown in the block diagram of Fig. 16.

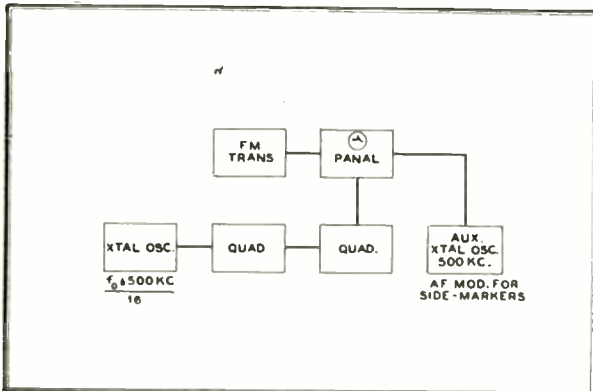


FIG. 15. SIMPLIFIED BLOCK DIAGRAM FOR THE USE OF THE PANALYZOR AT FM STATIONS

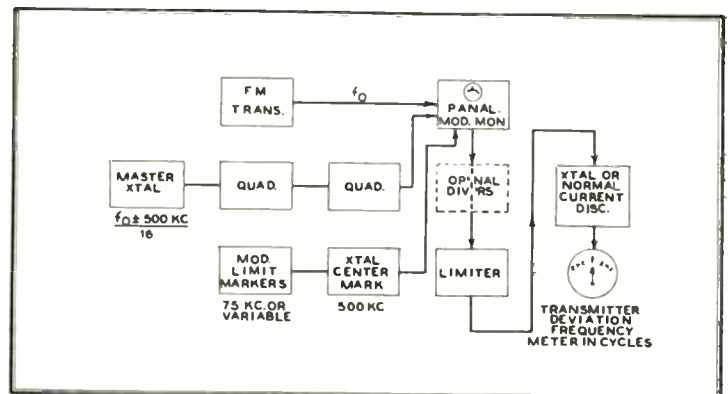


FIG. 16. SUGGESTED DYNAMIC FM MODULATION AND FREQUENCY METER ARRANGEMENT

### ALLOCATIONS FOR 920-940 AND 940-960 MC.

In the FCC report of allocations from 25 mc. to 30,000 mc., the frequency band of 920 to 940 mc. was allocated to the experimental broadcast services, and the 940 to 960 mc. band was allocated to fixed and experimental broadcast services, the latter band on a shared basis between broadcasting and low-power fixed services, such as police facsimile, control circuits, public service, special emergency automatic relays or repeaters, relay broadcast, and broadcast studio-to-transmitter links.

The Commission has received urgent inquiries as to the exact manner in which these various services would be accommodated in the bands provided. Potential manufacturers and users of FM studio-to-

transmitter link equipment are particularly anxious to know what frequencies are available to that service.

Accordingly, the following tentative service-allocation plan for the frequency bands of 920 to 940 and 940 to 960 mc. has been formulated, reflecting the desire of the Commission that certain frequencies be made definitely available at once for services which need them urgently:

1. Assignments to FM studio-to-transmitter links may be made in the upper portion of the 920 to 940 mc. band in the event that future requirements indicate that insufficient space is available in the band from 940 to 952 mc.

2. Assignments to experimental broadcasting service in the 920 to 940 mc. band may be made progressively upward from 920 mc.

3. The band of frequencies from 952 to 960 mc. is to be used for fixed circuits such as police facsimile, control circuits, etc., with assignments progressing downward from 960 mc.

4. The band of frequencies from 940 to 952 mc. is to be used for FM studio-to-transmitter links with assignments progressing upward from 940 mc.

5. Assignments in the frequency bands from 920 to 940 and 940 to 960 mc. are to be on multiples of 100 kc., in order that a flexible channeling system may be provided. (The bandwidths required by the different services concerned can be accommodated through the assignment of an appropriate number of adjacent channels to each station.)

6. A frequency tolerance of .01% and (CONCLUDED ON PAGE 63)

# Part 1: MUNICIPAL & COUNTY EMERGENCY STATIONS

The Official Directory of Municipal and County Police Radio Transmitters — 6th Edition

## MUNICIPAL POLICE

ALABAMA				
WRBD	Anniston	WE	Mtr	33100 AM
WPFM	Birmingham	WE	Mtr	2382 AM
		Link	Mtr	30580 AM
		Mtr	Mtr	30980 FM
		Comp		2382 AM
WJZG		Mtr		35900 FM
WADN	Decatur	GE		35500 FM
WKAD	Dothan	Mtr		35900 FM
WKUH	Florence	Mtr		2382 AM
WQIC	Gadsden	RCA		30580 AM
		Mtr		35900 FM
WMHA	Huntsville	WE		2382 AM
WPGW	Mobile	Kaar	Mtr	30580 AM
		Coll		2382 AM
WMPM	Montgomery	Kaar	Mtr	30580 AM
		Mtr		35900 FM
WDBZ	Northport	WE		2382 AM
WASP	Selma	RCA		33500 AM
WBVS	Sylacauga	RCA		33500 AM
WQLH	Tuscaloosa	Mtr		35900 FM
ARIZONA				
KRHS	Bisbee	Comp		2430 AM
		Mtr		35100 AM
KRON	Casa Grande	SP		35100 AM
KFPX	Flagstaff	Mtr		35100 AM
KQJQ	Flagstaff (Co)	Temc		2430 AM
		Mtr		35100 AM
KRAC	Florence (Co)	SP		2430 AM
		Mtr		35100 AM
KICG	Hollbrook	Stnc		2430 AM
KOXU	Martinez (Co)	Mtr		30580 AM
KRIZ	Mesa	Mtr		2430 AM
		Mtr		30580 AM
KGZJ	Phoenix	deP		2430 AM
		Mtr		30580 AM
6XEJ		Mtr		118550 FM
KNHG	Prescott	Mtr		35100 AM
KQHM	Prescott (Co)	Mtr		2430 AM
		Mtr		35100 AM
KRJA	Safford	Mtr		35100 AM
		Mtr		35100 AM
KEVZ	S. Tucson	Temc		35100 AM
KEYU	Tempe	Mtr		35100 AM
KQEP	Tucson	PDL		2430 AM
		Comp		2430 AM
KQPW	Tucson (Co)	Mtr		35100 AM
		Mtr		117350 AM
6XEH		Mtr		2430 AM
KRDW	Winslow	Mtr	11M	35100 AM
		Mtr		2430 AM
KQEX	Yavapa (Co)	Comp		2430 AM
KADF	Yuma (Co)	Mtr	SP	35100 AM
ARKANSAS				
KSDC	Ark. City (Co)	Bass		2406 AM
		Kaar	Mtr	31500 AM
KPBA	Blytheville	Comp		2406 AM
		Stnc		30580 AM
KSDD	Dumas (Co)	Bass		31500 AM
KRND	Fayetteville	Comp		2406 AM
		Comp		30580 AM
KNIE	Fort Smith	Comp		2406 AM
		Mtr		30580 AM
KQEH	Hot Spgs (Co)	Comp		2406 AM
		RCA	Mtr	30580 AM
KOMC	" " Natl Pk	Kaar		2406 AM
KGHZ	Little Rock	RCA		2406 AM
		Mtr		30580 AM
KRGI	Little Rock (Co)	Mtr		31780 AM
		Mtr		31900 AM
KLOC	Marion	Mtr		37100 FM
KSDE	McGehee (Co)	Bass		31500 AM
KPMA	Mississippi (Co)	Comp		30580 AM
KPDM	Monticello	Comp		2406 AM
		Mtr		30580 AM
KRAE	N. Little Rock	Mtr		35100 AM
		Mtr		2406 AM
KQGT	Pine Bluff (Co)	Comp		2406 AM
		Mtr		30580 AM
KTAP	Texarkana	RCA		30580 AM
		Harv	Mtr	33220 AM
		Mtr		2406 AM
CALIFORNIA				
KQBR	Alameda	Comp		30700 AM
		Kaar		35100 AM
KPDA	Alameda (Co)	Comp		1658 AM
		Kaar		35220 AM
KPDB		Comp		1658 AM
KRGE		Comp		1658 AM
KGWC	Alhambra	Mtr		37780 AM
KQAH	Alhambra	Mtr		31500 AM
KHRQ		Mtr		31500 AM
KQCL	Anaheim	Comp		33780 AM
KQAF	Arcadia	Comp		33500 AM
KQXC	Atherton	Kaar		33780 AM
KIBR	Azusa	Mtr		31100 FM
KGPS	Bakersfield	Comp		30580 AM
KACS	Bakersfield (Co)	Wstg		244 AM
		Mtr		31780 AM
KQLY	Banning	Comp		30580 AM
KQHL	Banning (Co)	Mtr		2442 AM
KQJH	Beaumont	Comp		30580 AM
KRBC	Bell	Mtr		35500 AM
KBYC	Belvedere	Comp		3320 FM
KQSN	Benicia	Comp		2422 AM
		Link		30980 AM
KGFM	Berkeley	Comp		37780 AM
KGIH		Comp		37780 AM
KGFO		Comp		37780 AM
KCNL		Comp		37780 AM
KSW		Comp		1658 AM
		Mtr		37780 AM
6XBC		Mtr		154800 FM
KQAI	Beverly Hills	Mtr		37100 AM
KROD	Blythe (Co)	Mtr		2442 AM
KBYO	Butte (Co)	Comp		39380 AM
KBMP	Brawley	Comp		2490 AM

## SPECIAL INFORMATION

Every six months, through the courtesy and cooperation of the Federal Communications Commission, this Directory and the Directory of State, Zone, Interzone, Fire, Forestry, and Special Emergency Stations to appear next month, are completely revised. Thus their accuracy and completeness are assured.

1. Attention is called to an important change in this 6th edition. In the past, FCC records showed the names of the companies whose equipment is used at each station. Now, however, entirely new records have been set up, and that particular information is not available to us. Therefore, where changes or additions to the previous Directory have been made, the manufacturers' names do not appear.

2. Correspondence with Radio Supervisors of municipal radio stations should be addressed to Police Headquarters; and with those of county stations, at the Sheriff's Office. Listings of county stations are identified by the abbreviation (Co).

KADQ	Brea	Comp		2490 AM
		Comp		33780 AM
KQBE	Burbank	Comp		33500 AM
KQCM	Burlingame	Comp		33100 AM
		Comp		37220 AM
KQFI	Carmel-by-the-Sea	PDL		33100 AM
		PDL		35220 AM
KQEO	Chico	RCA		31500 AM
KQKN	Chino	Comp		33220 AM
KQJG	Chula Vista	PDL	CECr	33780 AM
		Comp		33780 AM
KQRY	Claremont	Mtr		33220 AM
KQFK	Coalinga	Mtr		33500 AM
KHWH		Mtr		35220 FM
KQVO	Colton	Comp		33220 AM
KQRO	Colusa (Co)	Comp		1722 AM
		Mtr		39380 FM
KQAG	Compton	Comp		33100 AM
KHNI	Contra Costa (Co)	Mtr		1658 AM
KRIV	Corona	PDL		2442 AM
		Comp		30580 AM
KQKV	Coronado	RCA	Mtr	33780 AM
KPCM	Corte Madera	RCA		33220 FM
KQJH	Covina	Mtr		33220 AM
KPDC	Culver City	Comp		37500 AM
KEYG	Delano	Mtr		35900 AM
KEIJ	El Cajon	Mtr		33780 AM
KNGJ	El Centro	Mtr		2490 AM
		Mtr		35100 AM
KQVN		Comp		2490 AM
KAMM	El Cerrito	Mtr		37780 AM
KROR	El Monte	CECr		39500 AM
KQJL	El Segundo	PDL	Mtr	37900 AM
KGTS	Esplanore	Comp		30580 AM
KQIIX	Escondido	Comp		2490 AM
		Comp		33780 AM
KQRM	Eureka	Kaar		30700 AM
KHCP	Eureka (Co)	RCA		2422 AM
		GE		39780 FM
KDIC	Fairfax	RCA		33220 FM
KPSH	Fairfield (Co)	Link		3520 AM
KRBY	Fairfield (Co)	deF		2414 AM
KGZA	Fresno	Comp		37220 AM
		Link		35220 FM
		Comp		2414 AM
KRDN	Fullerton	Comp		33780 AM
KQBN	Gardena	SP		1730 AM
KQEG		Mtr		39100 AM
6XIJ	Gilman Peak	Mtr		75980 AM
KROB	Gilroy	Kaar		1674 AM
KQZL	Glendale	PDL		33940 AM
KQCI		PDL	Mtr	33220 AM
		PDL		33940 AM
KHPA	Glendora	Mtr		31100 FM
6XGL	Grapevine (Co)	Comp		116150 AM
KGVV	Grass Valley	Comp		35220 AM
KEWB	Hanford (Co)	Mtr		2414 AM
		Comp		30580 AM
KBJT	Hemet	Comp		37900 AM
KRMZ	Hermosa Beach	PDL		1674 AM
KANQ	Hillborough	Comp		1674 AM
KSPH		Comp		33220 AM
		Mtr		1674 AM
KDHB	Hollister (Co)	Comp		35100 AM
		Mtr		33780 AM
KQAL	Huntington Beh	Mtr		39900 FM
KIIPM	Huntington Pk	Mtr		35100 FM
KEZJ	Imperial (Co)	Comp		30580 AM
KQJH	Indio	Mtr		2442 AM
KQAD	Inglewood	RCA		39500 AM
KQCL	Inyokern (Co)	Wstg		2414 AM
KEVE	Inyokern (Co)	Comp		1658 AM
KKFD	Kensington Pk	Comp		35220 AM
		Comp		117750 FM
6XIA	Kings (Co)	Comp		33780 AM
KQEN	Laguna Beach	Mtr		1610 AM
KAVL	Lakeport (Co)	Mtr		33220 AM
		Mtr		33780 AM
KEZT	La Mesa	Comp		31900 AM
KQDD	Lancaster (Co)	Comp		31900 AM

KDHI	Larkspur	RCA		33220 FM
KESL	La Verne	Mtr		33200 FM
KQPZ	La Verne	Mtr		33220 AM
KRIM	Lindsay	Coll		2414 AM
KNGY	Lodi	Link	GE	39380 AM
		CECr		33100 AM
KBQW	Long Beach	REL	PDL	33100 AM
KQAO		Temc	CECr	33100 AM
		RCA		31780 AM
		REL		31780 AM
		RCA	Temc	33100 AM
		Comp		33100 AM
KQST		Comp		33100 AM
KQXJ		Comp		1730 AM
KGPL	Los Angeles	RCA		35100 AM
		CECr		35220 AM
		CECr		37920 AM
		CECr		3780 AM
		CECr		39380 AM
		Comp		1730 AM
		Comp		37500 AM
		Comp		1730 AM
		Comp		1730 AM
		Comp		1730 AM
6XKM		Comp		154850 AM
		Comp		75980 FM
KQBY	Los Angeles (Co)	Mtr		31900 AM
KRGU		PDL		31900 AM
KERL	Los Banos	Kaar		2414 AM
		Kaar		37920 AM
		Comp		117750 AM
6XHA	Lyons Peak (San Diego)	Comp		117750 AM
		Comp		35500 AM
KQHK	Lynwood	PDL		35500 AM
KFWH	Madera (Co)	Mtr		37780 AM
		Mtr		37900 AM
		Mtr		1610 AM
KRIB	Manhattan Beh	Comp		35220 AM
KEZB	Marin (Co)	Comp		1658 AM
KQKA	Martinez	Link		1658 AM
KRBS	Martinez (Co)	Link		35220 AM
KQCE		Comp		1790 AM
		Comp		30580 AM
KADS	Marysville	Mtr		39380 FM
		Comp		35500 AM
KHNJ	Maywood	Kaar		33780 AM
KQXY	Menlo Park	Comp		2414 AM
KQDP	Merced	Mtr		37920 AM
		Comp		2414 AM
KSOM	Merced (Co)	Mtr		37920 AM
		RCA		33220 FM
KDIO	Mill Valley	Mtr		33920 FM
KESJ		Comp		117750 AM
6XIJ	Modjeska Pk (Co)	Comp		75980 AM
6XIL		Comp		2414 AM
KQDQ	Modesto	Comp		39380 AM
		Comp		2414 AM
KASE	Modesto (Co)	RCA		2414 AM
		Comp		39380 AM
KQAG	Monrovia	Mtr		33500 AM
KQFE	Montebello	PDL		37900 AM
KRIE	Monterey	Mtr		1674 AM
		Mtr		35220 AM
		Mtr		31500 AM
6				





