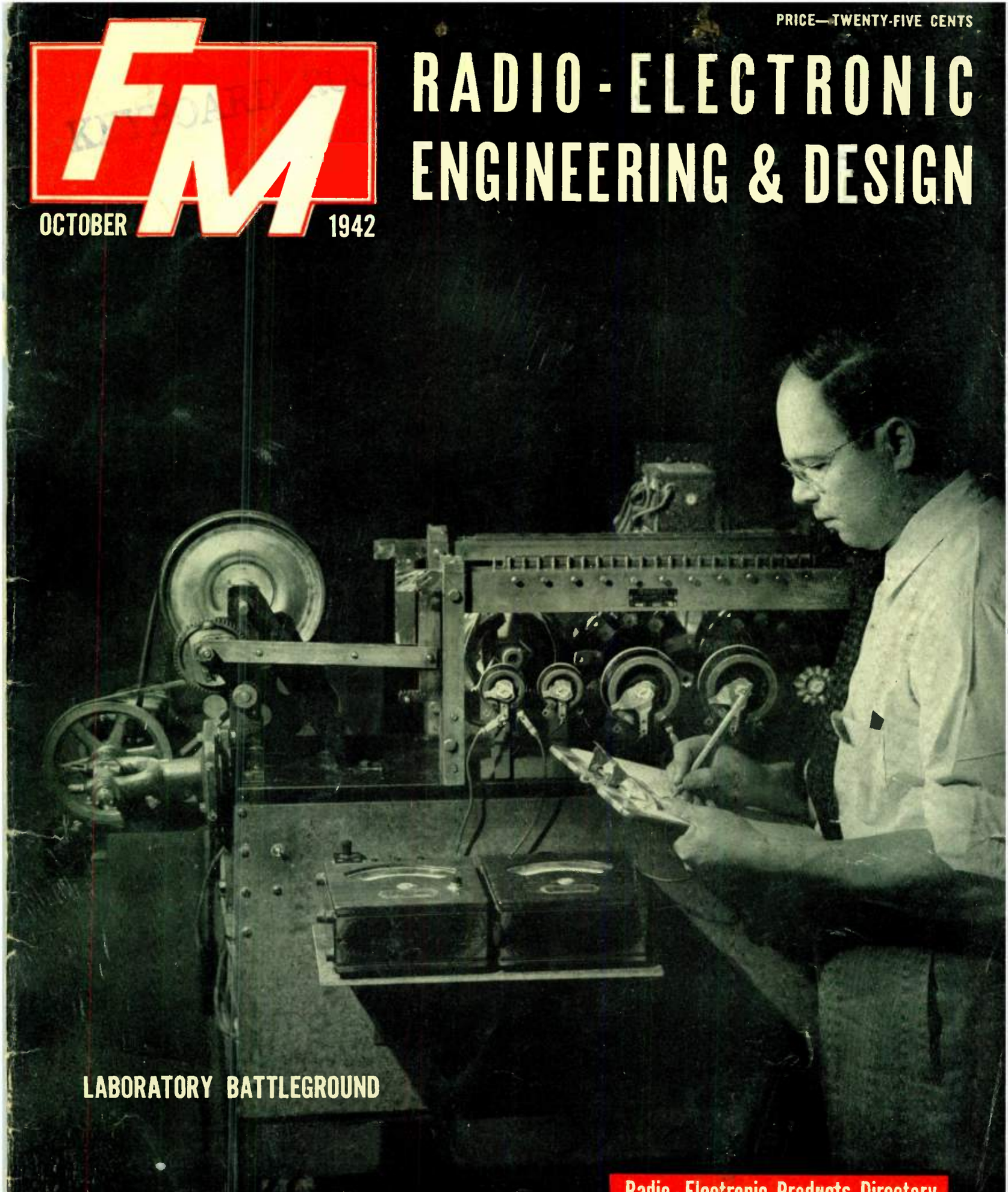
PRICE—TWENTY-FIVE CENTS

FM

RADIO-ELECTRONIC ENGINEERING & DESIGN

OCTOBER 1942



LABORATORY BATTLEGROUND

Radio-Electronic Products Directory

THE JOURNAL OF WARTIME RADIO-ELECTRONIC DEVELOPMENT, ENGINEERING & MANUFACTURING ★ Edited by M. B. Sleeper ★

U. S. NAVY OFFICIAL PHOTO

"ALL CLEAR"

When the "All Clear" of final victory sounds, Jefferson-Travis will again make available its two-way radio communication equipment for private and commercial use throughout the world. But until then we will concentrate all of our effort and energy in the continued production of equipment for the armed forces of the United Nations.

JEFFERSON-TRAVIS RADIO MFG. CORP.

Manufacturers of Aircraft, Marine and Mobile Radio Communication Equipment

NEW YORK, N. Y. WASHINGTON, D. C.

. . . all the engineering genius that made the Freed-Eisemann name synonymous with the finest in peacetime radio . . .

NOW SERVING AMERICA FOR THE DURATION

★ ★ ★

Completely converted to war production, the Freed Radio Corporation is now manufacturing, in ever-increasing quantity, communication equipment for the nation's armed forces — highly complex laboratory equipment — transmitters, receivers, test instruments and special devices, on prime government contracts.

It is quite natural that we should be handling manufacturing assignments which demand the highest caliber of engineering and craftsmanship. Prior to the WPB order to halt all civilian radio manufacture, we were creating some of the finest radio-phonographs ever produced in this country — magnificent instruments housed in beautiful furniture and capable of regular broadcast, short wave and Armstrong Wide-Swing Frequency Modulation reception.

We took great pride in manufacturing these radio-phonographs — just as our dealers have taken pride in demonstrating them, and just as music lovers take pride today in owning them. They represent the culmination of Freed-Eisemann peacetime engineering genius, which, since 1922, has been identified with front-line radio achievement. Freed-Eisemann was the first to produce crystal sets . . . neutrodyne sets . . . sets with self-contained speakers . . . non-battery sets. And with the invention of FM, we became the first to produce FM radio-phonographs exclusively.

At present, while we are employing every ounce of energy in wartime radio production, we are increasing our usefulness by expanding our manufacturing facilities and our plant.

A NAME FAMOUS IN RADIO SINCE 1922

Freed-Eisemann

FREED RADIO CORPORATION • 39 WEST 19th STREET, NEW YORK CITY • ENGINEERS AND MANUFACTURERS

FM RADIO-ELECTRONIC ENGINEERING & DESIGN

COMBINED WITH: APPLIED ELECTRONIC ENGINEERING

VOL. 2 | OCTOBER, 1942 | NO. 11

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* * * * * *

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The publishers will be pleased to receive articles, particularly those well illustrated with photos and drawings, concerning all phases of FM developments. Manuscripts should be sent to the publication office, at New York City. Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit.

Advertising correspondence, copy, and cuts should be addressed to the advertising office at New York City.

COVER PICTURE

With every radio manufacturer measuring his production against Army-Navy specifications, the War is having the effect of raising quality standards throughout the industry. Today, all kinds of equipment and components are being tested to destruction in order to determine and correct weak points of design which may develop in service. Typical of the "laboratory battlegrounds" is the machine which chief engineer Herbert Levy uses to check Ohmite resistors by turning the contactors back and forth until some element fails.

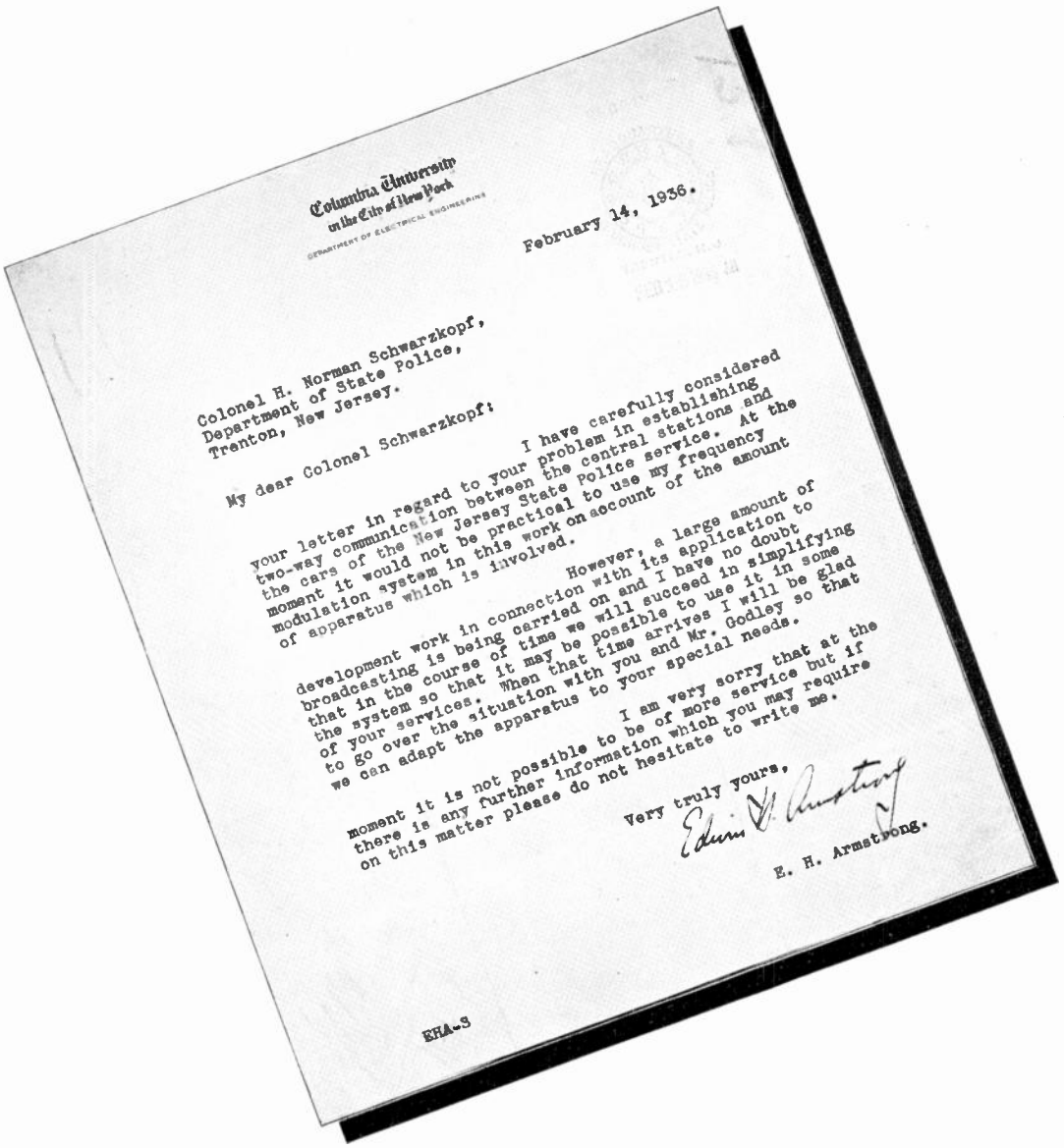
FOR OUTSTANDING ACHIEVEMENT

. . . *the "E" emblem* is the highest tribute to the prowess of American labor in the field of shortwave communications. Hallicrafters workers by their unswerving purpose to produce a product that is better, and to exceed their quotas in order that production schedules can be maintained, have been awarded this honor.

The accumulative electronic experience gained by Hallicrafters employes will be a dominant factor in future peace time production of advanced designs in shortwave communications receivers.

the hallicrafters co.
CHICAGO, U. S. A.

Keep Communications Open!



Columbia University
in the City of New York
DEPARTMENT OF ELECTRICAL ENGINEERING

February 14, 1936.

Colonel H. Norman Schwarzkopf,
Department of State Police,
Trenton, New Jersey.

My dear Colonel Schwarzkopf:

Your letter in regard to your problem in establishing two-way communication between the central stations and the cars of the New Jersey State Police service. At the moment it would not be practical to use my frequency modulation system in this work on account of the amount of apparatus which is involved.

However, a large amount of development work in connection with its application to broadcasting is being carried on and I have no doubt that in the course of time we will succeed in simplifying the system so that it may be possible to use it in some of your services. When that time arrives I will be glad to go over the situation with you and Mr. Godley so that we can adapt the apparatus to your special needs.

I am very sorry that at the moment it is not possible to be of more service but if there is any further information which you may require on this matter please do not hesitate to write me.

Very truly yours,

Edwin H. Armstrong.

E. H. Armstrong.

EHA:S

FM EMERGENCY COMMUNICATIONS

Correspondence from New Jersey State Police Files Shows Progress of 2-Way FM Equipment

BY LIEUT. JOHN E. MURNANE*

BEHIND the successful performance of New Jersey's State Police FM communications system there is an interesting story. Told in correspondence from the State Police files, it shows the remarkable progress that Major Armstrong has made in perfecting and simplifying his original FM transmitting and receiving equipment.

In 1935, Col. Schwartzkopf, then Superintendent of the New Jersey State Police, undertook to obtain equipment for a statewide radio communications system. A thorough investigation was made of the performance of various apparatus then available. However, it did not appear that two-way telephone conversations between fixed stations and patrol cars would be practical over the distances required. Installations tested at that time were, of course, all AM.

Col. Schwartzkopf asked Major Charles H. Schoeffel, then his Deputy and now the Superintendent, to inquire of Paul F. Godley about the possibilities of Frequency Modulation. Mr. Godley had been retained as consultant to the Department.

His reply is of particular interest as a comment on Major Armstrong's work at that time.

Upper Montclair, N. J.
February 4, 1936

MAJOR CHARLES H. SCHOEFFEL,
Deputy Superintendent,
New Jersey State Police,
Trenton, N. J.

Dear Major:

The Colonel no doubt has in mind Major E. H. Armstrong (now Professor), who has developed a new system of radio transmission and reception which quite completely sidesteps static as applied on the ultra-high-frequencies.

This is the same man who developed the regenerative, superregenerative, and superheterodyne circuits. As the result of his investigations of the operating characteristics of the 3-element vacuum tube in the years 1912 to 1914 we were shown the way to practical radio telephony and broadcasting. Aside from Marconi himself, this man has, in my opinion, contributed more to the radio art than any other individual.

He now holds a full Professorship at Columbia University, New York.

During his recent demonstrations

(CONTINUED ON PAGE 30)

*Communications Officer, New Jersey State Police, Trenton, N. J.

HIGH-FREQUENCY IRON CORES

Part 2. Characteristics of Specific Powdered Iron Core Materials at Frequencies Up to 50 Mc.

BY AUSTIN C. LESCARBOURA*

Choice of Core Materials ★ Working in close collaboration with coil designers and circuit engineers, powdered-iron-core specialists can now supply the specific materials best fitted for given critical requirements. Crowley materials offer a wide choice with which to meet widely differing characteristics as well as price considerations. The fabrication facilities not only include automatic presses for molding simple and even intricate shapes, but also various machine tools for the elaborate forms.

There is now a wide array of standard core forms for which dies or tools are generally available, as shown by the various illustrations in Part 1. When such standard dimensions and shapes are used, there is naturally a considerable economy, not to mention the usually all-important factor of delivery. Otherwise special dies or tools can be made to turn out unusual shapes and sizes, if the application warrants the additional cost and extra time involved.

*Part 1 of this paper was published in RADIO-ELECTRONIC ENGINEERING for August, 1942.

To convey some idea of the fitting of core materials to specific requirements, here are typical Crolite core materials now in general use, the frequency characteristics of which are given in the six sets of curves herewith:

It should be noted that the curves indicate the relative Q and permeability of the different materials suitable for each frequency range illustrated, based on an initial coil Q of 100.

HF-7 is considered the best all-round core material available today. It is the Crowley version of the former A-7 German iron, and is held to be considerably superior to the foreign product. It provides highest Q with medium permeability, and is the logical choice for antenna or RF circuits when improved Q is desired. It is also for high-quality IF transformers, and is especially desirable for high-frequency cores.

AE-7 is similar to the HF-7 material, but is less efficient at higher frequencies. Also, it is lower in cost.

