PRICE TWENTY-FIVE CENTS

FM AND TELEVISION

MAY 1946

OLD-TIMER AND NEW-BAND FM

SEE PAGE 3

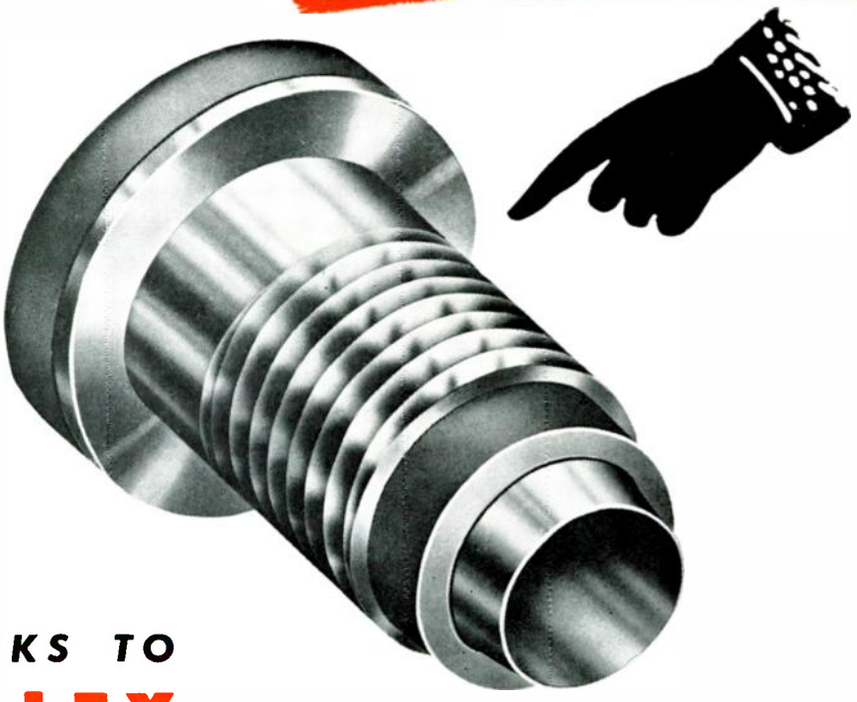
Review of FM Broadcasting

★ ★ Edited by Milton B. Sleeper ★ ★

REG. U.S. PAT. OFF.

LITTLE COMPONENT*

HUGE SUCCESS



. . . THANKS TO MYCALEX

THE "PERFECT" LOW LOSS INSULATION

The problem was to mold insulating material of exceptionally low loss factor and high dielectric strength into a closely integrated bond with a metal insert of high conductivity. The difficulty was acute, for both materials had to have virtually the same coefficient of expansion in order to insure an efficient electrical and mechanical seal. High resistance to arcing in the insulator was also imperative. It had to be moisture-proof and heat-resistant.

MYCALEX 410 (Molded Mycalex) proved to be the only solution after many other insulators had been tested and rejected . . . because MYCALEX has the ideal combination of electrical and mechanical properties for today's high frequency applications.

Have you a problem involving the sealing of highest type insulation with metal? Are your specifications particularly exacting? More than 25 years of leadership in solving the toughest high frequency insulating problems make MYCALEX a "natural" to solve yours. Our engineers will be pleased to cooperate.

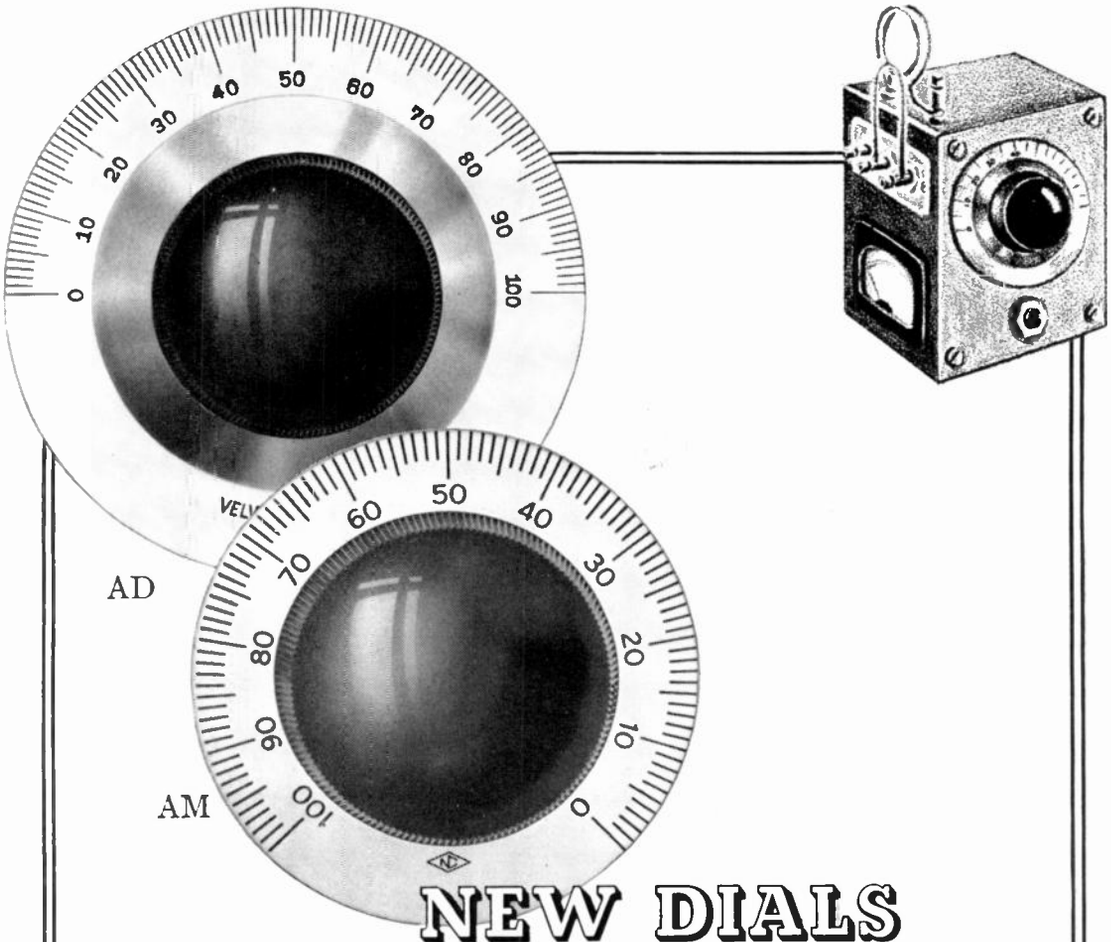
*PANEL JACK

SINCE 1919 MYCALEX THE INSULATOR TRADE MARK REG. U. S. PAT. OFF.

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.



NEW DIALS

Wartime requirements for accurate smooth-working dials resulted in the design of these two new models. Both make use of the time-tested "Velvet Vernier" drive unit which for more than twenty years has been a favorite because of its incomparably smooth action and sensitive control. The Type AM Dial is three inches in diameter and is available with 2, 3, 4, 5 or 6 scale. The four-inch Type AD Dial is made with 2, 3, 4 or 5 scale. Both are handsome in appearance and moderate in cost.

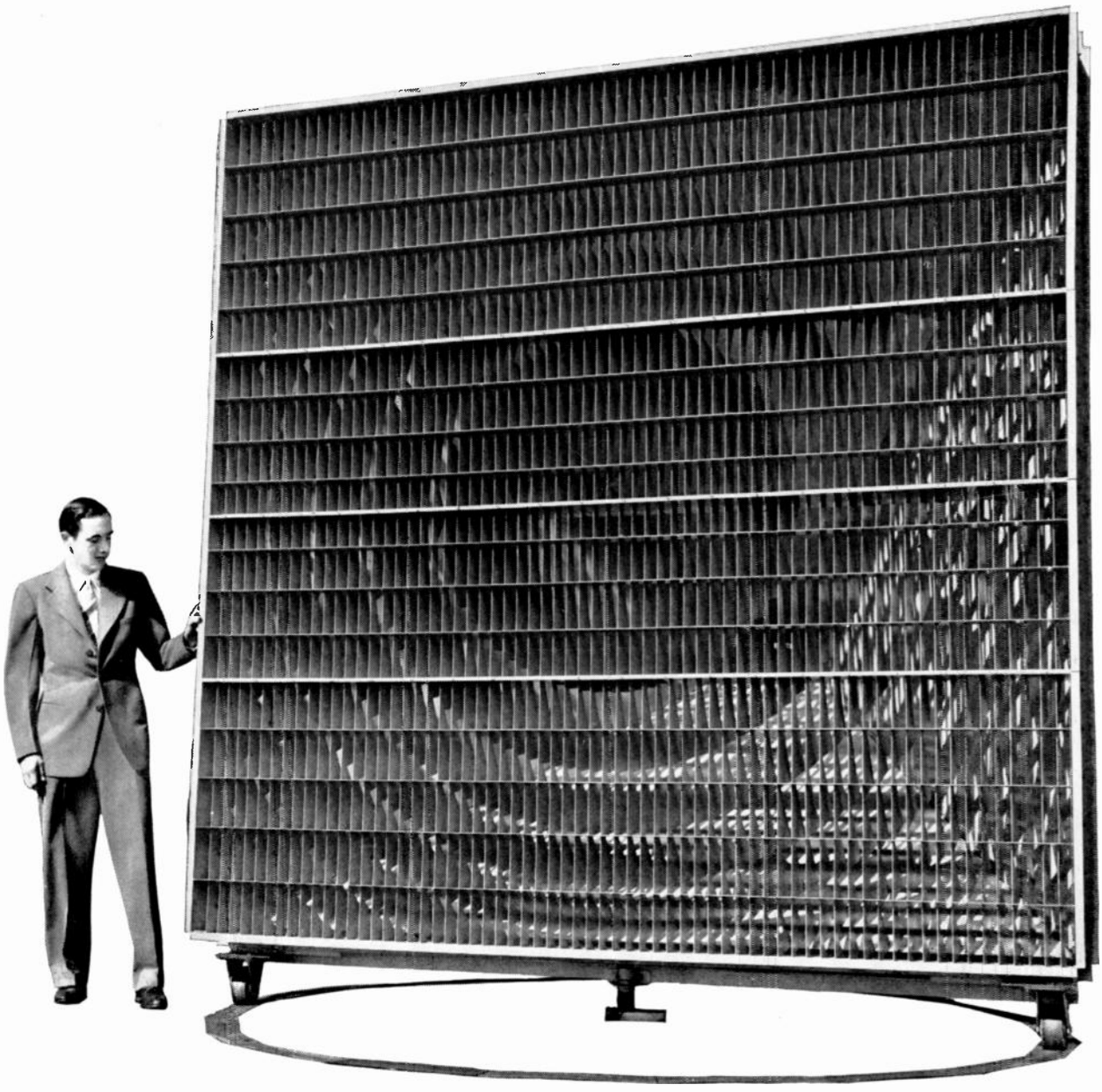
DIAL SCALES

Scale	Divisions	Rotation	Direction of Condenser Rotation for increase of dial reading
2	0-100	180°	Counter Clockwise
3	100-0	180°	Clockwise
4	150-0	270°	Clockwise
5	200-0	360°	Clockwise
6	0-150	270°	Counter Clockwise

ARMY E NAVY

ARMY E NAVY

NATIONAL COMPANY, INC., MALDEN, MASS. U.S.A.



A "SEARCHLIGHT" TO FOCUS RADIO WAVES

In the new microwave radio relay system between New York and Boston, which Bell Laboratories are developing for the Bell System, giant lenses will shape and aim the wave energy as a searchlight aims a light beam.

This unique lens—an array of metal plates—receives divergent waves through a waveguide in the rear. As they pass between the metal plates their direction of motion is bent inward so that the energy travels out as a nearly parallel beam. At the next relay point a similar combination of lens and waveguide, working in reverse, funnels the energy back into a repeater for amplification and retransmission.

A product of fundamental research on waveguides, metallic lenses were first developed by the Laboratories during the war to produce precise radio beams.

This "searchlight" is a milestone in many months of inquiry through the realms of physics, mathematics and electronics. But how to focus waves is only one of many problems that Bell Telephone Laboratories are working on to speed microwave transmission. The goal of this and all Bell Laboratories research is the same—to keep on making American telephone service better and better.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

FM AND TELEVISION

FORMERLY: FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 6 MAY, 1946 NO. 5

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★ ★ ★ ★ ★ ★

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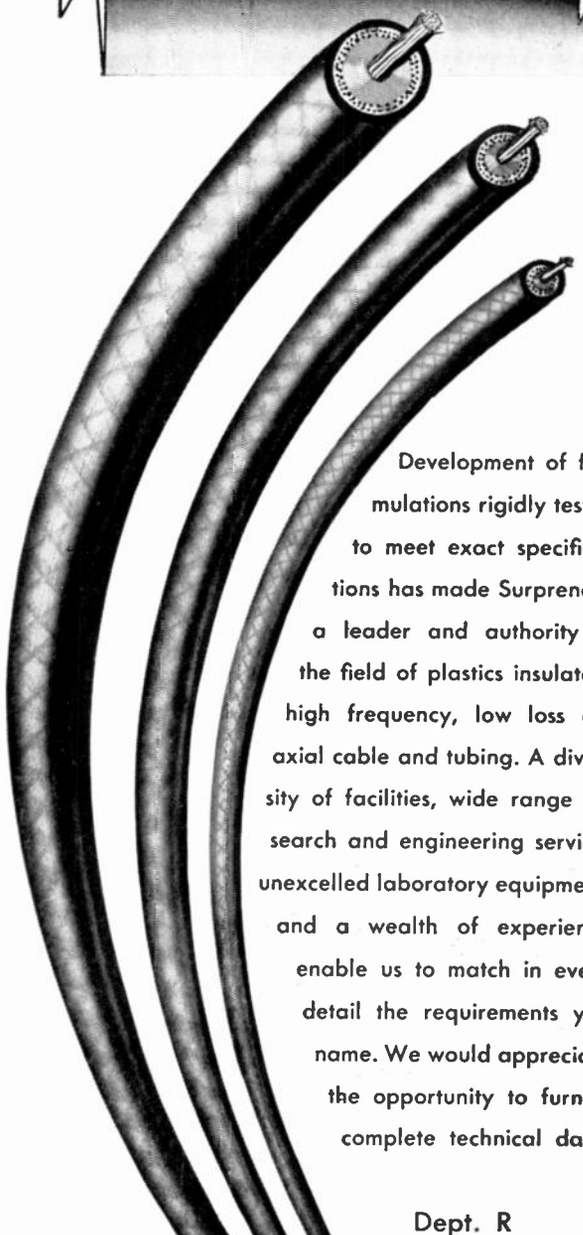
THIS MONTH'S COVER

Back in 1940, the late Joseph D. R. Freed engineered the first line of radio receivers in which every model was equipped with FM tuning. It was a complete line, ranging from table models to automatic phonograph combinations, with prices from $99.50 to $1050. Brother Arthur Freed, whose picture appears on this month's cover, is carrying on the tradition of the all-FM line in postwar models that have been shown at dealer meetings in Chicago and New York City. The model in our photograph includes high-band FM tuning, AM, and short waves, with an automatic phonograph.

CUSTOM MADE COAXIAL CABLE and TUBING



Development of formulations rigidly tested to meet exact specifications has made Surprenant a leader and authority in the field of plastics insulated, high frequency, low loss coaxial cable and tubing. A diversity of facilities, wide range research and engineering service, unexcelled laboratory equipment, and a wealth of experience enable us to match in every detail the requirements you name. We would appreciate the opportunity to furnish complete technical data.

Dept. R

URCO PRODUCT

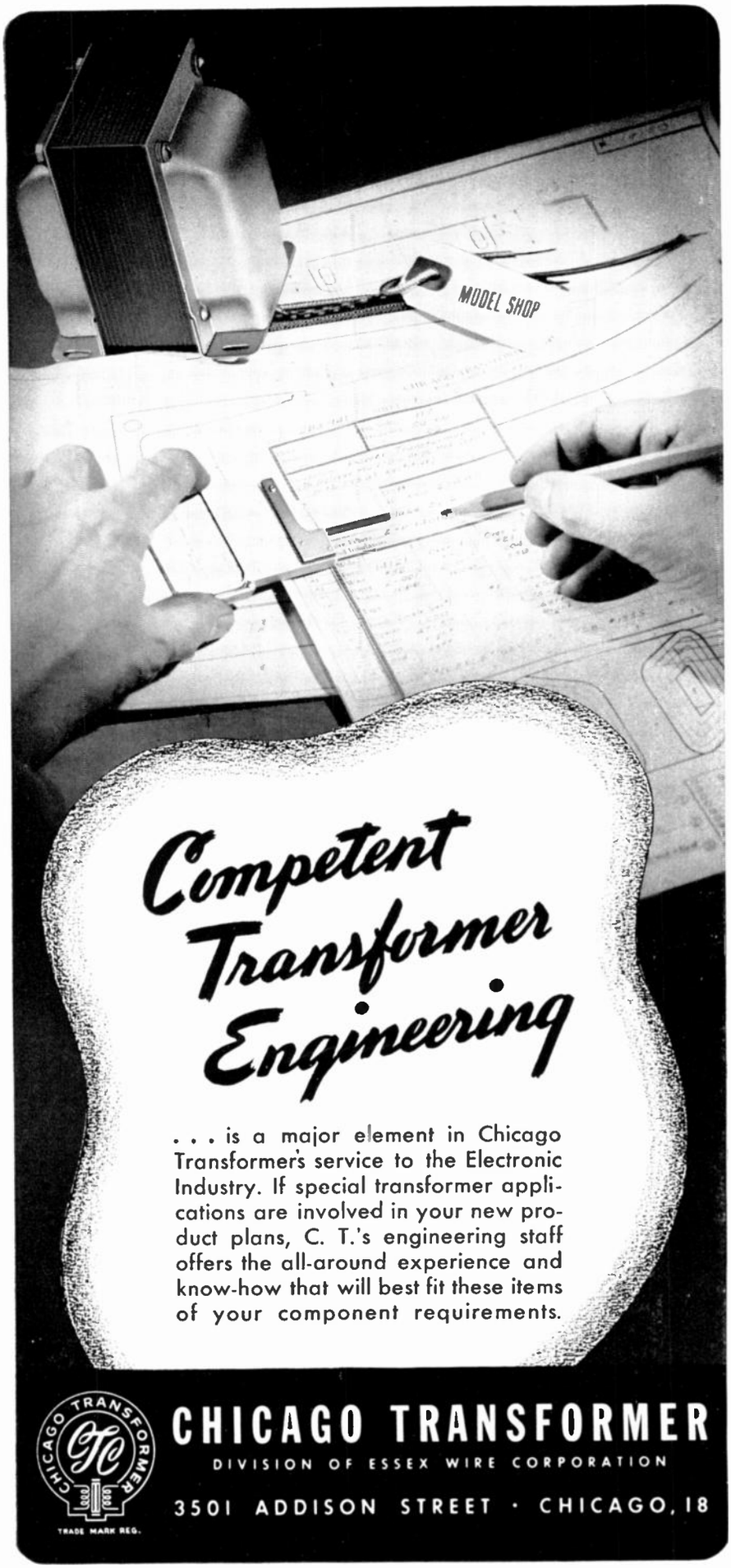
Surprenant

ELECTRICAL INSULATION CO.

84 Purchase St., Boston 10, Mass.

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

MEMBER, AUDIT BUREAU OF CIRCULATIONS ABC



WHAT'S NEW THIS MONTH

1. After Two Wars
2. Coincidence
3. Censorship by FCC

1. Back in 1913, so armed with knowledge of Clapp-Eastham radio catalogs that we could recite the text verbatim, and the considerable experience gained from winding tuning coils with bare wire spaced by thread, we decided that it was time to get a job in a radio factory.

As soon as school closed for the summer, we took the street car to Cambridge, where the Clapp-Eastham factory was located, and very respectfully presented ourself to Melville Eastham,[1] designing genius of those famous loose-couplers, variable condensers, and rotary quenched spark transmitters.

We can still remember how Mr. Eastham, without stopping whatever he was doing, listened to the recital of our ambitions, looked at us with very keen but friendly eyes and, in a kindly way, explained that the shop was not busy enough in the summer to take on any help. Beside, he strongly recommended that we continue in school. He was considerate enough to refrain from commenting on our qualifications!

It was a short interview, but we left with that warm feeling of having stood before a great Presence. What disappointment we might have felt was offset by our pride in telling members of our high school radio club that we had actually met and talked to Mr. Eastham.

Two wars later — last month, to be exact — a young chap, just out of the Navy after three years in the Pacific, came to see us. He hoped we could help him find a job in a radio factory in New York City, and could we give him any information?

We could, and did, to the best of our ability. We told him: "The prospects aren't good, because many of the plants aren't turning a wheel. Most of the others have only small crews, operating at a fraction of their prewar capacity. The majority of radio factory employees are still out of work.

"You can't work in a New York City plant, anyway, because you aren't a union member. Even if you had a union card, you couldn't apply for work at a radio factory, because the employers have

(CONTINUED ON PAGE 62)

[1] For the benefit of those who have entered the radio industry in recent years: Melville Eastham is the founder of the General Radio Company.

NEW!

UNIT 524 FAIRCHILD TRANSCRIPTION TURNTABLE

Recorded Broadcasts become "ALIVE"

Unit 524 Transcription Turntable

From now on your station announcement must be relied upon to *convince* your listeners that your program is recorded—not alive.

Why? Because there will be no telltale rumble, noise or 'wows' from the turntable. Rumble-free performance is assured through the unique method of mounting the famed Fairchild drive. This drive with its synchronous motor is mounted in a heavy casting in the base of the cabinet. It is connected to the turntable by means of a hollow shaft equipped with mechanical filters. Vertical vibration is eliminated by mounting the turntable in a heavy cast aluminum panel on the top of the solidly constructed cabinet.

'WOW' is reduced to a minimum at either 33.3 or 78 rpm by the patented Fairchild direct-from-the-center, two-speed drive. Evenness of speed is assured by a carefully calculated loading of the drive mechanism that keeps the motor pulling constantly, by precision control of all alignments that might cause intermittent grab and release.

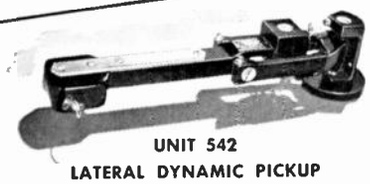
In addition, all of the natural beauty of recorded music or speech can be reproduced *with full naturalness* on the new Unit 524 Fairchild Transcription Turntable when equipped with the Fairchild Unit 542 Dynamic Pickup described below. The 'floating' pickup arm practically eliminates record wear to add long life to your library of fine recordings.

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

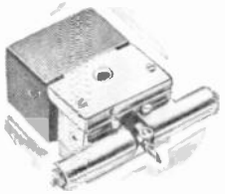
SOUND EQUIPMENT

Fairchild **CAMERA AND INSTRUMENT CORPORATION**

FOR IMPROVED PERFORMANCE



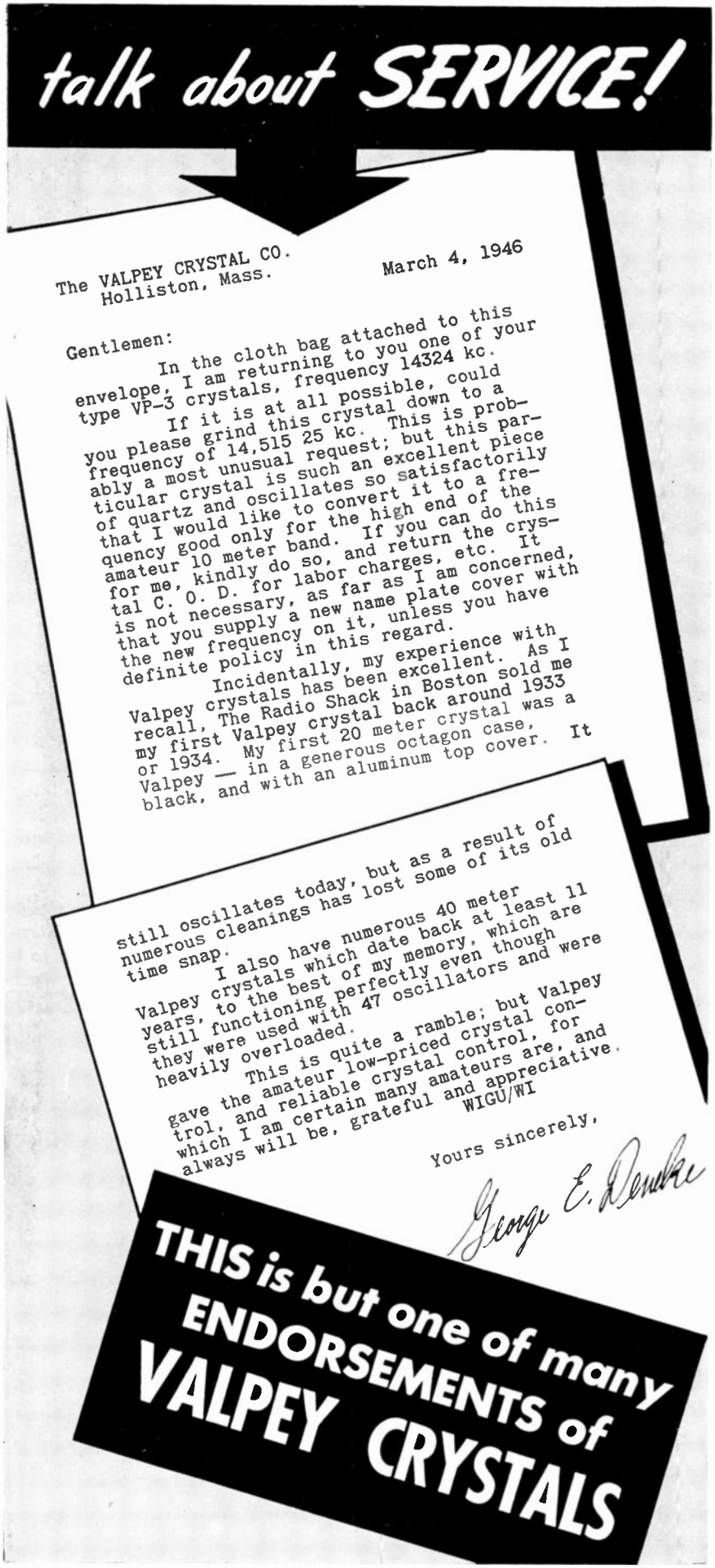
UNIT 542
LATERAL DYNAMIC PICKUP



UNIT 541
MAGNETIC CUTTERHEAD

Earlier FAIRCHILD portable models and many other types of recorder-playbacks will give vastly improved performance if equipped with an adapter and an improved Fairchild Pickup and Cutterhead.

Write for complete information.



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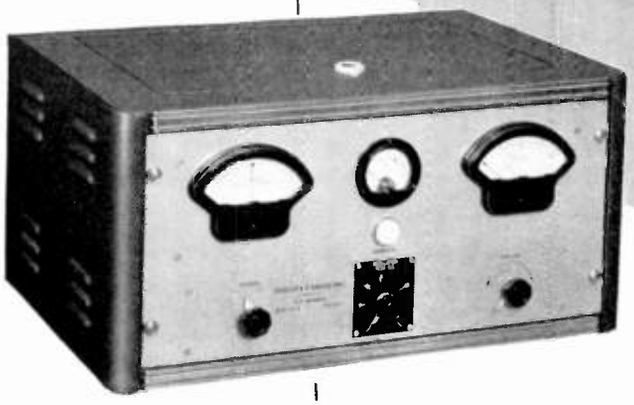
New FM FREQUENCY MONITORS

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

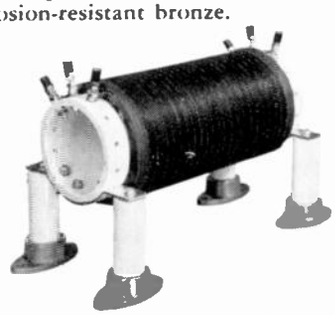
RADIO, INC.

Builders of Precision Communication Equipment

7421 SOUTH LOOMIS BLVD., CHICAGO 36, ILLINOIS

CODE BEACON FOR RADIO TOWERS

A 300 MM code beacon designed and built by ANDREW for lighting radio towers as aviation hazards. Required by the CAA on radio towers of 150 feet or greater in height. Two 500-watt prefocus lamps provide an intense light which passes through red pyrex glass filters and is radiated in a circular, horizontal beam by cylindrical fresnel lenses. Metal parts are made of light-weight cast aluminum, with hardware of corrosion-resistant bronze.

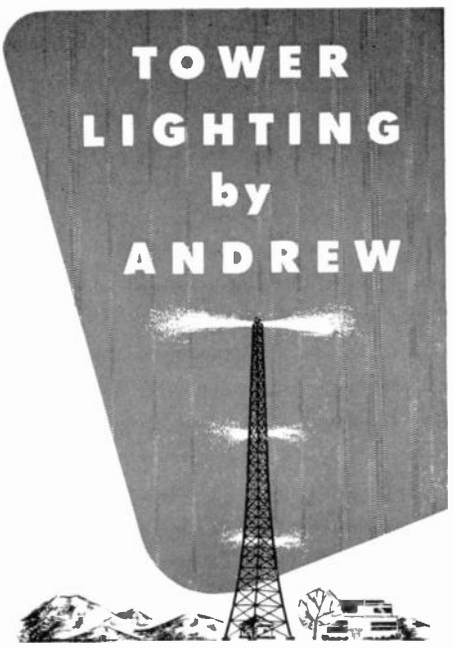


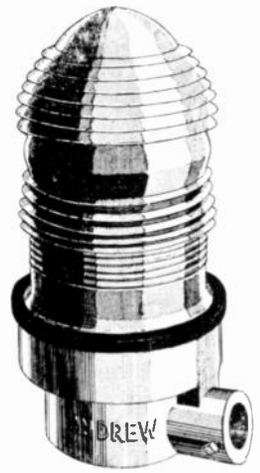
LIGHTING FILTER. The ANDREW Model 1803 lighting filter serves to connect the 60-cycle lighting voltage across the base insulator of a series excited tower without detuning the tower. Three windings provide for operation of code beacon and obstruction lights. Mica insulated by-pass condensers of ample current rating included. Also offered in weatherproof steel housing.

Pioneer Specialists in the Manufacture of a Complete Line of Antenna Equipment

ANDREW CO.
363 EAST 75th STREET
CHICAGO 19, ILLINOIS

TOWER LIGHTING by ANDREW





OBSTRUCTION LIGHT. Type 661 is a 100-watt unit fitted with a red fresnel lens to concentrate the light in a nearly horizontal direction. Used in pairs at ⅓ and ⅔ levels on radio towers for aircraft warning.

BURNOUT INDICATORS. Highly damped meter with special wattmeter scale indicates when code beacons or obstruction lights need re-lamping.

FLASHERS. Designed to flash 300 MM code beacons at rate of 40 cycles per minute, as prescribed by government regulations. Flashers have 25-ampere contacts and condensers for radio interference elimination. Use K-10347 for one or two beacons; use K-10348 to maintain constant 2000-watt load with three beacons.

TIME SWITCHES. Switch tower lights on at sunset and off at sunrise. Special astronomic dial follows seasonal variations in sunset and sunrise time. Photo-electric models also available.

LAMPS. A complete stock of lamps for code beacons and obstruction lights is carried for the convenience of users. Available in a wide variety of filament voltages.

ENGINEERING SALES

Hollywood: Capt. Louis G. MacKensie, recently released from the Signal Corps, has joined the staff of Norman B. Neely Enterprises, 7422 Melrose Avenue. Formerly city radio engineer at Battle Creek, he will be in charge of FM sales and installation for California, Arizona, Utah, and Nevada. Frank Koessler, after 3 years in the AAC, is back at his prewar job, in charge of parts and accessory sales.

Raytheon: John L. Brown, formerly of Zenith and RCA, has been appointed sales manager of replacement tubes for Raytheon, at Newton, Mass. He was recently released from the Navy with the rank of Lieutenant Commander.

Los Angeles: New member of Burgess Dempster staff is R. B. Bonney, previously with Crosley and RCA. He will concentrate on sales and engineering for the Freeland & Olschner tube line.

G.E.: Fred A. Parnell, who supervised the G.E. receiver division's advertising at the Maxon advertising agency, has joined the G.E. staff at Bridgeport as advertising and sales promotion manager of the receiver division.