WSTX	E. St Louis	Mtr	33100 AM	WANT	Auburn	Bass	2490 AM	KPDO	Ottumwa	Coll	2466 AM
WQRY	Edwardsville (Co)	RCA	31100 AM	WBIP	Bedford	Mtr	30580 AM	KIGH	Polk (Co)	Mtr	31780 AM
WJYL	Elgin	WE	33100 AM	WBPD	Bloomington	Temp	2442 AM	KGPK	St Louis (City)	Mtr	35220 FM
WQNC	Forest Pk	WE	33100 AM	WAMI	Bluffton	RCA	30580 AM			RTL	31780 AM
WQXJ	Elmhurst	Mtr	37220 AM			Stnc	2442 AM			Mtr	37800 FM
WEG	Elmwood Pk	Mtr	37500 AM	WAMI	Bluffton	Comp	2490 AM				
WQLO	Evanson	Mtr	37500 FM	WALI	Cass (Co)	Mtr	30580 AM	KACA	Atchison	Comp	2422 AM
WBKL	Evergreen Pk	Mtr	33780 AM	WBTI	Clinton (Co)	Coll	30580 AM	KGZF	Chanute	Comp	30980 AM
WBKJ	Flossmoor	Mtr	33780 AM	WBHJ	Columbia City (Co)	Mtr	30580 AM	KGZP	Coffeyville	Mtr	2450 AM
WBNG	Forest Pk	Mtr	37100 AM	WGHQ	Columbia City	Kaar	30580 AM			Comp	33220 AM
WJVT	Franklin Pk	Mtr	31500 FM	WRJF	Columbus	Temp	2442 AM			Comp	2450 AM
WKGI	Freeport (Co)	Mtr	33940 FM	WAMB	Connersville	Coll	2442 AM	KRHU	Crawford (Co)	Mtr	30980 AM
WBYF	Galesburg	Mtr	37100 FM	WACP	Crawfordsville	Stnc	33220 AM	KNGH	Dodge City	Htr	31500 AM
WDA	Geneva (Co)	WE	35800 AM	WAGT	Crown Pt (Co)	Mtr	37100 FM	KAEQ	Douglas (Co)	RCA	33220 AM
WQLN	Glencoe	WE	35900 AM	WAXU	Dekalb (Co)	Mtr	30580 AM	KAPD	Eldorado	RCA	2450 AM
WAEX	Glen Ellyn	Mtr	37220 AM	WRQT	E. Chicago	D & F	33940 AM	KQUJ	Emporia	RCA	30580 AM
WGIL	Glenview	Eroo	37100 AM	WQGP	Elkhart	D & F	33940 AM	KNFJ	Garden City	Coll	2450 AM
WQYC	Grantville City	Mtr	30580 FM	WBVH	Elkhart	Bass	2490 AM	KBQN	Great Bend	Comp	2474 AM
WALG	Harrisburg	Comp	31100 AM	WABF	Elwood	Bass Mtr	30580 AM	KGHN	Hutchinson	Comp	30580 AM
WQOK	Harvey	Mtr	33940 FM	WETS	Evansville	Comp	33220 AM	KAPG	Iola	RCA	2450 AM
WMQD	Henderson (Co)	B & D	33940 FM	WQKB	Evansville	Link	30700 AM	KBNG	Junction City	Comp	31500 FM
WQRE	Highland Pk	Mtr	35900 AM	WBST	Ft Wayne	Link WE	30700 AM	KQHI	Kansas City	Mtr	30980 AM
WKMB	Highwood	Mtr	35900 AM	WPDZ	Frankfort	Harv	2490 AM	KRJC	Manhattan	Comp	2422 AM
WROG	Hinsdale	Mtr	37220 AM	WAKK	Frankfort	Link	30700 AM	KAMH	Newton	Comp	30580 AM
WSKD	Homewood	D & F	37500 FM	WAEF	Gary	RCA	2490 AM	KGKD	Parsons	Mtr	35220 FM
WBHY	Homewood	B & D	33780 AM	WSKI	Goshen (Co)	Comp	30580 AM	KPGK	Pittsburg	Mtr	31500 AM
WQLW	Joliet	Mtr	33100 FM	WSVP	Goshen	Comp	30580 AM	KNGV	Salina	Comp	2422 AM
WTFU	Kankakee (Co)	D & F	2458 AM	WQYK	Hamilton (Co)	Link	30700 AM	KGZC	Topeka	GE	30580 FM
		D & F	30580 AM	WRGW	Hammond	WE	30700 AM	KGZP	Wichita	Mtr	30580 AM
WKPD	Kenilworth	Htr	35800 AM	WBXD	Howard (Co)	Comp	30700 AM	KQJK	Wyandotte (Co)	WE	2450 AM
WAPC	LaGrange	D & F	30980 AM	WAKA	Huntington	Comp	30580 AM			RCA	35100 AM
WQLE	LaGrange Pk	Mtr	31500 FM	WSTA	Huntington (Co)	Comp	30580 AM				
WQLK	Lake Forest	Eph	31500 AM	WMDZ	Indianapolis	Mtr	30580 AM				
WBMG	Lansing	Dool	31500 AM	WLSM	Jasper	Comp	2442 AM				
WQKR	LaSalle	Mtr	30700 FM	WJAI	Jeffersonville	Link	30700 AM				
WQV	Lawrenceville	Mtr	35940 FM	WMHV	Jeffersonville	Comp	30700 AM				
WQV	Lewistown (Co)	Mtr	33940 FM	WPIY	Kokomo	Comp	2490 AM				
WSYW	Libertyville	Dool	33220 AM	WQFQ	Lafayette	Comp	2490 AM				
WDBT	Lincoln	RCA	31900 AM	WMPL	LaPorte	Comp	2490 AM				
WDBU	Lincoln (Co)	RCA	31900 AM	WMPJ	Logansport	Mtr	30580 AM				
WKR	Lincolnwood	D & F	33780 AM	WBMK	Madison (Co)	RCA	30580 AM				
WDCV	Lions	GE	31500 FM	WRAY	Marion	Temp	2490 AM				
WMQK	Madison	Mtr	39100 FM	WSF	Marion (Co)	Temp	30580 AM				
WSCI	Main Twp (Co)	D & F	31900 AM	WSVF	Michigan City	Mtr	33220 AM				
WQHX	Marion	Mtr	33940 FM	WSKP	Minawakia	Bass	2490 AM				
WBX	Mattson	Mtr	33940 FM	WBVG	Montgomery (Co)	Bass Mtr	30580 AM				
WZBZ	Maywood	GE	31500 FM	WBTY	Mt Vernon	Link	30700 AM				
WNGQ	McLean (Co)	RCA	31900 AM	WPCP	Muncie	Hygd	2442 AM				
WJXF	Midlothian	B & D	33780 AM	WBWV	New Albany	RCA	23320 AM				
WAON	Moline	Mtr	33500 AM	WBNC	New Castle	Mtr	39100 FM				
WMQS	Monmouth	Mtr	33780 FM	WKUO	Noblesville	Temp	33220 AM				
		Mtr	33940 FM	WASC	Peru	Mtr	33220 AM				
WMHI	Monmouth (Co)	Mtr	35780 FM	WBVT	Porter (Co)	Bass	30580 AM				
		Mtr	33940 FM	WHBB	Putnam (Co)	Mtr	35100 AM				
WSKJ	Morton Grove	D & F	33780 AM	WPDH	Richmond	Link	33220 FM				
WMTV	Mt Vernon	RCA	39500 FM	WKRI	Shelby (Co)	Harv	33220 AM				
WLEB	Mt Vernon (Co)	RCA	39500 FM	WSTL	Shelby (Co)	Comp	35500 FM				
WASJ	Mundelein	Mtr	33940 FM	WDPN	Shelbyville	Temp	2442 AM				
WMKU	Nameoki	Comp	33220 AM	WPGN	South Bend	Mtr	30580 AM				
WROA	Naperville	RCA	37500 AM	WQOF	Terre Haute	RCA	2490 AM				
WQJR	Normal	RCA	31900 AM	WMPV	Valparaiso	Comp	2490 AM				
WRLN	N. Chicago	D & F	33220 AM	WBXF	Vandeburgh (Co)	Harv	30580 AM				
WVWL	Oak Lawn	Dool	33780 AM	WQKT	Vincennes	Link	33100 AM				
WQFL	Oak Park	D & F Mtr	30580 AM	WBIE	Wabash	Harv	33100 AM				
WSRZ	Oglesby	Mtr	33940 FM	WBH	Wabash (Co)	Bass	2490 AM				
WQKN	Ottawa	Mtr	37100 AM	WBHM	Warsaw (Co)	Mtr	30580 AM				
WQFZ	Ottawa (Co)	Mtr	33940 FM	WJKM	Warsaw	Mtr	30580 AM				
WBZD	Park Ridge	GE	30700 FM	WHCR	Warsaw (Co)	Temp	2490 AM				
WQWT	Paxton	RCA	33940 FM	WRIP	Wayne (Co)	Mtr	33220 AM				
WTO	Pekin	RCA	33500 AM	WRMW	W. Lafayette	Comp	33500 FM				
WANU	Pekin (Co)	RCA	33500 AM	WQJD	Whiting	Mtr	30580 AM				
WRIM	Peoria	RCA	33500 AM	WBTH	Whitley (Co)	Comp	37100 FM				
WASE	Peoria (Co)	RCA	33500 AM	KBIE	Adams (Co)	Coll	35220 FM				
WRNK	Peoria Hgts	RCA	33500 AM	KQFW	Ames	Coll	2466 AM				
WQKM	Peru	Mtr	37100 AM	KQAR	Burlington	Coll	31780 AM				
WBHU	Pinellas (Co)	Mtr	33500 AM	KKLJ	Calhoun (Co)	Coll	35220 FM				
WBKPS	Princeton (Co)	Mtr	33940 FM	KCUA	Carroll (Co)	Coll	35220 FM				
WBHQ	Quincy	RCA	33500 AM	KHQD	Cass (Co)	Coll	35220 FM				
WBMQ	Riverdale	Mtr	33780 AM	KPLZ	Cedar Rapids	Coll	33220 AM				
WQIN	River Forest	Comp	37900 FM	KRIX	Clinton	Comp	3466 AM				
WRFX	River Grove	Comp	37900 FM	KPCB	Council Bluffs	Coll	33220 AM				
WJWS	River Grove	Mtr	31500 FM	KGPN	Davenport	Mtr	33780 FM				
WCEV	Riverside	GE	31500 FM	KHGX	Des Moines (Co)	Coll	31780 FM				
WPVC	Rockford (Co)	Comp	2458 AM	KGZG	Des Moines	Coll	2466 AM				
		Comp	31500 AM	KQDT	Dubuque	Coll	2466 AM				
		Mtr	33940 FM	KQZF	Fort Dodge	Coll	2466 AM				
WPGD	Rockford	Comp	2458 AM			Coll	33220 AM				
		RCA	31500 AM			Coll	37100 FM				
WBDI	Rock Island	Mtr	31500 AM			Coll	33220 AM				
WBXM	Salem (Co)	Mtr	33940 FM			Coll	33220 AM				
WAOL	Salem	Mtr	33940 FM			Coll	33220 AM				
WMQV	Saline	Mtr	33940 FM			Coll	33220 AM				
WQXJ	Skokie	Link	31500 AM			Coll	33220 AM				
WBNS	Shelot	RCA	31500 AM			Coll	33220 AM				
WQXJ	Springfield	WE	31500 AM			Coll	33220 AM				
		Mtr	31500 AM			Coll	33220 AM				
WRSC	Springfield (Co)	D & F Htr	39500 FM			Coll	33220 AM				
WJKE	St Charles	D & F Eroo	37100 AM			Coll	33220 AM				
WSTY	Taylorville (Co)	WE	35500 AM			Coll	33220 AM				
WJYF	Taylorville (Co)	Mtr	33780 FM			Coll	33220 AM				
		Mtr	33940 FM			Coll	33220 AM				
WAGR	Urbana	Coll	2458 AM			Coll	33220 AM				
		Mtr	30580 AM			Coll	33220 AM				
WBQY	Vandalla (Co)	Mtr	35940 FM			Coll	33220 AM				
WJAE	Venice	Mtr	39100 FM			Coll	33220 AM				
WBWJ	Vermillion (Co)	Mtr	30580 AM			Coll	33220 AM				
WBLS	Villa Park	Mtr	37220 AM			Coll	33220 AM				
		Mtr	37500 AM			Coll	33220 AM				
WSVI	Washington (Co)	Mtr	39500 FM			Coll	33220 AM				
WQPN	Waukegan (Co)	D & F Htr	31500 AM			Coll	33220 AM				
		D & F Eroo	31500 AM			Coll	33220 AM				
		Mtr	33220 FM			Coll	33220 AM				
WQLM	Waukegan	Mtr	33220 FM			Coll	33220 AM				
WJEC	Waukegan	Comp	33100 AM			Coll	33220 AM				
WDJR	W. Chicago	Mtr	37220 FM			Coll	33220 AM				
WCTU	Westchester	Mtr	31500 FM			Coll	33220 AM				
WKYZ	Western Spgs	GE	31500 FM			Coll	33220 AM				
WQJV	Wheaton	Link	39500 FM			Coll	33220 AM				
WQJW	Wheaton (Co)	Mtr	37220 FM			Coll	33220 AM				
		Mtr	37500 AM			Coll	33220 AM				
WJKO	Will (Co)	Mtr	33100 FM			Coll	33220 AM				
WDEY	Wilmette	Mtr	30700 FM			Coll	33220 AM				
WQTO	Winnetka	RCA	35900 AM			Coll	33220 AM				

**INDIANA**

WEDX	Alexandria	Comp	2442 AM
		Mtr	33220 AM
WSKG	Allen (Co)	Mtr	30580 AM
WBMK	Auderson (Co)	Mtr	154800 FM
			155130 FM
			155370 FM
WMPJ	Anderson	Comp	2442 AM
		Comp	33220 AM
WIUM	Angola (Co)	Comp	2490 AM

**IOWA**

KBIE	Adams (Co)	Coll	35220 FM
KQFW	Ames	Coll	2466 AM
KQAR	Burlington	Coll	31780 AM
KKLJ	Calhoun (Co)	Coll	35220 FM
KCUA	Carroll (Co)	Coll	35220 FM
KHQD	Cass (Co)	Coll	35220 FM
KPLZ	Cedar Rapids	Coll	33220 AM
KRIX	Clinton	Comp	3466 AM
KPCB	Council Bluffs	Coll	33220 AM
KGPN	Davenport	Mtr	33780 FM
		Coll	2466 AM
KHGX	Des Moines (Co)	Coll	31780 FM
KGZG	Des Moines	Coll	2466 AM
		RCA	30580 AM
KQDT	Dubuque	Coll	2466 AM
		Coll	31780 AM
KQZF	Fort Dodge	Coll	2466 AM
		Coll	33220 AM
		Coll	37100 FM
		Coll	33220 AM
		Coll	33220 AM
KBYS	Fort Madison	Mtr	33500 AM
KAWP	Iowa City	Coll	2466 AM
		Coll	33220 AM
KRHL	Marshalltown	Coll	2466 AM
		Coll	31780 AM
KQAE	Mason City	Mtr	2466 AM
		Mtr	31780 FM
KCHR	Muscatine	Coll	39900 FM
KQJI	Oakaloosa	Coll	2466 AM
		Coll	3

WHMD	Hagerstown	Mtr	31100 AM
WMQE	Halethorpe (Co)	Link	37500 FM
WJLW	Hyattsville (Co)	Link	39900 FM
WAOL	Hyattsville	Link	39900 FM
WAPP	Pikesville (Co)	Link	37500 FM
WMQA	Relisterstown (Co)	Link	37500 FM
WKYX	Rockville (Co)	Link	37900 FM
WBVQ	Salisbury	GE	35500 FM
WHMM	Silver Spg (Co)	Link	37900 FM
WFL	Towson (Co)	Link	37500 FM
WJLU	Upper Marlboro (Co)	Link	39900 FM
WQIA	Washington ('o)	Link	39100 FM
WMPX	Woodlawn (Co)	Link	37500 FM

### MASSACHUSETTS

WITY	Acton	RCA	35900 AM
		Link	33500 FM
		Mtr	39380 FM
WMKZ	Agawam	Mtr	39100 AM
WBRJ	Andover	Link	36580 AM
WPED	Arlington	Link	30700 FM
		Link	31900 FM
		Link	34500 AM
WBJA	Athol	HW	33780 AM
WBVC	Attleboro	HW	
WBHC	Auburn	HW	
WRAQ	Barnstable (Co)	Harv	39900 AM
		HW	39900 AM
WRAR	Barre (MDC)	Harv	37900 AM
WAMQ	Bellmont	GE	37300 AM
WRJZ	Beverly	Game	33940 AM
WRBP	Beverly	RCA	33940 AM
WAGJ	Boston	GE	35500 AM
WQIP	Boston	GE	35500 AM
WRAN	Boston	GE	30980 AM
		Temco	35500 AM
WRAG	Bourne (Co)	Harv	39900 AM
WBUA	Braintree	Stnc	37900 AM
WMPB	Brookline	Comp	1714 AM
		Comp	30980 AM
WQKK	Brookline	Link	33500 FM
WQLF	Cambridge	Link	33100 FM
		Link	39380 FM
		Link	33100 FM
WKWU	Chatham (Co)	Mtr	39900 AM
WEWE	Chelmsford	WE	37100 AM
WSTI	Chelmsford	WE	31100 FM
WAPL	Chelsea	Game	30580 AM
WBMT	Chicopee	Game	39900 AM
		RCA	37500 AM
WBGV	Clinton (MDC)	RCA	1714 AM
WPGU	Cohasset	Comp	37780 AM
		RCA	37900 AM
WRAC	Concord	RCA	37900 AM
WRAU	Danvers	Harv	33100 AM
WRJT	Dartmouth	Harv	31500 AM
WRNU	Dedham	WE	30700 AM
WDBI	Duxbury	Link	31900 FM
WAMT	Easthampton	Mtr	31780 FM
		Mtr	31900 FM
		Wstg	1714 AM
WAKF	Everett	GE	37780 AM
		GE	30700 FM
WFMP	Fairhaven	GE	30980 AM
		Wstg	1714 AM
WAKV	Fall River	Wstg	39380 AM
		Wstg	39980 AM
WQTL	Falmouth (Co)	Harv	39900 AM
WPHA	Fitchburg	WE	2466 AM
		WE	33220 AM
WKMF	Foxboro	GE	33780 AM
		GE	33940 AM
WJMG	Framingham	Link	35100 FM
		Link	31900 FM
WFKB	Franklin	Link	31900 FM
WBWZ	Gardner	WE	33940 AM
WGMP	Gloucester	Comp	2422 AM
		Comp	31780 AM
		GE	39900 FM
WKQT	Greenfield	Harv	39900 AM
WQTM	Harwich (Co)	Harv	39900 AM
WHAV	Haverhill	WE	31900 AM
WQNT	Hingham	Mtr	37100 AM
WQIF	Holyoke	Harv	31500 AM
		Harv	37780 AM
WEHB	Hudson	Comp	31500 AM
		Comp	31780 AM
WQYD	Hull	Comp	37100 AM
WQYE	Hull	Comp	37100 AM
WRJH	Hyannis ('o)	Harv	39900 AM
WMJQ	Ipswich	Mtr	37900 AM
WKDX	Kingston	Link	31900 FM
WBLC	Lawrence	RCA	39900 AM
WBND	Leominster	WE	33500 FM
WBTZ	Lexington	RCA	39900 AM
WBOQ	Lincoln	RCA	35900 AM
WBUI	Longmeadow	Wstg	33100 AM
		Game	37220 AM
WQNR	Lowell	WE	37100 AM
WKLM	Lynn	GE	30700 FM
		GE	33220 FM
WLDP	Lynnfield	Link	35900 FM
WBVC	Malden	Comp	1714 AM
		Comp	33220 AM
WBRT	Manchester	RCA	33940 AM
WAQO	Manchester	Mtr	33780 AM
		Mtr	33940 AM
WBVZ	Marblehead	RCA	33500 AM
WKWS	Marion	Comp	37900 AM
WJHU	Marshfield	Mtr	31900 FM
WPHG	Medford	Comp	1714 AM
		WE	31780 AM
WMEJ	Melrose	Link	39900 FM
WBGA	Methuen	Link	30700 FM
WMAH	Middleboro	Link	30580 FM
		Link	30700 FM
WQRT	Milton (MDC)	Link	35220 FM
		Link	37500 FM
WRBA	Milton	Harv	31500 AM
		Harv	35100 AM
WBVJ	Nantucket (Co)	Mtr	39380 AM
WQJH	Natick	Harv	39500 AM
		Harv	1714 AM
WMPN	Needham	Mtr	33220 AM
		Harv	39900 AM
WPFN	New Bedford	Mtr	31100 FM
WBMF	Newburyport	Link	37900 FM
WBWV	Newbury	Comp	1714 AM
WPFA	Newbury	Comp	1714 AM
		GE	31780 AM
WFZL	Norfolk	Link	37900 FM
WQOV	North Adams	RCA	37100 AM
WEIV	North Andover	Mtr	31500 AM
		Mtr	35100 AM
WBMB	Northampton	Mtr	31780 FM
		Mtr	31900 FM
WCET	Norwood	Link	31100 FM
WMOV	Osterville	Link	39900 AM
WAVN	Pembroke	Link	31780 FM
WEIW	Phillipston	Comp	31780 AM
		Comp	31900 AM
WJKH	Pittsfield	GE	30580 FM
		GE	31100 FM
WQYJ	Plymouth	Link	31900 FM
WNUZ	Provincetown	Link	39900 AM
WQRP	Quincy	Comp	37220 AM
		REL	39100 AM