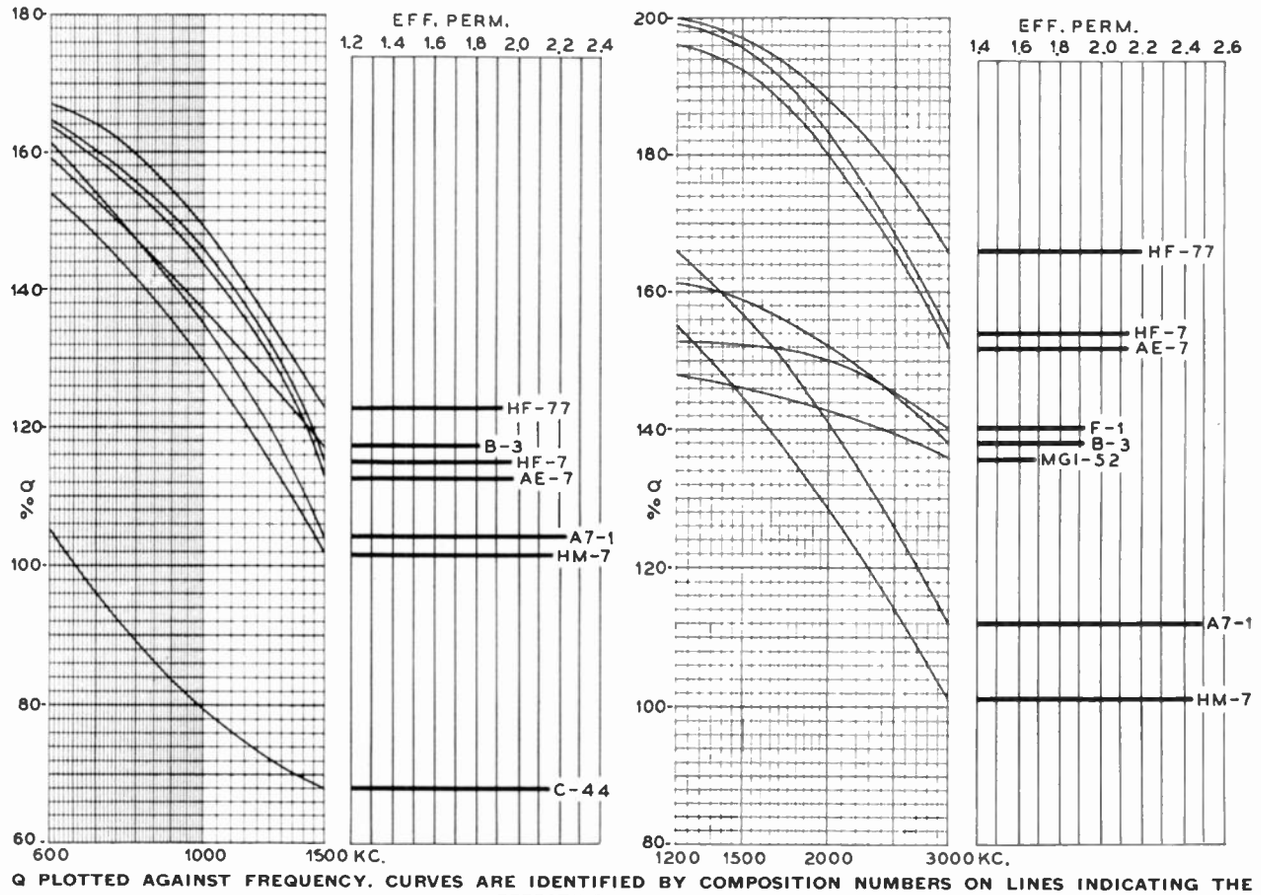
C-712, not shown on the curves, offers the highest Q and permeability combination. It can be made in long pieces, and is, therefore, the logical choice for permeability-tuning cores, replacing variable condenser tuning at greatly reduced cost. With proper design, a range of 3.3 to 1 in frequency is possible. C-712 is used principally for broadcast frequencies.

A-1, not shown on the curves, has a lower Q and permeability than either AE-7 or C-712, and is somewhat lower in cost. It is used mainly in antenna, RF, and IF circuits for improving Q. It is definitely a low-frequency material.

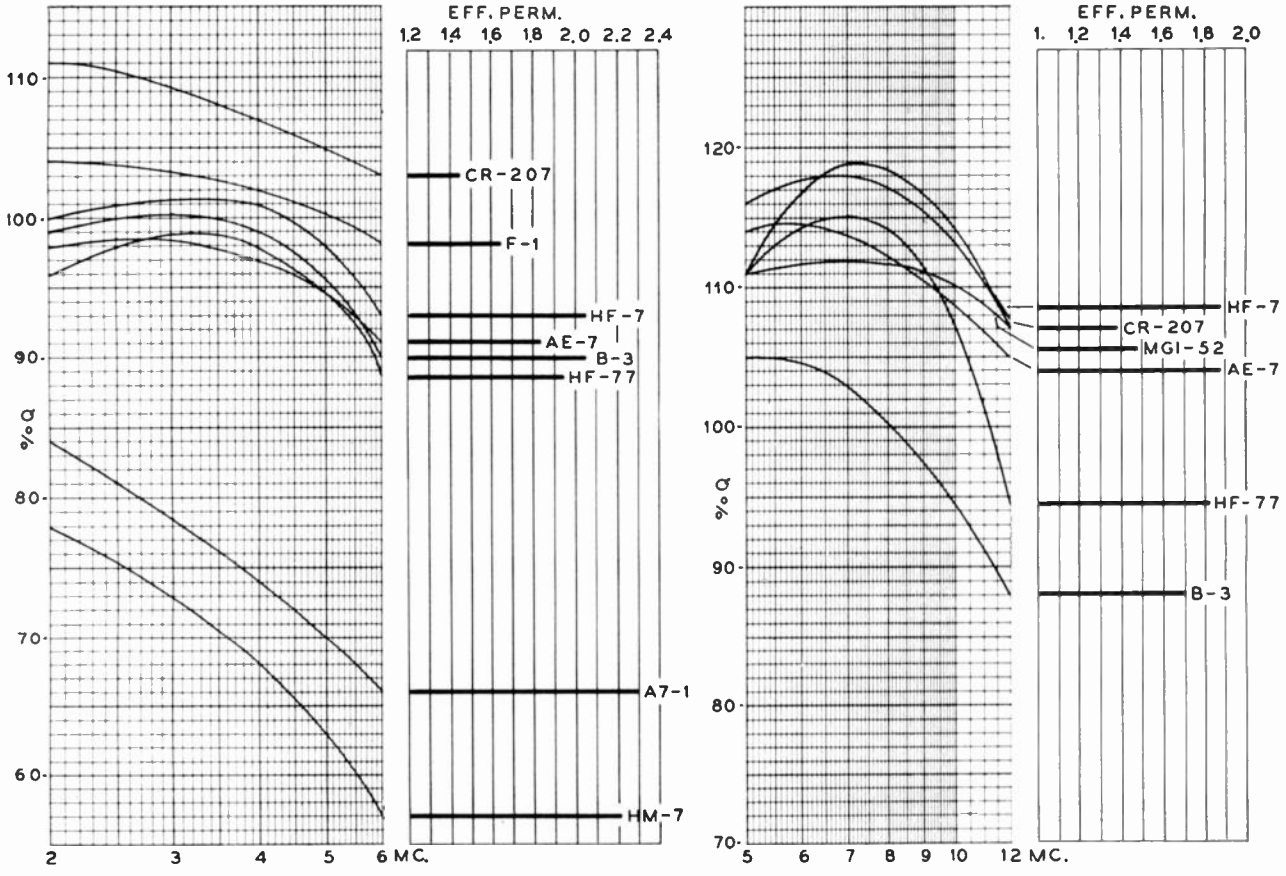
C-44 has a permeability nearly equal to that of C-712, with a low Q factor about equal to that of air. C-44 is used in IF transformers and oscillator circuits for push-button receivers. It is a low-frequency material.

SC-150, not shown on the curves, is in the same price range as C-44, with slightly higher Q than A-1 and somewhat lower permeability than either A-1 or AE-7. Used for IF transformers, and for oscillator circuit of push-button-controlled sets. Slight frequency shift with voltage

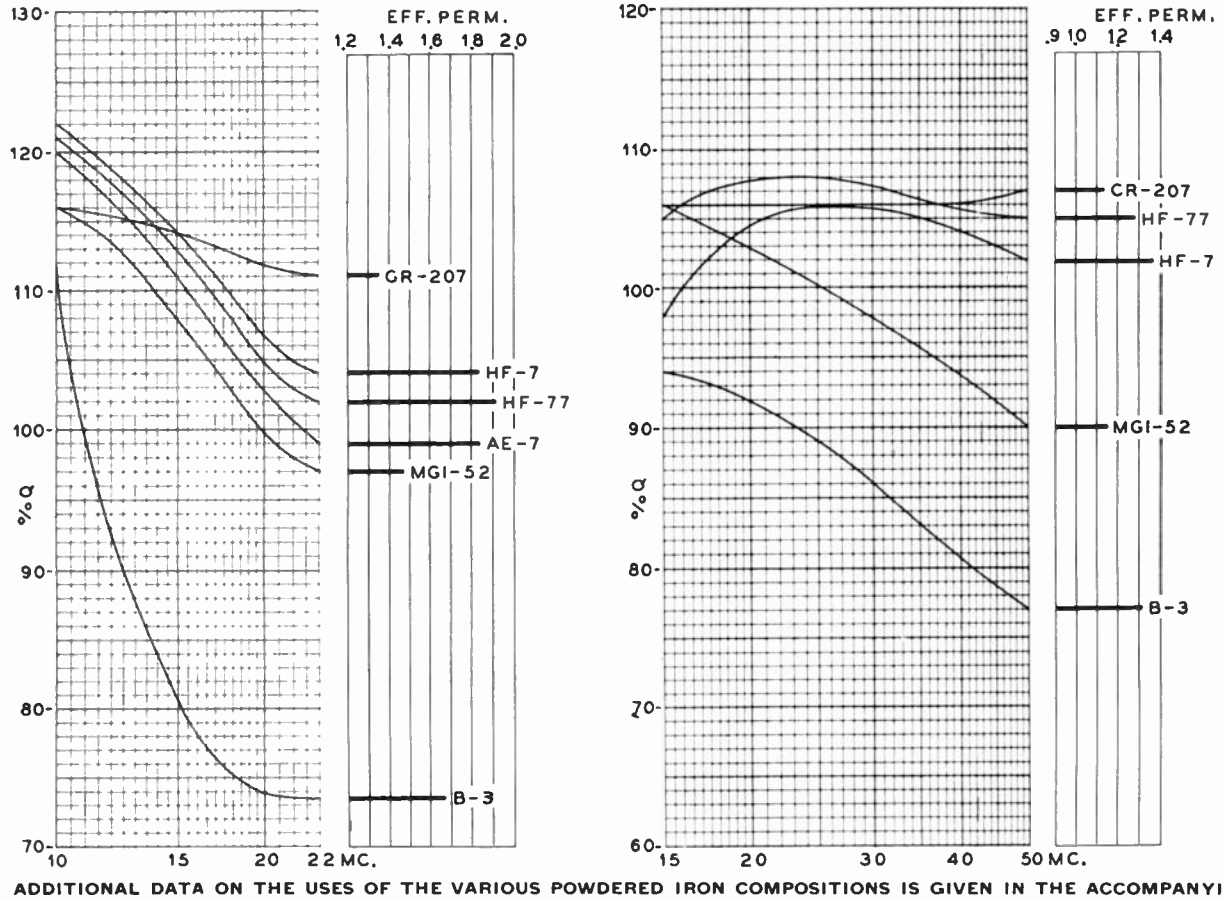
(CONTINUED ON PAGE 25)



Q PLOTTED AGAINST FREQUENCY. CURVES ARE IDENTIFIED BY COMPOSITION NUMBERS ON LINES INDICATING THE EFFECTIVE PERMEABILITY



SINCE ALL CURVES SHOWN IN THESE ILLUSTRATIONS WERE DRAWN TO THE SAME SCALE, DIFFERENT CURVES FOR THE SAME MATERIAL CAN BE FOLLOWED THROUGH THE RANGE OF FREQUENCIES. NOT ALL MATERIALS APPEAR THROUGHOUT THE FREQUENCY RANGE, HOWEVER



ADDITIONAL DATA ON THE USES OF THE VARIOUS POWDERED IRON COMPOSITIONS IS GIVEN IN THE ACCOMPANYING TEXT. NOTE THAT THESE CURVES SHOW RELATIVE Q AND PERMEABILITY FOR EACH FREQUENCY RANGE, BASED ON AN INITIAL COIL Q OF 100

REVISED ARMY-NAVY TUBE LIST

New Preferred List Is Changed by Additions and Deletions Since Last January

TO THOSE CONCERNED WITH THE DESIGN AND MANUFACTURE OF ARMY OR NAVY EQUIPMENT UTILIZING VACUUM TUBES

1. The accompanying Army-Navy Preferred List of Vacuum Tubes sets up a group of unclassified general purpose tubes selected jointly by the Signal Corps and the Bureau of Ships. The purpose of this list is to effect an eventual reduction in the variety of tubes used in Service equipment.

2. IT IS MANDATORY THAT ALL UNCLASSIFIED TUBES TO BE USED IN ALL FUTURE DESIGNS OF NEW EQUIPMENTS UNDER THE JURISDICTION OF THE SIGNAL CORPS LABORATORIES OF THE RADIO AND SOUND BRANCH OF THE BUREAU OF SHIPS BE CHOSEN FROM THIS LIST. EXCEPTIONS TO THIS RULE ARE HEREINAFTER NOTED.

3. The term "new equipments," as mentioned in Paragraph 2 above, is taken to include:

a. Equipments basically new in electrical design, with no similar prototypes.
b. Equipments having a similar prototype but completely redesigned as to electrical characteristics.
c. New test equipment for operational field use.

4. The term "new equipments," as mentioned in Paragraph 2 above, *does not* include:

a. Equipments either basically new or redesigned, that are likely to be manufactured in very small quantity, such as laboratory measuring instruments.
b. Equipments that are solely mechanical redesigns of existing prototypes.
c. Equipments that are reorders without change of existing models.
d. Equipments in the design stage before the effective date of adoption of this Preferred List.

NOTE: *The foregoing statements in Paragraphs 3 and 4 above are explanatory in nature and are not intended to be all-inclusive.*

5. In the event that it is believed that an unclassified tube other than these included in the Preferred List should be used in the design of new equipments for either the Signal Corps or Navy, specific approval of the Service concerned must be obtained. Such approval, when Signal Corps equipment is concerned, is to be requested from the Signal Corps Laboratory concerned with such equipment; the said Laboratory will then make known its recommendations in the matter to the Office of the Chief Signal Officer where the final decision will be made and returned to the laboratory for transmittal to the party requesting the exception. When Navy equipment is concerned, the request for exception shall be addressed to the Bureau of Ships, Navy Department.

6. The publication of the attached Army-Navy Preferred List of Vacuum Tubes has no application to the use of vacuum tubes classified as to security status, or to tubes which have no functional counterparts in the preferred list. The choice of vacuum tubes not covered by the preferred list is to be made with the approval of the Signal Corps or the Bureau of Ships, for Signal Corps or Navy equipment respectively as outlined in Paragraph 5 above.

7. The publication of this list is in no way intended to hamper or restrict development work in the field of vacuum tubes or vacuum tube applications.

8. This list is to take effect immediately.

September 28, 1942.

Office of the Chief Signal Officer, Headquarters, Services of Supply, War Department.

Chief of the Bureau of Ships, Navy Department.

RECEIVING

Filament Volts	Diodes	Diode Triodes	Triodes	Twin Triodes	Pentodes: Remote	Pentodes: Sharp	Rectifiers	Converters	Power	Indicators
1.4	1A3	1LH4	1G4GT 957 958A	1291 3A5	1T4	1S5 959 1LN5 1L4		1LC6 1R5	3A4 1299 3Q4 3Q5GT	991
5.0							5U4G 5Y3-GT			
6.3	6H6* 9004	6SQ7* 6SR7*	6J5* 1201 955 7193 9002	6SL7GT 6SN7GT	6SG7* 6SK7* 956 9003	6AC7* 6AG7* 6SH7* 6SJ7* 717-A 954 9001	6X5-GT 1005	6SA7*	6L6-G 6V6-GT 6N7-GT 6B4-G 6G6-G 6Y6-G	6E5
12.6	12H6*	12SQ7* 12SR7*	12J5GT	12SL7-GT 12SN7-GT	12SG7* 12SK7*	12SH7* 12SJ7*		12SA7*	12A6	1629

TRANSMITTING

Triodes	Tetrodes	Twin Tetrodes	Pentodes	Rectifiers: Vacuum	Rectifiers: Gas
801-A 811 826 833-A 838 1626 8005 8025 304TH	807 813 814 1625	815 829 832	803 837 2E22	2X2 836 1616 8020 (451) 705A 371A	83 866A 872A 4B25

MISCELLANEOUS

Grid Cont. Gas Rectifiers	Voltage Regulators	Phototubes
2050 884 394-A C1B C5B	VR-90-30 VR-105-30 (38205) VR-150-30 (38250)	918 927

* Where interchangeability is assured GT counterparts of the preferred metal tubes may be used. September 28, 1942

RIGHT: RCA'S RADIO-ELECTRONIC RESEARCH LABORATORY AT PRINCETON, N. J., 488 FT. LONG. ABOVE: WINDOWS IN THESE LABORATORIES PERMIT SPECIAL OPTICAL INVESTIGATIONS

FOR RADIO-ELECTRONIC RESEARCH

Newest Arsenal of Military Research Is Dedicated by RCA to the Ultimate Service of Peace

LATEST of the electronic research laboratories to be completed is RCA's new structure at Princeton, N. J. Here, some of the Corporation's activities which have been carried on at various separate locations will be brought together and coördinated with many new undertakings.

Present and future plans were summed up by Otto S. Schairer, speaking at the dedication ceremonies: "When we leave here today, the gates will be closed to others than war workers. This structure will be as much a part of the nation's armament as are its arsenals and forts. The men who work here will be as much members of its Armed Forces as if they were in trenches on the battle fields. The results of the work they will do will be military secrets, carefully guarded against leakage or intrusion.

"But I can give you this prophecy: the scientific progress made here will play a most important part on all the battlefields — on land and sea, under the sea, and in the skies. When the war ends, and the ban of secrecy is lifted, the recital of accomplishments will thrill all of us and fill us with justifiable pride."

The new building houses 150 laboratory bays, variously equipped for research into the fields of acoustics, chemistry, physics, mechanics, optics, and electronics, and specific developments in cathode-ray tubes, fluorescent materials, lenses, and photography.

Various installations include air conditioning and equipment for supplying the individual laboratories with AC and DC voltages, water, air, gas, hydrogen, and oxygen. Every effort has been made to provide flexible accommodations suited to present and future needs for work on all types of tubes, transmitters, receivers, micro-wave apparatus, and under-water sound equipment.

