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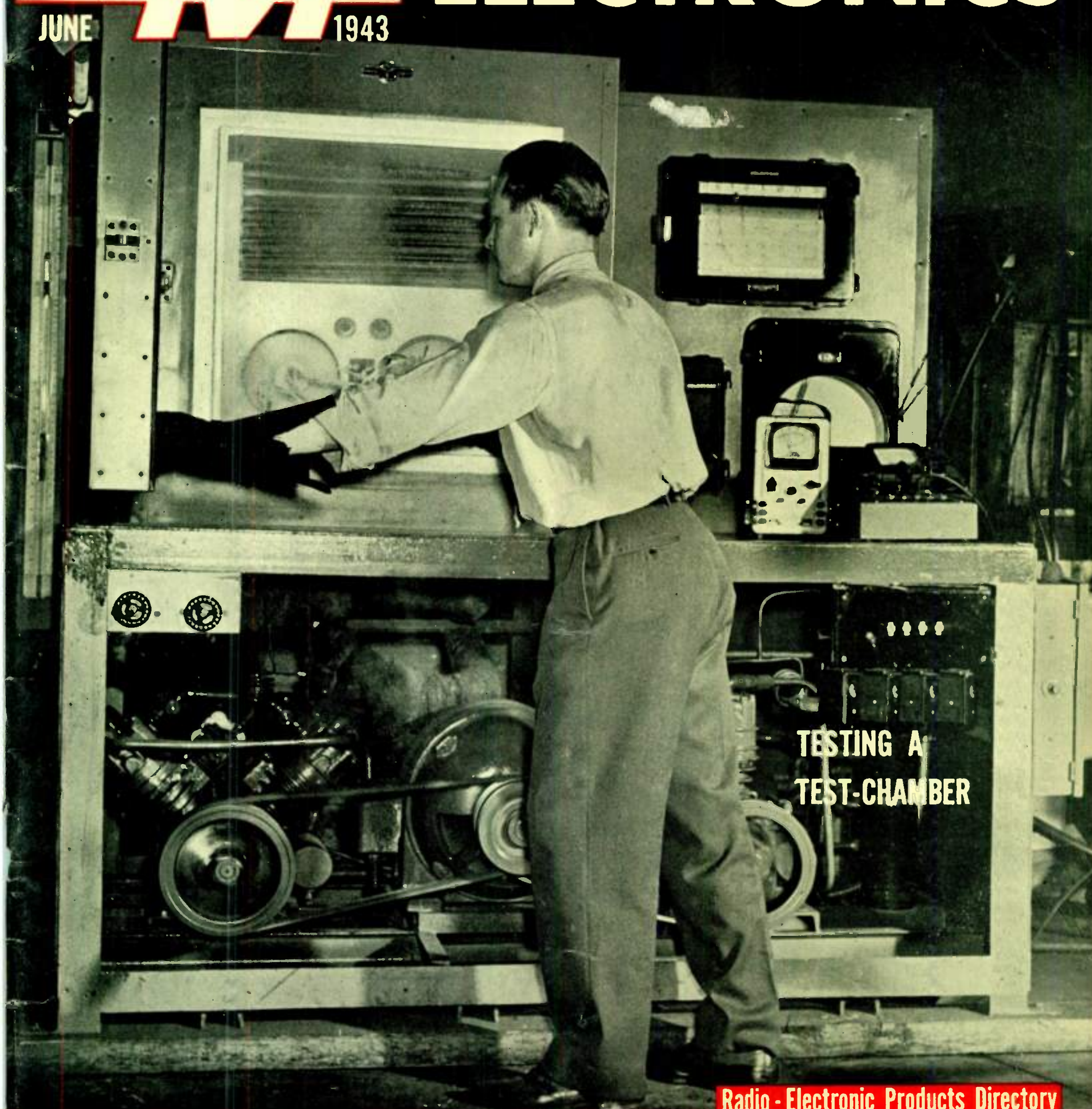
JUNE 1943