WQID	Reading	RCA	37900 AM
WMPR	Revere	Wstg	1714 AM
		Wstg	33780 AM
WQYI	Rockport	Harv	33100 AM
		Harv	33220 AM
WRCG	Salem	Mtr	31500 AM
		Mtr	39380 AM
WHNS	Salisbury	Link	37900 FM
WAYU	Saugus	Harv	31900 AM
		Harv	35100 AM
WQOJ	Scituate	Comp	37400 AM
WQSO	Sharon	Harv	33100 AM
WBOG	Shrewsbury	Link	37900 AM
WPEH	Somerville	Mtr	31500 FM
		Mtr	35100 FM
WAMX	Southboro (MDC)	GE	37900 FM
WBTV	Southbridge	HW	31100 AM
WQMD	Springfield	Comp	33500 AM
		Wstg	39380 AM
WRHB	Stoneham	RCA	31100 AM
WKTb	Taunton	GE	37220 FM
WQTY	Tewksbury	HW	39100 AM
WKWM	Wakefield	Link	36580 FM
		Link	30700 FM
WHNQ	Walpole	Link	31100 FM
WRNA	Waltham	Wstg	1714 AM
		Wstg	37780 AM
WAGL	Ware (MDC)	RCA	37500 AM
WSTW	Wareham	Hfrv	37900 AM
WBNE	Watertown	GE	31900 FM
WMKW	Webster	HW	33220 AM
		HW	33500 AM
WQJG	Wellesley	WE	33780 AM
		Harv	37100 FM
WPBM	Wellfleet (Co)	Mtr	39900 AM
WBBM	W. Bridgewater	Mtr	30980 AM
WAKW	Westford	WE	37900 AM
WBVI	Westford	WE	37100 AM
WBTE	Weston	Link	33940 FM
WMWP	Westport	Comp	1714 AM
WFLI	W. Springfield	Mtr	39380 FM
WKYA	Westwood	GE	31100 FM
WGBU	W. Yarmouth (Co)	Mtr	39900 AM
		Harv	39900 AM
WRLQ	Weymouth	RCA	39900 AM
WJYI	Wilmington	RCA	37900 AM
WJWJ	Wilmington	Mtr	37900 AM
WJHV	Winchendon	Link	31100 FM
WQSV	Winchester	GE	37100 FM
		GE	37220 FM
WAKZ	Woburn	Mtr	33780 AM
		Mtr	39100 AM
WPGX	Worcester	Wstg	2466 AM
		Link	33780 AM
WMGT	Wrentham	Link	37900 FM
WQRF	Wrentham	Mtr	37500 FM
WQIH	Wrentham	Mtr	37500 FM
WQRH	Wrentham	Mtr	37500 FM

### MICHIGAN

WARZ	Albion	Link	33100 FM
WSKH	Allen Park	Comp	31500 AM
WQKV	Alpena	Mtr	31500 AM
WQRK	Ann Arbor	Comp	2466 AM
		Mtr	35100 FM
WQGS	Bad Axe (Co)	Mtr	33100 FM
WRLM	Battle Creek	Mtr	33100 FM
		Comp	33220 AM
WMLU	Battle Crk. Twp.	Comp	31000 FM
WPGA	Bay City	Comp	2466 AM
		Comp	31780 AM
WEKA	Bay City (Co)	Kaar	31780 AM
WBSV	Benton Harbor	Mtr	33100 FM
WRIZ	Berkley	Mtr	35600 AM
		Comp	39380 AM
WRJY	Birmingham	Comp	33500 FM
WQOG	Bloomfield Hills	Comp	31100 AM
		Comp	35100 AM
WBNR	Center Line	Harv	39900 AM
WBXK	Center Line	Mtr	39900 AM
WHNA	Charlottesville (Co)	Mtr	31000 FM
WRJA	Clawson	Comp	35500 AM
		Comp	39380 AM
WQND	Dearborn	Comp	33100 AM
		RCA	37780 FM
		Deol	37780 FM
WCK	Detroit	Coll	2430 AM
		Mtr	31780 AM
		Link	31780 FM
		Link	33780 FM
		Mtr	33780 FM
		Link	35220 FM
		Mtr	37220 FM
WPDx	Detroit	WE	2430 AM
		Link	39100 FM
WJHK	Dowagiac	Mtr	33100 FM
WAEZ	East Detroit	Mtr	39900 AM
WQMH	Eastland	Mtr	35900 FM
WATA	Escanaba	Mtr	35900 FM
WRJB	Ferndale	Comp	35500 AM
WQZY	Flat Rock	Mtr	37500 FM
WPIF	Flint	Coll	2466 AM
		Mtr	31780 AM
WYAG	Flint (Co)	Mtr	39500 FM
WSOJ	Grand Haven	Link	2442 AM
		Comp	33780 AM
WOMN	Grand Haven (Co)	Mtr	33100 FM
WCPN	Grand Rapids	Comp	2442 AM
WPFb	Grand Rapids	RCA	2442 AM
		Mtr	33100 FM
		Comp	33780 AM
WQMT	Grosse Pointe	WE	37100 AM
WRDR	Grosse Pointe	Comp	2466 AM
		Comp	30580 AM
WQFD	Hamtramck	Comp	37900 AM
WHUL	Hart (Co)	Mtr	33100 FM
WAVQ	Hastings	Mtr	33100 FM
WAVO	Hastings	Mtr	33100 FM
WJUG	Hazel Park	Comp	39380 AM
		Comp	35500 AM
WQVX	Hazel Park	Mtr	35500 AM
WMO	Highland Park	Mtr	2414 AM
		Mtr	32220 AM
WIHM	Holland	Mtr	33100 FM
WIJC	Huntington Wds.	Mtr	35500 AM
		Mtr	39380 AM
WPHP	Jackson	GE	33100 FM
		GE	33220 FM
WAUK	Jackson (Co)	GE	33100 FM
WAMG	Kalamazoo	Coll	2442 AM
		Mtr	33220 AM
		Mtr	33100 FM
WJVE	Kalamazoo (Co)	Mtr	33220 AM
WBVU	Kalamazoo (Co)	Comp	33220 AM
Lansing		Comp	33220 AM
WPIL	Lansing	Mtr	33100 FM
WQLL	Lincoln Park	Comp	31500 AM
WBLJ	Marquette	Mtr	30700 AM
WBPK	Marshall (Co)	Mtr	33100 FM

WDBM	Marysville	Comp	31780 AM
WMLF	Mason	Mtr	33100 FM
WRZQ	Menominee	Mtr	33500 AM
WBLA	Midland	Mtr	31500 AM
WQTB	Monroe	Comp	33220 AM
		Comp	37900 AM
WSRQ	Mount Clemens	Mtr	39900 AM
WRPV	Mt. Clemens (Co)	Mtr	2442 AM
WPFC	Muskegon	Comp	30580 AM
WBSU	Muskegon (Co)	Mtr	39380 FM
WBKD	Muskegon Hts.	Mtr	30580 AM
		Mtr	39380 FM
		Comp	39900 AM
WBHW	New Haven	Comp	30580 AM
WRQF	Niles	Comp	35500 AM
WDBK	Oak Park	Link	31100 AM
WOLX	Orchard Lake	Link	35100 AM
		Link	35100 AM
WQRZ	Oakland (Co)	Comp	35100 AM
		Comp	35100 AM
WAQM	Ovid	Mtr	2466 AM
WDDI	Owosso	Comp	2466 AM
		Mtr	33780 FM
		Mtr	33100 FM
WBXO	Parchment	Mtr	33220 AM
WRJD	Pleasant Ridge	Comp	39380 AM
		Comp	39380 AM
WQMG	Pontiac	Bass	31100 AM
		Mtr	35100 AM
WPGB	Port Huron	Comp	2466 AM
		Comp	31780 AM
WROQ	River Rouge	Link	33500 AM
		Comp	35100 AM
WRIR	Roseville	Mtr	39900 AM
WBWM	Royal Oak	Mtr	35500 AM
WQMB	Royal Oak	Comp	35500 AM
WQVX	Royal Oak Twp.	Comp	2442 AM
WPES	Saginaw	Comp	31780 AM
		Comp	31780 AM
WRNH	Saginaw (Co)	Comp	31780 AM
WSPV	St. Clair (Co)	Comp	39900 AM
WAGP	St. Clair Shs.	RCA	33100 FM
WBSQ	St. Joseph	Mtr	33100 FM
WSTJ	St. Joseph (Co)	Mtr	37900 FM
WCBQ	St. St. Marie	Mtr	37380 FM
WMLV	Spring Lake	Comp	2442 AM
WRMB	Traverse City	Comp	37220 AM
		GE	31900 FM
WQWN	Trenton	GE	35100 AM
WBVG	Washtenaw (Co)	REL	30980 FM
		REL	33940 FM
WQMF	Wayne (Co)	REL	31100 AM
		REL	31100 AM
WBOL	W. Bloomfield Twp.	REL	31100 AM
		REL	31100 AM
WRHV	Wyandotte	GE	39500 FM
WQOK	Ypsilanti	Mtr	31780 AM
		Comp	37100 AM

### MINNESOTA

KQBG	Austin	WE	371
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# Jensen

TYPE "RD"

## Reproducer

WITH THE NEW TYPE "H"  
ARTICULATED  
Coaxial



This new Reproducer, combining the Type "H" Coaxial speaker with the new Jensen Type "D" Bass Reflex cabinet, offers superior reproduction of your favorite program material and is unconditionally recommended for FM receivers, high quality phonograph reproduction, reviewing studios, monitoring, and home and public entertainment generally.

The cabinet is beautifully styled and fashioned of satin finish striped walnut. The harmonizing grille fabric is overlaid with a protecting pattern of flat, interlaced bronzed strips.

The Type "H" Coaxial, with all *ALNICO 5* design, employs a h-f horn and l-f (15-inch) cone which are electrically and acoustically coordinated to achieve brilliant and natural response throughout the entire useful frequency range. The frequency dividing network has variable control in the range above 4,000 cycles. Nominal input impedance to dividing network, 500 ohms; maximum power handling capacity 25 watts, in speech and music systems.

Model RD-151 Reproducer complete, approximate list price \$180.

\*Trade Mark Registered

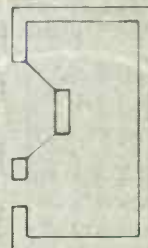
### JENSEN MANUFACTURING COMPANY

6609 S. LARAMIE AVE., CHICAGO 38, ILLINOIS

In Canada—Copper Wire Products, Ltd., 11 King Street, West, Toronto

### JENSEN BASS REFLEX

Acoustically-correct Bass Reflex Cabinet gives smoothly extended low register. Better than an "infinite" baffle . . . efficiently uses back radiation too.



*Specialists in Design  
and Manufacture of Fine  
Acoustic Equipment*

KBSO	Bozeman	Coll	2406 AM
KBPB	Butte	Dool WE	2406 AM
KGCR	Custer (Co)	WE Mtr	39380 AM
KROJ	Gallatin (Co)		39380 AM
KPGF	Great Falls	Comp	2406 AM
KHPM	Helena	Harv Mtr	39380 AM
		Temp D&F	2406 AM
KGKC	Kaipell	Coll	39380 AM
KFMW	Miles City	Dool	2406 AM
		Temp	39380 AM
KQKD	Missoula	Coll	2406 AM
		Temp	39380 AM

**NEBRASKA**

KANB	Alliance	GE	33940 FM
KRNK	Clearview (Co)	GE	37100 FM
KRAF	Falls City (Co)	Comp	2422 AM
KQAY	Grand Island	RCA Mtr	33000 FM
KRLX	Hastings	Mtr	30700 FM
KGZU	Lincoln	Coll	2490 AM
		Mtr	30580 AM
KNGN	Norfolk	Comp	2490 AM
KGWI	North Platte	Mtr	33500 FM
KRGP	Omaha	Mtr	33780 FM
		Mtr	33940 FM
KSDZ		Mtr	33940 FM
KRNY	Omaha (Co)	GE	37100 FM
KRKV	Scottsbluff	Mtr	33500 AM
KQWD	S. Sioux City	Mtr	31780 AM

**NEVADA**

KGHG	Las Vegas	Comp	2474 AM
		Mtr	30580 AM
KGHM	Reno	Comp	2474 AM
		Mtr	30580 AM
KGHC	Sparks	Mtr	30580 AM
		Mtr	39380 FM
KKWC	Washoe (Co)		39380 FM

**NEW HAMPSHIRE**

WKUY	Cheshire (Co)		33500 FM
WKTJ	Claremont	Mtr	35500 FM
WRXJ	Concord	WE Mtr	37900 AM
WMYQ	Dover	Mtr	30700 FM
WJLR	Keene	Mtr	33500 FM
WCOT	Lacoma	Mtr	30700 FM
WLLQ	Manchester	WE Mtr	31500 AM
WPHB	Nashua	WE Mtr	39500 AM
WKSA	Portsmouth	Mtr	33500 FM
WGAZ	Rochester	Mtr	39500 FM

**NEW JERSEY**

WMQZ	Allenhurst	Link	39900 FM
WROE	Alpine	Link	37780 AM
WSOE		Link	31900 FM
		Link	31780 FM
WABM	Asbury Park	Link	31100 AM
WTVH	Atlantic City	Comp	33100 AM
WLDN		Comp	33100 AM
WQIY		REL	33100 AM
WJZB	Atlan. Highlands	Link	37780 FM
WETQ	Audubon	RCA	39900 FM
WBSK	Avon by the Sea	Link	39900 FM
WIZN	Bay Head	Link	37780 FM
WQXN	Bayonne	Link	33500 AM
WBNT	Belleville	Link	33100 FM
WQNT	Beltmar	Link	37100 AM
WRJU	Bergenfield	Link	35900 FM
WAKH	Bloomfield	Wstg	2430 AM
		Link	37220 AM
WAKD	Bloomingtondale	Bod	37100 AM
WIUA	Bocota	Link	39500 AM
WFUA	Boonton	Link	37900 FM
WQKA	Bound Brook	Link	37900 FM
WQHW	Bradley Beach	Link	39900 FM
WSKA	Bridgeton	RCA	31100 AM
WDBX	Brielle	Link	37780 FM
WJVN	Brigantline	Link	33100 AM
WQNA	Budd Lake	Link	33100 AM
WBSX	Burlington	RCA	37900 AM
WANZ	Butler	Bod	37100 AM
WAFP	Caldwell	Link	37900 FM
WQNI	Camden	RCA	37100 AM
WCJR	Camden (Co)	Link	33500 AM
WKVZ	Carlstadt	Link	37780 AM
WANV	Carteret	Link	33100 FM
WAWX	Cedar Grove	Link	33100 FM
WEQZ	Clark Twp.	Link	31500 AM
WBYX	Cliffside Pk	Mtr	33500 AM
WSQO	Clifton	Link	31100 AM
WRZL	Closter	REL	39500 AM
WQNG	Collingswood	RCA	33500 AM
WQMC	Cranford	GE	33500 AM
		Comp	39380 AM
WRPR	Cresskill	Link	39900 AM
WQOQ	Deal	REL	33100 AM
WDHM	Dover	Link	33501 FM
WBWN	Dumont	Mtr	37500 AM
WETA	East Hanover	Link	35900 AM
WQKI	East Orange	Link	39500 AM
WFVJ	Eatonen	Link	37780 FM
WBOO	Edgewater	Link	39100 AM
WRAD	Elizabeth	REL	39100 AM
WHBA	Emerson	Link	37900 AM
WQJK	Englewood	Link	33500 AM
WBMC	Englewood Cliffs	Link	37780 AM
WJJE	Englishtown	Link	37780 FM
WRKY	Ewing Twp.	Link	33100 AM
WCAK	Fair Lawn	Link	37900 FM
WQYZ	Fanwood	RCA	31500 AM
WSRL	Florham Park	Link	35500 AM
WBYC	Fords	Link	37500 AM
WBKN	Fort Lee	Mtr	35500 AM
WAIH	Frehold	Link	37380 FM
WAKC	Frehold (Co)	Wate	2366 AM
		Link	37780 FM
WRQE	Garfield	Link	39100 AM
WGIP	Garwood	Mtr	39380 AM
WAVK	Guttenburg	Link	39900 FM
WHLJ	Hackensack	Link	37500 AM
WPFK	Hackensack (Co)	Link	2430 AM
		Mtr	37780 AM
WRBJ	Haddonfield	RCA	39500 AM
		RCA	39500 FM
WRKH	Haddon Twp.	Link	33500 AM
WRAN	Haddon Hgts	RCA	35900 AM
WBTK	Haledon	Link	35500 AM
WQJM	Hamilton Twp.	Link	33100 AM
WLSH	Hanover	Mtr	35900 AM
WBYX	Hasbrouck Hgts	Link	33100 FM