The model shop is described as having the last word in modern precision tools. In the meter room there are more than 3,000 instruments for measuring and recording voltage, current, temperature, and speed, with all the necessary calibration equipment. The catalog of volumes in the library is complete in the communications field. An ultra-modern kitchen adjoins a cafeteria seating 180 to 200 people.

In short, the laboratories and their equipment are the materialization of the dreams and plans of men who have envisaged ideal means and surroundings for the most effective execution of their work.

These laboratories also represent another element in the highly organized scientific competition which is fast developing in this country, the benefits of which we shall begin to realize as soon as the war is over.

This was indicated in Mr. Schairer's statement that: "These laboratories are not intended to preëmpt the field of radio and electronic research. In science, as in everything else, competition is the greatest spur to healthful activity. The scientists who will man the work benches in the laboratories have been in keen but friendly competition with other scientists throughout the years. The sum of the efforts of all of them has greatly accelerated scientific progress.

"In the alliance of science with modern industry we need both individual inventors and organized research groups. Each has his field. The flame of some men's genius burns brightest alone. Many of our greatest inventions have been made by individual scientists, with primitive equipment and with little or no help, save the inspiration of their own unquenchable spirits.

"But there are many inventions that could never be made and developed that way. They call for organizations of men, of materials, of equipment, of resources. The workers in these modern and efficient laboratories will have at their command all these essential factors. They will also have a valuable association with the communications, broadcasting, and manufacturing services of the Radio Corporation of America. These services will be sources of ideas for development as well as of problems for solution. They will also be proving grounds for testing inventions and new devices in actual service and production. And the inventions that crystallize

(CONTINUED ON PAGE 29)

SPOT NEWS NOTES

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

Prediction: Official statement from NBC estimates that 14,000 home radios are going out of commission daily. Figure of 10,000,000 per year (Radio-Electronic Engineering, September) is probably more accurate.

Chairman Fly: Addressing International Association of Police Chiefs at New York City on conservation of police radio tubes and equipment: "I am informed by the engineers that power can, in many cases, be reduced by as much as 50% without impairing the quality of (police radio) service."

Colored Phenolic Nameplates: WPB has stopped production of colored phenolic sandwich stock with white core, used for engraved nameplates. Hereafter, only black stock will be available with the white core.

Purchased: By Philco Corporation, 191,729 shares of National Union Radio Corporation common stock at 67½c per share.

Emergency Radio: Since last December, the FCC has received an average of 20 applications a day for new police radio facilities. This is about double the number received during preceding six months. Nearly 14,000 police transmitters are now in service.

Materials Saved: Change from die cast to plastic handsets by Western Electric has saved 1,000 tons of zinc to date. Altogether, the Bell System's conservation efforts have cut their annual consumption of aluminum 90%, crude rubber 80%, zinc 75%, copper 70%. Concurrently, telephone construction program was reduced about 25%.

W. J. HALLIGAN, HALICRAFTERS PRESIDENT, EXCHANGES CONGRATULATIONS OVER ARMY-NAVY "E" WITH DOLORES YAGER AND ROBERT FOSS, COL. THOMAS L. CLARK, AND SALES MANAGER RAY DURST

WNYE: New York City's educational FM station at the Brooklyn Technical High School is on the air with a 1 kw. REL type 518DL transmitter. Located approximately at the geographical center of the city, WNYE is blanketing the area with a powerful signal from a W.E. coaxial antenna. Herman Haverkamp is in charge of the FM station which replaces the old AM transmitter.

LT. GENERAL WILLIAM S. KNUDSEN KEPT JOSEPH GILLIES BUSY ANSWERING QUESTIONS DURING AN INSPECTION OF PHILCO'S MILITARY RADIO PRODUCTION SET-UP

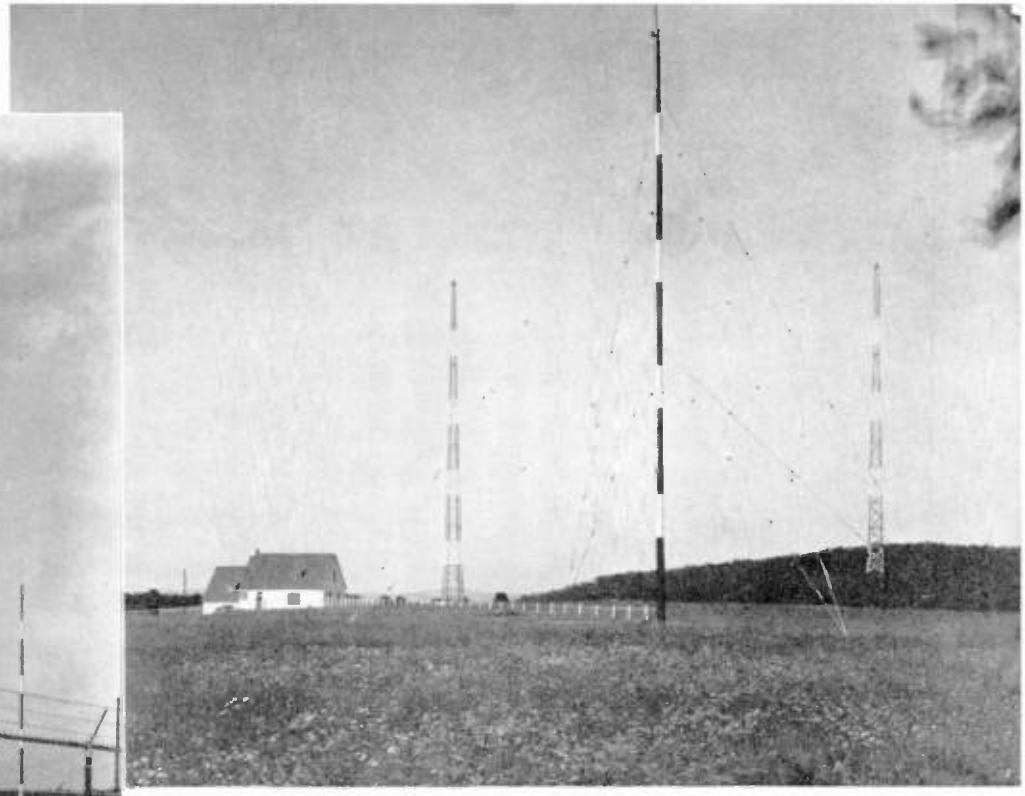
Rear Admiral Ben Morrell: Addressing labor union executives — "People cannot live without labor, but they can live without labor unions. They will damn well live without them here if all of us don't get in there and pitch."

FM DX: Commissioner Oscar G. Olander of the Michigan State Police reports that cars at Ionia, in the Grand River valley, pick up dispatches clearly from the Marquette FM transmitter, 300 miles distant. "Locking out" effect of FM receivers enables cars to talk to their respective headquarters stations without interference from more remote transmitters of the system working simultaneously on the same frequency. Motorola equipment is used in this state-wide installation.

FM Antennas: Richard A. White, Signal Corps Instructor at Ft. Monmouth, asks — "In his article 'FM Station Survey,' Dick Dorrance made the statement that horizontal polarization is universally accepted as standard for FM antennas. Several of the instructors of the Signal Corps Radio School, including myself, would like to know specifically why horizontal polarization is more advantageous than vertical polarization."

Editor's Note: We wrote Mr. White that we have not found engineering opinion unanimous on this subject, and that we shall be pleased to publish comments from our readers on this subject for the benefit of Ft. Monmouth instructors and others who would like to know both sides of this question.

(CONTINUED ON PAGE 22)



NEWS PICTURE

Station W49BN, at Binghamton, N. Y., is the latest FM transmitter to be completed. This installation is associated with WNBF, operated by Wylie B. Jones. The FM antenna is mounted on the black and white pole shown in the upper photos. Directly above, the 3-kw. REL transmitter, model 519DL, can be seen on the right, with an FM monitor receiver mounted on a column-type speaker. Chief engineer Lester Gilbert is seated at the control console. The right hand unit on the console is for the FM transmitter. According to Frank A. Gunther, REL chief engineer who installed this FM station, this is the last broadcast equipment his Company will deliver until the War is over.

FIG. 1. THIS 18-WATT UNIT OPERATES ON FIVE CRYSTAL-CONTROLLED FREQUENCIES

TWO-WAY MARINE RADIO

Data on the Jefferson-Travis 18-Watt Radio Telephone and Notes on Marine Installation Practice

BY EDWARD J. HEFELE*

THE design and manufacture as well as the installation of radiotelephone equipment for motor boats and auxiliary craft is a highly specialized part of the radio industry. Many unusual service conditions must be met that are not encountered ashore. Moreover, since radio communication is an emergency service at sea, and failure in time of need may result in the loss of lives and valuable property, dependability of operation must be of the highest order.

The information presented here on the Jefferson-Travis model 180 two-way phone equipment and the notes on marine radio installations are offered for the benefit of those who have not had the opportunity to gain first-hand familiarity with the design and use of such apparatus.

General Description ★ The Off-Shore Model is available in two types. Model 180-A is for a 6-volt DC supply and Model 180-B is for 12-volt operation.

The complete transmitter and receiver are carried on a single chassis in a heavy steel cabinet 17 ins. high, 12¼ ins. wide, and 9 ins. deep.

In the front are the main on-off switch combined with the volume control, the transmit-receive switch, and the channel selector switch.

The following specifications give the essential features of the equipment:

TRANSMITTER: Multiple frequency transmitting circuit is employed which has a single 6V6 crystal oscillator which is capacity-coupled to a pair of 6V6 tubes in the final amplifier. Plate modulation is obtained from a 6C5 speech amplifier driving a pair of 6V6 modulators. The input is from a single-button carbon microphone transformer coupled to the modulator.

ANTENNA: A simple method of matching the transmitter to Marconi-type antennas of various lengths or to a tuned quarter-wave antenna is provided, consisting of tapped coils and a variable tank.

FREQUENCY RANGE: Five pre-selected frequencies are available between 2 mc. and 3 mc.

FREQUENCY CONTROL: Quartz crystals control both the receiver and transmitter frequencies. These can be changed at any time if conditions require.

CRYSTAL: The crystals supplied are AT cut, with a low-temperature coefficient giving a drift of less than 4 cycles per mc. per degree C, maintaining frequency with an accuracy of ± .02%.

MODULATION: High-level plate modulation provides 100% modulation.

AF RESPONSE: Flat from 100 to 3,000 cycles within 5 db.

NOISE LEVEL: At least 30 db. below maximum output.

AF INPUT: Low impedance, single-button carbon microphone.

RF INPUT: Impedance of 15 to 500 ohms.

POWER SOURCE: Model 180-A operates from 6 volts DC; Model 180-B, from 12 volts DC.

POWER CONSUMPTION: In the stand-by position, with the receiver operating, the battery drain is 44 watts. In the transmitting position, the drain is 160 watts.

CONTROL: Carrier control is accomplished manually by a push-to-talk switch on the handset or the front panel.

RECEIVER CIRCUIT: A fixed-tuned superheterodyne circuit is employed, with AVC and crystal oscillator.

FREQUENCY CONTROL: The same quartz crystals are used for controlling the receiver frequencies and for the transmitter frequencies.

RF INPUT: Impedance of 50 to 600 ohms.

SENSITIVITY: Better than 10 microvolts absolute.

OUTPUT: 2 watts, available for the loudspeaker or the earphone of the handset.

TUBES: 6K7 input, 6K8 mixer-oscillator, 6K7 intermediate amplifier, 6SQ7 detector-audio-AVC, 6V6 audio-amplifier.

Notes on Installation ★ There are a number of special conditions encountered in installing radio equipment on small craft which are not met on shore. Anyone not familiar with this type of work should give the most careful consideration to the suggestions which follow.

The Jefferson-Travis Off-Shore model is intended for mounting on a bulkhead or other vertical surface. The unit can be operated in a horizontal position, but only if necessary.

If it is to be located in a confined space, such as a locker, ventilation must be provided which allows free circulation of air, and also access to the chassis when the cover is removed. The space chosen must be dry and away from any source of excessive heat. The farther the equipment is from the engine, the easier it will be to suppress ignition noise.

The following table shows the size of wire which should be used to connect the radio unit to the battery supply:

*Chief Engineer, Jefferson-Travis Radio Mfg. Corp., 380 Second Avenue, New York City.

	6-Volt Supply	*12-Volt Supply*
Up to 20 ft.	No. 2 B & S	No. 4 B & S
20 to 30 ft.	No. 1	No. 2
30 to 40 ft.	No. 0	No. 2
40 to 50 ft.	No. 00	No. 1

This may be either solid or stranded wire. The use of sizes smaller than those listed is certain to cause excessive voltage drop in the line, and will result in sacrifice of performance.

The transmitter-receiver unit is designed to be operated from battery connections having a HOT side and a GROUND side. The ground side of the set should be connected to the grounded side of the battery, regardless of polarity.

If the electric system to which the set is connected is not grounded on either side, connect the set so that its polarity is the same as that of the motor-starting battery, if one is used.

If faulty wiring or evidence of frequent grounds in the electric system is observed, or if several independent electric systems are used in such a manner that the polarity of the grounded sides of these systems is confused, such conditions must be corrected.

As a final check, remove the ground wire from the set while it is turned off, and watch closely for a spark when this is done. If a spark is observed, disconnect the set immediately, and check over the wiring to eliminate the reversed polarity thus indicated.

Then measure the potential between the grounded side of the set and the ground plate with a sensitive voltmeter of at least 1,000 ohms per volt. If *any* potential is indicated, all wiring and connections of the electrical systems must be checked until the cause is found, for zero ground potential must prevail in relation to all other electrical devises on the boat.

Antenna System ★ While radio receivers will operate on short lengths of wire or on loops, particular care and attention must be given to the antenna system when it is used for transmitting purposes. Height and length of the antenna are the controlling factors of the transmitting range.

To attain high-efficiency performance, the transmitter requires an antenna capable of being tuned to resonance at the operating frequencies. Special types of antennas and appropriate loading coils are therefore necessary on marine installations because the physical limitations preclude the erection of conventional antennas which are self resonating.

Loss of power, frequently amounting to a substantial percentage of the output capacity of the transmitter, occurs when it is necessary to apply much loading within the transmitter to compensate for lack of antenna. Because the type or size of many boats preclude erection of a conventional antenna of sufficient length or height, Jefferson-Travis engineers have developed a new type of vertical radiator that is unusually efficient, yet dimensioned for service aboard smaller boats, particularly those that do not afford facility for erection of a 30- to 60-ft. vertical or inverted L type antenna.

This improvement is produced by increasing the antenna current in the radiating portion of the antenna. The improvement is greatest when the transmitter is used on a single frequency, but may still be considerable even when the transmitter is used at other frequencies within its range.

In considering any other type of antenna, it should be kept in mind that, generally, a vertical antenna carried 30 ft. above the radiotelephone will allow a better performance than even 60 ft. of wire rigged horizontally over a low military type mast.

A suitable vertical antenna can be erected with a bamboo pole approximately 30 ft. long, supported by stay wires in an upright position. Enameled antenna wire can be wound on the pole and held in place with friction tape. This can be finished with varnish or Amphenol No. 9.

An inverted L-type single-wire antenna can be arranged on boats of 25 ft. or more in length. Nineteen-strand No. 16 hard drawn copper or phosphor bronze wire

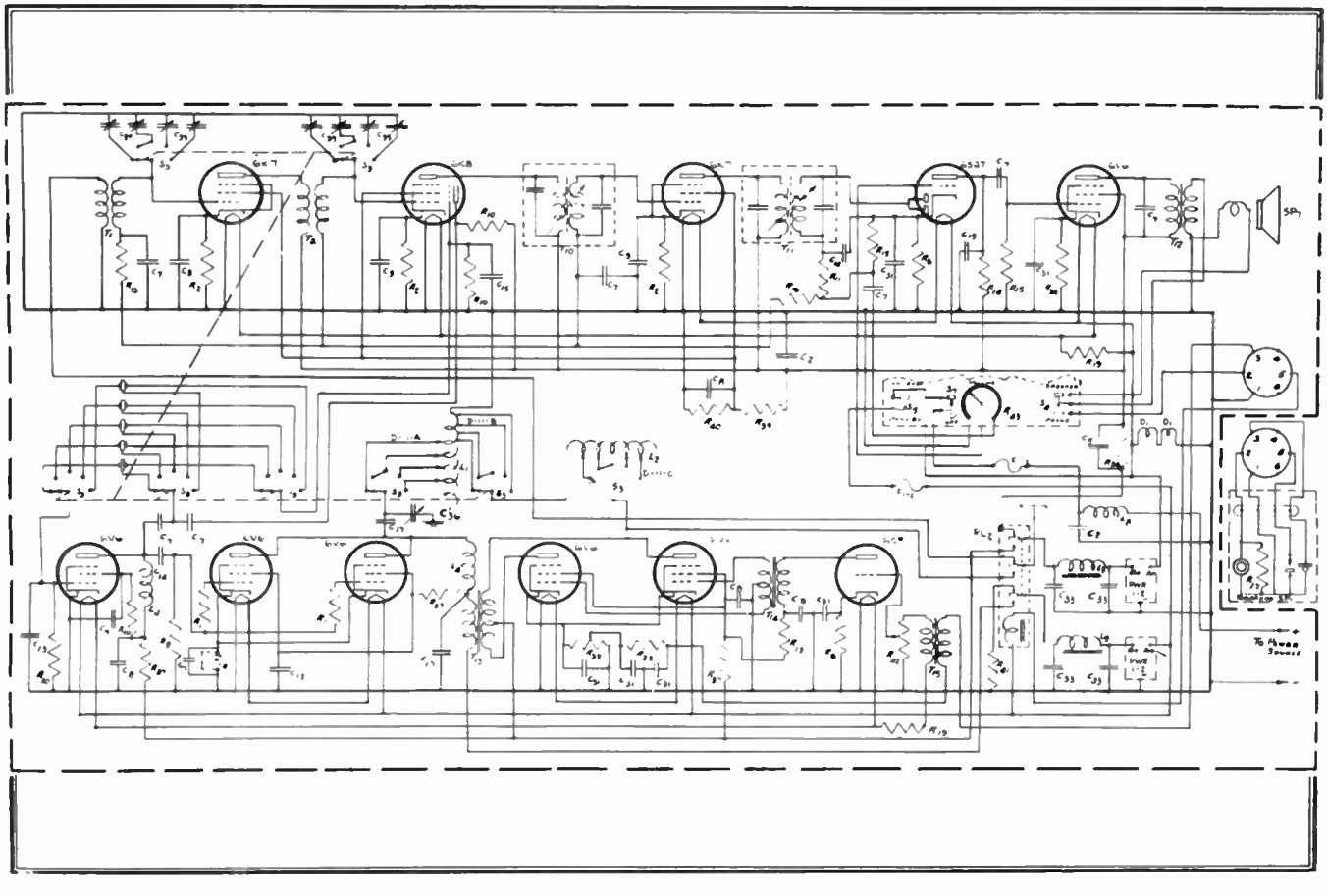


FIG. 2. SCHEMATIC OF THE TRANSMITTER AND RECEIVER, SHOWING THE DUAL USE OF THE CRYSTAL FREQUENCY CONTROL

should be used for antennas subject to rough weather conditions, while seven strands of No. 19 hard drawn copper is suitable for small antennas free from stress.

