PRICE—TWENTY-FIVE CENTS

FM AND TELEVISION

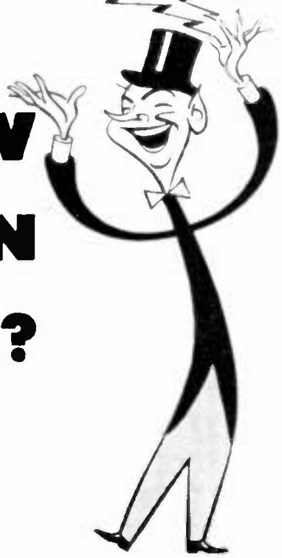
FEB. 1945

1944 & 1945 T.B.A. PRESIDENTS

FM & Television Products Directory

★ ★ Edited by Milton B. Sleeper ★ ★

WHEN AND HOW CAN TELEVISION TURN A PROFIT?



Interest in television is assuming flood proportions. Within 18 months after Victory there is every indication that television service will be available to 30,000,000 people . . . and enjoyment limited only by plant capacity of set manufacturers.

Prospective television station operators who reserve DuMont telecasting equipment *now* will be prepared to ride a wave of unprecedented popular enthusiasm . . . to ride the swift and inevitable commercial expansion of the greatest scientific advance of our time. Valuable prestige and good-will are natural windfalls of the early bird in this new field.

A fortune is not required to build a television station, nor years to "break even." DuMont designed and constructed 3 of the 9 television stations on the air today. The low operating cost and rugged dependability of DuMont equipment has been demonstrated week-in and week-out for more than 4 years. When and how television can turn a profit are questions to which DuMont holds factual answers. Would you like to hear them?

TELEFLASH! More than 90 requests for permission to construct and operate commercial television stations are on file with the Federal Communications Commission. As only a few channels are available for television, the number of stations in a trading area is limited. In consequence, options are already being sought for desirable "time." More than 61 advertising agencies have installed television departments. The value of riding with public interest is attracting more and more advertisers to television every week. They are learning to control the terrific sales impact of this wonderful new medium. Their experiments are well worth watching!

DUMONT *Precision Electronics and Television*

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

"The following is electrically transcribed..."

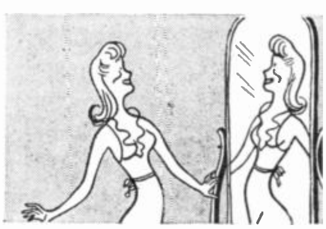
on PRESTO discs!

Pepsi-Cola's bouncy little ditty seems likely to become an American folksong. It has been played on the air more than a million times since 1939. You've heard it in swing-time and in "classical" versions for the intelligentsia. It has made Pepsi-Cola a buy-word in homes throughout the nation.

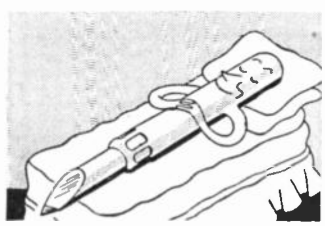
Pepsi-Cola "spots" are cut on PRESTO discs. *Most important transcriptions are.* For recording engineers know that PRESTO discs give finer results with less margin for error—*actually perform better than most of the recording equipment on which they are used.* That's why you'll find, in most large broadcasting stations, recording studios and research laboratories, the standard recording disc is a PRESTO.

WHY BROADCASTING STUDIOS USE MORE PRESTO DISCS THAN ANY OTHER BRAND

Less Surface Noise



No Distortion



Easier on Cutting Needle

No Fussy Needle Adjustments

WORLD'S LARGEST MANUFACTURER OF INSTANTANEOUS SOUND RECORDING EQUIPMENT AND DISCS

PRESTO

RECORDING CORPORATION

242 West 55th Street, New York 19, N. Y.

Walter P. Downs Ltd., in Canada

FM AND TELEVISION

FORMERLY: FM RADIO-ELECTRONICS

VOL. 5 FEBRUARY, 1945 NO. 2

CONTENTS

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THIS MONTH'S COVER

MUCH of the credit for developing the cathode-ray tube goes to Dr. Allen B. Du Mont. Some 12 years ago, when the few tubes used in the U. S. A. were mostly imported from Germany, he began to turn them out in a shop set up at his home. Today, the group of factories comprising Du Mont Laboratories are producing these tubes in quantities and for purposes undreamed of when he started. As first president of Television Broadcasters Association, 1944, he has been succeeded for 1945 by Jack Poppele (standing), the how-can-we-do-more-and-betterish-minded chief engineer of WOR and WBAM, and a television enthusiast who believes the quickest way to solve television's problems is to get transmission on the air.

WHAT'S NEW THIS MONTH

1. FCC Chairman Porter
2. Recorded FM Programs

1. The fact that Paul A. Porter had a very active part in President Roosevelt's election to a fourth term, and was subsequently appointed Chairman of the Federal Communications Commission would have called for no particular comment had it not been for the wide attention attracted by the appointment of another man of whom the President wrote: ". . . he displayed the utmost devotion to our cause, traveling almost incessantly and working for the success of the ticket in a great many parts of the Country."

That, of course, referred to CIO-PAC's Henry Wallace, but it also describes Mr. Porter's efforts as publicity director of the Democratic National Committee. In fact, a protest was filed against his nomination on the grounds that his appointment appeared to be a reward for his efforts in behalf of his party, a practice which is specifically forbidden by law.

However, this background will have proportions of significance only if Mr. Porter uses his office to channel other rewards to the faithful.

To whom might such rewards be given? Not, in all probability, to those who would seek to enter broadcasting as a business to make money, but rather to minority groups who would use radio to exert political controls.

Within the composite ranks of the Democratic (CIO-PAC) Party there are, undoubtedly, many such plans afoot at this time. Some may be proposed as commercial ventures. Union methods, generally unrestrained by considerations of business ethics, could certainly pry out substantial revenues from otherwise unresponsive advertisers. These would pay the operating expenses, support union officials in the manner to which they have become accustomed under the Government-sponsored check-off system, and pay for the ablest talent to produce entertaining propaganda for young people and their WPA-conditioned elders.

Other plans, less obvious but perhaps more sinister, will be built around applications for educational stations.

Nor will it be easy to refuse such applications, with FM providing an almost unlimited supply of frequencies. The obvious answer is that every listener is at liberty to choose his own programs, and

(CONCLUDED ON PAGE 71)

SYLVANIA NEWS

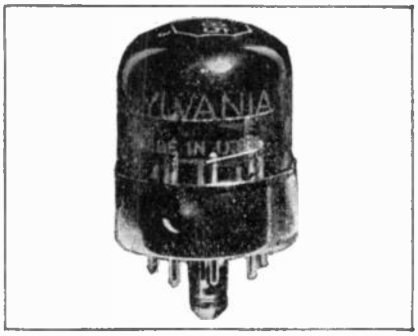
ELECTRONIC EQUIPMENT EDITION

FEBRUARY — *Published in the Interests of Better Sight and Sound* — 1945

Type 1AB5 Used as Mixer, RF Amplifier At 50Mc. and Above

Sylvania Electric's 1AB5 tube is a filament type pentode for use as a mixer or RF amplifier in circuits requiring a tube of greater mutual conductance than the 1LN5.

The 1AB5 is especially designed for operation at frequencies of 50Mc. and



higher. Its combination of characteristics results in higher effective input resistance at these frequencies.

The tube has an 8-pin base of the Lock-In type, and a Short T-9 bulb. It is designed to operate on a filament voltage of 1.2. Full technical data are available from Sylvania Electric.

DID YOU KNOW...

That new long, small diameter fluorescent lamps soon to be placed in production at Sylvania Electric will be of the instant starting type? Using no starters, they will need less maintenance.

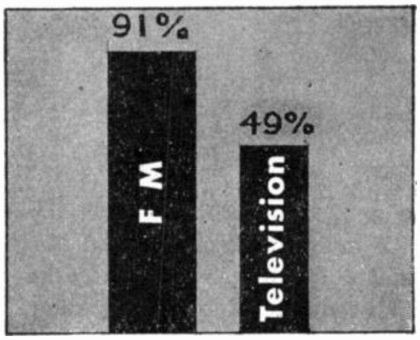
* * *

That the taking of tube characteristics by photographing an oscilloscopic trace permits the measurement of tube performance which could not otherwise be obtained? This is the method used in the Sylvania Laboratories.

Set-Owners Place FM First in Sylvania Survey of Radio Sets

91% of Consumers Interviewed Say They Want This Feature in Postwar Receivers

Preliminary reports of the nationwide survey being conducted by Sylvania Electric indicate a high degree of interest in frequency modulation. Of the thousands of set-owners who have been personally interviewed, 91% have indicated their desire to have FM incorporated in their postwar receivers.



Graph shows percentages of set-owners stating that they want FM and television in their postwar sets.

SYLVESTER SURVEY

"Would you be willing to go as high as $300 to have FM and television included in your radio set?"

70% said that they were willing to pay an additional sum in order to get this feature.

Television, while also a subject of considerable interest, ranked behind FM in the tabulation of survey results. 49% of those interviewed stated that they wanted television reception after the war. The same percentage indicated their willingness to pay extra for it.

INFLUENCE OF COST

As a guide to set manufacturers in their postwar planning, the Sylvania survey is also eliciting information on the amounts which consumers would be willing to pay in order to have FM and television. The results of this phase of the survey will be published in subsequent issues of SYLVANIA NEWS.

SURVEY CONTINUES

While the analysis of the results of personal interviews is going on, Sylvania Electric is continuing its survey, and broadening its scope, through the medium of a series of questionnaire-type advertisements appearing in leading national magazines.

The purpose of these advertisements is to gather additional information on consumer preferences and interest, not only in various types of radio and television receivers, but also in the possibility of using electronic devices in their homes.

SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC., *Radio Division,* Emporium, Pa.

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS

ADVERTISERS INDEX

ENGINEERING SALES

Arhco: J. Homer Robinson, after 15 years with National Union, has joined American Radio Hardware Company, Inc., Mt. Vernon, N. Y., as vice president and general sales manager. One of the best-known executives in the parts jobber field, he has had an active part in radio sales since 1921, when he joined de Forest.

Bendix: Has signed Walter E. Schott Appliance Company, 2320 Gilbert Avenue, Cincinnati, as distributor for the southwestern corner of Ohio, southeastern Indiana, and 10 counties in northern Kentucky. The newly-formed Pittsburgh Products Company, 407 Empire Building, Pittsburgh, headed by R. W. Evans, will distribute Bendix radio in western Pennsylvania, except in counties bordering on New York state.

RCA: Has increased the territory of McGregor's, Inc., Memphis, Tenn. distributor, to include the Little Rock area.

G.E.: Howard K. Smith, formerly in the Federal and marine divisions of the apparatus department has been appointed assistant to A. A. Brandt, general sales manager of the electronics department.

Zenith: New export sales manager is E. E. Loucks, for the past 16 years with International G.E., in charge of radio set sales.

Magnavox: Has appointed V. J. Sanborn as district sales manager for Ohio and Kentucky. His headquarters will be at 740 Superior Avenue, N.W., Cleveland.

Admiral: Has signed Fay-San Distributing Company, Buffalo, as distributors in that area, and Small & Schelosky Company, Evansville, as distributors for their section of Indiana.

Belmont: Has appointed Lewis E. Dorfman as sales representative for New York City, New Jersey, and New England. His office is at 1780 Broadway, New York City.

Zenith: Has appointed Shobe, Inc., 1095 Union Avenue, Memphis, Tenn. as distributor for western Tennessee, northeastern Arkansas, the northern half of Mississippi, and southeastern Missouri.

(CONTINUED ON PAGE 65)

EQUALIZERS by UTC

3AX . . . THE UNIVERSAL EQUALIZER FOR BROADCAST AND RECORDING SERVICE. PROVIDES ADJUSTABLE EQUALIZATION AT 25, 50, OR 100 CYCLES FOR LOW END, AND AT 4000, 6000, 8000, OR 10,000 CYCLES AT HIGH END. CALIBRATED CONTROLS READ DIRECTLY IN DB EQUALIZATION AND FREQUENCY SETTING. THE INSERTION LOSS EFFECTED BY THE EQUALIZER IS COMPENSATED THROUGH SPECIAL COMPENSATING PADS, SO THAT IT IS CONSTANT REGARDLESS OF SETTING. RAPID CHANGE IN TONE COLOR CAN BE OBTAINED WITH NEGLIGIBLE CHANGE IN VOLUME.

4C . . . AN IDEAL SOUND EFFECTS FILTER FOR BROADCAST AND RECORDING SERVICE. LOW PASS FILTER FREQUENCIES OF 100, 250, 500, 1000, 2000, 3000, 4000, AND 5000 CYCLES ARE PROVIDED. IDENTICAL HIGH PASS FILTER FREQUENCIES ARE PROVIDED. THIS UNIT EMPLOYS NOISELESS SWITCHING, AND A SUFFICIENTLY WIDE RANGE OF FREQUENCIES TO TAKE CARE OF ANY TYPE OF TONE COLOR REQUIRED.

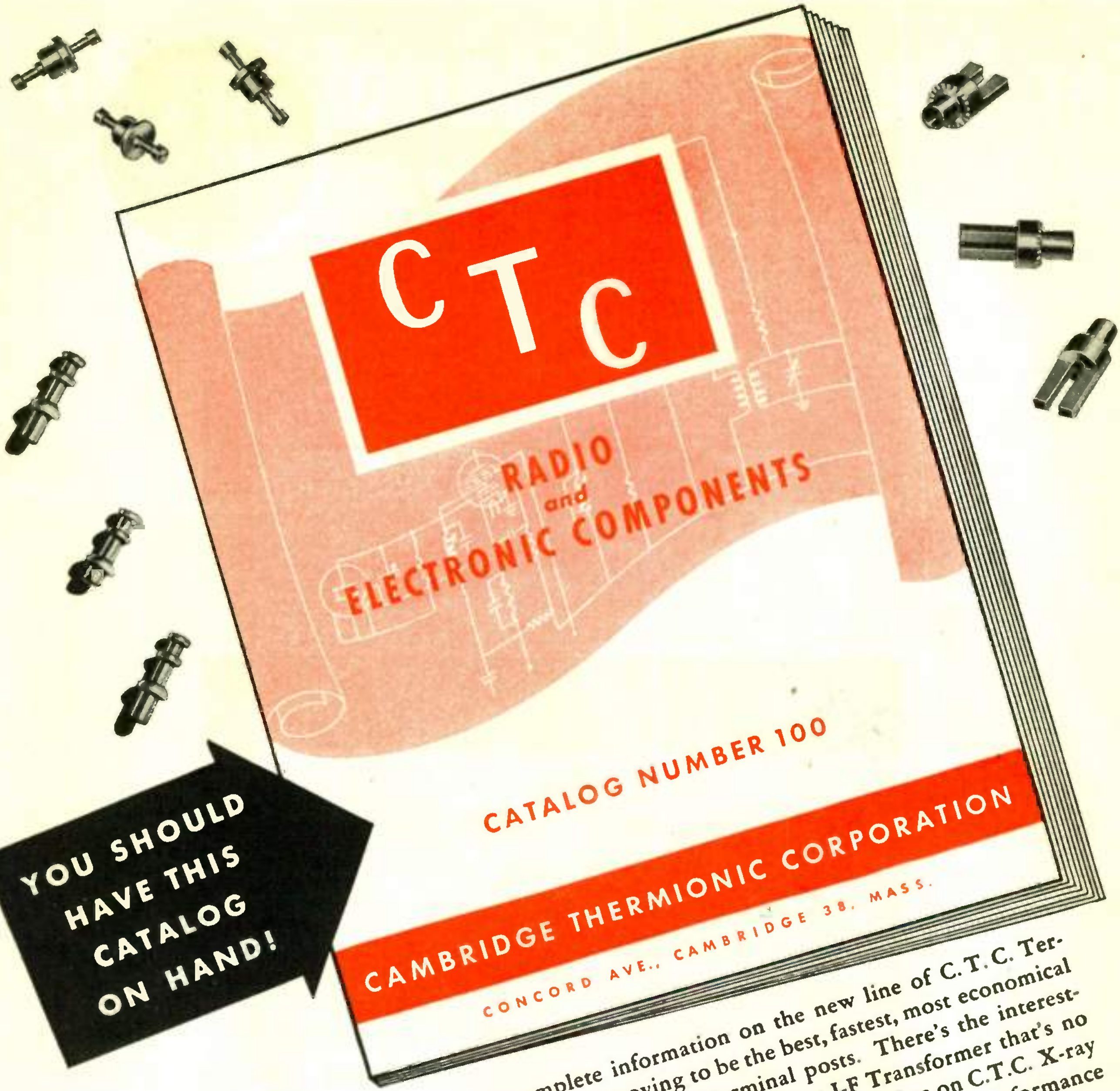
MAY WE COOPERATE WITH YOU ON DESIGN SAVINGS FOR YOUR APPLICATION . . . WAR OR POSTWAR?

ARMY E NAVY
ALL PLANTS

United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

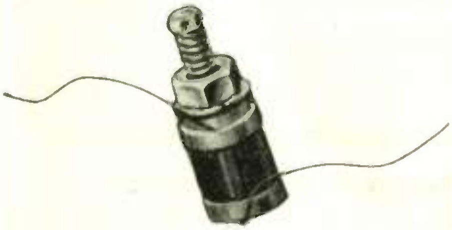
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

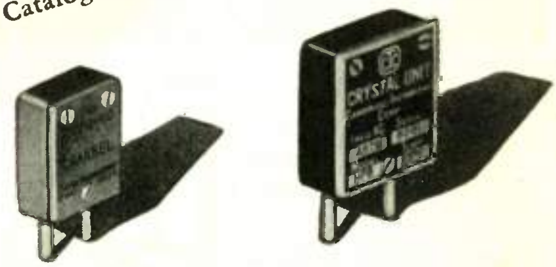


YOU SHOULD HAVE THIS CATALOG ON HAND!

It contains complete information on the new line of C.T.C. Terminal Lugs that are proving to be the best, fastest, most economical route to firm, swift soldering terminal posts. There's the interesting facts about an Ultra-High Frequency I-F Transformer that's no bigger than your thumb and complete information on C.T.C. X-ray Oriented Crystals which are setting new standards of performance and long life.

You may find the information in the Catalog very useful to you in connection with present or projected components. Write for it today. Ask for C.T.C. Catalog Number 100. No obligation, of course.





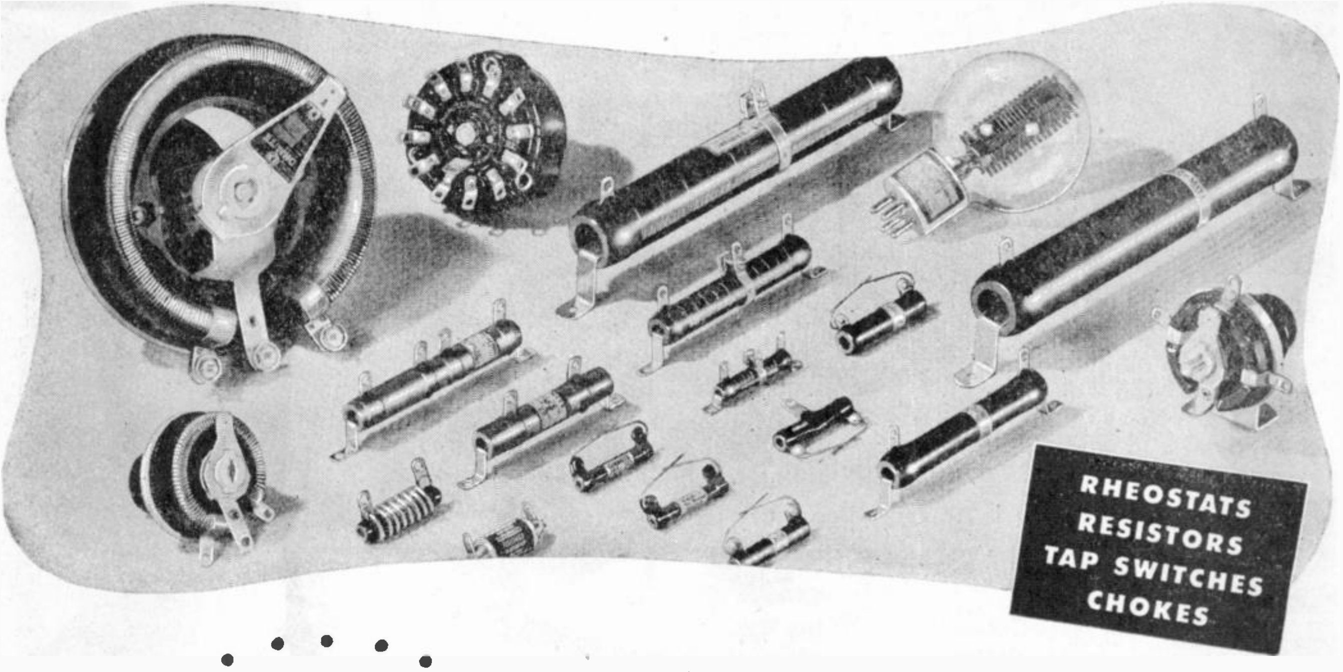
CTC

CAMBRIDGE THERMIONIC CORPORATION

443 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

OHMITE *Control* UNITS

GIVE ACCURATE, TROUBLE-FREE SERVICE



RHEOSTATS
RESISTORS
TAP SWITCHES
CHOKES

Designed and Built to Withstand

SHOCK
VIBRATION
TEMPERATURE EXTREMES
HUMIDITY
ALTITUDE

● Because they are so consistently reliable in actual service . . . Ohmite Rheostats, Resistors, Chokes and Tap Switches have become *"the control engineer's control units."*

Shown here are a few of the many types extensively used in military and industrial equipment. The wide variety of types and sizes in stock or special units provides a ready and exact answer to most applications.

In designing for war or postwar, let Ohmite experience help you.

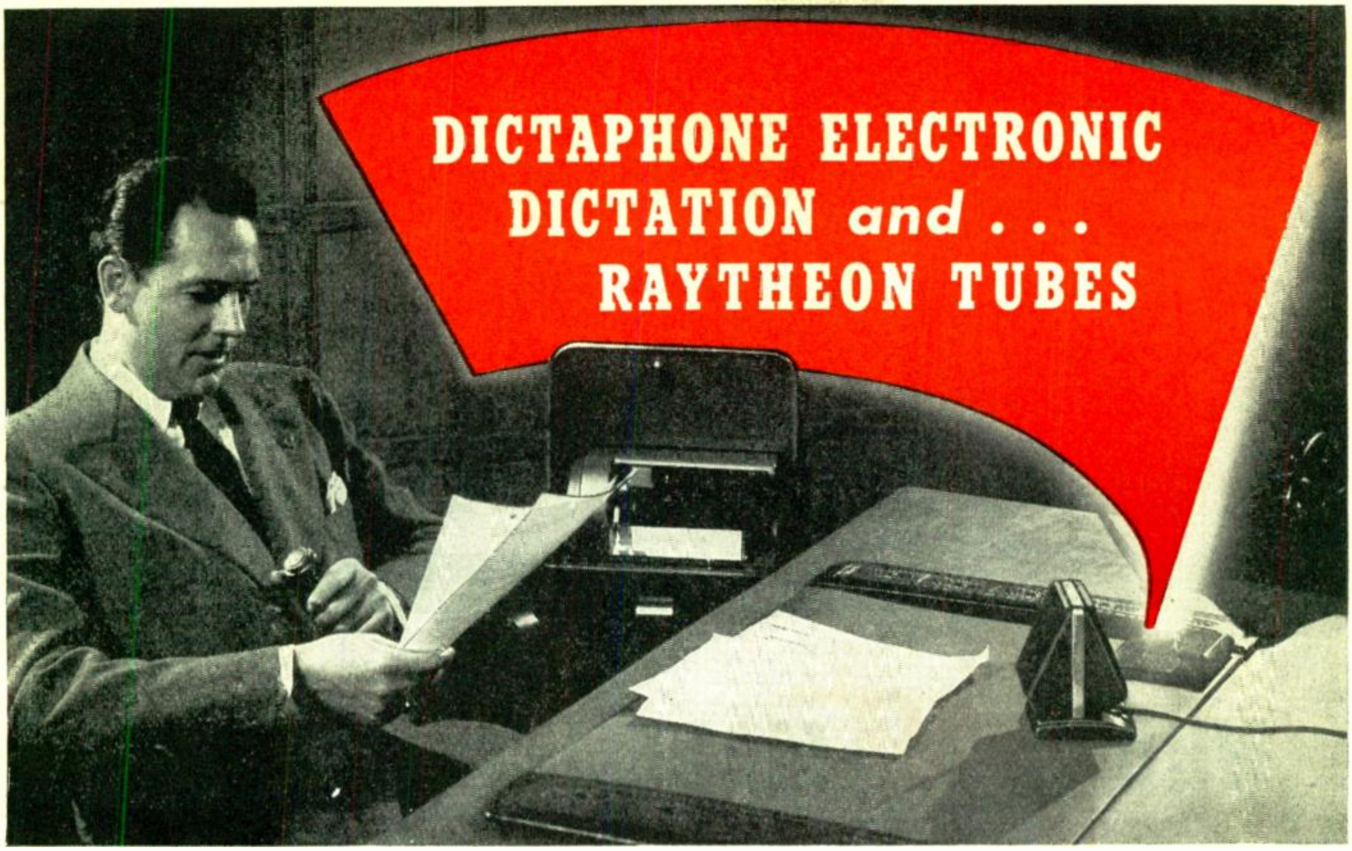
OHMITE MANUFACTURING COMPANY
4853 Flournoy Street — Chicago 44, U.S.A.

For helpful data and information, write on company letterhead for Industrial Catalog and Engineering Manual No. 40. Address Ohmite Manufacturing Co., 4853 Flournoy Street Chicago 44, Ill.

Be Right with **OHMITE**

RHEOSTATS • RESISTORS • TAP SWITCHES

DICTAPHONE ELECTRONIC DICTATION *and* . . . RAYTHEON TUBES



● If you're a radio serviceman or engineer, you'll appreciate the ingenuity and development work which produced this new Dictaphone Electronic Dictating Machine which is available for essential uses. And if you're a busy executive, as well, you'll praise it as an aid to getting things done more easily, more quickly and more conveniently. Not only does it record dictation, but over-the-desk conversations and both ends of phone-calls too!

Raytheon high-fidelity tubes used in this remarkable new machine consistently deliver clear, realistic reproduction and give long, dependable performance...just as they will in the future for this and an infinite variety of other electronic devices.

When peace comes, Raytheon tubes will be more readily available. And they'll be even finer than Raytheon's pre-war tubes, for their design and construction will have been proved by the toughest test of all—the acid test of battlefront performance. We can promise, too, if you're a serviceman or dealer, that the Raytheon tube line will be the most *beneficial* line for you to handle. After Victory it will pay you to switch to Raytheon high-fidelity tubes!

. . .

Increased turnover and profits . . . easier stock control . . . better tubes at lower inventory cost . . . These are benefits you will enjoy after the war as a result of the Raytheon standardized tube type program, which is part of our continued planning for the future.

Raytheon Manufacturing Company

RADIO RECEIVING TUBE DIVISION

Newton, Massachusetts • Los Angeles
New York • Chicago • Atlanta

Listen to
"MEET YOUR NAVY"
Every Saturday Night
ENTIRE BLUE NETWORK
Coast-to-Coast
181 Stations

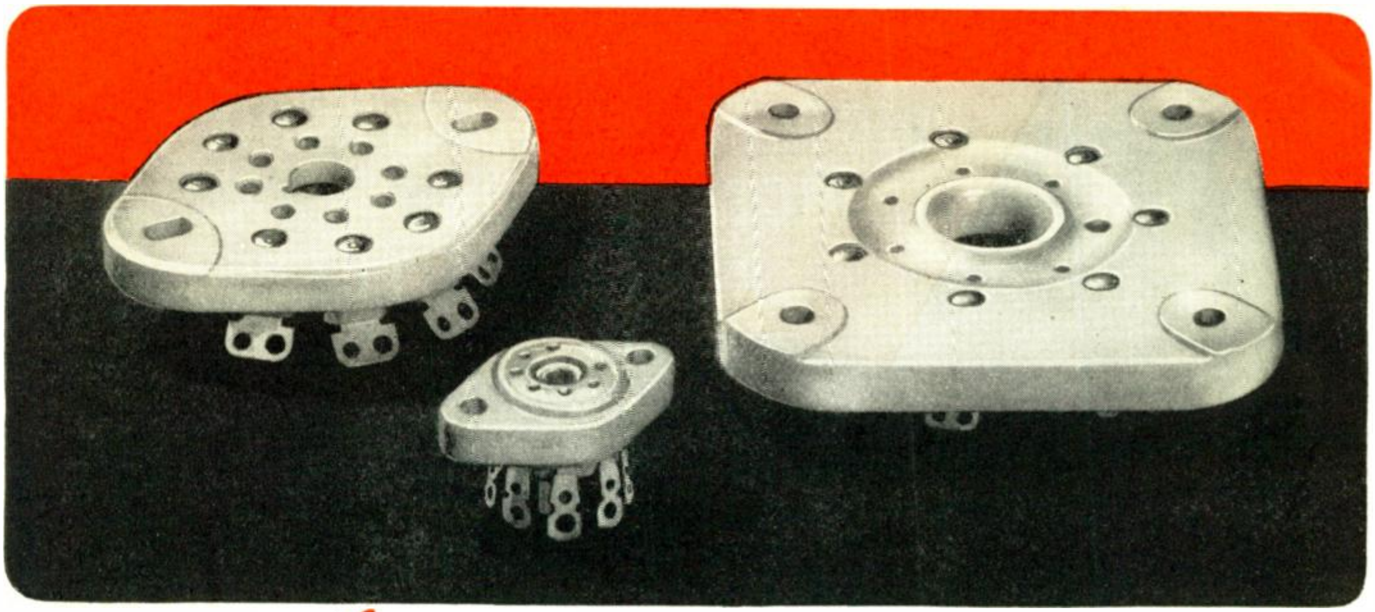
RAYTHEON

High Fidelity

ELECTRONIC AND RADIO TUBES

All Four Divisions Have Been Awarded Army-Navy "E" with Stars

DEVOTED TO RESEARCH AND MANUFACTURE OF TUBES FOR THE NEW ERA OF ELECTRONICS



More than 35 Years of Service to the RADIO INDUSTRY

AM
FM
TV

Whether Amplitude Modulation . . . Frequency Modulation . . . or Television — dependability is a *must* for all broadcast equipment.

Federal broadcast equipment has earned a reputation for that dependability because *it stands up.*

For more than thirty-five achievement-studded years . . . from the Poulsen Arc to the new CBS Television Station . . . Federal has served the broadcast industry with superior equipment.

Federal's background includes such milestones of electronic progress as the 1000 Kw Bordeaux Transmitter; Micro-ray, the forerunner of modern television technique; and the first UHF multi-channel telephone and telegraph circuits, part of a world-wide communications system . . .

All this, plus the war-sharpened techniques that are the result of ability *and* experience, combine to give you craftsmanship . . . the kind of craftsmanship that builds dependability into all Federal equipment.

In AM . . . FM . . . TV . . .

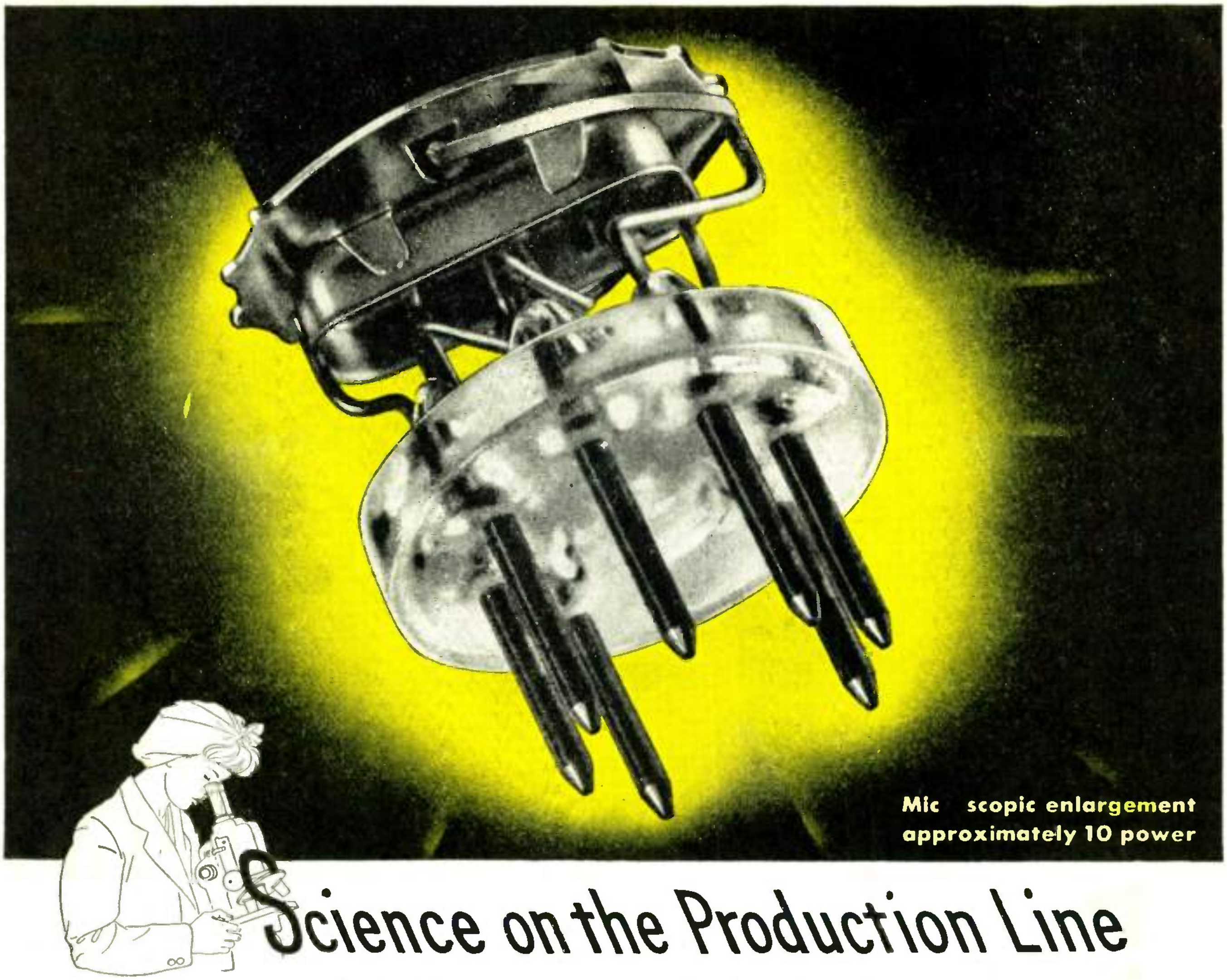
. . . your prime need in broadcast equipment is dependability — *look to Federal for it.*

FEDERAL TELEPHONE RADIO FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.



Science on the Production Line

Commonly you think of the microscope as a scientific laboratory instrument. But at National Union, these days, you will find it even more extensively used, as a *production* machine, insuring microscopic precision step by step through many processes of manufacture.

With the aid of microscopes, National Union workers accurately check almost invisibly small parts. They *see* to it that welds are sound, clearances are exact and the structure is mechanically perfect. In the photograph above for example, a N. U. 6AG5 miniature tube mount, no higher than your thumb nail is enlarged approximately 10 times, to permit minute examination of important structural factors. Enlargements up to 500 times—making a hair on your head look as tall as a tree—are just as readily obtained, when needed. Moreover, this tube, assembled from 31 individual parts, must pass 40 individual inspections, in addition to thorough examination under the microscope.

Here, again, is one of those unusual techniques developed by National Union engineers to make tube manufacture a more exact science. Such infinite care makes certain that every electronic tube which carries the National Union name will deliver a uniformly high level of performance with long service life. *Count on* National Union.

NATIONAL UNION RADIO CORPORATION, NEWARK, N. J.
Factories: Newark and Maplewood, N. J.; Lansdale and Robesonia, Pa.

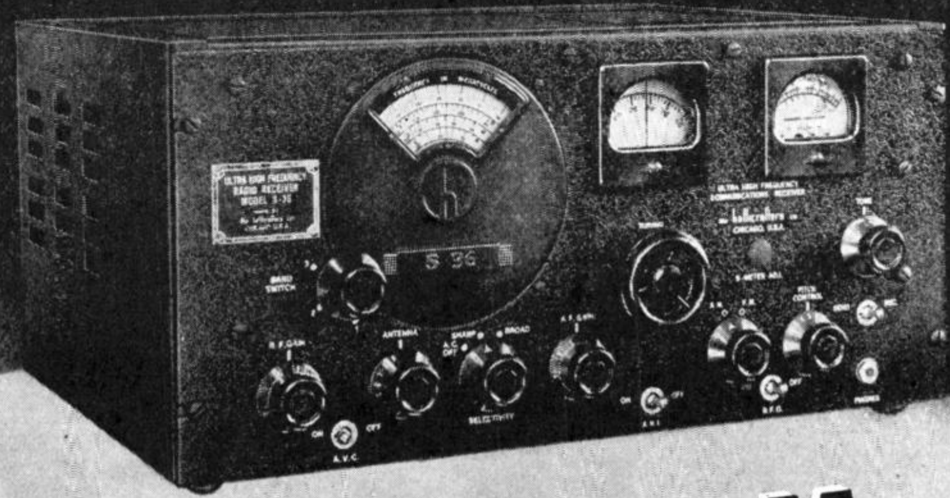
NATIONAL  UNION

RADIO AND ELECTRONIC TUBES

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs

5 YEARS AHEAD OF ITS TIME

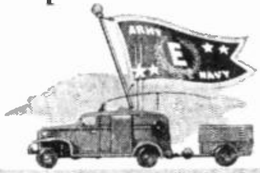
FM
AM
CW



27.8 to 143 Mc
Covers old and new FM bands

hallicrafters Model S-36

EXACTLY five years ago—in 1940—Hallicrafters introduced a very high frequency communications receiver with a range of 27.8 to 143 Mc. This model was clearly five years ahead of its time in its anticipation of new and exciting possibilities for superior performance on the higher frequencies. Today Model S-36 stands by itself as the only commercially built receiver covering this range. It is outstanding for sensitivity, stability, high fidelity. With its extraordinary VHF versatility it is ready for immediate application in the ever widening fields of FM and higher frequency development work. Engineering imagination at Hallicrafters is reaching out beyond the next five years, beyond the present known limits of radio technique so that Hallicrafter's equipment will continue to be always ahead of its time, above and beyond your best expectations.



BUY A WAR BOND TODAY!

hallicrafters RADIO

THE HALLICRAFTERS COMPANY, MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

FINAL DECISION ON FM FREQUENCIES

We Don't Want a Successful Operation and a Dead Patient on Our Hands

WHATEVER difference of opinion exists between those who would move FM broadcasting to 84–102 mc. and those who want the band to start below 50 mc., all agree that if production of FM transmitters and receivers cannot be started as soon as military contracts are cut back, there will be a period of reduced employment that will seriously endanger an industry of great importance to national recovery.

Opinion on FM Frequencies ★ The RTPB Panel on FM, comprised largely of engineers who have had some 4 years' experience or more with civilian and military FM equipment, recommended to the FCC that the postwar FM band start below 50 mc., and include 80 to 100 channels 200 kc. wide.

Conspicuous by his absence from the FM Panel was Comdr. Paul deMars, an engineer who is qualified as an expert on propagation by his research at Tufts College, and as an expert on FM broadcasting by his experience as former chief engineer of the Yankee Network. Although he is understood to concur with the opinion expressed by the FM Panel, he was not permitted by the Navy Department to testify at the Allocations Hearing.