WRGN	Hawthorne	Link	39900 AM
WRNL	Hilchland Pk	GE	33940 FM
WSYL	Hillside	Link	35500 AM
WMFH	Hoboken	Mtr	35900 FM
WSRP	Hoboken	Link	37780 AM
WAAG	Interlaken	Link	37780 FM
WLBN	Irvington	Link	35900 FM
WQRS	Jersey City	Link	31900 AM
WRMN		Link	31900 AM
		WE	39900 AM
WRPH	Kearyn	Link	37780 FM
WDCM	Keyport	Link	37780 FM
WRBT	Lakewood	REL	37900 AM
WQJN	Lawrenceville	RCA	33100 AM
WRTH	Leonia	Link	35900 AM
WRBO	Lincoln Pk	Link	31500 AM
WAQJ	Linden	Link	31100 AM
WJKI	Little Falls	Link	33100 FM
WFAB	Little Silver	Link	37780 FM
WQMK	Livingston	RCA	35900 AM
WQNF	Long Branch	Link	37100 AM
WQMP	Longport	REL	37100 AM
WBTT	Lower Penns Neck	Mtr	35500 AM
WSOM	Lynhurst	Link	37500 AM
WQUJ	Madison	Link	35500 AM
WCCB	Mahwah	Bod	31100 AM
WMMJ	Manasquan	Mtr	37780 FM
WBYR	Manville	Mtr	31900 AM
WAPK	Maplewood	Link	37500 FM
WRLY	Marcata City	REL	37100 AM
WCBL	Matawan	Link	37780 FM
WKZB	Matawan	Link	37780 FM
WQMN	Maywood	Link	39100 AM
WQLT	Metuchen	WE	37100 AM
WQZD	Middlesex	Link	37900 AM
WBXZ	Middletown	Link	37780 FM
WRBX	Midland Park	Link	33500 AM
WQKJ	Milburn	Link	37100 AM
WRHR	Millville	RCA	33940 AM
WQMO	Montclair	Link	33220 AM
WRPM	Montville	Link	37100 AM
WGNQ	Moorestown	Link	37500 AM
WQNK	Moorestown	WE	39100 AM
WBNE	Mountainside	Mtr	33500 FM
WBOD	Mt Holly	RCA	30700 AM
WBYD	Neptune	Link	31900 FM
WQKJ	Neptune City	Link	37780 FM
WNHT	Newark	Comp	30700 AM
WQIE		Stnc	30700 AM
WQRE	New Brunswick	WE	33500 AM
		Game	39380 AM
WGSN	New Milford	Link	37900 AM
WRZR	N. Arlington	Link	31500 AM
		Link	31780 AM
WAHG	N. Bergen	Link	31100 FM
WBVF	N. Haledon	Link	35500 AM
WQJN	N. Plainfield	Bod	39500 AM
WRHG	Nutley	WE	37100 AM
WBMG	Oaklyn	RCA	33500 AM
WHMG	Oaklyn	RCA	39100 AM
WCBU	Oceanport	Link	37780 FM
WGMU	Oradell	Link	37900 AM
WQTS	Oran	WE	39500 AM
WPPP	Palisades Pk	Mtr	37100 AM
WBFE	Paramus	Link	33780 AM
WQKH	Passaic	Link	35900 AM
WRGO	Paterson	Link	35500 AM
WSPF	Pennsauken	RCA	39100 AM
WBBL	Penns Grove	Mtr	35500 AM
		Bod	35500 FM
WANX	Penquoanok	Link	37100 AM
WFTK	Perth Amboy	Link	37900 FM
WENN	Phillipsburg	Link	39500 FM
WQIY	Piscataway	Link	39900 AM
WAOW	Pitman	Mtr	39900 AM
WQKQ	Plainfield	Link	31500 AM
WQMQ	Pleasantville	Comp	37100 AM
WASN	Pt Pleasant	Link	37780 FM
WSWI	Pompton Lakes	Bod	37100 AM
WQTA	Princeton	Link	37100 AM
WRBI	Princeton	Link	37100 AM
WBTL	Prospect Pk	Link	35500 AM
WQYG	Rahway	WE	31500 AM
WQJC	Raritan	Link	37220 AM
		Link	39500 AM
WBWJ	Raritan Twp.	Link	37780 FM
WBJE	Red Bank	Link	39380 FM
WBKP	Ridgefield	Link	37500 AM
WSKM	Ridgefield Pk	Mtr	39500 AM
WQYF	Ridgefield	Link	35500 AM
WAKJ	Ringwood	Bod	37100 AM
WDDY	River Edge	Link	37780 AM
		Link	35900 AM
WQZQ	Roseland	Link	35500 AM
WQMY	Roselle Pk	Link	37500 AM
WQKQ	Rumson	RCA	35900 AM
WBMJ	Rutherford	Link	37900 AM
WMHT	Saddle River	Link	37780 AM
WSGK	Salem	RCA	35500 AM
WSPF	Secaucus Plains	Arvc	33500 FM
WFLU	Sea Cliff	Link	37780 FM
WQHL	Secaucus	Link	37100 AM
WRSO	Somerville	Mtr	31100 AM
WRJD	S. Belmar	Link	37780 FM
WBXJ	S. Bound Brook	Link	37900 AM
WQJG	S. Orange	Link	31900 FM
WABU	S. Plainfield	Mtr	39900 AM
WSLG	Sparta	Bod	31500 AM
WBHG	Springfield	Link	39100 FM
WRZA	Spring Lake	Comp	35500 AM
WSLI	Spring Lake Hgts	Link	37780 FM
WQJQ	Summit	RCA	39900 AM
WGVZ	Tenack	Link	31500 AM
WRGI	Tenafly	Link	39900 AM
WJKC	Totowa	Link	31500 AM
WQJZ	Trenton	RCA	33100 AM
WRPI	Trenton	RCA	33100 AM
WQJL	Union	Link	37900 AM
WQNY	Union City	Bod	33100 AM
WAVE	Upper Penns Neck	REL	35500 AM
WQKN	Ventnor City	REL	37100 AM
WBWH		Comp	37100 AM
WLDJ		Comp	37100 AM
		Link	37900 FM
WPHL	Verona	Link	37780 FM
WAKM	Wall Twp.	Link	37100 AM
WCWD	Washington	Bod	37900 AM
WSPE	Watchung	Bod	39500 AM
WSLC	Wayne	Link	31500 AM
WKGL	Wehauken	Mtr	31500 FM
WSQN	W. Caldwell	RCA	35900 AM
WQJN	Westfield	Link	33100 AM
WFOV	W. Long Branch	Link	37780 FM
WBNG	W. Milford	Bod	37100 AM
WQRN	W. New York	Link	37900 AM
WSKN	West Orange	WE	39500 AM
WUCO	West Paterson	Link	31500 AM
WRMZ	Westwood	Link	37900 AM
WBOJ	Whidwood	Link	31500 AM
WQJE	Woodbridge	Link	37500 AM
WRLV	Woodbury	RCA	31900 AM
WPLY	Woodlyne	RCA	33500 AM

**NEW MEXICO**

KGZX	Albuquerque	GE	39100 FM
KRIQ	Chaves (Co)	Mtr	33220 AM
KNFA	Clovis	Comp	2414 AM
KHMQ	Hobbs		39900 FM
KRNM	Roswell	RCA	33220 AM
		RCA	2414 AM
KGPF	Santa Fe	Comp	2414 AM

**NEW YORK**

WPGH	Albany	WE	2458 AM
WHDI	Amityville	Ero	35900 AM
WKNI	Amsterdam	GE	37900 FM
WMLG	Arcade	Mtr	37900 FM
WAUF	Armonk		35900 FM
WPDN	Auburn	def	2482 AM
		SP	39380 AM
WROI	Babylon	Ero	35900 AM
WRQP			35900 AM
WRJS	Batavia	RCA	33500 FM
WEJZ	Bath (Co)	Mtr	37900 FM
WJXL	Bear Mountain	REL	31900 FM
		REL	31780 FM
WHZT	Binghamton	Link	37900 FM
WPGJ		WE	2442 AM
WBDN	Briarcliff Manor	Bod	37100 AM
WQOY	Bronxville	RCA	37900 AM
WBZN	Broome (Co)		37900 FM
WMJ	Buffalo	RCA	2422 AM
		SP	39580 AM
WKQO		Mtr	37500 FM
		RCA	37220 FM
WCAV	Canandaigua (Co)	Mtr	37900 FM
WLTN	Canandaigua		37900 FM
WLTN	Canton (Co)	Link	2414 AM
WELU	Chappaqua	Bod	39100 FM
WBLF	Clarkstown	Bod	31100 AM
WKPI	Corning	Mtr	37900 FM
WBID	Cortland	Comp	2382 AM
		GE	35100 FM
WALK	Dunkirk	Mtr	37900 FM
WQLC	Eastchester	Bod	33100 AM
WHTU	Easthampton (Co)	Link	31900 FM
WKVI	East Hampton	Link	37500 FM
WANK	Ellicott (Co)	Mtr	31500 FM
WBLI	Elmira	Mtr	37900 FM
WKKE	Endicott	Link	33500 AM
WBID	Florida Park	Link	31500 AM
WIOH	Fonda (Co)	Mtr	37900 FM
WAFR	Freeport	Ero	37900 AM
WBIC	Fulton	Link	33500 AM
WQCO	Garden City	Ero	37100 AM
WAZS	Genesee (Co)	Mtr	37900 FM
WQOU	Geneva	Mtr	31500 AM
WRJG	Glen Cove	Ero	2490 AM
		Ero	33780 AM
WJQL	Gloversville		33100 FM
WQHS	Goshen (Co)	Mtr	37900 FM
WBVK	Grand View		37900 FM
	on Hudson	Ero	31100 AM
WQKZ	Greenburgh	Bod	33100 AM
WBRX	Hanover	Mtr	37900 FM
WQLX	Harrison	Bod	37500 AM
WBLG	Haverstraw	B	

# fm



Complete 1 KW or  
3 KW Transmitter.



Complete 250 Watt  
FM Transmitter. This  
unit is also used as  
the exciter for higher  
powered transmitters.

## New! . . . SIMPLIFIED PHASE SHIFT MODULATION and DIRECT CRYSTAL CONTROL

- **SIMPLICITY**—Recognizing Phase Shift Modulation as the best method of Modulating, Raytheon has engineered greater stability, and efficiency into this method by exclusive and greatly simplified circuit design.
- **RUGGED DEPENDABILITY**—Direct crystal control, independent of modulation, gives positive and automatic control of the mean carrier frequency. Simple linear type tank circuits are used for all stages operating in the FM band—cannot get out of tune or adjustment.
- **EFFICIENCY**—Every circuit is completely shielded to eliminate power losses by radiation, interaction and parasitic oscillation.
- **UNIT CONSTRUCTION**—Buy now only the power you need and add a unit for increased power later. All units are perfectly matched in size, styling and colors.
- **EASY INSTALLATION**—Unit dimensions have been held to convenient cubicle sizes for moving through standard doors, in elevators, etc.
- **LASTING ECONOMY**—Not only is the purchase price of a Raytheon transmitter less but your savings continue through lower operating costs achieved by greater operating efficiency, lower power consumption and long life quality tubes and components.
- **OPERATING SAFETY**—Complete power interlock and an automatic shut-off of power when rear doors are opened provide absolute safety for all operating personnel.

*but by*

# RAYTHEON

YES, there is a difference. FM by Raytheon is a greatly simplified, more dependable Phase Shift Modulation that is entirely new. Do not be satisfied with complicated, older circuits when Raytheon can give you this important improvement plus many more exclusive features—and at a lower price.

## RAYTHEON MANUFACTURING COMPANY

Broadcast Equipment Division  
7517 No. Clark Street, Chicago 26, Illinois  
Devoted to Research and Manufacture for the Broadcasting Industry

# RAYTHEON

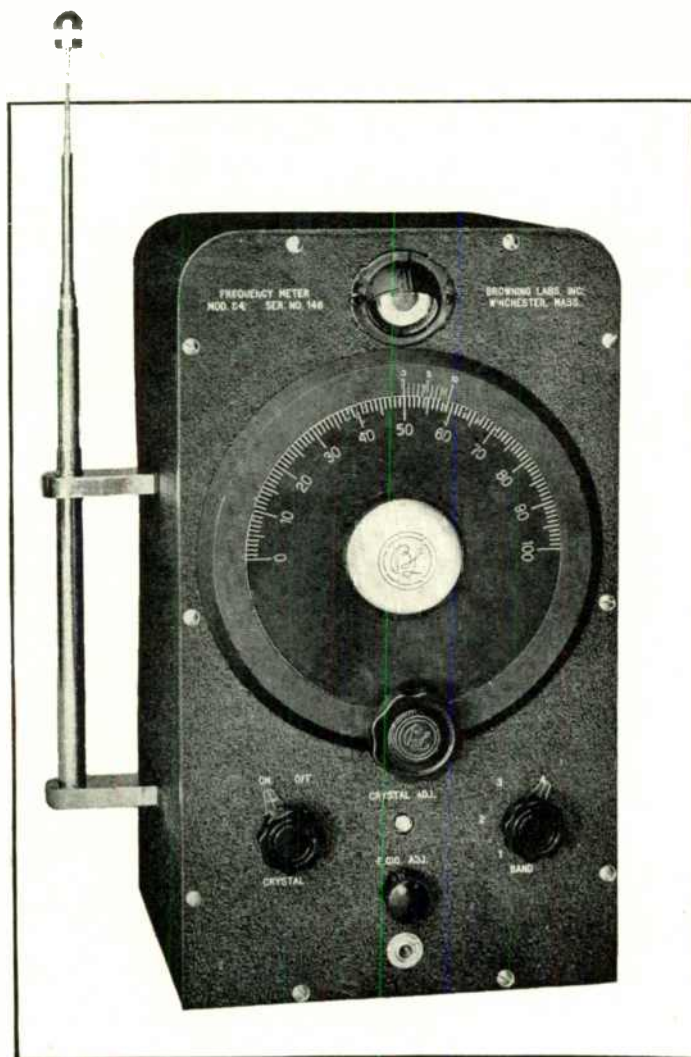
*Excellence in Electronics*

WQFJ	Oneonta	Comp		2414 AM	WNKQ	Campbell	Link	WE	37220 AM	WQWQ	Will-O-Wisak	RCA	Mtr	31500 AM
WBVJ	Onondaga (Co)	Link	Harv	30580 AM	WQKW	Canton	Link	WE	33100 AM	WNEG	Wooster	RCA	Mtr	39500 FM
WNQH	Oesining	Bod		37780 FM	WBZY	Canton (Co)	Link	GE	39380 FM	WBVA	Wyoming	GE	Mtr	2458 AM
WMVE		BRL		37100 AM	WJWO	Champaign (Co)	Mtr		37900 FM	WPDG	Youngstown	Comp		37220 AM
WJZX	Oswego (Co)	Mtr		37900 FM	WJJO	Chardon (Co)	Mtr		2430 AM	WRMY	Youngstown (Co)	Link		37220 AM
WRNE	Patchogue	Arvc		2490 AM	WRIC	Chillicothe	Temc		3320 AM	WFHO	Zanesville	Wstg		2430 AM
WBZW	Peekskill	Arvc		37780 AM	WKDU	Cincinnati	RCA		1706 AM			Comp		33220 AM
WDAG	Pelham	RCA		31500 AM			RCA	Mtr	30580 AM					
WQOT		Bod		37100 AM			Mtr		35220 FM					
WFJU	Pelham Manor	Link		37100 AM					35500 FM					
WQOS		Link		37100 AM					2458 AM					
WRHE	Piermont	Bod		31100 AM					33500 AM					
WDGS	Plattsburg	GE		37100 FM					2458 AM					
WRND	Port Chester	Link		33500 AM					30580 AM					
WQXY	Port Jefferson	Arvc		2490 AM					30980 AM					
WABN	Port Wash.	Link		33100 FM					31780 AM					
		Ereo		35220 AM					33100 AM					
		Ereo		2490 AM					33500 AM					
		RCA	Mtr	30700 AM					33780 AM					
WRCV	Poughkeepsie	RCA	Mtr	31100 AM	WRPD	Cleveland Hgts	GE		37500 FM					
WBHL	Ramapo	Hod		31900 FM	WRSO	Clyde	Comp		30580 AM					
WJPV	Riverhead (Co)	Link		31900 FM	WLDO	Columbus	RCA	Wstg	2430 AM					
WPDR	Rochester	Link	WE	31900 FM	WPID		Mtr		37220 AM					
		RCA	Harv	30580 AM					37220 AM					
		RCA	Mtr	35500 FM					37800 FM					
WRAH	Rockville Centre	Mtr		37900 FM					37900 FM					
WKHZ	Rome	Bod		31900 AM					37900 FM					
WKHU	Rye	GE		37900 FM					37900 FM					
WBSB	Salamanca	Bod		35900 AM					37900 FM					
WQHZ	Sands Point	Ereo		33100 AM					37900 FM					
WQKL	Scarsdale	Bod		33100 AM					37900 FM					
WQRB	Schenectady	GE		37100 FM					37900 FM					
WBQJ	Schenectady (Co)	GE		39500 FM					37900 FM					
WJJO	Sherman	Arvc		31500 FM					37900 FM					
WBWN	Siatsburg	Mtr		31100 AM					37900 FM					
WAFV	Smithtown Br.	Bod		31900 AM					37900 FM					
WHTS	Southampton (Co)	Link		31900 FM					37900 FM					
WHTT	Southold (Co)	Link		31900 FM					37900 FM					
WBVR	South Nyack	Bod		31100 AM					37900 FM					
WSWJ	Sparkill	Link		31100 AM					37900 FM					
WBLL	Spring Valley	Bod		31100 AM					37900 FM					
WBLM	Suffern	Bod		31100 AM					37900 FM					
WPEA	Syracuse	WE	GE	2382 AM					37900 FM					
		Mtr	GE	37500 FM					37900 FM					
		RCA	WE	30980 AM					37900 FM					
		Mtr	WE	37780 FM					37900 FM					
WBLN	Tarrytown	Mtr		35500 FM					37900 FM					
WRCD	Troy	RCA		33100 AM					37900 FM					
WQJD	Tuekaho	Bod		33100 AM					37900 FM					
WBLO	Upper Nyack	Bod		31100 AM					37900 FM					
WPJG	Utica	GE		31500 FM					37900 FM					
WQJK	Viola (Co)	Bod	Mtr	31100 AM					37900 FM					
WMLJ	Wassaw	Mtr		37900 FM					37900 FM					
WBPE	Wassaw Twp (Co)	Mtr		37900 FM					37900 FM					
WCDX	Watertown	GE		37100 FM					37900 FM					
WMJN	Watervliet	Mtr		37900 FM					37900 FM					
WJKS	White Plains (Co)	Mtr		30580 FM					37900 FM					
		Mtr		30700 FM					37900 FM					
WQKS	White Plains	WE		37100 AM					37900 FM					
WRNJ	Williamsville	Link		31500 FM					37900 FM					
WPFY	Yonkers	WE		2442 AM					37900 FM					
		Link		37220 FM					37900 FM					