An insulated stay wire can be employed aboard a sailboat for the antenna, or the antenna wire can be carried from a high spreader to the deck and firmly fastened. Heavy strain insulators of the compression type, similar to those used to guy electric and telephone poles, should be spliced into stay wires used for antenna supporting purposes.

The antenna and the equipment should be installed so that the lead-in wire is maintained in as near vertical position as practicable, leading from the antenna to the set with the least horizontal run possible. The lead-in should not be carried below the level of the antenna binding post on the set at any point.

Keep antenna and lead-in wires as far as possible from stays and other large metal objects. Rigging stays that are not bonded or grounded may cause the antenna current to fluctuate and make crackling noises in the receiver, with heavy losses in both transmitter and receiver.

Use large porcelain or Pyrex insulators with a leakage path of at least 7 ins. at the ends of horizontal antennas, especially where sooting or icing occurs. A watertight ceramic or Pyrex transmitter type lead-in bushing and stand-off insulators should be used to carry the antenna to the equipment.

Generally, wire used for a horizontal antenna and lead-in should not be smaller than No. 12 B & S gauge. For antennas subject to heavy strain, requiring high tensile strength, steel core copperweld or 1/8-in. stranded bronze tiller wire are suggested.

The radiotelephone, its antenna system and all accessories, should be located as far away from gasoline engines as practical to minimize the pickup of ignition noise by the receiver. A vertical antenna and lead-in is of great advantage in this regard.

Radio Ground ★ The metal hull of a boat or the metal keel of a sailboat can be employed for the radio ground. However, if the vessel's construction does not include a large flat metallic area under water, to which the radiotelephone can be grounded, a sheet metal ground plate must be attached to the bottom planking or keel of the boat.

Sheet copper, Monel or sheet brass may be used for this purpose; copper is normally recommended. Sheet copper should be firmly attached to the planking or keel with cut copper boat nails, screws for brass, Monel nails or screws for Monel metal.

Metal complementary to the underwater fittings and fastenings of the boat should be selected for the ground plate to keep electrolysis to a minimum.

Sixteen-ounce sheet copper is sufficiently heavy, although 24-ounce metal may be used if desired. A 1/2-in. bronze, Monel or brass bolt should be soldered or brazed to the sheet metal and carried through a tight hole into the hull, and made up inside with a large washer and lock nuts. The ground lead from the set should then be soldered to this bolt inside the hull.

A large ground plate area is desirable. In practice it has been found that square or rectangular plates of approximately the following dimensions have produced satisfactory results:

5 to 12-watt sets — 4 to 8 square feet.
15 to 30-watt sets — 10 to 12 square feet.
35 to 100-watt sets — 16 to 20 square feet.

For short ground leads, 1/2-in. tinned copper shield braid is recommended. This is readily tacked in place. For longer leads, heavier braid, or a strip of sheet copper 1/2-in. to 3/4-in. wide should be used. Copper tubing or battery cable may also be employed.

Ignition Interference ★ On spark-ignition engines a .5 mfd. condenser should be connected from the battery side of each ignition coil to the motor block. These condensers should be the type used on automobiles for the purpose.

A suppressor of the automotive distributor type should be inserted as near the distributor as possible in the wire leading from the center of the distributor cap to the ignition coil.

Operation of each individual generator and other motors in such devices as bilge pumps, water systems, and electric fans should be checked with the radiotelephone receiver turned on. Each device that creates radio interference should have a .5 to 1. mfd. condenser connected across the leads close to the motor.

If the above procedure does not eliminate enough of the noise, try bonding the various noise producing devices to the engine block or ground plate, using 1/2-in. tinned copper shield braid or ribbon copper. In making such connections, be sure to use heavy wire so that the same ground potential is maintained as between engine and ground plate and other underwater fittings.

Remember that a good ground and an antenna with the lead-in as nearly vertical as possible is a great help in reducing ignition noises.

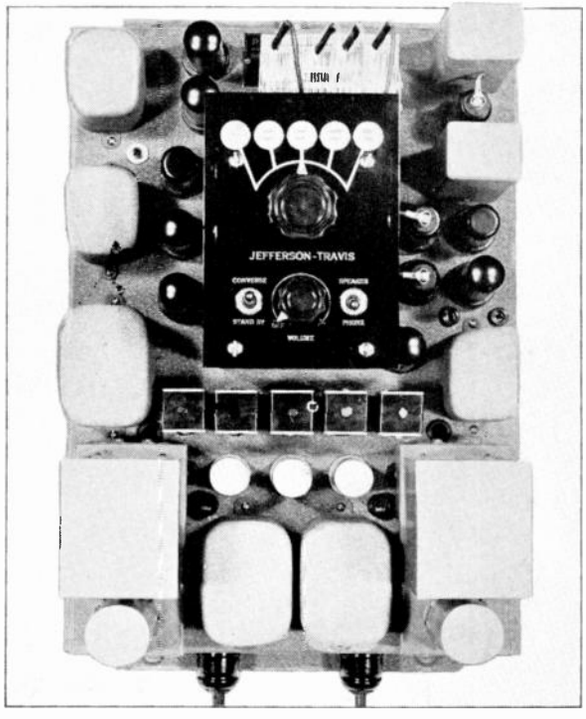


FIG. 3. JEFFERSON-TRAVIS MARINE TRANSMITTER-RECEIVER WITH COVER REMOVED

If ignition noises persist after following the above suggestions, effective results may be obtained by lining the underside of the hatches over the engine compartment deck with fine-gauge copper mosquito screening, grounded from at least two places to the engine block. Use strips of tinned copper shield braid or sheet copper carried to ground and tack them down along the ends or sides of hatches to make contact with the copper screening.

Marine Installations ★ These notes have been taken from specialized experience with marine radio installations, and should be given careful consideration because the conditions on small boats are so entirely different from those encountered ashore. While they apply specifically to Jefferson-Travis equipment, the suggestions offered will prove valuable for obtaining maximum performance from any similar marine equipment.

Men wanted for the Signal Corps of the U. S. Army

You can (1) serve your country, (2) learn the rapidly advancing science of electronics, (3) prepare yourself for a promising career after the war by joining "The Nerve Center of the Army" now.

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This is a war of communications. "The message must get through!" Radio communication equipment and electronic devices known only to the men of the U. S. Signal Corps are fighting the war on world fronts.

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General Electric is a leader in electronic research. We are definitely interested in having available, when victory comes, trained men for the sales and service of future electronic devices. This is a highly specialized field, and good men will be in demand.

If you are now an expert in radio, or are ambitious and willing to learn at good pay, General Electric urges you to consider the Signal Corps now. The Signal Corps is also sponsoring courses in the fundamental theories of radio and electronics in many colleges and universities. . . . Get in on the ground floor today!

* * *

For further information regarding enlistment, call at the nearest Army Recruiting and Induction Station. Or write to "The Commanding General" of the Service Command nearest you. For Civilian Training information, call at any office of the U. S. Civil Service or U. S. Employment Bureau.

U. S. Army Signal Corps Photographs

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Leader in radio, television, and electronic research

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POLICE RADIO MAINTENANCE & REPAIR

How Parts Can Be Obtained for Servicing Emergency Radio Equipment, under WPB Rules

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Those which are so unique that failure would inevitably result in long delay in resumption of essential operations.

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For the purposes of these regulations, "Material" means any commodity, equipment, accessory, assembly, or product of any kind.

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"Repair" means the reconstruction or restoration without expansion, improvement or change of design of any portion of an operator's buildings, structures and equipment when such portion has been rendered unsafe or unfit for service by wear and tear or other similar causes, but not including reconstruction or restoration of any portion damaged or destroyed by fire, flood, tornado, earthquake, act of God or the public enemy; and this, without regard to whether the expenditures therefor are for any reason required to be recorded in the operator's accounting records in accounts other than maintenance and repair.

"Operating supplies" means any material which is essential to and consumed directly in the operation of the communications system, but does not include recording discs, film, other recording media, fuel, office or building supplies.

The need for conserving the present equipment of emergency communications systems cannot be over-emphasized. Conditions are now such as to raise a very serious question on this point. Already, police officials are complaining that they have mobile units which are out of commission, and which they will not be able to use until they obtain replacements.

The WPB advises that the problem is not so much one of assigning still higher priority ratings as it is shopping around to find the parts jobber who has in stock what is required. Police departments will have to adopt the methods of manufacturers and laboratories who write, wire, or telephone one supplier after another right across the country, until the necessary components are found.

The most effective way to conserve the useful life of transmitter components is to reduce power, as Chairman Fly recommended in his recent talk to police officials. This not only extends the life of transmitter tubes, but of condensers, chokes, transformers, and other parts subject to failure.

Particularly during the winter months, when mobile equipment necessarily takes severe punishment, greater consideration must be given to the radio apparatus. Protection from dampness is most important, since this factor is the number one cause of failures. Every radio car should be inspected for conditions that might permit water to leak into the compartment where the apparatus is installed.

The compartments must be inspected frequently to make sure that they are kept clean and dry, and free of any accumulation of damp cloths and papers, or chains and other gear which might have been covered with snow when they were stowed away. Strict and repeated inspection and prompt attention to service needs will be well repaid by longer and more efficient performance of present equipment.

NEW RADIO-ELECTRONIC DESIGN PRACTICE

Part 1. Extreme Conditions of Military Service Are Exposing Weaknesses of Conventional Designs and Methods

BY M. B. SLEEPER

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The Army and Navy have built up basic specifications for materials, designs, and performance, but since the outbreak of World War II, the accelerated progress of the radio-electronic art outstripped the rate at which new specifications could be established. Consequently, added to the problems of re-educating engineers of the keep-it-cheap-it's-good-enough school of design, there have been unpredictable failures in new kinds of equipment never used under service conditions encountered in parts of the world where military operations are being carried out today.

Primary Causes of Failure ★ The primary causes of failure in radio-electronic equipment are:

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Experience is showing that these are not simple factors but, under some conditions, are highly complex, calling for the most careful study and investigation.

It might seem, for example, that companies building commercial communications equipment for use in Central and South America would know all the answers to tropical conditions. Apparently, they do not. Perhaps that is because commercial stations are installed in well-constructed buildings which afford protection against factors conducive to electrical and mechanical failures.

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Vibration ★ The simplest primary cause of failure is vibration, and it is the easiest to understand because its effects can be studied on the shake table. Since it is a relatively simple matter, many engineers are inclined to discount its importance.

Actually, vibration is a very serious matter, since it may be encountered while equipment is in transit, even though it is intended for fixed service upon delivery.

Some of the first home radio sets sent overseas were found, upon arrival, to have been effectively disassembled by constant vibration in the ship's hold. This effect is accentuated during storms at sea, for a ship fairly shakes when the bow plunges down and the stern goes up, bringing the propeller partly out of the water.

Equipment intended for sea-going use, particularly on small, high-speed craft, must be tight and secure in every last mechanical detail if it is to withstand the effects of continuous vibration in service. This is equally true of equipment for tanks, jeeps, and planes.

Tight construction is not merely a matter of putting lock washers under all the nuts. Still better fastening means, such as stop-nuts or their equivalent should be used for securing all heavy elements or assemblies. Stop-nuts, in turn, should be riveted in place, and not fastened with screws and nuts.

Better still, parts should be combined as far as possible in the original design, or put together by welding. However, spot welding of thin aluminum parts should be avoided, because the metal is weakened around the welded spot. Gas welding of aluminum box seams has been widely specified, but it is a slow and costly process, with so many rejections that die castings are being used in many instances to speed production and reduce manufacturing cost.

Wiring must have its share of consideration. A simple rule is that if a wire can be moved after connections have been soldered, it will probably vibrate in service until it crystallizes and breaks. So, if a single wire or a group of wires laced together can be moved with the forefinger, a clamp or other fastening means is necessary. This applies particularly to lengths of concentric cable or wire with heavy rubber insulation. Shake-table tests show that if the period of vibration approaches the natural period of the wire, it may fail at one of the terminals in a few minutes.

Vacuum tubes and plug-in crystals sometimes wiggle right out of their sockets when subjected to vibration. It is a simple matter to put a retaining strip over a crystal. Tubes require more elaborate clamps, or spring-clips to catch over the bottom shoulder of metal tubes. Variable condensers and even small air trimmers go their merry way because the weight of the plates is not distributed evenly around the shaft. A friction collar on the shaft is not entirely dependable. The collar should be tightened by a nut on a tapered thread.

Shock-absorbing rubber mounts, such as the Lord or U. S. Rubber types, reduce the transmission of vibration to assemblies, but they are in no wise substitutes for tight construction. These insulating devices must be selected with great care, according to the weight of the load they are to support and the prevailing period of vibration. Charts and tables are available from the manufacturers for determining the exact method and type of support which should be used.

When the first model has been completed, operation during a shake-table test is certain to disclose unexpected weaknesses which will have to be corrected before the equipment or device can be considered fit for service. The failure of relays to stay closed or latched is liable to show up in this final design check.

The shake table also affords the best final-inspection method for locating any uncertain connections or wires which have been put on terminals but were not soldered.

Shock ★ Still less consideration is given to the effects of severe shocks, yet this is a vital design factor of equipment for military use. The source of this disturbance may be exploding depth charges, shells, bombs, or torpedoes. Tank equipment must take a terrific beating from shocks in the course of ordinary maneuvers.

Aircraft equipment can hardly be protected from direct hits under anti-aircraft fire, but it must withstand shock from concussion. Everything on a dive bomber is subject to a 9-times-the-pull-of-gravity effect that strains to tear everything apart. A poor landing deals the radio apparatus a terrific wallop. This may happen rarely on

(CONTINUED ON PAGE 22)

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Some of the first home radio sets sent overseas were found, upon arrival, to have been effectively disassembled by constant vibration in the ship's hold. This effect is accentuated during storms at sea, for a ship fairly shakes when the bow plunges down and the stern goes up, bringing the propeller partly out of the water.

Equipment intended for sea-going use, particularly on small, high-speed craft, must be tight and secure in every last mechanical detail if it is to withstand the effects of continuous vibration in service. This is equally true of equipment for tanks, jeeps, and planes.

Tight construction is not merely a matter of putting lock washers under all the nuts. Still better fastening means, such as stop-nuts or their equivalent should be used for securing all heavy elements or assemblies. Stop-nuts, in turn, should be riveted in place, and not fastened with screws and nuts.

Better still, parts should be combined as far as possible in the original design, or put together by welding. However, spot welding of thin aluminum parts should be avoided, because the metal is weakened around the welded spot. Gas welding of aluminum box seams has been widely specified, but it is a slow and costly process, with so many rejections that die castings are being used in many instances to speed production and reduce manufacturing cost.

Wiring must have its share of consideration. A simple rule is that if a wire can be moved after connections have been soldered, it will probably vibrate in service until it crystallizes and breaks. So, if a single wire or a group of wires laced together can be moved with the forefinger, a clamp or other fastening means is necessary. This applies particularly to lengths of concentric cable or wire with heavy rubber insulation. Shake-table tests show that if the period of vibration approaches the natural period of the wire, it may fail at one of the terminals in a few minutes.

Vacuum tubes and plug-in crystals sometimes wiggle right out of their sockets when subjected to vibration. It is a simple matter to put a retaining strip over a crystal. Tubes require more elaborate clamps, or spring-clips to catch over the bottom shoulder of metal tubes. Variable condensers and even small air trimmers go their merry way because the weight of the plates is not distributed evenly around the shaft. A friction collar on the shaft is not entirely dependable. The collar should be tightened by a nut on a tapered thread.

Shock-absorbing rubber mounts, such as the Lord or U. S. Rubber types, reduce the transmission of vibration to assemblies, but they are in no wise substitutes for tight construction. These insulating devices must be selected with great care, according to the weight of the load they are to support and the prevailing period of vibration. Charts and tables are available from the manufacturers for determining the exact method and type of support which should be used.

When the first model has been completed, operation during a shake-table test is certain to disclose unexpected weaknesses which will have to be corrected before the equipment or device can be considered fit for service. The failure of relays to stay closed or latched is liable to show up in this final design check.