New York City: Williams Export Associates, Inc., export agents handling Echophone receivers, has moved to new quarters at 37 Wall Street, New York City 5.

Lear: Midwest Furniture Distributors, Minneapolis, has been appointed distributors of Lear radios for the state of Minnesota.

I.R.C.: Victor Nicholson, I.R.C.'s merchandise sales engineer at Philadelphia, has joined Harry B. Segar Company, manufacturers representatives at Buffalo, N. Y. His place at I.R.C. will be filled by Robert Butler.

Stromberg-Carlson: T. R. Mathews, of Des Moines, Iowa, has joined the S-C sales staff as a district merchandiser. He will carry out the dealer-help program in Michigan, Indiana, Wisconsin, Iowa, Minnesota, Nebraska, Missouri, Oklahoma, and Colorado.

New York City: Newark Electric Company of Chicago has opened a second New York City store at 212 Fulton Street. These stores are under the supervision of Adolph Cross and Dave Armont.

(CONCLUDED ON PAGE 58)

Every product that enjoys the full confidence of those who use it has its "priceless ingredient." In Bliley crystals it's "techniquality."

Cutting, grinding, and finishing alone do not transform raw quartz into a sensitive frequency control device. Behind these operations there must be a background of technical skill and creative engineering that is gained only through years of experience.

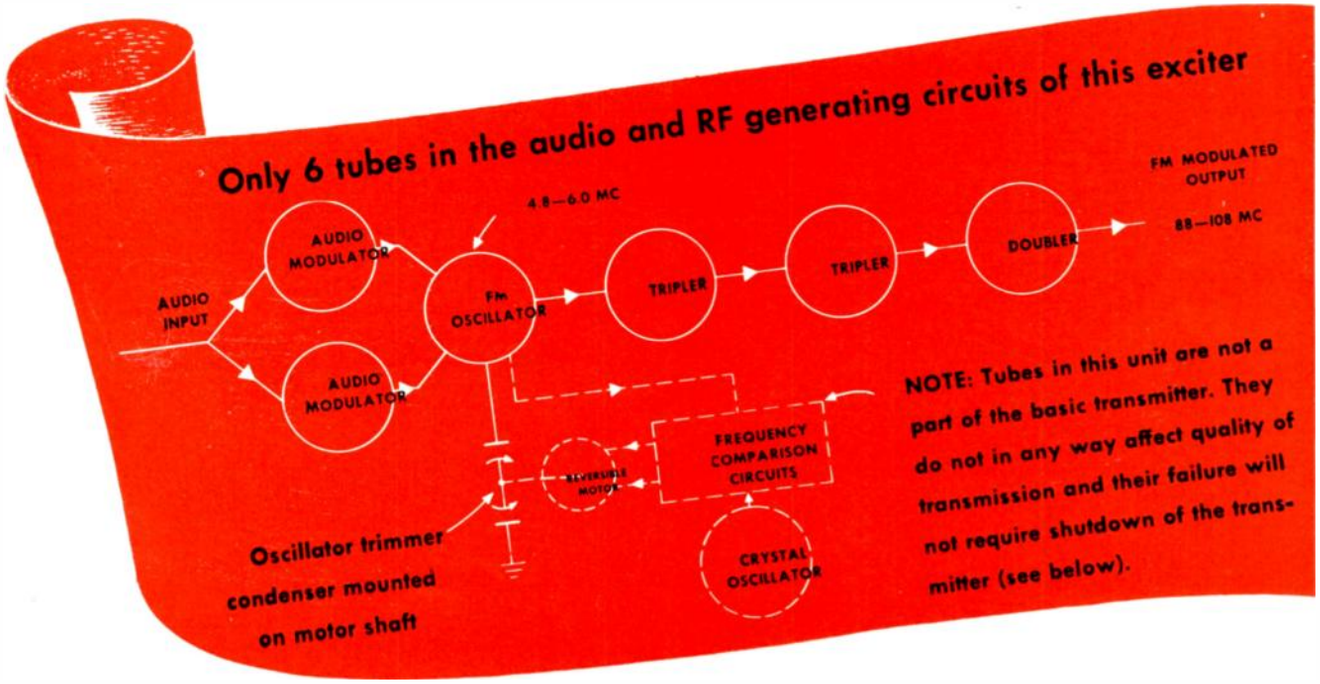
Bliley crystals have a reputation for "techniquality" that started fifteen years ago. Today, the fact that Bliley crystals are used in practically every phase of radio communications is tacit proof that leading engineers have found it is best to specify Bliley "techniquality" crystals.

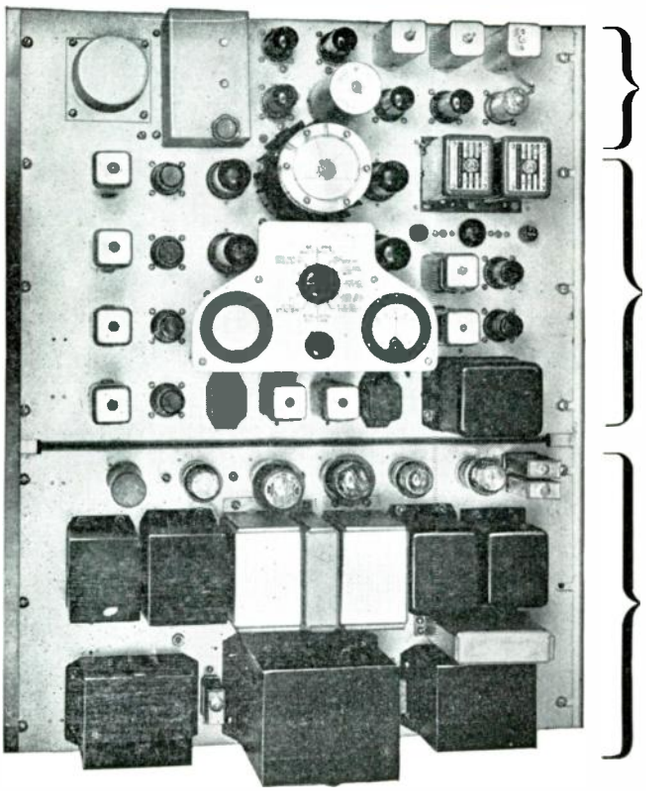
Bulletin 27 describes the crystal units engineered for the needs of today. Write for your copy.

Bliley CRYSTALS

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA

"DIRECT FM"





BASIC CIRCUITS are mounted on this part of the exciter panel. They include two audio modulators, an FM oscillator, and three frequency multiplying stages (see diagram above).

AUTOMATIC FREQUENCY CONTROL is provided by the circuits in this part of the exciter panel. Two temperature-controlled, precision-ground crystals (one a spare) are provided. Sub-harmonics of the crystal oscillator and FM oscillator are compared. Any difference between these frequencies operates a reversible motor with a vernier condenser mounted on the motor shaft. The motor never turns more than 90 degrees either way. No gears, counter circuits, or compensating voltages are involved. Failure in this section does not take the transmitter off the air, since operation may be continued by making occasional manual frequency corrections.

REGULATED POWER SUPPLY is contained on this panel. Provides close control of plate voltages regardless of changes in a-c supply voltages.

GROUNDED GRID FM

provides the lowest distortion!

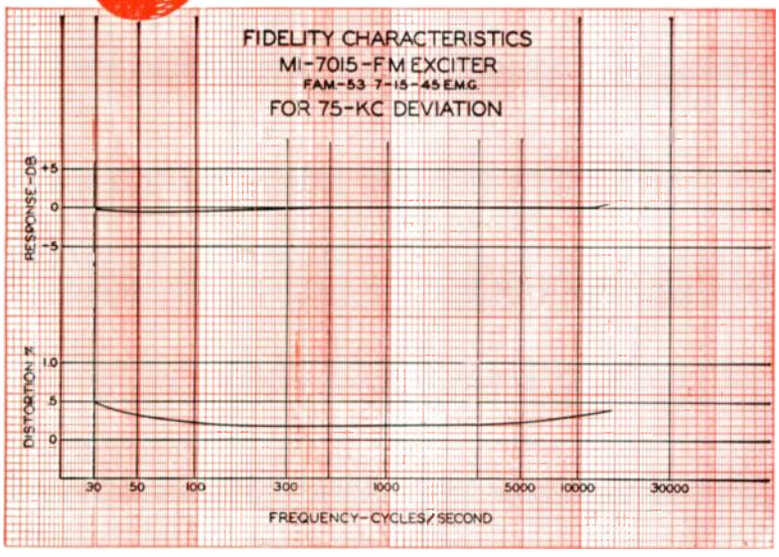
COMPARE these laboratory performance measurements on one of the new RCA "DIRECT FM" EXCITERS

✔ **Distortion:**

Less than ½% from 30 to 15,000 cycles

✔ **Frequency Response:**

Within ±½ db from 30 to 15,000 cycles



THE CURVES at the left show the distortion and response versus frequency as actually measured on one of the first of the new RCA "Direct FM" exciter units. Distortion has been measured at less than one-half of one per cent over the whole "FM range" of 30 to 15,000 cycles, with frequency response varying less than ½ db over the same range.

The fidelity which can be obtained in an FM transmitter is basically limited by the distortion and noise introduced in the FM generating circuits located in the exciter. The simple, straightforward circuits used in the RCA exciter are inherently capable of lower distortion and lower noise level than any other type yet developed. The curves at the left prove this!

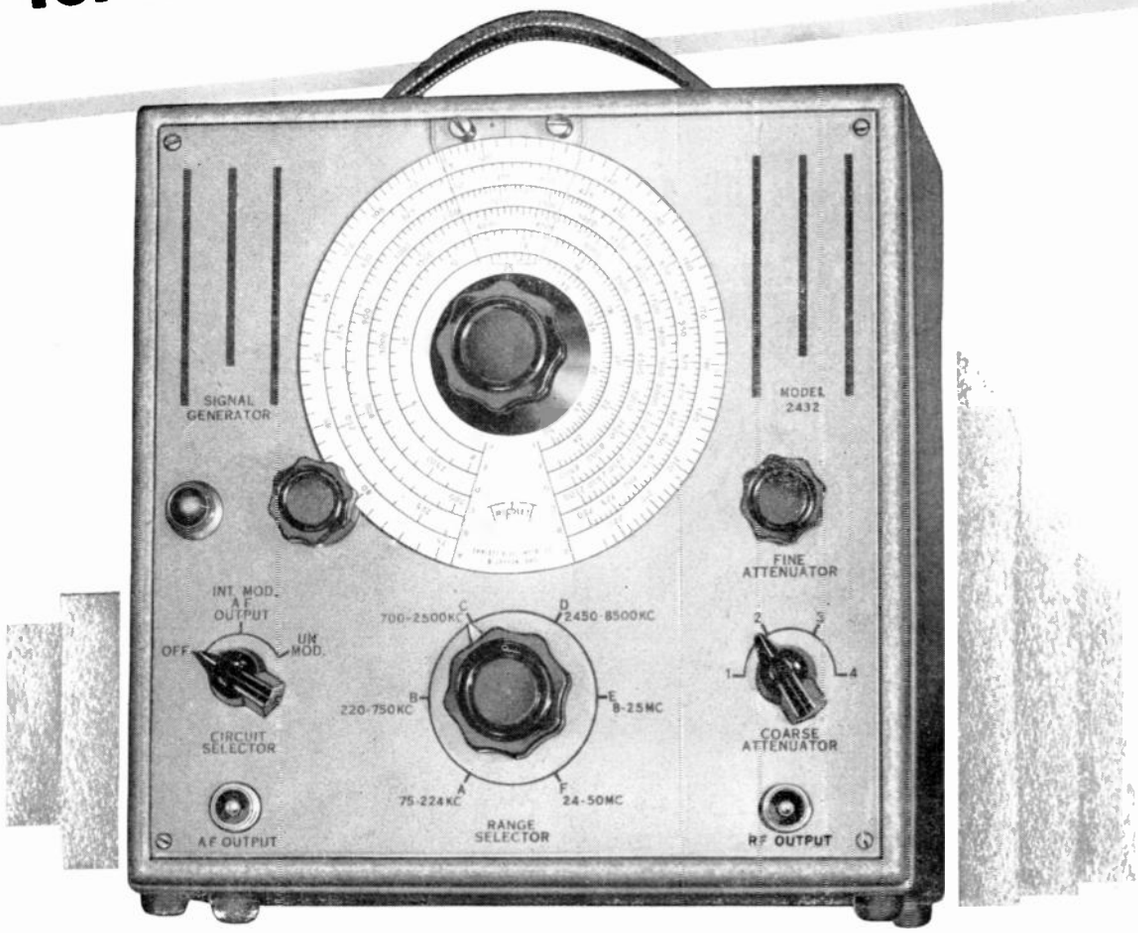
The station which proposes to provide true "FM Quality" should start with the best exciter available. We believe that the RCA "Direct FM" exciter is just that!

BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

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 course 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.

See the 1947 Triplett Models. Radio Parts Show. Booth 139

Precision first ...to last

STANDARDS ARE SET BY TRIPLETT

Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

self-synchronizing

finch facsimile

World's Fastest and Most Accurate *Communications Equipment*

POINT TO POINT (*Mobile or Stationary*)

TELEFAX

the "Instant Courier"

With Finch Facsimile equipment ("Telefax"), illustrated and written messages called Faxograms can be sent at great speed between any two points that can be connected by radio or wire. These points may be stationary (as between factory and office) or mobile (as between ship to airplane or station to patrol car). Anything or everything that can be printed, drawn or written on a sheet 8½" x 11" can be transmitted or received by radio in two minutes or by wire at slightly slower speeds depending upon type of circuit used.

BROADCAST

AIR PRESS

TELEFAX ILLUSTRATED NEWS

Pictures and printing broadcast to homes

With Finch Facsimile equipment, illustrated printed matter such as newspapers or magazines can be sent by radio to homes. Stations are now being licensed to render this service. Home recorders and recording paper will be moderately priced. Broadcasts will include all news and features such as cartoons, market reports, photographs, and maps besides illustrated and printed advertisements. In one hour, the equivalent of more than twenty pages of tabloid size can be transmitted and received.

For Full Information write to:

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Here's Federal's 1 Kw FM transmitter that stole the show at the sixth annual Broadcast Engineering Conference at Ohio State University. A group of engineers are shown examining the equipment in actual operation at the conference.

Federal Features for Better FM

- Federal's new "FREQUEMATIC" FM modulator—a radically improved type of modulator-oscillator unit—gives FM transmission outstanding fidelity and mean-carrier stability, with unsurpassed dependability and economy.
- By means of simple all-electronic circuits, "FREQUEMATIC" maintains the center-frequency stability within a tolerance of plus or minus one thousandth of one per cent of the assigned value—only *half* of the present FCC tolerance requirement.
- Remarkable noise-level reductions resulted in an actual measured signal-to-noise ratio of 5600 to 1—a level so low that Federal had to build special test equipment for its measurement.
- Undistorted modulation of all audio signals between 50 and 15000 cycles is maintained, even when the transmitter is overmodulated as much as three hundred per cent by transient passages.
- This outstanding performance is obtained with simple circuits and standard receiver tubes, and the equipment depends mainly on resistances and capacitances for critical and non-critical functions.
- Another feature—of special interest to all broadcasters—is the extreme ease of initial alignment and operational maintenance. The unit can be completely tuned in a matter of minutes, as only two tuning operations are necessary. There are no tuned circuits in the crystal oscillator or frequency divider networks.

New high-efficiency, air-cooled and water-cooled tubes, developed by Federal, are employed in the power amplifier stages of the transmitter, contributing to long life, stable operation and low noise level.

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FM STEALS THE SHOW

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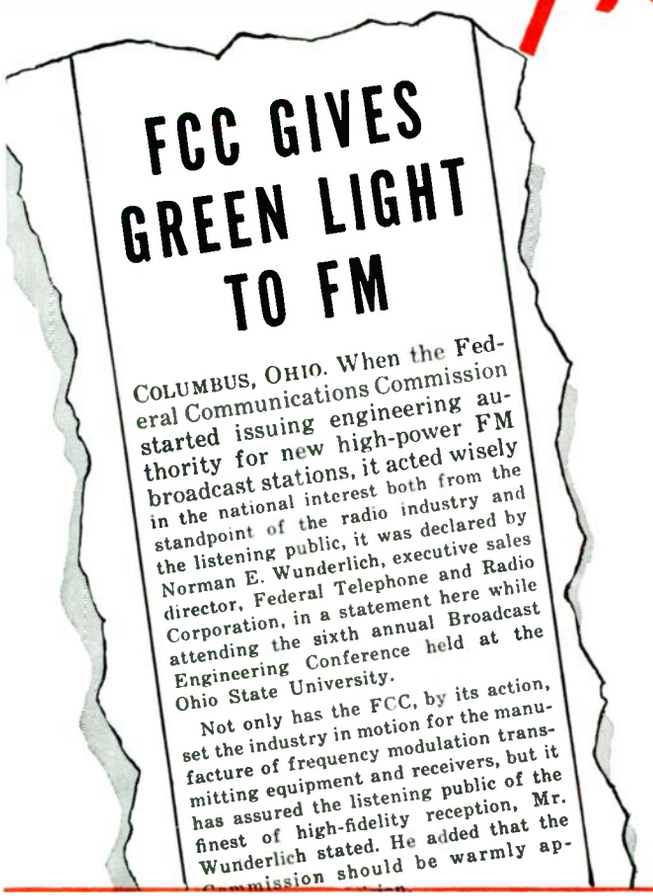

FCC GIVES GREEN LIGHT TO FM

COLUMBUS, OHIO. When the Federal Communications Commission started issuing engineering authority for new high-power FM broadcast stations, it acted wisely in the national interest both from the standpoint of the radio industry and the listening public, it was declared by Norman E. Wunderlich, executive sales director, Federal Telephone and Radio Corporation, in a statement here while attending the sixth annual Broadcast Engineering Conference held at the Ohio State University.

Not only has the FCC, by its action, set the industry in motion for the manufacture of frequency modulation transmitting equipment and receivers, but it has assured the listening public of the finest of high-fidelity reception, Mr. Wunderlich stated. He added that the Commission should be warmly ap-

Federal's display of FM transmitting equipment, in actual operation at the sixth annual Broadcast Engineering Conference, created a real sensation among the country's foremost broadcast engineers. The new "FREQUEMATIC" modulator, an exclusive feature of Federal's 1, 3, 10, 20, 50 kw transmitters, made big news—exceeding the exacting requirements of the FCC Standards of Good Engineering Practice on every technical point. Of outstanding importance, too, is the fact that this new FM equipment is in actual production now!

Federal is ready to provide your new FM station with the finest transmission equipment available—complete in every detail, from microphone to transmitting tower. This outstanding "one-source" service means completely matched components for the entire system—all precision engineered, all of highest quality, all designed to work together as a single, perfected and coordinated FM system.

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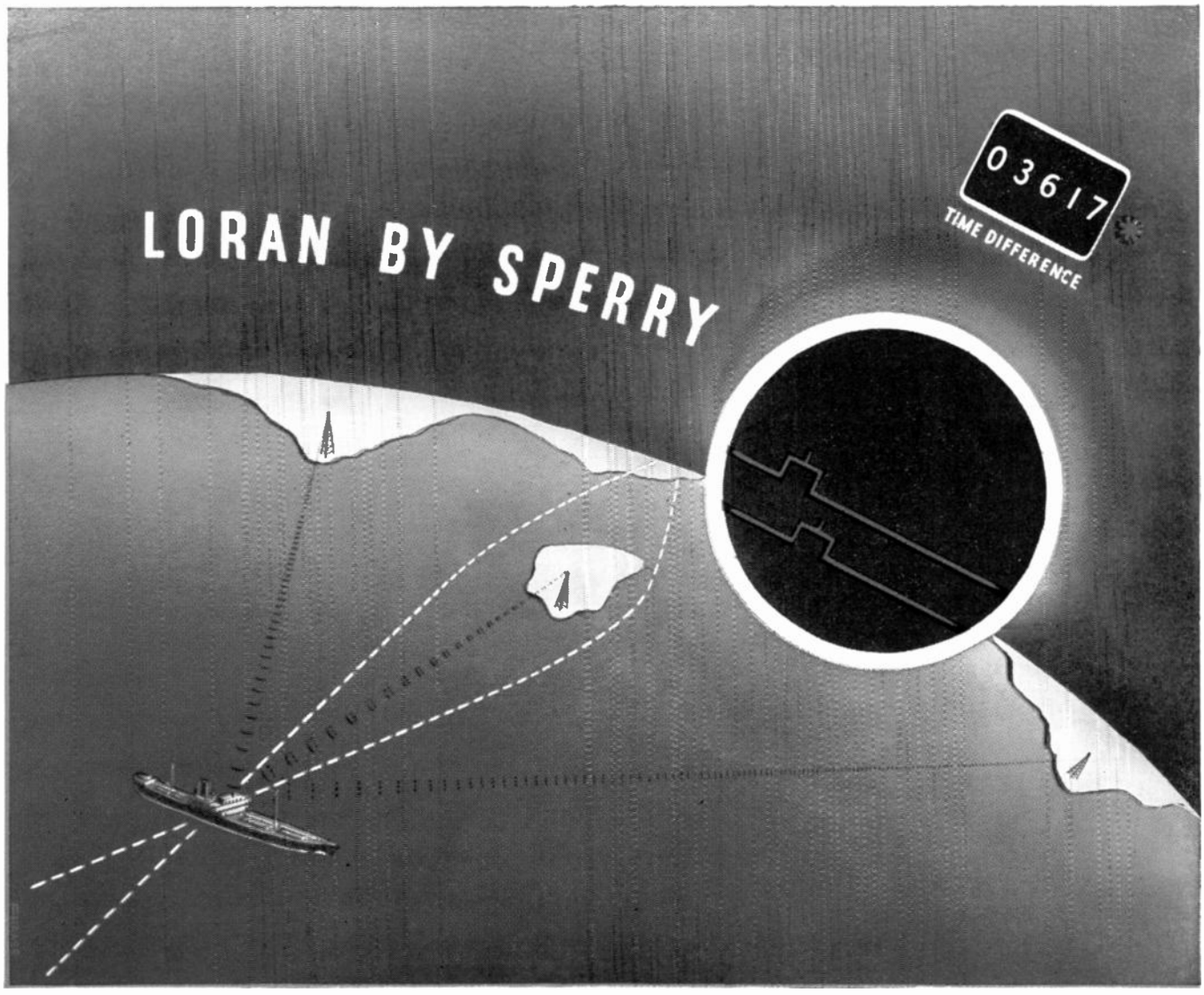

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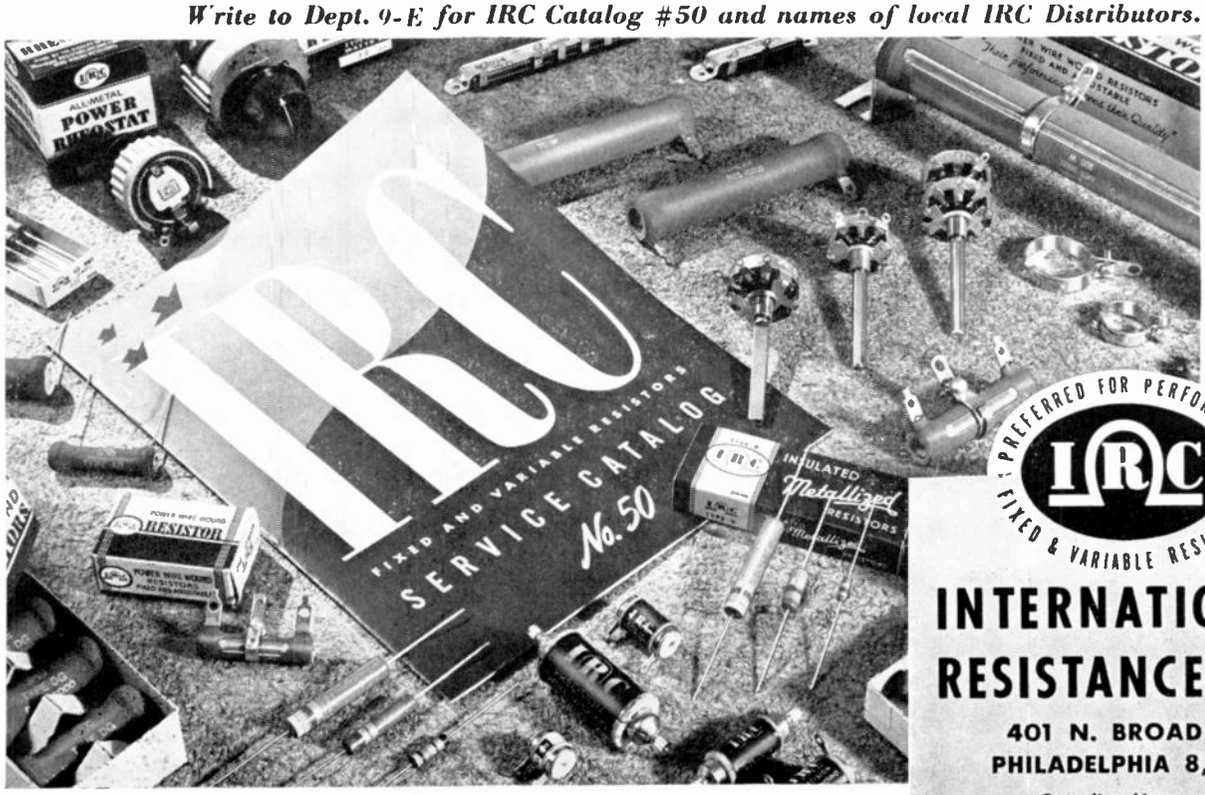

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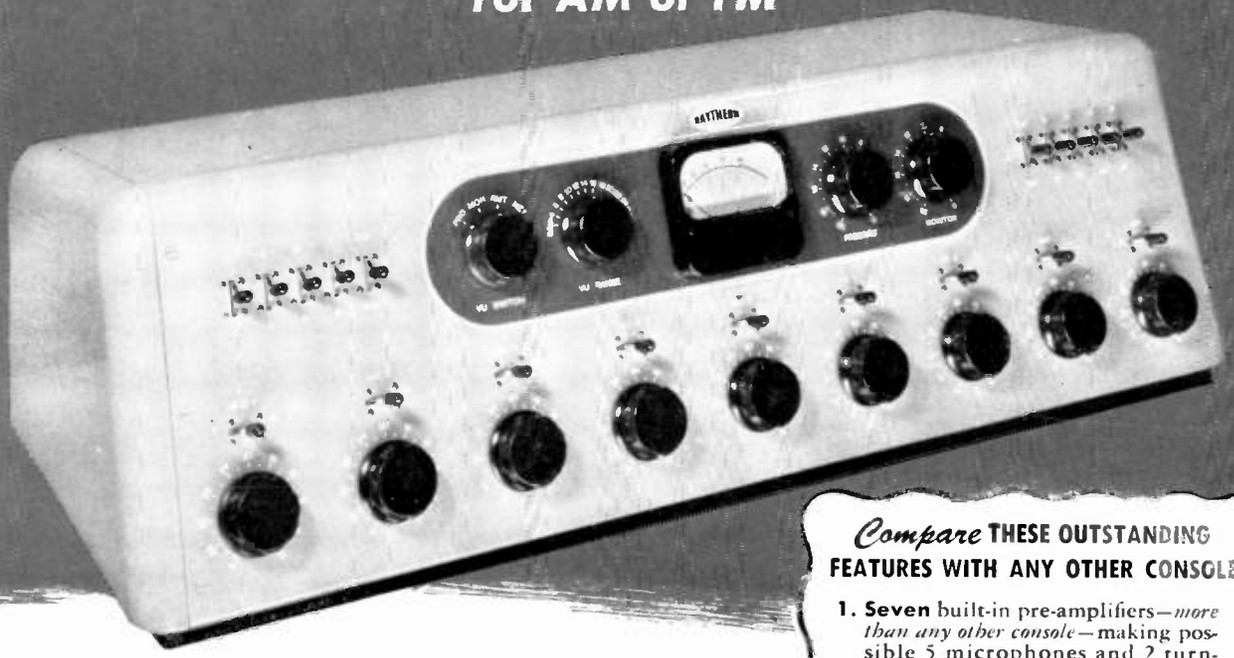

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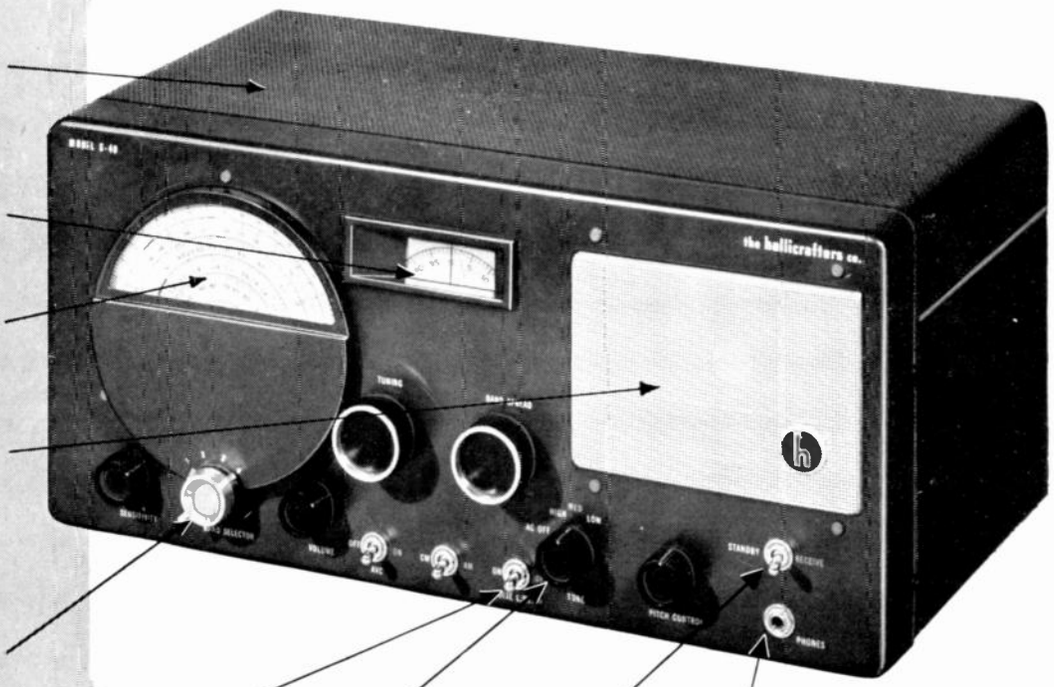

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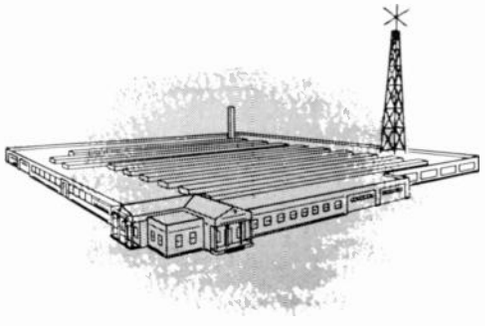

INSIDE STUFF: Beneath the sleek exterior of the S-40 is a beautifully engineered chassis. One stage of tuned radio frequency amplification, the S-40 uses a type 6SA7 tube as converter mixer for best signal to noise ratio. RF coils are of the permeability adjusted "micro-set" type identical with those used in the most expensive Hallicrafters receivers. The high frequency oscillator is temperature compensated for maximum stability.

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PROGRESS OF FM BROADCASTING

With FM Applications Approaching Number of AM Stations, Delaying Tactics of Opposition Prove Futile, While Facsimile Promises Added Public Service

BY MILTON B. SLEEPER

ACCORDING to a story that still persists, the House of Representatives was once urged to vote favorably on a bill prohibiting the installation of bathtubs, because their use was a menace to public health.

If this is true, it is also true that the proponents were not motivated by any factual knowledge that bathtubs were a threat to the health of our Nation. Time has proved that. It is clear now that they were trying to protect themselves from the shuddering gasps which beset them as they quaked before the seeming terrors of a tin tub brimming with unheated water.

AM vs. FM ★ Looking back on the progress of FM broadcasting through the perspective of the eleven years since Major Armstrong demonstrated this system to the IRE, we can see that all the early efforts to forestall FM by denying it space on the ether, and the later, more successful drive to sidetrack its use by shifting it to new and untried frequencies were pure and simple expressions of self-protective interest, with no more factual foundation in honest, intelligent effort to serve public interest, convenience, and necessity than was felt by those who undertook, by legislative process, to set up the wash basin as the legal limit on progressive sanitation.