### NORTH CAROLINA

WFPS	Asheville (Co)	Comp		2474 AM	WAWI	Knox (Co)	Mtr		37900 FM	WQWQ	Will-O-Wisak	RCA	Mtr	31500 AM
WQMJ	Burlington	Comp		30580 AM	WHTL	Lakewood	Mtr		37900 FM	WNEG	Wooster	RCA	Mtr	39500 FM
WRIE	Charlotte	Link		33500 AM	WQFO	Lancaster	Temc		33220 FM	WBVA	Wyoming	GE	Mtr	2458 AM
WPID		Link		35900 FM	WIIA	Licking (Co)	Mtr		30580 FM	WPDG	Youngstown	Comp		37220 AM
WRPL		GE		35900 FM	WAFU	Lima	RCA	Wstg	37900 FM	WRMY	Youngstown (Co)	Link		37220 AM
		Link		33940 FM			Wstg		2474 AM	WFHO	Zanesville	Wstg		2430 AM
WSLF	Charlotte (Co)	Link		37900 FM	WBMZ	Lockland	RCA		37900 FM					
WQNE	Concord	Link		33100 AM	WBOH	Logan	Mtr		31500 AM					
WDPM	Durham	Coll Link		33100 AM	WLOP	Lorain	Mtr		37100 FM					
WQZE	Edison	Link		35900 FM	WRMY	Mahoning (Co)	Link		37220 AM					
WBVI	Elizabeth City	Link		35900 FM	WMGW	Mansfield (Co)	Link		37500 FM					
WROS	Fayetteville	Link		33500 FM	WQFY	Mansfield	Mtr		37900 FM					
WRPU	Forsyth (Co)	Link		33500 AM	WMVH	Maple Heights	Mtr		37900 FM					
WQNZ	Gastonia	Coll WE		37100 AM	WRGL	Marietta	RCA		31500 AM					
		Link		37100 FM	WJJI	Marion	Temc		2474 AM					
WABQ	Greensboro	Link		35900 FM	WBGJ	Martinsville	Temc		30980 AM					
WQMR	Greensboro	Link		37100 AM	WMOP	Mentor	Link		37100 AM					
WLGS	Greensboro (Co)	Link		37100 AM	WAIB	Mentor-on-the-Lake	Mtr		31500 AM					
		Link		37220 FM	WMGV	Miami (Co)	Mtr		37900 FM					
WJPT	Greenville	Link		35900 FM	WHVB	Middletown	Mtr		36900 AM					
WHPK	High Point	Link		37500 AM	WBYA	Montgomery (Co)	Mtr		31780 AM					
WDBR	Iredell (Co)	Link		39500 FM	WVNV	Montgomery	Mtr		37900 FM					
WIUD	Kings Mtn.	Link		33940 FM	WVNV	Montgomery	Mtr		37900 FM					
WQLR	Kinston	Link		35900 FM	WQRW	Newark	RCA	D&F	30580 FM					
WBJF	Leakeville	Link		37500 AM			Mtr		30580 FM					
WBNL	Lenoir	RCA	Mtr	37500 AM	WRQL	Niles	Link		37500 AM					
WRNT	Lexington	Link		33100 AM	WQRW	N. Newark	Link		37900 FM					
WSLF	Mecklenberg (Co)	Link		39080 AM	WQUM	Norwalk	Mtr		37900 FM					
WKZM	Monroe	GE		39500 FM	WBYG	Norwood	Mtr		38080 AM					
WBXT	Morganton (Co)	Mtr		37500 AM	WBKC	Oakwood	Mtr		38500 AM					
WQME	Mount Airy	GE		35900 FM	WQOL	Ottawa Hills	GE		31500 FM					
WADKX	New Bern	GE		35900 FM	WKHL	Palmersville	Mtr		37900 FM					
WBTK	Newton (Co)	Mtr		37500 AM	WBOK	Palmersville (Co)	RCA		31800 AM					
WGLY	Raleigh	Link		31500 AM	WQZC	Parke (Co)	Mtr		37900 FM					
WRPW	Railsville	Link		37500 AM	WKYP	Perryburg	Mtr		37900 FM					
WQLI	Rocky Mount	RCA		33500 AM	WQTF	Piqua	Mtr	WE	37106 AM					
		Link		33500 FM	WSTM	Port Clinton	Mtr		37100 AM					
		Link		33500 FM	WPGI	Portsmouth	Comp		2480 AM					
WATU	Rutherfordton (Co)	Link		33500 FM			Stnc		30580 AM					
WQLU	Salisbury	Link		33100 FM	WFRK	Ravenna (Co)	Link		37900 FM					
WANY	Shelby	Link		37500 AM	WRAA	Ravenna	Link		37900 FM					
WDBS	Statesville	RCA		33940 FM	WCDE	Reading	Mtr		37900 AM					
WETO	Thomasville	Link		39500 FM	WAFX	Rocky River	Link		39500 FM					
WJIZ	Wayne (Co)	Link		45900 FM	WJBS	St. Bernard	Mtr		37500 AM					
WDPW	Wilmington	Link	Mtr	39380 FM	WAKL	St Charlesville (Co)	Comp		2480 AM					
		Link	Mtr	39500 FM	WBOW	Salem	Link		37100 FM					
WQNU	Wilson	Link	RCA	33500 AM	WAKI	Sandusky	Comp		37100 FM					
WQMS	Winston-Salem	Link	RCA	33500 AM			GE		30980 FM					

**The new Model S4 meets all FCC requirements for the emergency services. AC-DC operation**



## *More Miles Per Watt for All Police and Special Emergency Systems*

**A**RE you getting second-rate performance from a high-priced, first-class communications equipment? Unless you are using a precision frequency meter, such as the BROWNING crystal-controlled Model S4, to check your transmitters, you don't know the answer to that question!

It's not unusual for off-frequency operation to reduce the range of a transmitter 50% or more. If that's the case with some of your transmitters, it is also likely that you are causing interference on adjacent channels,

and violating FCC rules.

Consult the supervisor of any communications system that is maintained at top efficiency, and it's 100 to 1 that he'll tell you: "Every one of my transmitters is checked regularly with a BROWNING Frequency Meter."

A BROWNING Model S4, calibrated to your particular assigned frequencies, is an investment in economy, for it will enable you to get the full dollar-value of performance from your equipment. For complete details and prices, address:

# **BROWNING LABORATORIES, Inc.**

Engineers & Manufacturers

Winchester, Massachusetts

July 1946 — formerly FM, and FM RADIO-ELECTRONICS

45

WQLS	Erie	Wstg Dool	RCA	37100 AM
WBGH	Farrell	Comp		37000 FM
WKXX	Folsom	Mtr		31780 AM
WBRA	Foster Twp.	Link		37000 FM
WGQD	Fox Chapel Boro	Comp		39380 FM
WRJX	Glennolden	Link		37900 AM
WQHP	Hanover	REL		37900 AM
WQOH	Harrisburg	RCA		33940 AM
WBWA	Huntingdon Valley	Link		37500 FM
WREZ	Ingram	Link		33500 AM
WRMA	Jeannette	RCA		33940 AM
WBK(O)	Jenkintown	Link		33940 AM
WRHW	Kingston	RCA		31100 AM
WQTV	Lancaster	Mtr		37100 FM
WQNB	Lansdowne	RCA		39500 AM
WRLH	Latrobe	RCA		35900 AM
WBMV	Lebanon	Link		35900 FM
WBXR	Lewistown	Mtr		33500 AM
WBNB	Lock Haven	RCA		33500 AM
WRRII	Marple Twp.	Mtr		33500 AM
WQIC	McKeesport	RCA		33100 AM
WRGZ	Meadville	RCA		37100 AM
WBXX	Meda	Mtr		31780 AM
WBHF	Milton	GE		35500 FM
WQFP	Monessen	Link		39500 FM
WIEQ	Monongahela	Link		39500 FM
WRMC	Morrisville	RCA		33100 AM
WANF	Nether Prov. Twp.	Comp		31780 AM
WPCT	New Castle	Comp		2482 AM
WLDI	New Kensington	Link		37780 FM
WMCN	Norristown (Co)	GE		31900 FM
WQMU		RCA		2366 AM
WRIIY	Norwood	RCA	Link	30580 FM
WRPH	Oil City	Comp		37900 AM
WBLL	Parkside	Comp		2482 AM
WRGQW	Philadelphia	Mtr		31780 AM
WRDP		RCA		2474 AM
WQNJ	Phoenixville	Mtr		30980 FM
WMLK	Pittsburgh	RCA		30700 AM
WPDU	Pottsville	Link		37500 FM
WPIM	Upper Prov. Twp.	Link		1714 AM
WJPP	Pottsville	Link		39900 FM
WSTQ	Prospect Pk	Link		39380 FM
WPF	Reading	Link		35900 FM
WABH	Ridley Pk	Comp		2442 AM
WBHE	Rose Valley	Comp		37920 AM
WQTV	Scranton	RCA	Link	31780 AM
WBXP	Sewickley	WE		31100 AM
WQIA	Sewickley Hgts	WE		33100 AM
WRBY	Shaler	Link		39380 FM
WQFA	Sharon	Link		31500 FM
WQOC	Sharon Hill	RCA	GE	37900 AM
WRMU	Southampton	Link		30580 FM
WRUQ	Spring City	Link		30580 FM
WRST	Springfield (Co)	CECO		31780 AM
WJZD	State College	Mtr		3780 AM
WPFQ	Swartmore	Comp		2474 AM
WBOI	Tinleum	Link		31780 AM
WQTN	Uniontown	Link		39100 FM
WBYN	Upper Dublin Twp.	Link		31780 AM
WBLL	Upper Dublin Twp.	Link		31780 AM
WANF	Wallingford	Mtr		3780 AM
WENZ	Warren	Link		31100 FM
WKYR	Washington	Link		39500 FM
WIUY	Waynesboro	Mtr		33500 AM
WQNV	West Chester	RCA		33100 AM
WMIU	West Mifflin	Link		37500 FM
WTFD	West View	Link		39380 FM
WQOH	Wilkes-Barre	Wstg		2442 AM
WGOH	Williamsport	RCA	Mtr	33100 AM
WSBV	Willow Grove	RCA		33940 AM
WRLO	Yeaton	Link		33940 FM
WKYS	York	Mtr		37780 AM
WAKX		RCA		2442 AM

**RHODE ISLAND**

WBRI	Bristol	Comp		1714 AM
WKAA	Central Falls	Mtr		39380 AM
WPKG	Cranston	Comp		2466 AM
WPEI	E. Providence	Link		31780 FM
WMPH	Newport	Comp		33220 AM
WPFV	Pawtucket	Comp		1714 AM
WPGF	Providence	Comp		30580 AM
IXVI		Wstg		2466 AM
WPIA	Warren	Wstg		39380 AM
WSYV	Warwick	RCA	WE	1714 AM
WNIZ	Wickford	Abbt		11650 AM
WPMM	Woonsocket	Abbt		11690 AM
		Abbt		11730 AM
		Comp		1714 AM
		HW		2466 AM
		Mtr		37780 FM
		Link		37100 FM
		Mtr		39900 FM
		Mtr		35100 FM

**SOUTH CAROLINA**

WRJQ	Anderson	Link		37500 AM
WCPC	Charleston	Wstg		2430 AM
WCMP	Columbia	Link		2430 AM
WMYR	Florence	Link		37500 FM
WBDW	Gaffney	Link		37500 FM
WQLG	Greenville	RCA	Mtr	33100 AM
WSVQ	Greenwood	Mtr		33500 AM
WJKE	Rock Hill (Co)	Mtr		37780 AM
WPRH	Rock Hill	Wstg		2430 AM
WSSC	Spartanburg	Coll		2430 AM
WLAH	Sumter	Coll	Mtr	33220 AM
		Link		33100 FM

**SOUTH DAKOTA**

KAWC	Aberdeen	Dool		39100 AM
KRQA	Aberdeen (Co)	Mtr		39100 FM
KVPB	Huron	Coll		2450 AM
KQSP	Mitchell	Mtr		31500 AM
KNGM	Rapid City	Comp		2450 AM
KHQR	Redfield	Mtr		39380 FM
KBTY	Sioux Falls	Mtr	D&F	39100 FM
KSDT	Spink (Co)	Mtr		33100 AM

KQMJ	Watertown	Mtr		37900 AM
KQXR	Yankton	Mtr		31500 AM
WHTW	Bristol	Link		37900 FM
WPHV	Chatanooga	Coll	RCA	33100 AM
WRCK	Chatanooga (Co)	Link		33100 AM
WFJN	Cleveland	Link		33500 FM
WNOS	Dyersburg	Link	WE	39500 AM
WBSV	Dyersburg	Link		2422 AM
WPHY	Elizabethton (Co)	Comp		2474 AM
WRSJ	Jackson	Mtr		31500 FM
WPGZ	Johnson City	Comp		2474 AM
WQTV	Kingsport	GE		35100 FM
WPFO	Knoxville	Harv		37100 AM
WRCK	Lookout Mtn.	Link		2474 AM
WPEC	Memphis	Link		30580 FM
WBYH	Nashville	RCA	WE	2466 AM
WRHT	Nashville (Co)	Link	RCA	30580 AM
WBTB	Paris	GE		37100 FM
WRLX	Union City	Comp		37900 AM

**TENNESSEE**

**TEXAS**

KADR	Ablene	Mtr		2458 AM
KAER	Alamo Heights	Mtr	RCA	30980 AM
KQZW	Amarillo	Stnc		2458 AM
KQDH	Amarillo	Mtr		33220 AM
KFTX	Anahuac	Comp		2466 AM
KBHI	Angleten	Comp		30580 AM
KGIH	Austin	Comp		1714 AM
KGPJ	Beaumont	Comp		37220 AM
KETB	Beeville (Co)	Link	HM	37220 AM
KPBT	Bexar (Co)	Mtr	WE	1714 AM
KACM	Big Spring	Comp		33220 AM
KGCV	Borger	Kaar		2466 AM
KGHT	Brownsville	Mtr		30580 AM
KNGW	Brownwood	Comp		2382 AM
KPBR	Bryan	Mtr		35100 AM
KHIV	Carthage	Comp		2458 AM
KRSY	Carthage	Coll		30580 AM
KNGE	Cleburne	Mtr		1714 AM
KGHV	Corpus Christl	Comp		30580 AM
KRGA	Corsicana	Comp		33220 AM
KVPA	Dallas	Mtr		30980 AM
KQAT	Dallas (Co)	Mtr		1714 AM
KRMB	Dalson	Mtr		33220 AM
KNHF	Denton	Mtr		31500 AM
KPDE	Electra	Comp		1714 AM
KGZM	El Paso	Comp		2414 AM
KRIV	El Paso (Co)	Comp		33100 AM
KAAV	Ennis	Comp		33100 AM
KRGU	Florencia (Co)	Mtr		35100 FM
KQAN	Fort Worth	Comp		33220 AM
KRLJ	Galveston	Comp		33100 AM
KADM	Gainesville	Coll	RCA	1714 AM
KGCT	Galveston (Co)	Comp		30580 AM
KRPW	Galveston	Link		33220 AM
KHGC	Goose Creek	Comp	RCA	1714 AM
KISE	Grand Prairie	Comp		33220 AM
KFKL	Grayson (Co)	Comp		39100 FM
KIFH	Greenville	Comp		31500 AM
KDLV	Henderson	Comp		35100 FM
KQGN	Highland Pk	Comp		1714 AM
KHPR	Houston	RCA		37100 AM
KHTP	Houston	RCA		1714 AM
KHQR	Houston (Co)	Comp		33220 AM
KHCZ	Houston (Co)	Comp		35500 FM
KHPA	Howard (Co)	Comp		33220 AM
KKPD	Kilgore	Comp		1714 AM
KACU	Longview (Co)	Comp		33220 AM
KGZV	Lubbock	Comp		1714 AM
KQDN	Lufkin	Comp		2458 AM
KADT	Marshall	Mtr		33220 AM
KTWP	McKinney	Comp		1714 AM
KQXW	Mexia	Mtr		37220 AM
KRLE	Midland	Comp		2458 AM
KRPJ	Midlothian	Comp		33220 AM
KRAN	Nacogdoches	Kaar		35100 FM
KWSP	Newgulf (Co)	RCA		1714 AM
KBGC	Odessa	RCA		37220 AM
KOTP	Olmos Pk.	Kaar		2458 AM
KEZU	Orange	Comp		35100 FM
KPAM	Pampa	Comp		33220 AM
KQKM	Paris	Kaar	Link	37220 AM
KPPD	Paradena	Mtr		2466 AM
KRKQ	Plainsville	Comp		1714 AM
KPAT	Port Arthur	Link		33220 AM
KASD	San Angelo	Comp		2442 AM
KGZE	San Antonio	Comp		33220 AM
KQIS	Sherman	RCA	Mtr	2482 AM
KAPJ	Sweetwater	WE		33500 AM
KRKY	Temple	RCA		2442 AM
KTWL	Texas City	Comp		31500 AM
KQJB	Terrell Hills	Comp		1714 AM
KQCF	Tyler	Comp		33220 AM

KQZI	University Pk	GE	Mtr	31500 AM
KHZZ	Vernon	Comp		30580 AM
KBLB	Vernon (Co)	Comp		2458 AM
KEPL	Victoria (Co)	Comp		30580 AM
KGZQ	Waco	Comp		1714 AM
KQIH	Waxahachie	Comp		30580 AM
KRRK	Waxahachie (Co)	Mtr		35100 FM
KRIW	Westover Hills	Mtr		1714 AM
KHQK	West University Pl.	Mtr		33100 AM
KWSO	Wharton (Co)	Comp		33220 AM
KGZI	Wichita Falls	Link		1714 AM
		Link		33220 AM
		Comp		2458 AM
		Comp		30580 AM

**UTAH**

KBUO	Brigham City	Mtr		37500 FM
KBIJ	Farmington (Co)	Mtr		35780 FM
KHGB	Helper City	Mtr		35900 FM
KHQW	Logan	Mtr		37500 FM
KBGZ	Logan (Co)	Mtr		35780 FM
KSHA	Midvale	Mtr		35780 FM
KBPJ	Morgan (Co)	GE		35780 FM
KIKN	Murray	GE		35780 FM
KQCH	Ogden	Comp		2406 AM
KBNL	Payson City	Mtr	GE	30580 AM
KCBJ	Price (Co)	Mtr		35780 FM
KPGU	Provo	Mtr		35900 FM
KPMU	Provo	Mtr		38900 FM
KGPM	Salt Lake City	RCA		33500 FM
		Mtr		2406 AM