The shake table also affords the best final-inspection method for locating any uncertain connections or wires which have been put on terminals but were not soldered.

Shock ★ Still less consideration is given to the effects of severe shocks, yet this is a vital design factor of equipment for military use. The source of this disturbance may be exploding depth charges, shells, bombs, or torpedoes. Tank equipment must take a terrific beating from shocks in the course of ordinary maneuvers.

Aircraft equipment can hardly be protected from direct hits under anti-aircraft fire, but it must withstand shock from concussion. Everything on a dive bomber is subject to a 9-times-the-pull-of-gravity effect that strains to tear everything apart. A poor landing deals the radio apparatus a terrific wallop. This may happen rarely on

(CONTINUED ON PAGE 22)

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You can (1) serve your country, (2) learn the rapidly advancing science of electronics, (3) prepare yourself for a promising career after the war by joining "The Nerve Center of the Army" now.

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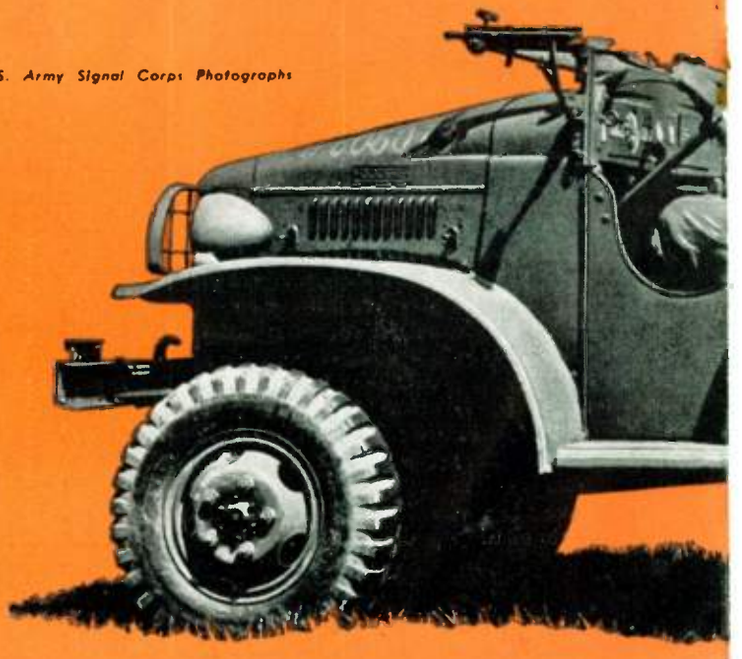
U. S. Army Signal Corps Photographs



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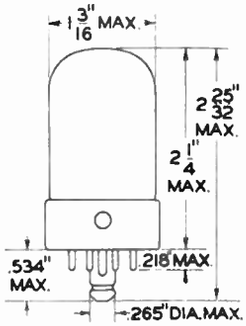
VACUUM TUBE REVIEW

A reference index of tubes listed in previous issues of Radio-Electronic Engineering will be found on page 22. A revised index is published each month

7W7

High Frequency Amplifier Pentode



TUBE AND BASE DIAGRAM (BOTTOM VIEW)

7W7 is a cathode type RF pentode especially designed for modern ultra-high frequency applications. Type 7W7 is the same as the 7V7 except that the cathode has been brought out to two separate base pins. This tube will operate at frequencies at least as high as 300 mc. Most high mutual types fall off rapidly in performance at about 30 mc. Type 7W7 surpasses any other high mutual type at 30 megacycles except possibly in wide band receivers.

Type 7W7 has a very low grid to plate capacity (.0025 $\mu\mu$f.) and is provided with double cathode leads. At higher frequencies this cathode lead arrangement triples the input resistance. The Type 7W7 is a useful radio frequency amplifier tube at frequencies as high as 200 mc. When employed as a mixer tube with signal grid injection, it operates satisfactorily at even higher frequencies. It is also an excellent intermediate frequency amplifier tube for use in high frequency receivers.

When Type 7W7 is employed as an amplifier, pin No. 7 should be grounded and the filament by-pass condensers returned to it while the plate and screen by-pass condensers should be returned to the cathode at pin No. 4. When used as a mixer tube, both pins No. 7 and No. 4 may be grounded. The lock-in construction provides rugged structure and extremely low lead inductance.

RATINGS AND CHARACTERISTICS

Heater voltage (nominal) AC or DC	7.0 volts
Heater current (nominal)	0.480 amp.
Plate voltage, max.	300 volts
Screen voltage, max.	150 volts
Plate and screen dissipation (total)	4.0 watts
Screen dissipation, max.	0.8 watt
Direct interelectrode capacitances [1]:	
Grid to plate, max.	0.0025 $\mu\mu$f.
Input: G_1 to $(F + K + G_s + S_u + I_s)$	9.5 $\mu\mu$f.
Output: P to $(F + K + G_s + S_u + I_s)$	7.0 $\mu\mu$f.

[1] With RMA tube shield M8-308 connected to cathode.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

	Condition I [2]	*Condition II* [2]
Heater voltage	6.3	6.3 volts
Heater current	0.450	0.450 amp.
Plate voltage	300	300 volts
Screen supply voltage [3]	150	300 volts
Screen series resistor	—	40,000 ohms
Suppressor and pin No. 5	0	0 volts
Cathode bias resistor, min.	160	160 ohms
Plate resistance	0.3	0.3 meg.
Mutual conductance	5,800	5,800 μmhos
Plate current	10.0	10.0 ma.
Screen current	3.9	3.9 ma.
Grid voltage for cathode current cutoff	— 6	— 14 volts

[2] Conditions I and II represent operation with fixed screen supply and with series screen resistor respectively. Condition II gives an extended cut off characteristic and should be used when gain is controlled by varying the bias.

[3] When a screen supply voltage in excess of 150 volts is used a series screen resistor must be used to limit the voltage at the screen to 150 volts when the plate current is at its rated value of 10.0 milliamperes.

28D7

Double Beam Power Amplifier

BASE PIN CONNECTIONS

1. Heater
2. Control Grid 2
3. Screen Grid 1 & 2
4. Plate 2
5. Plate 1
6. Cathode & BCP 1 & 2
7. Control Grid 1
8. Heater

28D7 is a Lock-In output tube designed especially for operation directly from a 28-volt battery without requiring any auxiliary high voltage power supply. It consists of two beam power amplifier units in the same bulb. The control grid and plate of each section are brought out to separate pins; a common connection is used for the cathodes and likewise there is a common terminal for the screen grids. The heaters are connected in series internally, and the cathodes are not tied to either heater terminal.

The two sections of the tube may be operated separately, they may be connected in parallel, or they may be employed in a push-pull circuit. Two different recommended loads per section are specified, the choice depending on whether both sections are to function as single-ended amplifiers or whether the two sections are to operate in push-pull. Where each section is used as a single-ended amplifier, the load per section should be 4,000 ohms, to secure reasonably low second and third harmonics. If the two sections operate in parallel, the load would be approximately half this value. For push-pull operation, the load per section should be 3,000 ohms since with this value the third harmonic is low and the second harmonic, although high, will cancel due to the push-pull circuit. A plate-to-plate load of 6,000 ohms should therefore be employed.

Ratings are shown for both self-bias and fixed-bias operating conditions. In general, self bias will probably be employed and under such conditions power outputs exceeding 150 milliwatts can readily be obtained from a single tube operating in push-pull. If a separate bias voltage supply can be provided, fixed-bias operation will furnish additional power output since it permits utilization of the total supply voltage. An increase in effective B voltage of about 3.5 volts is an important factor at low voltage operation. In some applications bias voltage may be obtained from an oscillator, thus making it unnecessary to provide a separate battery for grid bias and also permitting the use of the total plate supply voltage.

The ratings indicate a lower plate current value for self-bias operation than under the fixed-bias condition. The data also indicate preferred resistor values. Low plate current drain is important because any voltage drop in the output transformer primary will reduce the effective plate voltage. Low resistance primary windings on output transformers and good power supply regulation are vital factors in securing the full capabilities of this tube.

Heater voltage	28.0 volts
Heater current	0.400 ampere
Maximum plate voltage, per section	100 volts
Maximum screen voltage, per section	67.5 volts
Maximum plate dissipation, per section	3.0 watts
Maximum screen dissipation, per section	0.5 watt
Style	Lock-in
Base	Lock-in 8-pin
Bulb	T-9
Diameter	$1\frac{3}{16}$" max.
Overall length	$3\frac{5}{32}$" max.
Seated height	$2\frac{5}{8}$" max.

OPERATING CONDITIONS AND CHARACTERISTICS

Amplifier Class A

Per section except heater

	Self Bias	*Fixed Bias*
Heater voltage	28.0	28.0 volts
Heater current	0.400	0.400 amp.
Plate voltage	28.0	28.0 volts

(CONTINUED ON PAGE 22)


The FIRST American Landing in Japan ....
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RADIO-ELECTRONIC DESIGN PRACTICE

(CONTINUED FROM PAGE 15)

land, but it is not uncommon for Navy planes landing on the unsteady flight decks of carriers.

For test purposes, the usual practice is to roll a heavy iron ball down an incline so that it will strike a platform on which the equipment is mounted. A simpler method is to set up the instruments on a base, and then drop it on the floor from various heights.

Engineers are loath to make shock tests, yet equipment that cannot run this gantlet is certain to fail in the field!

Corrosion Due to Rust ★ The Navy has built up detailed specifications concerning the protection of metal parts from corrosion due to salt-water spray and dampness. Manufacturers of sea-going commercial communications equipment, also, know the need for guarding against this source of trouble. Designers of civilian receivers have never taken it seriously, despite the complaints from coastal sections, notably Florida, where broadcast sets are known to fail in a discouragingly short time. They could tell the dealers: "That's funny. We haven't had any other complaints." But the Navy can't be brushed off that way, as some engineers have been learning.

Steel parts are, of course, most subject to rusting. In general, cadmium or zinc plating is the most effective protection for small parts.

Enamels or wrinkle finishes are not adequate to prevent rust. All parts finished in that way must have a foundation of cadmium followed by a primer coat of zinc chromate, on which the wrinkle finish is applied. The reason for this preparation is that any paint can be scratched or chipped off in handling.

Stainless steel stands up against the effects of salt spray provided it has not been annealed by welding or other processing. Welded joints on stainless steel rust as quickly as cold rolled steel.

Other specific cases of corrosion and effective measures of protection will be taken up later in a discussion of specific circuit components. There is also a related factor which must be given careful consideration in choosing both metals and protective platings. This is:

Corrosion Due to Electrolysis ★ To most radio designers, the electrolysis which takes place when dissimilar metals are in contact or are adjacent in the presence of salt air or are immersed in salt water is an entirely new factor. Designers of sea-going equipment know this effect only too well, but the Army has not taken it seriously until now when so much action is taking place in coastal regions.

This type of corrosion is due to contact between dissimilar metals in the presence of salt-water dampness or actual immersion in salt water.

Very definite specifications have been set up by the Navy concerning the use of dissimilar metals. For example, although bronze is capable of withstanding corrosion, it cannot be used in contact with steel because of the strong electrolytic action set up between the two metals.

Under some circumstances, small parts can be plated, thereby separating the dissimilar metals, but even this is not permitted in all cases.

This subject will not be discussed fully here because information is readily available. Moreover, many cases must be considered individually, on their own merits.

Freezing ★ Related to the problems of metals in contact is the trouble being encountered, particularly in extremely high temperatures, with the freezing of aluminum parts brought together under pressure.

For example, the threaded parts of aluminum connectors sometimes freeze within a few minutes after they are tightened, and cannot be freed without the actual destruction of the outer sleeve. This can be prevented by the use of a very small amount of zinc oxide grease on the parts in contact. However, some other means of completing electrical circuits must be provided, because this treatment may introduce resistance.

Editor's Note: Part 2 of this article will present details of failures due to corrosion and disintegration, and attack by plant life and insects in tropical humidity, giving specific examples and their prevention.

VACUUM TUBE REVIEW

28D7 Double Beam Power Amplifier

(CONTINUED FROM PAGE 20)

Screen voltage	28.0	28.0 volts
Grid voltage	...	−3.5 volts
Cathode bias resistor	390	... ohms
Zero signal plate current	9.0	12.5 ma.
Zero signal screen current	0.7	1.0 ma.
Maximum signal plate current	6.5	8.1 ma.
Maximum signal screen current	1.6	1.9 ma.
Plate resistance	...	3000 ohms
Transconductance	...	3000 μmhos
Peak AF signal voltage	4.9	4.9 volts
Load resistance	4000	4000 ohms
Power output	80	100 mw.
Total harmonic distortion	9	7 %

PUSH-PULL OPERATION, CLASS A

Values are for both sections

	Self Bias	*Fixed Bias*
Heater voltage	28.0	28.0 volts
Plate voltage	28.0	28.0 volts
Screen voltage	28.0	28.0 volts
Grid voltage	...	−3.5 volts
Cathode bias resistor	180	... ohms
Zero signal plate current	18.5	25 ma.
Zero signal screen current	1.2	2.0 ma.
Maximum signal plate current	14.5	19 ma.
Maximum signal screen current	2.5	3.0 ma.
Peak AF signal voltage (grid to grid)	9.8	9.8 volts
Load resistance (plate to plate)	6000	6000 ohms
Total harmonic distortion	2.5	2.0 %
Power output	175	225 mw.

PARALLEL OPERATION, CLASS A

Values are for both sections

	Self Bias	*Fixed Bias*
Heater voltage	28.0	28.0 volts
Plate voltage	28.0	28.0 volts
Screen voltage	28.0	28.0 volts
Grid voltage	...	−3.5 volts
Cathode bias resistor	180	... ohms
Zero signal plate current	18.5	25 ma.
Zero signal screen current	1.3	2 ma.
Maximum signal plate current	13.1	16 ma.
Maximum signal screen current	2.8	3.5 ma.
Peak AF signal voltage	4.9	4.9 volts
Load resistance	2000	2000 ohms
Total harmonic distortion	9.5	8.0 %
Power output	160	200 mw.

NOTE: The above characteristics may be realized provided the DC plate circuit resistance does not exceed 50 ohms per section.

Reference Index: Vacuum Tube Reviews

Complete design data on the following tubes has been presented in Radio-Electronic Engineering to date:

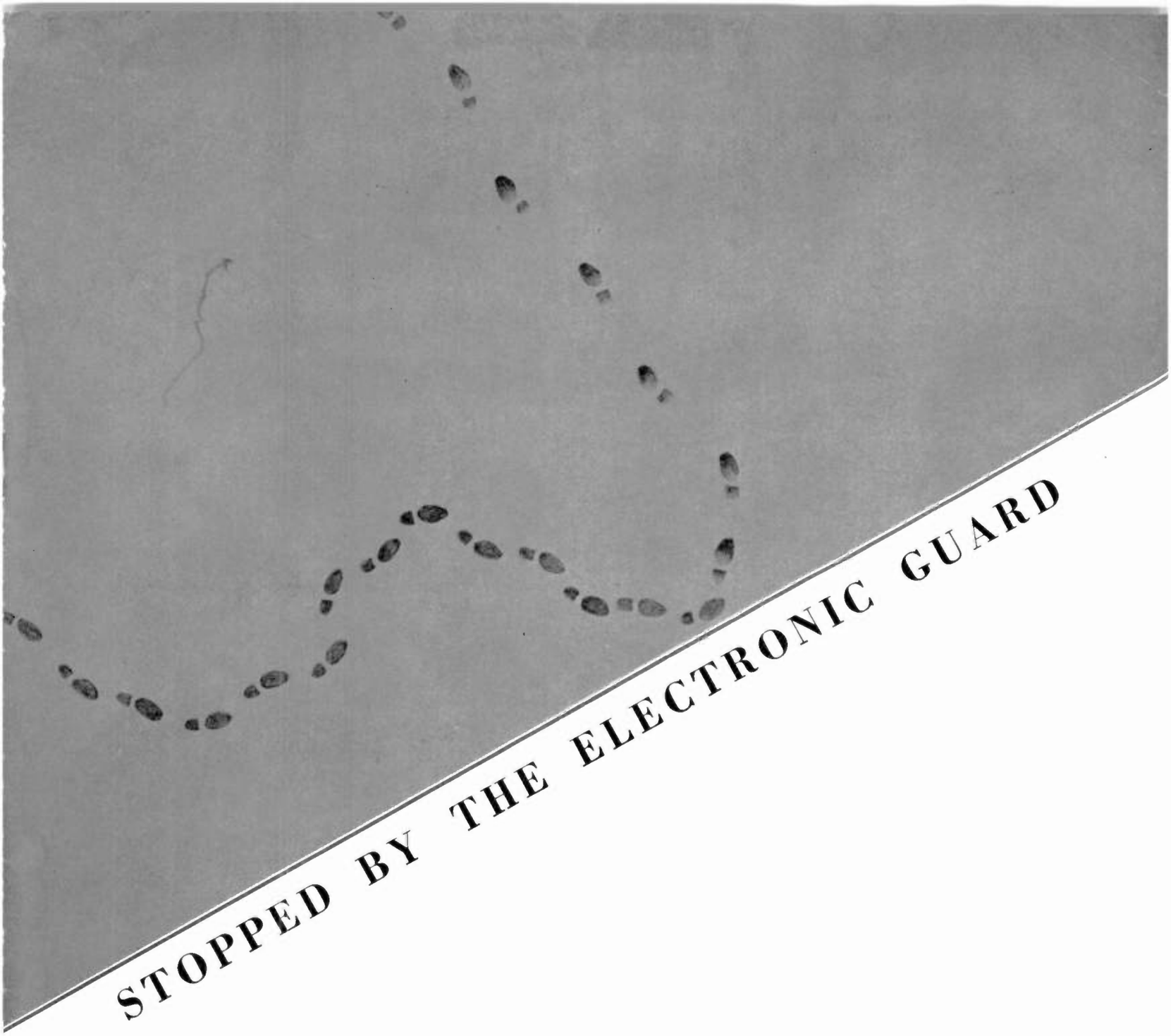
1635	Class B twin amplifier	June, 1942
1642	Twin triode amplifier	June, 1942
9004	UHF diode	May, 1942
9005	UHF diode	May, 1942
1A3	HF diode	May, 1942
3A4	Power amplifier pentode	May, 1942
3A5	HF twin triode	May, 1942
829A	P-P RF beam power amp.	July, 1942
832A	P-P RF beam power amp.	Sept., 1942
6C4	HF power pentode	May, 1942
28D7	Double beam power amplifier	Oct., 1942
9JP1/1809P1	9-in. cathode ray	June, 1942
1L4	RF amplifier pentode	May, 1942
7W7	HF amplifier pentode	Oct., 1942

HE MISSED AN OPPORTUNITY

According to John H. Payne, G.E. engineer on the U.S.S. George Washington which took President Wilson to the Peace Conference at Versailles in 1919, our former President might have been the first government head in the world to speak to his people over the radio.