Radio - Electronic Products Directory

ENGINEERING • MANUFACTURING • OPERATION

★ ★ Edited by M. B. Sleeper ★ ★

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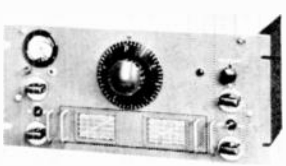

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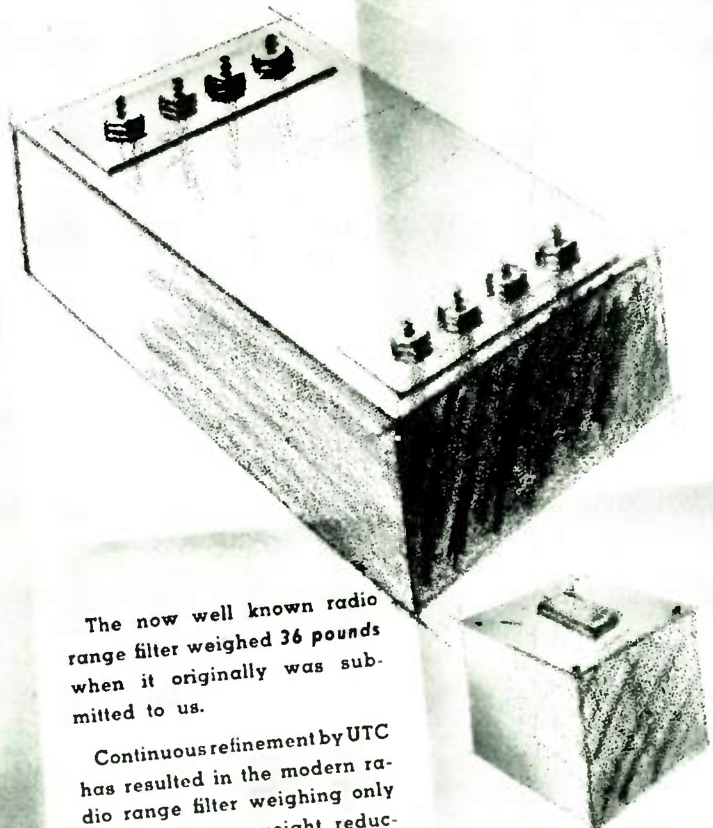

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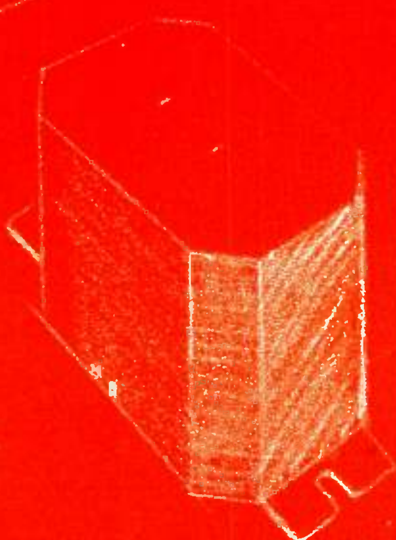

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FM RADIO-ELECTRONICS

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COMBINED WITH: APPLIED ELECTRONIC ENGINEERING

VOL. 3 — JUNE, 1943 — NO. 7

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THIS MONTH'S COVER

The design and manufacture of test chambers which reproduce flight conditions has become an important field of refrigeration engineering. Originally, Mobile Refrigeration Corp., in whose plant the cover photo was taken, built refrigerating units for cars and trucks. Now their entire facilities are devoted to test chambers, large and small. When chief engineer E. Lodwig opened the door, temperature was −100° C., and the cold from the chamber made the moisture in the outer air condense into what looked like a cloud of steam.

WHAT'S NEW THIS MONTH

OF ALL recent literature on the subject of electronics, one contribution stands out because it can be understood by scientist, engineer, businessman, and layman alike, and from it each can learn much, according to his lights.

It is an article entitled *Electronics*, appearing in the July issue of FORTUNE MAGAZINE.