With the weight of best-informed opinion against a radical change, it was surprising that the FCC disregarded the practical aspects of the frequency problem, and proposed a shift to 84–102 mc. on the strength of theoretical interpretations of propagation data presented by Kenneth A. Norton, a former FCC engineer.

If FM Stays Down ★ All FM planning has been predicated on the assumption that the postwar band would start below 50 mc., and would be extended to a width of about 20 mc. Both transmitters and receivers, representing substantial improvements over prewar models, have been designed, field-tested, and can be put into production as soon as authority is granted by the WPB.

The service rendered by FM broadcasting during the war, limited as it has been in hours and tone fidelity, has created enthusiasts numbered in the millions. Publicity on Frequency Modulation, particularly in recent months, has whetted the interest of people in areas where there is no FM service yet. Dealers, remembering the greater profits on FM-AM sets as compared to cheap AM models, are ready to concentrate their sales efforts on FM types.

Where there are FM stations already, dealers will have an immediate market. Where there is no FM service now, dealers will sell sets in advance of the erection of stations, thus assuring an audience before new FM stations start. There will be no chicken-or-egg situation.

Of course, sets now in use will not cover the extended FM band, but they will continue to deliver reception from stations below 50 mc., thus easing transition to the new tuning range. This will avoid breaking up the audiences which, at great expense, FM stations have maintained during the war.

Since each new FM transmitter put on the air will create a demand for thousands of receivers, manufacturers will have markets for FM-AM sets as fast as cutbacks on military contracts permit them to step up production of civilian equipment. In that way, employment can be maintained at maximum level.

If FM Goes Up ★ A radical change in the FM band will introduce several aspects of the chicken-or-egg stalemate. As Dr. Ray Manson of Stromberg-Carlson has pointed out, problems involved in meeting the new conditions cannot be met simultaneously, but must progress in a series of stages. In other words:

High-power tubes for the 84-102-mc. band have not been developed at this time. That work must be completed and production samples must be available before transmitters can be designed. When the first models are ready, they must be put through exhaustive tests which, invariably, disclose the need for revisions. Past experience shows that new types of transmitters cannot be put into commercial operation without extensive tests and alterations. Until installations have been made under various typical conditions, at least 6 months must be allowed from the time equipment is delivered until regular transmission can start. There is already a background of experience with transmitters for the lower frequencies, but that will be of no value at 84–102 mc.

Final determination of receiver design and performance, prior to release for production, cannot be made in the laboratory. Actual field testing is required. That is true of conventional AM models. It is doubly true of sets which must work on new frequencies, under undetermined receiving conditions. Therefore, receiver production cannot start until sometime after there are transmitters on the air.

There is little in this situation to encourage broadcasters. They will ask: "Are we expected to erect and program transmitters for some indefinite length of time while set manufacturers perfect receiver designs? Who will pay the operating costs during that period?"

This, briefly, is the chicken-or-egg headache which will confront the industry if the FCC does not alter its plan of moving FM to an entirely new spot in the radio spectrum. As for the resulting delay and the dislocation of the industry at a time when it needs to have every factor in its favor — it doesn't take much understanding of the prewar conditions to see that manufacturers will be forced to fall back into the old scramble to sell cheap AM sets, and that sales volume and wages will quickly drop to 1939 levels.

The Final Decision ★ What is wrong with the lower frequencies for FM? Listeners have not complained about bursts or reflections, or any such interference. The broadcasters and set manufacturers are satisfied to have the widened FM band start below 50 mc.

Former FCC chairman Fly, speaking at the Television Press Club on February 6th, said of FM frequencies: "Around the 40's we were worried about certain conditions (of propagation), and it may well be that if we knew more about the 90's we would have greater worries up there."

Dr. Dellinger, propagation expert of the Bureau of Standards, found no fault with the lower frequencies and no assurance anything would be gained by an upward shift. He told the FM Panel of RTPB that vagaries are encountered at all frequencies.

Mr. Norton did not claim to have heard interference with FM reception on the present band. He is only apprehensive about the interference which, according to his interpretations of propagation data, listeners should hear, even if they don't.

With all his fine enthusiasm for shifting the FM band, he is not prepared to promise that serious propagation troubles will not be encountered that are not present in the lower band. But even if that is not the case, we might still have a situation where the operation was successful, but the patient died.

VHF TETRODE FOR MEDIUM OUTPUT POWER

Two Type 4-125A Tubes in Conventional Push-Pull Circuit Deliver up to 750 Watts at 120 Mc.

BY CLAYTON E. MURDOCK*

FURTHER progress in the development of tubes capable of delivering more power at higher frequencies is indicated by the new Eimac 4-125A. A development of the Eitel-McCullough laboratory design group, this tube is a medium-power transmitting tetrode, incorporating design features which allow operation well into the VHF region.

For example, a pair of these tubes in a conventional push-pull arrangement is capable of delivering as much as 750 watts output at frequencies as high as 120 mc. The driving power requirements are low enough to permit great simplification of the driver design. Less than 5 watts of total driving power will satisfy the requirements of two 4-125A's under maximum output conditions.

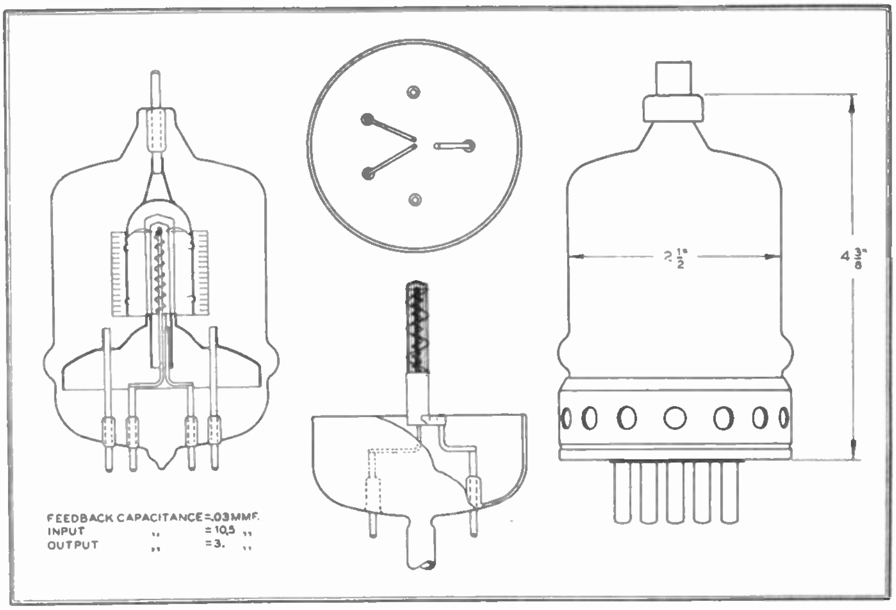


FIG. 1. MECHANICAL DESIGN DETAILS OF THE TYPE 4-125A POWER TUBE

Design Characteristics ★ Through careful design, it has been possible to keep the interelectrode capacitances of the 4-125A to rather low values for a tube having such substantial power capabilities. The plate-to-grid capacitance is 0.03 mmf., while the input and output capacitances measure 10.5 mmf. and 3.0 mmf. respectively.

Lead inductance has been kept to a minimum in the 4-125A through the use of a dish-type stem and short, heavy leads, as shown in Fig. 1. To aid in holding the screen grid at ground RF potential, two screen leads have been provided.

Physically, the 4-125A is a rather small tube, the seated height being only 4⅜ ins. by 2½ ins. in diameter as Fig. 1 shows.

The combination of low interelectrode capacitance, low lead inductance, and small physical size allows the tube to operate without neutralization and with full output at frequencies as high as 100 mc. Above this frequency, a slight amount of neutralization is required, but full power output can be obtained up to 120 mc. Even at 160 mc., it is possible to realize an output of 250 watts per tube. The ultimate capabilities of the tube at frequencies above 160 mc. have not been fully investigated at this time, but preliminary tests have shown an output of 175 watts per tube at 215 mc.

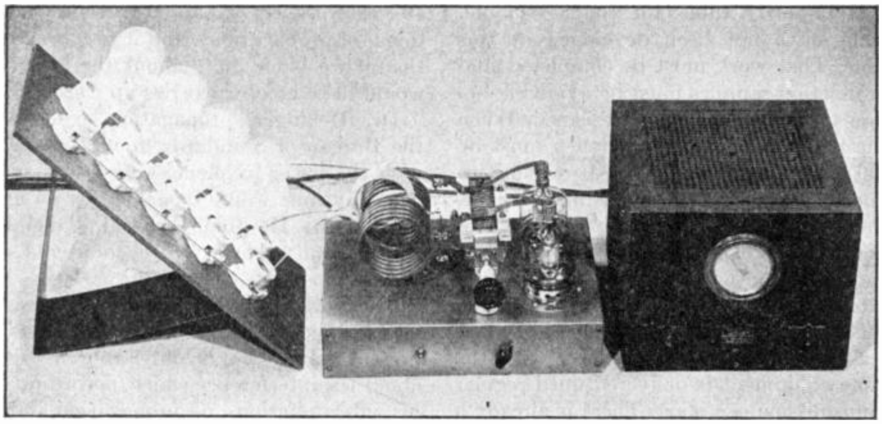


FIG. 3. USE OF MEISSNER SIGNAL SHIFTER AS EXCITER FOR THIS 750-WATT, 14-MC. TEST UNIT SHOWS LOW DRIVING POWER REQUIREMENTS OF 4-125A

The 4-125A has been constructed in a manner which permits the elimination of all internal insulators. The 32-watt thoriated tungsten filament, tantalum control grid, and tantalum screen grid are supported by their leads from a dish-type stem. The plate, which is also of tantalum, is supported by a single lead from the top of the envelope. A large shield structure, which serves to join the screen grid to its supporting leads, separates the tube into two sections. Below this shield are those parts of the tube associated with the input circuit, while the output circuit is concentrated in the space above the shield.

This shielding feature is carried into the external structure of the tube by allowing the metallic base shell to extend up to a point opposite the internal shield. When the base shell is grounded, the shielding between input and output circuits is nearly complete.

Operating Characteristics ★ Fig. 2 shows the constant-current characteristics of the 4-125A. Applications of the tube are illustrated by two typical RF amplifier test units which were constructed in connection with the development of the tube. One amplifier unit, Fig. 3, which served

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for several relatively low frequency tests at 14 mc., was completely contained in a cabinet measuring 15 by 11 by 9 ins. This unit, which employed two tubes, was easily capable of handling an input power of 1000 watts at a plate efficiency of 75%. On several occasions, the low driving power requirements of the 4-125A were illustrated by driving the 14-mc. amplifier utilizing linear grid and plate tank circuits was employed. This is illustrated in Fig. 4. There were no significant differences between the operation of the tubes at 14 mc. and 100 mc. The driving power at 100 mc. was found to be less than 5 watts per pair of 4-125A's, and there was no difficulty in obtaining a plate circuit efficiency of 75%.

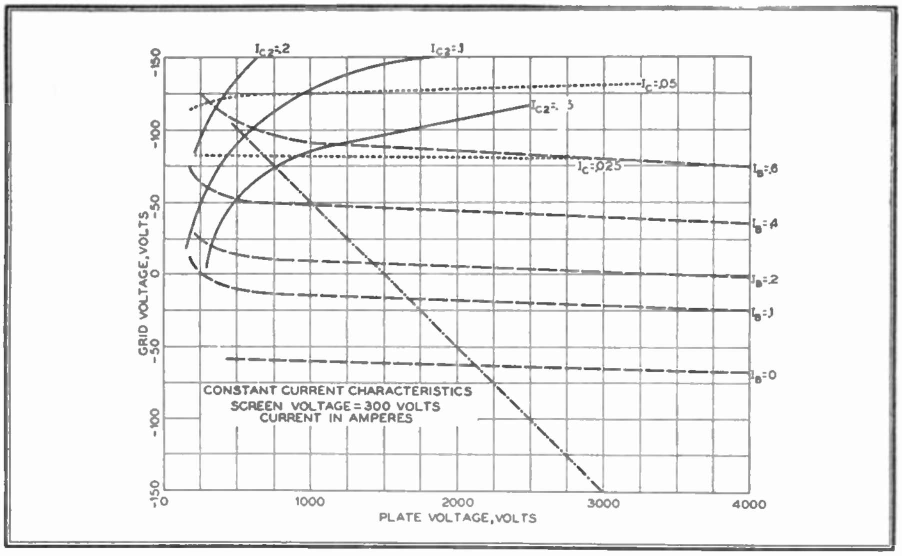

FIG. 2. CURVES SHOWING CONSTANT CURRENT CHARACTERISTICS OF THE 4-125A

to its full rated 1000 watts input by means of a standard Meissner signal shifter. The signal shifter consists merely of an oscillator-doubler unit, with a 6L6 as the output-doubler stage.

For tests at 100 mc. and above, a unit

It is expected that the 4-125A will find wide application in television and FM equipment operating in the VHF range, as well as in conventional apparatus on lower frequencies. Thus tube research and development are advancing steadily toward the goal of providing adequate power as higher frequencies come into use.

EIMAC 4-125A CHARACTERISTICS

Filament	Thoriated Tungsten
Voltage	5.0 volts
Current	6.3 amps.

Direct Interelectrode Capacitances, Av.

Grid-Plate, without shielding, base shell grounded	.03 mmf
Input	10.5 mmf.
Output	3.0 mmf.

RF Power Amplifier & Oscillator Class C Telegraphy

Typical Operation, 1 Tube

DC Plate Voltage	2000	3000 volts
DC Plate Current	200	167 milliamps.
DC Screen Voltage	350	350 volts
DC Screen Current	25	50 milliamps.
DC Grid Voltage	−150	−150 volts
DC Grid Current	8	8 milliamps.
Plate Power Output	300	375 watts
Plate Power Input	400	500 watts
Plate Dissipation	100	125 watts
Peak RF Grid Input Voltage	260	270 volts
Driving Power, approx.	2	2.1 watts
Power Gain, approx.	150	178

Maximum Ratings

DC Plate Voltage	3000 volts
DC Plate Current	225 milliamps.
DC Screen Voltage	400 volts
Plate Dissipation	125 watts
Peak RF Grid Input Voltage	500 volts

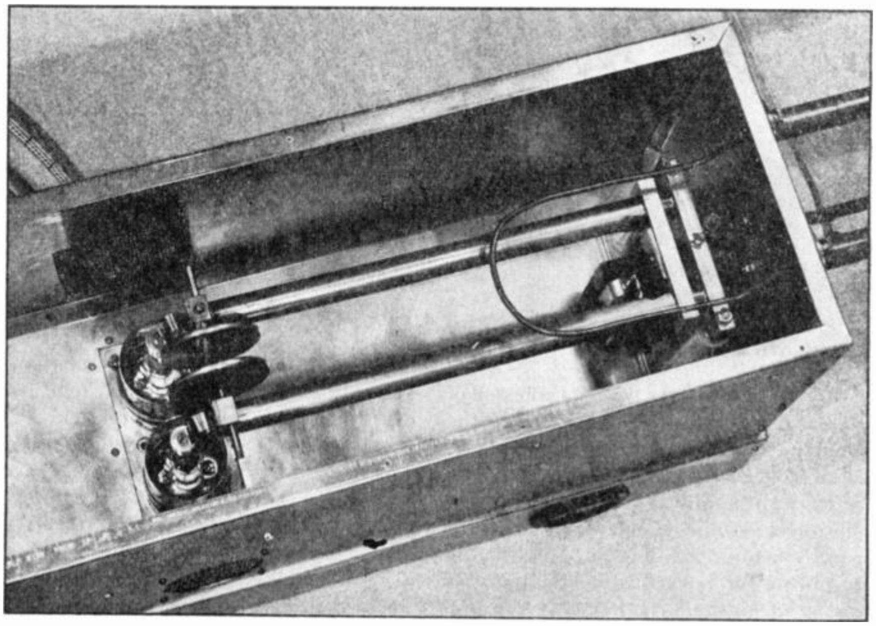

FIG. 4. NO NEUTRALIZING CIRCUIT IS REQUIRED TO OBTAIN 750 WATTS OUTPUT FROM THIS 100-MC. TEST AMPLIFIER USING TWO 4-125A TUBES

FM FOR FIRE DEPARTMENT

The Boston Fire Department, which has used an AM radio system for many years to communicate with its fire boats, now has a modern FM installation that includes 33 two-way installations on cars and fire-fighting units.

The system is operated from Fire Alarm Headquarters in the Fenway, but the transmitter is installed on the Suffolk County Court House, giving the antenna an elevation of 420 ft. above sea level. Call letters are WEY, and the frequency assigned to the system is 37.74 mc.

Installations on fire department units include the three fire boats operating in Boston harbor and the cars of the district and deputy fire chiefs. Equipment was supplied by the Galvin Manufacturing Corporation.

Although the system has been in operation only a few months, experience has already shown two-way radio is of great usefulness in checking correct fire locations quickly, reporting the need for more or less fire equipment, and in keeping Fire Alarm Headquarters in direct contact with the deputy or district chief at the scene of the fire.

The success of this installation has confirmed the wisdom of the FCC in making it possible for fire departments to operate radio systems independently of police radio. Superintendent A. L. O'Banion of the Boston Fire Alarm Division has already declared that "Two-way radio has increased the efficiency of our Fire Department tremendously, and to be without it is unthinkable."

SPOT NEWS NOTES

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

FM Frequencies: Well-informed opinion is predicting the following frequency assignments when allocations are settled:

44–46 mc.	Amateurs
46–64	FM (ed. and comm.)
64–70	Unassigned
70–76	Television Band No. 1
76–78	Amateurs
78–84	Television Band No. 2

Navy Radio Research: Prior to 1942, the Naval Research Laboratory was operated on a fund of $300,000 to cover salaries of scientific personnel and project material. The fund for this purpose in the fiscal year of 1945 is $8,855,000.

FM for Bus Line: C.P. has been granted W. V. and M. Coach Company, Arlington, Va. for a 250-watt FM station and five 30-watt units for service trucks. System will enable dispatcher to expedite repairs and removal of inoperative buses stalled in heavy traffic. System will operate on 39.86 mc.

Lt. Comdr. Paul A. deMars: Has become associated with the consulting firm of Raymond M. Wilmotte, 1469 Church Street,

JOINS WILMOTTE CONSULTING FIRM

N.W., Washington, D. C. As Professor of Electrical Engineering and head of the Department of Electrical Engineering at Tufts College, Commander deMars initiated a program of research covering ionosphere studies and field intensity measurements, and developed automatic equipment for recording field intensities ranging up to the VHF band.

As vice president and chief engineer of Yankee Network, he had charge of the design and construction of the first 50-kw. FM station, WGTR Paxton, the first mountain peak FM station, WMTW Mt. Washington, and the first ST link, operating from Boston to Paxton. He is a graduate of M.I.T., '17.

Raymond Wilmotte, consultant in broadcast and communications engineering, is known particularly for his original work in the use of directional antennas to provide mutual protection for broadcast stations on the same frequency. His work in this field goes back to 1931, when he built the first of such antenna installations at WFLA.

New activities of this firm will include engineering service covering all aspects of FM, AM, and television broadcasting from the initial surveys to the design of stations from studio to antenna.

Lt. Col. Robert L. Coe: Is back at KSD, St. Louis and will now have charge of engineering services on television, FM, and facsimile. At the time of his retirement from the Army, Colonel Coe was deputy chief of staff of the Army's Troop Carrier Command.

4 Major Nets: Upped time sales in 1944 to $126,330,491 (before deducting agency commissions). This is more than double 1939, and 21% above 1943. Network affiliated stations now total: Mutual 244, Blue 194, CBS 143, NBC 149.

I.R.E. Building Fund: Half-million dollars will be raised by the Institute of Radio Engineers to provide new permanent quarters. Enthusiasm of members and the industry for this project promises to assure its success. Chairman of Building Committee is Dr. B. E. Shackelford, 55 West 42nd Street, New York 18.

Horse Meat?: Asks *The New York Times:* "Upon what meat doth this, our (Little) Caesar, feed that he is grown so great?" Broadcasters should know the answer to that one!

Radio Club of America: The oldest radio organization in continuous existence, re-elected for the 1945 term president F. A. Klingenschmitt, vice president O. James Morelock, treasurer Joseph Stantley, corresponding secretary M. B. Sleeper. Offices of the Radio Club are at 11 West 42nd Street, New York City.

Television Stations: Construction permit for a new experimental television station at Arlington, Va. has been issued to Philco, to be used as the Washington end of the Philadelphia-Washington relay system.

Allen B. DuMont Laboratories have been issued a construction permit, reinstated, for an experimental television station to be installed at Hotel Harrington Washington, D. C.

Another construction permit had been issued to P. R. Mallory for an experimental television station at Indianapolis.

Frequencies are to be assigned by the FCC. Applicants were notified that these grants are not to be construed as a commitment by the FCC for approval of commercial operation.

Capt. J. B. Dow: Appointed Director of U. S. Navy's newly created Electronics division, Bureau of Ships, which supersedes the Radio Division. Personnel under Capt. Dow now totals 1200. Volume of Navy's radio, radar, and sonar equipment deliveries rose from $4 million per month in 1941 to more than $100 million per month in 1944.

Thomas A. White: Who joined the Jensen Radio Manufacturing Company as sales

NEW PRESIDENT OF JENSEN COMPANY

manager in 1928 has been made president and general manager. He takes the place of W. E. Maxon, who retired recently at his own request. He has had a financial interest in the Jensen Company from the start. In 1940 he was made vice president in charge of sales and advertising, and has contributed much to the Company's growth and development. Tom White is a graduate of the University of Minnesota, College of Electrical Engineering '29, and a vice president of R.M.A.

Handie-Talkies: Were used at the Rose Bowl game, with great effectiveness, to speed the movement of 32,000 automobiles. Pasadena Police Chief Neil F. Anderson, from a vantage point in the press box

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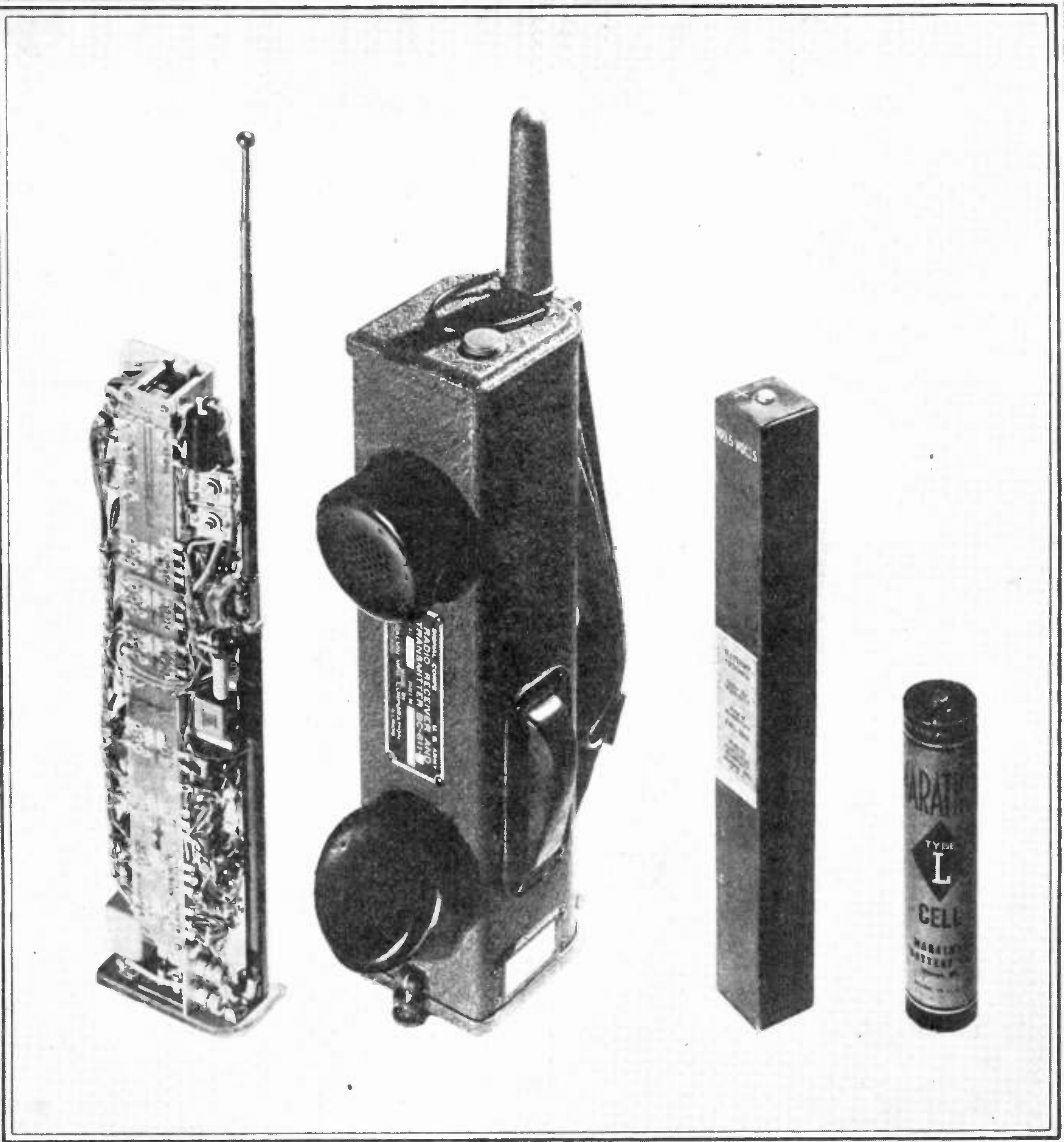


NEWS PICTURE

MOST intriguing of the FCC's frequency allocations is provision for a Citizens Radio-communications Service on 460 to 470 mc. This plan is based on the successful use of the handie-talkie, an innovation in radio equipment conceived by Donald H. Mitchell, Galvin's director of engineering.

If, as expected, the price can be brought down to a popular level, CRS versions of the Army's type SCR-536 may rival prewar portables in volume of sales because there are so many possible uses for 2-way radio communications in such convenient form.

The present design, operating at much lower frequencies, weighs just over 5 lbs., including the batteries shown above. Standard cells have an average life of $12\frac{1}{2}$ hours when used for both transmitting and receiving, or 50 to 60 hours for receiving only. Considering that, in portable service, the actual operating time would be limited to brief intervals, battery cost seems quite reasonable.

No doubt a vibrator power supply will be available to replace batteries for use in cars or at camps, and an AC supply for homes, offices, and farms.

All kinds of modifications of the walkie-talkie to adapt it to many, varied peacetime applications are expected.

15,000 CYCLES FOR ALL NETWORKS

An Explanation of the Network Map Included with This Month's Issue

IN MOST AREAS, high-quality FM programs are now remembered along with such prewar luxuries as tapioca pudding, golf balls, and silk neckties. One of these days, though, the FCC will reinstate its rule requiring a minimum number of hours of standard-quality transmission. It is quite probable that, eventually, all FM programs will have to be transmitted on full 15,000-cycle fidelity.

15,000-Cycle Programs ★ There has been much serious discussion of this situation among broadcasters already. Affiliation with networks using the present 5,000-cycle lines will be of no advantage to independent FM stations when they are called upon to transmit full FM fidelity. They will be limited to the use of high-quality transscriptions, assuming they are available, and to live talent shows. The former will serve a useful purpose, but they will not suffice as the only source of programs. The latter, if they employ talent good enough to compete with network programs, will be far too expensive.

The plight of the AM network stations which operate FM transmitters will be no better. While they can transmit local originations on high-fidelity, separate programs will be required on FM during network hours. That will put their AM and FM transmitters into competition, and cut the network audience.

Moreover, a nation-wide postwar FM audience will soon demand the transmission of popular network programs with real FM quality. Since the abandonment of the American Network's plan to set up a high-quality radio relay network, the only facility available is the telephone system.

Thus, broadcasters are confronted with the necessity of 1) using a separate FM network capable of delivering 15,000 cycles or 2) abandoning the present 5,000-cycle system and using 15,000-cycle lines to serve both FM and AM transmitters.

Very little figuring is required to show that the cost of operating a 15,000-cycle network for FM stations, paralleling the 5,000-cycle lines now in use for AM, would be prohibitive, particularly in the immediate postwar period. Stations operating both AM and FM transmitters will charge no more than their established rates for AM time, and new stations operating only on FM will be limited to low rates until they can build audiences.

Still, we must have programs which will utilize the full audio capabilities of Frequency Modulation. Otherwise, listeners will not have the extra enjoyment, nor advertisers the extra impact of FM's realism.

15,000-Cycle Networks ★ The impression has prevailed in many quarters that A. T. & T. has been indifferent to the idea of supplying 15,000-cycle lines, and that, if such facilities were available, the cost would be prohibitively high. Still, the ideal way to meet postwar requirements seems to be through the use of 15,000-cycle networks for both FM and AM stations. This would certainly provide full quality to FM transmitters, and the higher frequencies could be cut off at AM transmitters with simple filters.

> ### THIS MONTH'S SUPPLEMENT
>
> **THE map which accompanies this issue, prepared at the request of FM AND TELEVISION by the American Telephone & Telegraph Company, shows lines which are now carrying frequencies of 15,000 cycles or higher for telephone purposes. As soon as suitable terminal equipment is available, these lines can be used for FM radio program networks.**
>
> **Since the FCC will undoubtedly require that the full audio capabilities of FM be made available to listeners, plans must be initiated in the near future to furnish high-fidelity programs to independent FM stations and to those operated in conjunction with AM stations.**
>
> ***FM* AND TELEVISION offers this map in support of the proposition that lines will be available when needed for 15,000-cycle networks, and that the most practical and least expensive method of operation will be to use such nets for programming both AM and FM stations.**

Not satisfied to merely speculate on this possibility, *FM* AND TELEVISION asked the American Telephone & Telegraph Company about it.

From Walter M. Reynolds, A. T. & T. information manager at 195 Broadway, New York City, we learned that frequencies of 15,000 cycles and even higher are being transmitted right now, for regular message telephone purposes, over lines which constitute a nation-wide network.

The A. T. & T. Company stated that: "With facilities now available and in prospect, the Telephone Companies have a wide degree of flexibility in meeting future requirements for FM broadcasting stations. There is, first of all, the possibility of networks of the type commonly used for standard broadcasting, transmitting a band of about 5,000 cycles. There is a broader-band system, transmitting about 8,000 cycles, which has been a standard offering of the Telephone Companies for about 10 years, but which, so far, has received little use.[1] The facilities already in the telephone plant, and the adaptation of broad-band multiplex systems, make it possible for the Telephone Companies, on reasonable notice, to provide networks of this sort.

"There is also the 15,000-cycle type of circuit which has already been designed for routes transmitting 12-channel groups of telephone circuits, and which can be readily adapted for transmitting over other types of telephone circuits. The situation may be summed up by saying we believe we are already in a position, when war restrictions are relaxed, to give the FM broadcasters nation-wide networks meeting any transmission requirements which they select as desirable."

That is information of great significance to broadcasters. But we wanted to present it in a form that broadcasters could use as a basis for definite postwar planning. So we asked them to draw a map that would show as many as possible of the cities connected by existing lines capable of carrying 15,000 cycles.

Existing 15,000-Cycle Lines ★ Accordingly, with the coöperation of the American Telephone & Telegraph Company, *FM* AND TELEVISION presents, as a supplement to this month's issue, an official map of the intercity routes over which the Telephone Companies have been providing frequencies of 15,000 cycles or more for telephone purposes. Such lines can be used for 15,000-cycle program transmission if they are required, by adding suitable terminal equipment.

Presumably, the cost would be higher

(CONCLUDED ON PAGE 68)

[1] This is hardly surprising because if AM stations transmitted 8,000 cycles and receivers had corresponding audio characteristics, the response to background noise would be so strong that listeners would cut off the higher frequencies with their tone controls. Hence there is no useful purpose served by carrying more than 5,000 cycles on program networks for AM stations. However, under the performance standards established by the FCC for FM broadcast stations, 15,000-cycle quality, free from background noise, can be obtained from a well-designed FM receiver operated within the service area of an FM broadcast transmitter. — *Editor's Note.*

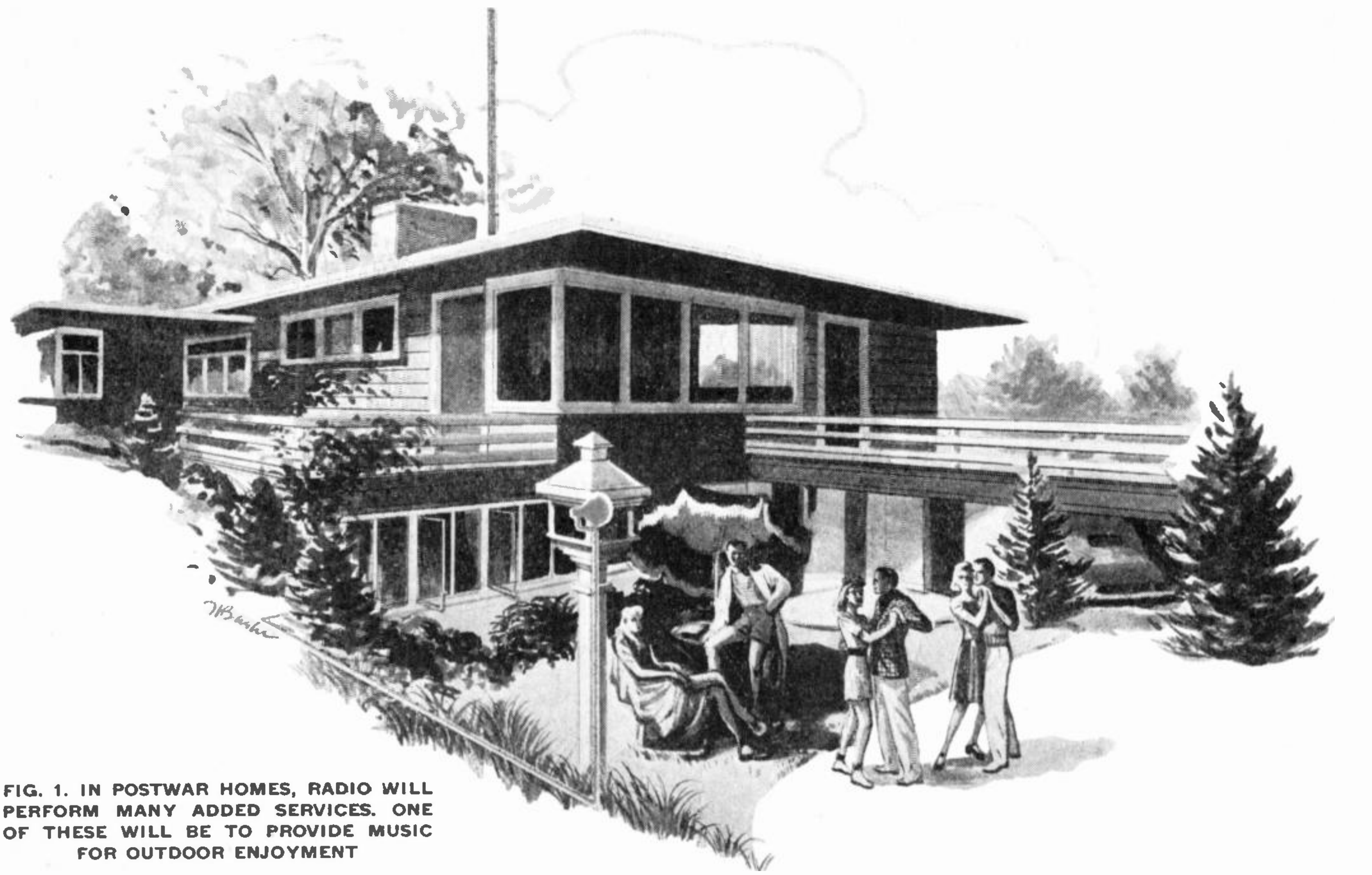


FIG. 1. IN POSTWAR HOMES, RADIO WILL PERFORM MANY ADDED SERVICES. ONE OF THESE WILL BE TO PROVIDE MUSIC FOR OUTDOOR ENJOYMENT

BETTER WAYS TO MEET LISTENERS' NEEDS

Part 1 — A Study of Prewar Radio Sets and of Postwar Design Requirements

BY MILTON B. SLEEPER

BY THE time civilian radio sets can be produced again, both manufacturers and listeners will have a three-year perspective on prewar home radio equipment, together with a fund of accumulated ideas that are bound to bring fundamental changes in old designs that we see now were inadequate in many respects.

New Angles ★ Our Army and Navy have not hesitated to discard their conventions and traditions when they have been offered improved methods or equipment. No one knows that better than the radio manufacturers. After the war, men and women from all branches of the Armed Forces, conditioned to a high degree of mental agility and critical seeking for better means, are going to expect home radio sets to be decidedly improved over what they left behind them!

A year ago, *FM* AND TELEVISION initiated a study of 1) prewar set designs and their limitations, 2) requirements of new services which will be available after the war, 3) methods for adapting the equipment to the styles and dimensions of modern homes, and 4) above all, provisions for the convenience of those we expect to buy and use the instruments.

This study, which we believe represents some of the best thinking of architects, decorators, and radio engineers, will present, in full detail, three different home radio installations:

1. An installation planned to include all radio services and conveniences without limitation as to cost.

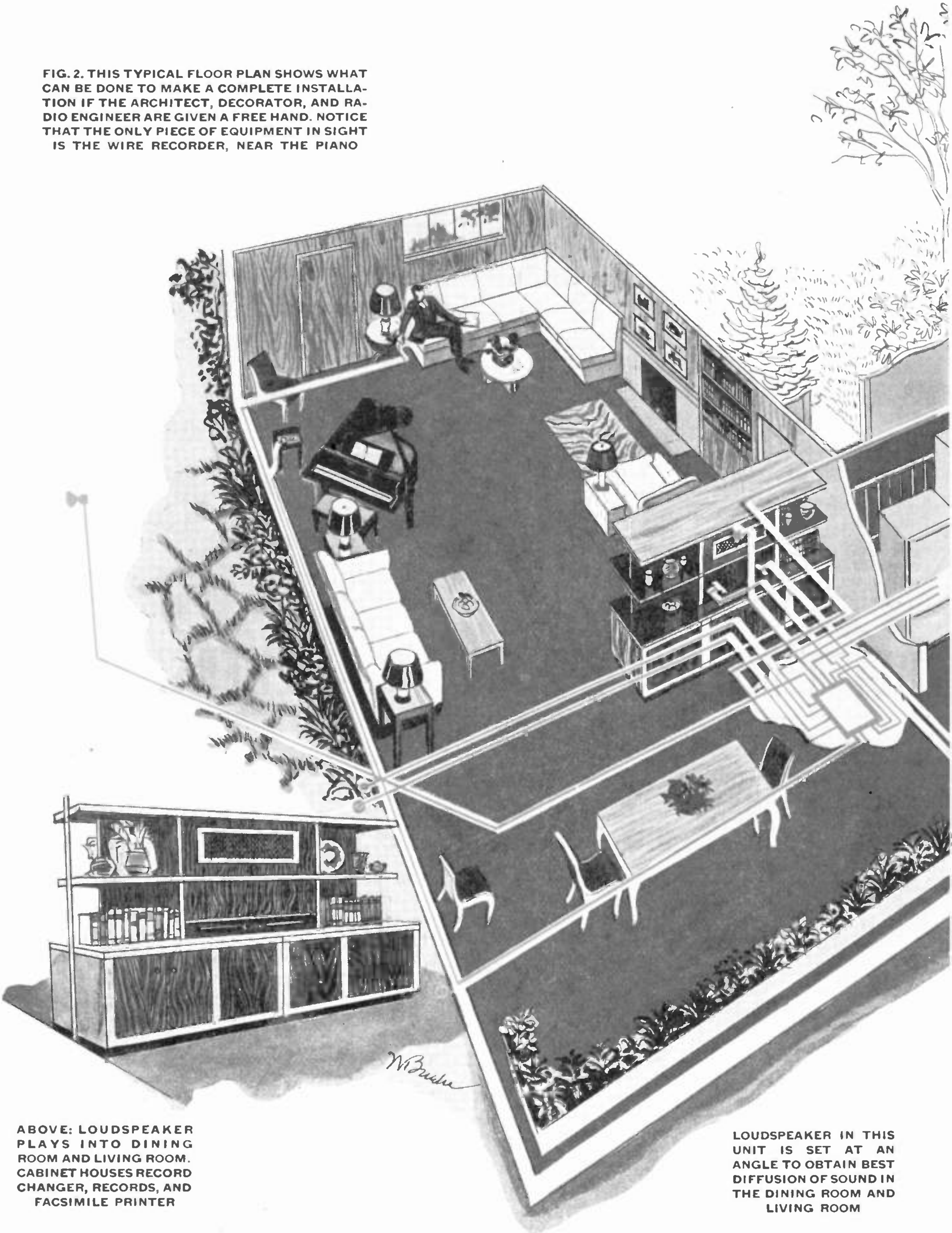
2. An installation embodying all radio services, but scaled down in cost.