The occasion was his address to the soldiers and crew of the George Washington. The radio engineers were told that it might make the President nervous to have a microphone before him, and it was not proper to disturb him with anything of that sort.

Accordingly, a microphone was hidden where he was expected to stand, but at the last moment he decided to speak from a lower deck, and it was too late to move the microphone.



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

★ Indicates that addresses and phone numbers of representatives in War Production centers are listed at the end of the Radio-Electronic Products Directory

ANTENNAS, Mobile Whip
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., Long Island City, N. Y.
Ward Products Corp., 1523 E. 45 St., Cleveland, O.

ANTENNAS, Transmitting
Blaw-Knox Co., Pittsburgh, Pa.
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

BEADS, Insulating
American Lava Corp., Chattanooga, Tenn.
Dunn, Inc., Struthers, 1321 Cherry, Phila., Pa.
Star Porcelain Co., Trenton, N. J.
Steward Mfg. Co., Chattanooga, Tenn.

BOLTS, NUTS & SCREWS, Machine
American Screw Co., Providence, R. I.
Bristol Co., The, Waterbury, Conn.
Central Screw Co., 3519 Shields Av., Chicago
Chandler Prods. Corp., Cleveland, O.
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corp., New Britain, Conn.
Federal Screw Prod. Co., 224 W. Huron St., Chicago
Harper Co., H. M., 2609 Fletcher, Chicago
International Screw Co., Detroit
Lamson & Sessions Co., Cleveland, O.
National Screw & Mfg. Co., Cleveland
New England Screw Co., Keene, N. H.
Ohio Nut & Bolt Co., Berea, Ohio
Parker Co., Charles, Meriden, Conn.
Parker-Kalon Corp., 198 Varick, N. Y. C.
Pawtucket Screw Co., Pawtucket, R. I.
Progressive Mfg. Co., Torrington, Conn.
Republic Steel Corp., Cleveland, O.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Mfg. Co., Waterbury, Conn.
Shakeproof, Inc., 2501 N. Keeler, Chicago
Southington Hardware Mfg. Co., The, Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

CABLE, Coaxial
American Phenolic Corp., 1830 S. 54 Av., Chicago
Anaconda Wire & Cable Co., 25 B'way, N. Y. C.
Andrew Co., Victor J., 363 E. 75 St., Chicago
Belden Mfg. Co., 4673 W. Van Buren, Chicago
Boston Insulated Wire & Cable Co., Boston
Communications Prods. Co., Jersey City, N. J.
Cornish Wire Co., 15 Park Row, N. Y. C.
General Cable Corp., 420 Lexington, N. Y. C.
Doolittle Radio, Inc., 7521 S. Loomis Blvd., Chicago
General Insulated Wire Corp., 53 Park Pl., N. Y. C.
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.
Gavett Mfg. Co., Brookfield, Mass.
Holyoke Wire & Cable Corp., Holyoke, Mass.

CASTINGS, Die
Aluminum Co. of America, Pittsburgh, Pa.
American Brass Co., Waterbury, Conn.
Dow Chemical Co., Dowmetal Div., Midland, Mich.

CERAMICS, Bushings, Washers, Special Shapes
Akron Porcelain Co., Akron, O.
Electronic Mechanics, Inc., Paterson, N. J.
Isolantite, Inc., Belleville, N. J.
Lapp Insulator Co., Leroy, N. Y.
Louthan Mfg. Co., E. Liverpool, O.
Star Porcelain Co., Trenton, N. J.
Steward Mfg. Co., Chattanooga, Tenn
Victor Insulator Co., Victor, N. Y.

CHOKES, RF
Aladdin Radio Industries, 501 W. 35th, Chicago
Alden Prods. Co., Brockton, Mass.
American Communications Corp., 306 B'way, N. Y. C.
Barker & Williamson, Upper Darby, Pa.
Coto-Coil Co., Providence, R. I.
D-X Radio Prods. Co., 1575 Milwaukee, Chicago
General Winding Co., 254 W. 31 St., N. Y. C.
Guthman & Co., Edwin, 400 S. Peoria, 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., 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., 4017 W. Lake St., Chicago

CLIPS, Connector
Mueller Electric Co., Cleveland, O.

CLIPS & MOUNTINGS, Fuse
Alden Prods. Co., Brockton, Mass.
Dante Elec. Mfg. Co., Bantam, Conn.
Hoco 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.

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.

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 Av., N. Y. C.
Automatic Winding Co., East Newark, N. J.
Bud Radio, Inc., Cleveland, O.
Cardwell Mfg. Corp., Allen D., Brooklyn, N. Y.
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 L., 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., 3123 N. Crawford, Chicago
General Radio Co., Cambridge, Mass.
Girard-Hopkins, Oakland, Calif.
H. R. S. Prods., 5707 W. Lake St., Chicago
Illinois Cond. Co., 3252 W. North Av., Chicago
Industrial Cond. Corp., 1725 W. North Av., Chicago
Insuline Corp. of America, Long Island City, N. Y.
Johnson Co., E. F., Waseca, Minn.
Kellogg Switchb'd & Supply Co., 6650 Cicero, Chicago
Mallory & Co., P. R., Indianapolis, Ind.
Micamold Radio Corp., Brooklyn, N. Y.
Muter Co., 1255 S. Michigan, Chicago
Potter Co., 1950 Sheridan Rd., N. Chicago
RCA Mfg. Co., Camden, N. J.
Sangamo Elec. Co., Springfield, Ill.
Solar Mfg. Corp., Bayonne, N. J.
Sprague Specialties Co., N. Adams, Mass.
Teleradio Engineering Corp., 484 Broome St., N. Y. C.

CONDENSERS, Small Ceramic Tubular
Centralab, Div. of Globe-Union, Inc., Milwaukee, Wis.
Erie Resistor Corp., Erie, Pa.

CONDENSERS, Tubular Ceramic Transmitting
Cornell-Dubilier, S. Plainfield, N. J.
RCA Mfg. Co., Inc., Camden, N. J.
Solar Mfg. Corp., Bayonne, N. J.

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. 33rd 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.
Radio Condenser Co., Camden, N. J.
Reliance Die & St'p'g Co., 1260 Clybourn Av., Chicago

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.

CONDENSERS, Variable Trimmer
★ Aerovox Corp., New Bedford, Mass.
Alden Prods. Co., Brockton, Mass.
American Steel Package Co., Defiance O.
Bud Radio, Inc., Cleveland, O.
Cardwell Mfg. Corp., Allen, Brooklyn, N. Y.
Centralab, Milwaukee, Wis
General Radio Co., Cambridge, Mass.
Guthman, Inc., E. L., 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.
Alden Prods., Brockton, Mass.
Amer. Microphone Co., 1915 S. Western Av., Los Angeles
Amer. Phenolic Corp., 1830 S. 54th St., Chicago
American Radio Hardware Co., 476 B'way, N. Y. C.
Andrew, Victor J., 6429 S. Lavergne Av., Chicago
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
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.
Insuline Corp. of Amer., L. I. City, N. Y.
Jones, Howard B., 2300 Wabansia, Chicago
Mallory & Co., P. R., Indianapolis, Ind.
Radio City Products Co., 127 W. 26 St., N. Y. C.

CONTACT POINTS
Mallory & Co., Inc., P. R., Indianapolis, Ind.

CRYSTAL GRINDING EQUIPMENT
Felker Mfg. Co., Torrance, Calif.

CRYSTALS, Quartz
Bausch & Lomb Optical Co., Rochester, N. Y.
Bellefonte Eng. Labs., Bellefonte, Penna.
Billey Elec. Co., Erie, Penna.
Burnett, Wm. W. L., San Diego, Cal.
Collins Radio Co., Cedar Rapids, Iowa
General Electric Co., Schenectady, N. Y.
General Radio Co., Cambridge, Mass.
Harvey-Wells Communications, Southbridge, Mass.
Hipower Crystal Co., 2035 W. Charleston, Chicago
Hollister Crystal Co., Merriam, Kan.
Hunt & Sons, G. C., Carlisle, Pa.
Kaar Engineering Co., Palo Alto, Cal.
Miller, August E., North Bergen, N. J.
Peterson Radio, Council Bluffs, Iowa
Precision Crystal Labs., Springfield, Mass.
Precision Piezo Service, Baton Rouge, La.
Premier Crystal Labs., 63 Park Row, N. Y. C.
RCA Mfg. Co., Camden, N. J.
Scientific Radio Service, Hyattsville, Md.
Standard Piezo Co., Carlisle, Pa.
Valpey Crystals, Holliston, Mass.
Zeiss, Inc., Carl, 485 Fifth Av., N. Y. C.

DIALS, Instrument
Rogan Bros., 2003 S. Michigan Ave., Chicago

FELT
American Felt Co., Inc., Glenville, Conn.
Western Felt Works, 4031 Ogden Av., 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.
Taylor Fibre Co., Norristown, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

FILTERS, Electrical Noise
Mallory & Co., Inc., P. R., Indianapolis, Ind.
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.

FREQUENCY METERS
General Radio Co., Cambridge, Mass
Lavoie Laboratories, Long Branch, N. J.
Measurements Corporation, Boonton, N. J.

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

FREQUENCY STANDARDS, Quartz Secondary
Millen Mfg. Co., Inc., Malden, Mass.

FUSES, Enclosed
Dante Elec. Mfg. Co., Bantam, Conn.

From month to month, new companies are entering the Radio-Electronic field. Older concerns are adding new products. Accordingly, this Directory is revised every month, so as to assure engineers and purchasing agents of up-to-date information. We shall be pleased to receive suggestions as to company names which should be added, and hard-to-find items which should be listed in this Directory.

HIGH-FREQUENCY IRON CORES

(CONTINUED FROM PAGE 7)

change. This is a low-frequency material, with higher permeability than B-3.

F-1, not shown on the curves, has slightly lower *Q* than C-712 and about the lowest permeability. Used mainly in IF transformers, it has about one-half frequency shift with voltage change of B-3.

B-3 has slightly lower *Q* than F-1, but higher permeability, and is comparable with magnetite. It is a low-frequency material, low in cost, used mainly in IF transformers. This material has the greatest frequency shift with voltage change.

MGI-52, not shown in all the curves, is a high-frequency material of lower permeability than HF-7. O-9 is the best high-frequency material with permeability similar to MGI-52.

HM-7 is a high permeability carbonyl material having high *Q* characteristics at low frequencies, especially suitable for audio-frequency applications and permeability tuning at lower radio frequencies.

Special core materials have been developed for applications requiring low thermal drift. For such applications high *Q* material with a drift of approximately .0011% per degree C., is available. This same material is also produced with very high insulation resistance which at a minimum is 100 megohms between points $\frac{1}{8}$ in. apart. This property is especially valuable in applications where two or more iron components are in contact and are liable to produce noise voltages in associated circuits due to low contact resistance.

Other materials are already available to meet still more specialized requirements not covered by the wide array of materials just listed, while new materials are under development.

Material Conservation ★ The stepped-up efficiency provided by iron-core coils is being reflected in the material conservation effected in the production of present radio equipment. Receivers can be reduced to simpler proportions, with fewer tubes and other components. Shielding is reduced to an absolute minimum with resultant economies in aluminum. The size and weight of radio receivers particularly, but also radio transmitters, have been considerably reduced. Those portable military sets, particularly the ultra-compact walkie-talkie transceivers, are in large measure a direct result of iron-core coils. There is usually a weight reduction of from 20 to 35% due to the use of iron-core coils.

Thus the high-frequency iron core has become part and parcel of our present-day radio art. And, thanks to the far-sighted ingenuity of our technicians, an all-American industry has been set up which can take care of this important factor in our wartime radio efforts.

Jefferson Elec. Co., Bellwood, Ill.
Littlefuse, Inc., 4753 Ravenswood Av., Chicago

GEARS & PINIONS, Metal
Continental-Diamond Fibre Co., Newark, Del.
Gear Specialties, Inc., 2650 W. Medill, Chicago
Perkins Machine & Gear Co., Springfield, Mass.
Thompson Clock Co., H. C., 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, Chicago
Synthane Corp., Oaks, Pa.
Taylor Fibre Co., Norristown, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

GENERATORS, Gas Engine Driven
Kato Engineering Co., Mankato, Minn.

HEADPHONES
Brush Development Co., Cleveland, O.
Conn. Tel. & Electric Co., Meriden, Conn.
Carrier Microphone Co., Inglewood, Cal.
Cannon Co., C. F., Springwater, N. Y.
Carron Mfg. Co., 415 S. Aberdeen, Chicago
Chicago Tel. Supply Co., Elkhart, Ind.
Connecticut Tel. & Elec. Co., Meriden, Conn.
Elec. Industries Mfg. Co., Red Bank, N. J.
Kellogg Switchboard & Supply Co., 6650 S. Cicero Av., Chicago
Murdock Mfg. Co., Chelsea, Mass.
Trimm Radio Mfg. Co., 1770 W. Berteau, Chicago
Universal Microphone Co., Inglewood, Cal.

HORNS, Outdoor
University Laboratories, 195 Chrystie St., N. Y. C.

INSTRUMENTS, Radio Laboratory
Ballantine Laboratories, Inc., Boonton, N. J.
General Radio Co., Cambridge, Mass.
Hewlett Packard Co., Palo Alto, Calif.
Measurements Corporation, Boonton, N. J.

INSULATORS: Ceramic Stand-off, Lead-in, Rod Types
Isolantite, Inc., Belleville, N. S.
Lapp Insulator Co., Inc., Leroy, N. Y.

IRONS, Soldering
Hexacon Electric Co., Roselle Park, 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.
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.
Radio City Products Co., 127 W. 26 St., N. Y. C.
Rogan Bros., 2001 S. Michigan, Chicago

LABORATORIES, Electronic Research
★ Browning Labs., Inc., Winchester, Mass.

LIGHTS, Pilot or Indicator
Alden Prods. Co., Brockton, Mass.
Dial Light Co. of America, 90 West, N. Y. C.
Drake Mfg. Co., 1713 W. Hubbard, Chicago
General Control Co., Cambridge, Mass.
★ General Elec. Co., Lamp Dept., Nela Specialty Div., Hoboken, N. J.
Herzog Miniature Lamp Works, 12–19 Jackson Av., Long Island City, N. Y.
Kirkland Co., H. R., Morristown, N. J.
Mallory & Co., P. R., Indianapolis, Ind.

LUGS, Copper
Burndy Engineering Co., 459 E. 133rd St., N. Y. C.
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 Av., Providence, R. I.
Sherman Mfg. Co., Battle Creek, Mich.

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

MACHINES, Numbering
Altair Machinery Corp., 55 VanDam, N. Y. C.
Numberall Stamp & Tool Co., Huguenot Park, Staten Island, N. Y.

MACHINES, Riveting
Chicago Rivet & Machine Co., Bellwood, Illinois

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

MAGNETS, Permanent
★ General Elec. Co., Schenectady, N. Y.
Thomas & Skinner Steel Prod. Co., Indianapolis, Ind.

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.

METALS, Pressed Powder
Gibson Elec. Co., Pittsburgh, Pa.
Mallory & Co., P. R., Indianapolis, Ind.

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.
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.

MICA
Brand & Co., Wm., 276 Fourth Av., N. Y. C.
Insulation Mfgrs. Corp., 565 W. Wash. Blvd., Chicago
Macallen Co., Boston, Mass.
Mica Insulator Corp., 196 Varick, N. Y. C.
New England Mica Co., Waltham, Mass.
Richardson Co., Melrose Park, Chicago

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.
Carrier Microphone Co., Inglewood, Cal.
Elect. Industries Mfg. Co., Red Bank, N. J.
Electro Voice Mfg. Co., South Bend, Ind.
Kellogg Switchboard & Supply Co., 6650 S. Cicero, Chicago
Radio Speakers, Inc., 221 E. Cullerton, Chicago
Philmore Mfg. Co., 113 University Pl., N. Y. C.
Permoflux Corp., 4916 W. Grand Av., Chicago
Rowe Industries, Inc., Toledo, O.
★ Shure Bros., 225 W. Huron St., Chicago
Turner Co., Cedar Rapids, Ia.
Universal Microphone Co., Inglewood, Cal.

MONITORS, Frequency
★ Browning Labs., Inc., Winchester, Mass.
★ Link, F. M., 127 W. 17 St., N. Y. C.