**VERMONT**

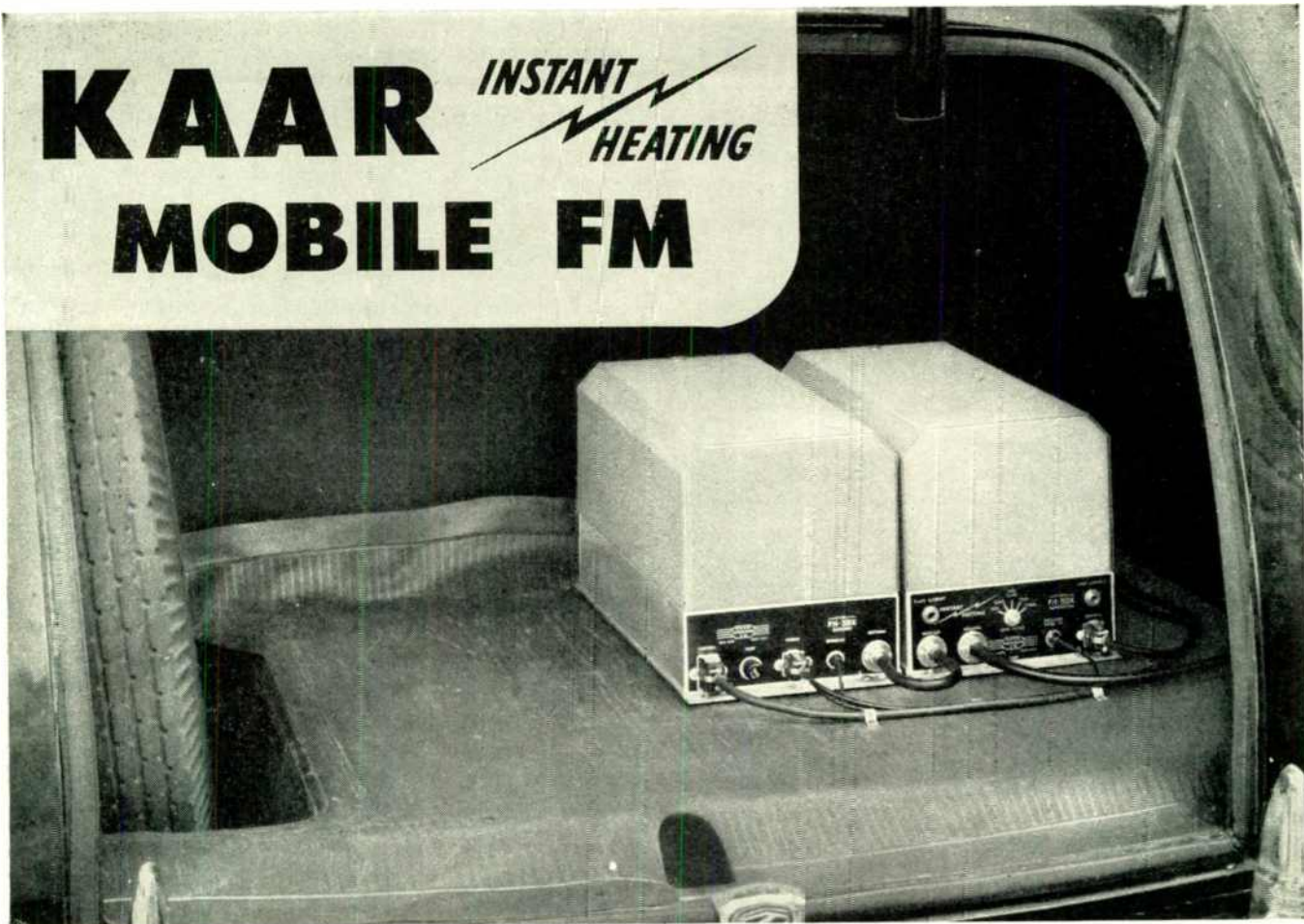
WBQG	Brattleboro	Mtr		33500 FM
WRCW	Burlington	RCA		35900 AM
WBMI	Rutland	GE		39100 FM
WIUF	Springfield	Mtr		39100 FM

**VIRGINIA**

WAVA	Alexandria	Link		31100 FM
WNKY	Appomattox (Co)	Link		39380 FM
WPAV	Arlington (Co)	GE		33500 FM
WBCL	Bedford (Co)	Link		39380 FM
WROM	Bedford (Co)	Comp		2450 AM
WQSL	Buckingham (Co)	Link		39380 FM
WATO	Charlotte (Co)	Link		39380 FM
WQTE	Charlottesville	Link	</	



# KAAR *INSTANT HEATING* MOBILE FM

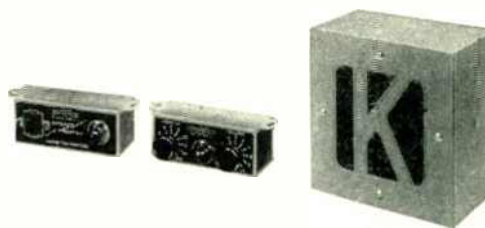


## *Now available!* An FM Radiotelephone with a truly **NATURAL** voice quality!

New KAAR FM radiotelephones offer an improvement in tone quality which is surprising to anyone who has had previous experience with mobile FM equipment. The over-all audio frequency response through the KAAR transmitter and receiver is actually within plus or minus 5 decibels from 200 to 3500 cycles! (See graph below.) This results in vastly better voice quality, and greatly improved intelligibility. In fact, there is appreciable improvement even when the FM-39X receiver or one of the KAAR FM transmitters is employed in a composite installation.

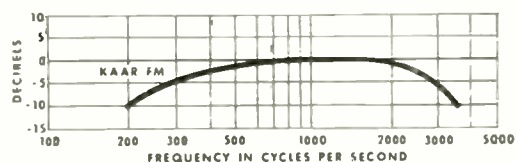
KAAR FM transmitters are equipped with instant-heating tubes, thus making it practical to operate these 50 and 100 watt units from the standard 6 volt ignition battery without changing the generator. Inasmuch as standby current is zero, in typical emergency service the KAAR FM-50X (50 watts) uses only 4% of the battery current required for conventional 30 watt transmitters. Battery drain for the KAAR FM-100X (100 watts) is comparably low.

For full information on new KAAR FM radiotelephones, write today for Bulletin No. 24A-46.



KAAR LOUD SPEAKER, remote controls for transmitter and receiver (illustrated above) and the famous Type 4-C push-to-talk microphone are among the accessories furnished with the equipment.

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



**KAAR ENGINEERING CO.**  
PALO ALTO • CALIFORNIA



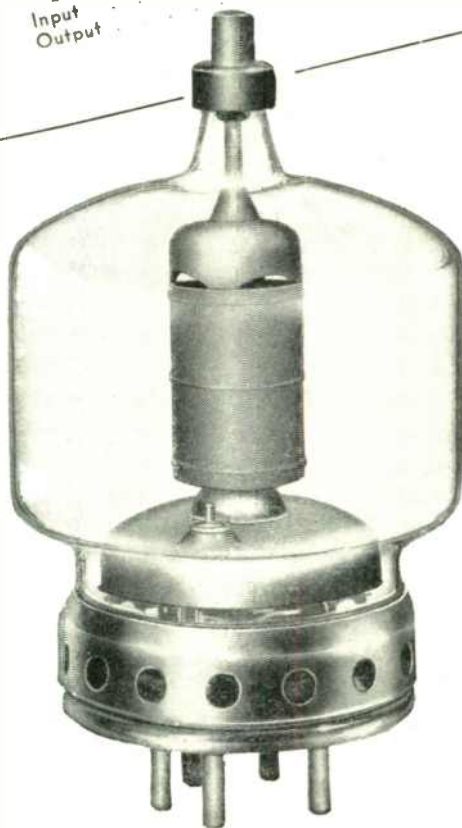


# THE LOGICAL CHOICE...

## Eimac 4-250A Tetrode

### ELECTRICAL CHARACTERISTICS—EIMAC 4-250A

Filament: Thoriated Tungsten	5.0 volts
Voltage	14.5 amps
Current	250 watts
Plate Dissipation (Maximum)	
Direct Interelectrode Capacitances: (Average)	
Grid-Plate (Without shielding, base grounded)	0.12 $\mu$ fd
Input	12.7 $\mu$ fd
Output	4.5 $\mu$ fd



Proven performance is the reason why the EIMAC 4-250A tetrode is the logical choice when a dependable power-amplifier tube is needed. Below are listed characteristics and design features of the EIMAC 4-250A which explain why this tetrode is *picked for power*

#### HIGH POWER—LOW DRIVE:

At frequencies up to 70 Mc. the EIMAC 4-250A develops a power output of 750 watts with a drive of less than 6 watts.

#### LOW PLATE—GRID CAPACITANCE:

Extremely low plate to grid capacitance, only 0.12  $\mu$ fd, permits operating without neutralization in many cases—simplifies neutralization in others.

#### OPERATIONAL STABILITY:

The unique arrangement of low inductance leads, plus especially treated grids insures exceptionally stable operation.

#### COMPACT—RUGGED:

Approximately 3½ x 6½ inches in size, the 4-250A has been constructed to withstand abnormal abuse—and give extra long life.

The 4-250A is just one of a host of EIMAC tubes designed for long-life and trouble-free operation. Investigate the possibilities of their use in your transmitters today. Contact your nearest EIMAC representative, or write direct for full technical information.

EITEL-McCULLOUGH, INC., 1265L San Mateo Ave., San Bruno, Calif.  
Export Agents: Frazer and Hansen, 301 Clay St., San Francisco 11 Calif. U.S.A.

### CALL IN AN EIMAC REPRESENTATIVE FOR INFORMATION

ROYAL J. HIGGINS (W9AID), 500 So. Michigan Ave., Room 818, Chicago 5, Ill. Phone: Harrison 5948.  
VERNER O. JENSEN, Verner O. Jensen Company, 2616 Second Ave., Seattle 1, Wash., Phone: Elliot 6871.  
M. B. PATTERSON (W5CD), Patterson & Co., 1124 Irwin-Keasler Bldg., Dallas 1, Tex., Phone: Centra 5764.  
ADOLPH SCHWARTZ (W2CN), 220 Broadway, Room 2210, New York 7, N. Y., Phone: Cortland 7-0011.

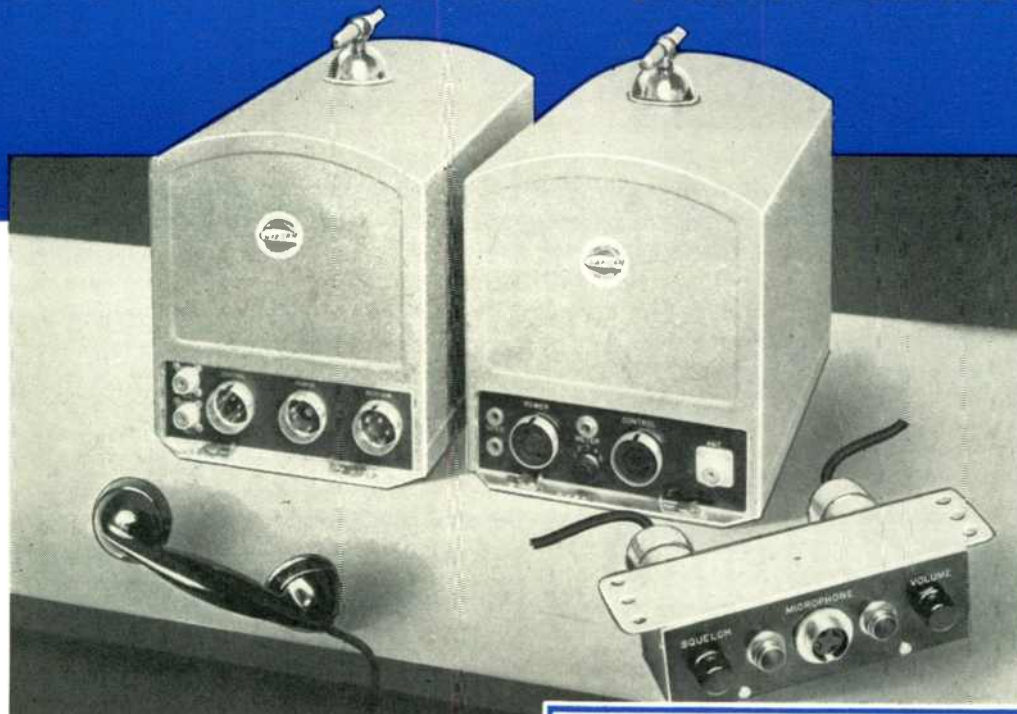
HERB BECKER (W6QD), 1406 So. Grand Avenue, Los Angeles 15, California, Telephone: Richmond 6194.  
TIM COAKLEY (WIKKP), 11 Beacon Street, Boston 8, Massachusetts, Telephone: Capitol 0050.  
RONALD G. BOWEN, 1846 South Humboldt Street, Denver 10, Colorado, Telephone: Spruce 9568.  
JAMES MILLAR ASSOCIATES, J. E. Joyner, Jr. (W4TO) 1000 Peachtree Street, N.E., Atlanta, Georgia.

Follow the Leaders to

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

THE COUNTERSIGN  
OF DEPENDABILITY IN ANY  
ELECTRONIC EQUIPMENT

# HAR-CAM *Mobile* Transmitters and Receivers for Better PERFORMANCE — Greater FLEXIBILITY



A few of the many important construction and operating features that make HAR-CAM Emergency Communications Equipment standards of quality and performance:

## FM-AM RECEIVER

13 tube, crystal controlled double conversion super-heterodyne

Either AM or FM available by throwing toggle switch

Frequency Range: 30-44 megacycles

Selectivity: 40 kc off resonance (adjacent channel) greater than 60 db down.

Selectivity: 80 kc off resonance greater than 120 db down

Image response greater than 100 db down

FM Quieting Signal: not greater than .3 microvolts

Greatly improved squelch control for the FM receiver equally effective when receiver is used on AM. Squelch control adjustable from .1 microvolt to 1 microvolt.

## FM TRANSMITTERS

Power Outputs — 25, 40 or 70 watts

Frequency Range — 30 to 44 megacycles

Frequency Modulation — deviation 15 kc either side of center frequency

## RECEIVER POWER SUPPLIES

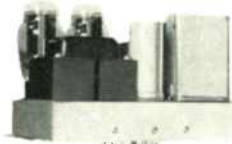


A. C.



D. C.

## TRANSMITTER POWER SUPPLIES



A. C.



D. C.

## HAR-CAM POWER SUPPLIES

Either AC or DC operation is made available instantly with HARVEY'S plug-in type power supplies like those shown here. No other electrical or mechanical changes in the circuit are required.

Characteristics of 152-162 mc equipment essentially similar. For further information on HAR-CAM Transmitters and Receivers write for Bulletins H-35 and H-36.

# HARVEY RADIO LABORATORIES, INC.

443 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS



The advertisement features a central globe with a reddish-brown hue. Surrounding the globe are several electronic components: a rectangular component with 'Bliley' and '12' markings, a smaller component with 'Bliley' and '12' markings, a cylindrical component with 'CRYSTAL UNIT' and 'Bliley' markings, a rectangular component with two pins, a larger cylindrical component with 'Bliley CRYSTAL' and 'TEMPERATURE STABILIZED' markings, and a rectangular component with two pins. The text 'TOPS IN...' is in a black box above the globe, and 'THE WORLD OVER!' is in a black box below the globe. The word 'Techniquality' is written in a large, stylized script across the globe.

**TOPS IN ...**

# Techniquality

**THE WORLD OVER!**

Creative engineering at Bliley is never at a standstill. Since the early days of home built sets to the present era of frequency modulation, radar and world wide communications, Bliley techniquality has kept pace with every important development in communications engineering. With Bliley techniquality "at the controls" frequency precision is never a problem. Bliley techniquality signifies original engineering and "follow-through" It's an ability that has been developed through 15 years of frequency control engineering exclusively 'To communications engineers the world over Bliley techniquality means the right crystal for the specific job.

**Bliley**  
CRYSTALS

Radio Engineers  
write for  
bulletin FM-27

**BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA**

July 1946—formerly FM, and FM RADIO ELECTRONICS



-AND NOW THE NEW

# CONSOLETTTE

STUDIO A



MICROPHONES



"ON-AIR" AND "REHEARSAL" LIGHTS



LOUDSPEAKER



4 SPECIAL CUE INPUTS

STUDIO B



MICROPHONES



"ON-AIR" AND "REHEARSAL" LIGHTS



LOUDSPEAKER

ANNOUNCE BOOTH



MICROPHONE



LOUDSPEAKER



"ON-AIR" LIGHT

8 REMOTE LINES (INCLUDING NETWORK)



STUDIO AND STATION EQUIPMENT • TRANSMITTERS

# GENERAL ELECTRIC

160-E7-6914

FM AND TELEVISION

## CONTROL ROOM



HEADPHONES



ANNOUNCE MICROPHONE



TALK-BACK



LOUDSPEAKER



TRANSCRIPTION MACHINES



"ON-AIR" LIGHT

2 OUTGOING CIRCUITS  
TO "ST," LINES, OR  
TRANSMITTER

The new G-E two-studio Consolette is a compact, flexible and economical speech input equipment designed to meet the needs of every station, FM or AM.

A Partial List of the Features that make the G-E Consolette an Important Part of Every Station, FM or AM:

- Contains all amplifiers and controls for complete operation of 2 studios, announce booth, turntables, and remote lines.
- Input connections for 8 studio microphones, 2 announce microphones, talkback microphone, 8 remote lines (including network), 2 transcription turntables, and 4 special cue input circuits.
- Output connections for 2 outgoing lines, 4 loudspeakers, 4 sets of "on-air" and "rehearsal" lights, and headphones.
- 4 pre-amplifiers provide simultaneous operation of 4 microphones.
- 2 program amplifiers provide extreme flexibility in operation and reliability of service. Each amplifier has individual gain control and power supply.
- Monitor amplifier with individual power supply is also used for talk-back circuit with "over-ride" feature. All "interlocking" is built in.
- Simultaneous facilities for broadcasting and rehearsing.
- Electrical performance to meet FM requirements. At normal output level distortion is less than 1% rms, 50 to 7500 cycles. Response is within 2 db, 30 to 15,000 cycles. Noise level is 65 db below program level.
- Two-tone, blue-gray cabinet is only 10½ inches high, providing complete visibility over top of consolette.

## Big-Station Studio Control Flexibility for Every FM and AM Station

THE General Electric Consolette provides complete studio control facilities—monitoring, cueing, simultaneous broadcasting and rehearsing, and over-ride talk-back that operates without need for order wires—all at a price *any* station can afford, FM or AM.

Here is an outstanding control unit that contains all the amplifiers and controls needed for complete operation of one studio, two studios, or two studios and an announcer's booth—including ten microphone inputs. Two program amplifiers permit instantaneous switching of the program from one amplifier to the other.

A new improved push-button system and simplified switching gives the G-E Consolette exceptional flexibility and new freedom from operating errors. Careful arrangement of controls and a correctly sloped panel combine full visibility with operating ease unmatched by ordinary consolettes. A hinged top and a hinged-type chassis mounting provide complete accessibility.

Ask your nearest G-E office for complete data on the new G-E Consolette, or write: *Electronics Department, General Electric Company, Syracuse 1, N. Y.*

*Have you placed your order yet?*

ANTENNAS • ELECTRONIC TUBES

RECEIVERS

**FM • TELEVISION • AM**

*See G.E. for all three!*

**NOW YOU  
CAN SEE  
THE TROUBLE**



**ALTEC LANSING**

*Intermodulation Analyzer*

What happens when a string bass and piccolo sound out together? Any distortion? Intermodulation? This intermodulation analyzer, designed by Altec Lansing for measuring the efficiency of their own amplifier and loudspeaker systems, will let you see the results at a glance. No calculations are necessary. A five-minute check on the Altec Lansing Intermodulation Analyzer gives you the information it takes hours to get by other methods. Available for Prompt Delivery.