Listeners Forgotten ★ Joined with this eleven-year fight against the coming of FM, and as a product of the purposes behind it, has come a distinct change in the status of radio listeners.

Indeed, to those broadcasters, manufacturers, and Government officials who have fought the progress of FM broadcasting step by step, the radio listener has become the forgotten man.

Something Slipped ★ How successful have those forces been in withholding FM's superior service from the public? Their strategy has won only a delaying action, and in terms of end results, their defeat is clear for all to see.

Here are the facts: Full-scale production of FM transmitters and receivers has been delayed about one year as a result of shifting frequencies to the higher band. If the opponents of FM had guessed correctly, that delay would have dealt FM a staggering blow, because the strategy was to flood the market with AM receivers in 1946, and to issue AM station licenses or power increases to friends of the administration.

But those who are over-eager to serve selfish purposes are most apt to overlook potential pitfalls. Labor troubles, material shortages, and OPA complications have prevented large-scale production of AM receivers. For the same reason, equipment for AM stations has been held up. Even in cases where transmitters left over from prewar production are available, their installation is not possible because CPA has put a limit of $1000 on new construction.

Engineering and development work, however, have not been affected by these conditions. With AM production stalled, there has been ample time to complete and perfect the designs and manufacturing plans for new-band FM transmitters and receivers. All this boils down to two significant facts:

1. By the time AM equipment can be installed for new stations or to increase the power of old ones, new-band FM transmitters up to 10 kw. will be available, and FM receivers will be rolling out in large quantities. Then holders of CP's for AM stations will find their money invested in the wrong kind of equipment, and assets represented by construction permits changed to liabilities.

2. As for radio listeners — the postwar demand for cheap AM sets has proved to be far below the level anticipated. That is partly due to the tremendous publicity given by the newspapers to the hearings on FM, which has awakened a lively interest in this improved system of broadcasting, and partly to the fact that new AM receivers evidence no demonstrable improvement over prewar models. Even the dealers are indifferent to making any serious effort to sell new AM sets. Many of them learned during the war that there's more profit in servicing old receivers than in selling new ones in the $19.95 to $29.95 price bracket.

Facts ★ These conditions represent only the negative advantages which FM has salvaged from what was intended to be its coup de mort. Let us examine the positive gains made by FM since VJ-Day:

Official figures released by the FCC show that 834 applications for FM stations had been filed and accepted up to April 1, 1946. This total can be broken down as follows:

18 Construction permits granted
32 Basic engineering approvals issued
425 Condition grants issued
131 Applications in hearing
228 Awaiting initial action

834 Total Applications Filed

The total of these applications is almost equal to the number of AM stations on the air. Thus, while it is not yet possible to estimate the time required to manufacture and install 834 transmitters, these official figures give a conclusively affirmative answer to the question: "Is the future of nation-wide FM broadcasting assured?"

Distribution of applications is as follows. The first column lists the FM applications from those who do not own AM stations; the second column lists FM applications from AM operators; the third column lists the present number of AM stations.

	FM[1]	FM[2]	AM
NORTHEASTERN			
Conn.	6	12	12
Del.	0	2	2
Md.	8	9	9
Me.	0	4	9
Mass.	15	20	23
N. H.	1	3	7
N. J.	7	7	12
N. Y.	26	30	59
Penn.	28	39	52
R. I.	1	1	4
Vt.	2	0	4
D. C.	1	10	6
Total	101	140	199
GREAT LAKES			
Ill.	21	28	38
Ind.	9	14	20
Ky.	2	10	14
Mich.	12	17	31
Ohio	29	42	36
W. Va.	3	10	14
Wisc.	4	20	25
Total	80	141	178
MIDWEST			
Iowa	1	9	24
Kan.	3	5	17
Minn.	5	11	21
Mo.	2	16	23
Nebr.	0	5	14
N. D.	2	0	9
S. D.	0	0	9
Total	13	46	117

	FM[1]	FM[2]	AM
SOUTHERN			
Ala.	2	11	23
Ark.	2	1	16
Fla.	5	16	30
Ga.	5	22	35
La.	4	9	16
Miss.	0	5	18
N. C.	10	24	37
S. C.	1	8	17
Tenn.	6	13	28
Va.	2	13	24
Total	37	122	246
SOUTH CENTRAL			
Okla.	6	9	19
Tex.	8	26	66
Total	14	35	85
MOUNTAIN			
Ariz.	0	0	10
Colo.	0	4	14
Ida.	0	5	11
Mont.	0	0	9
Nev.	0	2	4
N. M.	0	0	11
Utah	0	1	10
Wyo.	0	1	6
Total	0	13	75
PACIFIC			
Calif.	25	18	67
Ore.	3	8	24
Wash.	0	8	31
Total	28	64	122
U. S. Total	273	561	1020

[1] FM applicants with no AM affiliations
[2] FM applications from operators of AM stations

Here are some additional facts disclosed by the FCC:

561 applications (67.2%) are from AM station operators. In other words, the majority of AM broadcasters are laying their plans already for the shift from AM to FM.

273 applications (32.8%) are from newcomers to radio broadcasting.

330 applications (39.6%) have been

(CONCLUDED ON PAGE 44)

HOW FM WAS USED TO FIND SUBMARINES

Developed for the Army but Used by the Navy, the Sono-Buoy Transmitted Underwater Sounds to Scouting Aircraft

BY MURRAY WEINSTEIN*

FIG. 1. A SONO-BUOY FM TRANSMITTER FALLING FROM A PLANE TO THE WATER

IN THE early months of 1942, with the last our our civilian FM receivers shipped out, it looked as if our work at Freed Radio on FM equipment was over for a long time. At least, we knew that the Signal Corps then considered FM of limited military usefulness, while Navy officials generally felt that AM could do any job that FM could perform, and do it better.

At that time, you may recall, German submarines were playing cops and robbers with our shipping all along the Atlantic seaboard, coming in so close that many people watched sinkings from the shore.

In such a critical situation, the most unexpected things could happen, and did. Among them was the appearance at our plant of a group of engineers from the NDRC Underwater Sound Laboratory at New London, Conn. They brought with them a strange-looking piece of apparatus, assembled on four copper discs about 4 ins. in diameter and spaced apart by rods, so that the unit could slide into a long paper tube.

This, they said, was an FM transmitter intended to listen to submarines and transmit what it heard to Army seaplanes which were then being used to hunt subs along the coast. Could we help them in perfecting the unit, and then manufacture them in quantities?

We could, and we did. Eventually, we made thousands and thousands of them.

The laboratory model certainly didn't look like any FM transmitter we had ever seen. In fact, when Major Armstrong saw one of the first production samples, even he didn't know what it was!

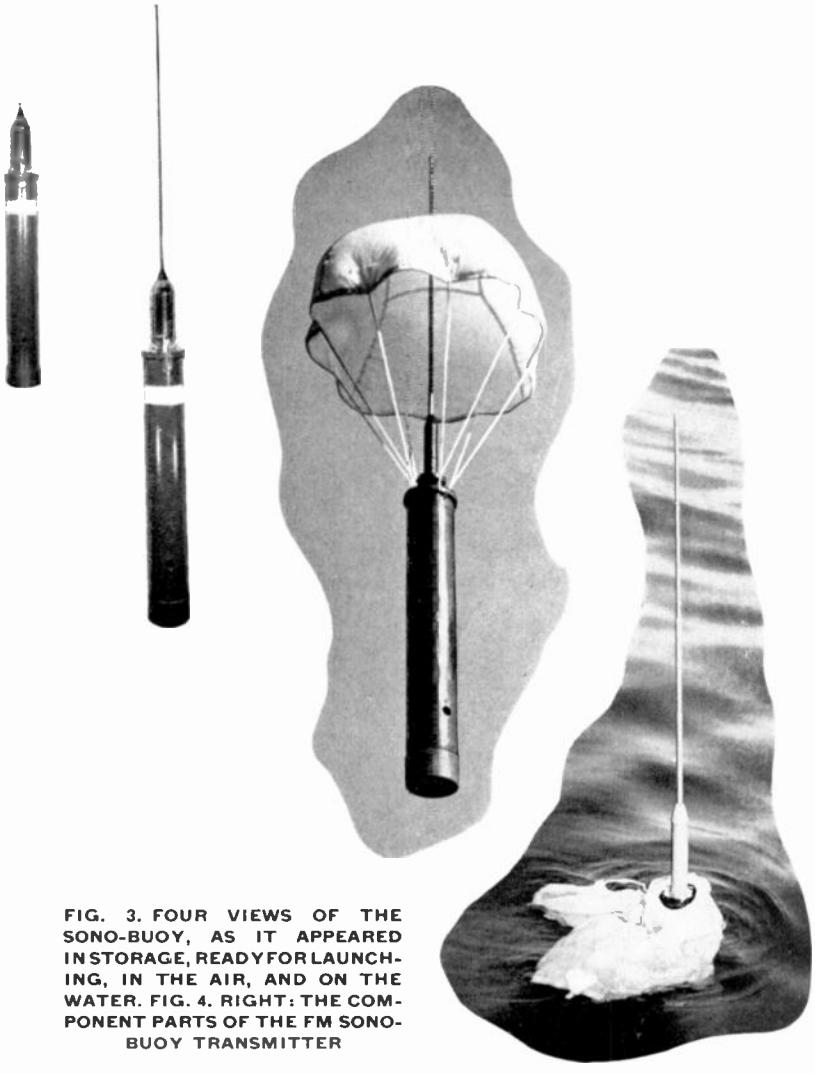
As we learned later, the appearance of the device really was deceptive. For such a small and simple-looking piece of apparatus, it proved to be a veritable bag of tricks, some of which weren't mastered until we had worked on them for months.

Essentially, this equipment, called the Sono-Buoy, was an expendable, battery-operated FM transmitter which, when dropped by parachute from a plane, released a hydrophone on 20 ft. of cable, so that sounds picked up by the hydrophone were transmitted to planes scouting for submarines.

Fig. 1 shows a Sono-Buoy falling, while the magneto-striction microphone is depicted in Fig. 2. The four views in Fig. 3 show, from left to right, the Buoy as it appeared in storage, with the antenna extended and ready for launching from a plane, the parachute opened by the static

*Chief Engineer, Freed Radio Corporation, 200 Hudson Street, New York City.

FIG. 2. THIS MAGNETO-STRICTION MICROPHONE LISTENED TO SUBMARINES



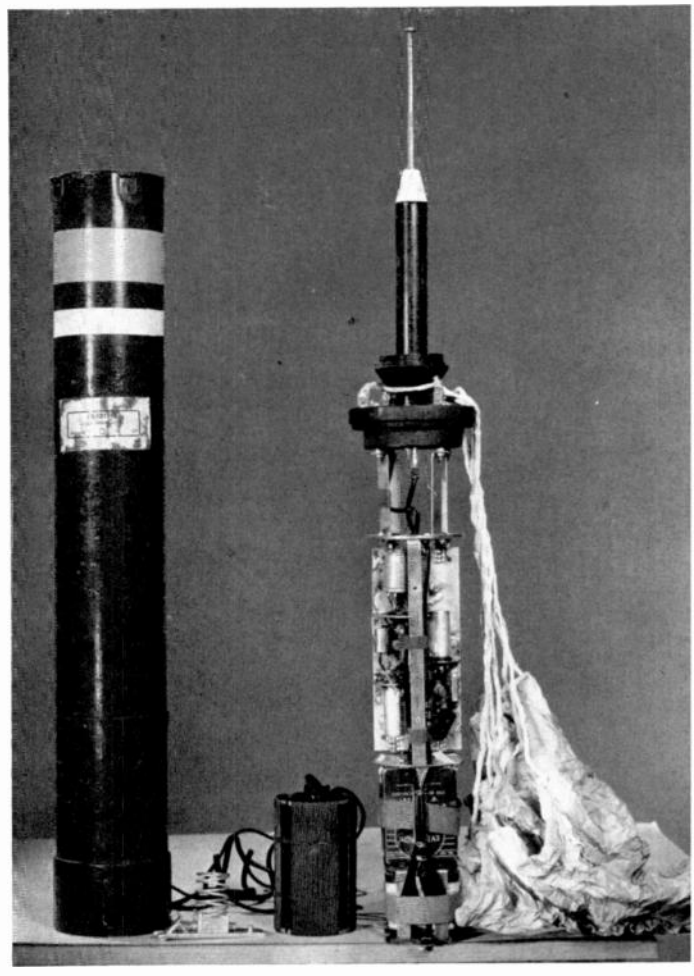


FIG. 3. FOUR VIEWS OF THE SONO-BUOY, AS IT APPEARED IN STORAGE, READY FOR LAUNCHING, IN THE AIR, AND ON THE WATER. FIG. 4. RIGHT: THE COMPONENT PARTS OF THE FM SONO-BUOY TRANSMITTER

line or rip-cord, and finally the unit resting on the water.

The component parts are illustrated in Fig. 4. They are: the case fitted with an iron ring that carries the hydrophone release; the release mechanism which, upon striking the water, falls out and lets the hydrophone drop; and the electrical unit with the batteries below and an unfurled parachute at the side.

There you see the finished product, of which great quantities were made for use in both the Atlantic and Pacific oceans. What you don't see, of course, are the headaches that kept a group of NDRC engineers at New London, Navy men at Washington, and our own project corps on the run for months.

By the time the Sono-Buoy kinks were all ironed out, the submarines had already been chased off shore, and the Army had turned over its sub-hunting job to the Navy. However, we had then started sending men and supplies in huge convoys, and enemy submarines were after these bigger, deep-sea objectives. That was why the Navy took over the Sono-Buoy project. The planes flying from the baby flat-tops accompanying our ships, needed just such a device.

The radio circuit of the transmitter, Fig. 5, offered the least trouble. Signals from the hydrophone were fed into a 2-stage, resistance-coupled amplifier, and thence to a reactance-tube modulator. The electron-coupled oscillator was of the

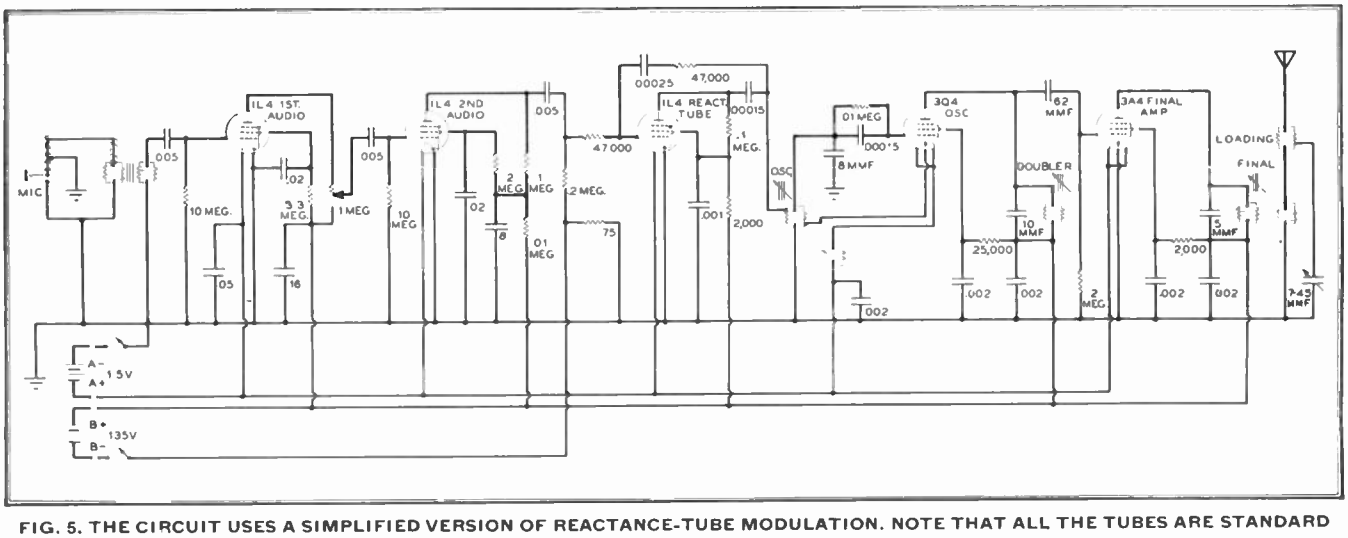


FIG. 5. THE CIRCUIT USES A SIMPLIFIED VERSION OF REACTANCE-TUBE MODULATION. NOTE THAT ALL THE TUBES ARE STANDARD TYPES

shunt-feed type, operating at 17.5 mc. The output circuit, tuned to 35 mc., acted as a frequency doubler. In the final power output stage, the frequency was doubled again. This made an excellent and very simple 5-tube FM transmitter of small dimensions.

Operating from four standard flashlight cells in parallel for an A battery, and with two small 67.5-volt B batteries, the useful life of the transmitter was about 4 hours. Of course, the batteries were greatly overloaded, since the A current was approximately .3 amp., and the B current .025 amp. This gave an RF output of about .1 watt, sufficient for a useful range of approximately 22 miles to a plane flying at 2,000 ft.

Four hours was the maximum intended life of the Buoy, since the top of the case was fitted with a soluble plug that gradually melted away, finally admitting the sea water and causing the unit to sink. It is doubtful if the enemy ever saw one of these Buoys.

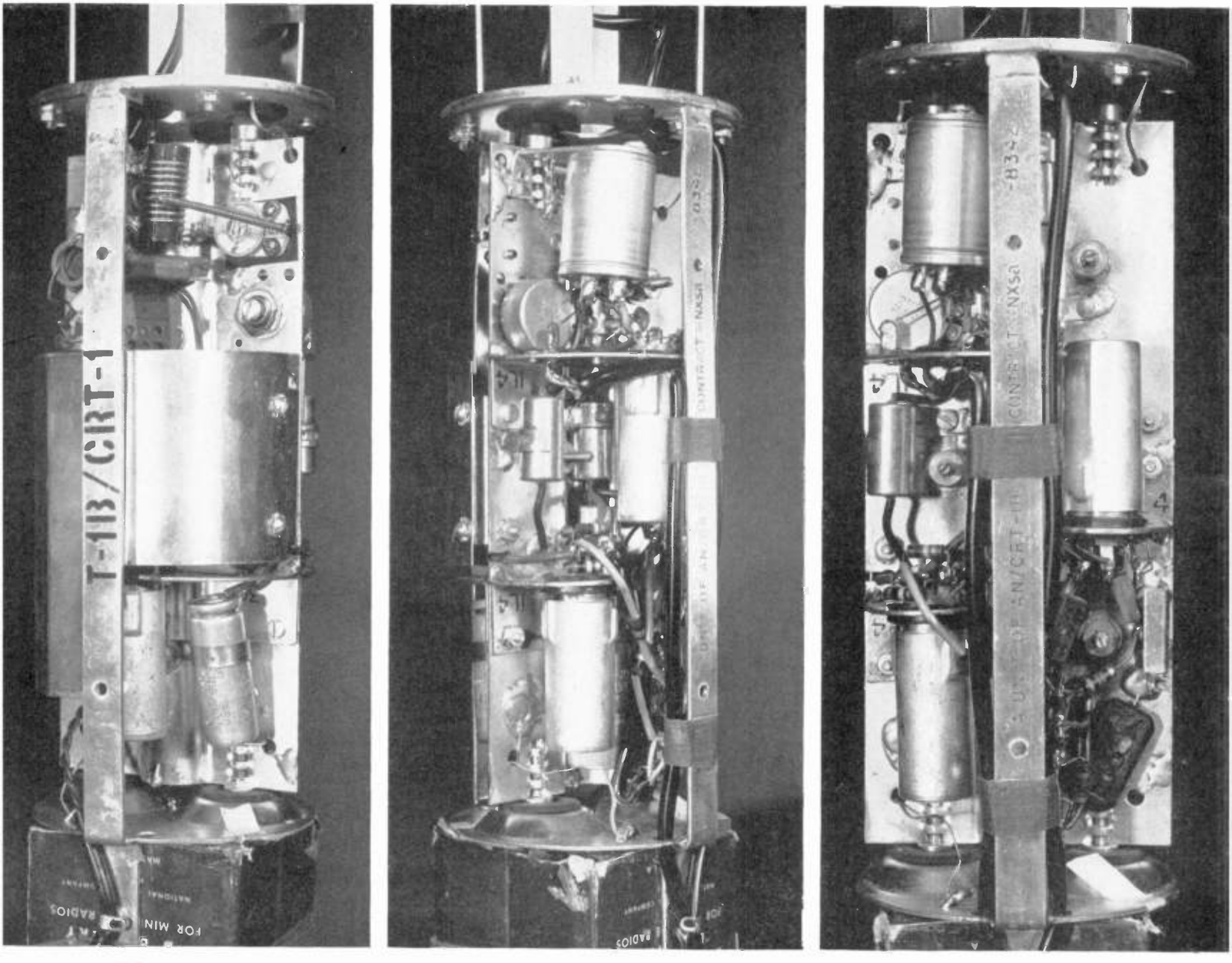
The FM circuit functioned beautifully, delivering clear, static-free reception of whatever the hydrophone picked up. In some of the tests at the Underwater Sound Laboratories we used to listen to the workers on the subs at the Electric Boat yard across the bay. An interesting associated project was the development of a special aircraft receiver to work with the Buoy. Since the transmitter did not use crystal control, we developed a receiver with automatic frequency control that followed the transmitter drift.

Some of the problems we encountered are of special interest. You might expect that the shock to the components and tubes when the Buoy hit the water at 30 MPH would have caused considerable damage. Actually, the units seldom failed from that cause. Even the standard tubes took the blow without injury, although there was no shock absorption in the original design. Later, when the components were mounted on two vertical plates, as shown in Fig. 6, the bolts holding the plates at the top and bottom were set into rubber bushings.

Trouble developed, rather, in simple things. For example, the original NDRC model used impregnated paper tubing for the outside casing, and the tube was covered with copper foil to provide a ground. In practice, we found it almost impossible to cement the foil smoothly and securely to the tube, and even with ordinary handling the foil was torn. That trouble was eliminated by spattering molten copper directly on the tube. This coating was tough, and adhered to the tube as tightly as a coat of paint. Also, we could solder a

(CONTINUED ON PAGE 48)

FIG. 6. THREE VIEWS OF THE RADIO TRANSMITTER CHASSIS. THE A AND B BATTERIES ARE STRAPPED TOGETHER BELOW THE BOTTOM PLATE



NEW CONCEPT OF ACOUSTICAL TREATMENT

Diffusion, Reflection, and Absorption Combine to Produce a Bright Effect, with Excellent Sound Transmission Characteristics

BY ARNOLD NYGREN

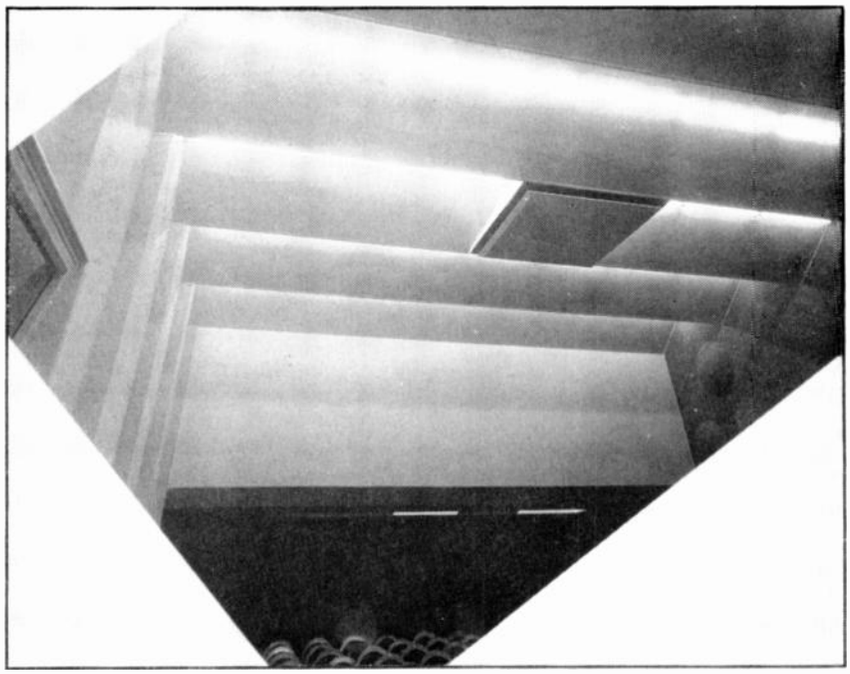


FIG. 1. SAW-TOOTH CEILING, WITH FLUORESCENT LIGHTS IN THE ANGLES

THE National Broadcasting Company's new studio 6D, in New York City, offers many interesting ideas to those who are concerned with high-quality broadcasting. Acoustically, this installation was designed to provide optimum reverberation time and frequency characteristics through a carefully-planned use of refracting surfaces. Moreover, the architectural, lighting, and engineering features have been coördinated in a manner to serve the functional requirements of the artists, operators, and sponsors. Another feature of Studio 6D which makes it of particular interest is its size. Measuring 30 ft. wide by 67 ft. deep, with the stage occupying 34 ft. of this depth, the dimensions and the seating capacity of 154 are ideal for a wide variety of programs.

Acoustical Design ★ The ceiling, illustrated in Fig. 1, is made up of a series of transverse, saw-tooth surfaces. This is an effective way to diffuse impinging sounds. A continuous line of fluorescent lights is mounted at the apex of each angle. This provides excellent lighting, with a high level of illumination at the plane of the musicians' stands.

The floor of the auditorium and stage is highly reflective to sound, although this is altered, of course, when an audience is present. The wall at the rear of the stage, Fig. 2, is also reflective, but it is largely covered by irregularly-spaced spherical segments made of plaster. Acoustical variations are made possible by the use of a curtain which can be drawn across the wall, or pulled all the way to the sides.

The west wall is shown in Fig. 3. This is treated with a number of islands comprising 2-in. rock wool blankets covered with perforated asbestos board. They are shaped irregularly for decorative rather than acoustic reasons. Between the islands, the wall is treated with spherical segments of plaster, located at random. Because their function is to diffuse sound waves, they have been given the name "diffusispheres."

The rear wall, behind the audience, is divided into two longitudinal sections, both with plane surfaces. The upper section slopes out, so that it projects over the lower section. About one half the area of each is covered with 2-in. rock wool blanket, faced with perforated asbestos board.

At the right, the wall is made of a series of vertical serrations, alternately treated over half their area with the rock wool and asbestos board previously described. The wall is further broken up by windows for the control booth and the client's booth.

Figs. 4 and 5 show the acoustical characteristics of the studio, with frequency plotted against reverberation time when the curtain at the rear of the stage is open and closed. It will be noted that the frequencies above 1,000 cycles were affected by opening the curtain, but there was little modification of the low frequencies.

FIG. 2. CURTAINS AND DIFFUSING REFLECTORS AT STAGE REAR

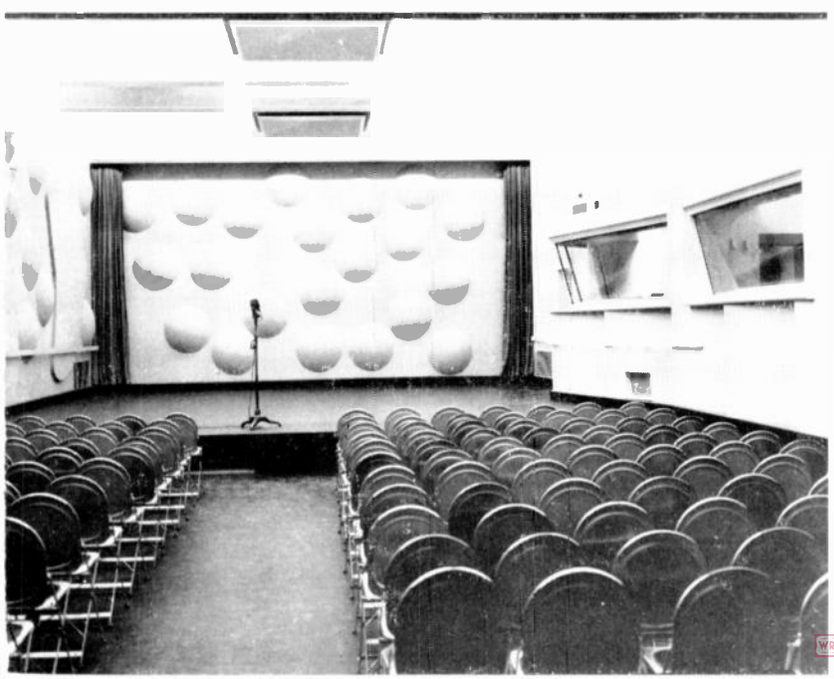


FIG. 3. DIFFUSING, REFLECTING, AND ABSORBING WALL

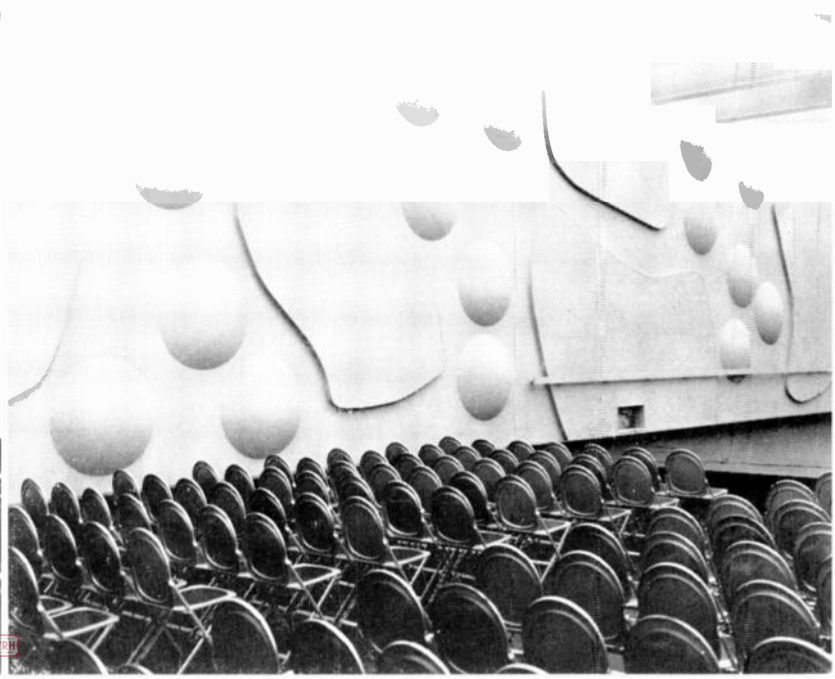


Fig. 6 represents the averages of measurements made with a microphone at 15 locations throughout the studio, picking up a sound source on the stage. This curve shows excellent frequency transmission characteristics. The higher frequencies, which usually manifest drooping characteristics in studio measurements, are sustained to a surprising degree.

Comments from users of the studio, including musicians, production men, and engineers, have been highly favorable in substantially all cases. Programs originating in this studio can be described as sounding "bright" and astonishingly lifelike because the tonal blending of instrumental groups is not blurred by excessive reverberation, or deadened by a high degree of absorption.

Experience gained from the use of this studio confirms the belief that it is desirable, insofar as possible, to combine diffusely reflecting surfaces with those treated to absorb sound vibrations.