MOTOR-GENERATORS, Dynamotors, Rotary Converters
Alliance Mfg. Co., Alliance, O.
Air-Way Mfg. Co., Toledo, O.
Bendix, Red Bank, N. J.
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.
Elcor, Inc., 1060 W. Adams, Chicago
Electric Motors Corp., Racine, Wis.
Electric Specialty Co., Stamford, Conn.
Electrolux Corp., Old Greenwich, Conn.
Eureka Vacuum Cleaner, Detroit, Mich.
★ 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.
Webster Co., Chicago, Ill.
Westinghouse Elect. Mfg. Co., Lima, O.
Wincharger Corp., Sioux City, Iowa

MOUNTINGS, Shock Absorbing
Lord Mfg. Co., Erie, Pa.
U. S. Rubber Co., 1230–6th Ave., N. Y. C.

MYCALEX
★ General Electric Co., Schenectady, N. Y.
Mycalex Corp. of Amer., 7 E. 42 St., N. Y. C.

NUTS, Self-Locking
Elastic Stop Nut Corp., Union, N. J.
Palnut Co., Inc., Irvington, N. J.

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Standard Pressed Steel Co., Jenkintown, Pa.

OVENS, Industrial & Laboratory

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

PILOT LIGHTS

Amer. Radio Hardware Co., Inc., 467 B'way, N. Y. C.
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 Fourth Ave., N. Y. C.
Extruded Plastics, Inc., Norwalk, Conn.
Irvington Varnish & Insulator Co., Irvington, 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.
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.
Dow Chemical Co., Midland, Mich.
Durez 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.
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.
Radio City Products Co., 127 W. 26 St., N. Y. C.
Richardson Co., Melrose Park, Chicago
Rogan Bros., 180 N. Wacker Dr., Chicago
Rohm & Haas Co., Philadelphia
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.

PLASTIC, Sheet for Name Plates

Mica Insulator Co., 200 Varick St., N. Y. C.

PLUGS & JACKS, Spring Type

Eby, Inc., Hugh H., Philadelphia, Pa.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Ucinite Co., Newtonville, Mass.

PLUGS & JACKS, 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., 1627 W. Walnut, Chicago
Jones, Howard B., 2300 Wabansia Av., Chicago
Mallory & Co., Inc., P. R., Indianapolis, Ind.

PRESSES, Plastic Molding

Kux Machine Co., 3930 W. Harrison, Chicago

PRESSES

Stokes Machine Co., F. J., Philadelphia
Watson-Stillman Corp., The, Roselle Park, N. J.

RECTIFIERS, Current

★ Benwood Linze Co., St. Louis, Mo.
Continental Elec. Co., 903 Merchandise Mart, Chicago
Electronics Labs., Indianapolis, Ind.
Fansteel Metallurgical Corp., N. Chicago, Ill.
★ General Electric Co., Bridgeport, Conn.
International Tel. & Radio Mfg. Corp., E. Newark, N. J.
Mallory & Co., P. R., Indianapolis, Ind.
Nothelfer Winding Labs., Trenton, N. J.
United Cinephone Corp., Torrington, Conn.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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.
Ferranti Elec., Inc., 30 Rockefeller Plaza, N. Y. C.
★ General Elec. Co., Schenectady, N. Y.
H-B Elec. Co., Philadelphia
Sola Electric Co., 2-52a Clybourn Av., Chicago
United Transformer Corp., 150 Varick St., N. Y. C.

RELAYS, Small Switching

G-M Laboratories, Inc., 4313 N. Knox Ave., Chicago
Struthers Dunn, Inc., 1326 Cherry St., Philadelphia
Ward Leonard Electric Co., Mt. Vernon, N. Y.

RELAYS, Small Telephone Type

Amer. Automatic Elect. Sales Co., 1033 W. Van Buren St., Chicago
Clare & Co., C. P., 1719 W. Sunnyside Ave., Chicago
Guardian Electric Co., 1625 W. Walnut St., Chicago
Wick Organ Co., Highland, Ill.

RELAY TESTERS, Vibration

Kurman Electric Co., Inc., 241 Lafayette St., N. Y. C.

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.
Centralab, Milwaukee, Wisconsin
Clarostat Mfg. Co., Brooklyn, N. Y.
Cont'l Carbon, Inc., Cleveland, O.
Daven Co., 158 Summit St., Newark, N. J.
Dixon Crucible Co., Jersey City, N. J.
Erie Resistor Corp., Erie, Pa.
Globar Div. Carborundum Co., Niagara Falls, N. Y.
Hardwick, Hindle, Inc., Newark, N. J.
Instrument Resistors Co., Little Falls, N. J.
Intern'l Resistance Co., Philadelphia
Lectrohm, Inc., Cicero, Ill.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Ohmite Mfg. Co., 4835 W. Flournoy, Chicago
Precision Resistor Co., Newark, N. J.
Sensitive Research Inst. Corp., 4545 Bronx Blvd., N. Y. C.
Shalleross Mfg. Co., Collingdale, Pa.
Sprague Specialties Co., N. Adams, Mass.
Stackpole Carbon Co., St. Marys, Pa.
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

Instrument Resistors, Inc., Little Falls, N. J.
Intern'l Resistance Co., Philadelphia
Ohmite Mfg. Co., 4835 Flournoy St., Chicago

RESISTORS, Variable

★ Aerovox Corp., New Bedford, Mass.
Allen-Bradley Co., Milwaukee, Wis.
Amer. Instrument Co., Silver Spring, Md.
Atlas Resistor Co., N. Y. C.
Centralab, Milwaukee, Wis.
Chicago Tel. Supply Co., Elkhart, Ind.
Cinema Eng. Co., Burbank, Cal.
Clarostat Mfg. Co., Brooklyn, 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.
Hardwick, Hindle, Inc., Newark, N. J.
Instrument Resistors, Inc., Little Falls, N. J.
Intern'l Resistance Co., Philadelphia
Mallory & Co., P. R., Indianapolis, Ind.
Ohio Carbon Co., Cleveland, Ohio
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago
Precision Resistor Co., Newark, N. J.
Shalleross 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

Ohmite Mfg. Co., 4835 Flournoy St., Chicago

RIVETS, Plain

Central Screw Co., 3519 Shields Av., Chicago
Progressive Mfg. Co., Torrington, Conn.
Republic Steel Corp., Cleveland, O.

SCREW MACHINE PARTS, Non-Metallic

Continental-Diamond Fibre Co., Newark, Del.

FOR RADIO-ELECTRONIC RESEARCH

(CONTINUED FROM PAGE 9)

here will also be available under licenses to the whole radio and electronic industry."

This latter remark is indicative of plans to continue RCA's policy of expanding its patent-holding and license set-up, for Mr. Schairer, referring to the employment of myriads of workers and vast amounts of capital in industries vitalized by research said: "Research is distinctly constructive and beneficial. It does not invade the fields or destroy the rights of others. Its conquests are won only in the realm of the previously unknown and non-existent. Truly it is an instrument of the first order of social and economic importance.

"With prophetic vision and wisdom our forefathers framed measures for the encouragement of scientific research — patent laws for protecting the inventions which are its logical results. No more effective or economical method of promoting the progress of science and the useful arts has ever been devised. It has been the bulwark of our industrial and social progress. It has stimulated the translation of scientific discoveries into industrial achievements. It has accelerated the movement of inventions into the humblest homes.

"Without our patent system, research would languish, the streams of invention would become trickles, our industrial supremacy would be lost, employment would be reduced, and improvements in our standards of living would be retarded.

"Let us, therefore, preserve this wholesome system unimpaired in order that we may continue to enjoy the maximum benefits of research and invention. Let us be careful, in attempting to effect desirable improvements in this system and to prevent its misuse, that we do not weaken or destroy it. And let us also, by every means at our command, promote and expedite the distribution of its benefits to all the people."

Colonel David Sarnoff also spoke at the dedication ceremony. Referring to the work which will be done at the laboratories and the men who will comprise the staff, he said: "It is significant that the foundations of this building were laid in time of Peace, and its superstructure has been raised in time of War. Similarly, the modern sciences of radio and electronics have had their roots in peaceful soil — in the search by men of good will for ways and means to make the world a better place to live in. Yet these sciences, and all science, are now enlisted in total war. . . . We are moved by the deep respect in which we hold the virtues of scientific accuracy and intellectual integrity. These are the virtues possessed to a high degree by the type of men who will work within these walls. These are the qualities which are helping to preserve our civilization, and which, in turn, make our civilization worth fighting for."

These are, indeed, words of hope and faith and promise, but almost while they were being uttered an absurd-looking, chubby-faced man, whose intellectual stature could not measure up to fourth-grade requirements, told officials of the United States Treasury that they could not use frequency modulation broadcasting stations for promoting War Bond sales because these stations do not employ AFM musicians.

It is startling to realize that this little man, puffed up with the airs of Al Capone's by-gone day, is now aggressively extending his control over one of the greatest products of scientific research and engineering which, if its progress is unhampered, may be one of the most effective channels for industrial recovery and re-employment after the war.

The answer to this problem and all its far-reaching implications will not come from within the cloistered walls of a research laboratory, but from men who, with vision to scan other horizons, are needed to implement the work of our scientists.

SPOT NEWS NOTES

(CONTINUED FROM PAGE 10)

Incognito: On an increasing amount of military equipment, factory identifications are being obliterated. Company names on radio apparatus have a certain post-war advertising value which will be lost if this practice becomes general.

Wrinkle Finish: The Glidden Company has developed a wrinkle finish which does not use strategic China wood oil base. New finish is called Glidden No. 44. Metal surface is given coat of zinc chromate primer, air-dried for 4 hours, followed by coat of black enamel wrinkle finish baked at 250° F. for 2 hours. Sherwin Williams, Beckwith Chandler, Du Pont Paint, and others also have finishes which do not use China wood oil.

Complaint: Of Justice Department against AFM-Petrillo, to be decided by Supreme Court, charges conspiracy to restrain commerce in phonograph records, electrical transcriptions, and radio broadcasting:

(1) By preventing the manufacture and sale of all phonograph records and electrical transcriptions, thus destroying entirely those industries, from manufacturer to retailer, and preventing sales to all users.

(2) By requiring network companies to boycott such of their affiliated stations as refuse to hire stand-by musicians whose services are neither necessary nor desired.

(3) By eliminating all live musical talent over the air except that of AFM members.

A-N Award: To Henry L. Crowley & Company, Inc., at West Orange, N. J., for the excellence of their record of stepping up production of ceramics and special products, developed for military use.

FM EMERGENCY COMMUNICATIONS

(CONTINUED FROM PAGE 5)

and disclosures of the new system before the Institute of Radio Engineers, the Sigma Xi Society, and the Radio Club of America I had the great honor of being chosen to operate the demonstration equipment for him.

Yours very truly,
(*Signed*) PAUL GODLEY

Col. Schwartzkopf then wrote to Major Armstrong:

Trenton, N. J.
February 5, 1936

My dear Major Armstrong:

Mr. Paul F. Godley has explained to me that you have a new application which, when applied to radio transmission and reception, practically eliminates static and assures a much finer quality of reception. In the approach to the problem of applying radio communication to police work, we have been confronted with a major difficulty in establishing two-way radio between station and car over any considerable distance. With the report of Mr. Godley that you can assure practically perfect transmission and reception with a very much lower powered transmitter, it is my thought that possibly a development of your appliance would go a long way toward the solution of our police radio problem.

Not being a radio engineer myself, undoubtedly the foregoing will be hardly intelligible to you. I do have a definite idea, and hope that I have expressed it, and a statement of your reaction to my suggestion will be greatly appreciated.

We are definitely in earnest in this work.

Thanking you for the courtesy of your consideration, I beg to remain,

Very respectfully yours,
(*Signed*)
H. NORMAN SCHWARTZKOPF,
Colonel and Superintendent,
New Jersey State Police

MAJOR E. H. ARMSTRONG,
Columbia University,
New York City.

Major Armstrong's reply is reproduced here (page 5). As he so modestly predicted, "the amount of apparatus involved" was soon simplified and reduced in size to the point where a 35-watt FM transmitter, capable of outperforming AM transmitters of the same power, could be contained in a single small case, with an FM receiver, effectively cutting out static interference, built into another case of corresponding dimensions.

Thus Major Armstrong made good his promise that "we will succeed in simplifying the system so that it may be possible to use it in some of your services."

Indeed, under Col. Schoeffel's administration, our original plan to install a unified radio network has been realized, and is in full operation. We now have 125 cars equipped for 2-way FM telephone communication with our fixed stations.[1]

G.E. EMPLOYS 38 WOMEN TESTERS

Faced with the necessity of replacing an increasing number of men workers, General Electric Company is training women to handle the testing of radio transmitters and receivers.

Already, 38 graduate women engineers have qualified to do this work, by completing the course given in G.E.'s radio, television, and electronics department.

Graduates from colleges in all parts of the country are in the present group. More are coming in at a rapid rate. Requirements for the training course are a B.S. degree in physics or mathematics. Calculus is a "must". These women engineers are rotated among various departments for initial orientation. Their work consists of making computations, plotting graphs, calibrating fine instruments for machine tools, doing production testing work on simple devices, laboratory work and attending class-room lectures on engineering theory.

Thus, before they undertake test work on radio equipment, they are thoroughly grounded in all necessary fundamentals.

INDUSTRY GROUPS REPRESENTED ON WPB RADIO COMMITTEES

APPOINTMENT of radio executives and engineers to WPB parts and transmitting tube advisory committees announced by Frank H. McIntosh are as follows:

James P. Quam
Quam-Nichols Company, Chicago, Ill.
T. A. White
Jensen Radio Mfg. Company, Chicago
Ray F. Sparrow
P. R. Mallory & Co., Indianapolis, Ind.
Octave Blake
Cornell-Dubilier Elect. Corp., South Plainfield, N. J.
I. A. Mitchell
United Transformer Corp., N.Y.C.
Victor Mucher
Clarostat Mfg. Company, B'klyn, N. Y.
Ernest Searing
International Resistance Co., Phila.
J. J. Kahn
Standard Transformer Corp., Chicago
R. C. Sprague
Sprague Specialties Co., N. Adams, Mass.
F. R. Hopkins
Girard-Hopkins Co., Oakland, Calif.
F. P. Kenyon
Kenyon Transformer Co., Inc., N. Y. C.
W. M. Kohring
Continental Carbon Co., Cleveland, O.

[1] See New 2-Way FM Plan for Jersey, by Prof. Carl Neitzert and Lieut. John E. Murnane, Radio-Electronic Engineering, May, 1942.

Edwin I. Guthman
E. I. Guthman & Co., Inc., Chicago

The Transmitting Tube Industry Advisory Committee includes the following:

W. G. R. Baker
General Electric Co., Bridgeport, Conn.
H. C. Bonfig
RCA Manufacturing Company, Camden, N. J.
Roy Burlew
Ken-Rad Lamp & Tube Corp., Owensboro, Ky.
St. George Lafitte, Federal Telegraph Co., Newark, N. J.
S. Norris
Amperex Electronic Products Corporation, Brooklyn, N. Y.
Rex L. Taylor
Taylor Tubes, Inc., Chicago, Ill.
H. E. Wilson
Western Electric Co., Kearny, N. J.

One of the most important functions of the Replacement Parts Committee is to submit data and recommendations as to future requirements for maintaining civilian sets, and the possible simplification of stocks through substitution and the elimination of items in small demand.

WPB ELECTRONICS "L" ORDER

A NEW Limitation Order, L-183, covering all electronic equipment, has been issued by the War Production Board. This announcement came just after the September issue of RADIO-ELECTRONIC ENGINEERING warned that "lack of materials and engineering personnel has stopped off all activities in the field of industrial electronic applications except for those directly concerned with machines and processes used to manufacture essential military products."

Specifically, the Limitation Order states that "irrespective of the terms of any contract of sale, purchase, rental, or any other commitment, no manufacturer shall manufacture, fabricate, assemble, or produce any electronic equipment in excess of a minimum inventory required to meet deliveries on orders bearing a preference rating of A-3 or higher, and no manufacturer shall transfer electronic equipment except on orders bearing a preference rating of A-3 or higher."

This applies to "any electrical apparatus or device involving the use of vacuum or gaseous tubes and/or any associated or supplementary device, apparatus or part therefor" with the exception of (1) hearing devices, (2) telephone and telegraph equipment, (3) medical and therapeutic equipment, and (4) power and lighting equipment. Radio apparatus is already covered by WPB limitations.

All inquiries concerning L-183 should be addressed to: War Production Board, Radio and Radar Branch, Washington, D. C.

The WPB estimates that this Order will affect about 500 manufacturers of some 700 electronic items.

This action confirms the statement in the September issue of RADIO-ELECTRONIC ENGINEERING that: "For the duration of the War, our military requirements will consume all the materials, components, and finished equipment that industry can produce."

Listed among the devices specifically covered by L-83 are black-out controls, signal equipment, traffic counters, color sorters, thickness indicators, remote control apparatus, and door-openers.

Severe as the limitations of this order are, they will not have the effect of restricting the general progress of the electronic developments which will be greatest in post-War significance, since these have highly essential applications in our War effort.

It is an unusual circumstance that the developments which will have the widest peacetime applications are now guarded as military secrets, and are today unknown to the public and to non-military engineers.