3. An installation providing high-quality radio, phonograph and facsimile to cost under $400, with provisions for adding television reception.

A Fund of Ideas ★ For all that this study represents the composite thinking of many minds, it is recognized that no plans can be drawn which will be universally acceptable. Indeed, the results of this study are offered as a source of ideas — a starting point from which, through modification and adaptation, the way can be found to make radio dollars go farthest toward meeting to best advantage the needs of those who spend them.

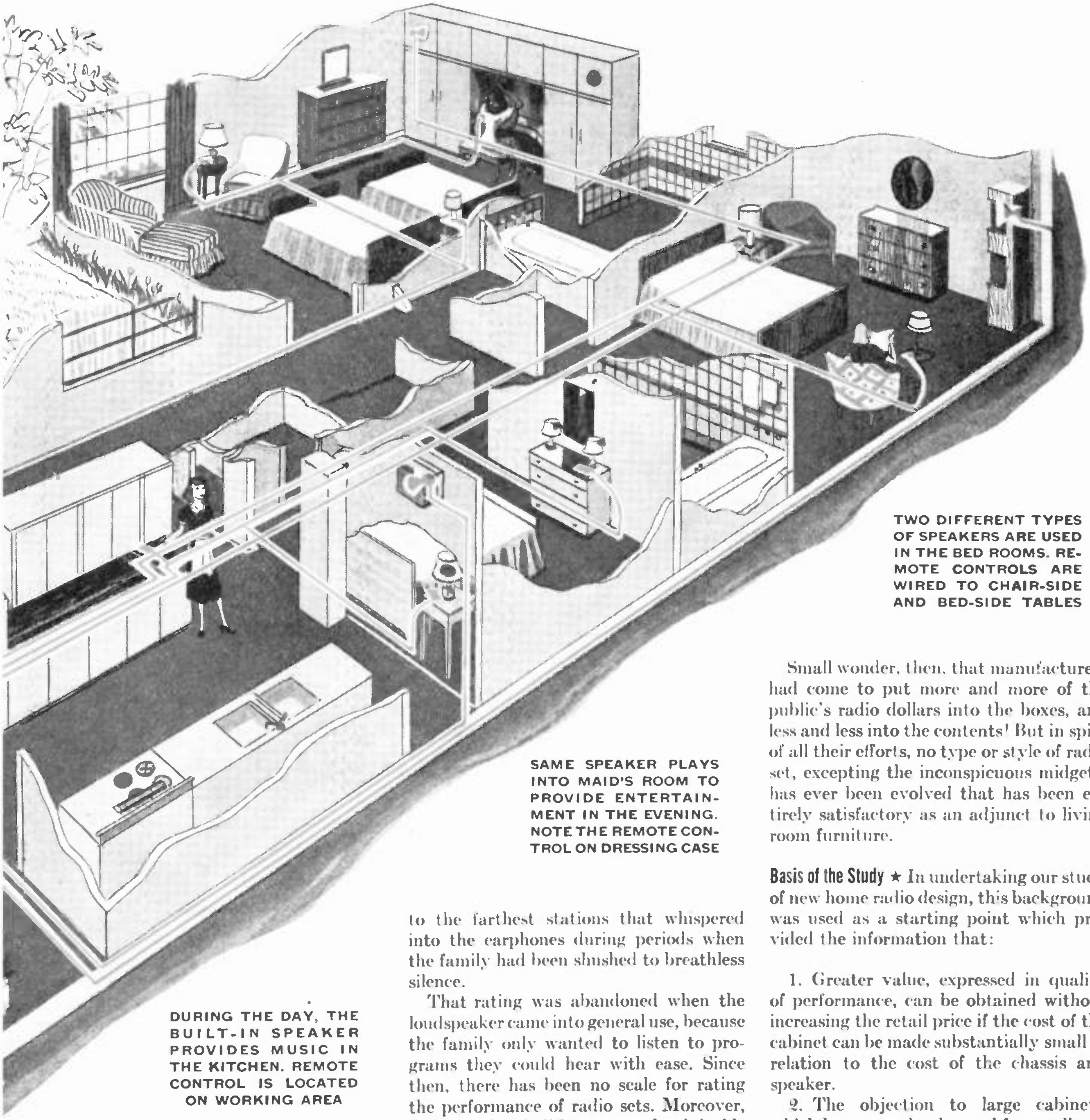
A Little History ★ In the early days of broadcasting, radio listening was a selfish activity. It was the special privilege of fathers or sons who, in an unaccountable way, became inoculated with something called the Radio Bug. This virus caused the victim to withdraw unsociably every evening to whatever part of the house had become the Radio Room, clamp headphones on his ears, and devote himself until all hours to the delicate adjustment of what he called a cat's whisker.

FIG. 2. THIS TYPICAL FLOOR PLAN SHOWS WHAT CAN BE DONE TO MAKE A COMPLETE INSTALLATION IF THE ARCHITECT, DECORATOR, AND RADIO ENGINEER ARE GIVEN A FREE HAND. NOTICE THAT THE ONLY PIECE OF EQUIPMENT IN SIGHT IS THE WIRE RECORDER, NEAR THE PIANO



ABOVE: LOUDSPEAKER PLAYS INTO DINING ROOM AND LIVING ROOM. CABINET HOUSES RECORD CHANGER, RECORDS, AND FACSIMILE PRINTER

LOUDSPEAKER IN THIS UNIT IS SET AT AN ANGLE TO OBTAIN BEST DIFFUSION OF SOUND IN THE DINING ROOM AND LIVING ROOM



TWO DIFFERENT TYPES OF SPEAKERS ARE USED IN THE BED ROOMS. REMOTE CONTROLS ARE WIRED TO CHAIR-SIDE AND BED-SIDE TABLES

SAME SPEAKER PLAYS INTO MAID'S ROOM TO PROVIDE ENTERTAINMENT IN THE EVENING. NOTE THE REMOTE CONTROL ON DRESSING CASE

DURING THE DAY, THE BUILT-IN SPEAKER PROVIDES MUSIC IN THE KITCHEN. REMOTE CONTROL IS LOCATED ON WORKING AREA

Not until the advent of the loudspeaker and the substitution of AC power for acid-filled storage batteries did the radio set emerge from the privacy of the radio room or kitchen corner to take its place in the living room where it could be enjoyed and used by all the family.

Since that time, women's influence has controlled the purchase, and therefore the design, of radio sets. Previously, receivers had been rated in performance, the measure of which was the number of miles to the farthest stations that whispered into the earphones during periods when the family had been shushed to breathless silence.

That rating was abandoned when the loudspeaker came into general use, because the family only wanted to listen to programs they could hear with ease. Since then, there has been no scale for rating the performance of radio sets. Moreover, with complete indifference to what is inside a radio cabinet or the sounds that issue from it, women buy on outward appearance only.

Women's Influence ★ Since women are uncritical of performance, the design of radio sets has deteriorated into competition to meet their ideas as to furniture design, color of wood, and type of cabinet; outward impression of value; convenience, which involves size, arrangement of doors, and tricky, point-of-sale gadgets; and, of course, the price.

Small wonder, then, that manufacturers had come to put more and more of the public's radio dollars into the boxes, and less and less into the contents! But in spite of all their efforts, no type or style of radio set, excepting the inconspicuous midgets, has ever been evolved that has been entirely satisfactory as an adjunct to living room furniture.

Basis of the Study ★ In undertaking our study of new home radio design, this background was used as a starting point which provided the information that:

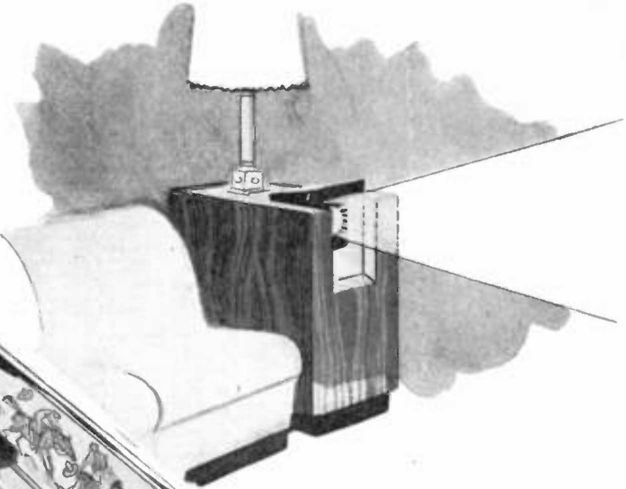
1. Greater value, expressed in quality of performance, can be obtained without increasing the retail price if the cost of the cabinet can be made substantially small in relation to the cost of the chassis and speaker.

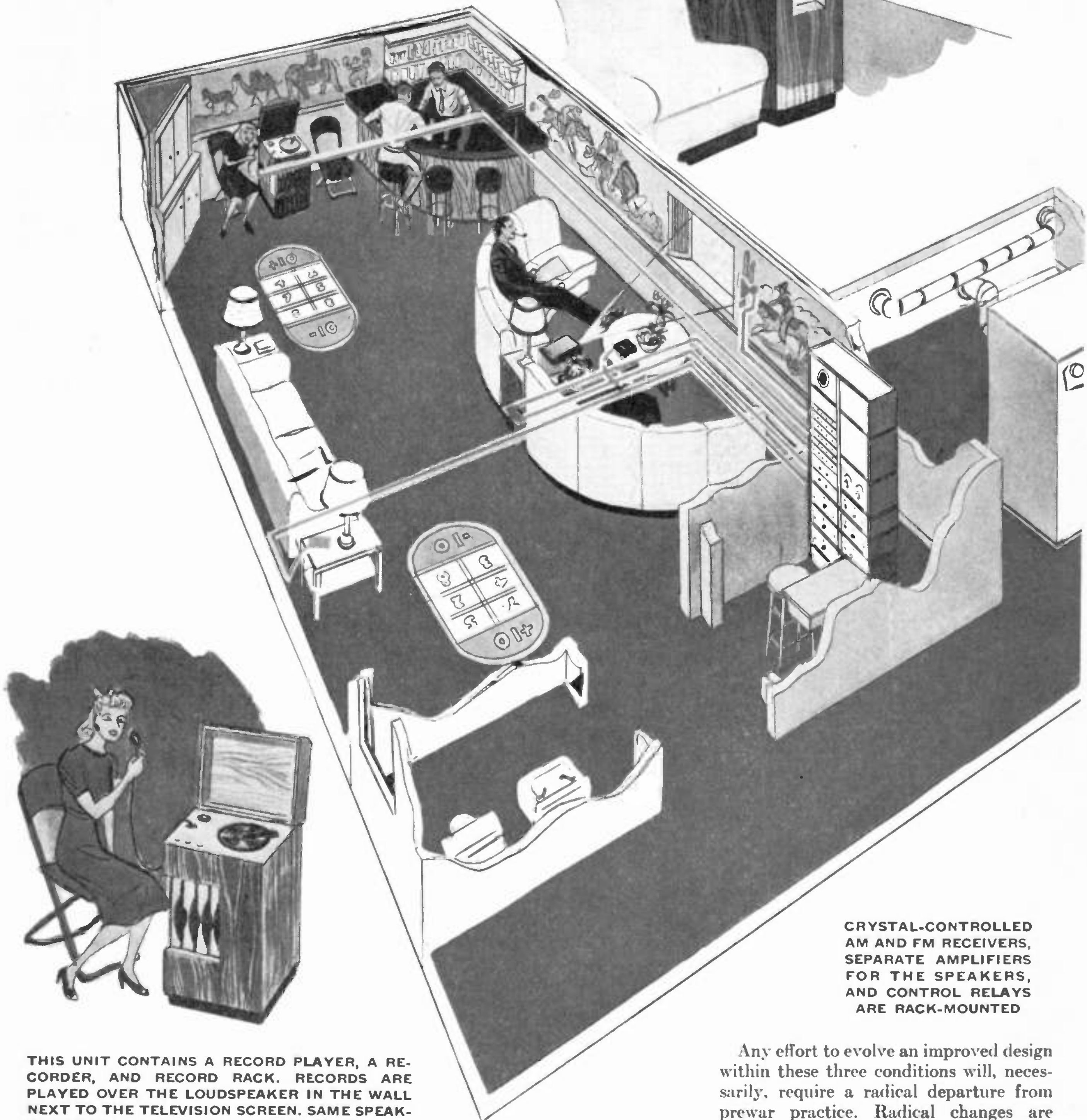
2. The objection to large cabinets, which has created a demand for small sets of limited performance capabilities, can be met by built-in equipment, achieving inconspicuous appearance without sacrifice of radio or audio performance.

Looking forward to plans now projected for new, postwar services, it was clear that:

3. If broadcast, television, and facsimile receivers are combined into one cabinet with an automatic phonograph, the dimensions will be so large that few homes could accommodate a piece of such size in any room.

FIG. 3. THIS PLAN SHOWS SPECIAL EQUIPMENT FOR THE GAME ROOM, INCLUDING A BUILT-IN SCREEN FOR PROJECTION TELEVISION AND HOME MOVIES. SEPARATE CRYSTAL-CONTROLLED FM AND AM RECEIVERS AND SEPARATE AMPLIFIERS PERMIT CHOICE OF PROGRAMS AT EACH SPEAKER





CRYSTAL-CONTROLLED AM AND FM RECEIVERS, SEPARATE AMPLIFIERS FOR THE SPEAKERS, AND CONTROL RELAYS ARE RACK-MOUNTED

THIS UNIT CONTAINS A RECORD PLAYER, A RECORDER, AND RECORD RACK. RECORDS ARE PLAYED OVER THE LOUDSPEAKER IN THE WALL NEXT TO THE TELEVISION SCREEN. SAME SPEAKER IS USED TO PLAY RECORDS FROM CHANGER UPSTAIRS, FOR TELEVISION, AND FOR RADIO RECEPTION

Any effort to evolve an improved design within these three conditions will, necessarily, require a radical departure from prewar practice. Radical changes are feared, and rightly so, by experienced designers and sales executives. Records of the industry show that departures from conventional designs have never met with public acceptance in the past — with one exception. That was after 1929, when the midget models offered the convenience of small size to a public whose buying power was no longer of console proportions.

From this, we know that changes which are merely departures from convention are not justified, but new designs, properly presented and promoted, can be highly successful if they meet some definite need even though that need was not first expressed by an articulate demand.

The following conclusions of this study are incorporated in the three home radio installations described in this series of articles:

1. Cabinet Cost ★ There seems to be no innovation in cabinet design or type that will be acceptable in appearance and substantially lower in cost. The only answer, then, is 1) to eliminate the wooden console entirely, and to substitute a plain steel case just large enough to hold the chassis, 2) to mount the speaker in a plain case that can be finished to match the woodwork of the room where it will be placed, or else to build the speaker into an opening in a wall or partition, and 3) to locate the automatic record changer in a convenient closet that would also provide space for record storage, or in a suitable piece of furniture.

With such an arrangement, the retail cost of the equipment would be $125 to $175, as compared to $275 to $350 for the same instruments mounted in a good console cabinet.

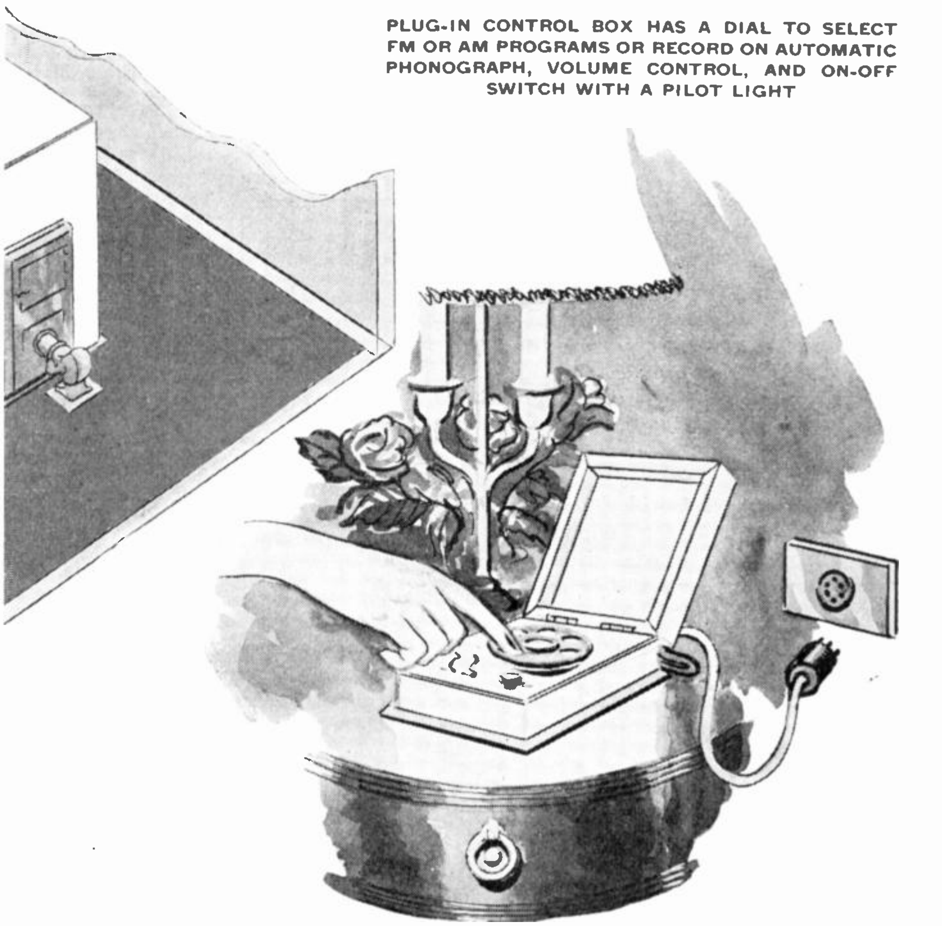
2. Cabinet Size ★ The chassis, in its plain steel case, can be put where it is out of sight, and yet conveniently located. Then the whole installation will be as inconspicuous as a midget radio, but the performance will equal that of an expensive radio-phonograph console at a saving in price that will be greater than the cost of having the equipment expertly installed.

3. Cabinet Capacity ★ Immediately after the war, high-fidelity FM broadcasting will be on the air in the large cities, and will spread rapidly to nation-wide service. Improved phonograph pickups and recorders will be available. Later will come television and facsimile.

If equipment for these services is bought in three separate units, each contained in its own cabinet, and probably in cabinets of unrelated design, the result will be unsatisfactory, to say the least, and in many living rooms there will be little space left for other furniture!

It is conceivable that all this equipment, at some future time, will be available in a single cabinet. But even if there is room for a cabinet large enough to contain the instruments, it would mean foregoing the enjoyment of the services that come first, and waiting no one knows how long until they are all in operation.

This poses a new problem, the logical answer to which is the kind of installation indicated above, where the instruments are distributed at points best adapted to accommodate them, instead of being centralized where their total cubic contents would require a cabinet of impractically large dimensions.



PLUG-IN CONTROL BOX HAS A DIAL TO SELECT FM OR AM PROGRAMS OR RECORD ON AUTOMATIC PHONOGRAPH, VOLUME CONTROL, AND ON-OFF SWITCH WITH A PILOT LIGHT

Why a Steel Case? ★ Reference to a steel case to hold the radio chassis calls up association with cheap and unsightly appearance. Steel cases are low in cost compared to well-built wooden cabinets, but they can be handsome in an inconspicuous way. The steel construction also effects a substantial reduction in packing and shipping costs.

Such cases have been widely used for amateur receivers, and some were of decidedly attractive design. Practically all the very beautiful broadcast station equipment is so mounted. Steel cases are used to the virtual exclusion of wood for military radio apparatus.

One of the virtues of putting the radio chassis in a plain case is that it has the honest appearance of being what it is, instead of being disguised as a piece of furniture which it isn't.

The adaptability of the high-quality chassis enclosed in a small case, made practical by mounting the loudspeaker separately, will be discussed fully in this study.

Loudspeaker Mountings ★ A large part of the cubic contents of a console is devoted to space for the loudspeaker, but any acoustic advantage in size is generally lost by putting the cabinet directly against a wall. In such a position, the cabinet faces toward an opposite wall which serves to reflect the sound directly back into the speaker. Thus, because the console is placed where it looks best, it is seldom positioned for best acoustic performance.

It is a different matter when the speaker is located separately. Then it can be mounted in a plain and inconspicuous acoustic chamber small enough in size to be put where the sound can be heard to best advantage.

This subject will be explored in Part 2 of this study, in which the circuits and design details of the first installation, pictured on these pages, will be discussed at length.

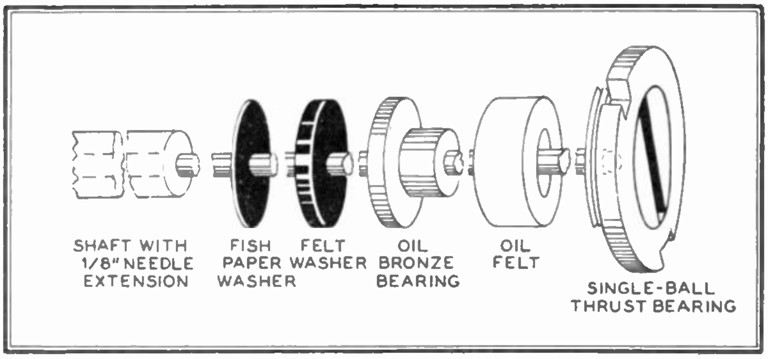


FIG. 1. EXPLODED VIEW OF OIL-LESS BEARINGS USED IN CARTER DYNAMOTORS

RADIO DESIGNERS' ITEMS

Notes on Methods and Products of Importance to Design Engineers

Oil-less Bearings: Fig. 1 shows an exploded drawing of the bearings used in Carter Generators with 1½- and 2-in. frames. Designed by the late Alva (Nick) Carter, this type of bearing serves the dual purpose of excluding the dirt and dust to which portable mobile equipment is exposed, and eliminates the need of replenishing the oil supplied at the time of manufacture.

These bearings have given over 5,000 hours of service, equivalent to 5 years normal use, without showing appreciable wear or need for adding oil. As the illustration shows, the bearing flange is surrounded by an oil-impregnated felt piece which furnishes lubrication to the bronze bearing as it is required. Service records show that the felt does not go dry, as it stores an ample amount of oil. A single ball at the end of the shaft takes up any tendency to develop end play due to vibration and swaying to which these units are subjected.

New Catalog: Issued by Cambridge Thermionic Corporation, Cambridge 38, Mass. presents mechanical data on single and double-ended turret terminals and split terminals, as well as hand and power press tools for swaging. Also listed are ultra-high frequency IF transformers and plug-in quartz crystals of types specially adapted to portable-mobile communications equipment.

Rhombic Antenna Coupling: A wide band impedance-matching unit, for coupling a rhombic antenna and coaxial cable, is now available from Andrew Company, Chicago 19, Ill. Circuit elements are contained in a weather-tight cast iron housing, with top terminals for the legs of the antenna and a bottom opening for the lead. Designed for 4 to 22 mc., the unit transforms the 700-ohm balanced antenna impedance to the 70-ohm unbalanced impedance required to match the transmission line.

Manufacturers' Code: Harry C. Forster, president of Radio Speakers, Inc., has suggested that R.M.A. set up a code for use on radio components which will identify manufacturers' names and the date of production. This would be a great convenience to set manufacturers for their inspection and stock control, and would eliminate objection to having components carry company names.

UHF Oscillator: Of light weight and convenient size has been put into production by General Radio Company, Cambridge 39, Mass. This type 857-A is shown in Fig. 2 Covering 100 to 500 mc., it has a maximum power output of .5 watt or more over the entire frequency range. Thus it is suitable as a power source for laboratory measurements.

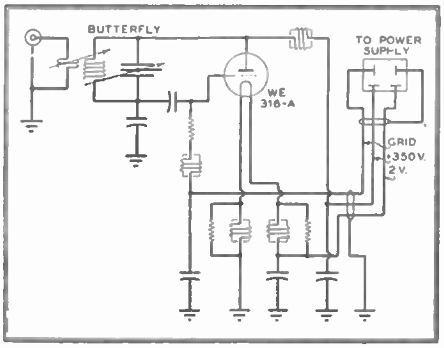


FIG. 3. CIRCUIT OF UHF OSCILLATOR, TUNED WITH BUTTERFLY CONDENSER

The frequency-determining element in this oscillator is a butterfly assembly which varies inductance and capacity simultaneously, with a single control. No electrical contact to the moving element is necessary. Oscillation is indicated by an electron-ray tube.

Frequency calibration of the direct-reading dial is ± 1%. A slow-motion dial provided close adjustment. The output, controlled by varying the coupling, terminates in a coaxial jack. Power is supplied from a separate unit, type 857-P1, operating on 115 or 230 volts, 42 to 60 cycles.

The oscillator unit measures 6⅛ by 7⅝ by 7¼ ins. overall, and weighs 6¼ lbs. Dimensions of the power supply are 5½ by 6⅝ by 7⅝ ins., and the weight 9½ lbs.

(CONCLUDED ON PAGE 41)

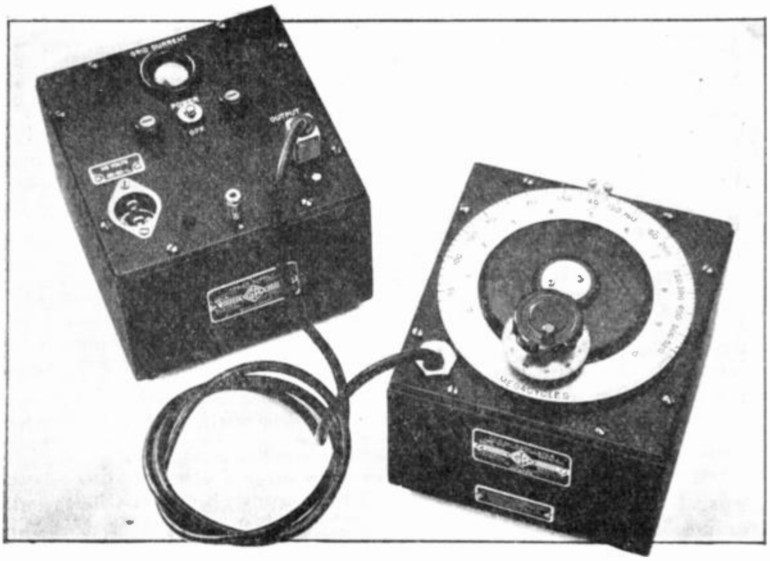


FIG. 2. UHF OSCILLATOR AND POWER SUPPLY. BUTTERFLY TUNING COVERS 100-500 MC.

FM BROADCASTING & COMMUNICATIONS HANDBOOK

Chapter 1: Amplitude-Modulated and Frequency-Modulated Waves

BY RENÉ T. HEMMES

RECENT years have witnessed the growth of a new system of radio communication, which is having a revolutionary effect upon nearly all branches of the radio art. This system, invented by Major Edwin H. Armstrong, is sometimes referred to as "Wide-Band Frequency Modulation." More often, it is simply called "FM."

Not only does FM provide transmission in which distortion is reduced to a very low order, but it virtually eliminates noise at the receiver, whether this noise be of atmospheric or man-made origin. Furthermore, uncertainties due to interference between stations and changing propagation characteristics which affect AM circuits are overcome by FM. For these reasons, FM has gained a firm foothold in radiotelephone communications as well as in the broadcasting industry. Also, FM has made possible many new services, while others have been converted from AM to FM.

The highly desirable characteristics of FM are due in part to the nature of the frequency-modulated wave and in part to the design of the FM receiver. In order to gain an insight into the methods whereby the vast improvement in reception is obtained, it is necessary first of all to understand the basic differences between the amplitude and frequency modulation systems of radio telephone transmission and reception.

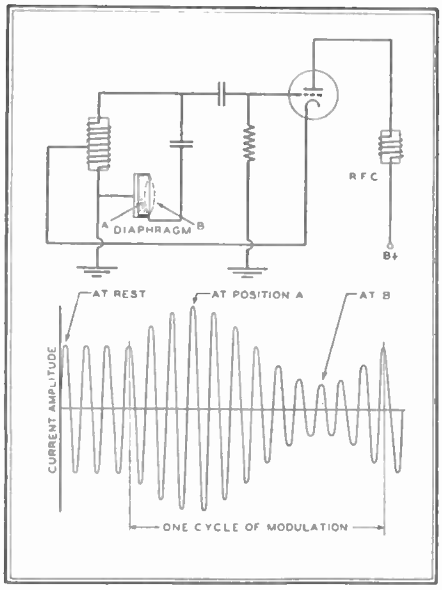


FIG. 1. ELEMENTARY AM TRANSMITTER

Modulation ★ The continuous transmission of a radio wave of constant amplitude, or output power, and unvarying frequency conveys no information to the listener, other than that an unidentified station is on the air. It becomes possible to transmit intelligence on the wave only when one of the characteristics of the wave, such as its amplitude or its frequency, is subjected to a controlled variation at the transmitter. Modulation is the process of varying the amplitude or the frequency of the wave in accordance with the instantaneous variations of a control device, such as a telegraph key or a microphone.

Amplitude Modulation ★ When the power output of a radio transmitter is made to vary above and below an average level in keeping with the vibrations of a microphone diaphragm, as in Fig. 1, the transmitter is said to be amplitude-modulated.

The transmitter in Fig. 1 is of the most elementary type, but will serve to illustrate a method by which amplitude modulation can be accomplished. The circuit is that of a tuned-grid triode oscillator in which an inductive load in the plate circuit causes regenerative feedback by way of the plate-grid capacity of the tube. If the losses in the tuned circuit are compensated for by the transfer of energy from the plate to the grid circuits, a radio frequency current will be generated in the tuned circuit. The frequency of this current is determined by the values of inductance and capacity in the tuned circuit. The amplitude of the current will depend upon the resistance of the tuned circuit, assuming that the plate supply voltage and other factors remain constant.

Most of the resistance in the tuned circuit is introduced by the carbon-button microphone in series with the coil and the condenser. When the diaphragm is at rest, the resistance of the microphone limits the current to a definite level, and the transmitter sends out a wave of constant amplitude. As mentioned previously, the presence of the unmodulated wave can be detected in a receiver but the wave is incapable of transmitting intelligence in itself; it serves merely to establish a channel between the transmitter and the receiver, over which intelligence can be sent by modulation. The unmodulated wave, therefore, is termed the "carrier."

If a sound wave now strikes the microphone, the vibration of the diaphragm causes the carbon granules to be subjected alternately to increased and decreased pressure. The resulting respective decrease and increase of microphone resistance causes the output of the transmitter to rise and fall in accordance with the volume and frequency of the sound, as shown in Fig. 1. The frequency of the wave remains the same since the inductance and capacity of the tuned circuit are not altered appreciably during modulation.

Frequency Modulation ★ An elementary circuit for the production of a form of frequency modulation is shown in Fig. 2. Here the carbon microphone of Fig. 1 has been removed and a condenser microphone is placed in parallel with the condenser of the tuned circuit. The oscillator generates a current of a frequency determined by the inductance of the coil and by the sum of the capacities across the coil. When a sound wave strikes the microphone, the diaphragm is first flexed toward the back plate, increasing the microphone capacity and hence also increasing the total capacity acting across the coil. This causes the oscillator to generate a lower frequency. Subsequently the diaphragm

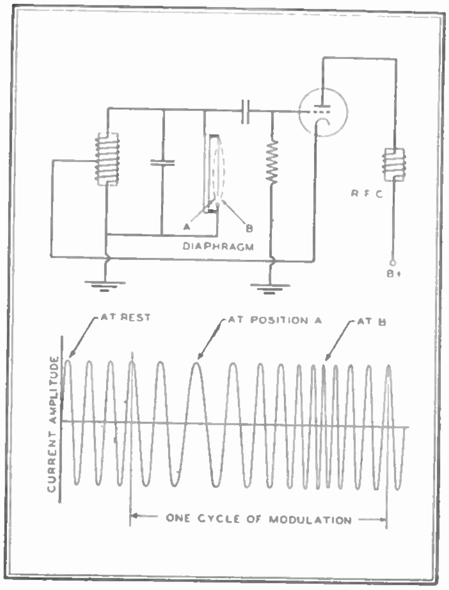


FIG. 2. ELEMENTARY FM TRANSMITTER

is flexed away from the back plate and the frequency of the oscillator is increased, because of the reduction in the amount of capacity in the tuned circuit. If a louder sound is made at the microphone, the diaphragm is flexed more in each direction, and the frequency is varied to a greater extent. In both cases, since the frequency of the generated wave has been varied above and below an average value by the action of sound waves on the microphone, a form of frequency modulation has been produced. Note that nothing has occurred during modulation to affect the power output. Hence the amplitude of the generated wave is constant.

Effects of Modulating Amplitude and Frequency ★ The contrast between the amplitude-modulated and frequency-modulated carrier wave will be emphasized by a consideration of what occurs when the amplitude or the frequency of the modulating voltage is changed. In Fig. 3, the audio frequency modulating voltage and the resulting amplitude- and frequency-modulated carrier waves are plotted to equal scales of time.

At the extreme left is illustrated the condition of zero modulation. It will be observed that the outputs of the amplitude- and the frequency-modulated transmitters are exactly identical, both being of constant amplitude and unvarying frequency.

Next to the right is shown a condition of slight modulation at a low frequency, such as would occur when a soft, low-pitched note is sounded at the microphone. In the case of the amplitude-modulated wave, the output power rises and falls over a narrow range, in keeping with the very low level of the modulating voltage. In the case of the frequency-modulated wave directly beneath, there is no change in output, but the frequency is increased and decreased slightly, at a rate corresponding to the modulating frequency, and to an extent corresponding to the low volume level.

Next to the right in Fig. 3 is shown the effect of an increase in the amplitude of the modulating voltage, the frequency of the modulating voltage remaining unchanged. This condition would be caused when the same low-pitched note is sounded at the microphone with greater intensity. The successive radio frequency peaks of the amplitude-modulated wave vary over a greater range, in accordance with the increased amplitude of the modulating voltage, but the time taken to complete cycle of variation is the same.

The frequency-modulated wave is observed to rise to a higher frequency and to fall to a lower frequency than before, but going through this cycle of change at the same rate as before.

Further to the right are shown the forms of the modulating and the modulated waves when both the frequency and the amplitude of modulation are increased. This is equivalent to sounding a louder and higher-pitched note at the microphone. In the case of the amplitude-modulated wave, the modulation peaks and troughs are more pronounced, and are created at a higher rate. The frequency-modulated wave still has no variation of its amplitude, but shifts to higher and lower frequencies than before, and completes each cycle of frequency variation at a faster rate.

If the amplitude of the modulating voltage is increased still further, as shown at the extreme right in Fig. 3, so that the negative peak of modulation would tend to exceed the carrier amplitude, then the amplitude-modulated wave is rendered discontinuous and severe distortion of the wave form of the modulation results. This limitation upon the extent of modulation is inherent in the amplitude-modulated wave. Under the same condition of modulating voltage, the frequency of the frequency-modulated wave would simply increase and decrease over a still greater range, the limitations of the range being set by the transmitting and receiving equipment rather than by the nature of the wave.

Analysis of AM Wave ★ From the above physical concepts of the two types of modulated waves, certain points of contrast are already evident. Other significant differences can be discovered when each of the waves is analyzed with a view to learning the nature of its components.

At the top of Fig. 4 is shown a wave of radio frequency F that is being subjected to amplitude modulation by a modulating voltage having a sine wave form and an audio frequency F_M.

In describing the extent of the modulation, it is customary to state the percentage relationship which the maximum *variation* from carrier amplitude bears to the carrier amplitude itself. For example, if the amplitude of the modulated wave on a positive modulation peak is twice the carrier amplitude, then the percentage of modulation is $100(2 - 1)/1$ or 100 per cent. Similarly, if the amplitude rises to 1.5 times carrier amplitude at a positive peak of modulation, the modulation percentage is $100(1.5 - 1)/1$ or 50 per cent.

However, in describing the extent of modulation in equations of the wave, it is more convenient to use the *modulation factor* symbol M, which is the decimal equivalent of the modulation percentage. The condition shown in Fig. 4 is that of 100 per cent modulation, equivalent to a modulation factor M of 1.0.

In writing the equation immediately beneath the diagram of the wave, it has been arbitrarily assumed that the modulated wave begins (when t equals zero) at the positive maximum of the modulation cycle. This assumption has been made solely to facilitate the construction of a clear drawing, and accounts for the difference between the equation shown and other equally correct forms which may be encountered in textbooks.

By using the trigonometric identity shown (for readers who are interested in the mathematical procedure) the equation is rewritten in the form which indicates that the amplitude-modulated wave may be regarded as the sum of three components: 1) A component of the same amplitude and frequency as the unmodulated wave, usually termed the carrier component; 2) a component whose frequency is higher than that of the carrier by the amount of the modulation frequency, and whose amplitude is directly proportional to the modulation factor, but never exceeding half the carrier amplitude (called the upper sideband component); 3) a component whose frequency is lower than that of the carrier by the amount of the modulation frequency and whose amplitude is the same as that of the upper sideband component. This component is called the lower sideband.

The carrier and the sideband components have been drawn underneath the modulated wave to a common scale of time in order to facilitate graphical proof that the sum of the carrier and sideband components at any instant will equal the value of the modulated wave at the same instant. The vertical dotted lines representing several instants selected at random will aid in checking this point.

It may be remarked here parenthetically that many laymen unfamiliar with the methods of mathematical analysis doubt the reality of sidebands; others, acknowledging that sidebands may exist, are inclined to question the propriety of looking upon the amplitude-modulated wave as a single-frequency variable-amplitude affair in one instance and as the sum of three different frequency components of constant amplitude in another instance.

The cardinal principle that guides the mathematician in this matter is the axiom which states that the whole is equal to the sum of all its parts. Once it has been definitely established that a given whole is equal to the sum of certain components, thereafter the whole, or the expressed sum of all the components of the whole, can be used interchangeably. It is only necessary to observe all the laws of algebra and to account for all components. Whether the whole or the expressed sum of all the components of the whole will be employed is merely a choice of convenience for attacking the problem at hand.