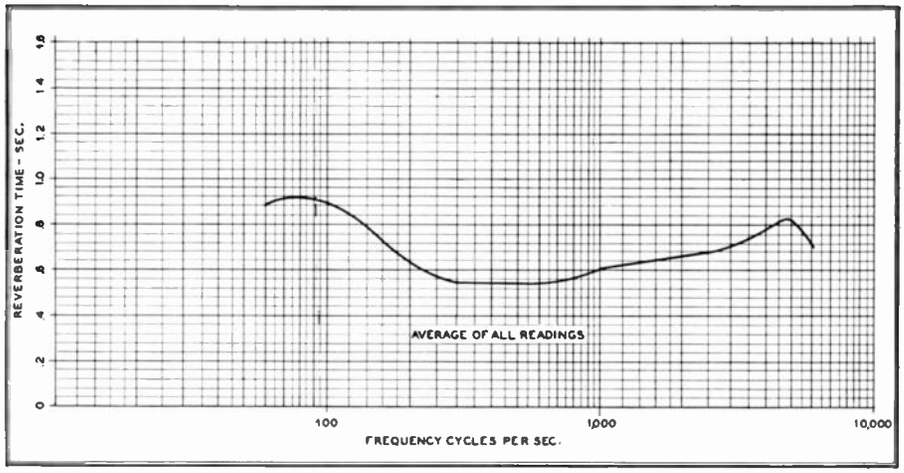


FIG. 4. REVERBERATION CHARACTERISTICS WITH BACK-STAGE CURTAIN CLOSED

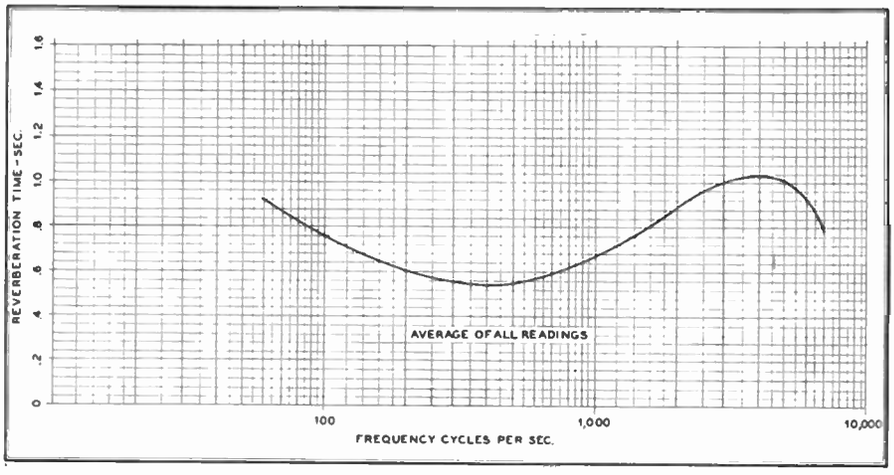


FIG. 5. REVERBERATION CHARACTERISTICS WITH BACK-STAGE CURTAIN OPEN

New Control Features ★ While the equipment for studio 6D was being designed, it was decided to try out some changes in mixer arrangements and operating procedure. Studio operating personnel had expressed a desire for a split mixer which would enable the operator to fade out a group of microphones simultaneously, while leaving other microphones in normal use. This was accomplished by using two master faders, to either of which any number of the ten microphone faders could be pre-connected by means of key switches. This arrangement can be seen by referring to the simplified schematic in Fig. 7. These keys are of the lever type and are recessed in the panel to prevent accidental operation.

The Nemo fader, used for remote pickups, is combined with the two master faders into a 3-position mixer which puts remote pickups and studio programs to be under fader control when the Nemo key is thrown to the left. When the circuit arrangements are such that there is danger of a feedback, as when an instantaneous switch is made to an out-of-town program, the Nemo key is thrown to the right where an auxiliary contact operates relays which short circuit the studio program.

Proper identification of faders has always been a problem. Some sort of designation is very desirable so that the engineer can label the cast, orchestra, sound effects, and special microphones. These designations must be easy to change because they usually differ with each show. In studio 6D, a piece of frosted white plastic sheet is mounted over each fader, on which penciled notes can be written. These can be erased for a new set-up.

In other NBC studios having platforms, microphone outlets were installed in stage pockets, in order to locate some of them in the middle of the platform. This worked out satisfactorily except for the fact that the stage pockets collected dirt and had to be cleaned out frequently. As the standard length of microphone cable at NBC is 30 ft., long enough to reach any place on the platform of studio 6D, it was decided to group the microphone outlets in a few spots rather than to distribute them around the studio. The most useful place was found to be toward the front. Accordingly, the outlets were installed on the proscenium end of the stage walls, at each side. Since microphone plugs have often been damaged when accidentally hit by heavy movable units, the outlets were recessed about 4 ins. The east wall outlets can be seen in Fig. 2, directly underneath the control booth.

Communication from the control booth to the studio is necessary during rehearsals, and is accomplished in the usual manner by means of a microphone in the booth and a loudspeaker in the studio. It

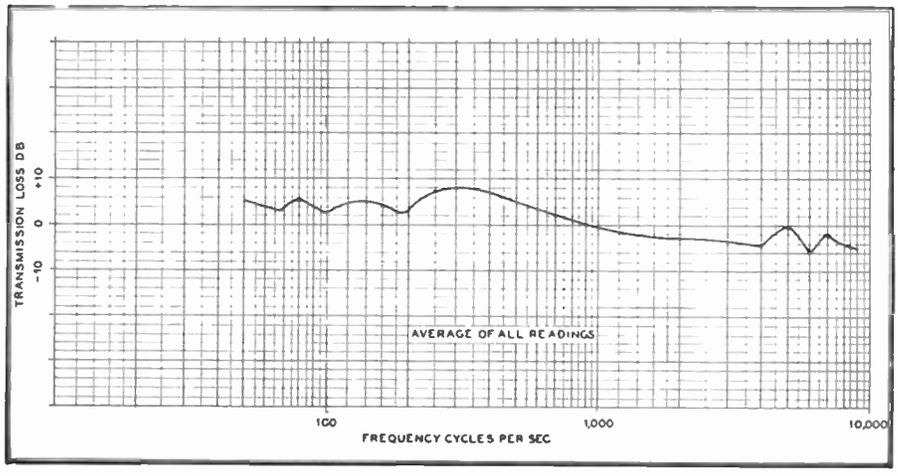
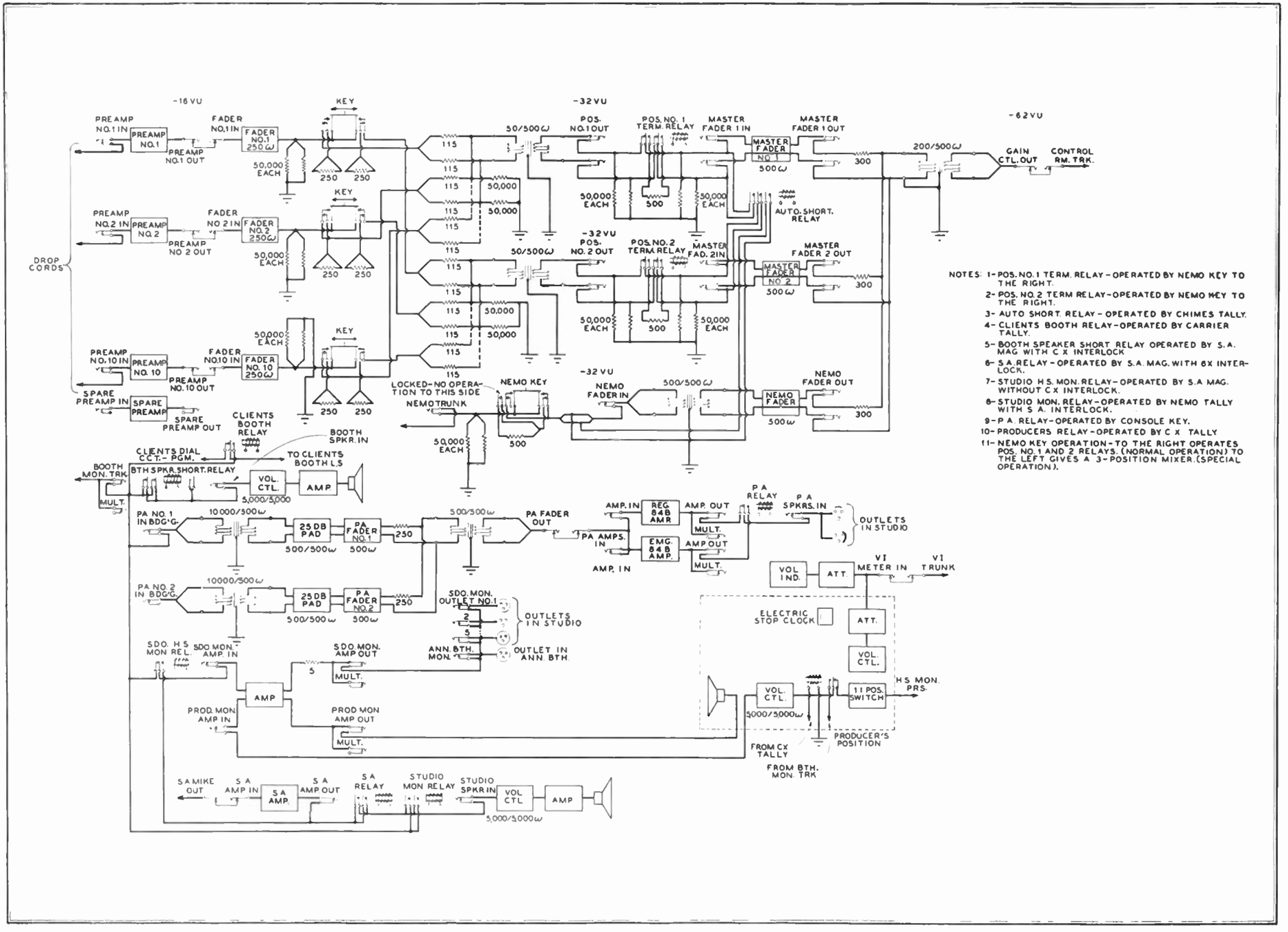


FIG. 6. TRANSMISSION LOSS, CURTAIN HALF CLOSED, WITH MUSICAL INSTRUMENTS AND 40 CHAIRS SET UP ON THE STAGE



NOTES: 1- POS. NO. 1 TERM. RELAY - OPERATED BY NEMO KEY TO THE RIGHT.
2- POS. NO. 2 TERM RELAY - OPERATED BY NEMO KEY TO THE RIGHT.
3- AUTO SHORT. RELAY - OPERATED BY CHIMES TALLY.
4- CLIENTS BOOTH RELAY - OPERATED BY CARRIER TALLY.
5- BOOTH SPEAKER SHORT RELAY OPERATED BY S.A. MAG WITH C X INTERLOCK
6- S.A. RELAY - OPERATED BY S.A. MAG. WITH 6X INTERLOCK.
7- STUDIO H.S. MON. RELAY - OPERATED BY S.A MAG. WITHOUT C X INTERLOCK.
8- STUDIO MON. RELAY - OPERATED BY NEMO TALLY WITH S A. INTERLOCK.
9- P A. RELAY - OPERATED BY CONSOLE KEY.
10- PRODUCERS RELAY - OPERATED BY C X TALLY
11- NEMO KEY OPERATION - TO THE RIGHT OPERATES POS. NO. 1 AND 2 RELAYS. (NORMAL OPERATION) TO THE LEFT GIVES A 3-POSITION MIXER. (SPECIAL OPERATION).

FIG. 7. SIMPLIFIED SCHEMATIC DIAGRAM OF THE AUDIO EQUIPMENT AND CONTROLS USED AT NBC'S STUDIO 6D

is also desirable to talk to the studio when the show is on the air, so a few outlets were installed in the studio into which headsets could be plugged. These headset outlets are fed from the Booth Monitoring Trunk at all times except when switched to the output of the booth microphone for communication.

It has been customary at NBC for the announcer to set up the relays feeding the program to the outgoing line before giving the go ahead signal, to switch microphones during the show, and to release all facilities at the end. This required the installation of a control box in the studio with push keys, tally lights, and headset monitoring facilities for cues. In studio 6D this control box has been eliminated and the controls have been put under the surveillance of the studio engineer. Monitoring facilities for cues consist of a midget loudspeaker and a selector switch in the producer's cabinet. With this new arrangement, the relays preset by Master Control for feeding the program to an outgoing line come up automatically as soon as the studio engineer in the preceding studio releases them. Microphones are thereafter faded in and out as required.

Other controls now operated by the studio engineer are the Standby and Go Ahead signals for the standby musician who fills in when required, the Standby signals for the recording department, the Rehearsal signs outside the studio doors, and the One Minute Standby sign in the studio itself. On the Air signs outside the studio doors are turned on automatically by means of relays when the studio goes on the air.

A small announce booth is located offstage. It contains a microphone outlet and a headset monitoring outlet similar to those in the studio. This headset monitoring enables the announcer to follow the progress of the show, hear his cues, and also to receive instructions from the control booth.

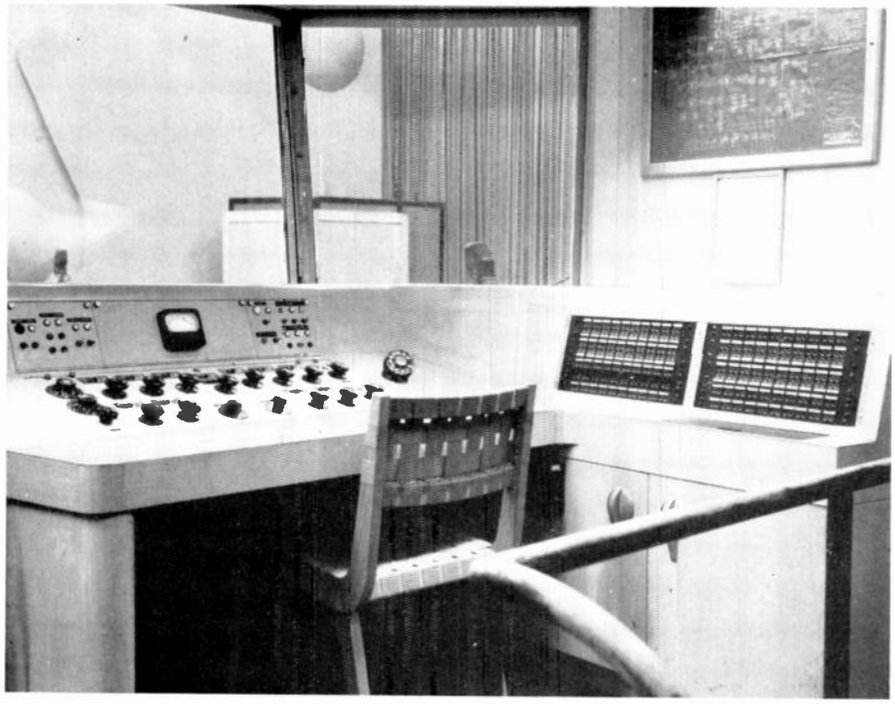


FIG. 8. ENGINEER'S CONSOLE DIFFERS FROM STANDARD NBC DESIGN PRACTICE

Studio Lighting ★ Studio lighting is accomplished by the use of 4-ft. fluorescent tubes mounted end to end across the width of the studio within the angles of the serrated ceiling. "No-blink" starters are used so that a defective tube will extinguish itself and remain extinguished, thereby avoiding the usual flicker. As ordinarily supplied, the auxiliaries are mounted on the fixtures. In this installation the danger of acoustic and electric hum pickup with AC reactor equipment all over the ceiling would be too great. Therefore, the auxiliaries were installed in a small room outside the studio.

Audio Equipment ★ All amplifying and monitoring equipment is identical with that which has been in use at NBC for many

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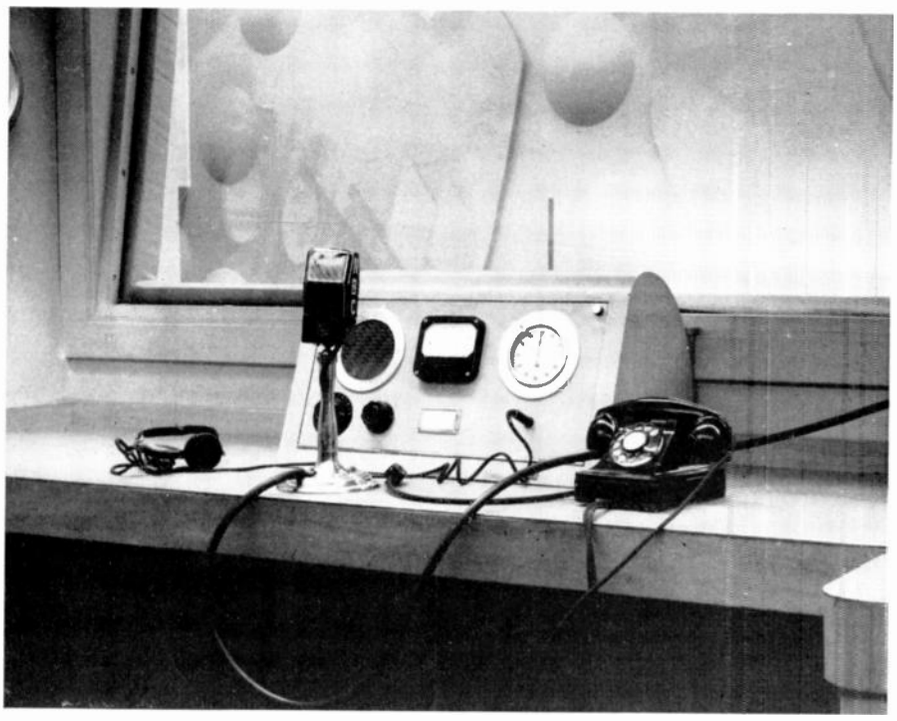


FIG. 9. CONSOLE PROVIDED IN THE CLIENT'S BOOTH. THE CLIENT AND HIS GUESTS CAN WATCH BOTH THE PERFORMANCE AND THE CONTROL ENGINEER

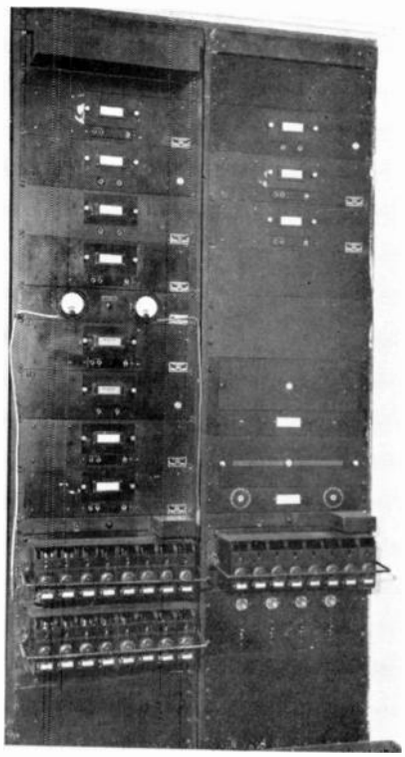


FIG. 10. THE AUDIO EQUIPMENT RACKS

MODIFYING THE JFM-90 FOR THE NEW BAND

The G.E. Translator Can Be Changed to Upper-Band Tuning by Following These Instructions

BY R. A. GROSSELFINGER*

IN COMMON with many others who have had such excellent low-band FM reception on the G.E. model JFM-90 translator, the author was anxious to modify his translator for operation on 88 to 108 mc. Of course, it is possible to use a converter ahead of the translator, but experiments with this method resulted in unsatisfactory performance on the upper band. In the end, a modification of the translator itself proved to be the most efficient and least expensive solution. The manner in which this was accomplished is detailed here for the benefit of those who would like to make similar changes.

Fig. 1 shows the underside of the chassis after the changes were completed. Fig. 2 indicates the alterations required in the circuit. Fig. 3 is a top view of the chassis with the added condensers and the markings on the dial drive which coincide with the slotted plate segments on condenser C1, while Fig. 4 shows the frequency vs. C1 settings.

In order to make this modification successfully, the changes must be made in exact accordance with the following instructions, even to the placement of the additional parts. Otherwise, difficulty will be experienced with alignment, and loss of sensitivity will result.

Tools Needed ★ The tools required for this undertaking are a small jeweler's screw driver or a similar sharp instrument to permit prying the turns of the coil away from the coil form, a piece of No. 00 sandpaper to scrape the enamel off the coil winding, a pair of long nose pliers, a pair of cutting pliers, soldering iron, and rosin-core solder. The additional materials required are: 2 ft. of No. 16 bare tinned copper wire, 6 in. length 70-ohm coaxial transmission line, one Erie Ceramicon of 25-mmf. or one of 20-mmf. plus another of 5-mmf. The two latter should be connected in parallel if the single 25-mmf. is not obtainable. Also, a Ceramicon of 50-mmf. is needed. The 40-mmf. condenser, C5 in the oscillator circuit, will be suitable as a substitute if the capacity is toward the high side of its tolerance. Otherwise the set will not cover the complete 88–108 mc. tuning range.

Modifications ★ Remove the leads from the stators of the tuning condenser C1A and C1B. Remove the Ceramicon condenser presently connected across C1A. With the jeweler's screw driver, pry up the first turn of L2 (the one farthest from chassis) and break the winding. Remove turns from top down until a total of exactly 4 turns remain. Fold a piece of sandpaper about $\frac{1}{2}$ in. square so that the abrasive surfaces face each other, and scrape the wire clean at the end for a distance of 1 in. Solder the end of the winding to the point where the coil was connected originally, leaving a loop in the lead. This loop is required for the purpose of adjusting the inductance, and will be discussed later.

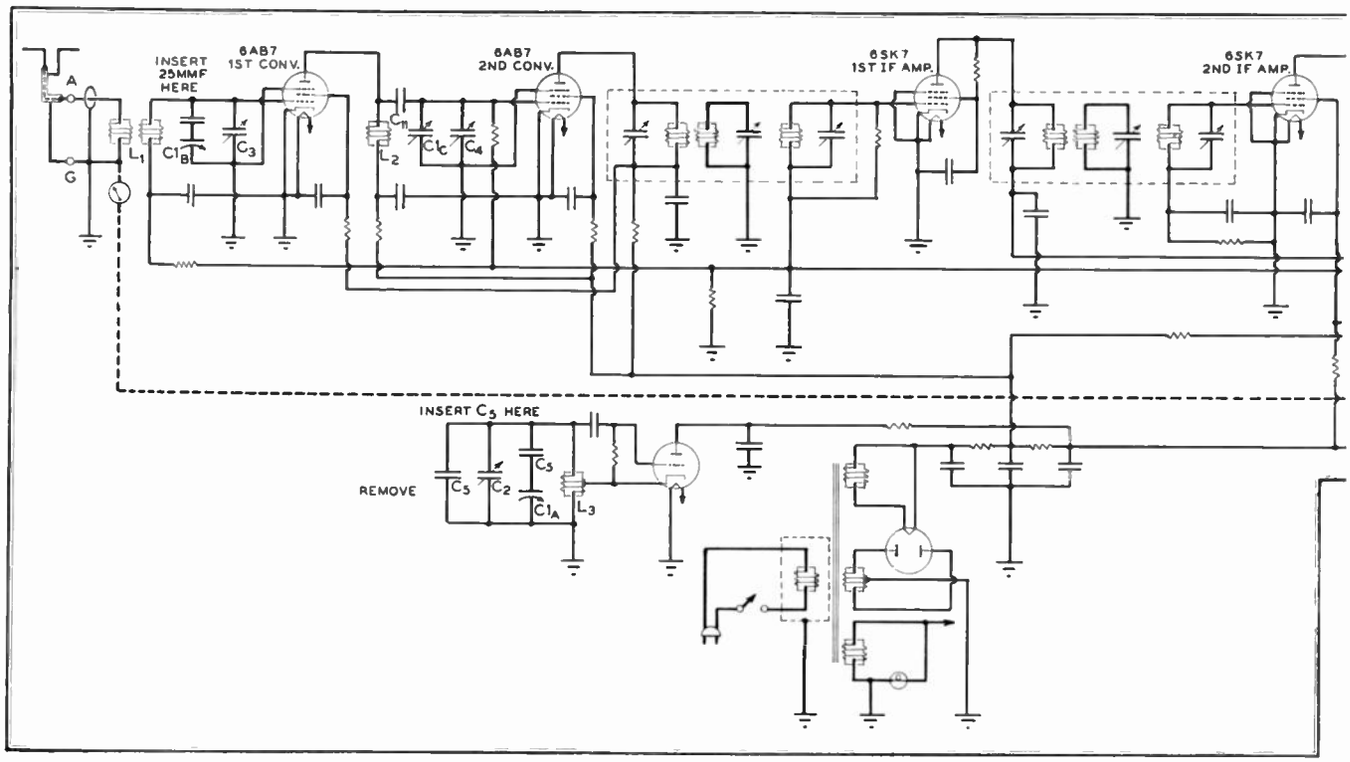
Remove all the antenna coupling coil L1 from the coil form, and the leads from the antenna binding posts at rear of chassis.

Next pry up the first turn of the RF input coil L1 and remove turns in the manner previously described until 2 turns remain. Clean the enamel from the wire and resolder the end of the coil to the original connecting point. No adjustment loop is needed since sufficient latitude is available in this circuit by spreading the turns.

Looking at the oscillator coil L3 from the top down, pry up the first turn, and remove the turns until a total of 5 remain. Connect the end of the coil to its original terminal. Since there is a considerable amount of wax on these windings, they will not uncoil of their own volition. Wind a 3-turn coil of No. 16 bare tinned wire around the coil form L1, coupling this within $\frac{1}{16}$ in. of the RF input coil L1, and fasten it in place as shown in Fig. 1. Cut the piece of coaxial cable to size and connect it to the antenna terminal strip. Fig. 1 illustrates this connection.

FIG. 1. CHASSIS OF THE TRANSLATOR AFTER CHANGES FOR HIGH BAND OPERATION

*236 Park Lane, Trenton, N. J.



For alignment purposes as well as antenna adjustment, it is advantageous to have some form of indicating instrument. For this purpose, resistor R15 is disconnected from ground at vacuum tube 6SJ7, the first limiter. Splice a wire to the open end of the resistor, and connect it to the unused post No. 2 of the antenna terminal strip. Other facilities will have to be furnished for this termination if both terminals are used for connection of a balanced transmission line. This completes the modification of the underside of the chassis, and it is then necessary to connect the 25-mmf. condenser in series with the stator of condenser C1C. Finally, the 50-mmf. Ceramicon C5, removed from condenser C2, must be connected in series with the stator connection of condenser C1A.

Tests ★ Connect a 200-microampere meter in series with terminal post No. 2 and ground, with the positive side of the meter to ground. If a signal generator or an oscillator capable of furnishing a signal in the 88- to 108-mc. range is not available, the antenna can be connected to the receiver to establish a source of signal energy. The antenna should consist of two pieces of copper tubing or similar material, each 27 ins. long, facing broadside to the FM station, and connected to the receiver by a 70-ohm coaxial line. In New York City, WABC-FM comes in at 96.9 mc., an appropriate point on the gang condenser, i.e., at the point where the first and second segments of the condenser are completely meshed. That makes WABC-FM useful for the initial tests. For locations where other stations must be used, refer to Fig. 4 to determine the proper position of gang condenser C1. Connect the translator to an audio amplifier, and you will be ready for the alignment. With the tuning condenser set at the approximate frequency of a local FM station, adjust trimmer C3, on top of C1B, 1 turn counterclockwise from maximum capacity. Adjust trimmer C4, on top of C1C, 3 turns counterclockwise from maximum capacity. Turn up the volume control near the maximum position. This will provide aural indication of signals if the signal at the first limiter is inadequate to actuate the microammeter during the preliminary adjustments. To offset the capacity introduced by the use of a metal screw driver between condenser C1A and ground during the adjustment of C2, an insulated tool should be used.

Rotate C2 very slowly from minimum capacity. When plates are about 40% meshed, a signal should be heard. If the signal is strong enough, and the C3 and C4 circuits are close to their optimum positions, sufficient signals should be received to cause an indication on the microammeter. In any case, adjust condenser C3 for maximum audio output or maximum indication on the microammeter.

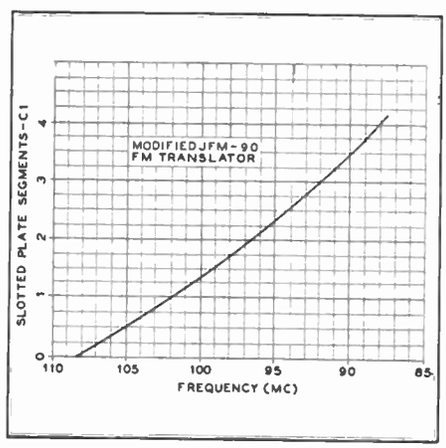


FIG. 4. CALIBRATION FOR 88 TO 108 MC.

Next adjust C4 for maximum indication on the microammeter. If either C3 or C4 does not give a peak indication on the meter before the end of their range is reached, it is suggested that trimmer condenser C2 be turned about one degree less in capacity, followed by a readjustment of the gang condenser. If a higher indication results, this procedure should be followed further until the limits of the increase are achieved. Conversely, this test should be made by increasing the capacity of C2, followed by the rocking of the gang tuning condenser for maximum indication. This adjustment will aid the adjustment of C3 and C4 within their circuits limits and permit a peak adjustment.

If a peak adjustment within the latitude of these condensers is not reached, spread the first turn on L2 away from the winding and form a closer loop to increase the cancellation effect of the loop. Recheck the adjustment of C4 to determine if a peak results, and continue until a satisfactory peak is obtained. The same procedure can be followed in the case of L1 by spreading the turns of the winding.

The above tests were based on the use of broadcasting stations as signal sources, and does not permit precise alignment over the entire range of 88 to 108 mc. For optimum performance over the entire range, a signal generator is much more satisfactory. If such a source is available, the initial adjustment should be made at 106 mc. by setting the tuning condenser in accordance with Fig. 4. With the signal generator set at 106 mc., adjust C2, C3

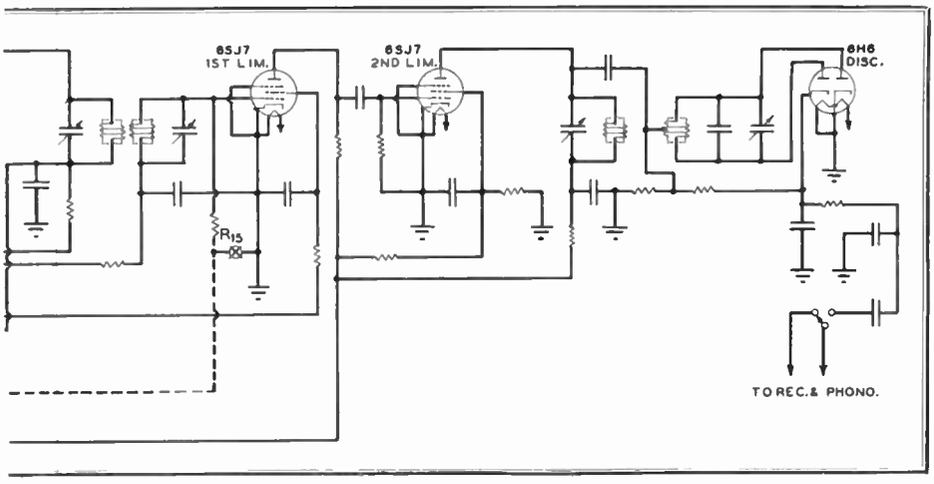


FIG. 2. THE JFM-90 CIRCUIT, WITH THE NECESSARY CHANGES INDICATED

and C4 for maximum on the microammeter. A chart recording signal generator output versus the indication on the microammeter should be made to facilitate tracking of the circuits throughout the tuning range.

Having recorded the first limiter current at 106 mc., the tuning condenser should be rotated so that the second slotted segment is fully meshed. This will be approximately 96.4 mc. Adjust trimmer C4 for maximum deflection. If readjustment results in a greater output indication, note whether more or less capacity was required for this result and readjust the condenser C4 to the original point as indicated by the microammeter. Press the rotor plate toward the stator or away from the stator, whichever is necessary, until the maximum reading is achieved as was possible by adjustment of C4. Rotate the gang condenser until the third segment is fully meshed, and follow the same procedure through the complete tuning range. Return to the original setting, 106 mc., adjust C4 to maximum, and then recheck through the tuning range at each check point. If the plates have been properly adjusted, a further change of trimmer condenser C4 will not increase the meter reading. This test will probably have to be repeated two or three times, since a slight change in the positioning of the plates at the low frequencies will affect the plates at the high frequency position of the condenser. Follow the same procedure in tracking the center gang condenser C1B. This completes the alignment.

Each of the three translators modified on the basis of this information gave satisfactory results, and it is believed, therefore, that if this data is followed precisely, satisfactory results will be obtained by others.

EDITOR'S NOTE: *The original details of the JFM-90 were published in FM Magazine for March, 1941. A few copies are still available for those who may need additional data on this unit in connection with the work of revamping the circuits.*

FM PROGRAMS

One of the questions most frequently asked by FM listeners is: "When will we hear something beside recordings on FM?"