**ALTEC**

LANSING CORPORATION

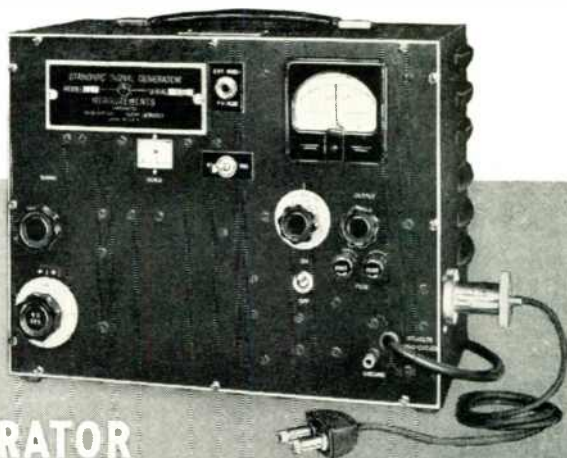
1161 NORTH VINE ST.  
HOLLYWOOD 38, CALIF.

250 West 57th St.  
New York 19, N. Y.

"KEEP ADVANCING WITH ALTEC LANSING"

*Laboratory  
Standards*

**FM**  
MODEL 78  
SIGNAL GENERATOR



**SPECIFICATIONS:**

- CARRIER FREQUENCY RANGE:** 86 to 108 megacycles. Individually calibrated dial.
- OUTPUT SYSTEM:** 1 to 100,000 microvolts with negligible carrier leakage.
- OUTPUT IMPEDANCE:** Constant at 17 ohms.
- MODULATION:** 400 cycle internal audio oscillator. Deviation directly calibrated in two ranges: 0 to 30 kc. and 0 to 300 kc. Can be modulated from external audio source. Audio fidelity is flat within two db from d.c. to 15,000 cycles. Distortion is less than 1% at 75 kc. deviation.

PROMPT DELIVERY

**MANUFACTURERS OF**  
Standard Signal Generators  
Pulse Generators  
FM Signal Generators  
Square Wave Generators  
Vacuum Tube Voltmeters  
UHF Radio Noise & Field Strength Meters  
Capacity Bridges  
Megohm Meters  
Phase Sequence Indicators  
Television and FM Test Equipment

**MEASUREMENTS CORPORATION**  
BOONTON NEW JERSEY

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Other sheet metal fabricated components manufactured to specifications.



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# Amphenol

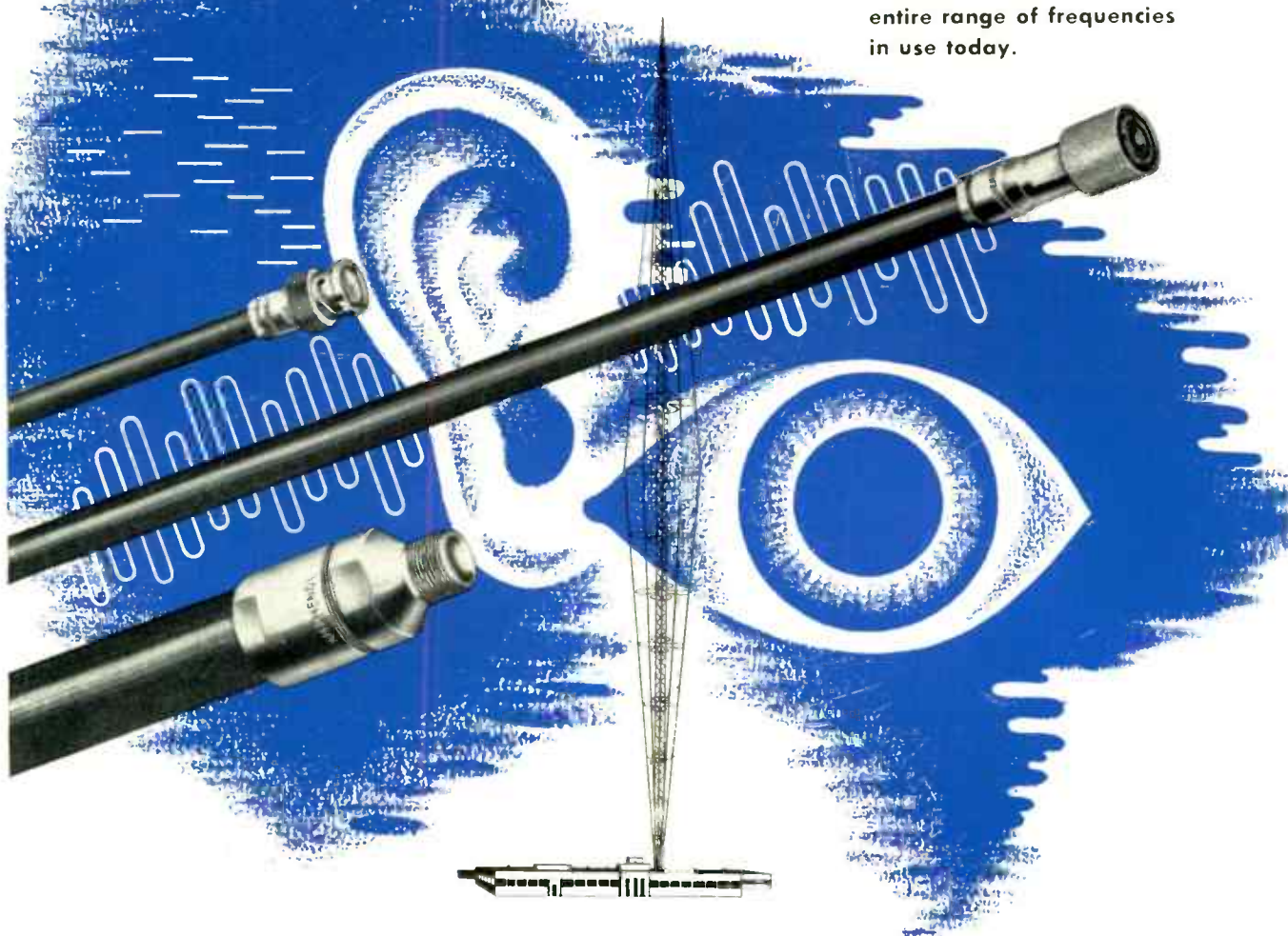
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July 1946—formerly FM, and FM RADIO ELECTRONICS

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For six years, FM and TELEVISION Magazine has been the leading source of information on FM communications equipment and installations. More articles and more detailed working data on these subjects have appeared in FM and TELEVISION than in all other radio publications combined.

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FM communications has become the most rapidly expanding field of radio development. With an enormous increase in frequencies made available by the FCC for this service, much new equipment has been brought out since the end of the war. New uses are being found for 2-way FM at such a rate that the FCC is swamped with license applications. In addition, many prewar AM installations are being replaced with FM systems.

All these postwar developments, from theory to application, are covered in the completely new FM RADIO HANDBOOK. This large volume, edited by men of long experience in FM communications, gives detailed, working information on all phases of 2-way installations, including the latest fixed and mobile equipment for operation on all the newly-assigned frequencies, antennas, unattended relays, selective dial calling, and maintenance methods. Also included is a complete Emergency Station Directory, listing details of all municipal, county, state, zone, fire, forestry, public utility, and special communications systems.

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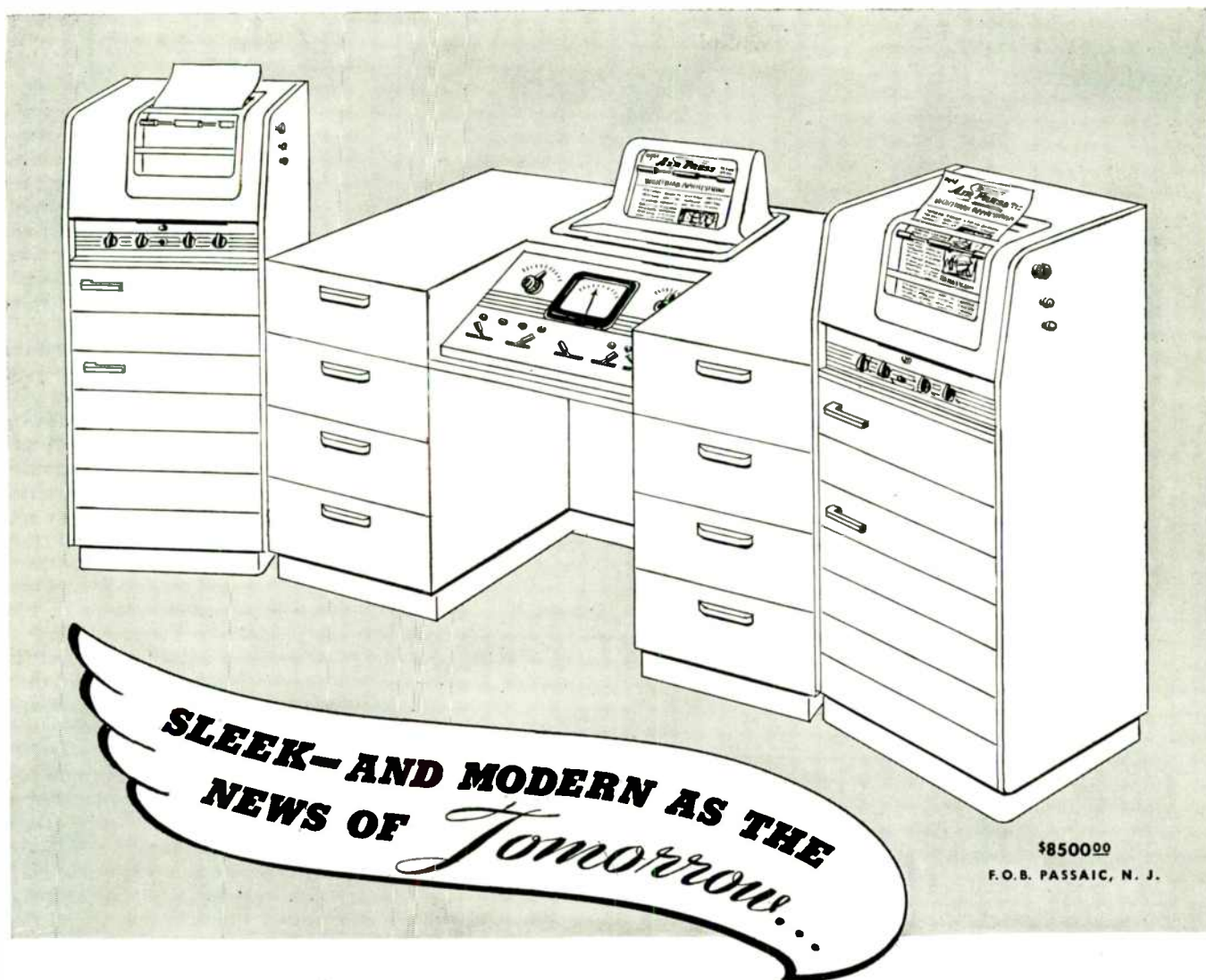
In short, it is an essential book for engineers engaged in the manufacture, installation, operation, or service of communications equipment.

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**which it will put on the air, this first postwar Finch Telefax facsimile broadcasting installation soon will be ready for delivery to those FM stations with early orders.\***

**S**URPRISINGLY low priced, its moderate initial cost and maintenance budget are due partly to Finch experience and know-how, and partly to the fact that, in many details, it is closely related to the Finch family of proved facsimile communication equipment—which means that the cost of its careful development was held down and the savings passed on to the purchaser.

Provided with two transmitting scanners to facilitate continuous flow of program material to the radio transmitter, the installation includes a monitor control desk for convenient, comfortable, and accurate control by the operator.

**Only Finch Telefax brings you these advantages:**

1. Simple, reliable, time-saving, push-button operated, automatic, copy loading and unloading.
2. Automatic scanner-carriage return at the end of each page.
3. Separate monitor recorder built into each scanner for convenient, easy adjustment and observation.

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5. Convenient centralized control of scanner operation comfortably handled by a seated operator.

6. A license authorizing use of the applicable Finch patents for facsimile broadcasting, and a guarantee protecting you against necessary infringement of facsimile patents are embodied in our sales contract.

*After FCC facsimile standards have been established, units purchased now will be modified, if necessary, at moderate cost.*      \*      \*      \*

\*Finch Telefax special receivers are now available in limited quantities to purchasers of Finch broadcasting equipment; Finch Telefax home receivers, for use with FM radio sets, will be available to the public in a few months.

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# Astatic goes Nylon

**Designs NEW Pickup Cartridge with NYLON Chuck and REPLACEABLE, Long-Life, Sapphire-Tipped NYLON Needle**

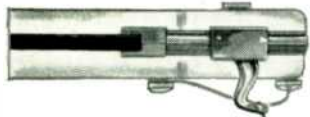
● Constantly alert to the possibilities for improvement in the design and performance of phonograph pickup cartridges. Astatic research has unearthed a material, other than metal, for the better transmission of signals from the record grooves to the crystal element. That material is NYLON! No other known substance possesses all the properties which make Nylon ideal for this purpose. Astatic, therefore, has employed this revolutionary material in the manufacture of a new crystal pickup cartridge known as Astatic Nylon 1-J . . . a low pressure, wide-range, general purpose cartridge incorporating a Nylon chuck and Nylon, sapphire-tipped needle.

## CONTROL OF QUALITY OF REPRODUCTION

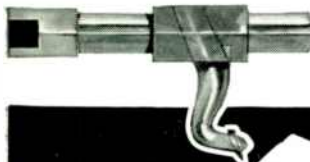
In using this Nylon 1-J Crystal Pickup Cartridge, the phonograph manufacturer, as well as the user, is assured that the quality of reproduction will REMAIN CONSTANT regardless of needle replacements, because the needle is matched to the cartridge, and the Nylon needle designed for this particular Cartridge is the ONLY one that can be used with it.



**PARTIAL VIEW** of cartridge, showing knee-action Nylon needle and metal needle guard. The cushioning action of Nylon affords additional protection for the sapphire stylus.



**INTERIOR VIEW** showing crystal element, Nylon chuck and sapphire-tipped Nylon needle.



**PHANTOM VIEW** showing how tapered shank of Nylon needle fits into tapered hole in Nylon chuck.

Astatic Crystal Devices  
manufactured under Brush  
Development Co. patents.

# THE Astatic CORPORATION

ASTATIC CONNEAUT, OHIO

IN CANADA: CANADIAN ASTATIC LTD., TORONTO, ONTARIO

## WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 33)

be installed, operated, and maintained.

**Broadcasting** ★ The broadcasters have their headaches. All during the war years, they rode high, wide, and handsome. Every nook and cranny of the monthly log was jammed to the split second with commercial time, some of which was good entertainment, much was of indifferent value to listeners, and not a little was just plain awful. Programs deteriorated at about the same rate that revenues increased.

Then, with the turn of the first year of peace, came an avalanche of time contract cancellations, followed by left and right jabs from the FCC in the form of complaints about program content. Added to these blows were labor troubles and the sudden realization that the protection against competition, afforded by the shortage of AM frequencies, had been swept away by the coming of nation-wide FM service.

So great, in fact, has the demand for FM broadcast frequencies become, that, at this time of writing, the FCC is confronted with the need of adding new channels. Prevailing opinion is that the No. 1 Television channel from 44 to 50 mc. will be given to FM and, at a later date, the No. 2 channel, from 50 to 56 mc. Only opposition to this comes from CBS, to which the No. 2 band is assigned in New York City. However, that will hardly be considered by the FCC, in view of Columbia's insistence that low-band television will be made obsolete before it can get under way by the more perfect transmission possible in the upper band.

The alternative would be the assignment of television channels No. 5 and 6, from 76 to 82 and 82 to 88 mc. This is not favored, however, since there are no receivers available for that range, while prewar sets and new 2-band models would cover the range from 44 to 50 mc. at once.

**Television** ★ Television has benefited greatly from the experimental work on programming, and from RCA's introduction of the image orthicon camera tube. Much valuable engineering effort has been put into the side issue of color. It is hard to believe, however, that CBS is sincere about its claims that color television has made black-and-white obsolete, since we have contradictory evidence in the survival of monochrome movies.

The enthusiasm of the enthusiasts has been fanned to white heat by the response to NBC's televising of the Louis-Conn fight. Some estimates place the television audience on this occasion at 200,000. Grumbling from those who paid for ring-side seats and still couldn't see the fight was in sharp contrast to satisfaction expressed by the audiences that witnessed the fight by television.

(CONCLUDED ON PAGE 59)

FM AND TELEVISION

## WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 58)

Just what this proves about the commercial aspect of television is not so clear, beyond confirming Mike Jacob's estimate of public interest in heavy-weight boxing. The fight drew a record-breaking audience to radio sets tuned to the ABC network, too, but it would be silly to say that this event established a day-to-day coverage by ABC greater than that delivered by competing nets. Nor could it be claimed that radio listeners' interest on this occasion proved that all criticisms of radio programs are unwarranted.

As matters stand today, the only thing that can give television, or any other advertising medium, any real encouragement is an upswing of production sufficient to reverse present tendencies to cut advertising budgets.

**Facsimile** ★ Facsimile will come into wide use rapidly for police, and probably for railroads and airlines, as well for handling many kinds of business traffic. These applications will start first because suitable designs are available. Home facsimile broadcasting will follow.

Meanwhile, experimental use by the broadcast stations will lead to the adoption of universal standards, which the FCC will require, and to the perfection of simultaneous sound and facsimile transmission. When this much has been accomplished, and with the mechanical details ironed out for low-cost, quantity production, facsimile will come into general use for home radio reception.

If television and facsimile were developed to the point of competing with sound broadcasting, it is likely that facsimile would be gaining now at the expense of the other two systems. That is because facsimile is the least expensive to program. How the three will compare in results produced for sponsors we shall not know for several years. While television adds sight to sound, neither can perform a service equivalent to facsimile.