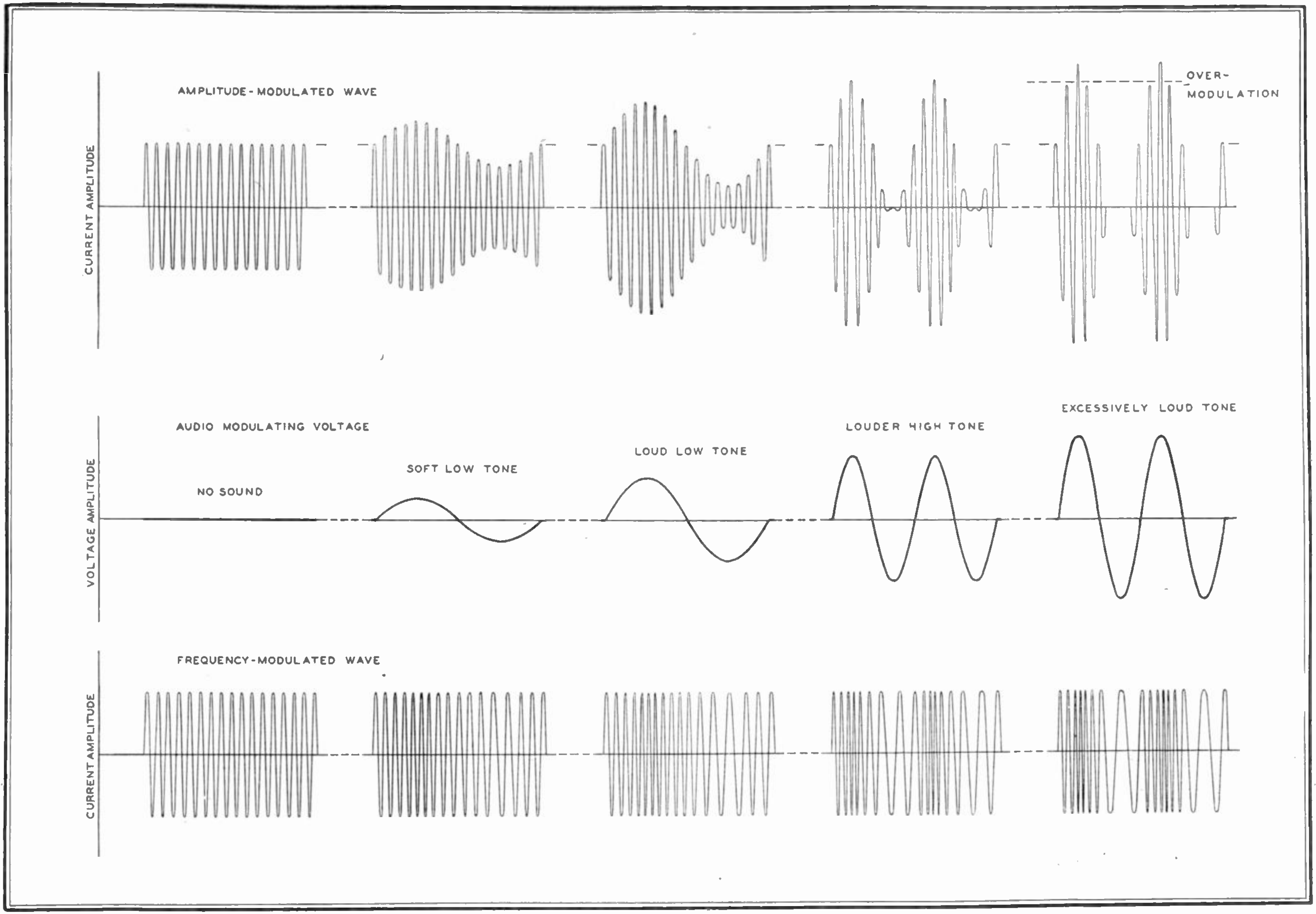


FIG. 3. CENTER, MODULATING VOLTAGE DUE TO AUDIO FREQUENCIES OF VARIOUS AMPLITUDED DIRECTED INTO THE MICROPHONE. TOP, RESULTING MODULATION OF AM TRANSMITTER OUTPUT, SHOWING THAT RF FREQUENCY IS CONSTANT, WHILE OUTPUT CHANGES. BOTTOM, RESULTING MODULATION OF FM TRANSMITTER OUTPUT. THE OUTPUT IS CONSTANT, BUT MODULATION CHANGES THE RF FREQUENCY

This principle finds very wide usage in all mathematical work. For example, to find the complement of an angle of 25°, one subtracts 25 from 90°. However, to find the complement of an angle of 37° 15′ 22″, one subtracts from 89° 59′ 60″.

Similarly, when describing the operation of a device that is responsive to voltage amplitude, such as a diode detector, the amplitude-modulated wave will be regarded as having a single frequency and a variable amplitude. On the other hand, when considering the effects of a tuned band pass circuit upon an amplitude-modulated wave, it is more convenient to consider the wave as the sum of a carrier component and sidebands, because the effects of the circuit upon the different frequency components may not be the same. To keep the amplitudes of the sideband components and the carrier in their original proportion with respect to each other, the band-pass circuit must pass all three frequencies with equal ease. This demands that the band width be twice the modulating frequency and that its tuning be centered on the carrier frequency. In the usual case where the wave is subject to amplitude modulation at various modulating frequencies, the band width must be twice the *highest* modulating frequency, in order that the amplitudes of the high audio frequency components of the reproduced sound at the receiver may have the same proportion with respect to the low audio frequency components as exists at the microphone.

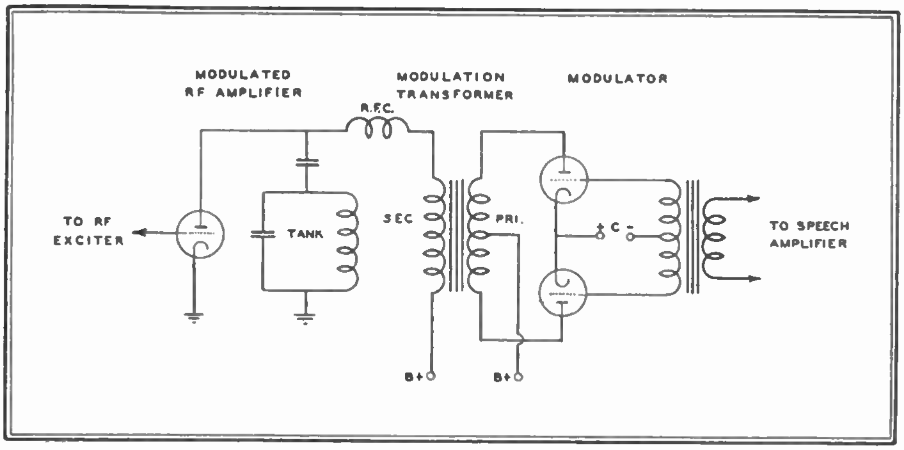


FIG. 5. THE CIRCUIT ELEMENTS OF AN AM TRANSMITTER

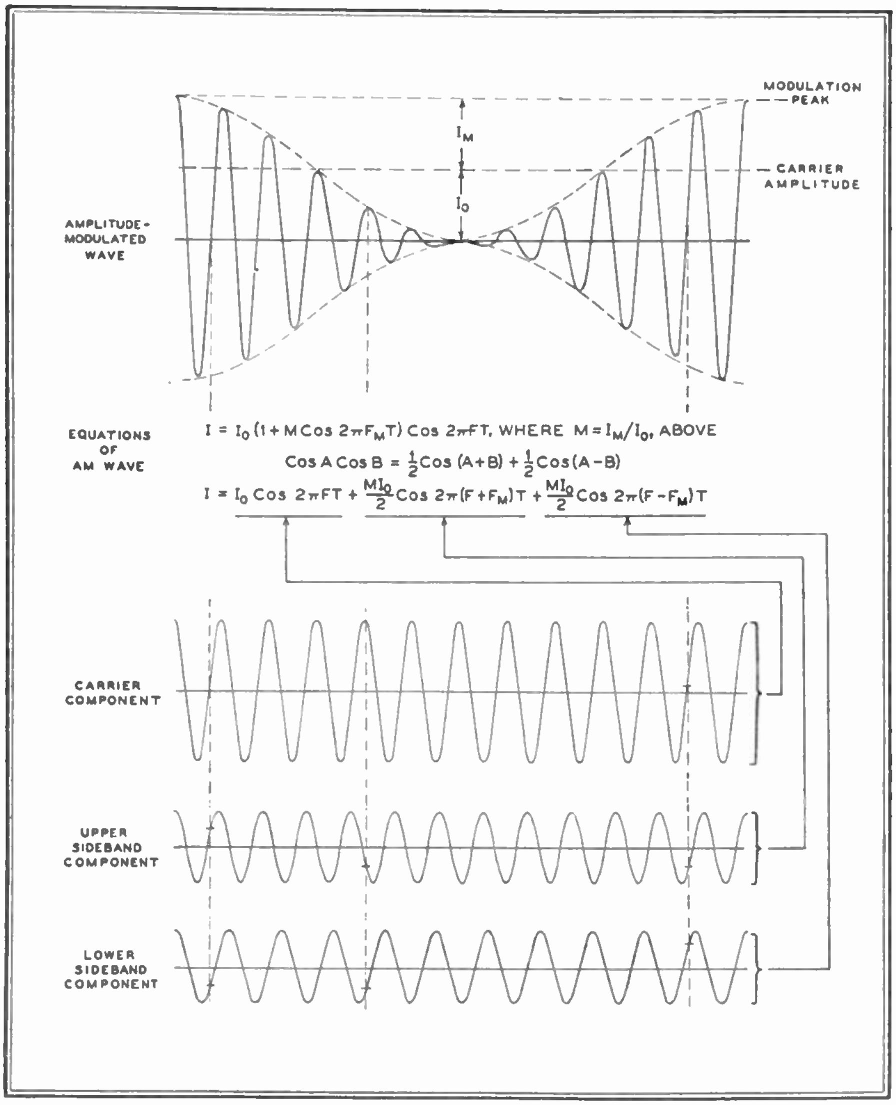


FIG. 4. THE AM WAVE AND ITS COMPONENTS AT 100% MODULATION

From the analysis of the wave shown in Fig. 4, it is also evident that during modulation the amplitude of the carrier frequency component is unaffected, but two sideband components are added. This means that the power in an amplitude-modulated wave is greater than that in an unmodulated wave by the sum of the two I^2R products of the sideband currents. What is the source of this extra power? What is its significance in transmitter design?

The essential elements of a modern amplitude modulation transmitter circuit are shown in Fig. 5. At the left is a radio frequency amplifier which is excited from an oscillator, either directly or through one or more intermediate amplifiers. At the right in the diagram is an audio power amplifier or modulator whose output voltage is applied in series with the plate supply voltage of the radio frequency amplifier.

In the absence of modulation, the voltage across the secondary of the modulation transformer is essentially zero, and the amplitude of the radio frequency output is determined by the RF amplifier plate voltage. Power is drawn only from the DC plate voltage source and a portion of this power is converted to the RF carrier output of the amplifier.

When sound waves strike the microphone at the studio, the modulator is excited at audio frequency through a chain of speech amplifiers, and an audio modulating voltage appears across the secondary of the transformer. This voltage alternately adds to or subtracts from the plate supply voltage of the RF amplifier causing a proportionate increase and decrease in the RF amplifier plate current. The RF oscillations set up in the tuned circuit (tank) by the plate current pulses undergo the same audio frequency variation of amplitude.

During modulation the *average* plate current drawn from the DC plate supply of the RF amplifier remains unchanged, because for each pulse whose amplitude exceeds the unmodulated value by a certain amount, there is another pulse, 180° later in the modulation cycle, whose amplitude is less than the unmodulated value by the same amount. With both the average current and the voltage of the DC plate supply unchanged, this source furnishes the same amount of power as when there is no modulation. It follows that the extra power furnished to the RF amplifier for the generation of sidebands during modulation is the audio frequency power output of the modulator, derived from the DC plate supply of the modulator tubes.

Under a condition of complete or 100 per cent modulation, the amplitude of each sideband is one half that of the carrier. Since the power expended in a fixed amount of resistance varies as the square of the current amplitude, each of the sidebands represents one fourth as much power as the carrier. The total power in *both* of the sidebands may therefore be as great as one half that in the carrier. Furthermore, the modulator must also furnish the power dissipated in the radio frequency amplifier in the course of its generation of the sidebands. Suppose the rated carrier output of the transmitter is 1,000 watts, and the efficiency of the final radio frequency amplifier is 60%. At 100% modulation, the sideband power is 500 watts and the modulator is called upon to furnish 500/.6 or 833 watts of audio power, not including modulation transformer losses!

There are several strategems available to the designer for reducing such large audio power requirements. For example, the final stage may be modulated in the grid circuit rather than in the plate circuit, or the stage before the final may be modulated. However, it is not practical to attempt amplitude modulation at an early, low power stage, and to employ a chain of several linear amplifiers to bring the modulated wave up to a high power level; it is too difficult to adjust linear amplifiers for good linearity. Thus in transmitters of moderate or high power output employing amplitude modulation, the modulation is effected at or near the final amplifier stage. In general, therefore, tubes of the *power* rather than the *voltage amplifier* type are used in the modulator.

Of greater importance is the fact that on peaks of 100% modulation the radio frequency amplifier must deliver four times as much power as during carrier level condition. It is necessary that the tubes have adequate filament emission to supply a momentary two-fold increase in plate current over that occurring at carrier level. Also, the *average* power delivered during a cycle of 100% modulation is half again as great as the power furnished at carrier level. Thus the output obtainable from tubes in an AM final amplifier is only about two thirds that obtainable in an application where the amplitude is constant, as in FM. Hence tubes in AM final amplifiers operate at relatively low efficiency.

Summary of AM ★ The salient points about amplitude modulation, which will presently be contrasted with conditions found in frequency modulation, may be summarized as follows:

1. The amplitude of the wave, or the radiated power, is varied during modulation but its frequency is unchanged.

2. A higher modulating frequency increases the rate at which the amplitude is varied.

3. An increase in the amplitude of the modulating voltage causes the amplitude of the transmitted wave to vary over a wider range.

4. The limits of the range over which the amplitude can be varied is determined by the carrier amplitude. If the negative modulation peak tends to exceed the carrier amplitude, it is not reproduced and the wave is rendered discontinuous, which results in serious distortion.

5. When subjected to amplitude modulation at a single modulating frequency of sinusoidal wave form, the AM wave becomes the sum of three components, a carrier identical in frequency with the unmodulated wave, and a pair of sideband components of frequencies above

TABLE 1

BESSEL FACTORS FOR FINDING AMPLITUDES OF CENTER AND SIDEBAND FREQUENCY COMPONENTS*

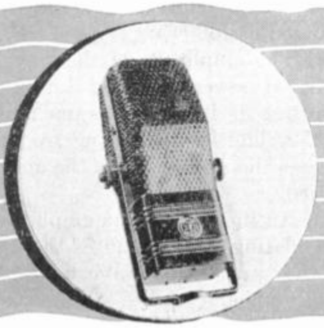
M	$J_0(M)$ F	$J_1(M)$ $F \pm F_M$	$J_2(M)$ $F \pm 2F_M$	$J_3(M)$ $F \pm 3F_M$	$J_4(M)$ $F \pm 4F_M$	$J_5(M)$ $F \pm 5F_M$	$J_6(M)$ $F \pm 6F_M$	$J_7(M)$ $F \pm 7F_M$	$J_8(M)$ $F \pm 8F_M$	$J_9(M)$ $F \pm 9F_M$
0.0	1.000									
0.1	.9975	.0499								
0.2	.99	.0995								
0.3	.9776	.1483	.0112							
0.4	.9604	.196	.0197							
0.5	.9385	.2423	.0306							
0.6	.912	.2867	.0437							
0.7	.8812	.329	.0589	.0069						
0.8	.8463	.3688	.0758	.0102						
0.9	.8075	.4059	.0946	.0144						
1.0	.7652	.4401	.1149	.0196						
1.2	.6711	.4983	.1593	.0329	.005					
1.4	.5669	.5419	.2073	.0505	.0091					
1.6	.4554	.5699	.257	.0725	.0150					
1.8	.3400	.5815	.3061	.0988	.0232					
2.0	.2239	.5767	.3528	.1289	.034	.007				
3.0	−.2601	.3391	.4861	.3091	.1320	.0430	.0114			
4.0	−.3971	−.066	.3641	.4302	.2811	.1321	.0491	.0152		
5.0	−.1776	−.3276	.0466	.3648	.3912	.2611	.131	.0534	.0184	
6.0	.1506	−.2767	−.2429	.1148	.3576	.3621	.2458	.1296	.0565	.0212

To find the amplitude of any sideband pair, enter the table with the modulation index M, read the amplitude factor for the sideband pair and multiply the factor by the amplitude of the unmodulated carrier. The amplitude of the center frequency component is found in the same manner, taking the factor from the $J_0(M)$ column.

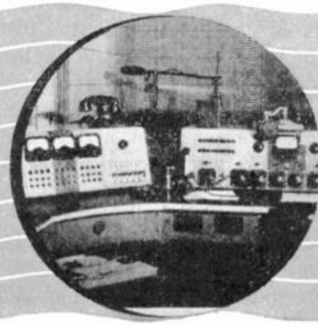
* Where no value is given, the actual value is less than .005 and the sideband pair is not important.

In Equipment for

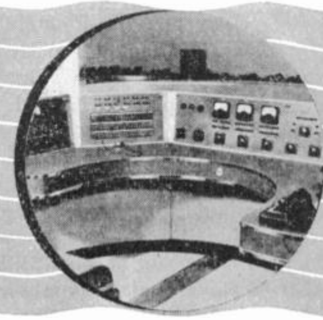
Before the war, RCA engineers had designed a complete line of equipment for FM broadcast stations. A considerable number of RCA-built, FM broadcast transmitters were installed and are on the air today. In the important (because it is chiefly used in New York, Chicago and other metropolitan centers) 10KW category, for instance, five RCA 10KW, FM transmitters have been installed. More than of any other make. An additional quantity of these transmitters was built but was diverted for war purposes.



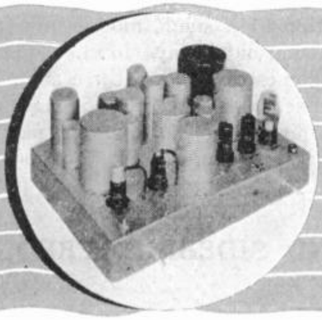
1. HIGH FIDELITY MICROPHONES—The RCA 44-BX Microphone is the standard of the industry. After the war, RCA will have even better microphones, insuring maximum FM response characteristics.



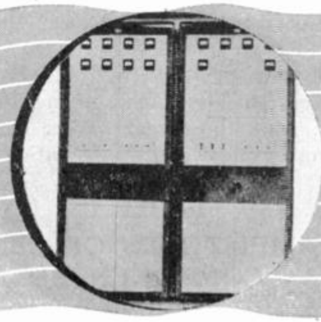
2. STUDIO CONSOLETTES — The RCA 76-B2 Consolette is well-suited for small and medium-sized FM stations and the individual studio booths of larger stations. Complete facilities for two studios, booth announcements, turntables, remotes, etc.



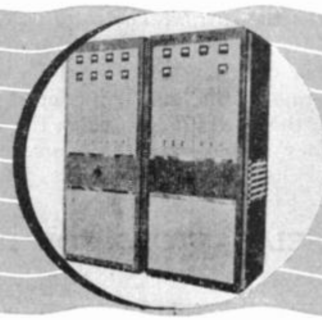
3. STUDIO CONSOLES— RCA, custom-built studio consoles are ideal for the high-quality requirements of FM. Shown here is the control console of FM Station WBRL, Baton Rouge, La.



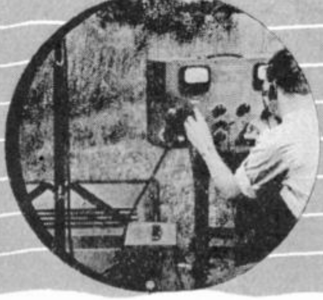
7. HIGH-QUALITY AMPLIFIERS—The several types of standard, RCA studio amplifiers are well-suited for FM use. All amplifiers have a flat frequency response, which may be compensated, when desired, for particular installations.



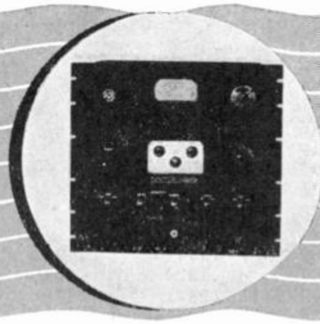
8. 1 KW FM TRANSMITTER—This is the RCA FM-1-B Transmitter, built before the war, a number of which were installed and are in operation. After the war, RCA will offer a complete new line of FM transmitters of all powers.



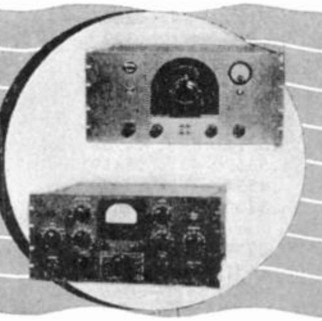
9. 3 KW FM TRANSMITTER—This is the RCA FM-3-B Transmitter, built and sold before the war. The same exciter is used in all RCA FM Transmitters from 1 KW to 50 KW.



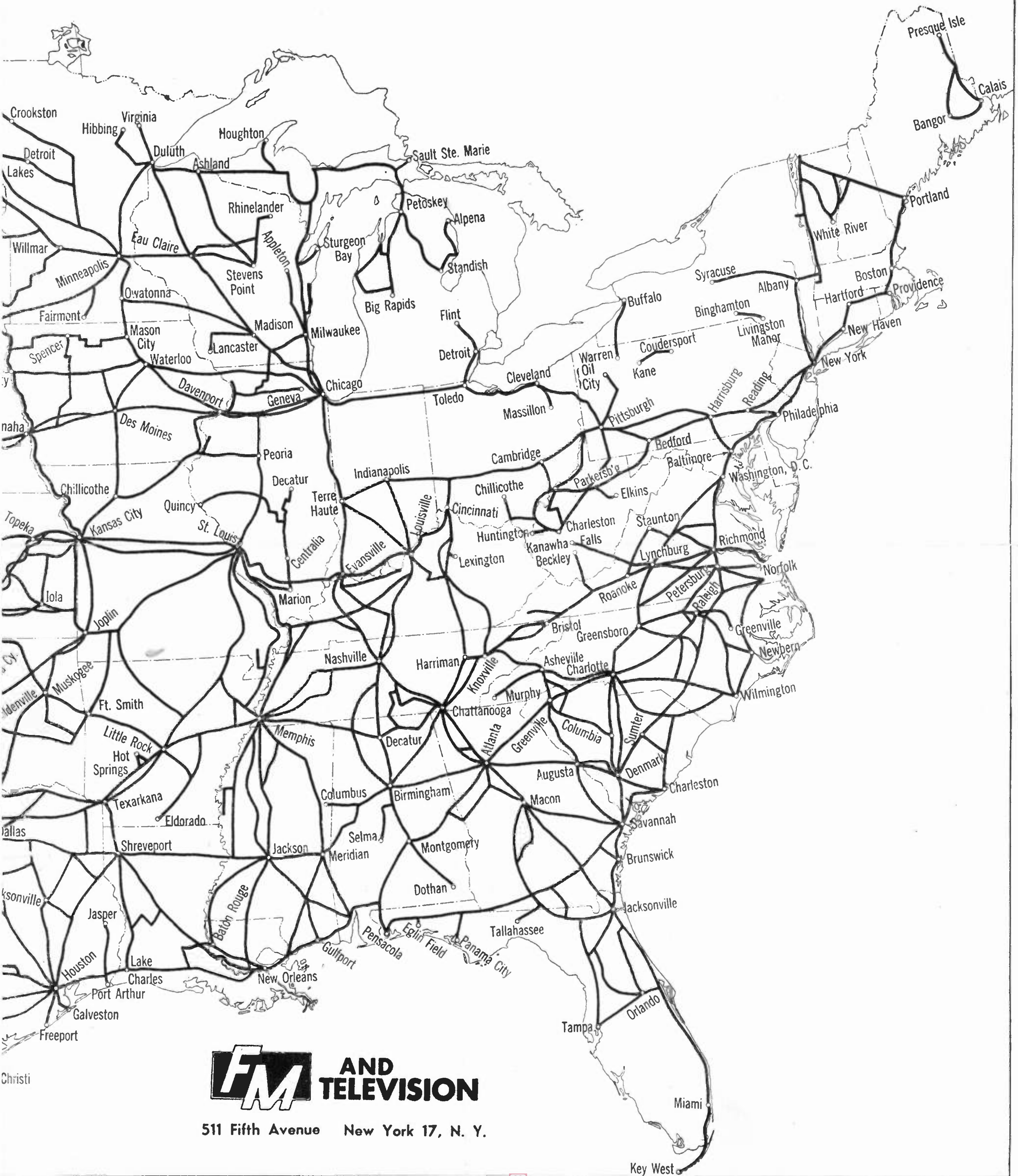
13. FM FIELD-INTENSITY METER—The RCA 301-B Field Intensity Meter, which has a frequency range of 20 to 125 megacycles—and a built-in discriminator circuit—is the only commercially produced unit suitable for FM use.



14. FM MONITORS — RCA FM frequency monitors and FM modulation monitors are the finest built for this specific purpose—are fully approved by the FCC for FM station use.

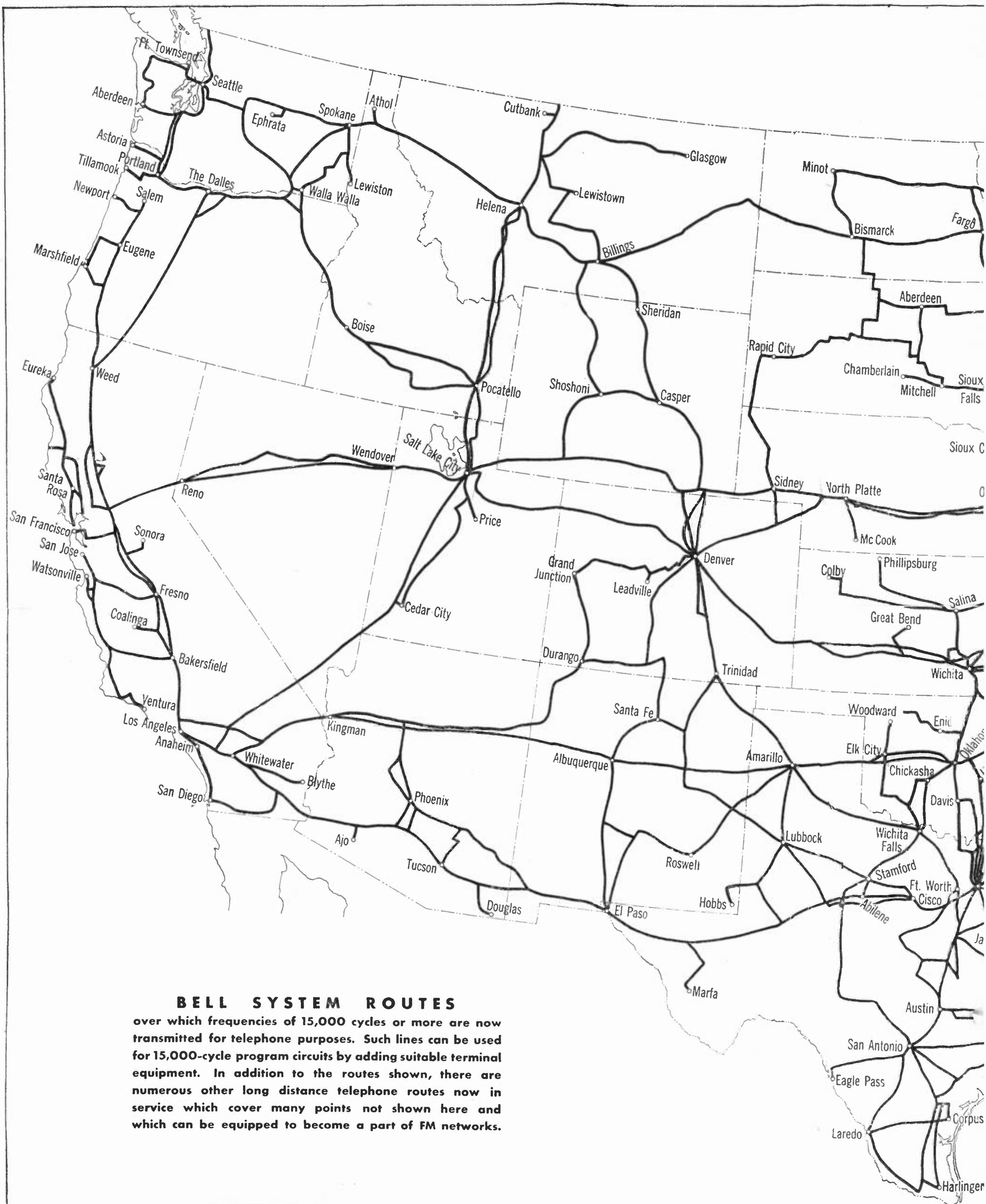


15. MEASURING EQUIPMENT — For making "proof-of-performance" measurements of AM noise level, FM noise level, frequency response and distortion, the RCA 68-B Oscillator and 69-C Distortion Meter are recommended.



FM AND TELEVISION

511 Fifth Avenue New York 17, N. Y.



BELL SYSTEM ROUTES

over which frequencies of 15,000 cycles or more are now transmitted for telephone purposes. Such lines can be used for 15,000-cycle program circuits by adding suitable terminal equipment. In addition to the routes shown, there are numerous other long distance telephone routes now in service which cover many points not shown here and which can be equipped to become a part of FM networks.

and below the carrier by the amount of the modulation frequency.

6. The modulation factor is defined as the ratio of the maximum variation from carrier level during modulation to the unmodulated carrier amplitude. As the modulation factor is increased, the amplitudes of the upper and lower sidebands increase in the same proportion, reaching a maximum of half the carrier amplitude when the modulation factor is at its maximum value of 100 per cent. The amplitude of the carrier component of the wave is unchanged during modulation.

7. Since only one pair of sidebands is produced during amplitude modulation, a band width of twice the modulating frequency is sufficient for satisfactory passage of the amplitude-modulated wave under any degree of modulation.

8. Inasmuch as amplitude modulation can only be effected in or near the final stage of the transmitter, a relatively large audio output is required to obtain the considerable increase in power output during modulation peaks.

9. In order to have the margin of safety necessary for handling the highest positive peaks of modulation, the tubes in the final stage of the radio frequency amplifier must be operated at considerably less than their normal ratings during carrier-level conditions; this tends to lower the overall efficiency of the transmitter.

Analysis of FM Wave ★ At the top of Fig. 6 is shown the form of a frequency-modulated wave. In the mathematical expression for the wave immediately beneath the diagram, F represents the carrier or mean frequency of the wave, and the audio modulating frequency is designated by F_M.

The amplitude of the FM wave, of course, is constant and the extent of modulation must be described in other terms than those of the amplitude-modulated wave.

When referring to a class of stations operating in the same service, a certain maximum frequency swing may be agreed upon by engineers as representing 100% modulation. For example, in the case of FM broadcast stations, a frequency swing of ±75 kc. from the unmodulated center frequency is commonly considered as being the equivalent of 100% modulation.

However, the more widely applicable method of describing the extent of modulation lies in stating the value of the modulation index. This index (M in the equations of Fig. 6) is simply the ratio of the amount by which the transmitted frequency swings from its average frequency to the amount of the modulating frequency. For example, if the modulating voltage has an amplitude sufficient to swing the transmitted frequency over the range ±5 kc., and the modulating frequency is 5,000 cycles, then the modulation index, M, is 5000/5000 or 1.

It is to be carefully noted, in describing the extent of frequency modulation, that the modulation percentage and the modulation index are defined in a different manner. The modulation percentage is proportional to the frequency swing. The modulation index is not only directly proportional to the frequency swing but also is inversely proportional to the highest modulating frequency. Thus, in contrast to amplitude modulation, the modulation index of a frequency-modulated wave is not the decimal equivalent of the modulation percentage. The modulation index of a frequency-modulated wave, for example, will exceed 1 by many times when the frequency swing is large and the modulating frequency is low.

By higher mathematics, it can be shown that the frequency-modulated output is the sum of a center frequency component and numerous pairs of sideband frequency components. The center frequency component has the same frequency as the unmodulated carrier. The two components of the first sideband pair have frequencies respectively higher and lower than the center frequency by the amount of the modulating frequency, just as in amplitude modulation. In frequency modulation, however, there are additional pairs of sideband components which can have appreciable amplitude. For example, the second pair of sidebands, having frequencies that are higher and lower than the center frequency by *twice* the amount of the modulating frequency, can also be important. The same can be true of the third pair of sidebands, which is removed from the center frequency by *three* times the modulating frequency, and of higher orders of sideband pairs whose frequencies differ from the center frequency by correspondingly greater amounts.

When the modulation is slight, only the pair of sidebands nearest in frequency to the carrier frequency component will have sufficient amplitude to be important. Under this condition, the band width required is no greater than for an amplitude-modulated wave.

As the frequency modulation is increased, however, more pairs of sidebands acquire appreciable amplitude and the band width requirements are greater than for amplitude modulation.

The actual amplitudes of the various components of the frequency-modulated wave, compared to an unmodulated carrier amplitude of 1, may be read directly from Table I for modulation indices up to 6.

Consider the case where the modulating frequency is 5,000 cycles and the frequency swing is ± 5 kc., making M equal to 5000/5000 or 1. For M of 1, $J_0(M)$ is 0.7652, indicating that the amplitude of the center frequency component is 76.52% of the amplitude of the unmodulated carrier. Similarly, the relative amplitude of each of the first pair of sidebands, of frequencies $F + 5{,}000$ cycles and $F - 5{,}000$ cycles, is $J_1(M) = .4401$ or 44 per cent. The second pair of sidebands, of $F \pm 10{,}000$ cycles, has a relative amplitude of 11.5%; and the third pair, of $F \pm 15{,}000$ cycles, has a relative amplitude of 1.96%. The fourth pair has an amplitude of less than .01 or 1%, and hence is considered unimportant.

The components have been plotted to a common scale of time in Fig. 6, so that graphical addition can be made to check the validity of the mathematical work.

Note particularly that the band width required depends upon the number of important pairs of sidebands as well as the modulating frequency; for this reason the band width required can be greater than the overall frequency swing resulting from modulation. In the case cited above, three pairs of sidebands are important. The frequencies of the third pair differ from the center frequency by the greatest amount and hence determine what band width will be needed. One of these sideband frequencies is higher than the center frequency by the amount of three times the modulating frequency of 5 kc., and the other sideband frequency is lower than the center frequency by the same amount. Thus the difference between the frequencies of the third pair of sidebands, which establishes the band width, is six times the modulating frequency of 5 kc., or 30 kc. The extent of the frequency swing is only ± 5 kc., or 10 kc. from peak to peak.

The values of $J_0(M)$, $J_1(M)$ and $J_2(M)$ over the range $M = 0$ to $M = 16$ are plotted in Fig. 7. A study of these curves reveals some interesting facts about the composition of frequency-modulated waves.

$J_0(M)$ is less than 1 for all values of M greater than zero. This indicates that as sideband components appear with modulation, the amplitude of the center frequency component is less than its amplitude in the absence of modulation. The reasonableness of this fact is evident when it is remembered that the amplitude of the frequency-modulated wave is constant, so that the average power during each radio frequency cycle is the same as that during any other radio frequency cycle. In order that the power in the wave may not change when frequency modulation causes sideband currents to appear, the amplitude of the center frequency component must decrease sufficiently to keep the total of the I^2R products of *all* the components equal to the power of the unmodulated wave.

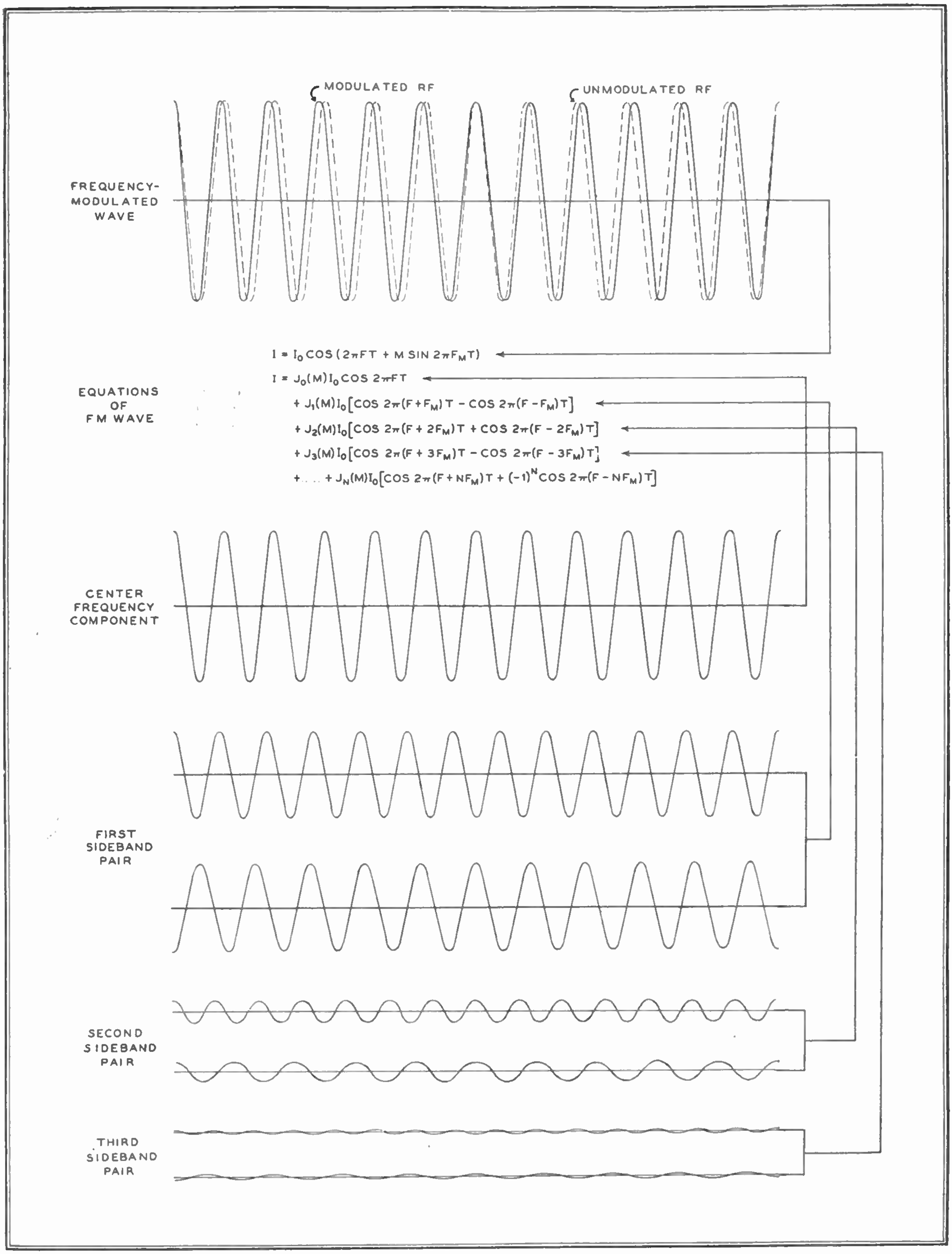


FIG. 6. THE FREQUENCY-MODULATED WAVE AND ITS COMPONENTS WHEN THE MODULATION INDEX IS 1

Fig. 7 also shows that at certain degrees of modulation the center frequency component disappears altogether. This fact is the basis of a certain method of modulation measurement to be discussed later. It will also be observed that at certain degrees of modulation the carrier component is negative, a reversal of phase.

When M is less than about .4, only the first pair of sidebands is important, and the relative amplitudes of sideband and carrier components can approach those of an amplitude-modulated wave. However, it should not be supposed that the two types of waves can be identical when both waves are slightly modulated. The sidebands of the FM wave are differently phased and add themselves to the carrier frequency component in a different manner from those of the AM wave.

Reference to Table I shows that for values of M between 0.4 and 3, the number of important sideband pairs is about $2M$. As M is made to exceed 3, the number of sideband pairs continues to increase but is somewhat less than $2M$. This information provides a useful rule of thumb for estimating the band width required, since the width needed is determined by the number of pairs of important sideband pairs that are present, as well as by the modulating frequency.