However fine the quality of the records, they do not take the place completely of the commercial AM programs, and this is a serious handicap for FM at the present time. So far, the matter of the AFM ban on dual transmission has not been clarified to the point where broadcasters are prepared to put chain programs back on FM. As in the past, Petrillo takes the position that whatever he chooses to do is right because he does it. In the meantime, AM broadcasters are unwilling to take chances on getting into trouble with the musicians.

Matters are liable to drag along in this fashion until there are a few FM stations on the air which have no AM affiliates. Then the program problem will straighten out quickly. As fast as independent FM stations go into operation, networks will be formed, and program services will be created to compete with those now on AM. It is expected that they will be radio and not wire nets, so that the operating costs will be low. That will give the FM stations a chance to compete with AM while they are building up their audiences. At that time, and it's not far off, AM operators will very quickly settle with the AFM.

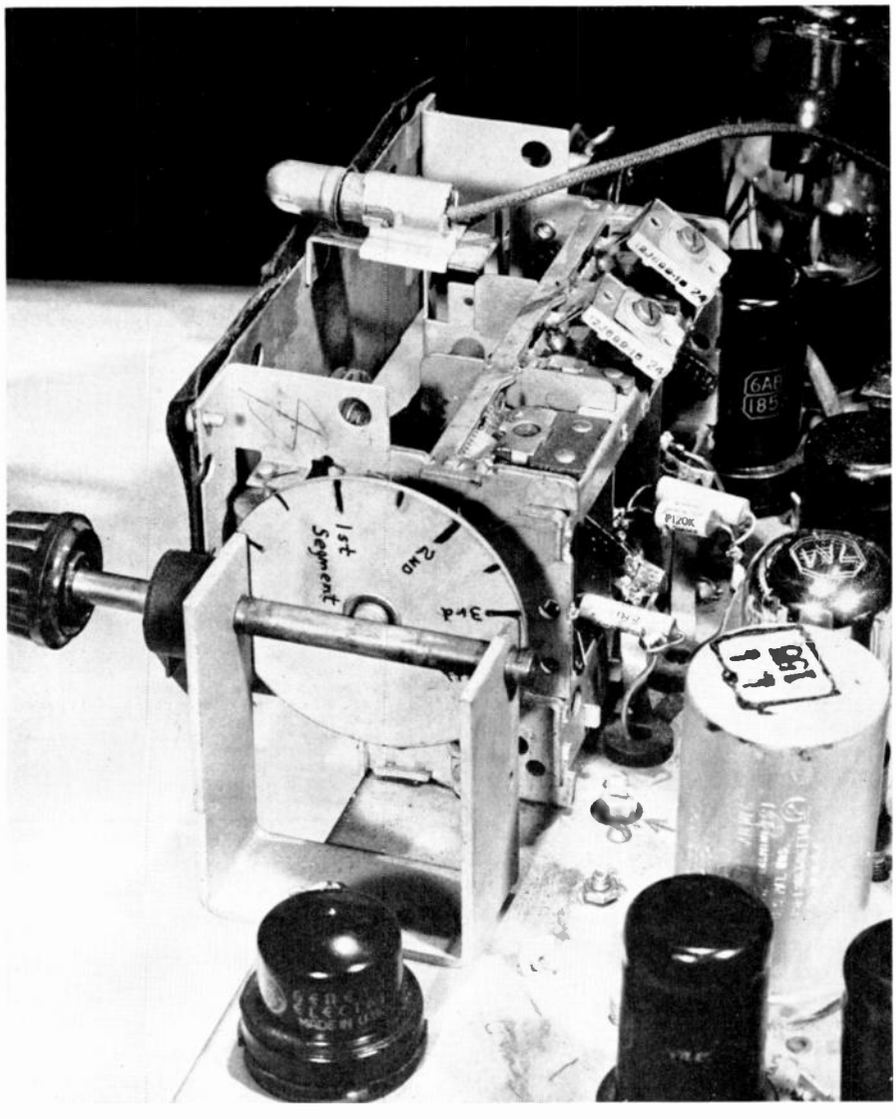


FIG. 3. VIEW OF THE TUNING CONDENSER ASSEMBLY AND DIAL DRIVE DISC

SPOT NEWS NOTES

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

Television Argument: Why all the talk about color? When laymen — those are the ones we hope will pay the bills — complain that television isn't perfected yet, they aren't asking for color. They simply want to see as much detail as in motion pictures, and with no more eyestrain. If there must be an argument, what about the relative quality of monochrome reception on the high and low bands?

James I. Benjamin: Appointed manager of the radio and electronics division at Lewyt Corporation, Brooklyn. Formerly general manager of Pilot Radio Corporation, James Benjamin will direct Lewyt's entry into the manufacture of brand-name FM and AM receivers, television sets, and phono combinations.

Radiophone Service: National Electronics Laboratories, Alexandria, Va., is the first newcomer to the communications field authorized to set up a radiophone system. Initial equipment will comprise headquarters station on 30.56 mc. and 25 mobile units on 39.54 mc. A 24-hour service will be maintained. No service for hire is permitted by FCC, but an installation charge of $25 is authorized, plus moderate maintenance fees.

Maine State Police: Is replacing AM equipment with Motorola FM units. One 250-watt transmitter will be controlled by radio from both the Scarboro and Wells barracks, while another will be operated by wire lines from Bangor. The system will operate on 39.900 mc., with 72.100 and 74.580 mc. for the remote controls.

Lancaster, Pa.: Modern war-built tube plant of 326,000 sq. ft. on one floor, operated by RCA, has been purchased from the U. S. Navy by its occupants for the price of $4,362,500. RCA will spend an additional $2,000,000 on further expansion and modernization.

CPA Limitation? RMA is shedding crocodile tears over the $1,000 limitation on new broadcast station construction, assuring everyone that FM will be retarded for months. What, no sympathy for all the administration favorites who won't be able to use their CP's for new AM stations or AM power increases?

Col. Fred P. Andrews: Now assistant to the president at Press Wireless. His office will be at the Times Square headquarters. During the past five years, Col. Andrews was Commanding Officer of the Alaskan Communications System.

Set Prices: Commenting on House proposal to remove OPA ceilings, Paul A. Porter warned that this would send radio set prices "sky high." What sets and what prices? Thanks to OPA, there aren't enough radio sets being produced now to support even a black market.

Collingsdale, Pa.: Shalleross Manufacturing Company has acquired the manufacturing rights and licenses to produce the Variaten attenuators and gain sets produced by Cinema Engineering Company, Burbank, Calif.

ECONOMICS OF GOVERNMENT CONTROL

HERE are the simple facts about the radio industry's procurement problems, as explained by RMA president R. C. Cosgrove on April 16th, over the CBS network:

Home radio receivers have been in low supply for lack of components — those parts that go to make up a radio receiver, manufactured mainly by specialty companies, and this shortage is due to low price ceilings which will not permit recovery by these manufacturers of their actual costs.

These costs are made up mostly of labor, which has almost doubled in the radio business since pre-war. The component or parts people are also having extreme difficulty in getting partially fabricated or completely fabricated parts from their suppliers for the same reason.

The OPA does not permit to be included in the ceiling prices the actual cost increases realized by these manufacturers.

There are thousands of individual items to be costed and priced, and no one is smart enough to intelligently and realistically establish ceiling prices that eliminate inequalities on all of these items.

Therefore, certain materials are being manufactured, and certain other materials are not being manufactured. Plants are making those materials on which they can obtain their costs, and are not making those on which they cannot.

As a consequence certain parts are not flowing to the radio set manufacturers, and here we are eight months after V-J Day and in those eight months my own company has made only as many radios as we should have made in each of these eight months.

The radio industry has reported to the Office of Price Administration and to Mr. Paul Porter, its Chief, detailed facts on all of the components in short supply, together with statistical information to justify a modification of policy.

Many meetings have been held by the Industry Advisory Committees with OPA officials over a long period of time, and we are still holding meetings, hoping to correct this situation. The industry had a very easy reconversion job to do, and by this time the market should have been flooded with radio receivers — but this is why you can't get radio receivers today.

Taxicab Radio: FCC has issued CP's to 13 taxi operators for FM dispatching equipment. They are: 44 Cab Company, Pine Bluff, Ark., Yellow Diamond Cabs, Charleston, S. C., Blue & White Cabs, Corpus Christi, Tex., City Transportation Company, Los Angeles, United Cab & Drivurself, Inc., Rockford, Ill., Yellow Cab & Baggage Company, Topeka, Kans., Longview Transit Company, Longview, Tex., Six-O-Six Taxi, Hattiesburg, Miss., Jolly Cab Company, Memphis, Tiller Cars, Norfolk, Va., Diamond Taxi, Inc., Lowell, Mass., Flamingo Cabs, Miami, and Yellow Cabs, Twin Falls, Ida. All will use Motorola units, operating in the band from 152 to 162 mc.

Plant Closed: On April 22nd, Philco let out 3,500 workers, expecting to take them back May 6th. Shut-down resulted from steel strike, copper trouble, and lack of components on which OPA prices preclude reasonable profit.

Allentown, Pa.: Penn-Allen Broadcasting Company, FM applicant comprised of five veterans who have pooled their savings to enter broadcasting, will issue a weekly news letter to all dealers in their area. Purpose is to lay groundwork of information on FM, and to encourage dealers to make a quick start on FM set sales as soon as they are available.

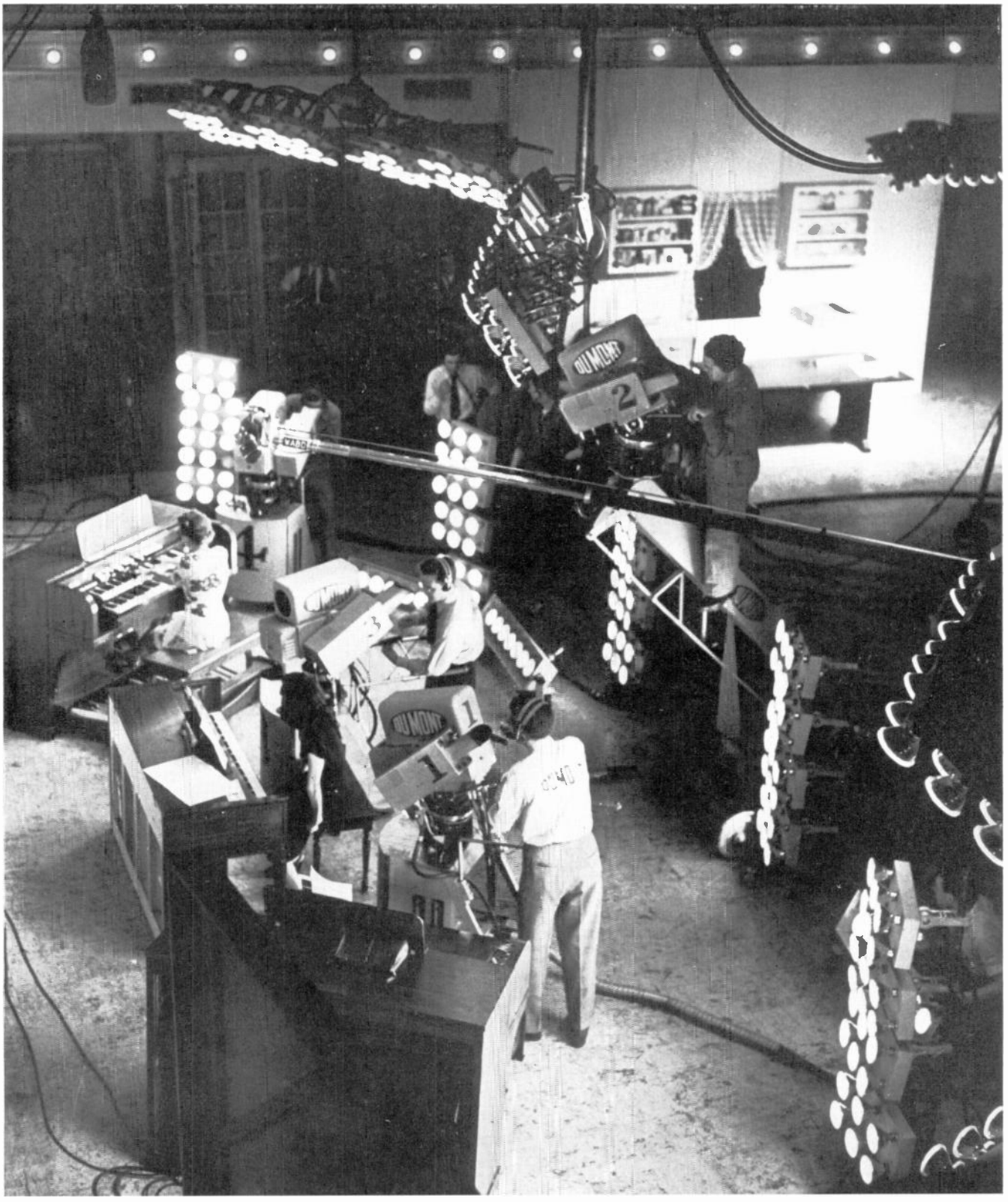
Lea Act: With the President's signature affixed to the Lea bill on April 16th, it became Public Law No. 344, a part of the Communications Act of 1934, as amended. It is now illegal to force or threaten to force broadcasters to hire more people than are required for any program, and to exact payment for services not rendered or for transcriptions of previous performances. Immediate result was to render AFM's president virtually speechless when he was asked to comment on the new law. Effect on broadcasters cannot be appraised yet.

Facsimile: That facsimile is ready for adaption to both home and business use was demonstrated at the ANPA convention in New York last month. Both Finch and Radio Inventions equipment were operated by FM broadcast stations. What arrangements will be made for quantity production has not been disclosed yet.

Color Television: Will be demonstrated in Philadelphia by CBS affiliate WCAU. Station will apply for CP on an upper-band television transmitter, and withdraw low-band application. Plan is to show programs carried by coaxial lines from CBS studios in New York City.

What Next!: Alarmed because prices set on broadcast stations are higher than the "going concern and physical property values," indicating that a substantial value is placed on the frequency, acting

(CONTINUED ON PAGE 59)



NEWS PICTURE

AFTER many months of preparation, the new DuMont television studios are in operation at the Wanamaker department store in New York City. The inauguration of program service was timed with the shift of station WABD to its new frequency.

The foremost undertaking of its kind, this installation will contribute much to the perfection of program techniques, and the promotion of public interest in television. At the same time, it provides a special spot of interest at the Wanamaker store, since visitors can see both television reception and the actual staging of the programs. Also, it is to be expected that Wanamaker's radio department will become a headquarters for the sale of television receivers as soon as they are available.

In the meantime, an increasing number of advertising agencies are experimenting with various types of programs, and training their staffs in the new art of writing, arranging, and producing television shows and the visual commercials which must pay the bills.

FM STATION MONITOR

Discussion of FM Monitor Design Problems and a Description of the G.E. Monitor

BY H. R. SUMERHAYES, JR.*

FM BROADCAST stations are required by the Federal Communications Commission to have in operation approved monitors for indicating frequency, percentage modulation, and modulation peaks. In 1940, General Electric originated the idea of combining these functions in a single station monitor assembly, and developed an instrument wherein four important characteristics of a frequency-modulated broadcast signal were continuously monitored.

The instrument measured and continuously indicated the mean frequency and the percentage modulation of the radiated signal. It also provided a modulation peak indicator with a warning flasher to show when modulation peaks exceeded some preset value, and it provided an audio output for use with an external amplifier for aural monitoring of the program. A description of this monitor was given in an earlier paper.[1]

When the 42- to 50-mc. FM broadcast band was raised to 88 to 108 mc., it became necessary to provide an instrument to accommodate the new frequency range. The performance of the new instrument was also extended to meet the extremely low distortion and noise level required for making the transmitter Proof of Performance tests specified by the Federal Communications Commission. In addition, a balanced audio output was desired, as was also a means for indicating the radio frequency input level to the monitor.

As is often the case in engineering undertakings, the primary difficulty of the task is not in simply devising an instrument which will meet specifications, but rather in designing it in such a way that it will meet specifications at a competitive price.

Development Problems ★ Since the original instrument performed the basic monitoring functions simply and satisfactorily, there were obvious advantages in using the same general circuit in the new one. The old circuit was essentially a superheterodyne receiver with additional measuring and indicator circuits. The local oscillator signal was derived from a crystal-controlled oscillator with appropriate frequency multiplier stages. Some limiting action was achieved by introducing the transmitter signal into the mixer at a saturation level. There was a single, very broad IF transformer at 5.4 mc. in the mixer plate circuit. The discriminator amplifier was operated class A to avoid the spurious center-frequency change encountered when limiting is used at the discriminator amplifier grid. The discriminator itself was a modification of the commonly used double-tuned circuit with two diodes, each one connected to rectify the sum of the primary voltage and one-half the secondary voltage. However, the structure of the more conventional discriminator was modified in such a way as to facilitate monitoring the frequency directly without DC amplification.[2] Other features, such as a specially wound inductance coil and a crystal-controlled calibration oscillator were included to meet the stringent requirements on discriminator accuracy.

When the present instrument was developed, each of the new requirements was considered to see whether or not it could be met by improvements on the original design. The increase in operating frequency to 88 to 108 mc. called for redesign of the frequency multiplier and mixer sections, with miniature tubes indicated for the high frequency stages. This requirement, as well as others including measurement of RF level and change in the audio system, could still be met by the basic design of the original instrument.

Noise Level & Harmonic Distortion ★ The most difficult requirement was the one on audio distortion and noise level. As is usual in a measuring device, the performance must be considerably better than the devices it is used to measure. It is desired to indicate transmitter noise as low as 70 db. below 100% modulation, and transmitter harmonic distortion of less than .5%. These considerations led to specifying an inherent noise level for the monitor not to exceed — 75 db., and a total harmonic distortion not to exceed the value of .25%.

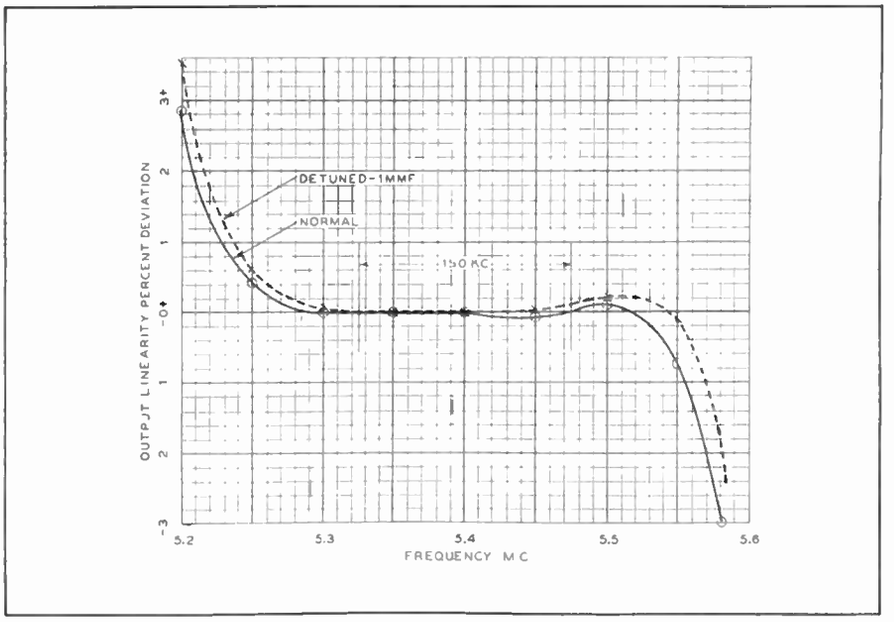


FIG. 1. DEVIATION FROM DESIRED LINEARITY BETWEEN FREQUENCY & OUTPUT VOLTAGE

The noise specification can be met with the tuned discriminator as far as audio noise due to power supply ripple is concerned. It is more difficult to keep to a low level the spurious beat notes arising from harmonics of the crystal-controlled oscillator mixing with the intermediate frequency or its harmonics. For ordinary noise considerations, it is sufficient to avoid the more obvious combinations of frequency but, in this case, where the noise level should be below — 75 db. it was found that beat notes arising from such combinations as the fourth harmonic of the crystal controlled oscillator frequency and the third harmonic of the intermediate frequency gave interference trouble. These difficulties are inherent in a superheterodyne circuit using a crystal-controlled oscillator with a frequency multiplier, and can only be obviated by careful choice of oscillator frequency and multiplication factor.

* Engineering Dept. General Electric Co. Schenectady, New York. A paper delivered before the Broadcast Engineers Conference, Columbus, Ohio, March 18-23, 1946.

[1] H. R. Summerhayes, Jr., "A Frequency Modulation Station Monitor," FM Radio-Electronics, June, 1943.

[2] U. S. Patent No. 2,309,481.

The specification of 0.25% on allowable total harmonic distortion includes distortion due to non-linearity of the discriminator detection characteristic as well as distortion produced in the audio amplifier. It was decided that 0.15% for the discriminator and 0.1% for the audio amplifier would be satisfactory. There was considerable discussion as to whether a tuned discriminator could meet 0.15% distortion, or whether it would be necessary to change to a counter type discriminator.

Accordingly, a very broad-band tuned discriminator was constructed with provision for making precision point-by-point measurements of its characteristics. Frequency was measured with an accuracy of 0.01% by comparison with harmonics of a crystal-controlled frequency standard. The DC output voltage was measured by comparison with a stable voltage source using a precision divider. The frequency and the comparison voltage were changed in equal increments and the difference between the actual output voltage and the comparison voltage was measured. The resultant data are the deviations from the desired linear relation between frequency and output voltage. These data are plotted in Fig. 1, with the ordinate scale showing the deviations from linearity expressed as a percentage of the total voltage change for a 150-kc. change in frequency. It is seen that the maximum deviation over a 150-kc. band width is approximately 0.1% for the properly tuned primary and approximately 0.15% for the case of 1 mmf. change in tuning from the optimum. It is reasonable to presume that the percentage of total harmonic distortion generated by such a detection characteristic cannot exceed the maximum percentage deviation from linearity of the characteristic.

This investigation proved that the tuned discriminator is capable of providing linear frequency modulation detection with a distortion in the order of 0.15%, and that the amount of detuning likely to be encountered with the change in capacitance due to changing tubes produces negligible effect on distortion.

Test Equipment ★ Having made the decision to use the tuned discriminator in the new monitor and the same basic circuit as in the original instrument, it then became necessary to design test equipment to prove the performance under actual modulation. Such test equipment is also required during production testing, where it would be practically out of the question to use the precision point-by-point method for aligning each discriminator.

When the specifications for the test equipment are considered, the problem becomes more difficult. The monitor is called upon to meet a distortion factor of 0.25%. Therefore, the test equipment, which includes a precision Frequency Modulation generator, must in itself generate a frequency-modulated wave having in the order of 0.1% harmonic distortion. This tolerance, in turn, is divided internally in the generator between the audio oscillator and the modulator so that each should have less than 0.1% distortion.

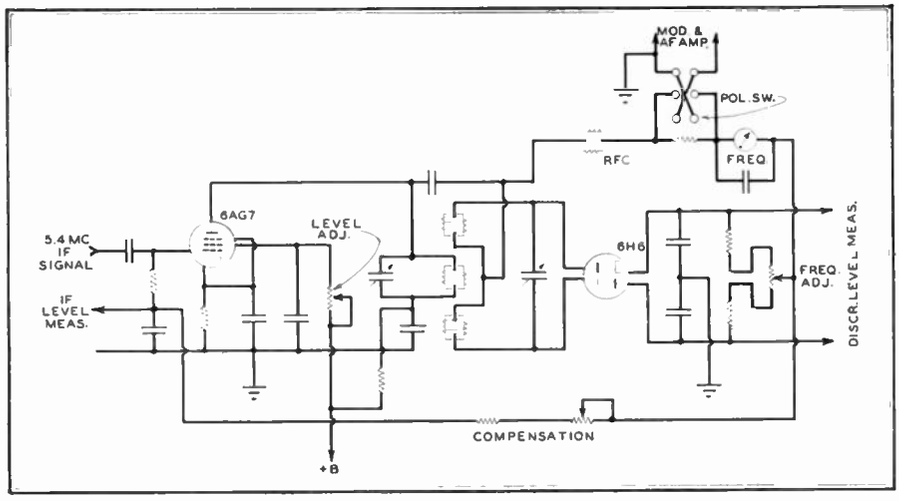


FIG. 2. DISCRIMINATOR COMPENSATION IS OBTAINED FROM RECTIFIED GRID BIAS

Then, of course, a test discriminator is needed to prove the performance of the generator and such a discriminator in its turn should have much less than 0.1% distortion to be of much use in testing the generator.

As a practical solution to these difficulties, it was decided to build a precision FM generator and a test discriminator having a different principle of operation from the one in the monitor, but not necessarily lower distortion, because that would be too difficult to attain. In making measurements, the signal generator is lined up as well as can be with the test discriminator. The generator signal is then applied to the monitor under test and the monitor is lined up for minimum distortion. If this is excessive, the generator and the test discriminator and, if necessary, the monitor, too, are readjusted until both discriminators show simultaneous distortion less than the prescribed amount. The simultaneous use of two discriminators of different types makes it almost a certainty that there is no appreciable cancellation of distortion taking place between the monitor and the generator due to detection characteristics which are equally curved but in opposite directions.

The signal generator employs a reactance-tube modulator with considerable negative feedback to help minimize the distortion. It is hoped that this device will be described in a later paper.

Limiting ★ Since the discriminator used in the monitor is sensitive to amplitude variations as well as to frequency variations, it is essential to use limiting. Otherwise, any slight variation from a flat IF response would produce amplitude modulation which, in turn, would produce additional discriminator output. In general, the additional output resulting from the amplitude modulation causes considerable distortion unless the circuit producing the amplitude modulation happens to have a V-shaped deviation from a flat response.

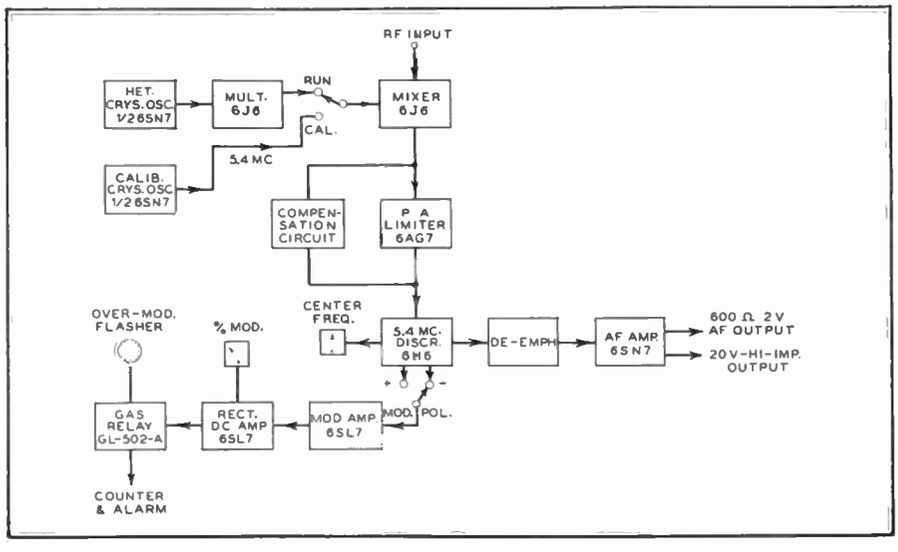


FIG. 3. THIS BLOCK DIAGRAM SHOWS MULTIPLE FUNCTIONS OF THE MONITOR

Furthermore, limiting is necessary to reduce the allowable — 50 db. level of amplitude modulation noise on the transmitted wave. Perhaps the simplest method of limiting is the use of a saturation level of signal at the grid of the discriminator amplifier. This results in a discriminator level which is very nearly independent of input level over a wide range.

However, limiting in itself introduces another problem when precision measurements of center frequency are required. It is found that a spurious change in the center-frequency indication may be obtained as the level at the limiter grid is changed, even though the level at the discriminator and the frequency of the applied signal stay constant. This change in indication is obtained from the response of the discriminator to the second and even to the third harmonic of the intermediate frequency. Although small, this response is sufficient to give observable changes in the center frequency indication as the required accuracy limitation is increased, and it was felt desirable to eliminate this effect. During the condition of limiting, considerable harmonic plate currents are generated, and their amount increases with the amount of limiting.

Fortunately, the change is nearly proportional to grid level. This proportionality allows the effect to be compensated for by introducing into the discriminator a compensating current which is also proportional to grid level but is of opposing phase. Such a current is easily derived from the rectified grid bias obtained from the circuit shown in Fig. 2. Proper adjustment of the compensating resistor, which is not particularly critical, causes the two currents flowing through the frequency indication instrument (one due to harmonic response and the other derived from grid bias) to cancel each other over a grid voltage range of approximately 25%.

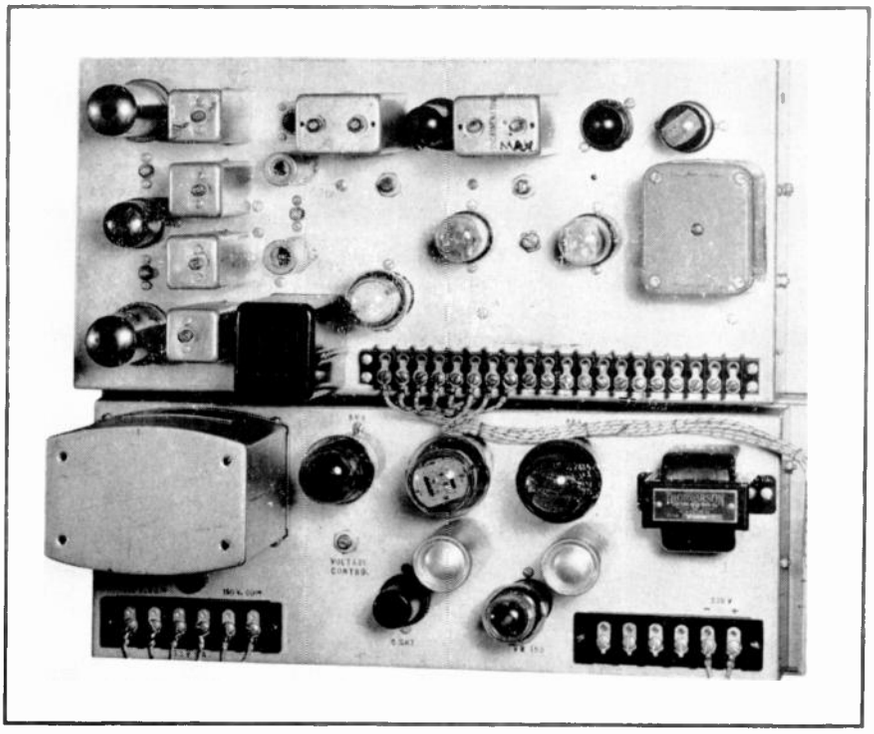


FIG. 5. INDICATOR AND POWER SUPPLY ASSEMBLY VIEWED FROM THE REAR

This is a sufficient range for this application, particularly since the signal level from the transmitter must be maintained practically constant, and additional limiting is also provided at the mixer where the transmitter signal is introduced at a saturation level. Thus, the variations in intermediate frequency signal level due to variations in input level are greatly reduced in this monitor circuit.