It is even possible that the same facsimile recorders might be operable by telephone. At least, that seems to be the most practical way to leave a message for the person who is not at home. And it would be a splendid way to deliver telegrams. Home facsimile has already been given a tremendous boost by the FCC's decision to permit all FM broadcast stations to transmit facsimile. — *Milton B. Sleeper*

### SPOT NEWS NOTES

(CONTINUED FROM PAGE 28)

metropolitan size. Fort Wayne has a population of 130,000. Programs are already being originated in the new studios for AM station WGL, and if the Farnsworth FM application is granted, the (CONCLUDED ON PAGE 60)



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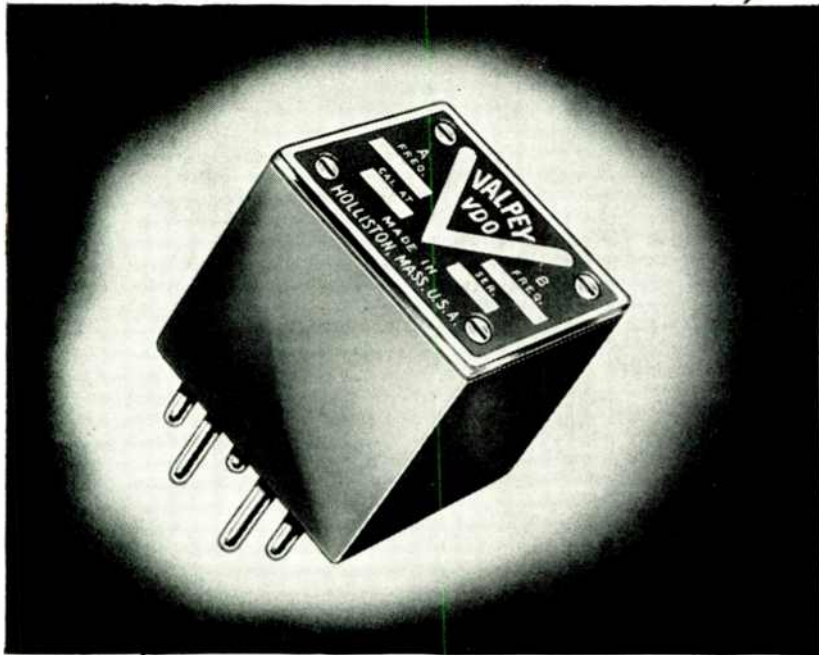
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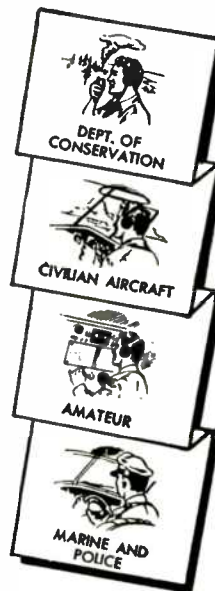
Type VDO — a compact unit utilizing one or two crystals in the same holder with or without temperature control — is a 5-pin mount designed to fit the standard 5-prong tube socket. Particularly adaptable for use in transmitter equipment where both transmitter and receiver channels are crystal controlled.

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**CRYSTALS**

**CRAFTSMANSHIP IN CRYSTALS SINCE 1931**



**SPOT NEWS NOTES**

(CONTINUED FROM PAGE 59)

Corporation intends to have an FM transmitter on the air this fall.

**Los Angeles:** Max J. Maraban, after 10 years as chief electrical engineer for Delco Radio at Kokomo, has joined Hoffman Radio Corporation as director of engineering. Al Bennett is now chief engineer of the receiver section, with Stan Cutler chief engineer of the special products section. Walt Harmon, formerly vice president in charge of engineering, has resigned to set up as a manufacturers' agent.

**Intensity Meter:** A new field intensity meter, type 101-C, manufactured by Federal Telephone & Radio, has been officially approved by the FCC. As a result of this action, field measurements made with this meter can be submitted to the Commission without having the meter first calibrated by the Bureau of Standards.

**FCC Appointments:** Cyril M. Braum has been appointed Chief of the FM Division, and Curtis B. Plummer, Chief of the Television Division. These are divisions of the Broadcast Branch of the FCC Engineering Department. Previously, Mr. Braum and Mr. Plummer served as acting Chiefs of their respective divisions.

**Propagation:** Publication of the monthly "Basic Radio Propagation Predictions," prepared by the Bureau of Standards, has been resumed. Single copies at 15¢ or annual subscriptions at \$1.50 can be ordered from the Superintendent of Documents, Washington, D. C.

**Edward J. Content:** Widely known as an expert on studio acoustics, has left WOR to establish his own office as an acoustical consultant and specialist in studio design. One of the old-timers in broadcasting, he was transmitter supervisor at WOR from 1926 to 1930, and assistant chief engineer until 1945. He will make his headquarters at Roxbury Road, Stamford, Conn.

**Television Statistics:** Sylvania's survey of the television market shows that, of those planning to buy sets, 8% are from families with annual incomes above \$5,000; 17% with incomes of \$3,000 to \$5,000; 53% with incomes of \$1,000 to \$3,000; and 22% with incomes less than \$1,000. These figures are of great interest as indicating price ranges at which manufacturers must shoot.

**Cyrus T. Read:** W9AA has resigned as a member of Hallicrafters' engineering staff to become supervising buyer of electronic equipment at Montgomery Ward, Chicago.

F.M. AND TELEVISION



**For the Man Who Takes Pride in His Work**

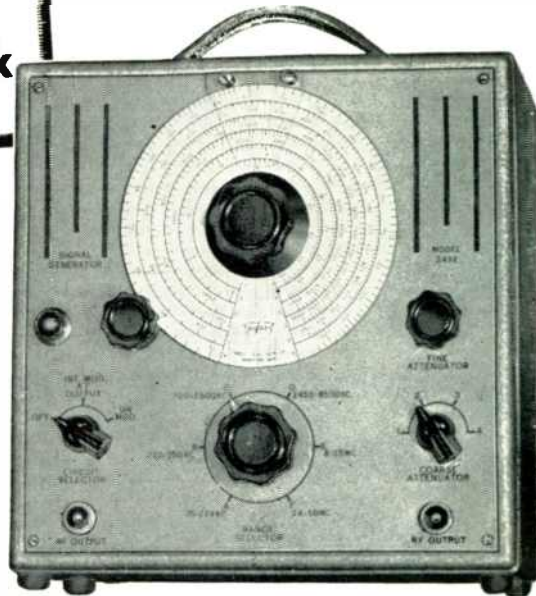
**MODEL 2432 SIGNAL GENERATOR**

Another member of the Triplett Square Line of matched units this signal generator embodies features normally found only in "custom priced" laboratory models.

**FREQUENCY COVERAGE**—Continuous and overlapping 75 KC to 50 MC. Six bands. All fundamentals. **TURRET TYPE COIL ASSEMBLY**—Six-position turret type coil switching with complete shielding. Coil assembly rotates inside a copper-plated steel shield. **ATTENUATION**—Individually shielded and adjustable, by fine and coarse controls, to zero for all practical purposes. **STABILITY**—Greatly increased by use of air trimmer capacitors, electron coupled oscillator circuit and permeability adjusted coils. **INTERNAL MODULATION**—Approximately 30% at 400 cycles. **POWER SUPPLY**—115 volts, 50-60 cycles A.C. Voltage regulated for increased oscillator stability.

**CASE**—Heavy metal with tan and brown hammered enamel finish.

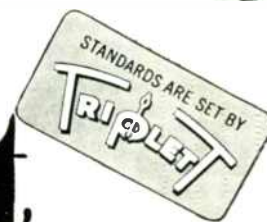
There are many other features in this beautiful model of equal interest to the man who takes pride in his work.



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FM AND TELEVISION  
CIRCULATION DEPARTMENT  
Great Barrington, Mass.

## 920-940 AND 940-960 MC.

(CONTINUED FROM PAGE 36)

a bandwidth of 500 kc. are advocated for FM studio-to-transmitter links.

The relatively narrow beams which can be employed by point-to-point stations in this region of the spectrum should make possible a high degree of frequency conservation by means of geographic separation as differentiated from frequency separation. It is expected that the authorization of FM studio-to-transmitter equipment will require the showing of a definite need for the use of a radio circuit instead of a wire circuit.

It should be noted that general provisions have been made in the Commission's report of allocations for 25 to 30,000 mc., dated May 25, 1945, for the operation of the services in bands other than 940 to 960 mc., and the proposed policies do not preclude such operation provided a proper need can be shown. However, detailed allocation plans for such bands must necessarily be formulated around the over-all indicated requirements of all services to which the bands apply, with particular reference to the suitability of the bands for the services.

The Commission wants to have the comments of all services which expect to use frequencies between 920 and 960 mc. with regard to these proposed policies and with particular attention to the following details:

A. Distances to be covered and power considered necessary.

B. Practical transmission bandwidth, frequency tolerance, and receiver selectivity data for each type of emission and communication service contemplated.

C. Whether the frequency space proposed for each service is considered adequate.

D. Directive characteristics of antennas proposed for each type of service and the maximum degree of directivity believed practical.

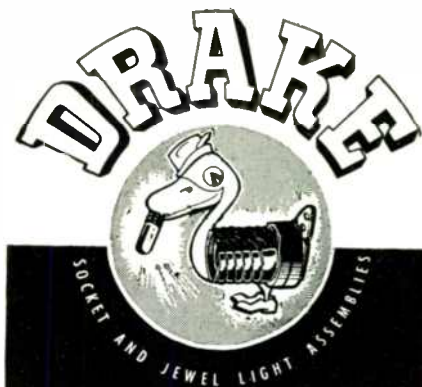
To those who are not familiar with the design of transmitters and receivers in these two bands, it may seem strange indeed to think of operating commercial services on wavelengths measured in centimeters. However, microwave equipment is coming rapidly into more and more use. For example, the RCA television relay which was used to carry the television signals of the Louis-Conn fight from the arena to the NBC television broadcast transmitter was a microwave installation of quite simple design. The parabolic reflectors, used as antennas, were less than 3 ft. in diameter. Most serious problem of installation is setting the mireometer screws which orient the reflectors. This requires extreme accuracy, because of the narrow beam transmitted. Normal range of the portable television relay is 15 miles but, with favorable terrain, fixed stations, using higher power, can be separated by 30 miles or more.



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## *An Announcement to the Readers of* **FM and Television**

ON August 31st, the subscription rate of *FM* and *TELEVISION* will be \$5 for 1 year, or \$10 for 3 years. However, present subscriptions may be extended or new subscriptions placed at the old rate of \$3 for 1 year or \$6 for 3 years, provided the orders are postmarked not later than August 31, 1946, and addressed to our Publication Office at Great Barrington, Mass., or to our New York office at 511 Fifth Avenue.

There is no secret about the reason for this increase. For the information of those who are interested, we are glad to present the facts which led to this decision:

When you subscribe to *FM* and *TELEVISION*, or to any other magazine, the amount you pay is probably less than the cost of the bookkeeping, stenciling, addressing, and mailing involved in handling your subscription — plus the average sales expense for letters and circulars or commission for the agent through whom your subscription was placed.

In 1945, for example, *FM* and *TELEVISION* spent ap-

proximately \$20 to give you the 12 copies for which you paid \$3. The difference of \$17 was paid by advertisers to put their messages before you.

In other words, prior to the end of the war, general practice in magazine publishing was to charge subscribers something less than the circulation and mailing expense. That was our practice, too.

Between VJ-Day and March 1st, 1946, wage increases in the engraving, paper, and printing industries almost doubled our manufacturing costs. Fortunately, a 50% increase in our circulation justified a 20% increase in advertising rates. The increase in circulation also offset some of the increase in manufacturing cost *per copy*. In addition, the reorganization of our addressing department and the purchase of new equipment effected a saving through increased efficiency.

Then, after March 1st, came further wage increases, the most recent of which was effective July 1st in the printing trades. *Against these, the only economies*

*available to us are a reduction in the quality of our paper or a cut in editorial expense.*

We are now printing this Magazine on 70-lb. coated stock. Although no other radio publication uses paper of this quality, we believe this is not an extravagance but a service to our readers, because it enables us to convey so much more information in illustrations than is possible with paper of inferior printing surface.

As for cutting editorial expense — plans which we shall put into effect during the next six months to expand the value of *FM* and *TELEVISION* to our readers call for a sharp increase, not a reduction, in this item.

*These are the facts which present to us the choice of giving our readers less value at the same price, or a greater value at a higher price. At a time when FM and TELEVISION is performing such an essential information service to those who are taking a leading part in the industry's reconstruction and expansion, we believe that the latter course will be preferred by our readers.*  
— Milton B. Sleeper

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# *The Collins 6M... A Modern program amplifier for progressive broadcasters*

If you are planning an up-to-date, forward looking broadcast station or recording studio, or if you are modernizing the one you have, the Collins 6M high fidelity program amplifier will fit into your plans. The thorough engineering that has gone into its design and development is evident in its outstanding performance in both AM and FM applications.

Utilizing choice quality components, conservatively operated, the 6M amply fulfills the requirements for dependable, continuous duty. The self-contained power supply will furnish power for the 6M itself and as many as five preamplifiers. One of the two meters indicates the 6M output in VU; the other measures the power supply voltage and the current drain of the 6M and preamplifiers.

Emphasizing high performance, accessibility, and reliability, the 6M will make a valuable and practical contribution to the quality of your station or studio. Write today for an illustrated bulletin.

#### **SPECIFICATIONS:**

Frequency response: 30-15,000cps±1.0 db

Noise level: -60 db from program level

Distortion: Less than 1% at normal program level

Input impedance: 50/250/600 ohms

Output impedance: 600 ohms

Input level: -50 to -10 dbm

Output level: -10 to +30 dbm

Mounting dimensions: 19" w, 10½" h,  
7½" d

Power source: 115 volts a-c, 60 cps

Finish: Metallic gray or black wrinkle

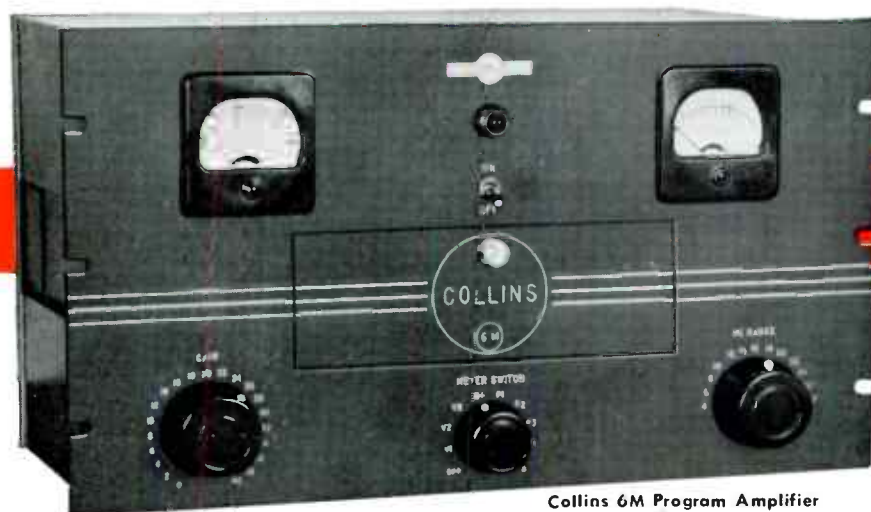
**COLLINS RADIO COMPANY**

Cedar Rapids, Iowa

11 W. 42nd Street, New York 18, N. Y.

458 S. Spring Street, Los Angeles 13, California

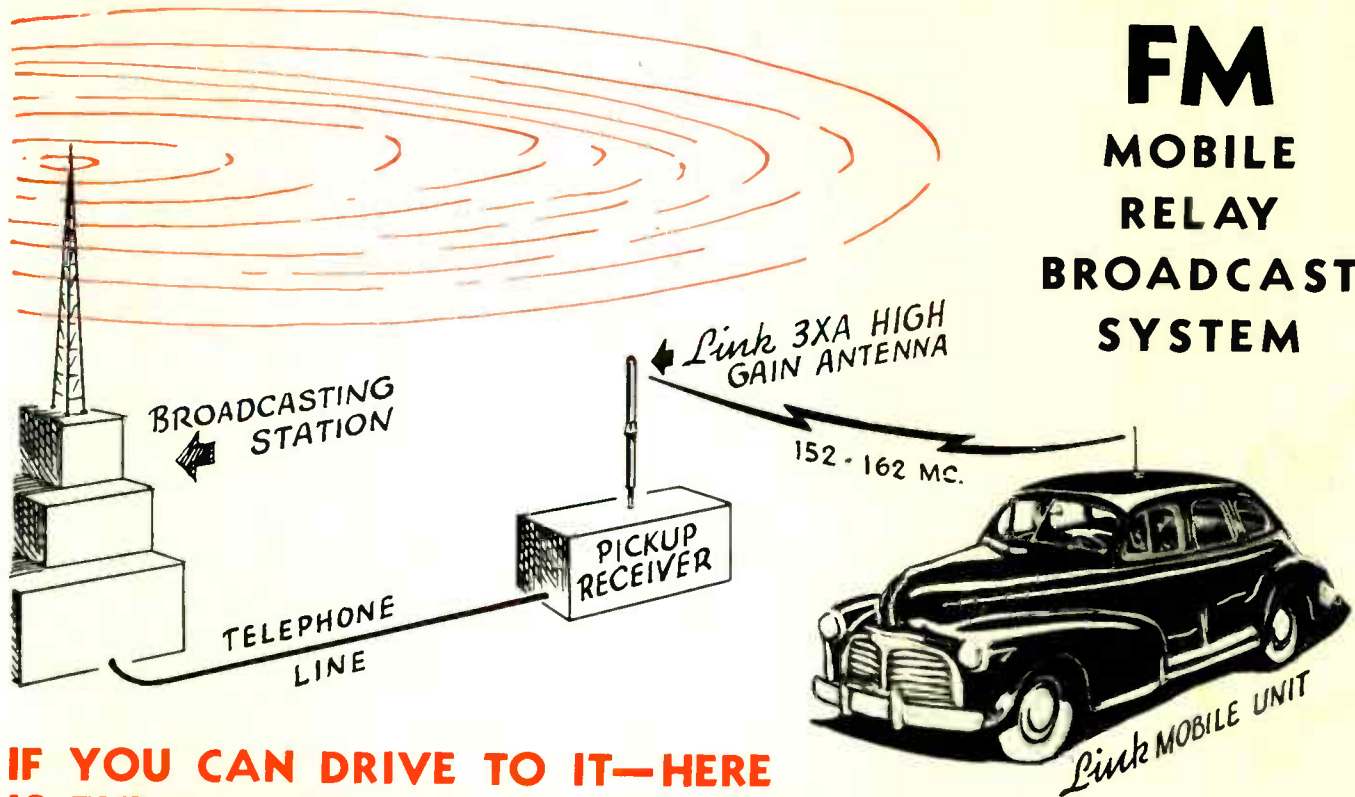
**FOR BROADCAST QUALITY, IT'S . . .**



Collins 6M Program Amplifier

# SPOT COVERAGE WITH *Link*

## FM MOBILE RELAY BROADCAST SYSTEM



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### SPORTS



### DISASTERS



### PARADES



The hi-fidelity Link Type 50-MRB Mobile Relay Broadcast Transmitter is especially designed to fill the broadcaster's need for an immediate "on the scene" radio circuit. Where no land lines are available or the fidelity of existing lines is low, the mobile transmitter's signals may be relayed to one or more Link Type 1927 Radio Receivers located at suitable predetermined pickup points for complete reliable coverage of any area.

Whatever the job, wherever the place, if it can be driven to, it can be broadcast from . . .

**WIRE — WRITE OR PHONE**

**CHelsea 2-1100**

ENGINEER • MANUFACTURER

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PREFERRED *FM* RADIO  
COMMUNICATION EQUIPMENT