For example, if the amplitude of the modulating voltage of an FM station is such as to cause a frequency swing of ± 20 kc., and the frequency of the modulating voltage is 10 kc., then the value of M is 20/10 or 2. By the rule of thumb given above, the number of significant sideband pairs is $2M$ or 4. The total band width required is $4 \times 2 \times 10$ kc. or 80 kc. Again, the band width required (80 kc.) has been found to exceed the peak to peak frequency swing (40 kc.).

Suppose that while the frequency swing is maintained at ± 20 kc., the modulating frequency is reduced from 10 kc. to 4 kc. The modulation index becomes 20/4 or 5. The number of important sideband pairs can be expected to be somewhat less than $2M$ or 10. Reference to Table I shows the values of the factors for the carrier and successively higher orders of sideband pairs to range from − .1776 for $J_0(M)$ to .0184 for $J_8(M)$. For $J_9(M)$ and higher order factors, the amplitude is less than .01; hence the ninth and higher orders of sidebands are unimportant.

It is evident that the reduction in modulating frequency has caused the number of important sideband pairs to increase from three to eight. However, the band width required is now $2 \times 8 \times 4$ kc. or 64 kc., which is *less* than before.

In general, it can be said that for FM waves having the same frequency swing, the greatest spectrum area will be required by the wave having the highest modulating frequency. As the modulating frequency is lowered, more sidebands are created, but the number of sidebands does not increase as rapidly as the frequency interval between the sidebands is reduced; hence, the overall effect of lowering the modulating frequency while keeping the frequency swing unchanged is a reduction in the channel width.

If the modulating frequency is made very low, but the volume level is kept constant to maintain the same frequency swing, M becomes quite high and a veritable multitude of sideband pairs are created; however, the band width required is reduced still more, although it can never be less than the peak to peak frequency swing nor twice the modulating frequency, whichever is the greater.

For purposes of design, it is sufficient to consider the extreme condition of maximum frequency swing and highest modulating frequency. This presents the requirement for the greatest band width. If this requirement is satisfied, then the band width will be adequate for any condition of a lower modulation frequency and/or less frequency swing.

For example, consider the design of the output network of an FM broadcast transmitter whose maximum frequency swing is ± 75 kc. and whose maximum modulating frequency is 15 kc. The modulation factor M has a value of 75/15 or 5, indicating that eight important pairs of sidebands are present, as explained above. The band width of the output network theoretically should be $2 \times 8 \times 15$ kc. or 240 kc. The actual width employed can be slightly less because the amplitude of the eighth sideband pair is quite small, being only 1.84% of the unmodulated carrier amplitude. The band width used may be in the order of 225 kc., or 50% greater, in this case, than the peak to peak frequency swing of 150 kc.

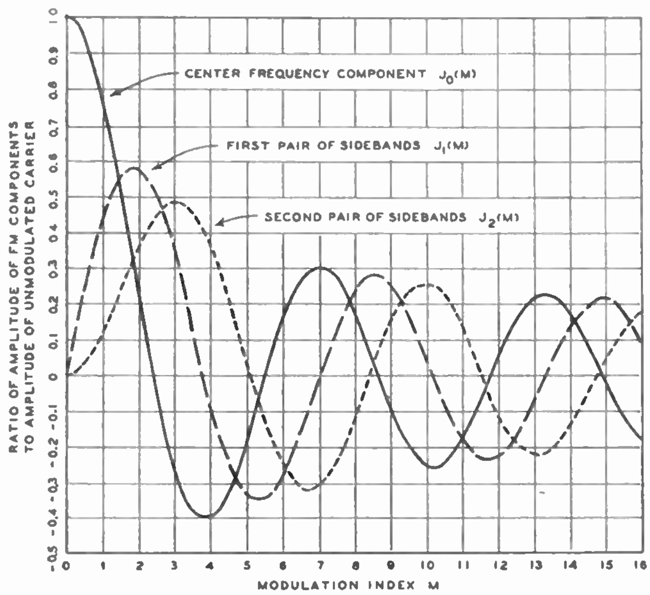


FIG. 7. HOW FM WAVE COMPONENTS VARY WITH THE DEGREE OF MODULATION

Summary of FM ✶ Frequency-modulated waves differ from amplitude-modulated waves in the following respects:

1. During modulation the frequency is varied but its amplitude remains unchanged.

2. A higher audio modulating frequency increases the rate at which the radio frequency is varied.

3. An increase in the amplitude of the audio modulating voltage causes the radio frequency to be varied over a wider range.

4. The limits of the range over which the radio frequency can be varied is determined by the characteristics of the transmitter, rather than by the nature of the frequency modulated wave.

5. When subjected to frequency modulation at a single modulating frequency

(CONTINUED ON PAGE 56)

RADIO DESIGNERS' ITEMS

(CONTINUED FROM PAGE 30)

Vertical Radiators: Antenna supporting poles for FM and television are among the illustrations contained in a brochure on vertical radiators issued by John E. Lingo & Son, Inc., Camden, New Jersey. Handy information is given for ground systems and FCC minimum radiator heights for all class stations throughout the standard broadcast band.

Hand Searchlight: Shown in Fig. 4, projects an intense beam 2,500 ft. or, with a snap-on lens, a diffused light over a large area. Current is supplied by a rugged 6-volt storage battery. The design is ideal for police use, or for night emergencies at broadcast stations. Manufactured by U-C Lite Mfg. Company, Chicago 11.

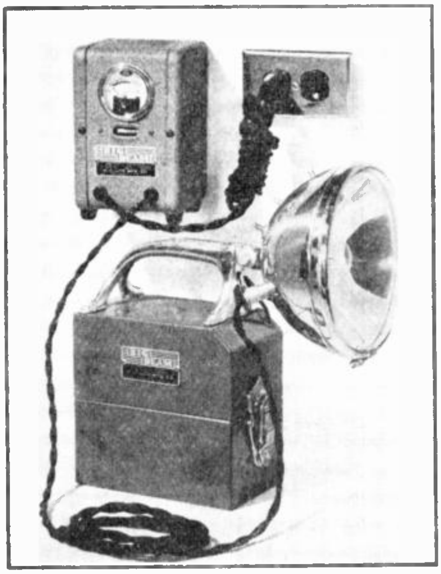


FIG. 4. LAMP THROWS 2500-FT. BEAM

Transformers of Reduced Weight: By the use of pressed steel end covers, Acme Electric Company, Cuba, N. Y., has reduced the weight of their air-cooled power transformers about 22%. This applied to types of 1 kva. to 15 kva. In some sizes, overall length has been reduced as much as 4½ ins.

Metal Finish: A chemical process for putting a black finish on ferrous parts has been developed by Turco Products, Inc., Los Angeles 1. An immersion process suited to ordinary plating equipment, it is said to be simpler than oxide finishing, and does not chip, flake, or peel off under repeated flexing. Finishing can be completed with non-drying oils, lacque, or synthetic resin. This process, known as Ferrotone, meets Army specification 57-0-2C, type 3, class A.

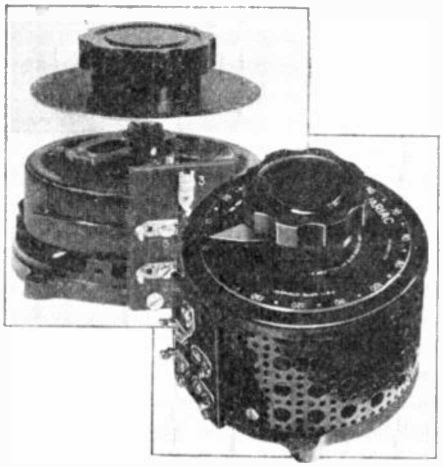


FIG. 5. 400-CYCLE VOLTAGE CONTROL

400-Cycle Voltage Control: A new model voltage control, type 60-A, rated at 400 cycles and 5 amperes at 115 volts has been added to General Radio's line of Variacs. It is illustrated in Fig. 5.

It can be used at any frequency between 400 and 2,600 cycles at 860 volt-amperes. Output voltages up to 135 volts can be obtained with a 115-volt input. A new type of brush and radiator construction is used so that the brushes can be changed, when necessary, in a few seconds. Overall height is 4⅛ ins. by 5½ ins. overall diameter. Weight cased is 3½ lbs.

Keying Relay: The aircraft-type relay shown in Fig. 6 has 7 poles, including the double-pole vacuum switch mounted outside the case. Life-tests show an ample margin beyond the 5,000,000 operations required by A-N specifications.

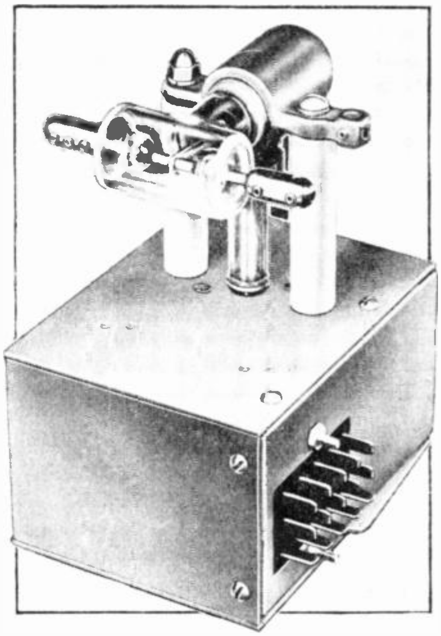


FIG. 6. NEW VACUUM KEYING RELAY

Plating on Glass & Ceramics: Is possible with a method offered by Electro Plastic Processes, Chicago 47. Adaptability to all temperature ranges for producing hermetic seals is indicated by tests of plating on Pyrex glass, in which plating is unaffected by heating parts to 350° F. and then immersing them in dry ice. It is claimed that glass or ceramic parts so plated can be soldered by ordinary irons, or oven or electronic methods, without the need of special solder.

Glass-Enclosed Resistors: A new series of wire-wound resistors, designed to exceed JAN-R-26 specifications of mechanical strength for power resistors, has been introduced by International Resistance Company, Philadelphia 8. Illustrated in Fig. 7, they correspond to A-N types RW-10F to RW-16F, with resistance values included in the 7 sizes from .1 to 46,000 ohms, and power ratings from 15 to 140 watts. Sealing between the ferrules and Pyrex glass enclosure is of pure lead which has a melting point well above the maximum operating temperature of 275°C.

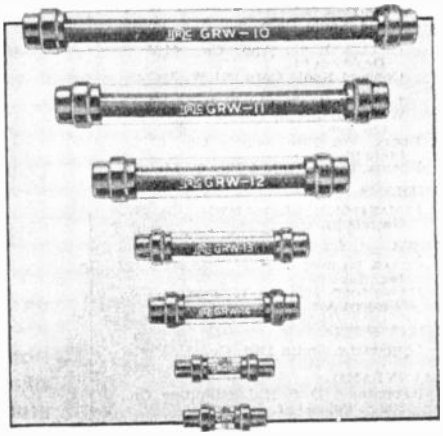


FIG. 7. JAN HEAVY-DUTY RESISTORS

Vacuum Condenser: A complete line of compact vacuum condensers has been developed by Industrial & Commercial Electronics, of Belmont, Calif.

These units are available in capacity values ranging from 10 to 110 mmf., in steps of 1 mmf. and accurate to plus or minus 1 mmf. In addition, a special grade is offered with capacity tolerances accurate to plus or minus 0.1 mmf.

Vest Pocket Resistor Chart: For quickly identifying values of color-coded resistors or determining correct markings for any given resistance can be obtained on request to Stackpole Carbon Company, St. Marys, Pa. Coding shown is for American War Standard, A-N, and R.M.A. specifications. Ask for the VPR Chart.

FM & TELEVISION PRODUCTS DIRECTORY

The Radio Engineers' & Purchasing Agents' Guide to Essential Materials, Components, and Equipment

NEW LISTINGS ADDED THIS MONTH

Company addresses will be found in the Directory listings

We shall be pleased to receive suggestions as to company names and hard-to-find items which should be added to this Directory

NOTE: For the convenience of engineers and purchasing agents, we have added, under the heading "SUPPLY HOUSES," a list of parts jobbers in 48 cities. These houses carry large stocks of components, instruments, and tubes, and are prepared to fill mail or telegraph orders.

AMPLIFIERS, Studio
Langevin Co.

ANTENNAS, Built-in Loop
Sickles Co., F W

BUSHINGS, Terminal Sealing
Sprague Electric Co.

CABINETS, Metal
Corry-Jamestown Mfg. Corp.
Porter Metal Prod. Co.

CHOKES, AF
Langevin Co.

COUPLINGS, Flexible
Hammarlund Mfg. Co.

FREQUENCY STANDARDS, Secondary
James Knights Co.

HANDSETS, Telephone
Stromberg-Carlson Co.

HORNS, Outdoor
Langevin Co.

INDUCTORS, Variable Tuning
Standard Winding Co.

MYCALEX
Intl. Products Corp.

PLUGS, Coaxial
Andrew Co.

PLUGS, Miniature Battery
Intl. Resist. Co.

RADIO RECEIVERS & TRANSMITTERS
Admiral Corp.
Ansley Radio Corp.
Com. Equip. Corp.
Hoffman Radio Corp.
Howard Pacific Corp.
Intl. Detrola Corp.
Meissner Mfg. Co.
Packard Bell Co.
Remler Co. Ltd.
Trav-Ler Karenola Corp.
Wilcox-Gay Corp.

RELAYS, Hermetically Sealed
Betts & Betts Corp.

RELAYS, Vacuum
Ind. & Com. Electronics
Struthers Dunn Inc.

SHIELDS, Tube
Eby Inc., H. H.
Hammarlund Mfg. Co.

SPEAKERS, Cabinet Mounting
Langevin Co.
Operadio Mfg. Co.

SUPPLY HOUSES
Tydings Co.

TRANSFORMERS, RECEIVER Audio & Power
Howard Pacific Corp.
Langevin Co.
Peerless Elec. Prod. Co.

SUPPLY HOUSES

CALIFORNIA
SAN FRANCISCO, Zack Radio Supply Co., 1426 Market St.

CONNECTICUT
BRIDGEPORT, Hatry & Young, 117 Cannon St.
HARTFORD
Hatry & Young, 203 Ann St.
Scell & Co., 227 Asylum St.
NEW HAVEN, Hatry & Young, 1172 Chapel St.

DISTRICT OF COLUMBIA
WASHINGTON, Southern Wholesalers, Inc., 1519 L St. N. W.

GEORGIA
ATLANTA
Concord Radio Corp 265 Peachtree St.
Yancey Co., Inc., W. Peachtree St.
MACON, Specialty Dist. Co.
SAVANNAH, Specialty Dist. Co.

ILLINOIS
CHICAGO
Allied Radio Corp., 833 W. Jackson Blvd.
Chicago Radio App. Co., 4155 S. Dearborn St.
Concord Radio Corp 901 W. Jackson Blvd.
Radio Parts Co 612 W Randolph St
Walker-Jimieson, Inc., 311 S. Western Ave.
ELGIN, Fox Elec. Supply Co., 67 N. State St.
PEORIA, Klaus Radio & Elec Co Main St

INDIANA
INDIANAPOLIS, Kiefer-Stewart Co., W. Georgia St.

IOWA
CEDAR RAPIDS, Checker Elec. Supply, Inc., 1st S. E.
DAVENPORT, Midwest-Timmerman Co., Western Ave.

KENTUCKY
LOUISVILLE, Smith Dist. Co., E. B'way

MARYLAND
BALTIMORE, D & H Distributing Co., 202 S. Pulaski St.

MASSACHUSETTS
BOSTON, Radio Wire Television, Inc., 110 Federal St.
CAMBRIDGE, Eastern Co.
SPRINGFIELD, Cushing, T. F.
WORCESTER, Radio Maint. Supply Co.

MICHIGAN
FLINT, Shand Radio Spec., W. Kearsley St.

MISSOURI
KANSAS CITY, Burstein Applebee Co., 1012 McGee St.
ST. LOUIS, Interstate Supply Co., 10th & Walnuts Sts.

NEW JERSEY
NEWARK
Radio Wire Television, Inc., 24 Central Ave.
Krich-Radisco Inc 422 Elizabeth Ave
Lippman & Co., Aaron, 246 Central Ave.

NEW YORK
BINGHAMTON, Morris Distributing Co., Inc., 25 Henry St.
GLOVERSVILLE, Fulton County Dist. Co.
ITHACA, Stallman of Ithaca, N. Tioga St.
NEW YORK
Bruno-New York Inc 460 W 34th St
Com. Radio-Sound Corp., 570 Lexington Ave.
Harrison Radio Corp., 12 W. B'way
Harvey Radio Co., 103 W. 43 St., N. Y. C.
Radio Wire Television, Inc., 100 Sixth Ave.
Sanford Electronics Corp., 136 Liberty St.
Sun Radio & Electronics Co., 212 Fulton St.
Terminal Radio Corp., 85 Cortlandt St.
SYRACUSE, Morris Distributing Co., Inc., 412 S. Clinton St.

NORTH CAROLINA
RALEIGH, Southeastern Radio Supply Co., E. Hargett St.

OHIO
CLEVELAND, Goldhamer Inc Huron Rd

PENNSYLVANIA
HARRISBURG, D & H Distributing Co., 3115 Cameron St.
PHILADELPHIA, Radio Elec. Service Co., 7th & Arch Sts.
PITTSBURGH
Cameradio Co., 963 Liberty St.
Tydings Co., 623 Grant St.

RHODE ISLAND
PROVIDENCE, Edwards Co., W. H., 94 B'way

SOUTH DAKOTA
SIOUX FALLS, Power City Radio Co., S. Main Ave.

TENNESSEE
KNOXVILLE, McClung Co., C. M.
MEMPHIS, Bluff City Dist. Co., Union Ave.
NASHVILLE, Electra Dist Co W End Ave

TEXAS
HOUSTON, Hall, R.C. & L.F. Caroline St.

UTAH
SALT LAKE CITY, Radio Studios, Inc., E. B'way

VIRGINIA
DANVILLE, Five Forks Battery Station
RICHMOND, Wyatt-Cornick, Inc., Grace St.

WASHINGTON
SEATTLE
Seattle Radio Supply, Inc., 2nd Ave.
Zobrist Co., 2016 Third Ave.

WEST VIRGINIA
CHARLESTON, Chemcity Radio Elec. Co., E. Washington St.
MORGANTOWN, Trenton Radio Co.

WISCONSIN
RACINE, Standard Radio Parts Co., State St.

AIRPORT RADIO Installations
Aircraft Accessories Corp., Funston Rd., Kansas City, Kans.
Air Associates, Inc., Los Angeles, Calif.
Bendix Radio, Towson, Md.
Collins Radio Co Cedar Rapids Ia
Communications Equip. Corp., 134 Colorado St., Pasadena, Calif.
Erco Radio Labs. Inc., Hempstead, L. I., N. Y.
Radio Receptor Co., Inc., 251 W. 19 St., N. Y. C.

AMPLIFIERS, Public Address
David Bogen Co Inc 663 Bway NYC 12
Langevin Co 37 W 65 St N Y C 23
Operadio Mfg. Co St Charles Ill
Radio Corp. of Amer. Camden N J
Western Electric Co 195 Bway N Y C

AMPLIFIERS, Studio
Fairchild Camera & Inst Corp Jamaica 1 N Y
Langevin Co 37 W 65 St N Y C 23
Radio Corp. of Amer. Camden N J
Western Electric Co 195 Bway N Y C

ANTENNAS, Loop, Built-in
DX Crystal Co 1200 N Claremont Ave Chicago 22
Sickles Co F W, Chicopee Mass.

ANTENNAS, Mobile Whip & Collapsible
Air Associates, Inc., Los Angeles
Aircraft Accessories Corp., Funston Rd., Kansas City, Kans.
Bendix Aviation Corp., Pacific Div., 116 Sherman Way, N. Hollywood
Birnbach Radio Co., 145 Hudson St., N. Y. C.
Brach Mfg. Corp., L. S., Newark, N. J.
Camburn Elec. Co., 484 Broome St., N. Y. C.
Galvin Mfg. Corp., Chicago, Ill.
Link, F. M., 125 W. 17th St., N. Y. C.
Premax Products, 4214 Highland Ave., Niagara Falls, N. Y.
Radio Eng. Labs., Inc., L. I. City, N. Y.
Snyder Mfg. Co., Noble & Darien Sts., Phila.
Tech. Appl. Co., 516 W. 34 St., N. Y. C.
Ward Products Corp., 1523 E. 45 St., Cleveland, O.

ANTENNAS, Tower Type
Blaw-Knox Co., Pittsburgh, Pa.
Harco Steel Cons. Co., E. Broad St., Elizabeth, N. J.
Lehigh Structural Steel Co., 17 Battery Pl., N. Y. C.
Lingo & Son, John E., Camden, N. J.
Truscon Steel Co., Youngstown, O.
Wincharger Corp., Sioux City, Iowa

ATTENUATORS
Cinema Engineering Co., Burbank, Calif.
Daven Co., Summit Ave., Newark, N. J.
General Radio Co., Cambridge, Mass.
Intl. Resistance Co 429 Broad St Phila
Mallory & Co., P. R., Indianapolis, Ind.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago
Remler Co., Ltd., 2101 Bryant St., San Francisco
Shallcross Mfg. Co., Collingdale, Pa.
Tech Labs, Lincoln St Jersey City N J
Utah Radio Prod. Co., 842 Orleans St., Chicago

BEADS, Insulating
Amer. Lava Corp., Chattanooga, Tenn.
Corning Glass Works, Corning, N. Y.
Star Porcelain Co., Trenton, N. J.
Steward Mfg. Co., Chattanooga, Tenn.

BEARINGS, Glass Instrument
Bird, Richard H., Waltham, Mass.

BERYLLIUM
Clifton Products Inc Painesville O

BINDING POSTS, Plain
Amer. Radio Hdware Co., Mt. Vernon, N. Y.
Franklin Mfg. Corp., 175 Varick St., N. Y. C.
Radex Corp., 1308 Elston Ave., Chicago

BINDING POSTS, Push Type
Amer Radio Hdware Co., Mt. Vernon, N. Y.
Eby, Inc., H. H., W. Chelten Ave., Phila.

BLOWERS, for Radio Equipment
L-R Mfg. Co., Torrington, Conn.
Trade-Wind Motorfans, Inc., 5725 S. Main St., Los Angeles

BOOKS on Radio & Electronics
Macmillan Co., 60 Fifth Ave., N. Y. C.
Maedel Pub. House, 593AE 38 St., Bklyn, N. Y.
McGraw-Hill Book Co., 330 W. 42 St., N. Y. C.
Pitman Pub. Corp., 2 W. 45 St., N. Y. C.
Radio Tech. Pub. Co., 45 Astor Pl., N. Y. C.
Rider, John F., 404 Fourth Ave., N. Y. C.
Ronald Press Co., 15 E. 26 St., N. Y. C.
Van Nostrand Co., D., 250 Fourth Ave., N. Y. C.
Wiley & Sons, John, 440 Fourth Ave., N. Y. C.

BRIDGES, Percent Limit Resistance
Leeds & Northrup Co., 4901 Stenton Ave., Phila.
Radio City Products Co., 127 W. 26 St., N. Y. C.
Shallcross Mfg. Co., Collingdale, Pa.

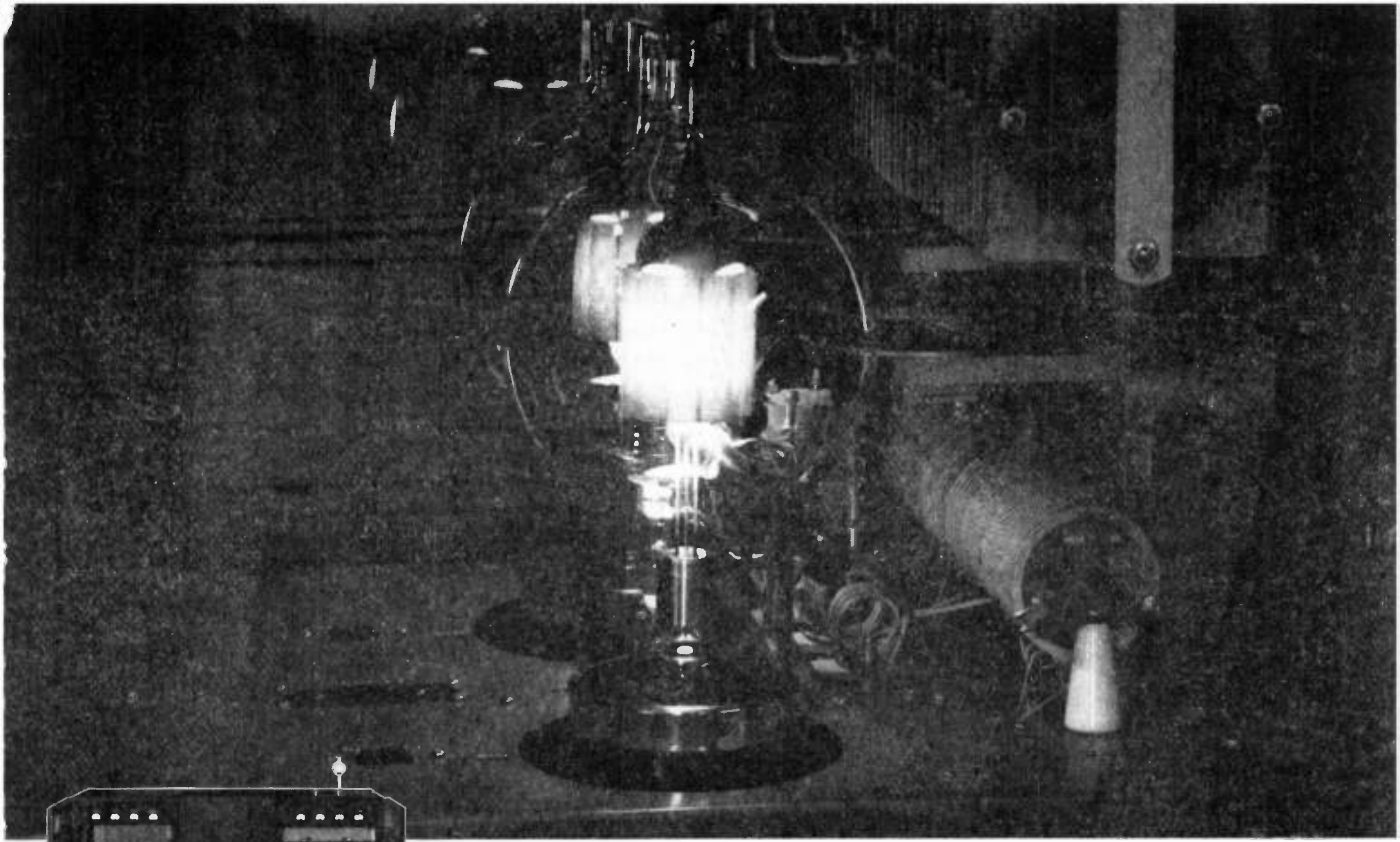
BRIDGES, Wheatstone
Industrial Instruments, Inc., Culver Ave., Jersey City, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Phila.
Shallcross Mfg. Co., Collingdale, Pa.

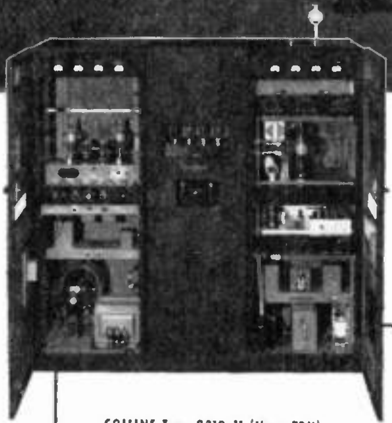
BUSHINGS, Terminal Sealing
Corning Glass Works, Corning, N. Y.
Electrical Industries, Inc., 42 Sumner Ave., Newark 4, N. J.
Lenox Inc Trenton 5 N J
Peerless Electrical Prod. Co., 6920 McKinley Ave., Los Angeles 1
Sperti, Inc., Cincinnati, O.
Sprague Elec Co N Adams Mass
Westinghouse Elect. & Mfg. Co., E. Pittsburgh, Pa.

CABINETS, Metal
Cole Steel Equip. Co 349 Bway N Y C
Corry-Jamestown Mfg Corp Corry Pa
Insuline Corp of Amer L I City N Y
Karp Metal Prod. Co Inc 126 30th St Bklyn 31
Par-Metal Prod. Corp., 32–49th St., L. I. City, N. Y.
Porter Metal Prod Co 490 Johnson Av Bklyn

CABINETS, Wood, for Home Radios
Churchill Cabinet Co., 2119 Churchill St., Chicago
Tillotson Furniture Co., Jamestown, N. Y.

CABLE, Coaxial
American Phenolic Corp., 1830 S. 54 Av., Chicago
Anaconda Wire & Cable Co., 25 B'way, N. Y. C.
Andrew Co 363 E 75 St Chicago
Belden Mfg. Co., 4673 W. Van Buren, Chicago
Boston Ins Wire & Cable Co Boston
Comm Prods Co 346 Bergen Av Jersey City 5 N J
Cornish Wire Co., 15 Park Row, N. Y. C.





Doolittle Radio, Inc., 7521 S. Loomis Blvd., Chicago
General Cable Corp., 420 Lexington, N. Y. C.
General Insulated Wire Corp., 53 Park Pl., N. Y. C.
Johnson Co., E. F., Waseca, Minn.
Lenz Electrical Mfg. Co.
Radex Corp., 1308 Elston Ave., Chicago
Simplex Wire & Cable Corp., Cambridge, Mass.

CABLE, Coaxial, Fittings

Andrew Co 363 E 75 St Chicago
Comm Prod Co 346 Bergen Av Jersey City 5 N J
Johnson Co, E. F. Waseca Minn

CABLE, Coaxial, Solid Dielectric

American Phenolic Corp., 1830 S. 54 Ave., Chicago
Federal Tel. & Radio Corp., E. Newark, N. J.
Simplex Wire & Cable Corp., Cambridge, Mass.

CABLE, Microphone, Speaker & Battery

Alden Prods. Co., Brockton, Mass.
Anaconda Wire & Cable Co., 25 Broadway, N. Y. C.
Belden Mfg. Co., 4633 W. Van Buren, Chicago
Boston Insulated Wire & Cable Co., Dorchester, Mass.
Gavitt Mfg. Co., Brookfield, Mass.
Holyoke Wire & Cable Corp., Holyoke, Mass.
Universal Microphone Co., Inglewood, Calif.

CABLES, Preformed

Belden Mfg. Co., 4633 W. Van Buren St., Chicago
Wallace Mfg. Co., Wm. T., Rochester, Ind.
Whitaker Cable Corp Kansas City 16 Mo

CASES, Wooden Instrument

Hoffstatter's Sons, Inc., 43 Ave. & 24 St., Long Island City, N. Y.
Tillotson Furniture Co., Jamestown, N.Y.

CASTINGS, Die

Aluminum Co. of Amer., Pittsburgh, Pa.
American Brass Co., Waterbury, Conn.
Dow Chemical Co., Dow Metal Div., Midland, Mich.

CERAMICS, Bushings, Washers, Special Shapes

Akron Porcelain Co., Akron, O.
Amer. Lava Corp., Chattanooga, Tenn.
Centralab, Div. of Globe-Union Inc., Milwaukee, Wis.
Corning Glass Works, Corning, N. Y.
Electronic Mechanics, Inc., Paterson, N. J.
Gen'l Ceramics & Steatite Corp., Keasbey, N. J.
Isolantite, Inc., Belleville, N. J.
Lapp Insulator Co., Leroy, N. Y.
Lenox, Inc., Trenton, N. J.
Louthan Mfg. Co., E. Liverpool, O.
Star Porcelain Co., Trenton, N. J.
Steward Mfg. Co., Chattanooga, Tenn.
Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.
Victor Insulator Co., Victor, N. Y.
Westinghouse Elect. & Mfg. Co., E. Pittsburgh, Pa.

CHASSIS, Metal

See STAMPINGS, Metal

CHOKES, AF

Hadley Co., R. M., 707 E. 61 St., Los Angeles
Langevin Co 37 W 65 St N Y C 23

CHOKES, RF

Aladdin Radio Industries, 501 W. 35th, Chicago
Alden Prods. Co., Brockton, Mass.
American Communications Corp., 306 B'way, N. Y. C.
Automatic Winding Co., Inc., Passaic Ave. E., Newark, N. J.
Barker & Williamson, Upper Darby, Pa.
Coto-Coil Co., Providence, R. I.
D-X Radio Prods. Co., 1575 Milwaukee, Chicago
Fast & Co., John E., 3109 N. Crawford, Chicago 41
Gen. Winding Co., 420 W. 45 St., N. Y. C.
Guthman & Co., Edwin, 15 S. Throop, Chicago
Hammarlund Mfg. Co., 424 W. 33 St., N. Y. C.
Johnson Co., E. F., Waseca, Minn.
Lectrohm, Inc., Cicero, Ill.
Meissner Mfg. Co., Mt. Carmel, Ill.
Miller Co., J. W., 5917 S. Main, Los Angeles, Cal.
Muter Co., 1255 S. Michigan, Chicago
National Co., Malden, Mass.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago
Radex Corp., 1328 Elston Av., Chicago
Sickles Co., F. W. Chicopee, Mass.
Teleradio Eng. Corp., 484 Broome St., N. Y. C.
Triumph Mfg. Co., 913 W. Van Buren St., Chicago

CLIPS, Connector

Mueller Electric Co., Cleveland, O.

CLIPS & MOUNTINGS, Fuse

Alden Prods. Co., Brockton, Mass.
Dante Elec. Mfg. Co., Bantam, Conn.

Ilsco Copper Tube & Prods., Inc., Station M., Cincinnati
Jefferson Elec. Co., Bellwood, Ill.
Jones, Howard B., 2300 Wabansia, Chicago
Littlefuse, Inc., 4753 Ravenswood, Chicago
Patton MacGuyer Co., Providence, R. I.
Sherman Mfg. Co., H. B., Battle Creek, Mich.
Stewart Stamping Co., 621 E. 216 St., Bronx, N. Y.
Zierick Mfg. Co., 385 Girard Ave., Bronx, N. Y. C.

CLOTH, Insulating

Acme Wire Co., New Haven, Conn.
Brand & Co., Wm., 276-4th Av., N. Y. C.
Endurette Corp. of Amer., Cliffwood, N. J.
Insulation Mfgrs. Corp., 565 W. Wash. Blvd., Chicago
Irvington Varnish & Insulating Co., Irvington, N. J.
Mica Insulator Co., 196 Varick, N. Y. C.

COIL FORMS, Glass

Corning Glass Works, Corning, N. Y.

COILS, Radio

See Transformers, IF, RF

CONDENSERS, Ceramic Case Mica Transmitting

Aerovox Corp., New Bedford, Mass.
Cornell-Dubilier, S. Plainfield, N. J.
RCA Mfg. Co., Inc., Camden, N. J.
Sangamo Electric Co., Springfield, Ill.
Solar Mfg. Corp., Bayonne, N. J.

CONDENSERS, Fixed

Aerovox Corp., New Bedford, Mass.
American Condenser Corp., 2508 S. Michigan, Chicago
Art Radio Corp., 115 Liberty, N. Y. C.
Atlas Condenser Prods. Co., 548 Westchester Ave., N. Y. C.
Automatic Winding Co., E. Newark, N. J.
Bud Radio, Inc., Cleveland, O.
Capacitron Co 318 W Schiller Chicago 10
Centralab, Milwaukee, Wis.
Condenser Corp. of America, South Plainfield, N. J.
Condenser Prods. Co., 1375 N. Branch, Chicago
Cornell-Dubilier Elec. Corp., S. Plainfield, N. J.
Cosmic Radio Co 699 E 135th St N Y C
Crowley & Co., Henry, W. Orange, N. J.
Deutschmann Corp Tobe Canton Mass
Dumont Elec. Co., 34 Hubert St., N. Y. C.
Electro-Motive Mfg. Co., Willimantic, Conn.
Erie Resistor Corp., Erie, Pa.
Fast & Co., John E., 3109 N. Crawford, Chicago 41
General Electric Co Schenectady N Y
General Radio Co., Cambridge, Mass.
Girard-Hopkins, Oakland, Calif.
Guthman & Co., Edwin I., 15 S. Throop St., Chicago
H. R. S. Prods, 5707 W. Lake St., Chicago
Illinois Cond. Co., 1160 Howe St., Chicago
Industrial Cond. Corp., 1725 W. North Av., Chicago
Insuline Corp. of America, Long Island City, N. Y.
Johnson Co., E. F., Waseca, Minn.
Magnavox Co., Fort Wayne, Ind.
Mallory & Co., P. R., Indianapolis, Ind.
Micamold Radio Corp., Brooklyn, N. Y.
Muter Co., 1255 S. Michigan, Chicago
Noma Electric Corp 55 W 13 St N Y C
Polymet Condenser Co., 699 E. 139 St., N. Y. C.
Potter Co., 1950 Sheridan Rd., N. Chicago
RCA Mfg. Co., Camden, N. J.
Sangamo Elec. Co., Springfield, Ill.
Sickles Co., F. W., Chicopee, Mass.
Solar Mfg. Corp., Bayonne, N. J.
Sprague Specialists Co., N. Adams, Mass.
Teleradio Engineering Corp., 484 Broome St., N. Y. C.
Westinghouse Elect. & Mfg. Co., E. Pittsburgh, Pa.

CONDENSERS, Gas-filled

Johnson Co, E. F. Waseca Minn
Lapp Insulator Co., Inc., Leroy, N. Y.

CONDENSERS, High-Voltage Vacuum

Centralab, Milwaukee, Wis.
Eitel-McCullough, Inc., San Bruno, Calif.
Erie Resistor Corp., Erie, Pa.
General Electric Co., Schenectady, N. Y.
General Electronics, Inc., Paterson, N. J.

CONDENSERS, Small Ceramic Tubular

Centralab: Div. of Globe-Union, Inc., Milwaukee, Wis.
Erie Resistor Corp., Erie, Pa.

CONDENSERS, Transmitter Neutralizing

Hammarlund Mfg Co 424 W 34 St N Y C
Johnson Co, E. F. Waseca Minn
National Co Inc Malden Mass
Millen Mfg Co Inc Malden Mass

CONDENSERS, Variable Receiver Tuning

Alden Prods. Co., Brockton, Mass.
American Steel Package Co., Defiance, Ohio
Barker & Williamson, Ardmore, Pa.
Bud Radio, Inc., Cleveland, O.
Cardwell Mfg. Corp., Allen D., Brooklyn, N. Y.
General Instrument Corp., Elizabeth, N. J.
Hammarlund Mfg. Co., 424 W. 34th St., N. Y. C.
Insuline Corp. of Amer., L. I. City, N. Y.
Meissner Mfg. Co., Mt. Carmel, Ill.
Millen Mfg. Co., Malden, Mass.
National Co., Malden, Mass.
Oak Mfg. Co., 1267 Clybourn Ave., Chicago
Radio Condenser Co., Camden, N. J.
Rauland Corp., Chicago, Ill.

CONDENSERS, Variable Transmitter Tuning

Barker & Williamson, Upper Darby, Pa.
Bud Radio, Cleveland, O.
Cardwell Mfg. Corp., Allen D., Brooklyn, N. Y.
Hammarlund Mfg. Co., 424 W. 33 St., N. Y. C.
Insuline Corp. of Amer., L. I. City, N. Y.
Johnson, E. F., Waseca, Minn.
Millen Mfg. Co., James, Malden, Mass.
National Co., Malden, Mass.
Radio Condenser Co., Camden, N. J.