WPB RADIO-RADAR ADMINISTRATION

As the Radio and Radar Branch of the WPB is now set up, its affairs are administered by the following executives:

John S. Timmons, Chief of the Radio and Radar Branch
Frank S. Horning, Chief, Industrial Section, in charge of applications and the Production Requirements Plan
Lt. William A. Gray, Chief, Vacuum Tube Section
Marvin Hobbs, Chief, Transmitter and Receiver Section
Sidney K. Wolfe, Chief, Components Section
M. J. Lowenstein, Chief, Critical Materials Section
Myron E. Whitney, Chief, Plant Facilities and Schedule Section
Frank H. McIntosh, Chief, Civilian Radio Section

There seems to be some misunderstanding of the priorities control on the part of engineers who do not come in direct contact with the WPB administration.

Under a formal directive issued on September 16th, a procedure was set forth "under which preference ratings will be issued by WPB officials only, in order to provide a closer check on the volume of materials for which ratings are assigned." The authority to issue ratings in the field was formerly delegated to Army, Navy, and other Government procurement officers.

Further changes in the WPB administration have been effected to take over functions of the Army and Navy Munitions Board, with Ferdinand Eberstat, former Chairman of the ANMB, now installed as Vice Chairman of the War Production Board.

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.
National 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.
Standard Pressed Steel Co., Jenkintown, Pa.
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
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
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
Parker-Kalon, 198 Varick, N. Y. C.
Standard Pressed Steel Co., Jenkintown, Pa.

SELENIUM
★ Benwood Linze Co., St. Louis, Mo.

SHAFTING, Flexible
Steward Mfg. Corp., 4311 Ravenswood Ave., Chicago
White Dental Mfg. Co., 10 E. 48 St., N. Y. C.

SHEETS, Electrical
American Rolling Mill Co., Middletown, O.
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

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 Hardware Co., 476 B'way, N. Y. C.
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.
Smith Co., Maxwell, Hollywood, Cal.

SOCKETS, Tube, Ceramic Base
National Co., Inc., Malden, Mass.

SOLDER, Self-fluxing
Garden City Laboratory, 2744 W. 37th Pl., Chicago
★ General Elec. Co., Bridgeport, Conn.
Kester Solder Co., 4209 Wrightwood Av., Chicago
Ruby Chemical Co., Columbus, O.

SOLDER POTS
Lectrohm, Inc., Cicero, Ill.

SPEAKERS, Cabinet Mounting
Jensen Radio Mfg. Co., 6601 S. Laramie St., Chicago

SPEAKERS, Outdoor Type
Jensen Radio Mfg. Co., 6601 S. Laramie St., Chicago
University Labs., 195 Chrystie St., N. Y. C.

SPRINGS
Accurate Spring Mfg. Co., 3817 W. Lake, Chicago
American Spring & Mfg. Corp., Holly, Mich.
American Steel & Wire Co., Rockefeller Bldg., Cleveland, O.
Barnes Co., Wallace, Bristol, Conn.
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.

SUPPRESSORS, Parasitic
Ohmite Mfg. Co., 4835 Flournoy St., Chicago

SWITCHES, Key
Chicago Tel. Supply Co., Elkhart, Ind.

SWITCHES, Micro
Micro Switch Corp., Freeport, Ill.

SWITCHES, Rotary Tap, Bakelite Base
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Stackpole Carbon Co., St. Marys, Pa.

SWITCHES, Rotary Tap, Ceramic Base
Ohmite Mfg. Co., 4835 Flournoy St., Chicago

TERMINAL STRIPS
Franklin Mfg. Corp., 175 Varick St., N. Y. C.

TEST CHAMBERS, Temperature, Humidity
Mobile Refrigeration, Inc., 630 5th Ave., N. Y. C.

TRANSFORMERS, Constant-Voltage Power
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.
Automatic Windings Co., E. Passaic, N. J.
Caron Mfg. Co., 415 S. Aberdeen, Chicago
D-X Radio Prods. Co., 1575 Milwaukee, Chicago
General Winding Co., 254 W. 31 St., N. Y. C.
Guthman & Co., 400 S. Peoria St., 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., Los Angeles, Cal.
Nat'l Co., Malden, Mass.
Sickles Co., F. W., Springfield, Mass.
Super Elect. Prod. Corp., Jersey City, N. J.
Teleradio Eng. Corp., 484 Broome St., N. Y. C.
Triumph Mfg. Co., 4017 W. Lake, Chicago

TRANSFORMERS, Midget Audio
Acme Electric & Mfg. Co., Cuba, N. Y.
Amer. Transformer Co., Newark, N. J.
Ferranti Electric Co., RCA Bldg., N. Y. C.
Jefferson Electric Co., Bellwood, Ill.
★ United Transformer Co., 150 Varick St., N. Y. C.

TRANSFORMERS, Receiver Audio & Power
Acme Elec. & Mfg. Co., Cuba, N. Y.
Amer. Transformer Co., Newark, N. J.
Amplifier Co. of Amer., 17 W. 20th St., N. Y. C.
Audio Devel. Co., N. Minneapolis, Minn.
Chaudagraph Speakers, Inc., 3929 S. Michigan, Chicago
Electronic Trans. Co., 515 W. 29 St., N. Y. C.
Ferranti Elec., Inc., 30 Rockefeller Plaza, N. Y. C.
Freed Trans. Co., 72 Spring St., N. Y. C.
Gen'l Radio Co., Cambridge, Mass.
General Trans. Corp., 1250 W. Van Buren, Chicago
Halldorson Co., 4500 Ravenswood, Chicago
Jefferson Elec. Co., Bellwood, Ill.
Kenyon Transformer Co., 840 Barry St., N. Y. C.
Magnetic Windings Co., Easton, Pa.
New York Transformer Co., 51 W. 3rd, N. Y. C.
Norwalk Transformer Corp., S. Norwalk, Conn.
Raytheon Mfg. Co., Waltham, Mass.
Skaggs Transformer Co., Los Angeles, Cal.
Standard Transformer Corp., 1500 N. Halsted, Chicago
Super Elect. Prod. Co., Jersey City, N. J.
Superior Elec. Co., Bristol, Conn.
Thordarson Elec. Mfg. Co., 500 W. Huron, Chicago
Utah Radio Prods. Co., 820 Orleans St., Chicago
★ United Transformer Co., 150 Varick St., N. Y. C.

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.
Farnsworth Tele. & Radio Corp., Ft. Wayne, Ind.
★ General Elec. Co., Schenectady, N. Y.
Hygrade Sylvania Corp., Salem, Mass.
Nat'l Union Radio Corp., Newark, N. J.
RCA Mfg. Co., Camden, N. J.

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.

TUBES, Photo-Electric
Bradley Labs., New Haven, Conn.
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 & Northrup Co., Philadelphia
Nat'l Union Radio Corp., Newark, N. J.
Photobell Corp., 123 Liberty St., N. Y. C.
RCA Mfg. Co., Camden, N. J.
Rehtron Corp., 2159 Magnolia Av., Chicago
Rhamstine, J., Detroit, Mich.
Westinghouse Lamp Div., Bloomfield, N. J.
Weston Elec. Inst. Corp., Newark, N. J.

TUBES, Receiving
★ General Electric Co., Schenectady, N. Y.
Hygrade Sylvania Corp., Salem, Mass.
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.
Federal Telegraph Co., Newark, N. J.
★ General Elec. Co., Schenectady, N. Y.
Heintz & Kaufman, S. San Francisco, Cal.
Hytron Corp., Salem, Mass.
Nat'l Union Radio Corp., Newark, N. J.
Raytheon Prod. Corp., 420 Lexington Av., N. Y. C.
RCA Mfg. Co., Camden, N. J.
Taylor Tubes, Inc., 2341 Wabansia, Chicago
United Electronics Co., Newark, N. J.
Westinghouse Lamp Div., Bloomfield, N. J.

TUBES, Voltage-Regulating
Amperite Co., 561 Broadway, N. Y. C.
Hygrade Sylvania Corp., Salem, Mass.
Hytron Corp., Salem, Mass.
RCA Mfg. Co., Camden, N. J.

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, Chicago
Synthane Corp., Oaks, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

TUBING & SLEEVING, Varnished Cambric, Glass-Fibre, Spaghetti
Bentley-Harris Mfg. Co., Conshohocken, Pa.
Brand & Co., Wm., 276 Fourth Av., N. Y. C.
Endurette Corp. of America, Cliffwood, N. J.
★ General Elec. Co., Bridgeport, Conn.
Insulation Mfgrs. Corp., 565 W. Washington Blvd., Chicago
Mica Insulator Co., 196 Varick St., N. Y. C.

VARNISHES, Insulating, Air-Drying
John C. Dolph Co., Newark, N. J.

VARNISHES, Insulating, Baking
John C. Dolph Co., Newark, N. J.

VIBRATORS, Power Supply
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Turner Co., Cedar Rapids, Ia.

WIRE, Bare
American Steel & Wire Co., Cleveland, O.
Anaconda Wire & Cable Co., 25 Broadway, N. Y. C.
Ansonia Elec. Co., Ansonia, Conn.
Belden Mfg. Co., 4633 W. Van Buren, Chicago
★ General Elec. Co., Bridgeport, Conn.
Phosphor Bronze Smelting Co., Philadelphia
Rea Magnet Wire Co., Fort Wayne, Ind.
Roebling's Sons Co., John, Trenton, N. J.

WIRE, Hookup
Garett Mfg. Co., Brookfield, Mass.

WIRE, Magnet
Acme Wire Co., New Haven, Conn.
American Steel & Wire Co., Cleveland, O.
Anaconda Wire & Cable Co., 25 Broadway, N. Y. C.
Ansonia Elec. Co., Ansonia, Conn.
Belden Mfg. Co., 4633 W. Van Buren, Chicago
Electric Auto-Lite Co., The, Port Huron, Mich.
★ General Elec. Co., Bridgeport, Conn.
★ General Elec. Co., Schenectady, N. Y.
Holyoke Wire & Cable Corp., Holyoke, Mass.
Rea Magnet Wire Co., Fort Wayne, Indiana
Rockbestos Prods. Corp., New Haven, Conn.
Roebling's Sons Co., John, Trenton, N. J.

DIRECTORY OF MANUFACTURERS' REPRESENTATIVES & SALES OFFICES IN RADIO WAR PRODUCTION AREAS

★ These manufacturers' names are starred in the Radio-Electronic Products Directory

AEROVOX CORP.
Boston: 94 Portland St., Lafayette 3484
Chicago: 4753 B'way, Long Beach 0109
Cleveland: 219 Film Ex. Bldg., Prospect 0719
Los Angeles: 1341 S. Hope St., Richmond 9121
New York: 347 Fifth Ave., Murray Hill 5 7090
Pittsburgh: 918 Hill St., Churchill 0838

BENWOOD LINZE CO.
Chicago: 549 W. Randolph St.
Hollywood: 6406 Sunset Blvd.
New York: 17 E. 42 St.
Pittsburgh: 337 Ave. F, Forrest Hills

BROWNING LABORATORIES, INC.
Address all correspondence to Winchester, Mass.: 755 Main St., Win. 2121

CARTER MOTOR CO.
Houston: Box 3113
Los Angeles: 942 Maple Ave.
New Orleans: 618 Girod St.
Seattle: 2411 First Ave.
Toronto, Can.: Manning Chambers, Queen at Bay Sts.

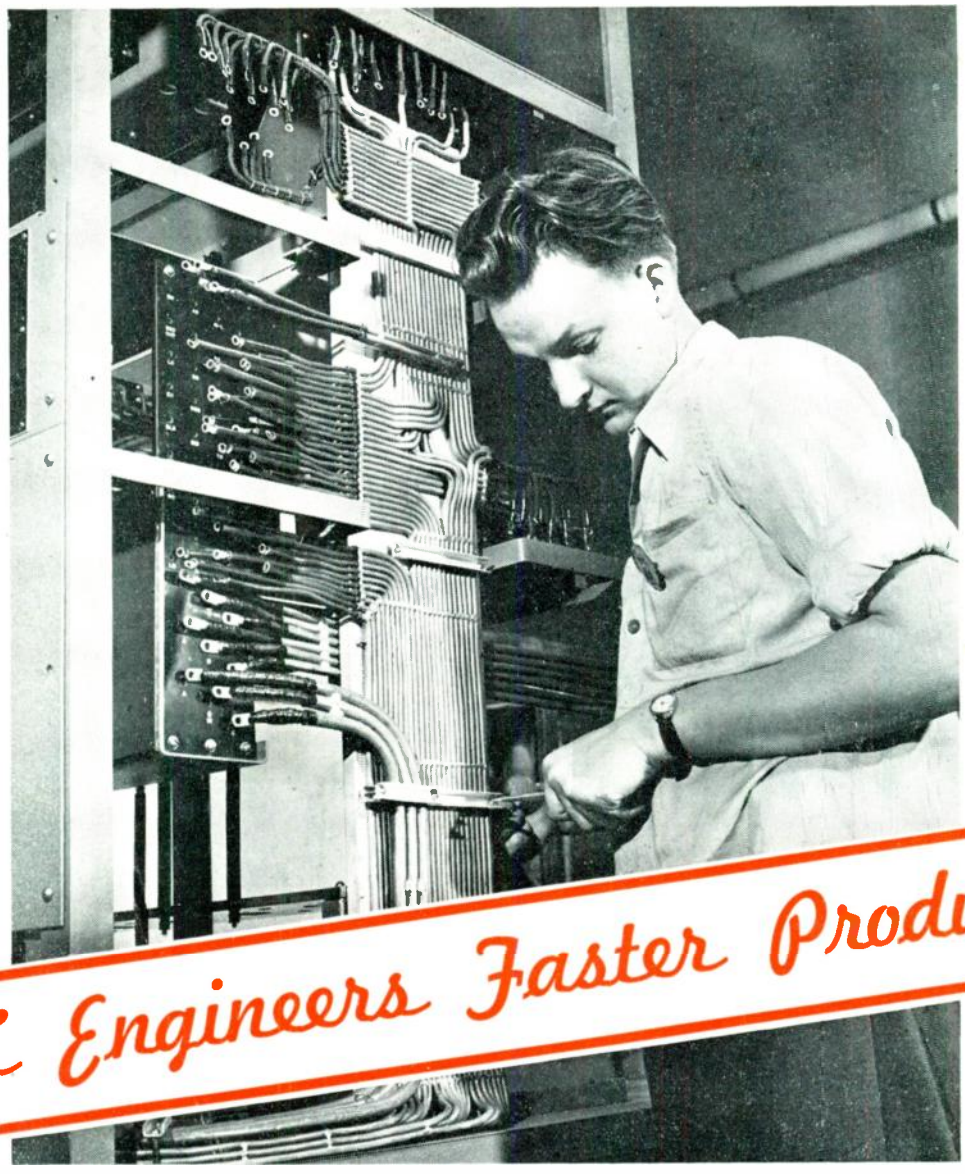
GENERAL ELECTRIC CO.
Boston: 140 Federal St., Hubbard 1800
Chicago: 840 S. Canal St., Wabash 5611
Cleveland: 4966 Woodland Ave., Endicott 4464
New York: 570 Lexington Ave., Wickersham 2 1311
Philadelphia: 1405 Locust Ave., Pennypacker 0000
San Francisco: 235 Montgomery St., Douglas 3740

LINGO & SON, INC., JOHN E.
Address all correspondence to Camden, N. J.: 28 & Van Buren Ave., Camden 487

LINK, F. M.
Address all correspondence to New York: 125 W. 17th St., Chelsea 3838

RADIO ENGINEERING LABORATORIES, INC.
Denver: 210 Fifteenth St.
Detroit: 2040 Grand River Ave., W.
Hollywood: 53334 Hollywood Blvd
Tampa: 115 S. Franklin St.
Export: 89 Broad St., N. Y. C.

SHURE BROTHERS
Chicago: 225 W. Huron St., Delaware 5381
Columbus: 85 E. Gay St., Adams 8928
New York: 136 Liberty St., Worth 2 6550
Philadelphia: 1343 Arch St., Rittenhouse 9778
San Francisco: 234 Ninth St., Hemlock 2625
Washington: 3308 Fourteenth St. N. W., Columbia 3938



REL Engineers Faster Production

BY discarding the old methods of apparatus design, and developing completely new construction techniques, REL is setting higher and higher production rates.

For example, by coordinating transmitter design with an original system of lead-cable wiring, REL engineers have reduced the 80 man-hours required for the conventional method to 14 man-hours — a saving of 82%.

The REL technique employs the steel chassis, of which the wiring is an integral part, as a shell within which the components are assembled.

This construction is capable of withstanding extreme punishment under service conditions. With all the wiring concentrated in one section, as the illustration shows, service in action is made easy, and performance is improved by reducing stray electrical fields.

This is a part of REL's effort to "cut corners into the Axis" by giving our Armed Forces finer equipment at a rate of production heretofore unknown to the radio industry.

REL

RADIO ENGINEERING LABS., Inc.
Long Island City New York

Sales Offices:

5334 Hollywood Blvd., Hollywood, California
2040 Grand River Ave. W., Detroit, Michigan
310 Fifteenth St., Denver, Colorado

RUMFORD PRESS
CONCORD, N. H.

URGENT MESSAGE

From: Fred M. Link

To: All Police Departments

Re: Availability of Radio Equipment

All Police Departments serving Defense Plants and areas are now eligible for Radio Equipment from the Government Reserve Pool established by the Defense Supplies Corporation with the WPB. As one of the accredited manufacturers who has been certified to produce radio equipment for the Police Radio Pool, you may write us at once for allocation application forms and procedure instructions, providing you have a real necessity for new or additional equipment in connection with Defense activities. Do not write the WPB or other Government agencies as the plan set-up directs the manufacturer to handle the forms and instructions. The procedure is simple and full information will be sent you on request. We urge you to act promptly.

FRED M. LINK

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