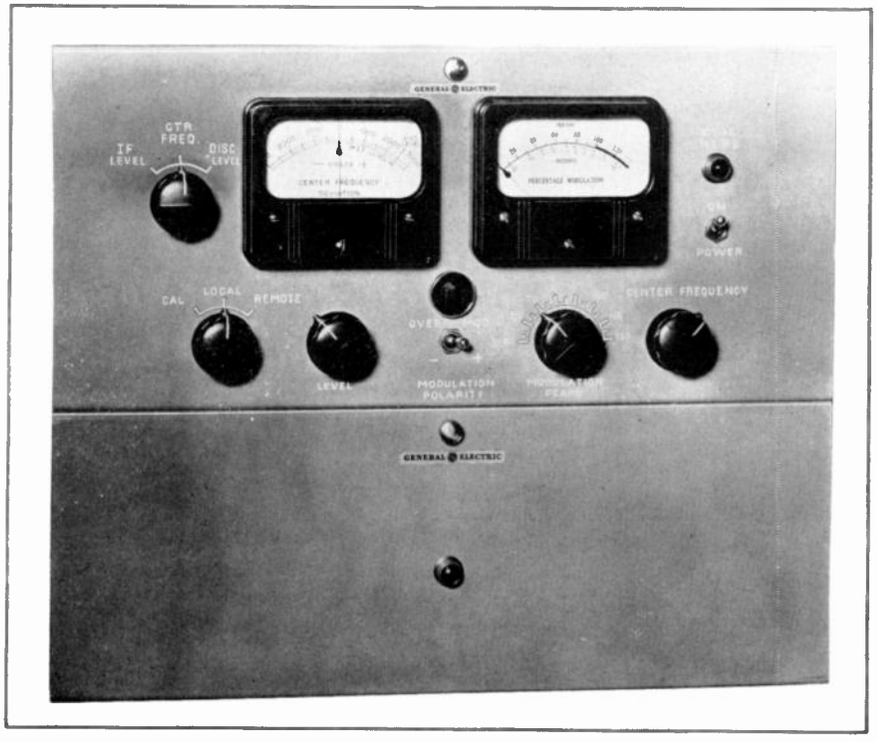


FIG. 4. COMPLETE MONITOR IS COMPRISED OF INDICATOR UNIT AND POWER SUPPLY

Description of Monitor ★ A block diagram of the monitor circuit is shown in Fig. 3. The structure of the circuit is much like that of the earlier FM Station Monitor developed by the General Electric Company. It includes a crystal controlled oscillator, frequency multipliers, mixer, discriminator amplifier, audio amplifier, modulation amplifier, over-modulation flasher, and indicating instruments. The position of the new compensating circuit is indicated on the block diagram.

Fig. 4 shows the development sample of the instrument as it appears from the front when mounted in a standard relay rack. Note that it is divided into two separate units, an indicator unit and a regulated power supply unit. These can be mounted some distance apart if desired. The division was made solely to employ vertical chassis design and still maintain units of reasonable size.

Fig. 5 shows the monitor as it appears from the rear when mounted in a standard relay rack. The chassis are mounted with the wiring facing front and the tubes and transformers facing the rear.

Fig. 6 shows the indicator unit alone as it appears when mounted in a standard relay rack, with the hinged front panel opened downward to give access to the circuit components. The switch which is used initially in measuring RF input level is located on the back of the front panel. In general, the setting of the RF input level is an installation adjustment and, once the coupling loop at the transmitter is set to give the correct indication of input level at the monitor, it need not be

readjusted. The monitor will operate satisfactorily over approximately a 2:1 input power range.

Specifications ★ A list of the specifications follows:

Power Supply: 105 to 125 volts, single phase, 50/60 cycles. Power consumption, approximately 100 watts.

Ambient Conditions: Temperature; 0° to 45° Centigrade. Relative Humidity, 0 to 95 per cent.

RF Input Signal: Frequency, 88 to 108 mc. Impedance, 50 ohms. Power, approximately 0.5 watts. Operating range, 2 to 1 with provision for indicating correct range. Amplitude limiting approximately 50 to 1.

Center Frequency Indication: Range, +3000 to −3000 cycles deviation. Continuous indication with or without modulation. Guaranteed accuracy ±1000 cycles. After adjustment to external standard ±500 cycles.

Modulation Indication: Range, 0 to 140 percent modulation; 100 percent equals ±75KC. swing. Type, semi-peak reading instrument, positive or negative polarity, selected by switch.

Overmodulation Indication: Range, adjustable from 50 percent to 120 percent modulation. Local Alarm, Red Flasher lamp. Remote Alarm, Acuated by relay. Audio Outputs: For aural monitoring, output impedance 600 ohm balanced, level approximately 2 volts rms at 100% modulation at low audio frequencies. Frequency characteristic, within 0.5 db of standard de-emphasis curve from 50 to 15,000 cycles. For proof of performance tests, load impedance at least 50,000 ohms, level approximately 20 volts rms at 100% modulation at low audio frequencies. Frequency characteristic within 0.5 db of standard de-emphasis curve from 50 to 15,000 cycles. Distortion less than 0.25% total harmonic. Noise level is down to at least 75 db below 100% modulation.

Remote Indications: Output signals provided for remote indication of center frequency, percentage modulation, overmodulation.

Physical Specifications: approximate dimensions, indicator panel 8¾ by 19 ins. depth behind panel 9 ins. Power supply panel 7 by 19 ins., depth behind panel 9 ins. Approximate Weight, indicator 20 lbs., power supply 35 lbs.

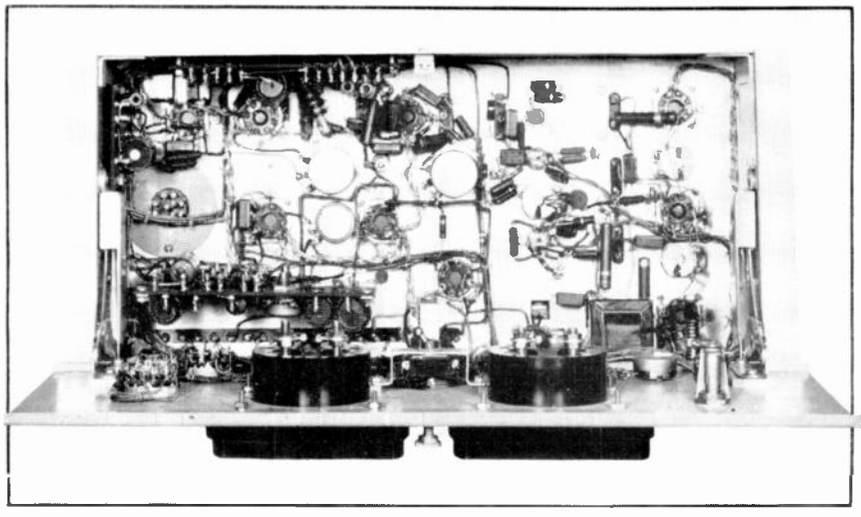


FIG. 6. INDICATOR UNIT WITH THE HINGED FRONT PANEL DROPPED DOWN

MILWAUKEE JOURNAL REVISES TELEVISION PLAN

Following the announcement that *The Milwaukee Journal* will not carry out the projected installation of a low-band television transmitter, this explanation was received from Walter J. Damm, vice president and general manager of radio: The Journal Company has applied to the Federal Communications Commission for permission to build and operate an experimental high frequency television station. At the same time the Company requested the Commission to dismiss without prejudice its request for extension of construction permit for the low-band television station WMJT. This action in no way lessens The Journal Company's interest in television, nor does it affect the Company's promise to bring television to Milwaukee when a program service becomes available which would merit the public's investment in television receiving sets.

The construction permit for proposed television station WMJT covered a low-frequency station capable of transmitting only black and white pictures. Recent developments in television indicate that the future trend of this new art lies in the high band where it will be possible to transmit black and white pictures of greater clarity and sharpness, and where, too, it will be ultimately possible to transmit television pictures in color.

The Journal's present action is taken with the full realization that high-frequency color television is still a long way off — possibly as much as five years from now. However, a consideration of all factors involved, such as building restrictions, the long wait for the delivery of transmitting equipment and the uncertainty of network television service out of Chicago, lead to conclude that it might take two to three years before a low-frequency black and white television station could be completed in Milwaukee. Therefore, such a station might have only some two years to operate before high-frequency color television becomes a reality. The Journal Company is convinced that it would be unfair to the people of Wisconsin to engage in a form of television which might become obsolete in such a comparatively short time, thereby leaving those who have invested in fairly high-priced receiving equipment with obsolete sets on their hands.

The decision to transfer its television activities into the high-frequency field is consistent with the Company's policy of providing the very best possible broadcasting service to the people it serves. To this end, the program of off-the-air experimentation and the training of the Radio City staff in the techniques of television will be continued. New camera and studio equipment of the latest design will be delivered during the next few months and will serve to accelerate the program which has already given the staff a head start in preparing for the efficient use of the new medium.

ARMY SURPLUS TRANSMITTERS

IN view of the fact that Army surplus walkie-talkies and other radio transmitting equipment are now being offered for sale in some stores over the nation, the Federal Communications Commission has now warned that the unauthorized use of such transmitters by the general public is illegal and may subject the user to a $10,000 fine or imprisonment or both.

Under the Communications Act no person may operate a radio transmitter without first obtaining a license from the FCC.

No licenses will be issued by the Commission for the walkie-talkie and other transmitters by the general public, except in the Amateur Service, until the Citizens Radiocommunication Service, designed to govern such use, is put into effect. This service will not be inaugurated until equipment operating in the Citizens Radiocommunication band, namely 460–470 mc., has reached a satisfactory stage of development, and until the Commission has completed certain technical and legal studies necessary to the formulation of

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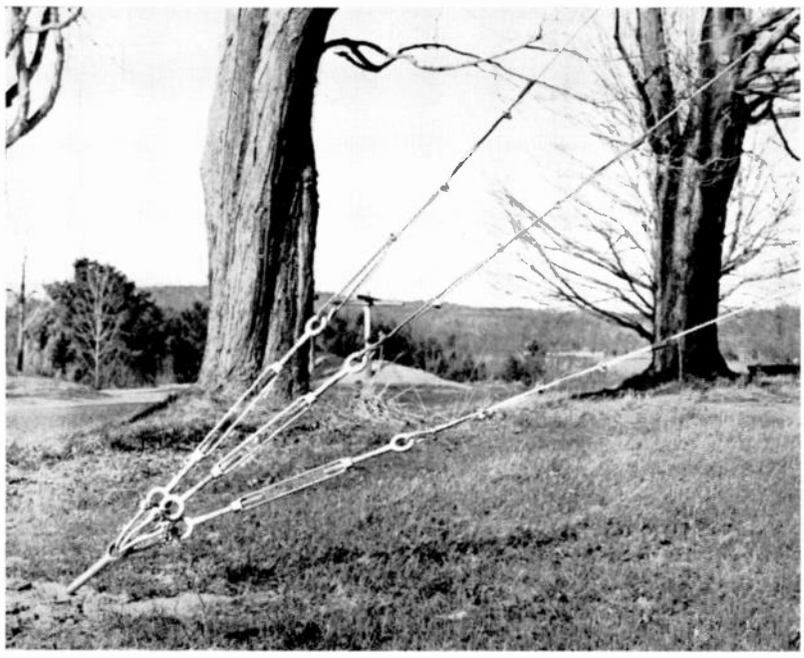

FIG. 16. THE FINAL ARRANGEMENT OF THE GUY WIRES AND TURNBUCKLES

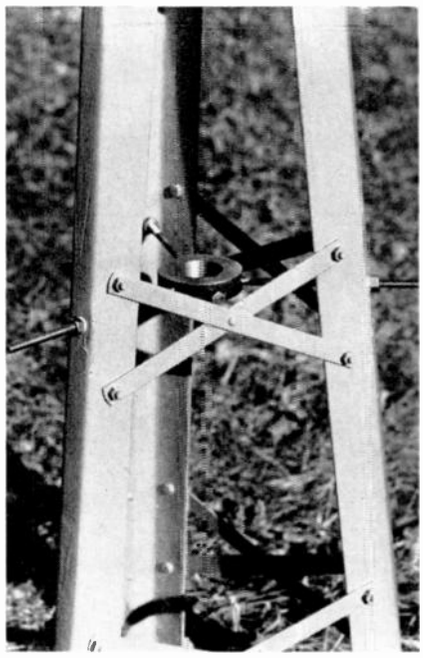

FIG. 17. LOWER SUPPORT FOR THE MAST

CONSTRUCTION OF AN EXPERIMENTAL FM ANTENNA

Part 2—The Mast and Lights—Mounting the Dipoles—Electric Wiring and Cables

BY MILTON B. SLEEPER

Arrangement of the Mast ★ Since this tower was planned for experimental use, it was necessary to provide a mast on which various rigs could be mounted and removed, and with the minimum amount of effort. After all, the best climber is limited in what he can do in a spot where there is hardly any foot-room, and very little opportunity to move around. Also, since the mast was to carry the tower lights at its top, it was important to plan for their replacement with the least possible complications and effort.

Under the circumstances, it seemed best to use a 1¼-in. pipe, so mounted that it could be slipped up or down through fittings on the tower peak. We had thought of using a wooden mast, but that idea was given up because, for the same strength, it would be heavier than the pipe, it would suffer mechanical damage from changing antennas, and it would not be as well suited for carrying the lights and their wiring.

At the top of the 5-ft. pointed tower section, Fig. 17, there is a split ring, closed by bolts, of the correct size to clamp around a 1½-in. pipe. For the second mounting point, we made up the ring and rods shown inside the tower section at Fig. 17. The rods are threaded into the ring, and secured to the legs by nuts on the inside and outside. Fortunately, the holes for the rods had been punched in the tower legs already.

A bolt in the ring is used as a set-screw, to keep the mast from turning, but the weight of the mast is carried by a pin passing through the pipe and resting on the top of the ring.

Thus, the finished mast was simply a 16-ft. length of galvanized iron pipe, threaded for 2 ins. at the top for the tower light fixture, and with a ½-in. hole 1 in. up from the bottom to take the holding pin. And of course it was given the same two coats of paint already specified for the tower.

Tower Lights ★ We used a double fixture for the tower lights, supplied by Crouse-Hinds. This can be seen in Fig. 18. CAA rules call for two bulbs with a relay so wired that when one burns out, the other will be switched on automatically. As a matter of economy, we decided to eliminate the relay and its water-tight mounting box by burning two lights simultaneously. Then, when one burns out, both will be replaced immediately. In 10 years' time, the extra current consumed will not equal the cost of the relay installation.

The rules call for the use of 50-watt clear glass bulbs. They should not be of the conventional design, however, but of the "traffic" type, in which the coiled filament is reinforced by several supporting wires. This assures longer life by protecting the filament from vibration.

Wiring the Tower Lights ★ No. 10 solid wire with weatherproof insulation was run in 1-in. conduit up the tower to a point 10 ft. below the ring support for the mast. Then, to keep rain from running into the conduit, we topped it with a 45° elbow and a 45° insulated outlet, so that the wires come out pointing straight downward.

There is a trick to this arrangement. Since the mast must be lowered and raised, flexible, rubber-covered wires were run from the tower-light fixture down the inside of the mast, and then 10 ft. more, in the clear, to the top of the conduit. That amount of cable in the clear is needed when the mast is dropped down, so it can form a loop. Otherwise, the wires would not permit the mast to be lowered. Fig. 19 shows the mast in place, while in Fig. 18 it has been lowered to mount the dipole antenna.

While the wires were being run, it seemed like an excellent opportunity to mount a spotlight on the tower. A weather-proof outlet box was inserted in the conduit, and wires brought out to the fixture shown in Fig. 22. It is of water-tight design, and holds a 300-watt reflector bulb. When we bought the fixture, the only reflector bulb available was the 150-watt size. However, this proved sufficient to give a strong light over a very large area on the ground.

Since the spotlight would be needed

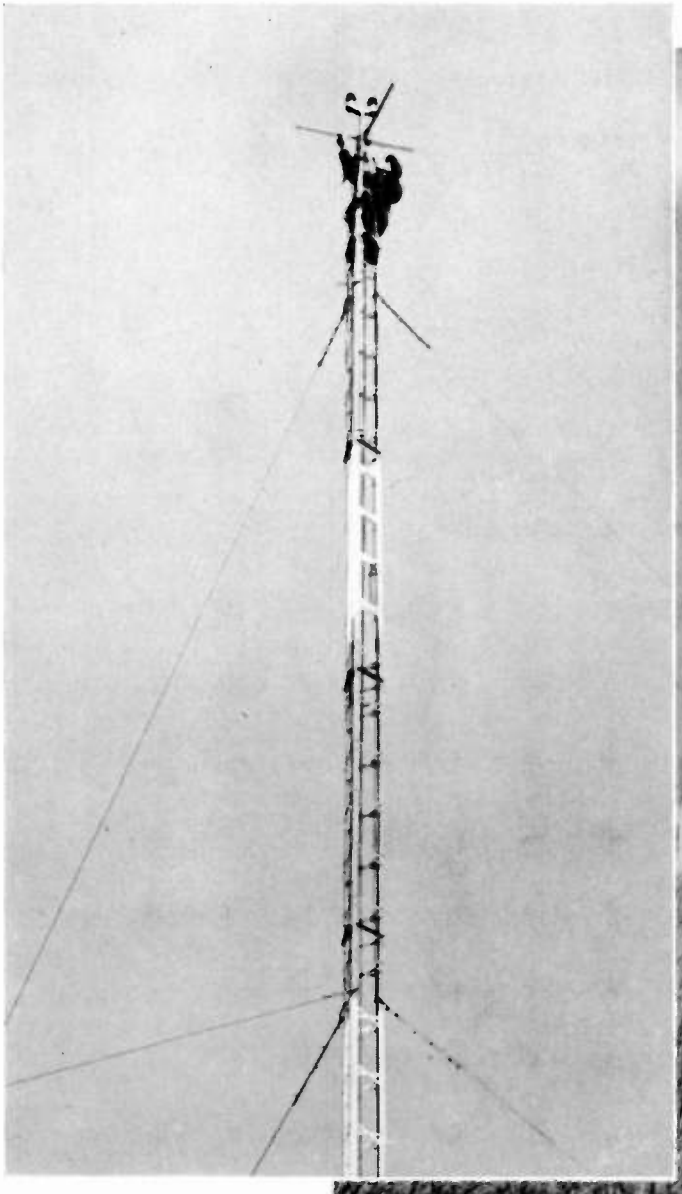

FIG. 18, ABOVE. THE MOUNT OF THE MAST PERMITS IT TO BE LOWERED FOR ATTACHING ANTENNA RIGS, OR FOR CHANGING THE LIGHTS. THIS HAS PROVED TO BE A VERY SATISFACTORY ARRANGEMENT

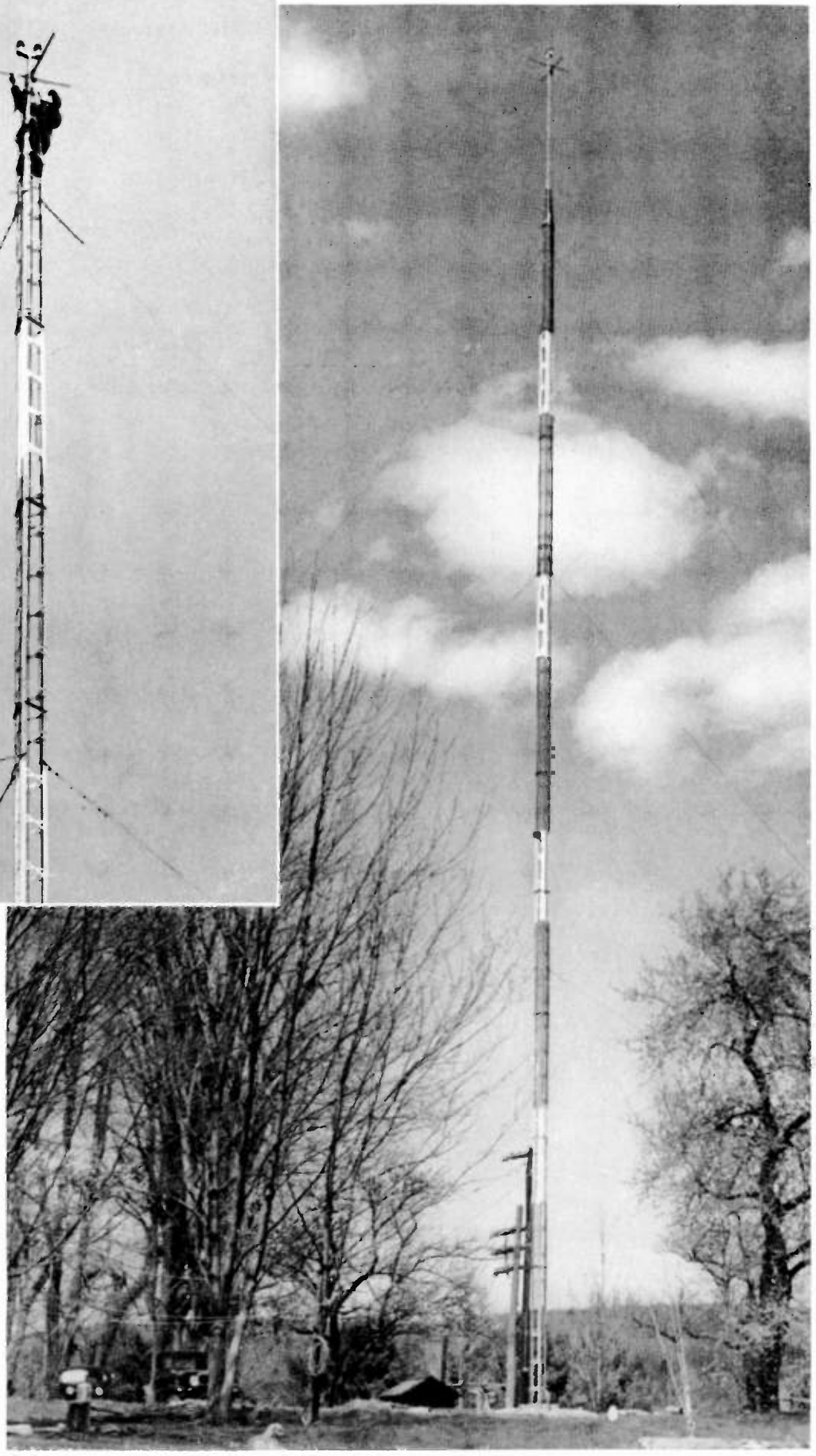

FIG. 19, RIGHT. THE COMPLETED TOWER, WITH THE MAST UP, AND TWO DIPOLES MOUNTED. THESE ARE CUT FOR THE 88- TO 108-MC. BAND. SEPARATE CABLES ARE USED FOR EACH SET OF DIPOLES, SO THAT A RECEIVER CAN BE SWITCHED ACCORDINGLY

only on special occasions, a third wire was run in the conduit from the light down to a separate switch, with one wire serving as a common for the tower lights and the spotlight.

Our local electrician had recommended running No. 10 wire. When we protested that it was much heavier than necessary, he said: "You don't know what you may

want to put on it later. Better provide plenty of capacity now, while you're running the wires." We took his advice. Also, to provide for future contingencies, we inserted an outlet box at the foot of the tower, above the point where the conduit bends out to clear the base and goes into the ground.

Since every part attached to the tower must be fastened rigidly and permanently, some means were needed to hold the conduit in place inside one tower leg. After much experimenting, we settled on the use of perforated steel strip, such as plumbers use to support piping.

The conduit was run to the house, where our equipment is set up, in a shallow trench, and through the foundation to the basement. There, a main switch, with 10-amp. fuses, cuts off the circuit entirely, while another switch turns the spotlight on or off separately. Obviously, there would be no reason for using the spotlight when the tower lights are off.

We made one mistake. We put the switches in the basement, because it was easy to get at the power main there. But it has proved to be a nuisance to run up and down the stairs to control the lights every night and morning. Later, the switch will be moved upstairs.

Dipole Mountings ★ It seemed like a simple job to design a fixture to hold the dipoles to the mast, but reasonably weatherproof connections to the coaxial cable presented a tough problem. Inquiries to the various manufacturers of cable connectors only elicited the information that they did not make anything suitable. They had connectors for every other purpose imaginable, but nothing to meet our needs.

Still, we knew that dipoles were used for military FM relay equipment, so something should have been available. After considerable sleuthing, we found that L. S. Brach, in Newark, N. J., had made those fittings. Figs. 20 and 21 show the standard type.

Referring to Fig. 20, one dipole threads into the grounded boss at the left, while the other threads into an insulated bushing on the right. The connector is mounted on and grounded to the main brass casting, with the center connected to the insulated dipole bushing. The threaded boss which can be seen in Fig. 20, and another on the opposite side, are intended to carry

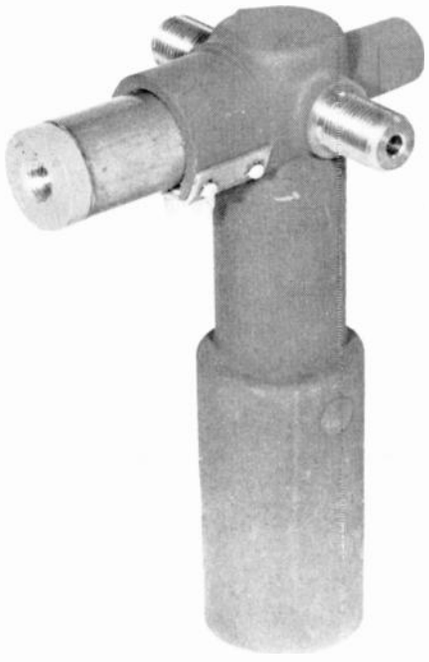

FIG. 21. MOUNTING FOR THE DIPOLES

supports for reflector and director rods, but we did not use them.

Unfortunately, this type of mounting was designed to fit on the top of a pipe mast, and our tower lights already occupied that position. However, with the help of our plumber, the problem of fastening these mountings to the side of the mast was solved in a simple manner. This is illustrated in Fig. 23. We purchased standard pipe hangers, intended to support 1¼-in. pipe, and fastened them to the lower section of the dipole mountings with short nipples. One hole in the mounting was provided by removing a steel pin that goes through the upper part of the lower section, leaving the hole that can be seen in Fig. 23. Then we drilled a second hole near the bottom. Both were tapped with a ¼-in. pipe tap to take the nipples. One of the threaded bosses, on the side next to

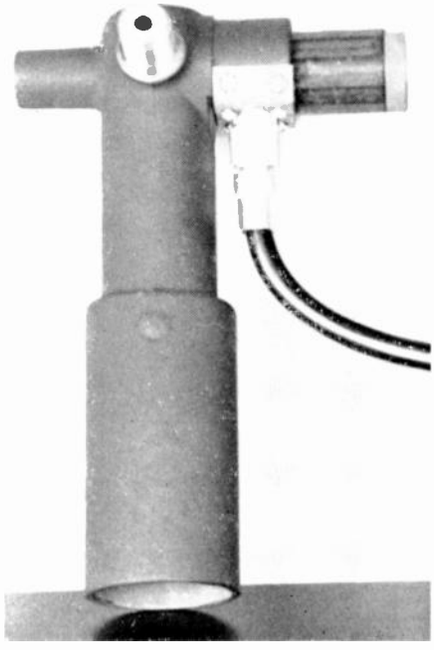

FIG. 20. DIPOLE CABLE CONNECTION

FIG. 22. SPOTLIGHT ON THE TOWER

the mast, was cut off because it stuck out too far.

Fig. 23 shows the complete assembly of the mounting and dipoles secured to the mast. It should be noted that pipe hangers are made slightly over-size. Consequently, they do not tighten down on the size of pipe they are intended to carry. That made it necessary to put a semi-circular shim of strip steel inside the ring, so that the hangers would clamp on the mast securely.

We had intended to make up our own dipoles, using a short length of solid brass rod threaded at one end for the mounting and turned down at the other to fit into a length of ⅜-in. brass tubing. However, Link Radio Corporation came to our rescue with adjustable rods of the type used with the mountings by the Army.

The dipoles shown in Figs. 18 and 19 were set to an overall length of 58 ins. Actually, the length is not highly critical, but for those who want to cut dipoles for specific frequencies, the length is:

$$L_m = \frac{300}{F_{mc.}} \times \frac{1}{2}$$

where L_m = overall length of the dipoles in meters

$F_{mc.}$ = Transmitter frequency in megacycles.

To change meters to inches, multiply by the conversion factor 39.37.

Since one set of dipoles was intended for north-and-south, and the other for east-and-west reception, they were set at right angles, as shown in Fig. 18.

When two sets of dipoles at right angles are connected together to give a circular or omnidirectional pattern, the efficiency

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- Current . . . . . 6.2 amperes

Plate Dissipation (Maximum) 125 watts

Direct Interelectrode Capacitances (Average)
- Grid-Plate (Without shielding, base grounded) . . . . 0.03 *uufd.*
- Input . . . . . 10.3 *uufd.*
- Output . . . . . 3.0 *uufd.*

Transconductance (i_b = 50 ma., E_B = 2500 v., E_{c1} = 400 v.) . 2450 *umhos*

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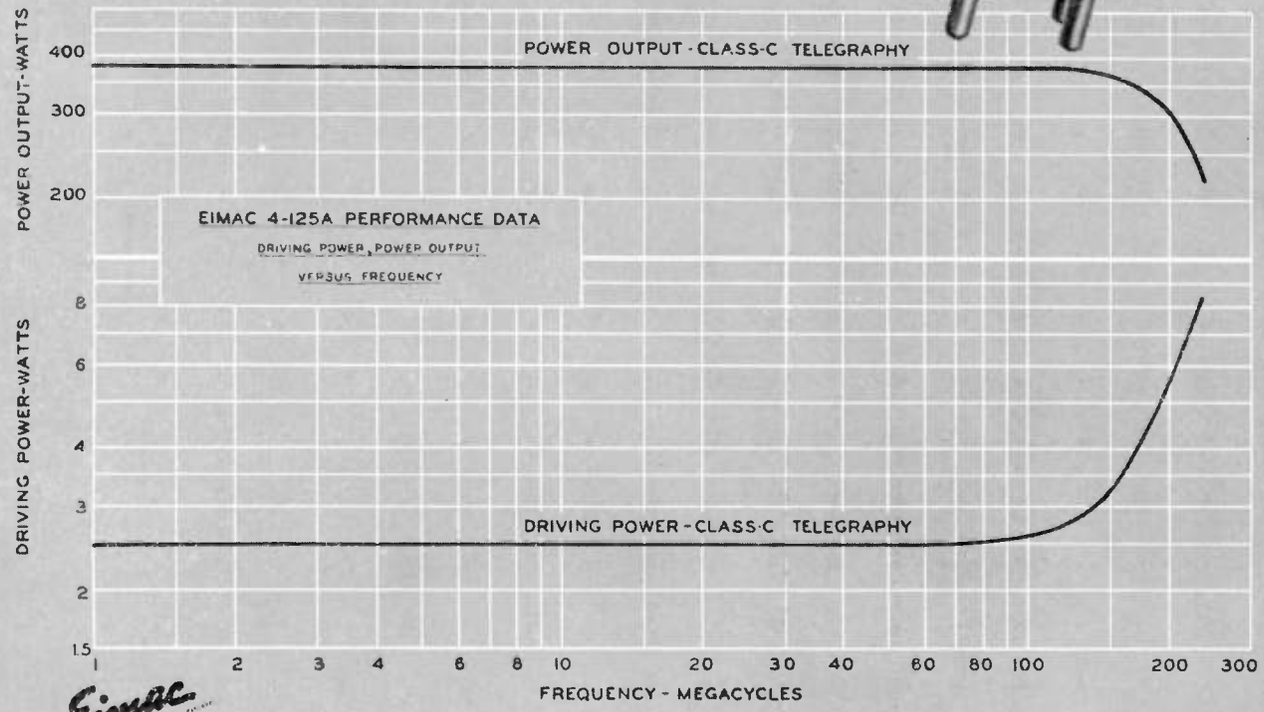


Eimac TUBES

THE COUNTERSIGN OF DEPENDABILITY IN ANY ELECTRONIC EQUIPMENT

of the combination drops to approximately .79 as compared to a gain of 1 for a single set. Therefore, to maintain maximum efficiency, a separate cable was brought down from each dipole. Fig. 21 shows the type of connector used. The cable is 70-ohm Amphenol coaxial line. Great care was taken in soldering the center conductor and the outside braid to the connectors, for these joints are exposed to heat, cold, rain, and vibration. Anything less than perfect joints would fail in a short time. As an extra precaution, Duco cement was run around the threads, after the connectors were tightened, to keep out the rain.

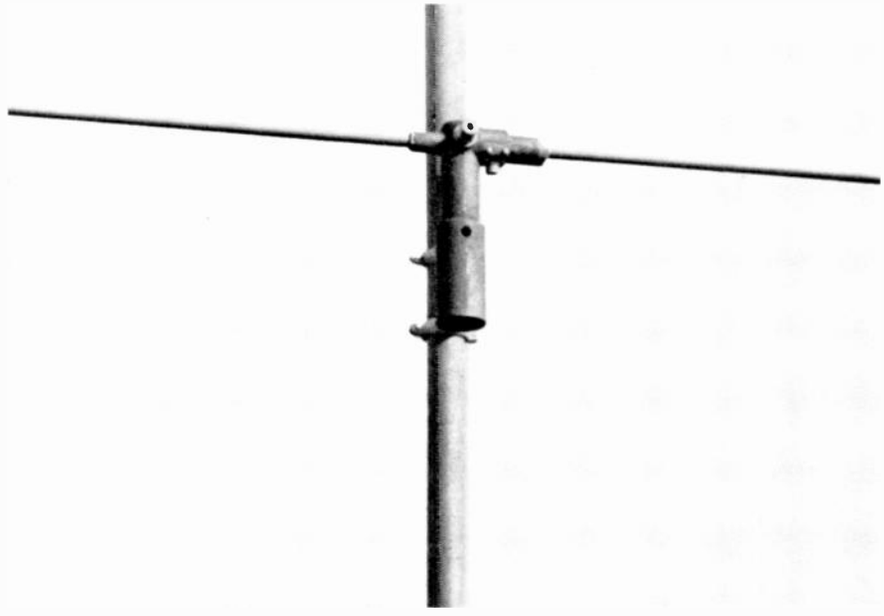


FIG. 23. THE DIPOLE MOUNTING FASTENED TO THE MAST WITH PIPE HANGERS

Both ends of one cable were marked EW, and the ends of the other NS, to identify them as to direction of reception. This was done with small pieces of paper, bearing the marks, fastened to the cable with several wraps of cellophane tape.