CONDENSERS, Variable Trimmer

Alden Prods. Co., Brockton, Mass.
American Steel Package Co., Defiance, O.
Bud Radio, Inc., Cleveland, O.
Cardwell Mfg. Corp., Brooklyn, N. Y.
Centralab, Milwaukee, Wis.
Fada Radio & Elec. Corp., Long Island City, N. Y.
General Radio Co., Cambridge, Mass.
Guthman, Inc., E. I., 400 S. Peoria, Chicago
Hammarlund Mfg. Co., 424 W. 33 St., N. Y. C.
Insuline Corp. of America, Long Island City, N. Y.
Johnson Co. E. F., Waseca, Minn.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Meissner Mfg. Co., Mt. Carmel, Ill.
Millen Mfg. Co., James, Malden, Mass.
Miller Co., J. W., Los Angeles, Cal.
Muter Co., 1255 S. Michigan Av., Chicago
National Co., Malden, Mass.
Potter Co., 1950 Sheridan Rd., N. Chicago
Sickles Co., F. W., Chicopee, Mass.
Solar Mfg. Corp., Bayonne, N. J.
Teleradio Eng. Corp., 484 Broome, N. Y. C.

CONNECTORS, Cable

Aero Electric Corp., Los Angeles, Calif.
Alradio, Inc., Stamford, Conn.
Alden Prods., Brockton, Mass.
Amer. Microphone Co., 1915 S. Western Av., Los Angeles
Amer. Phenolic Corp., 1830 S. 54th St., Chicago
Amer. Radio Hdware Co., Mt. Vernon, N. Y.
Andrew Co 363 E 75 St Chicago
Astatic Corp., Youngstown, O.
Atlas Sound Corp., 1442 39th St., Brooklyn, N. Y.
Birnbach Radio, 145 Hudson St., N. Y. C.
Breeze Mfg. Corp., Newark, N. J.
Brush Development Co., Cleveland, O.
Bud Radio, Cleveland, Ohio
Cannon Elec. Development, 3209 Humboldt, Los Angeles
Diamond Inst. Co Wakefield Mass
Eby, Inc., Hugh H., Philadelphia
Electro Voice Mfg. Co., South Bend, Indiana
Franklin Mfg. Corp., 175 Varick St. N. Y. C.
General Radio Co., Cambridge, Mass.
Intl. Resistance Co 401 N Broad St Phila 8
Harwood Co., 5405 S. La Brea, Los Angeles 36
Insuline Corp. of Amer., L. I. City, N. Y.
Jones, Howard B., 2432 W. George, Chicago
Mallory & Co., P. R., Indianapolis, Ind.
Monowatt Electric Co., Providence, R. I.
Northam Warren Corp., Stamford, Conn.
Radio City Products Co., 127 W. 26 St., N. Y. C.
Remler Co., Ltd., 2101 Bryant St., San Francisco
Schott Co., W. L., 9306 Santa Monica Blvd., Beverly Hills, Calif.
Selectar Mfg. Co., L. I. City, N. Y.
Universal Microphone Co., Ltd., Inglewood, Calif.

CONTACT POINTS

Brainin Co., C. S., 233 Spring St., N. Y. C.
Callite Tungsten Corp., Union City, N. J.
Fansteel Metallurgical Corp., N. Chicago, Ill.
Mallory & Co., Inc., P. R., Indianapolis, Ind.

CORES, Powdered Iron

See IRON CORES, Powdered

COUPLINGS, flexible

Cardwell Mfg. Corp., Brooklyn, N. Y.
Johnson Co., E. F., Waseca, Minn.
Hammarlund Mfg Co Inc 460 W 34 St N Y C
Millen Mfg. Co., James, Malden, Mass.
National Co., Inc., Malden, Mass.

CRYSTAL GRINDING EQUIPMENT

Cons. Diamond Saw Blade Corp., Yonkers Ave., Yonkers 2, N. Y.
Felker Mfg. Co., Torrance, Calif.

CRYSTAL HOLDERS

REC Mfg. Co., Holliston, Mass.
Howard Mfg. Co., Council Bluffs, Ia.

CRYSTALS, Quartz

Aircraft Accessories Corp., Funston Rd., Kansas City, Kans.
Bausch & Lomb Optical Co., Rochester, N. Y.
Bliley Elec. Co., Erie, Penna.
Collins Radio Co., Cedar Rapids, Iowa
Crystal Prod. Co., 1519 McGee St., Kansas City, Mo.
Crystal Research Labs., Hartford, Conn.
DX Crystal Co., 1200 N. Claremont, Chicago
Electronic Research Corp., 800 W. Washington Blvd., Chicago
Federal Engineering Co., 37 Murray St., N. Y. C.
General Electric Co. Schenectady, N. Y.
General Radio Co., Cambridge, Mass.
Harvey-Wells Communications, Southbridge, Mass.
Henney Motor Co., Omaha, Nebr.
Higgins Industries, Santa Monica, Calif.
Hipower Crystal Co., 2035 W. Charleston, Chicago
Hunt & Sons, G. C., Carlisle, Pa.
Jefferson, Inc., Ray, Westport, L. I., N. Y.
Kaar Engineering Co., Palo Alto, Cal.
Knights Co., The James, Sandwich, Ill.
Meck Industries, John, Plymouth, Ind.
Miller, August E., North Bergen, N. J.
Monitor Piezo Prod. Co., S. Pasadena, Calif.
Peterson Radio, Council Bluffs, Iowa
Precision Piezo Service, Baton Rouge, La.
Premier Crystal Labs., 63 Park Row, N. Y. C.
Quartz Laboratories, 1512 Oak St., Kansas City, Kans.
Radell Corp., Guilford Ave., Indianapolis, Ind.
RCA Mfg. Co., Camden, N. J.
Reeves Sound Labs., 62 W. 47 St., N. Y. C.
Scientific Radio Products Co., Council Bluffs, Ia.
Scientific Radio Service, Hyattsville, Md.
Standard Piezo Co., Carlisle, Pa.
Valpey Crystals, Holliston, Mass.
Wallace Mfg. Co., Wm. T., Peru, Ind.
Zeiss, Inc., Carl, 485 Fifth Ave., N. Y. C.

DIAL LIGHTS

See PILOT LIGHTS

DIALS, Instrument

Barker & Williamson, Upper Darby, Pa.
Crowe Name Plate Co., 3701 Ravenswood Ave., Chicago
General Radio Co., Cambridge, Mass.
Gits Molding Corp., 4600 Huron St., Chicago
Gordon Spec. Co 823 S Wabash Ave Chicago
Mica Insul. Co., 198 Varick St., N. Y. C.
National Co., Inc., Malden, Mass.
Rogan Bros., 2003 S. Michigan Ave., Chicago

SCHEDULE OF DIRECTORIES IN *FM* AND TELEVISION

JANUARY	FEBRUARY	MARCH	APRIL
All Police and Emergency Stations in the U. S. A.—includes names of the Radio Supervisors. CLOSING DATE JAN. 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE FEB. 5	FM, AM, and Television Stations in the U. S. A. and Canada—includes general managers, chief engineers. CLOSING DATE MAR. 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE APR. 5
MAY	**JUNE**	**JULY**	**AUGUST**
Radio Manufacturers in the U. S. A.—includes the names of general managers and chief engineers. CLOSING DATE MAY 5	Railway Signal Engineers on all roads in the United States, Canada and Mexico. CLOSING DATE JUNE 5	All Police and Emergency Stations in the U. S. A.—includes names of the Radio Supervisors CLOSING DATE JULY 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE AUG. 5
SEPTEMBER	**OCTOBER**	**NOVEMBER**	**DECEMBER**
FM, AM, and Television Stations in the U. S. A. and Canada—includes general managers, chief engineers. CLOSING DATE SEPT. 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE OCT. 5	Radio Manufacturers in the U. S. A.—includes the names of general managers and chief engineers. CLOSING DATE NOV. 5	Railway Signal Engineers on all roads in the United States, Canada and Mexico. CLOSING DATE DEC. 5

Federal Tubes...

come CLOSER to the

PERFECT VACUUM

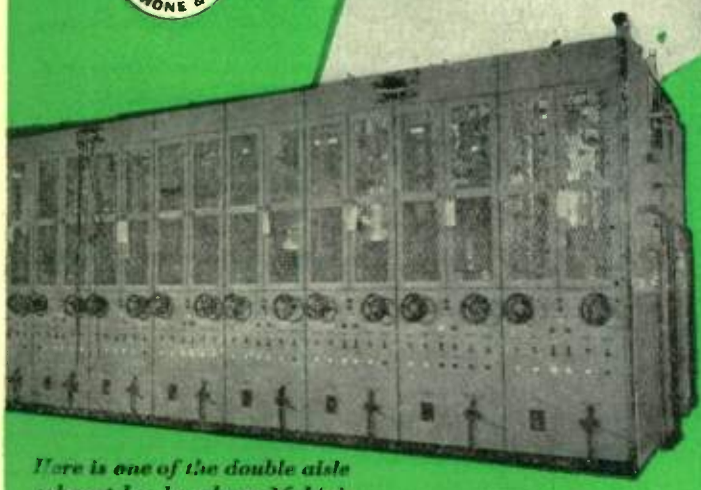
FEDERAL FTR TELEPHONE & RADIO

Always in the forefront of tube research and development, Federal makes another advance and now has added exhaust units of entirely new and original design to its production equipment.

This latest Federal achievement produces a tube that is substantially closer to the perfect vacuum—a tube with greater efficiency and longer life.

Arranged in banks of eight and operated with identical control equipment, these units exhaust uniformly every size of Federal tube—assuring a consistent and high standard of quality.

For any communication and industrial power tube need, turn to Federal now—test its reputation that "Federal always has made better tubes."



Here is one of the double aisle exhaust banks where 16 high power tubes can be exhausted at one time, each with individual control.

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

DISCS, Recording
Advance Recording Products Co., Long Island City, N. Y.
Allied Recording Products Co., Long Island City, N. Y.
Audio Devices, Inc., 1600 B'way, N. Y. C.
Federal Recorder Co., Elkhart, Ind.
Gould-Moody Co., 395 B'way, N. Y. C.
Presto Recording Corp., 242 W. 55 St., N. Y. C.
RCA Mfg. Co., Camden, N. J.

DYNAMOTORS — See Motor-Generators, Small

ENAMELS, Wood & Metal Finish
Sullivan Varnish Co., 410 N. Hart St., Chicago 22

ETCHING, Metal
Crowe Name Plate & Mfg. Co., 3701 Ravenswood Ave., Chicago
Etched Prod. Corp., 39-01 Queens Blvd., Long Island City, N. Y.
Premier Metal Etching Co., 21-03 44th Ave., Long Island City, N. Y.

FACSIMILE EQUIPMENT
Alden Products Co., Inc., Brockton, Mass.
Bunnell & Co., J. H., 215 Fulton, N. Y. C.
Faximile, Inc., 730 5th Ave., N. Y. C.
Federal Tel. & Radio Corp., Newark, N. J.
Finch Telecom., Inc., Passaic, N. J.
Press Wireless, Inc., 1475 B'way, N. Y. C.
R.C.A. Mfg. Co., Camden, N. J.

FASTENERS, Separable
Camloc Fastener Co., 420 Lexington Ave., N. Y. C.
Shakeproof, Inc., 2501 N. Keeler Ave., Chicago

FELT
Amer. Felt Co., Inc., Glenville, Conn.
Western Felt Works, 4031 Ogden Ave., Chicago

FIBRE, Vulcanized
Brandywine Fibre Prods. Co., Wilmington, Del.
Continental-Diamond Fibre Co., Newark, Del.
Insulation Mfgrs. Corp., 565 W. Wash. Blvd., Chicago
Mica Insulator Co., 196 Varick, N. Y. C.
Nat'l Vulcanized Fibre Co., Wilmington, Del.
Spaulding Fibre Co., Inc., 233 B'way, N. Y. C.
Taylor Fibre Co., Norristown, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

FILTERS, Electrical Noise
Bendix Aviation Corp., Pacific Div. 11600 Sherman Way, N. Hollywood.
Com. Equip. & Eng. Co., N. Parkside Ave., Chicago
Freed Radio Corp., 200 Hudson St., N. Y. C.
General Electric Co Schenectady N. Y.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Miller Co., J. W., 5917 S. Main St., Los Angeles
Solar Mfg. Corp., 285 Madison Ave., N. Y. C. 17
Tobe Deutschmann Corp., Canton, Mass.

FINISHES, Metal
Alrose Chemical Co., Providence, R. I.
Aluminum Co. of America, Pittsburgh, Pa.
Ault & Wiborg Corp., 75 Varick, N. Y. C.
Hilo Varnish Corp., Brooklyn, N. Y.
Maas & Waldstein Co., Newark, N. J.
New Wrinkle, Inc., Dayton, O.
Sullivan Varnish Co., 410 N. Hart St., Chicago 22

FREQUENCY STANDARDS, Primary
General Radio Co., Cambridge, Mass.

FREQUENCY STANDARDS, Secondary
Amer. Time Products, 580 Fifth Ave., N. Y. C.
Garner Co., Fred E., 43 E. Ohio St., Chicago
Hewlett-Packard Co., Palo Alto, Calif.
Higgins Industries, Inc., 2221 Warwick Ave., Santa Monica, Calif.
James Knights Co Sandwich Ill
Millen Mfg. Co., Inc., Malden, Mass.

FUSES, Enclosed
Dante Elec. Mfg. Co., Bantam, Conn.
Jefferson Elec. Co., Bellwood, Ill.
Littlefuse, Inc., El Monte, Calif.

GEARS & PINIONS, Metal
Continental-Diamond Fibre Co., Newark, Del.
Crowe Name Plate & Mfg. Co., 3701 Ravenswood Ave., Chicago
Gear Specialties, Inc., 2650 W. Medill, Chicago
Perkins Machine & Gear Co., Springfield, Mass.
Quaker City Gear Wks., Inc., N. Front St., Phila.
Thompson Clock Co., Bristol, Conn.

GEARS & PINIONS, Non-Metallic
Brandywine Fibre Prods. Co., Wilmington, Del.
Formica Insulation Co., Cincinnati, O.
Gear Specialties, Inc., 2650 W. Medill, Chicago
General Electric Co., Pittsfield, Mass.
Mica Insulator Co., 196 Varick St., N. Y. C.
National Vulcanized Fibre Co., Wilmington, Del.
Perkins Machine & Gear Co., Springfield, Mass.
Richardson Co., Melrose Park, Ill.
Spaulding Fibre Co., Inc., 233 B'way, N. Y. C.
Synthane Corp., Oaks, Pa.
Taylor Fibre Co., Norristown, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

GENERATORS, Beat Frequency
Boonton Radio Corp Boonton N J
General Radio Co Cambridge Mass

GENERATORS, Electronic AC
Communication Meas. Lab., 118 Greenwich St., N. Y. C.

GENERATORS, Gas Engine Driven
Hunter-Hartman Corp., St. Louis, Mo.
Kato Engineering Co., Mankato, Minn.
Onan & Sons, Royalston Ave., Minneapolis, Minn.
Pioneer Gen-E-Motor, 5841 W. Dickens Ave., Chicago, Ill.

GENERATORS, Hand Driven
Burke Electric Co., Erie, Pa.
Carter Motor Co., 1608 Milwaukee, Chicago
Chicago Tel. Supply Co., Elkhart, Ind.

GENERATORS, Standard Signal
Boonton Radio Corp., Boonton, N. J.
Ferris Instrument Co., Boonton, N. J.
General Radio Co., Cambridge, Mass.
Hewlett-Packard Co., Palo Alto, Calif.
Measurements Corp., Boonton, N. J.

GENERATORS, Wind-Driven, Aircraft
General Armature Corp., Lock Haven, Pa.

GLASS, Electrical
Corning Glass Works, Corning, N. Y.

GREASE, for Electrical Contacts & Bearings
Royal Engineering Co. (Royco Grease), East Hanover, N. J.

HANDSETS, Telephone
Automatic Electric Co., 1033 W. Van Buren, Chicago
Stromberg-Carlson Co Rochester N Y
Western Electric Co., 195 B'way, N. Y. C.

HEADPHONES
Brush Development Co., Cleveland, O.
Cannon Co., C. F., Springwater, N. Y.
Carron Mfg. Co., 415 S. Aberdeen, Chicago
Connecticut Tel. & Elec. Co., Meriden, Conn.
Consolidated Radio Prod. Co., W. Erie St., Chicago
Elec. Ind. Mfg. Co., Red Bank, N. J.
Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago
Murdock Mfg. Co., Chelsea, Mass.
Permoflux Corp., W. Grand Ave., Chicago
Telephonics Corp., 350 W. 31 St., N. Y. C.
Telex Products Co Minneapolis Minn
Trimm Radio Mfg. Co., 1770 W. Berteau, Chicago
Universal Microphone Co., Inglewood, Cal.
Utah Radio Prod. Co., 842 Orleans St., Chicago

HORNS, Outdoor
Altec Lansing Corp., 1680 N. Vine, Hollywood 28
Graybar Elect. Co., Lexington Ave. at 43 St., N. Y. C.
Jensen Radio Mfg. Co., 6601 S. Laramie Ave., Chicago
Langevin Co 37 W 65 St N Y C 23
Operadio Mfg. Co., St. Charles, Ill.
Oxford Tartak Radio Corp., 915 W. Van Buren St., Chicago
Racon Electric Co., 52 E. 19 St., N. Y. C.
RCA Mfg. Co., Camden, N. J.
University Laboratories, 225 Varick St., N. Y. C.

INDUCTION HEATING EQUIPMENT
Induction Heating Corp., 389 Lafayette St., N. Y. C.
Lepel High Frequency Labs., 39 W. 60 St., N. Y. C.

INDUCTORS, Transmitter
Barker & Williamson, Upper Darby, Pa.
Johnson Co. E. F. Waseca Minn

INDUCTORS, Variable Tuning
Barker & Williamson, Upper Darby, Pa.
Standard Winding Co Newburgh N Y

INSTRUMENTS, Radio Laboratory
Ballantine Laboratories, Inc., Boonton, N. J.
Boonton Radio Corp., Boonton, N. J.
Ferris Inst. Corp., Boonton, N. J.
General Electric Co., Schenectady, N. Y.
General Radio Co., Cambridge, Mass.
Hewlett-Packard Co., Palo Alto, Calif.
Measurements Corp., Boonton, N. J.

INSULATORS, Ceramic Stand-off, Lead-in, Rod Types
America Lava Corp., Chattanooga, Tenn.
Corning Glass Works, Corning, N. Y.
Electronic Mechanics, Inc., Clifton, N. J.
Gen. Ceramics & Steatite Corp Keasbey N J
Isolantite, Inc., Belleville, N. S.
Johnson Co., E. F., Waseca, Minn.
Lapp Insulator Co., Inc., Leroy, N. Y.
Locke Insulator Co., Baltimore, Md.
Millen Mfg. Co., Malden, Mass.
National Co., Inc., Malden, Mass.
Stupakoff Ceramic & Mfg Co Latrobe Pa

INTERFERENCE SUPPRESSORS
See FILTERS, Electrical Noise

IRON CORES, Powdered
Aladdin Radio Industries, Inc., 501 W. 35 St., Chicago
Crowley & Co., Henry, W. Orange, N. J.
Ferrocart Corp. of Amer., Hastings-on-Hudson, N. Y.
Genl. Aniline Wks., 485 Hudson St., N. Y. C.
Gibson Elec. Co., Pittsburgh, Pa.
Magner Mfg. Co., Inc., 444 Madison Ave., N. Y. C.
Mallory & Co., P. R., Indianapolis, Ind.
Pyroferric Co., 175 Varick St., N. Y. C.
Stackpole Carbon Co., St. Marys, Pa.
Western Electric Co., 195 Broadway, N. Y. C.
Wilson Co., H. A., Newark, N. J.

IRONS, Soldering
Acme Electric Heating Co., 1217 Washington St., Boston
Amer. Electrical Heater Co., 6110 Cass Ave., Detroit
Drake Elec. Wks., Inc., 3656 Lincoln Ave., Chicago
Electric Soldering Iron Co., Deep River, Conn.
General Electric Co., Schenectady, N. Y.
Hexacon Elec. Co., Roselle Park, N. J.
Sound Equipment Corp. of Calif., 6245 Lex. Ave., Los Angeles 38
Ungar, Inc., Harry A., 615 Ducommun St., Los Angeles 12
Vasco Electrical Mfg. Co., 4116 Avalon Blvd., Los Angeles
Vulcan Electric Co., Lynn, Mass.

JACKS, Telephone
Alden Prods. Co., Brockton, Mass.
Amer. Molded Prods. Co., 1753 N. Honore St., Chicago
Chicago Tel. Supply Co., Elkhart, Ind.
Guardian Elec. Mfg. Co., 1627 W. Walnut St., Chicago
Insuline Corp. of Amer., L. I. C., N. Y.
Johnson, E. F., Waseca, Minn.
Jones, Howard B., 2300 Wabansia Ave., Chicago
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Mangold Radio Pts. & Stamping Co., 6300 Shelbourne St., Philadelphia
Molded Insulation Co., Germantown, Pa.
Universal Microphone Co., Inglewood, Calif.
Utah Radio Prod. Co., Orleans St., Chicago

KEYS, Telegraph
Amer. Radio Hdware Co., Mt. Vernon, N. Y.
Bunnell & Co., J. H., 215 Fulton, N. Y. C.
Mossman, Inc., Donald P., 6133 N. Northwest Hy., Chicago
Renier Co., Ltd., 2101 Bryant St., San Francisco
Signal Electric Mfg. Co., Menominee, Mich.
Telegraph App. Co., 325 W. Huron St., Chicago
Telephonics Corp., 350 W. 31 St., N. Y. C.
Winslow Co., Inc., Liberty St., Newark, N. J.

KNOBS, Radio & Instrument
Alden Prods. Co., Brockton, Mass.
American Insulator Corp., New Freedom, Pa.
Chicago Molded Prods. Corp., 1025 N. Kolmar, Chicago
General Radio Co., Cambridge, Mass.
Gits Molding Corp., 4600 Huron St., Chicago
Gordon Spec. Co 823 S Wabash Ave Chicago
Imperial Molded Prods. Corp., 2921 W. Harrison, Chicago
Kurtz Kasch, Inc., Dayton, O.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Millen Mfg. Co., James, Malden, Mass.
Nat'l Co., Inc., Malden, Mass.
Northeastern Molding, Inc., 584 Commonwealth Ave., Boston 15, Mass.
Radio City Products Co., 127 W. 26 St., N. Y. C.
Rogan Bros., 2001 S. Michigan, Chicago

LABELS, Coding
Western Litho. Co., 600 E. 2nd, Los Angeles

LABELS, Removable
Avery Adhesives, 451 3rd St., Los Angeles
Western Litho. Co., 600 E. 2nd, Los Angeles

LABELS, Stick-to-Metal
Ever Ready Label Corp., E. 25th St., N. Y. C.
Tablet & Ticket Co., 1021 W. Adams St., Chicago
Western Litho. Co., 600 E. 2nd, Los Angeles

LABORATORIES, Electronic
Browning Labs., Inc., Winchester, Mass.
Electronic Corp. of Amer., 45 W. 18 St., N. Y. C.
Hazeltine Electronics Corp., 1775 B'way, N. Y. C.
Sherron Metallic Corp., Flushing Ave., Brooklyn, N. Y.
Worner Electronic Devices 609 W Lake St Chicago 22

LACQUERS, Wood & Metal Finish
Sullivan Varnish Co., 410 N. Hart St., Chicago 22

LOCKWASHERS, Spring Type
Natl. Lock Washer Co., Newark, N. J.

LUGS, Soldering
Cinch Mfg. Corp., W. Van Buren St., Chicago
Dante Elec. Mfg. Co., Bantam, Conn.
Ideal Commutator Dresser Co., Sycamore, Ill.
Ilsco Copper Tube & Prods., Inc., Station M, Cincinnati
Krueger & Hudepohl, Third & Vine, Cincinnati, O.
Patton-MacGuyer Co., 17 Virginia Ave., Providence, R. I.
Sherman Mfg. Co., Battle Creek, Mich.
Zierick Mfg. Co., 385 Girard Ave., Bronx, N. Y. C.

LUGS, Solderless
Aircraft Marine Prod., Inc., Harrisburg, Pa.
Burndy Eng. Co., 107 Eastern Blvd., N. Y. C.
Thomas & Betts Co., Elizabeth 1, N. J.

MACHINES, Impregnating
Stokes Machine Co., F. J., Phila., Pa.

MACHINES, Screwdriving
Detroit Power Screwdriver Co., Detroit, Mich.
Stanley Tool Div. of the Stanley Works, New Britain, Conn.

MAGNETS, Permanent
Arnold Engineering Co., 147 E. Ontario St., Chicago 11
General Elec. Co., Schenectady, N. Y.
Indiana Steel Prod. Co., 6 N. Michigan Ave., Chicago, Ill.
Thomas & Skinner Steel Prod. Co., Indianapolis, Ind.

MAIL ORDER SUPPLY HOUSES
See listing at head of Directory

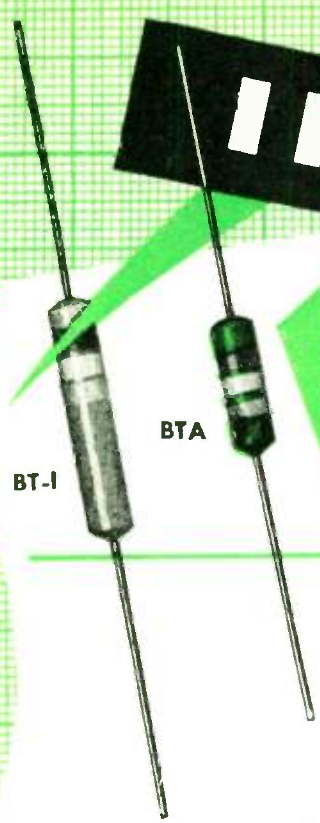
MARKERS, Wire Identification
Brand & Co., Wm., 276 4th Ave., N. Y. C.
Irvington Varnish & Ins. Co., Irvington, N. J.
Minn. Mining Co., 155 Sixth Ave., N. Y. C.
Ntl. Varnished Prod. Corp., Woodbridge, N. J.

MARKING MACHINES, Letters, Numbers
Marken Machine Co., Keene, N. H.

METAL, Thermostatic
Baker & Co., 113 Astor, Newark, N. J.
C. S. Brainin Co., 20 VanDam, N. Y. C.
Callite Tungsten Corp., Union City, N. J.
Chace Co., W. M., Detroit, Mich.
Metals & Controls Corp., Attleboro, Mass.
Wilson Co., H. A., 105 Chestnut, Newark, N. J.

METERS, Ammeters, Voltmeters, Small Panel
Cambridge Inst. Co., Grand Central Terminal, N. Y. C.
De Jur-Amsco Corp., Shelton, Conn.
General Electric Co., Bridgeport, Conn.
Hickok Elec. Inst. Co., Cleveland, O.
Hoyt Elec. Inst. Works, Boston, Mass.
J-B-T Instruments Inc New Haven Conn
McClintock Co., O. B., Minneapolis, Minn.
Norton Elect Inst Co Manchester Conn
Readrite Meter Works, Bluffton, O.
Roller-Smith Co., Bethlehem, Pa.
Simpson Elec. Co., 5218 W. Kinzie, Chicago
Triplett Elec. Inst. Co., Bluffton, O.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Weston Elec. Inst. Corp., Newark, N. J.
Wheelco Inst. Co., 847 W. Harrison St., Chicago

METERS, Frequency
Bendix Radio, Towson, Md.
Browning Labs., Inc., Winchester, Mass.
General Radio Co., Cambridge, Mass.
Higgins Industries, Inc., 2221 Warwick Ave., Santa Monica, Calif.
J-B-T Instruments Inc New Haven Conn
Lavoie Laboratories, Long Branch, N. J.
Link, F. M., 125 W. 17 St., N. Y. C.
Measurements Corp., Boonton, N. J.
North Amer. Philips Co., Inc., 419 Fourth Ave., N. Y. C.
Radio Corp. of Amer. Camden N J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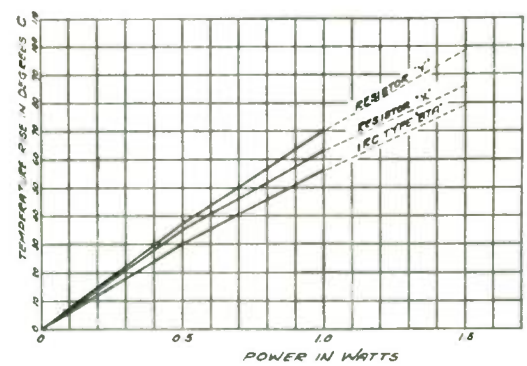
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RESISTOR "X"
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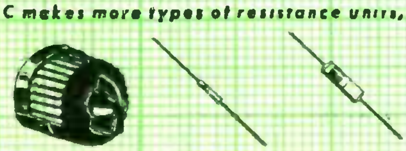
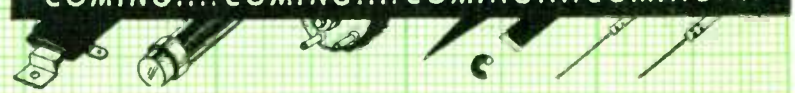
POWER IN WATTS





METERS, Q

Boonton Radio Corp., Boonton, N. J.

METERS, Vacuum Tube Volt

Ballantine Laboratories, Inc., Boonton, N. J.
Barber Labs. 34-04 Francis Lewis Blvd Flushing N Y
Ferris Instrument Corp., Boonton, N. J.
General Radio Co., Cambridge, Mass.
Hewlett-Packard Co., Palo Alto, Calif.
Measurements Corp., Boonton, N. J.
Radio City Products Co., 127 W. 26 St., N. Y. C.

METERS, Vibrating Reed

Biddle, James G., 1211 Arch St., Phila.
J-B-T Instruments, Inc., New Haven 8, Conn.
Triplett Elec. Inst. Co., Bluffton, O.

MICA

Brand & Co., Wm., 276 Fourth Av., N. Y. C.
Ford Radio & Mica Corp., 538 63rd St., Bklyn, N. Y.
Insulation Mfgrs. Corp., 565 W. Wash. Blvd., Chicago
Macallen Co., Boston, Mass.
Mica Insulator Corp 196 Varick N Y C
Mitchell-Rand Insulation Co., 51 Murray St., N. Y. C.
New England Mica Co., Waltham, Mass.
Richardson Co., Melrose Park, Ill.

MICROPHONES

Amer. Microphone Co., 1015 Western Av., Los Angeles
Amperite Co., 561 B'way, N. Y. C.
Astatic Corp., Youngstown, O.
Brush Development Co., Cleveland, O.
Electro Voice Mfg. Co., South Bend, Ind.
Kellogg Switchboard & Supply Co., 6650 S. Cicero, Chicago
Philmore Mfg. Co., 113 University Pl., N. Y. C.
Permoflux Corp., 4916 W. Grand Av., Chicago
Radio Corp. of Amer., Camden, N. J.
Radio Speakers, Inc., 221 E. Cullerton, Chicago
Rowe Industries, Inc., Toledo, O.
Shure Bros., 225 W. Huron St., Chicago
Telephonics Corp., 350 W. 31 St., N.Y.C.
Turner Co., Cedar Rapids, Ia.
Universal Microphone Co., Inglewood, Cal.

MONITORS, Frequency

General Electric Co., Schenectady, N. Y.
General Radio Co., Cambridge, Mass.
RCA Mfg. Co., Camden, N. J.

MOTOR-GENERATORS, Rotary Converters

Alliance Mfg. Co., Alliance, O.
Air-Way Mfg. Co., Toledo, O.
Bendix Aviation Corp., Pacific Div., 11600 Sherman Way, N. Hollywood
Black & Decker Mfg. Co., Towson, Md.
Bodine Elec. Co., 2262 W. Ohio, Chicago
Carter Motor Co., 1608 Milwaukee, Chicago
Clements Mfg. Co., Chicago, Ill.
Continental Electric Co., Newark, N. J.
Delco Appliance, Rochester, N. Y.
Diehl Mfg. Co., Elizabethport, N. J.
Dormeyer Co., Chicago, Ill.
Eclipse Aviation, Bendix, N. J.
Eicor, Inc., 1060 W. Adams, Chicago
Electric Indicator Co., Stamford, Conn.
Electric Motors Corp., Racine, Wis.
Electric Specialty Co., Stamford, Conn.
Electrolux Corp., Old Greenwich, Conn.
Eureka Vacuum Cleaner, Detroit, Mich.
General Armature Corp., Lock Haven, Pa.
General Electric Co., Schenectady, N. Y.
Jannette Mfg. Co., 558 W. Monroe, Chicago
Knapp-Monarch, St. Louis, Mo.
Leland Electric Co., Dayton, O.
Ohio Electric Co., 74 Trinity Pl., N. Y. C.
Pioneer Gen-E-Motor, 5841 W. Dickens Av., Chicago
Redmond Co., A. G., Owosso, Mich.
Russell Co., Chicago, Ill.
Small Motors, Inc., 1308 Elston Ave., Chicago
Webster Co., Chicago, Ill.
Webster Products, 3825 Armitage Ave., Chicago
Westinghouse Elect. Mfg. Co., Lima, O.
Wincharger Corp., Sioux City, Iowa

MOTORS, Very Small Types

Eastern Air Devices, Inc., 585 Dean St., Bklyn. 17, N. Y.
Kollsman Instrument Div., Elmhurst, Long Island, N. Y.
Utah Radio Prod. Co., 842 Orleans St., Chicago

MOUNTINGS, Shock Absorbing

Gen. Tire & Rubber Co Wabash Ind
Lord Mfg. Co., Erie, Pa.
Pierce-Roberts Co., Trenton, N. J.
U. S. Rubber Co., 1230-6th Ave., N. Y. C.

MYCALEX

Colonial Kolonite Co., 2212 W. Armitage Ave., Chicago
General Electric Co., Schenectady, N. Y.
Intl Products Corp Baltimore 18 Md
Mycalex Corp. of Amer., Clifton, N. J.
Precision Fab. Inc Rochester N Y

NAME PLATES, Etched Metal

See ETCHING, Metal

NAME PLATES, Plastic

Crowe Name Plate & Mfg. Co., 3700 Ravenswood Ave., Chicago
Hopp Press, Inc., 460 W. 34 St., N. Y. C.
Parisian Novelty Co., 3502 S. Western Ave., Chicago
Virginia Plate Co., 270 Madison Ave., N. Y. C. 16

NICKEL, Sheet, Rod, Tubes

Eagle Metals Co., Seattle, Wash.
Pacific Metals Co., Ltd., San Francisco, Calif.
Steel Sales Corp 3348 S Pulaski Rd Chicago
Tull Metal & Supply Co Atlanta, Ga
Whitehead Metal Prod. Co., 303 W. 10th St., N. Y. C.
Williams and Co., Inc., Pittsburgh, Pa.

NOISE FILTERS

See FILTERS, Electrical Noise

NUTS, Self-locking

Boots Aircraft Nut Corp., New Canaan, Conn.
Elastic Stop Nut Corp., Union, N. J.
Palnut Co., Inc., Irvington, N. J.
Standard Pressed Steel Co., Jenkintown, Pa.

OSCILLATORS, AF

General Radio Co., Cambridge, Mass.
Hewlett-Packard Co., Palo Alto, Calif.
Jackson Electrical Inst. Co., Dayton, O.

OSCILLOSCOPES, Cathode Ray

Du Mont Laboratories, Inc., Allen B., Passaic, N. J.
General Electric Co., Schenectady, N. Y.
General Radio Co., Cambridge, Mass.
Millen Mfg. Co., Malden, Mass.
Panoramic Radio Corp., 242 W. 55 St., N. Y. C.
Reiner Electronics Co., 152 W. 25 St., N. Y. C.
RCA Mfg. Co., Inc., Camden, N. J.
Radio City Products Co., Inc., 127 W. 26 St., N. Y. C.

OVENS, Industrial & Laboratory

General Elec. Co., Schenectady, N. Y.
Trent Co., Harold E., Philadelphia

PANELS, Metal Etched (See Etching, Metal)

PANELS, Phenolic, Cast without Molds

Creative Plastics Corp., 963 Kent Ave., B'klyn, N. Y.

PHONOGRAPH RECORDING BLANKS

See DISCS, Recording

PHONOGRAPH RECORD PLAYERS

See TURNTABLES, Phonograph

PILOT LIGHTS

Alden Prods. Co., Brockton, Mass.
Amer. Radio Hdware Co., Mt. Vernon, N. Y.
Dial Light Co. of Amer., 90 West, N. Y. C.
Drake Mfg. Co., 1713 W. Hubbard, Chicago
General Control Co., Cambridge, Mass.
Gothard Mfg. Co., Springfield, Ill.
Herzog Miniature Lamp Works, 12-19 Jackson Av., Long Island City, N. Y. C.
Kirkland Co., H. R., Morristown, N. J.
Mallory & Co., P. R., Indianapolis, Ind.
Signal Indicator Corp., 140 Cedar St., N. Y. C.

PHOSPHOR BRONZE

American Brass Co., Waterbury, Conn.
Bunting Brass & Bronze Co., Toledo, O.
Driver-Harris Co., Harrison, N. J.
Phosphor Bronze Smelting Co., Philadelphia
Revere Copper & Brass, 230 Park Av., N. Y. C.
Seymour Mfg. Co., Seymour, Conn.

PLASTICS, Extruded

Blum & Co., Inc., Julius, 532 W. 22 St., N. Y. C.
Brand & Co., Wm., 276 4th Ave., N. Y. C.
Extruded Plastics, Inc., Norwalk, Conn.
Industrial Synthetic Corp., Irvington, N. J.
Irvington Varnish & Insulator Co., Irvington, N. J.

PLASTICS, Injection Molded

Remler Co., Ltd., 2101 Bryant St., San Francisco
Tech-Art Plastics, 41-01 36th Ave., Long Island City, N. Y.
Universal Plastics Corp., New Brunswick, N. J.

PLASTICS, Laminated or Molded

Acadia Synthetic Prods., 4031 Ogden Av., Chicago
Alden Prods. Co., Brockton, Mass.
American Cyanamid Co., 30 Rockefeller Plaza, N. Y. C.
American Insulator Corp., New Freedom, Pa.
American Molded Prods. Co., 1753 N. Honore, Chicago
Auburn Button Works, Auburn, N. Y.
Barber-Colman Co., Rockford, Ill.
Brandywine Fibre Prods. Co., Wilmington, Del.
Brilhart Co., Arnold, Great Neck, N. Y.
Catalin Corp., 1 Park Av., N. Y. C.
Celanese Celluloid Corp., 180 Madison Av., N. Y. C.
Chicago Molded Prods. Corp., 1024 N. Kolmar, Chicago
Continental-Diamond Fibre Co., Newark, Del.
Creative Plastics Corp., 963 Kent Ave., B'klyn, N. Y.
Dow Chemical Co., Midland, Mich.
Dures Plastics & Chemicals, Inc., N. Tonawanda, N. Y.
Extruded Plastics, Inc., Norwalk, Conn.
Formica Insulation Co., Cincinnati, O.
General Electric Co., Plastics Dept., Pittsfield, Mass.
General Industries Co., Elyria, O.
Gits Molding Corp., 4600 Huron St., Chicago
Imperial Molded Prods. Co., 2921 W. Harrison, Chicago
Industrial Molded Prods. Co., 2035 Charleston, Chicago
Kurz-Kasch, Inc., Dayton, O.
Macallen Co., Boston, Mass.
Mica Insulator Co., 196 Varick, N. Y. C.
Monsanto Chemical Co., Springfield, Mass.
National Vulcanized Fibre Co., Wilmington, Del.
Northern Industrial Chemical Co., Boston, Mass.
Printloid Corp., 93 Mercer St., N. Y. C.
Radio City Products Co., 127 W. 26 St., N. Y. C.
Remler Co., Ltd., 2101 Bryant St., San Francisco
Richardson Co., Melrose Park, Ill.
Rogan Bros., 2000 S. Michigan Ave., Chicago
Rohm & Haas Co., Philadelphia
Spaulding Fibre Co., Inc., 233 B'way, N. Y. C.
Stokes Rubber Co., Joseph Trenton, N. J.
Surprenant Elec. Ins. Co., Boston
Synthane Corp., Oaks, Pa.
Taylor Fibre Co., Norristown, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

PLASTICS, Materials

Bakelite Corp., 30 E. 42 St., N. Y. C.
Carbide & Carbon Chemicals Corp., 30 E. 42 St., N. Y. C.

PLASTICS, Transparent

Acadia Syn. Prod. 4035 Ogden Ave Chicago 23
Carbide & Carbon Chemicals Corp., 30 E. 42 St., N. Y. C.
Celanese Celluloid Corp., 180 Madison Ave., N. Y. C.
Dow Chemical Co., Midland, Mich.
du Pont de Nemours & Co., E. I., Arlington, N. J.
Plax Corp., Hartford, Conn.,
Printloid Corp., 93 Mercer St., N. Y. C.
Rohm & Hass Co., Washington Sq., Philadelphia

PLATING, Metal on Molded Parts

Metaplast Corp., 205 W. 19 St., N. Y. C.

PLATINUM

Sigmund Cohn & Co 44 Goldt St N Y C

PLUGS (Banana), Spring Type

Amer. Radio H'dw're Co., Mt. Vernon, N. Y.
Birnbach Radio Co., 145 Hudson St., N. Y. C.
Eastman Kodak Co., Rochester, N. Y.
Eby, Inc., Hugh H., Philadelphia, Pa.
Franklin Mfg. Corp., 175 Varick St., N. Y. C.
General Radio Co., Cambridge, Mass.
Johnson Co., E. F., Waseca, Minn.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Ucinite Co., Newtonville, Mass.

PLUGS, Coaxial

Andrew Co 363 E 75 St Chicago 19

PLUGS, Miniature Battery

Intl. Resist. Co 429 N Broad St Phila 8

PLUGS, Telephone Type

Alden Prods. Co., Brockton, Mass.
American Molded Prods. Co., 1753 N. Honore, Chicago
Chicago Tel. Supply Co., Elkhart, Ind.
Guardian Elec. Mfg. Co., 1400 W. Wash. Blvd., Chicago
Insuline Corp. of Amer., L. I. City, N. Y.
Johnson Co., E. F., Waseca, Minn.
Jones, H. B., 2300 Wabansia, Chicago
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Remler Co., Ltd., Bryant St., San Francisco
Trav-Ler Karenola Corp., 1030 W. Van Buren St., Chicago 7
Universal Microphone Co., Ltd., Inglewood, Calif.
Utah Radio Prod., Orleans St., Chicago

PLYWOOD, Metal Faced

Haskelite Mfg. Corp., 208 W. Washington St., Chicago

QUARTZ, Rods, Tubes, Plates

Hanovia Chem. & Mfg Co Newark 5 N J

RACKS & PANELS, Metal

See STAMPINGS, Metal

RADIO RECEIVERS & TRANSMITTERS

Abbott Instrument, Inc., 8 W. 18 St., N. Y. C. 3
Admiral Corp Chicago Ill
Air Associates, Inc., Los Angeles
Aircraft Accessories Corp., Funston Rd., Kansas City, Kans.
Aircraft Radio Corp., Boonton, N. J.
Aircraft Radio Equip. Corp., 6244 Lex. Ave., Hollywood, Calif.
Air Communications, Inc., 2233 Grant Ave., Kansas City, Mo.
Air King Products Co., 1523 63rd Ave., Brooklyn, N. Y.
Airplane & Marine Inst., Inc., Clearfield, Pa.
Andrea Radio Corp., 43-20 34th St., Long Island City, N. Y.
Amplex Engineering, Inc., New Castle, Ind.
Ansley Radio Corp 2110-49th Av L I City N Y
Arnessen Electric Co., 116 Broad St., N. Y. C.
Automatic Radio Mfg. Co., 122 Brookline Ave., Boston, Mass.
Bassett, Inc., Rex, Ft. Lauderdale, Fla.
Belmont Radio Corp., 5921 Dickens Ave., Chicago
Bendix Aviation Corp., Pacific Div., 11600 Sherman Way, N. Hollywood
Bendix Radio, Div. of Bendix Aviation Corp., Baltimore, Md.
Boes Co., The W. W., Dayton, O.
Browning Laboratories, Inc., Winchester Mass.
Bunnell & Co., J. H., 215 Fulton St., N. Y. C.
Burnett Radio Lab., 4814 Idaho St., San Diego, Calif.
Collins Radio Co Cedar Rapids Ia
Colonial Radio Corp., Rano St., Buffalo, N. Y.
Com Equip Corp 134 W Colorado St Pasadena Calif
Communications Co., Inc., Coral Gables, Fla.
Conn. Tel. & Elec. Co., Meriden, Conn.
Continental Radio & Telev. Corp., 3800 W. Cortland St., Chicago
Cover Dual Signal Systems, Inc., 125 W. Hubbard St., Chicago
Crosley Radio Corp., Cincinnati, O.
de Forest Labs, Lee, 5106 Wilshire Blvd., Los Angeles
Delco Radio, Kokomo, Ind.
Detrola Corp., 1501 Beard Ave., Detroit, Mich.
De Wald Radio Mfg. Corp., 436 Lafayette St., N. Y. C.
Dictaphone Corp., 420 Lexington Ave., N. Y. C.
DuMont Labs., Inc., Allen B., Passaic, N. J.
Echophone Radio Co., 201 E. 26 St., Chicago
Eckstein Radio & Telev. Co., Inc., 1400 Harmon Pl., Minneapolis, Minn.
Electrical Ind. Mfg. Co., Red Bank, N. J.
Elect. Research Lab Inc Evanston Ill.
Electronic Communications Co., 36 N. W. B'way, Portland, Ore.
Electronic Corp. of Amer., 45 W. 18 St., N. Y. C.
Electronic Specialty Co., Glendale, Calif.
Emerson Radio & Phone Corp., 111 8th Ave., N. Y. C.
Erco Radio Labs. Inc Hempstead N Y
Espey Mfg Co Inc 33 W 46 St N Y C
Fada Radio & Elec. Corp. 30-20 Thomson Ave., Long Island City, N. Y.
Farnsworth Tele. & Radio Corp., Ft. Wayne 1, Ind.
Federal Electronics Div., 209 Steuben St., B'klyn, N. Y.
Federal Tel. & Radio Corp., Newark, N. J.
Finch Telecommunications, Inc., Passaic, N. J.
Fisher Research Lab., Palo Alto, Calif.
Foote Pierson & Co Inc 75 Hudson St Newark 5 N J
Freed Radio Corp., 200 Hudson St., N. Y. C.
Galvin Mfg. Corp., 4545 Augusta Blvd., Chicago
Garod Radio Corp., 70 Washington St., B'klyn, N. Y.
Gates Radio & Supply Co., Quincy, Ill.
General Communication Co., 681 Beacon St., Boston, Mass.
General Electric Co., Schenectady, N. Y.
General Telev. & Radio Corp., 1240 N. Homan Ave., Chicago
Gibbs & Co., Thomas B., Delavan, Wis.
Gilfillen Bros., Inc., 1815 Venice Blvd., Los Angeles, Calif.
Girdler Corp., Louisville, Ky.
Gray Mfg. Co., Hartford, Conn.
Gray Radio Co., West Palm Beach, Fla.
Grenby Mfg. Co., Plainville, Conn.
Guided Radio Corp., 161 6th Ave., N. Y. C.
Hallicrafters Co., 2611 Indiana Ave., Chicago
Halstead Traffic Com. Corp., 155 E. 44 St., N. Y. C.
Hamilton Radio Corp., 510 Sixth Ave., N. Y. C.
Hammarlund Mfg. Co., 460 W. 34th St., N. Y. C.
Harrel, D. H., 1527 E. 74 Pl., Chicago
Harvey Machine Co., Inc., 6200 Avalon Blvd., Los Angeles
Harvey Radio Labs, Inc., Cambridge, Mass.
Harvey-Wells Com., Inc., Southbridge, Mass.
Hazeltine Electronics Corp., Great Neck, N. Y.
Herbach & Rademan Co., 522 Market St., Phila.
Higgins Industries, Inc., 2221 Warwick Ave., Santa Monica, Calif.
Hoffman Radio Corp 3330 S Hill St Los Angeles
Hollywood Electronics Co., 800 Sunset Blvd., Los Angeles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Howard Pacific Corp 923 N Western Av Los Angeles
Hudson Amer Corp 25 W 43 St N Y C
Intl Detrola Corp Beard & Chatfield Sts Detroit 9
Jefferson, Inc., Ray, Freeport, N. Y.
Jefferson-Travis Radio Mfg. Corp., 245 E 23 St., N. Y. C.
Karadio Corp., 1400 Harmon Pl., Minneapolis, Minn.
Kemlite Labs., 1809 N. Ashland Ave., Chicago
Lear Avia, Inc., Piqua, O.
Lewyt Corp., 60 B'way, B'klyn, N. Y.
Link, F. M., 125 W. 17 St., N. Y. C.
Machlett Labs., Inc., Springdale, Conn.
Magnavox Co., Indianapolis, Ind.
Majestic Radio & Tel. Corp., 2600 W. 50 St., Chicago
McElroy Mfg. Corp., Brookline Ave., Boston
Megard Corp., 381 W. 38 St., Los Angeles, Calif.
Meissner Mfg Co Mt Carmel Ill
Midwest Radio Corp., Cincinnati, O.
Millen Mfg. Co., Inc., Malden, Mass.
National Co., Inc., Malden, Mass.
Noblitt-Sparks Ind. Inc., Columbus, Ind.
North Amer. Philips Co., 100 E. 42 St., N. Y. C.
Operadio Mfg. Co., St. Charles, Ill.
Packard Bell Co 1115 S Oak St Los Angeles
Panoramic Radio Corp., 245 W. 55 St., N. Y. C. 19
Philco Corp., Tioga & C Sts., Phila.
Philharmonic Radio Corp., 216 Williams St., N. Y. C.
Pierson-DeLane, Inc., 2345 W. Washington Blvd., Los Angeles
Pilot Radio Corp., L. I. City, N. Y.
Powers Electronic & Communication Co., Glen Cove, N. Y.
Precision Tube Co., 3828 Terrace St., Phila. 28
Press Wireless, Inc 1475 B'way N Y C
Radiation Products, Inc., 1142 S. Wall, Los Angeles 15
Radio Corp. of Amer., Camden, N. J.
Radio Craftsmen, 1340 S. Mich. Ave., Chicago
RadioEngineering Labs L I City N Y
Radio Frequency Labs., Inc., Boonton, N. J.
Radio Mfg. Engineers, Inc., Peoria, Ill.
Radiomarine Corp. of Amer., 75 Varick St., N. Y. C.
Radio Receptor Co., Inc., 251 W. 17 St., N. Y. C.
Radio Transceiver Labs., 86-27 115th St., Richmond Hill, L. I.
Remler Co Ltd 2101 Bryant St San Francisco
Richardson-Allen Corp., 15 W. 20 St., N. Y. C.
Rosen Co., Raymond, 32 & Walnut Sts., Phila.
Rauland Corp., Chicago, Ill.
Sanborn Co., Cambridge 39, Mass.
Schuttig & Co., 9th & Kearny Sts., Washington, D. C.
Scott Radio Labs, Inc., 4450 Ravenswood Ave., Chicago
Seeburg Corp., J. P., 1500 N. Dayton St., Chicago
Sentinel Radio Corp., Evanston, Ill.
Setchell-Carlson, Inc., 2233 University Ave., St. Paul, Minn.
Smith Co., Maxwell, 1027 N. Highland Ave., Hollywood, Calif.
Sonora Radio & Telev. Corp., 325 N. Hoyne Ave., Chicago
Sparks-Withington Co., Jackson, Mich.
Sperry Gyroscope Co Garden City N Y
Sperti, Inc., Cincinnati, O.
Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago
Stromberg-Carlson Co., Rochester, N. Y.
Tech. Radio Co 275 9th St San Francisco 3
Templetone Radio Co., Mystic, Conn.
Transmitter Equip. Mfg. Co., 345 Hudson St., N. Y. C.
Trav-Ler Karenola Corp 1030 W Van Buren St Chicago
United Cinephone Corp Torrington Conn
Warwick Mfg. Corp., 4640 W. Harrison St., Chicago
Watterson Radio Mfg. Co., 2608 Ross Ave., Dallas, Tex.
Waugh Laboratories, 420 Lexington Ave., N. Y. C.
Western Electric Co 195 B'way N Y C
Westinghouse Elec. & Mfg. Co., Wilkens Ave., Baltimore, Md.
Wilcox Electric Co., 14th & Chestnut Sts., Kansas City, Mo.
Wilcox-Gay Corp Charlotte Mich
Zenith Radio Corp., 6001 Dickens Ave., Chicago, Ill.

RECTIFIERS, Metallic Current

Benwood Linze Co., St. Louis, Mo.
Continental Elec. Co., 903 Merchandise Mart, Chicago
Electronics Labs., Indianapolis, Ind.
Fansteel Metallurgical Corp., N. Chicago, Ill.
Federal Tel. & Radio Corp Newark 1 N J
General Electric Co., Bridgeport, Conn.
Green Elect. Co., Inc., 130 Cedar St., N. Y. C.
Mallory & Co., P. R., Indianapolis, Ind.
Nothelfer Winding Labs., Trenton, N. J.
Selenium Corp. of Amer., 1800 W. Pico Blvd., Los Angeles
United Cinephone Corp., Torrington, Conn.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

RECTIFIERS, Metallic Instrument & Relay

Bradley Labs, Inc New Haven 10 Conn
Conant Elect. Labs, Lincoln Nebr
Selenium Corp. of Amer., 1800 W. Pico Blvd., Los Angeles

REGULATORS, Temperature

Allen-Bradley Co., Milwaukee, Wis.
Dunn, Inc., Struthers, 1321 Cherry, Philadelphia
Fenwal Inc., Ashland, Mass.
General Electric Co., Schenectady, N. Y.
Mercoid Corp., 4217 Belmont, Chicago
Minneapolis-Honeywell Regulator, Minneapolis, Minn.
Spencer Thermostat Co., Attleboro, Mass.

REGULATORS, Voltage

Acme Elec. & Mfg. Co., Cuba, N. Y.
Adams & Westlake Co., Elkhart, Ind.
Amperite Co., 561 Broadway, N. Y. C.
Ferranti Elec., Inc., 30 Rockefeller Plaza, N. Y. C.
General Elec. Co., Schenectady, N. Y.
H-B Electric Co., 6122 N. 21 St., Phila.
Sola Electric Co., 2525 Clybourn Av., Chicago
United Transformer Corp., 150 Varick St., N. Y. C.

RELAYS, Hermetically Sealed

Allied Control Co Inc 2 E End Ave N Y C
Betts & Betts Corp 551 W 52 St N Y C 19
Clare & Co, C. P. 4719 Sunnyside Ave Chicago 30
Sigma Instruments Inc 70 Ceylon St Boston 21

RELAYS, Plug-in

Clare & Co, C. P. 4719 Sunnyside Ave Chicago 30
Leach Relay Co 5915 Avalon Blvd Los Angeles
Sigma Instruments Inc 70 Ceylon St Boston 21

RELAYS, Small Switching

Advance Elec. Co., 1260 W. 2nd, Los Angeles
Allied Control Co Inc 2 W End Ave N Y C
Amperite Co., 561 Broadway, N. Y. C.
Automatic Elec. Co., 1033 W. Van Buren, Chicago
Bendix Aviation Corp., Pacific Div., 11600 Sherman Way, N. Hollywood
Birtcher Corp., 5087 Huntington Dr., Los Angeles 32
Cook Elec. Co., 2700 Southport Ave., Chicago
Electrical Prod. Supply Co., 1140 Venice Blvd., Los Angeles 15
G-M Laboratories, Inc., 4313 N. Knox Ave., Chicago
Guardian Elec. Co., 1400 W. Wash. Blvd., Chicago
Potter & Brumfield Co., Princeton, Ind.
Sigma Instruments, Inc., 76 Freeport St., Boston, Mass.
Struthers Dunn, Inc., 1326 Cherry St., Philadelphia
Ward-Leonard Elec. Co Mt Vernon N Y

RELAYS, Small Telephone Type

Advance Elec. Co., 1260 W. 2nd, Los Angeles
Allied Control Co 2 E End Ave N Y C
Automatic Elect. Co., 1033 W. Van Buren, Chicago
Clare & Co., C. P., 4719 W. Sunnyside Ave., Chicago
Cook Elec. Co., 2700 Southport Ave., Chicago
Guardian Elec. Co., 1400 W. Wash. Blvd., Chicago
Wick Organ Co., Highland, Ill.

RELAYS, Stepping

Automatic Elect. Co., 1032 W. Van Buren St., Chicago
Autocall Co., Shelby, O.
Guardian Elect. Mfg. Co., 1620 W. Walnut St., Chicago
Presto Elect. Co., N. Y. Ave., Union City, N. J.
Struthers Dunn, Inc., Arch St., Phila.

RELAYS, Time Delay

Advance Elec. Co., 1260 W. 2nd, Los Angeles
Amperite Co., 561 Broadway, N. Y. C.
Automatic Elec. Co., 1033 W. Van Buren, Chicago
Haydon Mfg. Co., Inc., Forestville, Conn.
H-B Electric Co., 6122 N. 21 St., Phila.
Industrial Timer Corp., Newark, N. J.
Sangamo Elec. Co., Springfield, Ill.
Ward-Leonard Elec. Co., Mt. Vernon, N. Y.

RELAYS, Transmitter Switching and Keying

Gordon Spec. Co 823 S Wabash Ave Chicago
Johnson Co, E. F. Waseca Minn
Leach Relay Co., 5915 Avalon Blvd., Los Angeles

RELAYS, Vacuum

Ind & Com Electronics Belmont Calif
Struthers Dunn Inc 1326 Cherry St Phila

RELAY TESTERS, Vibration

Kurman Electric Co., Inc., 3030 Northern Blvd., L. I. City, N. Y.

RESISTORS, Fixed

Acme Elec. Heating Co., Boston, Mass.
Aerovox Corp., New Bedford, Mass.
Allen-Bradley Co., Milwaukee, Wis.
Atlas Resistor Co., 423 Broome St., N. Y. C.
Carborundum Co., Niagara Falls, N. Y.
Centralab, Milwaukee, Wisconsin
Clarostat Mfg. Co., 130 Clinton St., Bklyn, N. Y.
Cont'l Carbon, Inc., Cleveland, O.
Daven Co., 158 Summit St., Newark, N. J.
Dixon Crucible Co., Jersey City, N. J.
Elco Resistors Co 114 W 18 St N Y C
Erie Resistor Corp., Erie, Pa.
Globar Div. Carborundum Co., Niagara Falls, N. Y.
Groves Corp Cape Girardeau Mo
Hardwick, Hindle, Inc., Newark, N. J.
Instrument Resistors Co., Little Falls, N. J.
Intern'l Resist. Co 429 N Broad St Phila 8
Lectrohm, Inc., Cicero, Ill.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Ohmite Mfg. Co., 4835 W. Flournoy, Chicago
Sensitive Research Inst., Corp., 4545 Bronx Blvd., N. Y. C.
Shallcross Mfg. Co., Collingdale, Pa.
Speer Resistor Corp., St. Marys, Pa.
Sprague Specialties Co., N. Adams, Mass.
Stackpole Carbon Co., St. Marys, Pa.
Utah Radio Prod. Co., 842 Orleans St., Chicago
Ward-Leonard Elec. Co., Mt. Vernon, N. Y.
White Dental Mfg. Co., 10 E. 40th St., N. Y. C.
Wirt Co., Germantown, Pa.

RESISTORS, Fixed Precision

General Radio Co Cambridge Mass
Inst. Resistors, Inc., Little Falls, N. J.
Intern'l Resist. Co 429 N Broad St Phila 8
Ohmite Mfg. Co., 4835 Flournoy St., Chicago
Shallcross Mfg. Co., Collingdale, Pa.

RESISTORS, Flexible

Clarostat Mfg. Co., Inc., Brooklyn, N. Y.

RESISTORS, Variable Laboratory Type

Biddle Co., J. G., 1211 Arch St., Phila.
General Radio Co Cambridge Mass
Sticht Co., Inc., H. H., 27 Park Pl., N. Y. C.

RESISTORS, Variable

Aerovox Corp., New Bedford, Mass.
Allen-Bradley Co., Milwaukee, Wis.
Amer. Inst. Co., Silver Spring, Md.
Atlas Resistor Co., N. Y. C.
Biddle Co., James G., Arch St., Phila.
Centralab, Milwaukee, Wis.
Chicago Tel. Supply Co., Elkhart, Ind.
Cinema Eng. Co., Burbank, Cal.
Clarostat Mfg. Co., 130 Clinton, Bklyn, N. Y.
Cutler-Hammer, Inc., Milwaukee, Wis.
DeJur Amsco Corp., Shelton, Conn.
Electro Motive Mfg. Co., Willimantic, Conn.
General Radio Co., Cambridge, Mass.
G-M Labs., Inc., Chicago, Ill.
Inst. Resistors, Inc., Little Falls, N. J.
Intern'l Resist. Co 429 N Broad St Phila 8
Lectrohm, Inc., 5125 W. 25th, Cicero, Ill.
Mallory & Co., P. R., Indianapolis, Ind.
Ohio Carbon Co., Cleveland, Ohio
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago
Shallcross Mfg. Co., Collingdale, Pa.
Stackpole Carbon Co., St. Marys, Pa.
Utah Radio Prods. Co., 820 Orleans St., Chicago
Ward-Leonard Elec. Co., Mt. Vernon, N. Y.
Wirt Co., Germantown, Pa.

RESISTORS, Variable, Ceramic Base

Lectrohm, Inc., 5125 W. 25th, Cicero, Ill.
Ohmite Mfg. Co., 4835 Flournoy St., Chicago

SCREW MACHINE PARTS, Brass, Steel

Chicago Aviation Co., 1200 N. Claremont, Chicago
Ward Products Corp., E. 45 St., Cleveland, O.

SCREW MACHINE PARTS, Non-Metallic

Continental-Diamond Fibre Co., Newark, Del.

SCREWS, Clutch Head

United Screw & Bolt Corp., 71 Murray St., N. Y. C.

SCREWS, Recessed Head

American Screw Co., Providence, R. I.
Bristol Co., The, Waterbury, Conn.
Chandler Prods. Co., Cleveland, O.
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corp., New Britain, Conn.
Federal Screw Prod. Co., 224 W. Huron St., Chicago
International Screw Co., Detroit, Mich.
Lamson & Sessions, Cleveland, O.
Manufacturers Screw Prod., 216 W. Hubbard St., Chicago 10
Nat. Screw & Mfg. Co., Cleveland, O.
New England Screw Co., Keene, N. H.
Parker Co., Charles, The, Meriden, Conn.
Parker-Kalon Corp., 198 Varick, N. Y. C.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Mfg. Co., Chicago
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Mfg. Co., Waterbury, Conn.
Shakeproof, Inc., 2501 N. Keeler Av., Chicago
Southington Hardw. Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

SCREWS, Self-Tapping

American Screw Co., Providence, R. I.
Central Screw Co., 3519 Shields Av., Chicago
Continental Screw Co., New Bedford, Mass.
Federal Screw Prod. Co., 224 W. Huron St., Chicago
Manufacturers Screw Prod., 216 W. Hubbard St., Chicago 10
Parker-Kalon Corp., 198 Varick, N. Y. C.
Shakeproof, Inc., 2501 N. Keeler, Chicago

SCREWS, Set and Cap

Allen Mfg. Co., Hartford, Conn.
Federal Screw Prod. Co., 224 W. Huron St., Chicago
Manufacturers Screw Prod., 216 W. Hubbard St., Chicago 10
Parker-Kalon Corp., 198 Varick, N. Y. C.
Republic Steel Corp., Cleveland, O.
Shakeproof, Inc., 2501 N. Keeler Av., Chicago

SCREWS, Hollow & Socket Head

Allen Mfg. Co., Hartford, Conn.
Central Screw Co., 3519 Shields, Chicago
Federal Screw Prod. Co., 224 W. Huron St., Chicago
Manufacturers Screw Prod., 216 W. Hubbard St., Chicago 10
Parker-Kalon, 198 Varick, N. Y. C.
Stand. Pressed Steel Co., Jenkintown, Pa.

SELENIUM

Federal Tel. & Radio Corp., S. Newark, N. J.
Benwood Linze Co., St. Louis, Mo.
Selenium Corp. of Amer., 1800 W. Pico Blvd., Los Angeles

SHAFTING, Flexible

Breeze Corps., Inc., Newark, N. J.
Mall Tool Co., 7708 S. Chicago Ave., Chicago
Steward Mfg. Corp., 4311 Ravenswood Ave., Chicago
Walker-Turner Co., Inc., Plainfield, N. J.
White Dental Mfg. Co., 10 E. 48 St., N. Y. C.

SHEETS, Electrical

Amer Rolling Mill Co Middletown Conn
Carnegie-Illinois Steel Corp Pittsburgh Pa
Follansbee Steel Corp Pittsburgh Pa
Granite City Steel Co Granite City Ill
Newport Rolling Mill Co. Newport, Ky.
Republic Steel Corp Cleveland O
Ryerson & Son Inc Jos T Chicago
Westinghouse Elect & Mfg Co E Pittsburgh Pa

SHIELDS, Tube

Eby Inc H H 18 W Chelton Av Phila 44
Goat Metal Stampings Inc 314 Dean St Brooklyn N Y
Cinch Mfg Corp 2335 W Van Buren St Chicago 12
Hammarlund Mfg Co Inc 460 W 34 St N Y C

SHOCK ABSORBERS

See MOUNTINGS Shock Absorbing

SIGNAL GENERATORS

See GENERATORS Standard Signal

SOCKETS, Cathode Ray Tube

Franklin Mfg Corp 175 Varick St N Y C

SOCKETS, Tube

Aladdin Radio Industries 501 W 35th St Chicago
Alden Prods Co Brockton Mass
Amer Phenolic Corp 1830 S 54th Av Chicago
Amer Radio Hdware Co Mt Vernon N Y
Birnbach Radio Co 145 Hudson N Y C
Bud Radio Inc Cleveland O
Cinch Mfg Co 2335 W Van Buren St Chicago
Cont'l-Diamond Fibre Co Newark Del
Eagle Elec Mfg Co Brooklyn N Y
Eby Inc H H Philadelphia
Federal Screw Prods Co 26 S Jefferson Chicago
Franklin Mfg Corp 175 Varick N Y C
Hammarlund Mfg Co 424 W 33 St N Y C
Johnson Co E F Waseca Minn
Jones Howard B 2300 Wabansia Chicago
Micarta Fabricators Inc 4619 Ravenswood Chicago
Millen Mfg Co James Malden Mass
Miller Co J W Los Angeles Cal
Nat'l Co Malden Mass
Remler Co San Francisco Cal

SOCKETS, Tube, Ceramic Base

Hammarlund Mfg Co Inc 460 W 34 St N Y C
Johnson Co E F Waseca Minn


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Nat'l Fabricated Products W Belden Ave Chicago
Ucinite Co Newtonville Mass

SOLDER, Self-fluxing

Garden City Laboratory 2744 W 37th Pl Chicago
Gardiner Metal Co S Campbell Ave Chicago
General Elec Co Bridgeport Conn
Kester Solder Co 4209 Wrightwood Ave Chicago
Ruby Chemical Co Columbus O

SOLDER POTS

Elec Soldering Iron Co Inc Deep River Conn
Lectrohm Inc Cicero Ill
Sound Equip Corp of Calif 6245 Lex Ave Los Angeles 38
Westinghouse Elect & Mfg Co E Pittsburgh Pa

SPEAKERS, Cabinet Mounting

Altec Lansing Corp 1680 N Vine Hollywood 28
Cinaudagraph Speakers Inc 3911 S Michigan Ave Chicago
Crescent Industries Inc Belmont Ave Chicago
Jensen Radio Mfg Co 6601 S Laramie St Chicago
John Meck Industries Plymouth Ind
Langevin Co 37 W 65 St N Y C 23
Magnavox Co Fort Wayne Ind
Operadio Mfg Co St Charles Ill
Quam-Nichols Co 33rd Pl Chicago 16
Rola Co Inc Superior St Cleveland O
Utah Radio Prod Co 842 Orleans St Chicago

SPEAKERS, Outdoor Type

Altec Lansing Corp 1680 N Vine Hollywood 28
Cinaudagraph Speakers Inc 3911 S Michigan Ave Chicago
Jensen Radio Mfg Co 6601 S Laramie St Chicago
Langevin Co 37 W 65 St N Y C 23
University Labs 225 Varick St N Y C

SPRINGS

Accurate Spring Mfg Co 3817 W Lake Chicago
Ace Mfg Corp 1255 E Erie Ave Phila 24
American Spring & Mfg Corp Holly Mich
American Steel & Wire Co Rockefeller Bldg Cleveland O
Barnes Co Wallace Bristol Conn
Crescent Industries Inc 4132 W Belmont Ave Chicago
Cuyahoga Spring Co Cleveland O
Gibson Co Wm D 1800 Clybourn Av Chicago
Hubbard Spring Co M D Pontiac Mich
Hunter Pressed Steel Co Lansdale Pa
Instrument Specialties Co Little Falls N Y
Muehlhausen Spring Corp Logansport Ind
Peck Spring Co Plainville Conn
Raymond Mfg Co Corry Pa
Security Steel Equip Corp Avenel N J
Standard Spring & Mfg Co Inc 236-42 St Brooklyn N Y
Willor Mfg Corp 794 E 104 St N Y C 54

STAMPINGS, Metal

Bud Radio Inc E 55 St Cleveland O
Goat Metal Stampings Inc 314 Dean St Brooklyn N Y
Hadley Co R M 707 E 61st Los Angeles
Insuline Corp of Amer Long Island City N Y
Par-Metal Prod Corp Long Island City N Y
Stewart Stamping Corp 621 E 216 St N Y C

Willor Mfg Corp 288-A Eastern Blvd N Y C

STEATITE, See Ceramics

SUPPRESSORS, Parasitic

Ohmite Mfg Co 4835 Flournoy St Chicago

SWITCHES, Aircraft Push

Square D Co Kollsman Inst Div Elmhurst N Y
Universal Microphone Co Inglewood Calif

SWITCHES, Key

Audio Development Co Minneapolis Minn
Chicago Tel Supply Co Elkhart Ind
General Control Co Cambridge Mass
Mossman Inc Donald P 6133 N Northwest Hy Chicago

SWITCHES, Midget Snap

Allied Control Co Inc E End Ave N Y C
Aero Electric Co 3167 Fulton Rd Cleveland
General Electric Co Schenectady N Y
Micro Switch Corp Freeport Ill
Spencer Thermostat Co Attleboro Mass

SWITCHES, Rotary, Bakelite Wafer

Mallory & Co Inc P R Indianapolis Ind
Stackpole Carbon Co St Marys Pa

SWITCHES, Rotary, Ceramic Wafer

Comm Prods Co 744 Broad Newark N J
Oak Mfg Co 1267 Clybourn Ave Chicago
Ohmite Mfg Co 4835 Flournoy St Chicago
Shallcross Mfg Co Collingsdale Pa

SWITCHES, Time Delay

Haydon Mfg Co Inc Forestville Ct
Industrial Timer Corp 115 Edison Pl Newark N J
Sangamo Elect Co Springfield Ill

SYNTHETICS, Wood & Metal Finish

Sullivan Varnish Co 410 N Hart St Chicago 22

TERMINALS, Hermetically Sealed

See BUSHINGS Terminal Sealing

TERMINALS, Soldered or Solderless

See LUGS Soldering and Solderless

TERMINALS (Turret Lugs)

Cambridge Thermionic Corp 443 Concord Ave Cambridge 38 Mass
Manufacturers Screw Prod 216 W Hubbard St Chicago 10
Ucinite Co Newtonville Mass

TERMINAL STRIPS

Burke Electric Co Erie Pa
Cinch Mfg Corp W Van Buren St Chicago
Cook Electric Co 2700 Southport Ave Chicago 14

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Franklin Mfg Corp 175 Varick St N Y C
Jones H B 2432 W George Chicago
Kulka Electric Mfg Co Mt Vernon N Y

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American Coils Co 25 Lexington St Newark N J
Industrial Filter & Pump Mfg. Co., W. Carroll Ave., Chicago
Kold-Hold Mfg. Co., 446 N. Grand Ave., Lansing, Mich.
Mobile Refrigeration, Inc., 630-5th Ave., N. Y. C.
Northern Engineering Labs., 50 Church St., N. Y. C.
Tenney Engineering, Inc., Montclair, N. J.

THERMISTERS

Western Electric Co 195 Bway N Y C

TRACING PAPERS, CLOTH, CELLOPHANE

Arkwright Finishing Co., Providence, R. I.
Brown & Bro., Arthur, 67 W. 44 St., N. Y. C.
Keuffel & Esser, Hoboken, N. J.

TRANSFORMERS, Constant-Voltage

Dongan Elec. Co., 74 Trinity Pl., N. Y. C.
General Electric Co., Schenectady, N. Y.
Raytheon Mfg. Co., Waltham, Mass.
Sola Electric Co., 2525 Clybourn Ave., Chicago

TRANSFORMERS, IF, RF

Aladdin Radio Industries, 501 W. 35th St., Chicago
Amer. Transformer Co., Newark, N. J.
Auto. Windings Co Inc 900 Passaic Ave E Newark N J
Browning Labs., Inc., Winchester, Mass.
Cambridge Thermionic Corp., Concord Ave., Cambridge, Mass.
Caron Mfg. Co., 415 S. Aberdeen, Chicago
D-X Radio Prods. Co., 1575 Milwaukee, Chicago
Essex Electronics 1060 Broad St Newark N J
Gen'l Winding Co 420 W 45 St N Y C
Greyhound Equip. Co., 1720 Church Ave., Brooklyn, N. Y.
Guthman & Co., 15 S. Throop, Chicago
Hammarlund Mfg. Co., 424 W. 33 St., N. Y. C.
Meissner Mfg. Co., Mt. Carmel, Ill.
Millen Mfg. Co., James, Malden, Mass.
Miller Co., J. W., 5917 S. Main, Los Angeles, Cal.
Nat'l Co., Malden, Mass.
Radex Corp., 1308 Elston Ave., Chicago
Sickles Co., F. W., Chicopee, Mass.
Sound Equip. Corp. of Calif., 6245 Lex. Ave., Los Angeles 38
Standard Winding Corp Newburgh N Y
Super Elec. Prod. Corp., Jersey City, N. J.
Teleradio Eng. Corp., 484 Broome St., N. Y. C.
Triumph Mfg. Co 4017 W Lake Chicago

TRANSFORMERS, Receiver Audio & Power

Acme Elec. & Mfg. Co., Cuba, N. Y.
Altec Lansing Corp., 1680 N. Vine, Hollywood 29
Amer. Transformer Co., Newark, N. J.
Amplifier Co. of Amer., 17 W. 20th St., N. Y. C.
Audio Devel. Co., N. Minneapolis, Minn.
Chicago Transformer Corp., 3501 Addison St., Chicago
Cinaudagraph Speakers, Inc., 3911 S. Michigan, Chicago
Cons. Radio Prod. Co 350 W Erie St Chicago 10
Dinion Coil Co., Caledonia, N. Y.
Dongan Elec. Co., 74 Trinity Pl., N. Y. C.
Electronic Trans. Co., 515 W. 29 St., N. Y. C.
Ferranti Elec., Inc., 30 Rockefeller Plaza, N. Y. C.
Foster Co., A. P. Lockland O
Freed Trans. Co., 72 Spring St., N. Y. C.
Gen'l Radio Co., Cambridge, Mass.
General Trans. Corp., 1250 W. Van Buren, Chicago
Hadley Co., R. M., 707 E. 61st, Los Angeles
Halldorson Co., 4500 Ravenswood, Chicago
Hercules Elec. & Mfg Co 2416 Atlantic Ave Bklyn 33
Howard Pacific Corp 932 N Western Av Los Angeles
Jefferson Elec Co Bellwood Ill
Kenyon Trans Co 840 Barry St N Y C
Langevin Co 37 W 65 St N Y C 23
Magnetic Windings Co Easton Pa
Merit Coil & Trans Corp 4427 N Clark Chicago 40
Newark Transformer Co., Newark, N. J.
N Y Transformer Co 22 Waverly Pl N Y C 3
Norwalk Transformer Corp S Norwalk Conn
Peerless Elec Prod Co 6920 McKinley Av Los Angeles
Raytheon Mfg Co Waltham Mass
Rola Co Inc Superior St Cleveland O
Standard Transformer Corp 1500 N Halsted Chicago
Super Elect Prod Co Jersey City N J
Superior Elec Co Bristol Conn
Thermador Elect & Mfg Co Riverside Dr Los Angeles
Thordarson Elec Mfg Co 500 W Huron Chicago
Utah Radio Prods Co 820 Orleans St Chicago
United Trans Co 150 Varick St N Y C
Westinghouse Elect & Mfg Co E Pittsburgh Pa

TRANSFORMERS, Variable Voltage

Amer Transformer Co Newark N J
General Radio Co Cambridge Mass
Superior Electric Co Bristol Conn

TUBE MANUFACTURING MACHINES

Hilton Eng Labs Redwood City Calif
Eisler Eng Co 7518 13th St Newark N J

TUBES, Cathode Ray

Dumont Labs Allen B Passaic N J
Electronic Tube Corp 1200 E Mermaid Phila 18
Farnsworth Tele & Radio Corp Ft Wayne Ind
General Elec Co Schenectady N Y
Ken-Rad Tube & Lamp Corp Owensboro Ky
Nat'l Union Radio Corp Newark N J
North Amer Philips Co Inc Dobbs Ferry N Y
Rauland Corp Chicago Ill
RCA Mfg Co Camden N J
Sylvania Elect Prod Inc Emporium Pa
Westinghouse Elect & Mfg Co E Pittsburgh Pa

TUBES, Current Regulating

Amperite Co 561 Broadway N Y C
Champion Radio Works Danvers Mass
Hytron Corp & Hytronic Labs Salem Mass
RCA Mfg Co Camden N J
Sylvania Elec Prod Inc Emporium Pa
Western Elec Co 195 B'dway N Y C

TUBES, Photo-Electric

Cont'l Elec Co Geneva Ill
De Jur-Amsco Corp Shelton Conn
De Vry Herman A 1111 W Center Chicago
Electronic Laboratory Los Angeles Cal
Emby Prods Co Los Angeles Cal
General Elec Co Schenectady N Y
General Scientific Corp 4829 S Kedzie Av Chicago
G-M Labs 4313 N Knox Av Chicago
Leeds & Northrop Co Philadelphia
Nat'l Union Radio Corp Newark N J
Photobell Corp 123 Liberty St N Y C
RCA Mfg Co Camden N J
Rectron Corp 2159 Magnolia Av Chicago
Westinghouse Lamp Div Bloomfield N J
Western Elec Co 195 B'way N Y C
Weston Elec Inst Corp Newark N J

TUBES, Receiving

General Elec Co Schenectady N Y
Hytron Corp Salem Mass
Ken-Rad Tube & Lamp Corp Owensboro Ky
Nat'l Union Radio Corp Newark N J
Raytheon Prod Corp 420 Lexington Av N Y C
RCA Mfg Co Camden N J
Sylvania Elect Prod Inc Emporium Pa
Tung-Sol Lamp Works Newark N J

TUBES, Transmitting

Amperex Electronic Prods Brooklyn N Y
Eitel-McCullough Inc San Bruno Cal
Electronic Enterprises Inc 65-67 Av Newark N J
Federal Telephone & Radio Corp Newark N J
General Elec Co Schenectady N Y
Gen'l Electronics Inc 101 Hazel St Paterson N J
Heintz & Kaufman S San Francisco Cal
Hytron Corp Salem Mass
Ken-Rad Tube & Lamp Corp Owensboro Ky
Machlett Labs Inc Norwalk Conn
Nat'l Union Radio Corp Newark N J
North Amer Philips Co Inc Dobbs Ferry N Y
Raytheon Prod Corp 420 Lexington Av N Y C

RCA Mfg Co Camden N J
Slater Electric & Mfg Co Brooklyn N Y
Sperry Gyroscope Co Inc Brooklyn N Y
Sylvania Elect Prod Inc Emporium Pa
Taylor Tubes Inc 2341 Wabansia Chicago
United Electronics Co Newark N J
Western Elec. Co., 195 B'way, N. Y. C.
Westinghouse Lamp Div., Bloomfield, N. J.