When the cables had been hauled up and plugged into their respective dipoles, they were taped to the mast at three points as it was raised to its full height, making due allowance for the need of removing the tape when the mast is lowered again. Then, starting 20 ft. below the top of the tower, the cables were taped securely to one leg.

From the base of the tower to the house, the cables were run under ground in 1½-in. conduit. They could have been strung across in the air except for the fact that, over a distance of 100 ft., two or three intermediate supports would have been necessary, and that would have made an unsightly appearance. Such a large conduit was not required, as the cable is slightly less than ½ in. in diameter. There again, however, it seemed wise to provide for future contingencies.

Painting ★ After the tower was completed, we realized that we had made a mistake in giving the individual sections their second coat of paint in the beginning. It would have been smarter to give them only the first coat because, with all the climbing up and down that was done during erection, a considerable amount of paint was scraped off. Consequently, we had to put on another coat after the mechanical work was completed.

The final coat was put on by two men, working opposite each other. That is much faster and easier than for one man.

(CONCLUDED ON PAGE 48)

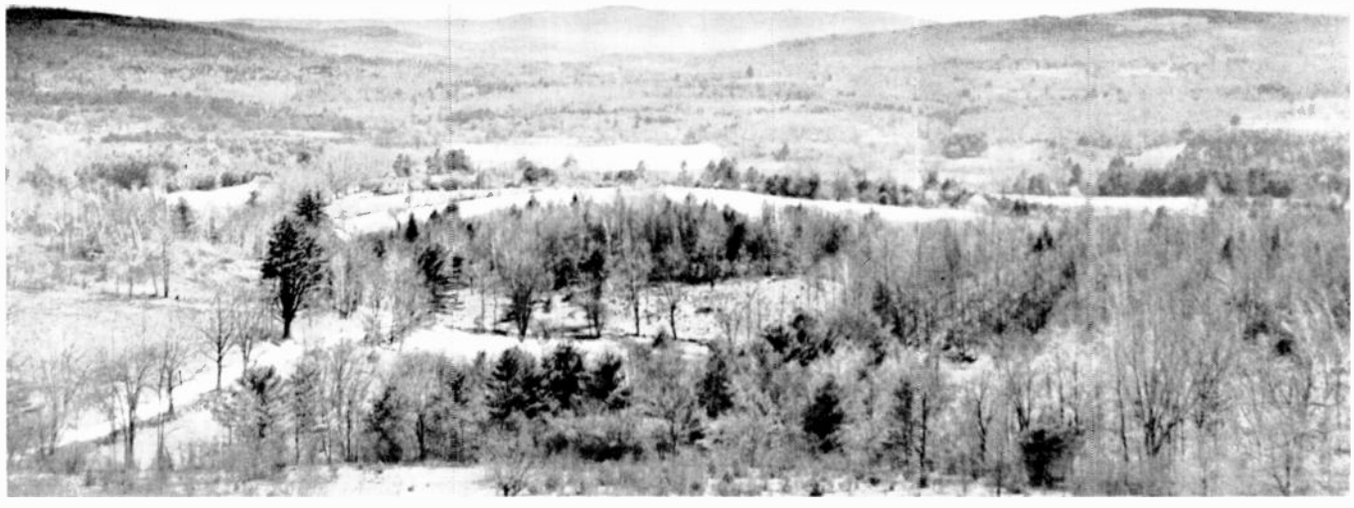
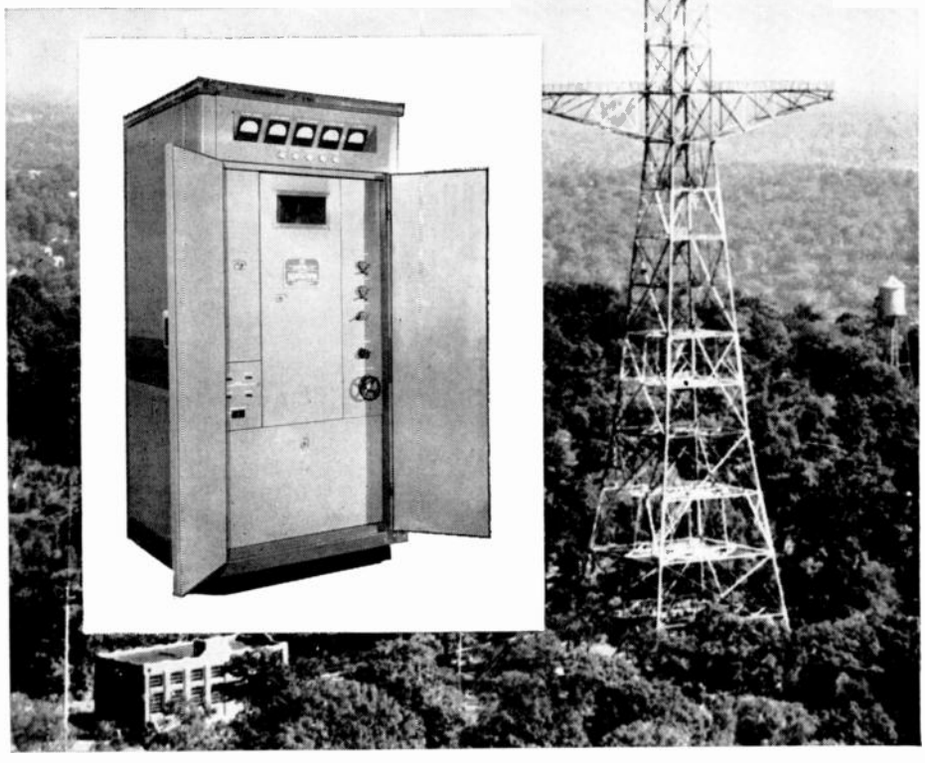


FIG. 24. VIEW TOWARD NEW YORK CITY FROM THE TOP OF THE MAST. FAR HILLS ARE DIRECTLY IN LINE OF SIGHT

THERE'S A NEW REL 1 KW FM TRANSMITTER NOW OPERATING AT ALPINE

The birthplace of FM, W2XMN (WFMN) Alpine, N. J. is owned and operated by Major Armstrong. Just as the first commercial FM equipment was delivered to Alpine by REL in 1938—so, in 1946 REL has again demonstrated its leadership.



Others who are now on the air with REL FM Transmitting Equipment are:

W3XO—
Washington, D.C. (WINX)

WDRC-FM—
Hartford, Conn.

WTIC-FM—
Hartford, Conn.

WENA—
Detroit, Mich.

WNBF-FM—
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WGTR—
Paxton, Mass.

WMIT—
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RADIO ENGINEERING LABS., INC.
Long Island City, N.Y.

PROGRESS OF FM BROADCASTING

(CONTINUED FROM PAGE 21)

filed by newspaper publishers. Of these, 200 already own AM stations, and 130 do not. The 130 newspapers which do not own AM stations are probably the most significant group, for they can be expected to move ahead quickly, and to put aggressive promotion behind the task of building their audiences. FM has given them their chance to compete with the service which has been giving them the stiffest competition, and they will make the most of it.

The only other sizeable groups are: manufacturers, 20 applications; labor organizations, 14 applications; and engineers, 11 applications.

Since April 1st, when the foregoing information was compiled, additional FM applications have brought the total up to 900. Before the end of June, the projected FM broadcast stations will exceed the number of AM stations.

FCC Absurdity ★ What is more striking than the figures themselves is the evidence of the power behind the movement to establish FM service on a national scale. To anyone who has had a part in the radio industry over a period of years, the scope of this movement shows that the recent release by the FCC of its survey of FM set production, and the statement that figures are disappointingly low, were significant as a signal to indicate the futility of any further effort to stem the FM tide.

Radio manufacturers, almost without exception, have never disclosed their plans, even if they have made them. When they answer questionnaires at all, the data they give out is seldom confirmed by performance. And in this particular instance, the manufacturers do not know what they are going to produce in 1946 because they do not know what OPA prices and material shortages will permit them to do!

The only information that can be stated with certainty is that 1) they will have their engineering work on FM receivers completed long before they can turn out *any* type of sets in quantity, 2) FM set production can and will be built up in step with the installation of new FM transmitters, and 3) the radio dealers generally are very indifferent toward putting serious sales effort behind cheap AM sets, preferring to concentrate on repair work until they can really go to work on FM receivers carrying prices that will bring a worthwhile return on their sales efforts.

FM Facsimile ★ There is still another factor to be considered. Adding further to the possibilities of FM broadcasting and to its service to the public are immediate plans to get facsimile under way. At the recent convention of the American Newspaper Publishers Association in New York City, both Finch and Radio Inventions demonstrated facsimile broadcasting by FM. The former used transmission from the Finch station WGHF, and the latter from WOR's affiliate WBAM and WQXR's affiliate WQXQ.

Both companies demonstrated reception adequate in speed and readability for either home reception or commercial service. Among the stations planning to use Finch equipment are WMGM New York and KMGM Los Angeles, both FM stations operated by MGM interests; KJS San Francisco; San Bernardino Broadcasting Company, Calif.; Western Reserve Broadcasting Company, Cleveland; and WJJD, operated by the *Chicago Sun*.

Radio Inventions, Inc., headed by John V. L. Hogan, is working with a group of broadcasters and newspapers known as Broadcasters' Facsimile Analysis. This comprises WOR New York, WCAE Pittsburgh, WOL Washington, D. C., WINX Washington, D. C., WWL New Orleans, WGN Chicago, WNBH New Bedford, Mass., WDRC Hartford, WHK Cleveland, KMBC Kansas City, Toronto Globe and Mail, WQXR New York, WABC New York, Boston Globe, KXOK St. Louis, WABF New York, KYW Philadelphia, WOKO Albany, WFIL Philadelphia, and Faximile, Inc. New York.

Important news of the activities of these groups can be expected very soon, and a considerable number of facsimile receivers may be in the hands of the public before the end of 1946.

Conclusion ★ This review of the status which FM broadcasting has already achieved recalls Major Armstrong's statement that ". . . at the time an invention is made, the only man who is right is the inventor, and everyone else is wrong. So that if you prevent him from developing what his idea is, he will never have the opportunity of making any converts."

However, it now appears that the strong opposition to FM did not come from those who were wrong because they did not understand, but were wrong because they appraised correctly the potential impact of a radical improvement on the established broadcasting system, and undertook to deny the public the benefits of this better service by their inevitably unsuccessful efforts to preserve a commercial status quo.

Perhaps those who still shudder at this transition will find some amelioration to soften the shock, such as hot-water heaters contributed to those early bathtub installations.

ACOUSTICAL TREATMENT

(CONTINUED FROM PAGE 28)

years. The engineer's control console, Fig. 8, however, is of a different design because of the many new control features built into the studio. Also, a producer's console, shown in Fig. 9, has been provided to allow him to operate independently of the engineer. All audio and monitoring equipment is contained on the two racks shown in Fig. 10.

The author wishes to thank W. A. Clark, George M. Nixon, and C. A. Rackey, all with the engineering department of the National Broadcasting Company, for their kind coöperation and assistance in preparing this article.

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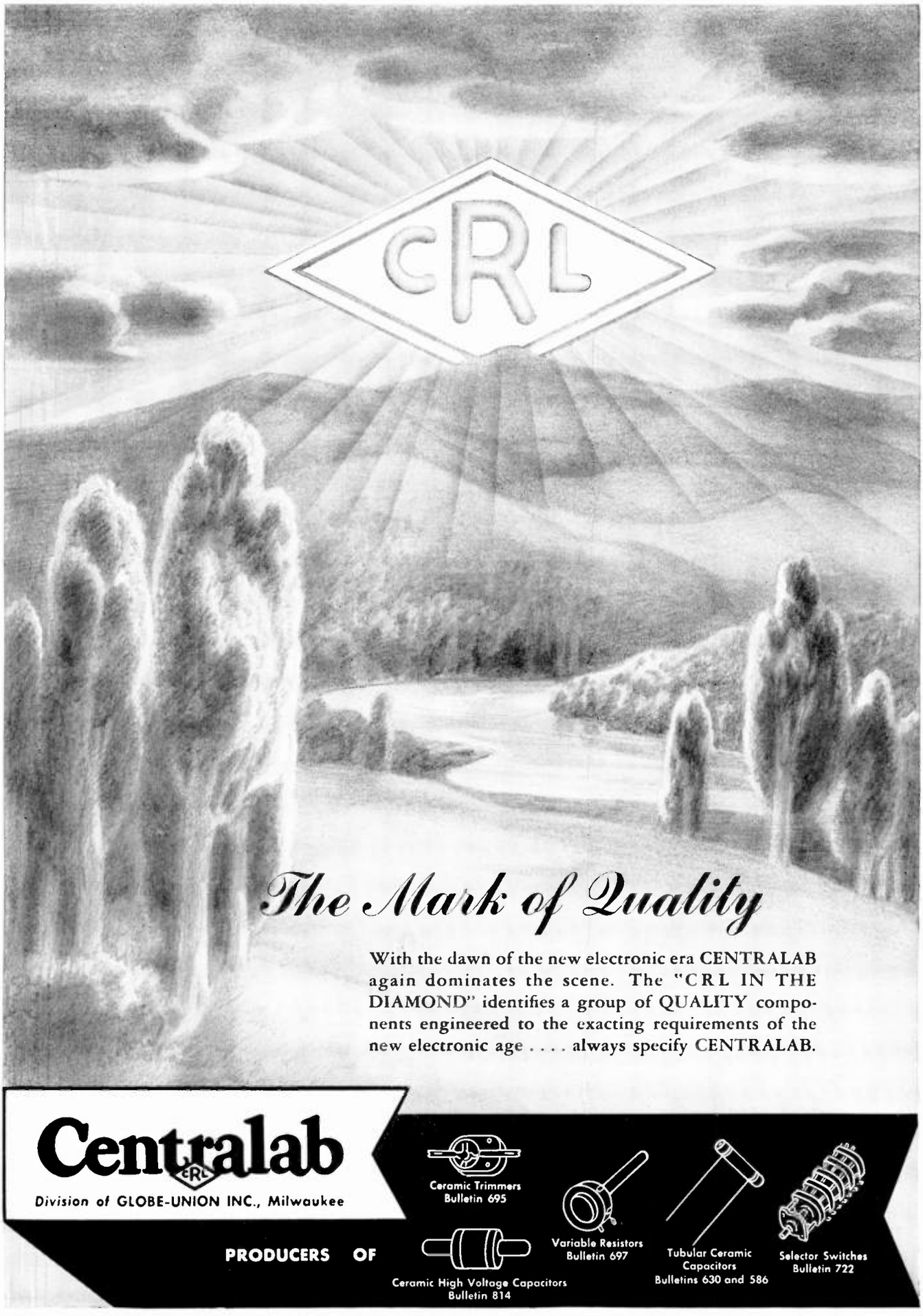
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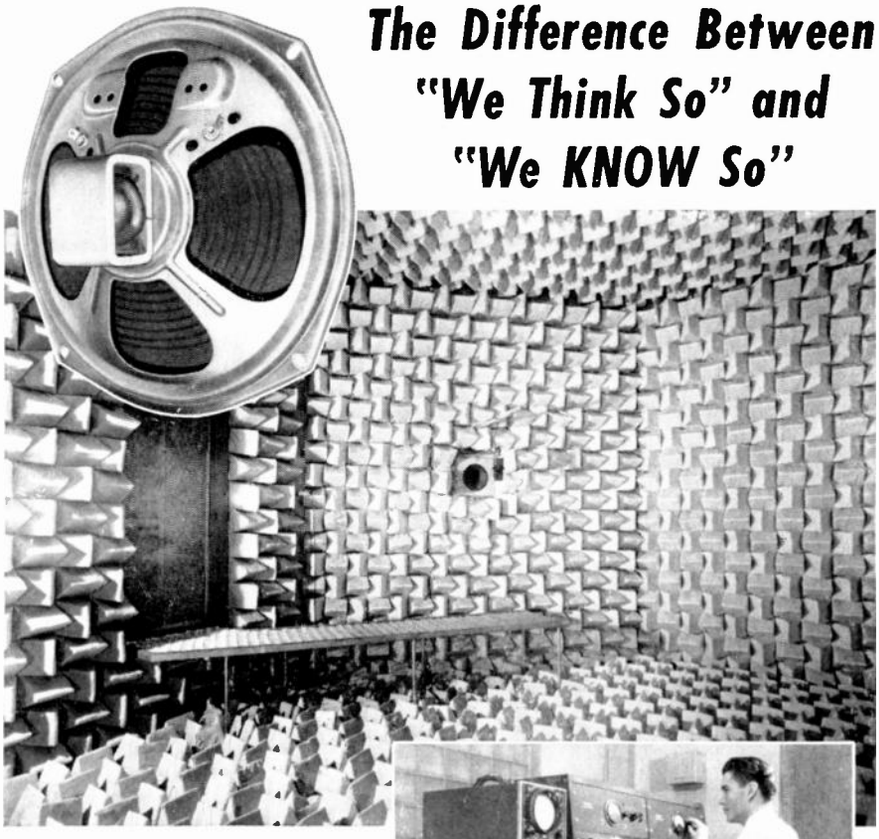

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EXPERIMENTAL FM ANTENNA

(CONTINUED FROM PAGE 42)

Cost ★ No two towers can be put up at exactly the same cost. Labor may vary considerably both as to the number of man-hours and rate. We paid a higher rate for work in the air than on the ground, but in some parts of the country a flat hourly rate is paid. Weather is another controlling factor. In our case, wind and low temperatures added considerably to the time required to complete the job. The distance from the tower to the radio equipment introduces another variable in the cost of conduit and cable.

Our complete installation, including the tower, lights, conduit, wire, fittings, and labor, came to just $500. That figure can be taken as an average. Another installation, at a different location, might run $100 less, or possibly $200 more.

Insurance ★ The Wincharger tower described here is the standard design used for hundreds of police transmitters and other communications purposes. The factors of safety are very high in this type of design and, as far as we have been able to learn, none of these towers has ever failed from ice loads or wind storms. However, it is wise to be protected against public liability by insurance. As long as the tower is only for private use, and not for any commercial purpose, the owner can be protected by a general-coverage home liability policy. In some cases, specific reference must be made to the tower in the policy. However, it is not necessary to take out separate liability insurance on the tower. Agents who handle this type of insurance can furnish exact and complete information with reference to any particular company.

FM HUNTED SUBMARINES

(CONTINUED FROM PAGE 24)

pig-tail to it for the transmitter ground.

The design of the hydrophone release was a tricky job. It fitted into the cast iron ring around the bottom of the case, and held the hydrophone and cable firmly up against a water-tight disc which closed off the transmitter compartment.

If the release was made secure enough to hold the hydrophone under conditions of ordinary handling, it still held when the Buoy hit the water. But when it was made delicately responsive to the pressure of landing, it was liable to let go at any time! Getting that release to drop only at the right time was almost like asking an AM receiver to differentiate between signals and static. We tried and discarded all kinds of bright ideas. In the end, patiently contrived refinements of the original design gave the most satisfactory results.

Nothing could be simpler than the hydrophone, as you can see from Fig. 2. It was merely a cylinder of magnetized

(CONCLUDED ON PAGE 57)

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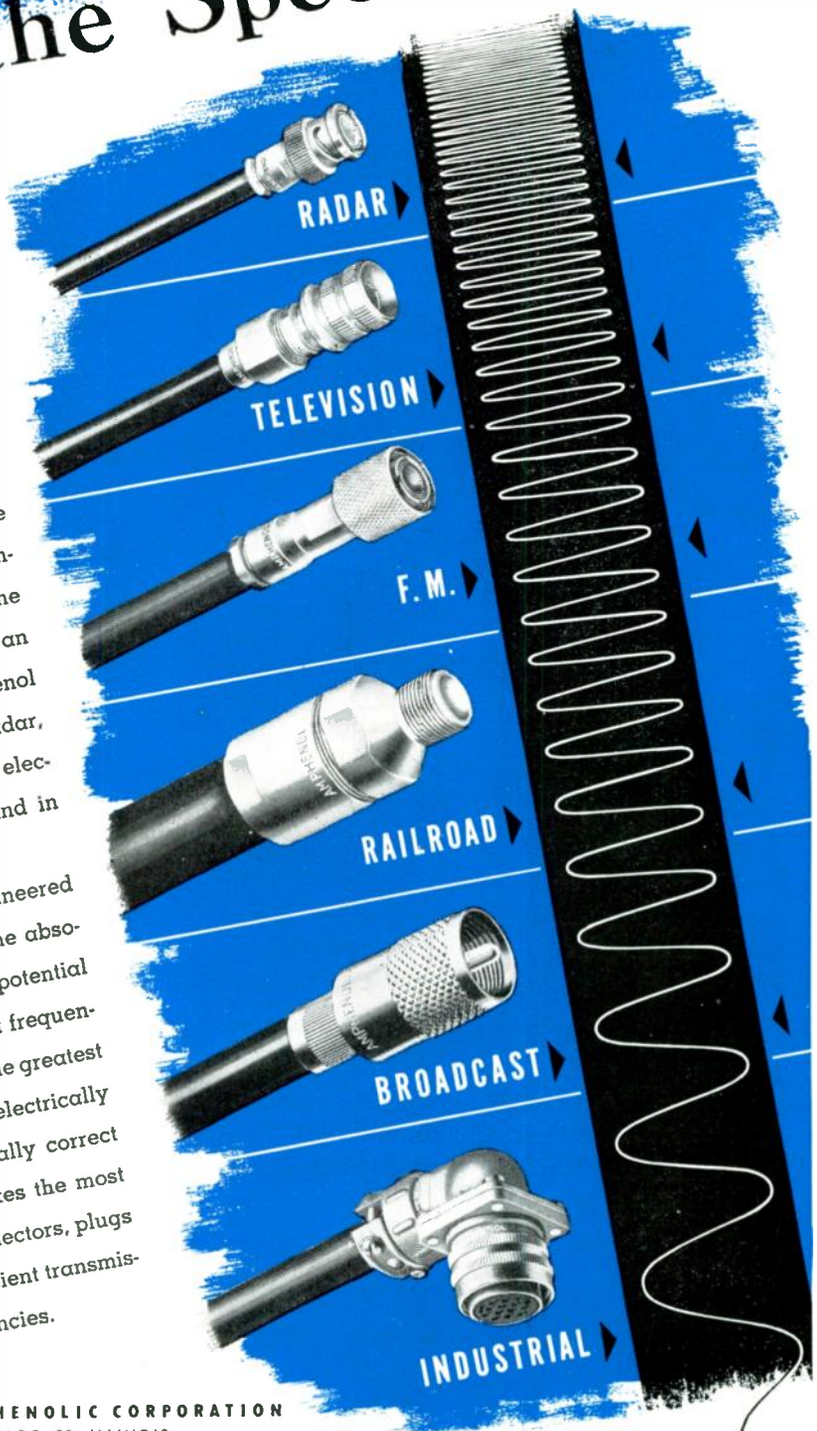

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Besides this revolutionary new method, Simpson offers you an equally revolutionary switching arrangement. The circuit is so arranged that, even though there are numerous combinations possible, very few switches require moving to test any one tube. Many of the popular tubes are tested in the "normal" position without moving any of the nine tube circuit switches.

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When you have finished a tube test, the Automatic Reset takes over to speed and simplify the next test. Just press the reset button and instantly all switches, both push button and rotary, return to normal automatically!

SIMPSON MODEL 330 MUTUAL CONDUCTANCE TUBE TESTER

1. Size—15½" x 9½" x 7".
2. Case—Sturdy plywood construction, with heavy fabricoid covering, corners trimmed in leather, rustproof hardware — removable cover with slip type hinges.
3. Panel — Heavy molded bakelite, beautiful satin grained finish. All characters, numerals, and dial divisions are engraved and filled in white, insuring long wearing qualities.
4. Meter—4½" rectangular of modern design with artistic four-colored dial indicating good, fair, doubtful, and bad—also "Percentage of Mutual Conductance" scale.
5. Sockets provided for all types of tubes including acorn tube.
6. Neon glow tube incorporated to indicate shorted tubes.
7. New simplified revolutionary switching arrangement (see description at left).
8. The tube chart provided is arranged for quickly identifying the tube and setting the controls.
9. Tests tubes with voltage applied automatically over the entire operating range and under conditions approximating actual operation in a radio set.

Price **$98.50**

ASK YOUR JOBBER

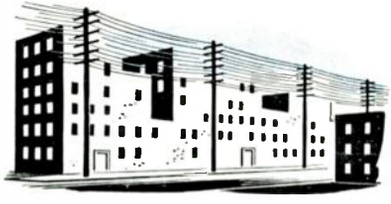
SIMPSON ELECTRIC COMPANY
5200-5218 West Kinzie St., Chicago 44, Ill.

Simpson

INSTRUMENTS THAT STAY ACCURATE

Why this team is a leader in VHF

1. *First voice circuits were single iron wires with ground return. Frequency limitations, noise and high losses soon ruled them out.*



2. *Big improvement was the all wire circuit—a pair of wires to a message Later came carrier which stepped up frequency and permitted several messages per circuit.*

3. *Lead covered cable compressed many wire circuits into small space—took wires off city streets. But losses are prohibitive at very high frequencies.*

4. *Coaxial cable—a single wire strung in a pencil size tube—extended the usable frequency band up to millions of cycles per second and today carries hundreds of messages per circuit, or the wide bands needed for television*

transmission

5. *Wave guides, fundamentally different in transmission principle, channel energy as radio waves through pipes; vary in size from several inches to under 1 cm.; become smaller as frequency rises.*

6. *Late model radar wave guides, similar to that used to feed the antenna above, can carry 3½ cm. waves at more than eight billion cps. Experimental guides for still shorter waves are being tested.*

Back in 1933, Bell scientists established an historic first when they transmitted very high frequency radio waves for hundreds of feet along hollow pipes called wave guides. For them it was another forward step in their long research to make communication circuits carry higher frequencies, broader bands and more messages per circuit.

Continuing Research showed the way

From the days of the single open wire line—through all-metallic circuits, phantoming, cable, carrier systems and coaxials—up to today's wave guides, every improvement has been the result of continuous fundamental study.

When Bell Laboratories started work on wave guides, there was no immediate application for the microwaves they guided. But the scientists foresaw that *some day* wave guides would be needed—so they kept on working until they had developed the wave guide into a practical device.

With the war came radar—and the problem of conducting microwave frequencies. Bell Laboratories had the answer—wave guides—without which radar at the higher frequencies would have been impractical.

What this means to YOU

Year after year, Bell Laboratories have continued to develop methods for handling higher and higher frequencies. Year after year Western Electric has provided equipment putting these scientific advances to work. This team has become the natural leader in the field.

When your requirement dictates the use of VHF—in mobile communications, broadcasting, or point-to-point radio telephony—depend on Western Electric to supply the latest and best equipment for your needs.

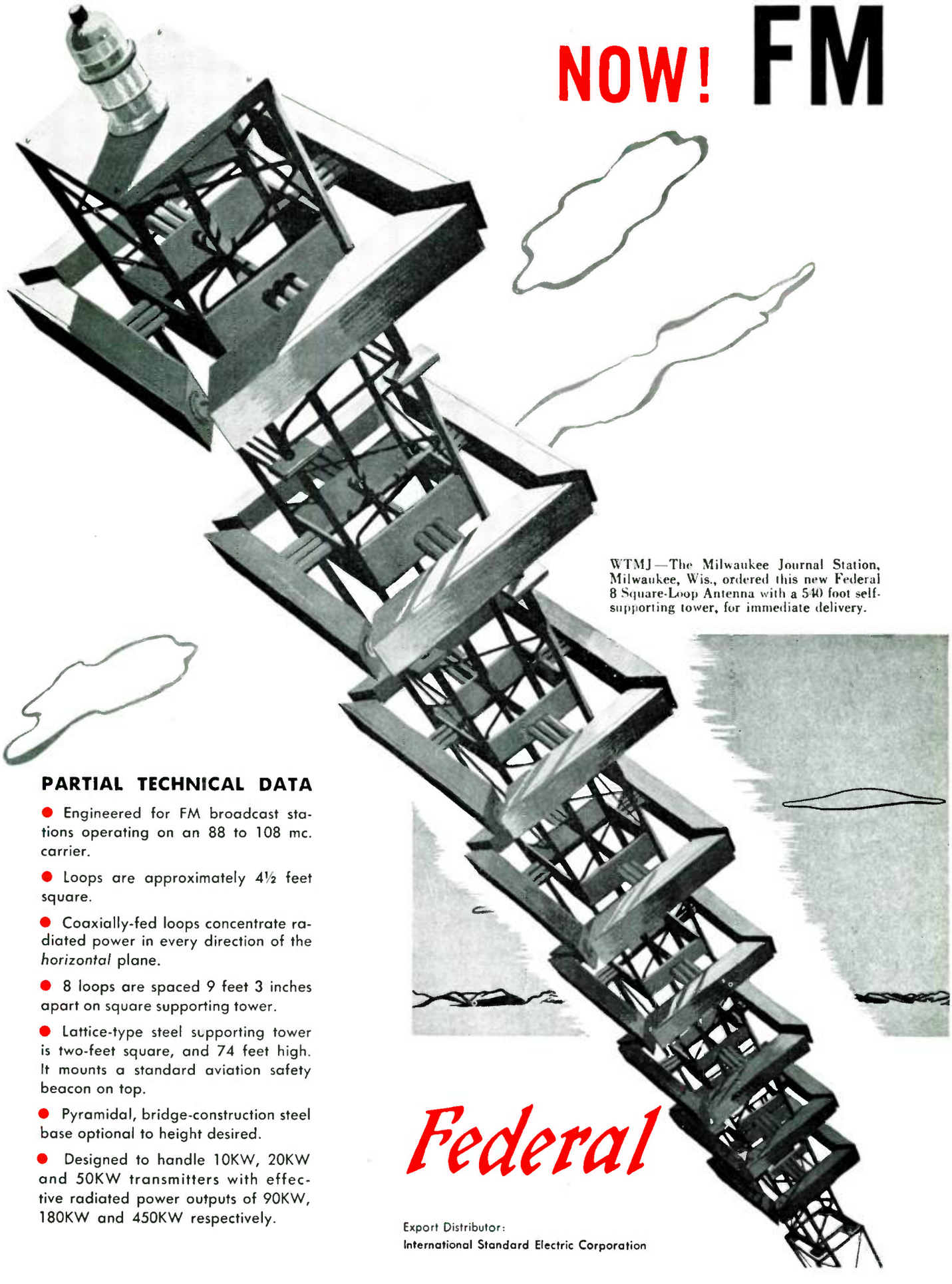
BELL TELEPHONE LABORATORIES

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

Western Electric

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

NOW! FM



WTMJ—The Milwaukee Journal Station, Milwaukee, Wis., ordered this new Federal 8 Square-Loop Antenna with a 540 foot self-supporting tower, for immediate delivery.

PARTIAL TECHNICAL DATA

- Engineered for FM broadcast stations operating on an 88 to 108 mc. carrier.
- Loops are approximately 4½ feet square.
- Coaxially-fed loops concentrate radiated power in every direction of the *horizontal* plane.
- 8 loops are spaced 9 feet 3 inches apart on square supporting tower.
- Lattice-type steel supporting tower is two-feet square, and 74 feet high. It mounts a standard aviation safety beacon on top.
- Pyramidal, bridge-construction steel base optional to height desired.
- Designed to handle 10KW, 20KW and 50KW transmitters with effective radiated power outputs of 90KW, 180KW and 450KW respectively.