TUBES, Voltage-Regulating

Amperite Co., 561 Broadway, N. Y. C.
Hytron Corp., Salem, Mass.
RCA Mfg. Co., Camden, N. J.
Sylvania Elec. Prod., Inc., Salem, Mass.

TUBES, X-Ray

Genl. Elec. X-Ray Corp 2012 Jackson Blvd Chicago
Machlett Labs. Inc South Norwalk Conn
North Amer. Philips Co Inc 100 E 42 St N Y C
Picker X-Ray Corp 300 4th Ave N Y C
Westinghouse Elec & Mfg Co E Pittsburgh

TUBING, Laminated Phenolic

Brandywine Fibre Prods. Co., Wilmington, Del.
Formica Insulation Co., Cincinnati, O.
General Electric Co., Pittsfield, Mass.
Insulation Mfgrs. Corp., 565 W. Washington Blvd., Chicago
Mica Insulator Co., 196 Varick, N. Y. C.
Nat'l Vulcanized Fibre Co., Wilmington, Del.
Richardson Co., Melrose Park, Ill.
Spaulding Fibre Co., 233 B'way, N. Y. C.
Synthane Corp., Oaks, Pa.
Taylor Fibre Co., Norristown, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

TUBING, Precision Metal

Superior Tube Co., Norristown, Pa.

TUBING & SLEEVING, Varnished Cambric, Glass-Fibre, Spaghetti

Bentley-Harris Mfg. Co., Conshohocken, Pa.
Brand & Co., Wm., 276 Fourth Av., N. Y. C.
Electro Tech. Prod., Inc., Nutley, N. J.
Endurette Corp. of Amer., Cliffwood, N. J.
General Elec. Co., Bridgeport, Conn.
Insulation Mfgrs. Corp., 565 W. Washington Blvd., Chicago
Irvington Var. & Ins. Co., Irvington, N. J.
Mica Insul. Co., 196 Varick St., N. Y. C.
Mitchell-Rand Insulation Co., 51 Murray St., N. Y. C.
Varflex Corp., Rome, N. Y.

TURNTABLES, Phonograph

Fairchild Camera & Inst. Co., 475 Tenth Av N. Y. C.
General Industries Co., Elyria, O.
General Inst. Corp., Elizabeth 3, N. J.
Presto Recording Corp., 242 W. 55 St., N. Y. C.
R C A Mfg. Co., Camden, N. J.
Seeburg Corp., J. P., 1510 N. Dayton St., Chicago
Webster Products, 3825 Armitage Ave., Chicago
Western Electric Co., 125 B'way, N. Y. C.

VARNISHES, Fungus Resistant

Comm. Prod. Co Inc 744 Broad St Newark
Insl X Co Inc 857 Meeker Ave Bklyn
Maas & Waldstein Co Newark N J

VARNISHES, Insulating, Air-Drying & Baking

Comm. Prods. Co., 744 Broad, Newark, N. J.
Dolph Co., John C., Newark, N. J.
Irvington Var. & Ins. Co., Irvington, N. J.
Mitchell-Rand Insulation Co., 51 Murray St., N. Y. C.
Stille-Young Corp., 2300 N. Ashland Av., Chicago
Zophar Mills, Inc., 112-26 St., Bklyn., N. Y.

VARNISHES, Wrinkle Finish

Sullivan Varnish Co., 410 N. Hart St., Chicago

VIBRATION TEST EQUIPMENT

Vibration Specialty Co., 1536 Winter St., Philadelphia
All American Tool & Mfg. Co., 1014 Fullerton Ave., Chicago

VIBRATORS, Power Supply

Amer. Telev. & Radio Co., St. Paul, Minn.
Electronic Labs., Indianapolis, Ind.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Radiart Corp., W. 62 St., Cleveland, O.
Turner Co., Cedar Rapids, Ia.
Utah Radio Prod. Co., Orleans St., Chicago

WAXES & COMPOUNDS, Insulating

Irvington Varnish & Ins. Co., Irvington, N. J.
Western Elec. Co., 195 B'dway, N. Y. C.
Zophar Mills, Inc., 112-26 St., Bklyn

WELDING, Gas, Aluminum & Steel

Treitel-Gratz Co., 142 E. 32 St., N. Y. C.

WIRE, Bare

Amer. Steel & Wire Co., Cleveland, O.
Anaconda Wire & Cable Co., 25 B'dway N. Y. C.
Ansonia Elec. Co., Ansonia, Conn.
Belden Mfg. Co., 4633 W. Van Buren, Chicago
Copperweld Steel Co., Glassport, Pa.
Crescent Ins. Wire & Cable Co., Trenton, N. J.
General Elec. Co., Bridgeport, Conn.
Phosphor Bronze Smelting Co., Phila.
Rea Magnet Wire Co., Fort Wayne, Ind.
Roebling's Sons Co., John, Trenton, N. J.
Velliff Mfg. Corp., Southport, Conn.

WIRE, Glass Insulated

Bentley, Harris Mfg. Co., Conshohocken Pa.
Gavitt Mfg. Corp., Brookfield, Mass.
Holyoke Wire & Cable Corp., Holyoke, Mass.
Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6
Owens-Corning Fiberglas Corp., Toledo, O.

WIRE, HOOKUP

Bentley, Harris Mfg. Co., Conshohocken Pa.
Gavitt Mfg. Co., Brookfield, Mass.
Lenz Elec. Mfg. Co., 1751 N. W. Av., Chicago
Rockbestos Prod. Corp., New Haven, Conn.
Runzel Cord & Wire Co., 4723 Montrose Ave., Chicago
Whitney Blake Co., New Haven, Conn.

WIRE & CABLE

Acme Wire Co., New Haven, Conn.
Amer. Steel & Wire Co., Cleveland, O.
Anaconda Wire & Cable Co., 25 B'dway, N. Y. C.
Ansonia Elec. Co., Ansonia, Conn.
Belden Mfg. Co., 4633 W. Van Buren, Chicago
Collyer Ins. Wire Co., Pawtucket, R. I.
Consolidated Wire Co., 1634 Clinton St., Chicago
Crescent Ins. Wire & Cable Co., Trenton N. J.
Elec. Auto-Lite Co., The, Port Huron, Mich.
General Cable Corp., Rome, N. Y.
General Elec. Co., Bridgeport, Conn.
Hazard Ins. Wire Works, Wilkes-Barre, Pa.
Holyoke Wire & Cable Corp., Holyoke, Mass.
Hudson Wire Co., Winsted, Conn.
Rea Magnet Wire Co., Fort Wayne, Ind.
Rockbestos Prods. Corp., New Haven, Conn.
Roebling's Sons Co., John, Trenton, N.J.
Runzel Cord & Wire Co., 4723 Montrose Ave., Chicago
Simplex Wire & Cable Co., Cambridge, Mass.
Western Ins. Wire, Inc., 1000 E. 62 St., Los Angeles
Wheeler Insulated Wire Co., Bridgeport, Conn.

WOOD, Laminated & Impregnated

Canfield Mfg. Co., Grand Haven, Mich.
Formica Insulation Co., Cincinnati, O.

WOOD PRODUCTS, Cases, Parts

Hoffstatter's Sons, Inc., 43 Ave. & 24 St., Long Island City, N. Y.
Tillotson Furniture Co., Jamestown, N. Y.

FACSIMILE FOR POLICE SERVICE

Another article in the series appearing in *FM* and Television on the subject of facsimile will be published in the March issue.

This will describe a unit suitable for both headquarters and mobile service, opening up an entirely new branch of police radio communications. — See it in the March issue.

★

FM HANDBOOK

(CONTINUED FROM PAGE 40)

of sine wave form, the FM wave becomes the sum of a component at the center frequency, and numerous pairs of sideband components above and below the center frequency, at intervals equal to the amount of the modulation frequency. When the modulation is slight, the amplitude of the pairs of sidebands more remote from the carrier becomes so low that their presence may be ignored.

6. The extent of the frequency modulation can be described in two ways. A certain frequency swing is agreed upon as being equivalent to 100% modulation. The extent of modulation can also be specified by stating the modulation index. This index is the ratio of the maximum frequency swing (away from the center) to the highest modulating frequency. In the case of FM, therefore, the modulation index is not the decimal equivalent of the modulation percentage.

7. The band width required in FM depends upon the level of modulation and upon the modulating frequency. The greatest channel width occurs when the wave is subjected to its maximum modulation at the highest modulating frequency; this band width may exceed considerably the peak to peak frequency swing. The least band width is required under a condition of slight modulation, but the channel width is never less than the amount of twice the modulating frequency.

8. Inasmuch as linearity of amplitude reproduction is not demanded of the amplifier stages of an FM transmitter, it is not necessary to introduce the modulating voltage at or near the last stage.

9. Since the RF power output of the FM transmitter is constant, modulation can be introduced in an early stage. Not only are the power output requirements for the modulator made extremely small, but also the tubes in all the stages of the transmitter subsequent to the modulated stage can be operated at their maximum Class C ratings, which makes for high overall efficiency.

REFERENCE DEFINITIONS

Amplitude: The amplitude of a quantity that is varying according to a sine wave form is the maximum value which the quantity attains; the peak value of the sine wave.

AM, Amplitude Modulation: The process whereby the amplitude of a wave is caused to vary according to the instantaneous variations of another wave.

Band-Pass Circuit: A circuit having filter characteristics such that frequencies within a certain range are passed while frequencies outside the range are blocked.

Band-width: Range of frequencies passed by band pass circuit.

Carrier Frequency: Frequency of an unmodulated AM transmitter.

(CONCLUDED ON PAGE 57)

CENTER FREQUENCY: Frequency of an unmodulated FM transmitter.

CYCLE: A complete course of change, at the end of which the original state is restored.

FREQUENCY: The number of cycles occurring in one second.

FREQUENCY MODULATION: The process whereby the frequency of a wave is caused to vary according to the instantaneous variations of a modulating frequency.

FM: Abbreviation for Armstrong system of Frequency Modulation.

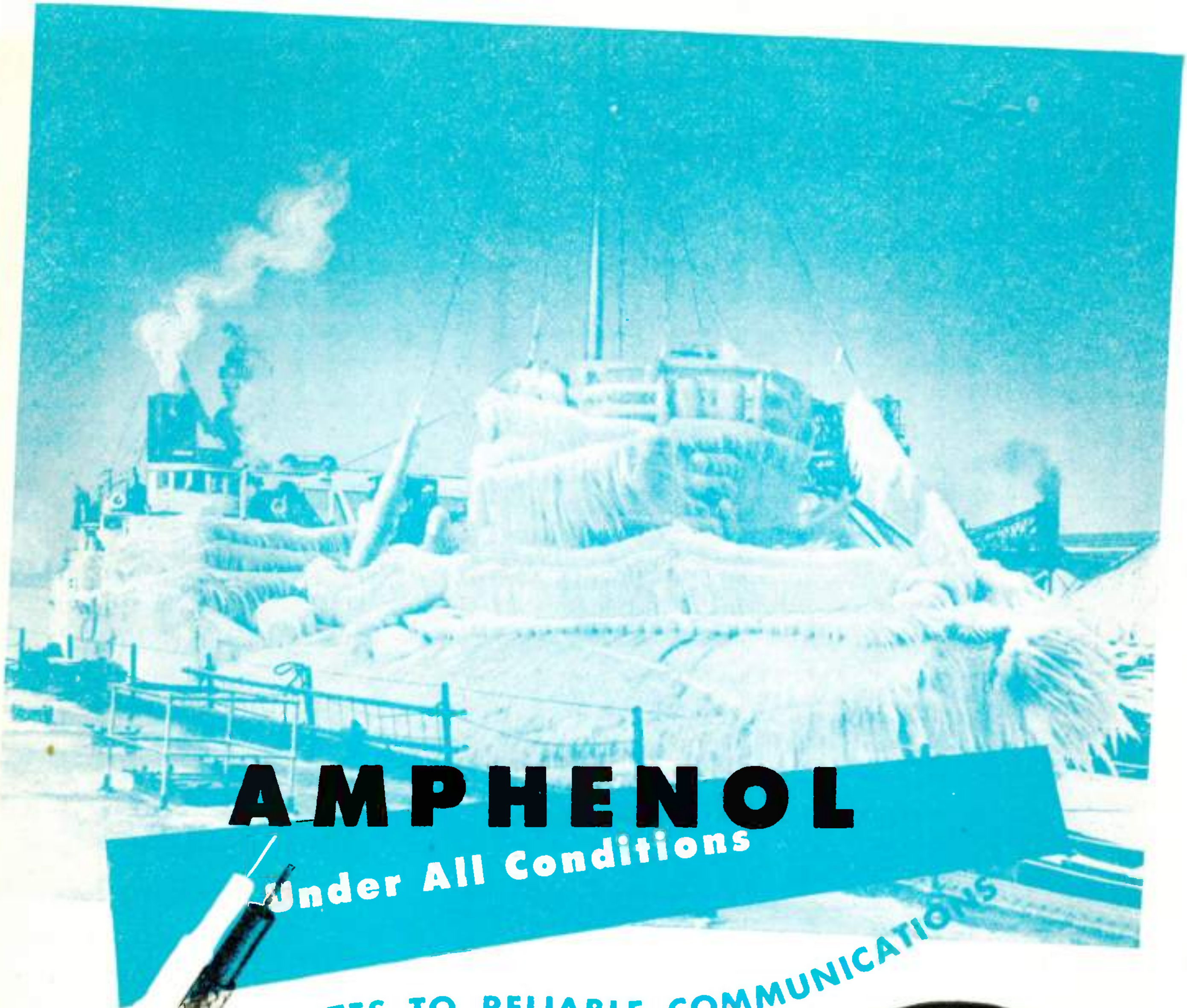
MODULATION: The process whereby one characteristic of a wave, amplitude, frequency, or phase, is varied as a function of the variations of another wave.

POSITIVE PEAK OF MODULATION: In amplitude modulation, the maximum of that alternation of the modulation cycle which causes the amplitude of the wave to rise above carrier level.

NEGATIVE PEAK OF MODULATION: In amplitude modulation, the maximum of that alternation of the modulation cycle which causes the amplitude of the wave to fall below carrier level.

SIDEBANDS: Frequencies higher and/or lower than the carrier frequency, produced during modulation.

TRIGONOMETRIC IDENTITY: Statement of the equivalence of two trigonometric expressions which holds for every value of the angles involved.



they said

it couldn't

be done . . .

and again . . .

THEY SAID

IT COULDN'T

BE DONE . . .

Hytron's telescoping of receiving tubes to BANTAM GT size was at first considered impracticable. Development of the BANTAM JR. was another impossibility to be proved possible. This first sub-miniature was a tiny tube whose diameter was about that of your little finger — and it was a pentode at that! As a production tube it just didn't seem to make sense.

Encouraged by hearing-aid manufacturers eager to gain the additional sensitivity of the vacuum tube, Hytron sweated it out for two long years. Operators were trained to assemble the minute parts under magnifying glasses. A simple reversal of the conventional stem made baseless tubes possible. Problems of obtaining suitable vacuum with such small bulbs, were licked.

Finally in 1938, Hytron introduced the first successful sub-miniature. Tiny but rugged despite a hair-like filament and a diminutive mount structure, its low current drain and compactness made the BANTAM JR. a natural for all kinds of portable equipment, hearing aids, and military electronic devices. After the war, watch for even smaller and better Hytron sub-miniatures.

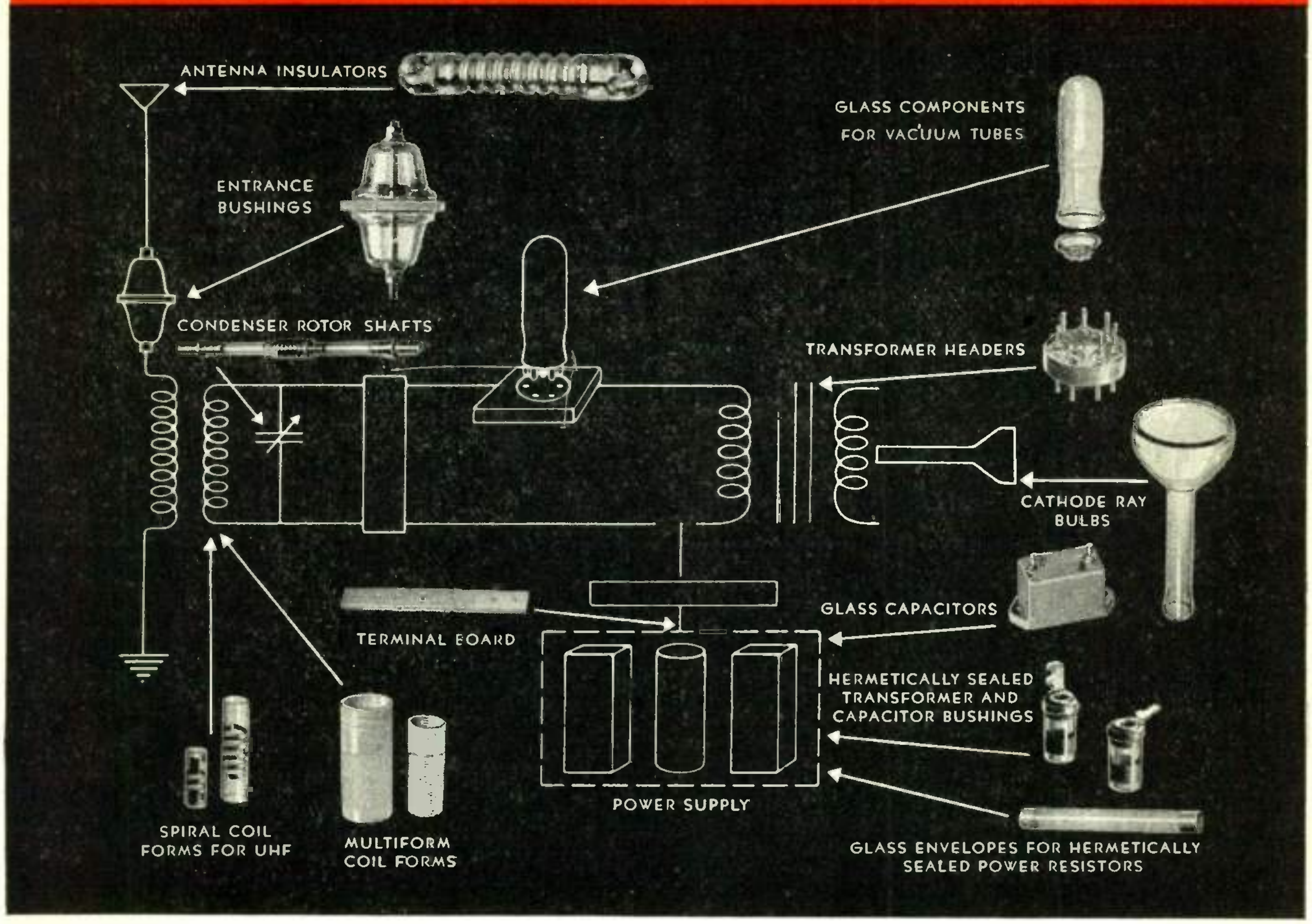
OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

BUY ANOTHER WAR BOND

ARE YOU LETTING GLASS HELP YOU ALL IT CAN?



IT wouldn't be surprising if you aren't familiar with everything glass is doing in electronic equipment today. Progress has been rapid. In the above *"circuit"*, for example, you'll find it on the job in (twelve) vital places. At Corning right now we're making a lot of other electronic glassware that we can't show. After the war we'll tell you all about it.

It's no accident that a major part of the electronic glassware in use got its start at Corning. We've dug in on some tough ones and ferreted out solutions. They told us we couldn't solder metal to glass — they needed glasses with a coefficient of expansion practically equal to that of fused quartz —they needed something to take the place of mica in capacitors — Corning Research found the answers to these and many other electronic problems.

Our 250 glass experts—the men behind "Corning Research"— our facilities and all our knowledge of glass are at your service. Write for a copy of an informative new booklet "There Will Be More Glass Parts in Postwar Electrical Products." Address Electronic Sales Dept. Bulb and Tubing Division, Corning Glass Works, Corning, N. Y.

CORNING *means* Research in Glass

Electronic Glassware

T. M. REG. CORNING U. S. PAT. OFF.

T. M. REG. PYREX U. S. PAT. OFF.

A NEW STAR IN THE ELECTRONIC FIELD

The stage is set for something new in Universal's line of products. Next month will bring the appearance of a new microphone to meet markets made by present and postwar demands. This will be the first microphone of its kind offered by Universal since the War. Universal has, since before Pearl Harbor, been manufacturing microphones and electronic voice communication components for the U. S. Army Signal Corps.

We are still pleased to manufacture all the microphones our fighting men require and we are pleased to make a new microphone to fill their and essential home front needs.

← **Emblems of quality in war production**

UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA

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

write for new bulletin SCV-102

LABORATORY VOLTAGES accompany your equipment into the field with built-in CONSTANT VOLTAGE

On the drafting boards of hundreds of sales-minded design engineers, product insurance is being written into the specifications of new electronic and electrically operated equipment.

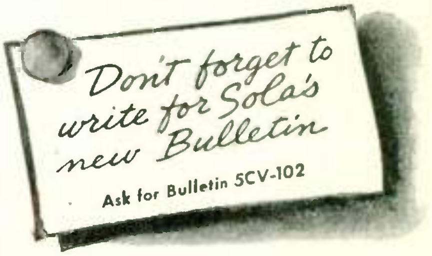
A critical analysis of sales department records of past performance usually discloses that the most frequent cause of equipment failure or sub-standard performance is the one most often overlooked — field voltages that do not correspond to the rated voltage at which the equipment is designed to operate.

Today sales-minded design engineers make certain that carefully controlled laboratory voltages, on which the operation of their equipment is predicated, go with it into the field, by writing "SOLA Constant Voltage Transformers" into their design specifications. In many cases the inclusion of the "CV" transformer is accomplished at an actual saving in cost over standard equipment design.

Thus rated voltage is available at all times because SOLA Constant Voltage Transformers instantly correct fluctuations as great as 30% to less than ±1% of rated requirements. These sturdy, automatic transformers require no pampering or supervision. They protect both themselves and the equipment against line surges and short circuits.

Standard units are available in capacities from 10VA to 15 KVA or special units can be built to your specifications.

SOLA Constant Voltage Transformers



Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.**

SPOT NEWS NOTES

(CONTINUED FROM PAGE 22)

tower, gave routing instructions to Capt. C. H. Morris, from whom orders were passed on to traffic police. Handie-talkies were furnished by Motorola.

Niles Trammell: President of NBC, has been elected to the board of directors of RCA, replacing Gen. Charles G. Dawes, who resigned on February 2nd.

Name Changed: Croname, Incorporated is now the name of the Crowe Name Plate & Manufacturing Company, at 3701 Ravenswood Avenue, Chicago 13.

Polymer Chemistry: Course has been organized at Polytechnic Institute of Brooklyn, N. Y. The establishment of a Polymer Research Bureau will make this a center for information and for advanced study and research.

R.R. Radio: General Railway Signal Company has been authorized to operate 2 portable and portable-mobile experimental stations of 10 watts power on 300 to 325 and 350 to 400 mc., for development of railroad communications systems.

E. L. Bragdon: Radio editor of the *New York Sun* from 1923 to 1942, and subsequently trade news editor at NBC, has joined the RCA department of information.

ENGINEERING SALES

(CONTINUED FROM PAGE 8)

Trade-in Prices: Federal Trade Commission has issued a stipulation against a company offering a purportedly bona fide trade-in allowance on sets which were marked up to a fictitious list to offset the allowance.

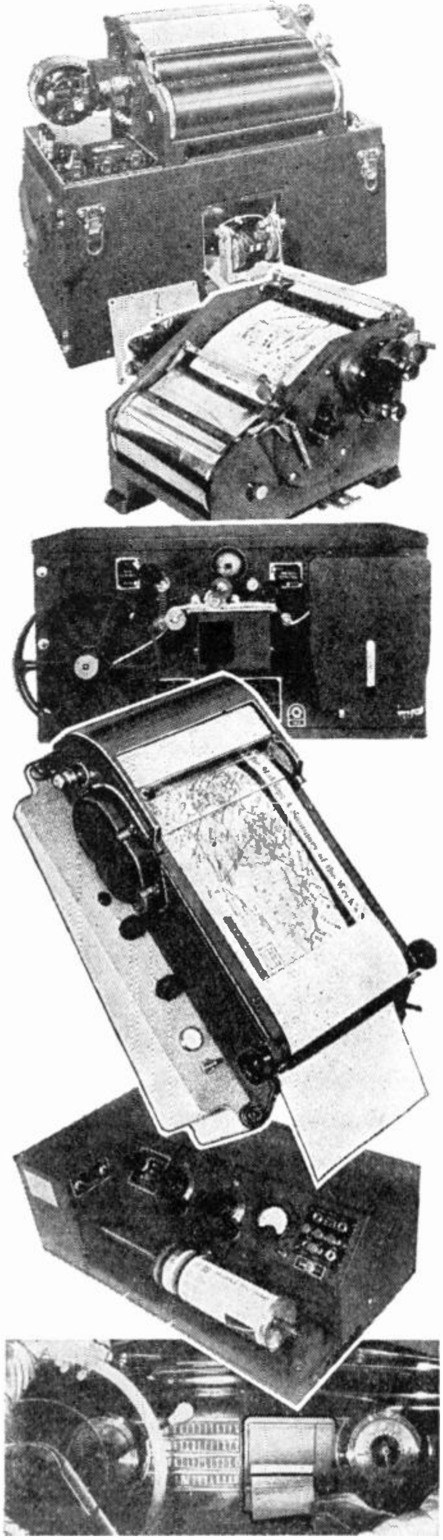
G.E.: Following the acquisition of Ken-Rad radio tube business by G.E., two former Ken-Rad executives have joined the G.E. electronics department. They are L. R. O'Brien, who will manage sale of receiving tubes to equipment manufacturers, and R. W. Metzner, who will manage sale of replacement receiver tubes. E. H. Fritschel will continue as manager of transmitter tube sales, and J. E. Nelson as manager of industrial tube sales.

Hudson-American: Their newly-created advertising and public relations division, at 331 Madison Avenue, New York City, will be headed by Henry A. Stephens, former assistant to the vice president.

Sentinel: Has announced the appointment of the following distributors: Central Furniture & Appliance Co., Boonville, Mo.; Cavanaugh Company, 274 W. Federal Street, Youngstown, O.; Brown Camp Hardware, Des Moines, Ia.; J. H. Gross & Co., 653 Hippodrome Annex Building, Cleveland, O.; Morrow Thomas Hard-

(CONCLUDED ON PAGE 68)

ALDEN



for Graphic Recording of any kind

OUR YEARS OF EXPERIENCE, and cumulative skills, in the designing and production of RADIO COMPONENTS, are now being used in making equipment which covers ***the entire field of FACSIMILE.***

Actual service, as found in war and communication work under all conditions, has given a PRACTICAL quality to our equipment which, under ordinary conditions, would not have been obtained in years of engineering with limited application.

ALDEN PRODUCTS COMPANY is manufacturing practically ALL TYPES AND SIZES of facsimile and impulse recording equipment—using all the varied recording mediums: Photographic Paper, Film, Electrolytic Paper, Teledeltos, and Ink.

ALFAX IMPULSE RECORDING PAPER

•

By "COVERING THE ENTIRE FIELD," we mean . . .

1. Some of our equipment has been used for the transmitting and receiving of photographic pictures of reasonably high resolution (such as the war pictures now appearing in the news).

2. Continuous Recorders—of the type whose value has been proven on National and International news service circuits—are now on their way to the Orient, to be used for the receiving of the so-called "picture" languages.

3. Also, through the use of ALFAX (the first high-speed black and white permanent recording paper), HIGH-SPEED Signal Analysis Equipment has been made possible for various laboratories and Government Departments. Other equipments have employed Teledeltos Paper for message work and other purposes.

4. For outlying posts, where servicing equipment is an impossibility, or, where radio or wire links are of poor quality and power, ALDEN Tape Recorders (recording medium, ink)—have been designed to operate with a minimum of trouble and adjustments, and have PROVED MOST SATISFACTORY.

5. The ability of ALFAX Paper and ALDEN Machines to record impulses *as they occur,* without the inertia problems of many previous methods, has made possible other recorders at various speeds (including slow). They will record a whole day's history of related phenomena, with time indicated, and often—with self-calibrated linear reference marks for ready interpretation.

ALDEN PRODUCTS COMPANY

117 North Main Street

BROCKTON [64F1], MASSACHUSETTS

• • • • • • •

FACSIMILE

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

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

★

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

★

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

★

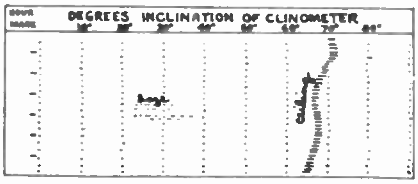
INTER-DEPARTMENT, or INTER-COMPANY MESSAGE, DESK SIZE RECORDERS—for memorandum or sketch dispatch, using ordinary typewriting for the scanning, but enlarged one and a half times, for legibility.

★

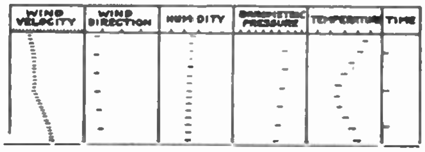
We do not want to miss an opportunity to discuss with you any interest you may have in facsimile or impulse recording. Write . . . or, better still, visit us by appointment.

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

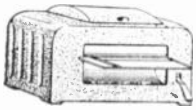
CATCHING THE CATHODE RAY SIGNALS IN A PERMANENT RECORD • Probably one of the greatest of all developments is the application of the cathode ray tube to make visible high frequency current for study and analysis. Now, Alfax paper and Alden recorders are the next step, making possible with certain ingenuity a permanent record on paper of what can be seen instantaneously on the cathode ray tube screen.



REFERENCE MARKS MAKE IT EASY TO INTERPRET RECORDING • This type of recording shows how standard or definite reference marks are recorded vertically for the accurate interpretation of received signals, whose intensity is indicated by shade and width of mark. Time intervals are impressed laterally.



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



Scanner

Recorder

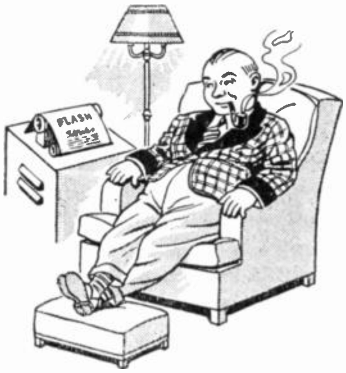
Typewriter

HERE IS A NEW SYSTEM FOR ALL TYPES OF RECORDING

Now you can write or type a message, insert in scanner, press a button, and—scanner automatically starts, (transmitting signal to start recorder). Copy is scanned and ejected, then scanner resets. Copy can be hand written or, for dispatch messages, written on roll paper as shown, in an ordinary typewriter. May be received enlarged one-and-one-half times appearing much like bold face type easily read several feet away. Ordinary typewriter may be used with adding machine width tape for copy.

Recorder is neat, simple and extremely compact. Mounts flat against dashboard, panel or desk. Parts that wear are made as replaceable units.

A practical system for messages to police, firemen, plane and ship pilots, taxidrivers, emergency service men, etc., when the proper radio or wire links are available.



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

ALFAX ELECTRICAL IMPULSE RECORDING PAPER

ENGINEERING SALES

(CONTINUED FROM PAGE 65)

ware Co., Amarillo, Texas; Shelley Electric Co., Wichita, Kan.; and Cincinnati Oil Works, Cincinnati, O.

R.C.A.: New regional manager for west coast area is Harold R. Maag, who will make his headquarters at 1016 N. Sycamore Street, Hollywood. He has been with RCA for 16 years.

Bendix: Additional distributors appointed are E. B. Latham & Company, Newark, N. J.; Youngstown Equipment Company, Boston, for eastern Massachusetts, New Hampshire, and Maine; Philadelphia Electronics, Inc., for eastern Pennsylvania, southern Jersey, and Delaware; and Acme Floor Coverings, 215 Occidental Building, Indianapolis, for central Indiana and parts of Illinois.

Westinghouse: Has purchased Pixley Electric Supply Company, 225 N. 4th Street, Columbus, O. L. A. Pixley, the former owner will now manage sales in the territory which includes outlets in Cincinnati and Evansville.

Motorola: Newly appointed distributors are Appliance Division of Higgins Industries, Inc., 521 City Park Avenue, New Orleans, for southern Louisiana and southern and central Mississippi; and Given Distributing Company, Inc., 709 Keith Building, Syracuse, N. Y. for the Syracuse area.

New York: Newark Electric Company, of 323 W. Madison Street, Chicago, has opened a branch at 115 W. 45th Street, New York City, operating as Newark Electric Co., Inc., with Adolf Gross as president. New branch will specialize in ham radio and industrial business.

15,000-CYCLE NETWORKS

(CONTINUED FROM PAGE 24)

than for the 5,000-cycle lines now in use. Exact cost data will be made available to existing or projected networks when they are ready to consider it.

At least, it seems certain that the increase would be amply justified by the improved service to radio listeners. In turn, the effectiveness of radio as an advertising medium would be greatly enhanced by the more powerful impact of realism which seems to move the studio stage right into every FM listener's living room.

This change is, in fact, essential not only to the development of nationwide FM broadcasting but to the projected shift of AM to FM transmission. The information made available by this map shows that broadcasters can start now to formulate plans for obtaining program service suitable for Frequency Modulation.

Laboratory Standards

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

SPECIFICATIONS

CARRIER FREQUENCY: 300 to 1000 megacycles.

OUTPUT VOLTAGE: 0.1 to 100,000 microvolts.

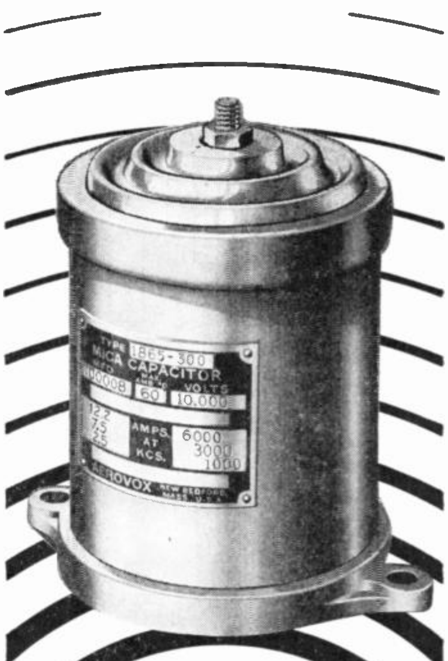
OUTPUT IMPEDANCE: 50 ohms.

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.

MEASUREMENTS CORPORATION
BOONTON · NEW JERSEY



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ULTRA-HIGH FREQUENCY
functions

● This Aerovox Type 1865 capacitor is designed for ultra-high-frequency radio power equipment such as television and FM transmitters. Especially recommended for fixed tuning, by-passing, blocking, coupling, neutralizing and antenna-series capacitance.

Losses are extremely low, due to highly refined sulphur dielectric used. Corona losses are avoided by the unique design, grounded case, and insulated terminal. Type 1865 (illustrated) has cast aluminum case; steatite insulator supports terminal. Lower-cost Type 1860 has aluminum can; mica disc insulator for terminal. Ratings up to 10,000 test volts effective. .00001 to .000125 mfd.

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Applicants must comply with WMC regulations

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Just off the Press—This complete 24 page Harco catalogue that every engineer and executive concerned with Radio Masts and Towers will want for their files. Write for it on your business letterhead.

Write Dept. AF.

HARCO
STEEL CONSTRUCTION CO., Inc.
Elizabeth 4, New Jersey

(CONTINUED FROM PAGE 4)

that he can tune out any program that offends him. However, even the tyros of the propagandist profession know that answer, for they have been taught to present their ideas in terms of what listeners want to hear.

An example of this technique in the hands of a master was Henry Wallace's broadcast speech of January 29th. Discredited as a financial executive by his own record, he made no claims of competence to direct the office of the RFC. Instead, he spoke with great feeling of his desire to serve the small business men of the Nation, and to assure employment to our returning soldiers and sailors!

Again, the answer is not the establishment of censorship over radio programs. By its nature, censorship may create greater abuse than that which it is intended to prevent. In radio broadcasting, not even the efforts of the Federal Trade Commission to control sponsors' claims have been thoroughly effective. Witness the claim for pills offered as a cure to those suffering from "borderline anemia." The use of these words as a threat and a promise is certainly not in accordance with the intent of FTC rules for the protection of radio listeners, yet it is as effective as a forthright statement which would be cited promptly by the FTC.

Thus, it is easy to see how the unlimited availability of FM broadcast channels will multiply the problems of the FCC, and what new responsibilities will confront Chairman Porter when he is asked to share his reward with others who, invited or not, worked "for the success of the (Democratic) ticket" and contributed "toward the victory which ensued."

2. The opinion seems to prevail among the majority of prospective FM broadcast station operators that they can dispose of the matter of programming by merely purchasing a library of records. They seem to know all about WQXR, and to feel that if WQXR could build an audience by playing records and then sell out for $1,000,000, there can't be much wrong with the idea.

But there is a lot wrong with it. First of all, too many others are doing the same thing on AM. Secondly, as WQXR knows, recordings have to be programmed with as much skillful planning as live talent. Moreover, while WQXR has been eminently successful in building up an audience for its recorded programs among AM listeners, the same music transmitted from WQXQ has brought little appreciation from FM listeners. Finally, the shortcomings of the relatively low-fidelity recordings now in use are emphasized by the high quality of FM transmission and reception.

Newcomers should be warned that programs are what build audiences, and audience-building requires much, much more than the services of a platter-turner.


WITH SUPER-PRO
'ROUND THE CLOCK
For twenty-four hours of every day "Super-Pro" receivers are assisting the "Round the Clock" bombing of the enemy.... In war and in peace "Super-Pro" leads the field.
THE SIGN OF QUALITY
ESTABLISHED 1910
THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., N.Y.C.
MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

REL in Philadelphia
FM STATION WFIL-FM

Frequency: 45.3 megacycles

Input to final amplifier: 11.3 KW

Antenna output: 10 KW

Total hours operation to date: Over 4,500

Type of transmitter: REL No. 520 DL

WFIL-FM has been functioning successfully since November 10, 1941. High above the city of Philadelphia, this station's huge tower is a monument to REL'S pioneering in staticless, high-fidelity Frequency Modulation, utilizing the Armstrong Direct Crystal Controlled Phase Shift System of Modulation.

REL

Sales Representatives

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MIDWEST
REL Equipment Sales, Inc.
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Hollywood, Cal.

PIONEER MANUFACTURERS OF FM TRANSMITTERS EMPLOYING ARMSTRONG PHASE-SHIFT MODULATION

RADIO ENGINEERING LABS., INC.
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WILL YOU BE PREPARED
WITH AN UNFAILING
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HURRICANE RAGES ALONG COAST—
Power and Communication Lines Down
(Sept. 1944 — Link FM used in all coastal states. North Carolina to Mass.)

FIRE DESTROYS CIRCUS TENT—
(July 1944 — Link FM used by Conn. State Police)

MUNITIONS BLAST FELT 7 MILES—
All Overhead Wires Torn Down
(July 1944 — Link AM used by Contra Costa County, Cal., Sheriff)

KILLER ESCAPES INSTITUTION—
(June 1944 — Link FM used by N. Y. State Police)

TRAIN WRECK CUTS WIRE LINES—
Highway Patrol Calls Aid with Radio
(Dec. 1943 — Link FM used by N. C. Highway Patrol)

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