Federal

Export Distributor:
International Standard Electric Corporation

ANTENNA WITH NOMINAL POWER GAIN OF 9!

FEDERAL's 8 SQUARE-LOOP ANTENNA PROVIDES 90KW EFFECTIVE POWER OUTPUT WITH A 10KW TRANSMITTER... 180KW WITH A 20KW TRANSMITTER...450KW WITH A 50KW TRANSMITTER!

HERE IS STILL ANOTHER EXAMPLE of Federal's leadership in the entire field of FM . . . an 8-loop antenna with the highest power gain ever available in the FM broadcast service.

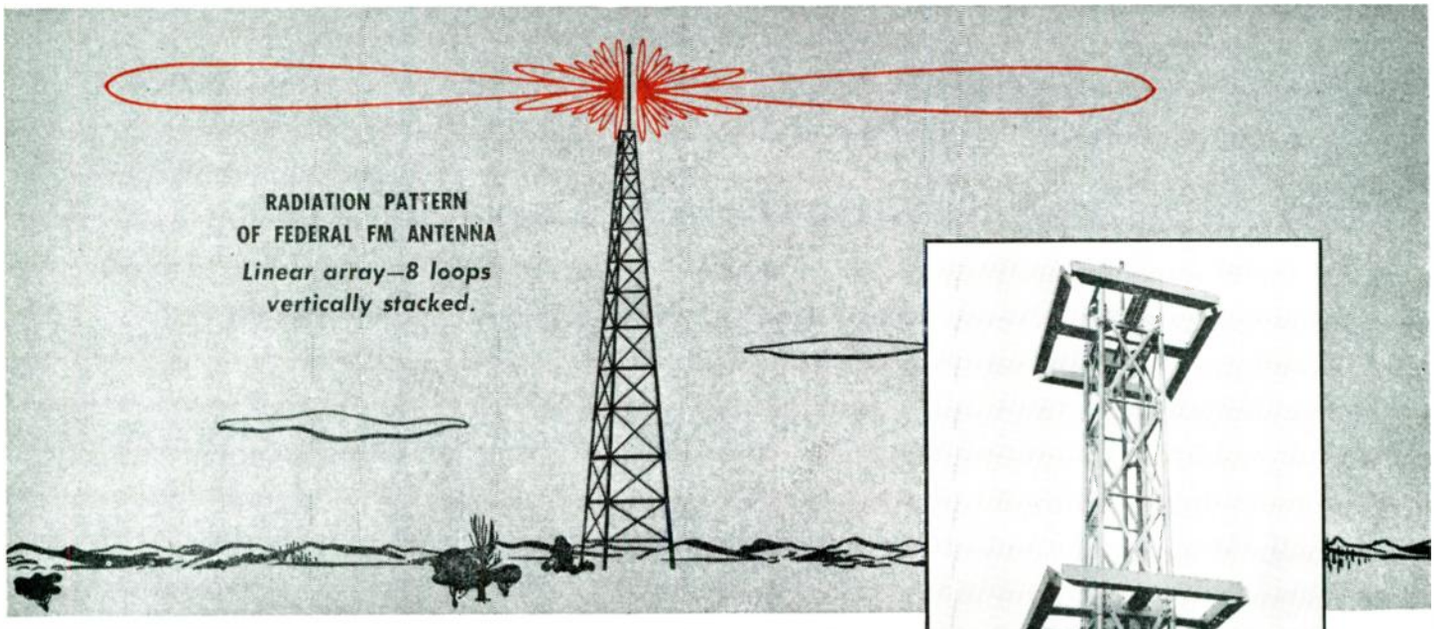
It radiates horizontally polarized waves so highly directive that very little energy is lost to useless ground or sky wave. Thus, with a power gain of 9, you can now get an effective power output of *90KW with a 10KW transmitter; 180KW with a 20KW transmitter and 450KW with a 50KW transmitter!* This not only means a great saving on the cost of original equipment, but important economies of operation as well.

Be prepared for future FCC action increasing the effective radiated power!

One antenna is built for use over the entire FM range . . . 88 to 108 megacycles. Only one predetermined stub adjustment per loop changes it for any frequency in this band. Also, antenna array may be fed in two sections with separate coaxial lines to allow for emergency auxiliary operation.

Structurally, the tower is designed not to disturb the circular pattern of the antenna's radiation . . . is supported on a rugged, pyramidal base. The entire unit withstands high wind velocities and heavy icing loads.

Coming at a time when the FCC has given the green light to FM station construction, this remarkable new antenna is another contribution to the advancement of FM transmission . . . part of the "completely packaged service" which Federal now makes available. A Federal engineer will be glad to give you full details.



Shown at right is a square loop antenna in operation at the Federal laboratories. Design is similar to the 8 square-loop antenna.

Telephone and Radio Corporation

Newark 1, New Jersey

AN IT&T ASSOCIATE

FEDERAL TELEPHONE & RADIO FTR

The acceptance of *FM* AND TELEVISION as a member of the Audit Bureau of Circulations is another important step in the progress of this publication ★ ★ But of greater significance to the radio industry is the fact that Frequency Modulation has progressed so far as to have an ABC magazine devoted to its particular interests ★ ★ The expanding postwar activity in FM broadcasting, communications, and facsimile is reflected by the fast-growing circulation of *FM* AND TELEVISION Magazine. Up 25% in the last five months to 7,500 copies, this coverage is concentrated among "The Men Who Set the Pace the Industry Follows." ★ ★

FM HUNTED SUBMARINES

(CONTINUED FROM PAGE 48)

nickel, 5 ins. long and 3 ins. in diameter, wound with a single layer of enameled wire. Waves set up in the water by sounds caused minute stresses in the nickel. This, in turn, changed the total magnetic flux and induced a varying voltage in the winding.

Our difficulties were a matter of metallurgical control. Some nickel pieces gave excellent results; other, practically none at all. The answer was a special and carefully controlled method of annealing which, eventually, produced tubing in quantity of uniform electrical characteristics.

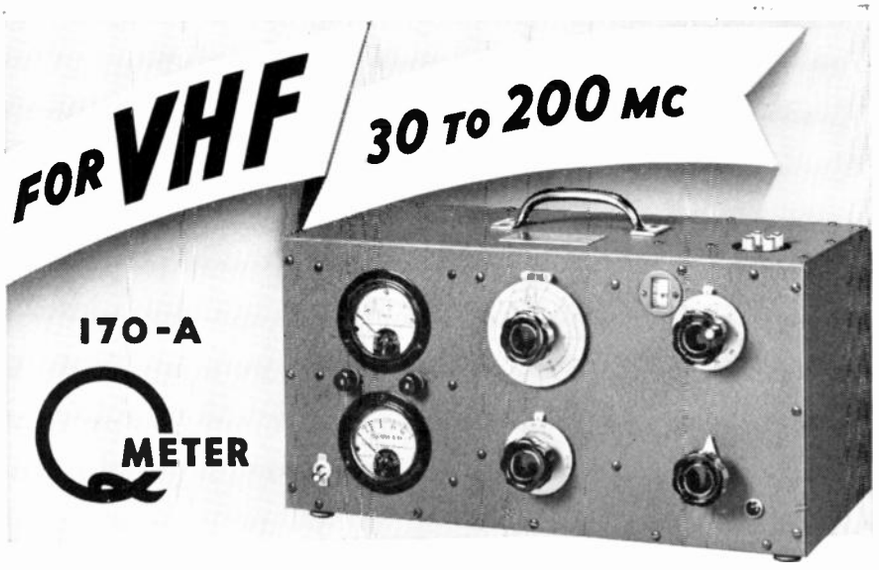
As you might expect, the parachutes usually opened up properly, but the percentage of failures was too high for battle conditions. Also, the cloth weakened under the influence of salt air dampness, particularly in the Pacific. The more protection we put on the parachute wrapping, the greater the danger that it would not open, or that the shroud lines would become entangled!

There wasn't any simple answer, evolved from an engineering brainstorm. It was just a matter of refinement, worked out patiently by the trial-and-error method. Fig. 3 shows how the parachute was packed around the mandrel supporting the antenna. Then it was encased in a sort of plastic wrapping that kept out the moisture, but tore easily and fell free after the Buoy was dropped. A manufacturer of ladies' corsets contributed much assistance in reaching the final design.

One cause of failure in action was due, we learned, to a purely human factor. The first Buoys were equipped with a simple switch, actuated by pulling a pin, to turn on the transmitter. In the excitement of submarine hunting, Buoys were launched with the switch pins still in place. Until this cause of failure was recognized, everything else was blamed. In the final design, we tied the switch pin with the shroud lines so that, as the parachute opened, the pin was automatically pulled out. However, for pre-flight testing, the pin could be removed and replaced by hand.

A similar trick was used on the soluble sinking plug. Since it was intended to melt away when wet, it sometimes became so soft under the influence of dampness that it let go soon after the Buoy hit the water, causing the Buoy to sink in a few minutes. If we put some kind of protection on it, it might not be removed before launching. Accordingly, a protective plug was put over the soluble wax, and tied to the static line which opened the parachute. That stopped another type of failure due to the human factor.

These and many other problems of a similar nature were met one by one, until the battle performance of the Buoy was virtually perfect.



A ruggedly constructed direct reading laboratory instrument specially designed to measure Q, inductance, and capacitance values quickly and accurately. Invaluable in selecting proper low loss components for high frequency applications.

SPECIFICATIONS:—FREQUENCY RANGE: 30-200 mc, accuracy ± 1%
RANGE OF Q MEASUREMENT: 80 to 1200
Q CAPACITOR RANGE: 11-60 mmf; accuracy ± 1% or 0.5 mmf, whichever is greater

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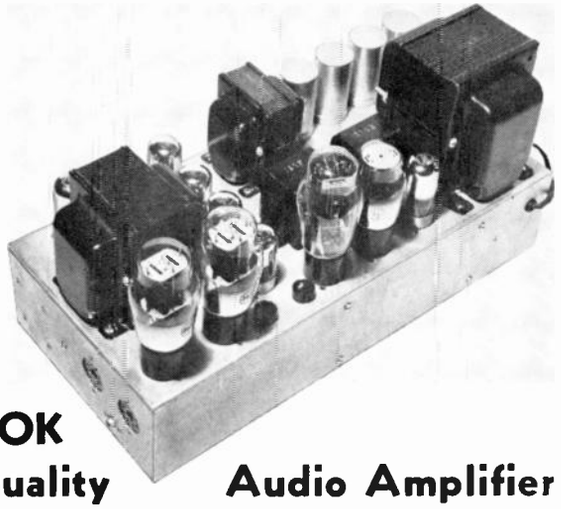

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ENGINEERING SALES

(CONTINUED FROM PAGE 8)

G.E.: Most of the sales personnel of the transmitter division have been transferred from Schenectady to the new G.E. plant on Thompson Road, Syracuse. Included in this move are J. D. McLean, manager of sales; W. R. David, broadcast equipment sales manager; and R. D. Jordan, advertising and sales promotion manager. Nat Gada, sales manager of communications equipment has been at Syracuse for the past 6 months. P. G. Caldwell and T. Johnson, Jr., respectively sales managers for television and carrier communications equipment, will continue at Schenectady.

John Meck: Harold Maynard has joined the Chicago sales staff of John Meck Industries. For the past five years, he was with Douglas Aircraft at Long Beach, Calif.

Sylvania: New director of sales for all divisions and subsidiaries is Robert H. Bishop, who joined Sylvania in 1946.

Boston: Michael Scott, who has been released from the Navy as Lieutenant Commander, has returned to the Boston branch of Radio Wire Television, Inc. as vice president and general manager. He joined R.W.T. in 1934.

Bendix: Paul J. Reed, who joined the Bendix radio division at its inception, has been promoted to the position of assistant to the general sales manager.

Stromberg-Carlson: Capt. James W. Shackleford, recently discharged from the Signal Corps, has been appointed district merchandiser for the southeastern states.

Maguire: Newly organized export-import department of Maguire Industries, Inc., will be headed by Albert E. Brodigan. He will make his headquarters at 500 Fifth Avenue, New York City.

Walsco: The Walter L. Schott Company, Beverly Hills, Calif., has launched a new promotion campaign on radio hardware items, packaged in cellophane bags. These items are planned for distribution by parts jobbers. Sales manager is Donald J. Terwilliger.

Chicago: Walker-Jimieson, Inc., has announced the appointment of Karl Bewlah as sales representative for eastern Iowa and western Illinois, exclusive of the metropolitan Chicago area. Before the war, he was connected with Midwest Timmermann, in Davenport, Ia.

Admiral: Fan-San Distributors of Buffalo have opened a branch at 95 North Street, Rochester, where they will handle the distribution of Admiral sets and appliances in the Rochester territory. Richard J. Levy heads up the sales division.

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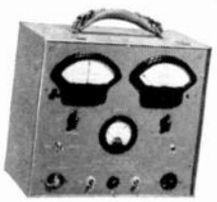
FM and AM FREQUENCY MONITORS

Direct reading. No charts or complicated calculations necessary. Available for all the frequencies used by the Emergency Services, including the new 152-162 mc. band. Designed for operation on 110 V. AC 60 cycles.

Also available for the New 88-108 mc. FM Broadcast Band.



PORTABLE FM MONITOR

Model FD-10A is similar to the FD-9A except operates on 6 Volts D.C. Designed for checking FM Mobile Transmitting Equipment at point of operation. Supplied for operating on one or two frequencies between 30-44 mc.

Other DOOLITTLE equipment includes Station and Mobile Antennae, Station Control Units, Mobile Receivers and Transmitters, Station Receivers and Transmitters for the Emergency Services.

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CHICAGO 36, ILLINOIS
BUILDERS OF PRECISION RADIO EQUIPMENT

SPOT NEWS NOTES

(CONTINUED FROM PAGE 32)

FCC chairman Denny has warned he will ask Congress for authority to control prices at which stations are sold. Mr. Denny may suddenly find himself as far out beyond his depth as his predecessor is at OPA. With this added to FCC's portfolio of controls, we would indeed reach the end of private ownership and operation of broadcasting.

FCC Set Survey: According to figures compiled from FCC questionnaires sent to set manufacturers, 21,129,760 sets will be produced this year, of which only 8.4% will have FM tuning. Remarked one realist: "That gang must have been behind the barn when God passed out the brains! In normal times, radio manufacturers never told the truth about their plans. Now they don't have to lie because they haven't the faintest idea what they will be able to do in the next 30 days. Remember when Paul Porter said he had been assured that 10-kw. FM transmitters would be immediately available?"

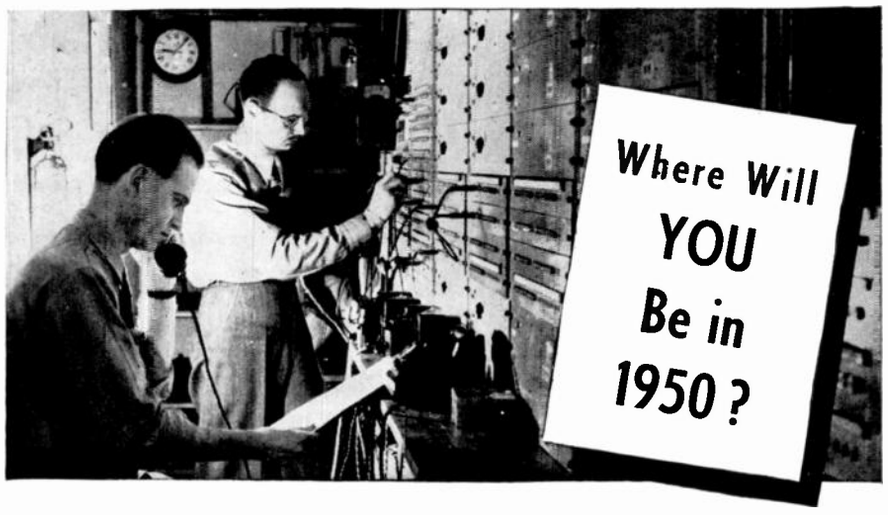
Chicago: Facilities and inventory of Oxford-Tartak Radio Corporation, speaker manufacturers, have been purchased by Noma Electric Corporation. Col. John A. Proctor, recently released from ATSC, has been elected president, with Robert Adams vice president and general manager, Joseph P. Wharton, Jr. treasurer, and David E. Davis secretary.

OPA Please Copy: Postcard from Federal Security Agency says: "In the interest of economy, the Government is making an earnest effort to reduce mailing lists and retain only names of persons currently interested in receiving publications. — If we do not hear from you in 30 days, your name will be dropped from the list." If the OPA propaganda department did that, 50,000 people would be thrown out of work, mail deliveries would be speeded up, and the threatened paper shortage averted. However, judging from the day's mail, it seems that no such relief is in sight.

Detroit: Television applications withdrawn in Detroit have reduced the number of applicants to less than the number of channels available. Accordingly, FCC called off scheduled hearings, and granted permits to the Evening News Association and King-Trendle Broadcasting Company.

Nelson P. Case: Former chief engineer of Hallicrafters receiver division has been made chief engineer for the entire Hallicrafters organization. He was with Hazeltine Electronics for 13 years, and for 2

(CONCLUDED ON PAGE 60)



Enjoy Security and Good Pay! Prepare Now With CREI Technical Home Study Training and Step Ahead of Competition into a Good Radio Job! — *CREI Offers You a Proved Program of Self-Improvement to Keep Pace With Modern U. H. F. Advancements and Get That Radio Engineering Job You Want*

Yes, there are GOOD JOBS . . . for GOOD men! The easy jobs are gone and once again knowledge and ability are the requirements to HOLD good jobs — to SECURE better ones. Employers once again can afford to be "choosey" . . . to select the best man for the best job. In the face of this showdown situation — where do YOU stand?

CREI home study training in Practical Radio-Electronics Engineering can equip you to meet the requirements to hold your job — or advance to a better one. CREI graduates are recognized throughout the Radio-Electronics industry. Your CREI diploma is the best recommendation for a better job. By adding CREI training to your present radio experience you can safeguard your future and keep pace with such new developments as U. H. F. Circuits, Cavity Resonators, Pulse Generators, Wave Guides, Klystrons, Magnetrons and other tubes. Are you equipped to handle them? CREI is equipped to help you, by providing the know-how and ability that is required.

In our proved method of instruction, you learn not only how but why! Easy-to-read-and-understand lessons are provided well in advance, and each student has the benefit of individual guidance and supervision from a trained instructor. This is the basis of the CREI method of training which many thousand professional radio men have completed during the past 19 years. CREI courses were used during the war to train thousands of Army and Naval radio technicians for the U. S. Signal Corps, U. S. Navy and U. S. Coast Guard.

It's up to you now to decide your course. What you do today will be the answer to where you will be in 1950 and the years after. It costs you nothing to read the interesting facts . . . to learn how CREI can help you enjoy the security you want . . . the better-paying job that can be yours. Write for particulars now! (CREI training for Veterans is approved under the "G.I." Bill.)

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SPOT NEWS NOTES

(CONTINUED FROM PAGE 59)

years was director of engineering design and development at Hamilton Radio.

WGYN: Muzak FM station in New York City is operating on 96.1 mc. from noon to 10:00 p.m. weekdays and 3:00 to 10:00 p.m. Sundays. Musical programs feature super-quality transcriptions, with 3 minutes of news before each hour.

New Publication: *Weston Engineering Notes*, offering "pertinent application engineering information for users of electrical indicating instruments," is being published bi-monthly by Weston Electrical Instrument Corporation, Newark 5, N. J. Copies will be sent without charge to engineers who ask to have their names put on the mailing list. Requests should be addressed to John Parker, Editor.

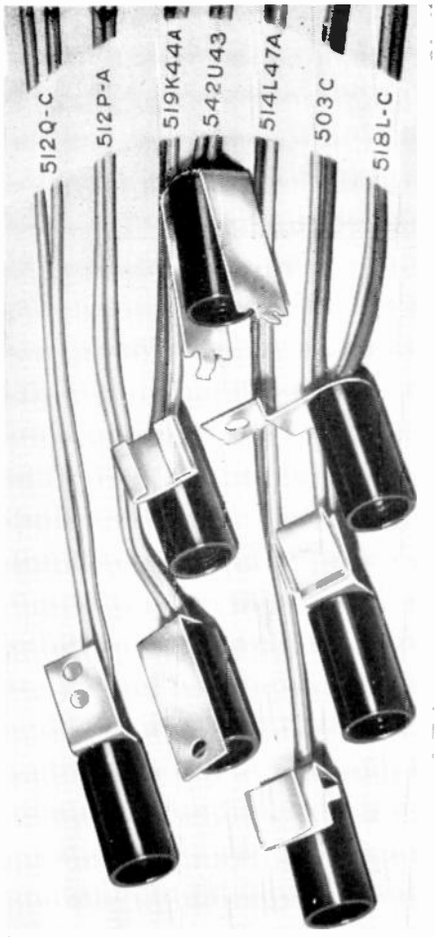
Britain's Television: Service from Alexandra Palace, London, discontinued on September 1st, 1939, will be resumed on June 7th. Using 405 lines, programs will be transmitted daily from 3:00 to 4:30 and 8:30 to 10:30 p.m. GMT. Also, for the benefit of manufacturers and dealers, demonstration films will be transmitted from 11:00 a.m. to noon.

Upper Darby, Pa.: Firm name of Airdesign & Fabrication, Inc. has been shortened to Airdesign, Incorporated. New board members are John A. Murphy, chairman, and David Warner.

Stamford, Conn.: New research laboratories devoted to sound recording have been opened by Audio Devices, Inc. Ernest W. Franck, research director, is in charge.

Rosel H. Hyde: His appointment by President Truman as an FCC Commissioner was confirmed by the Senate on April 12th. The former General Counsel for the Commission will fill the unexpired term of the late Governor William H. Wills, who passed away on March 6th. Republican Commissioner Hyde is a legal resident of Banock County, Idaho. He attended high school in Salt Lake City, Utah Agricultural College at Logan, Utah, and completed his law course in 1929 at George Washington University, Washington, D. C. He entered Government service in 1924, and joined the Federal Radio Commission in 1928. Mr. and Mrs. Hyde and their three sons live at 2709 McKinley Street, N.W., Washington.

Worcester, Mass: Cornell Dubilier has purchased an eight-story building in Worcester, where it had occupied three floors, during the war, for production of condensers used in proximity fuses. In addition, the Corporation will purchase the machinery and equipment from the U. S. Navy.



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FM HANDBOOK

In order to include data on new FM equipment which has just been completed, publication of the *FM* RADIO HANDBOOK has been delayed slightly. Copies are now scheduled for mailing about June 15th. When you receive your copy, we believe you will agree that this delay is amply justified.

If you haven't taken advantage of the opportunity to get a copy of the paper bound edition without charge with a year's subscription to *FM* AND TELEVISION, or with a renewal or extension of your present subscription, do so at once, for this offer will be withdrawn at the end of July, 1946.

ARMY SURPLUS TRANSMITTERS

(CONTINUED FROM PAGE 37)

rules and regulations. When this Service is opened to the public, the Commission will make an appropriate public announcement and set forth the conditions under which licenses may be obtained. A simple licensing procedure requiring only a minimum of knowledge of the regulations is contemplated.

The Commission also pointed out that none of the Army surplus walkie-talkie equipment which has come to its attention is built to operate in the 460–470 megacycle band allocated for the Citizens Radiocommunication Service.

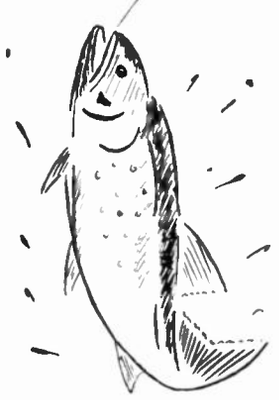
Retailers planning to sell Army surplus equipment or any other transmitters are urged by the Commission to assist in the enforcement of the Communications Act by attaching to each transmitter a tag explaining the penalties involved in unauthorized operation. These tags may be obtained without charge by writing to the Secretary, Federal Communications Commission, Washington 25, D. C. The tag reads as follows:

WARNING

The operation of a radio transmitter other than by the Federal Government without authorization from the Federal Communications Commission is in violation of the Communications Act of 1934, as amended, the penal provisions of which provide a fine not to exceed $10,000 or imprisonment for two years or both. For information write to the Secretary, Federal Communications Commission, Washington 25, D. C., indicating type of equipment and proposed use.

Tragic interference to the aviation, marine, police, fire, and military radio communication systems can result from the unauthorized operation of radio equipment, the Commission pointed out.

To detect illegal radio transmission, the Commission maintains a nationwide monitoring network equipped with direction-finding stations and mobile units patrolling the ether on a round-the-clock basis.



Fishing for your radio equipment is a gamble—you don't know what you'll get or when you'll get it.

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U.H.F. STANDARD SIGNAL GENERATOR *MODEL 84*

SPECIFICATIONS

CARRIER FREQUENCY: 300 to 1000 megacycles.

OUTPUT VOLTAGE: 0.1 to 100,000 microvolts.

OUTPUT IMPEDANCE: 50 ohms.

MODULATION: SINEWAVE: 0—30%, 400, 1000 or 2500 cycles. PULSE: Repetition—60 to 100,000 cycles. Width—1 to 50 microseconds. Delay—0 to 50 microseconds. Sync. input—amplifier and control. Sync. output—either polarity.

DIMENSIONS: Width 26", Height 12", Depth 10".

WEIGHT: 125 pounds including external line voltage regulator.

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R. W. T. BARGAINS of the MONTH

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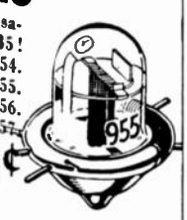
Socket for above, W8464, price 49c



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WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

agreed to do all their hiring through the CIO-UEW local. If you really believe in the fundamental principles of democratic government that you thought you were defending while you were in the United States Navy, you might not be able to get into the UEW, because bossman Julius Emspak, himself a student and a disciple of the Russian revolutionary leaders, favors like-minded members.

"Finally, if you were a UEW member, there's no telling when you could get a job, because the radio set manufacturers, even if they have their own OPA price schedules settled, and few of them have, still can't get parts as a result of the troubles that components producers are having with OPA."

That's the difference that two wars for democracy have made in the radio industry. We believe we presented the facts accurately, for the information was drawn from personal observation and from press releases sent out by UEW and the Electronics Manufacturers Association. If we're mistaken in any respect, we'd like to know about it, and pass the word along to our ex-Navy friend.

2. We wish *FM* AND TELEVISION could be as useful to all our readers as it was to the Jennings Television and Cinema Service, Brookfield, Conn., from whom we received the following letter:

April 27, 1946

Dear Mr. Sleeper,

Of all the amazing coincidences! Our 105-ft. Wincharger tower was lying on the ground, all ready for erection by Norwalk steeplejacks, but we hadn't received the instructions.

Your April issue, just arrived by mail, gives us the whole story in great detail. The boys are practically following your script.

Many thanks for your foresight in timing this article at a critical moment.

Yours for better television,
ROBERT A. JENNINGS

We can't take credit for the timing, because our antenna story was scheduled for earlier publication. But in our initial plans, we didn't consider what Old Man Winter could do, and did, up here in the Berkshires. Now we have gained a very healthy respect for those men who can put up radio towers anywhere at any time of the year.

3. The following paragraphs are taken from an editorial entitled "Censorship Thru Blackmail," which appeared in the *Chicago Daily Tribune*.

"The Communications Act of 1934, from which the Federal Communications Commission draws its authority to regu-

(CONTINUED ON PAGE 63)

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TELEVISION HANDBOOK

For the first time — a complete presentation of television theory, to appear monthly in *FM* and TELEVISION, and subsequently in book form under the title *Television Handbook*. The author, Madison Cawein, is Manager of Research at Farnsworth Television & Radio Corporation. This series will constitute a major contribution to television literature.

Watch for it in

***FM* AND TELEVISION MAGAZINE**

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 62)

late the radio industry and license broadcasting stations, specifically forbids the censorship of radio programs. The commission, however, is now seeking to do by indirection what it is forbidden to do directly.

"It has the power to license stations. The licenses must be renewed periodically and if the renewal is not granted a station is thrown off the air and an investment of hundreds of thousands, or millions, of dollars that have been spent to organize its staff and win it an audience is destroyed.

"The Commission's censorship program is based on its own interpretation of the requirement that a radio station must serve 'public interest, convenience, and necessity.' The Commission has published a report by which it purports to set up standards by which radio programs are to be judged. These standards are complex and self-conflicting. They go into numerous details of programs as regards their origin, advertising sponsorship, content, discussion of public issues, representation of minority views, and other subjects.

"The Commission doesn't promulgate these as regulations binding stations. It merely sets them up as standards by which it may choose to extend or withhold a license. As such, they are not subject to legal review. Not until a station has been denied its license could the matter be brought before a court. This is censorship by blackmail.

"Few owners of radio stations will be found willing to risk destruction of their investment by an arbitrary curtailment of their license in order to test the power of the Commission to regulate programs. The regulation, however, is present.

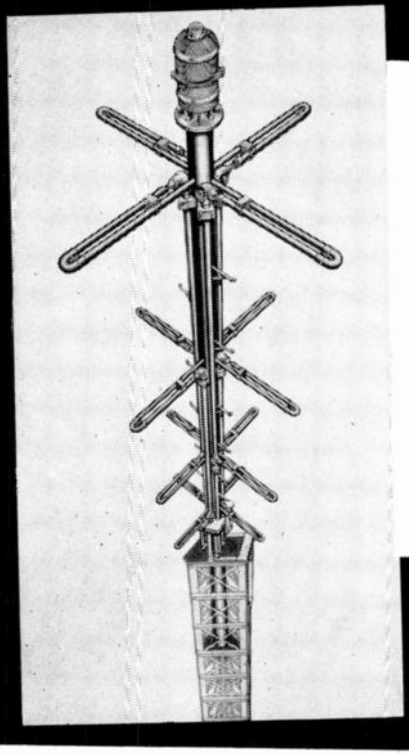
"Broadcasting will have to suffer, perhaps, for a long time as newspapers suffered to establish freedom of the press. Eventually, that freedom must take the form of an ownership as nearly absolute as the ownership of a hotel or theater, and subject to forfeiture only for conduct comparable to that which would cause a hotel or theater to be closed.

"This, of course, is on the assumption that radio broadcasting is to be developed as the Communications Act intended it to be, a vehicle for communication of public information and entertainment, free from government censorship, and not, as the Communications Commission has been trying to make it, a propaganda institution for the political party in power."

Even granting that the present intent is only to exercise a benign censorship over radio broadcasting, it must be remembered that this control could be used as a sword and a scourge in the hands of a succeeding administration. — *Milton B. Sleeper.*

At Long Last!

A FOLDED DIPOLE TURNSTILE F.M. ANTENNA



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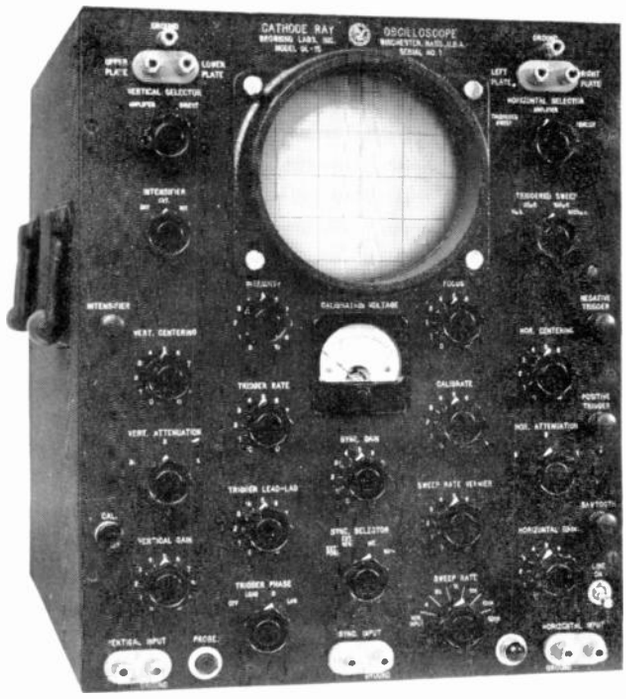

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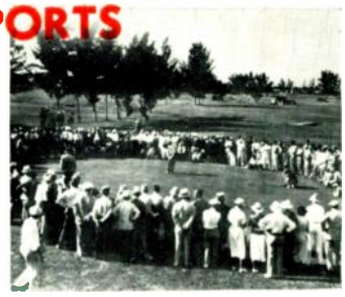

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