Starting with the description of "electronics" as a glamour word, more dazzling than descriptive, it proceeds "to separate the whoopla from the real revolution," defines the separate fields of radio-electronics and industrial electronics, and then examines the present state and future possibilities of each.

The definition of the two fields follows the classification set forth in the market analysis chart which appeared in *FM* RADIO-ELECTRONICS for September, 1942. That is, the FORTUNE article groups radio communications, AM and FM broadcasting, television, facsimile, and radar under the heading of radio-electronics, and lists under industrial electronics the applications to power conversion, industry and manufacturing, medicine and surgery, and research techniques.

Considerable space is devoted to the work done by Westinghouse and General Electric in the development of tubes for power transmission lines, converting AC to DC, and for frequency-changer links between 60-cycle and 25-cycle lines. In dollar volume of sales, such applications probably constitute the major portion of the industrial-electronics field.

Surprisingly little, however, is said of induction heating although, sales-wise, it is now second to power transmission equipment, and may be equal to all the remaining applications combined.

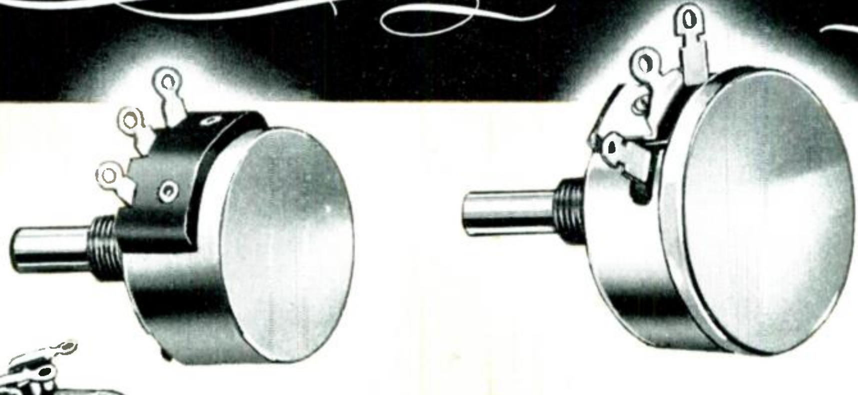
The subject of electronics in the home is disposed of briefly: "For ten years the American home might have had, at a price, electronic devices to open its doors, open garage doors, remove dust from its air, and turn on its lights at dusk. People still seem to prefer to turn on their own lights."

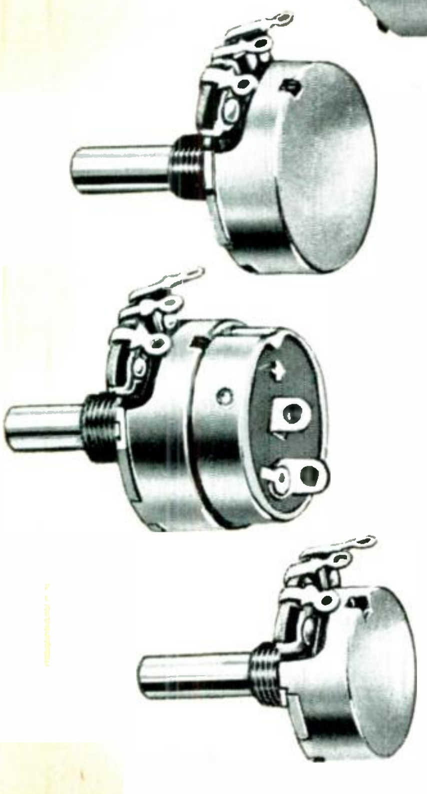
The discussion of industrial-electronics concludes with the reminder that the radio industry came a cropper in 1930, and now, "What bothers the pessimist is that nowhere does he see a new mass market for electronics, outside of radio and television."

Elements of the radio-electronics field are discussed in a realistic manner which

(CONTINUED ON PAGE 37)

a Message to: MANUFACTURERS OF ELECTRONIC EQUIPMENT





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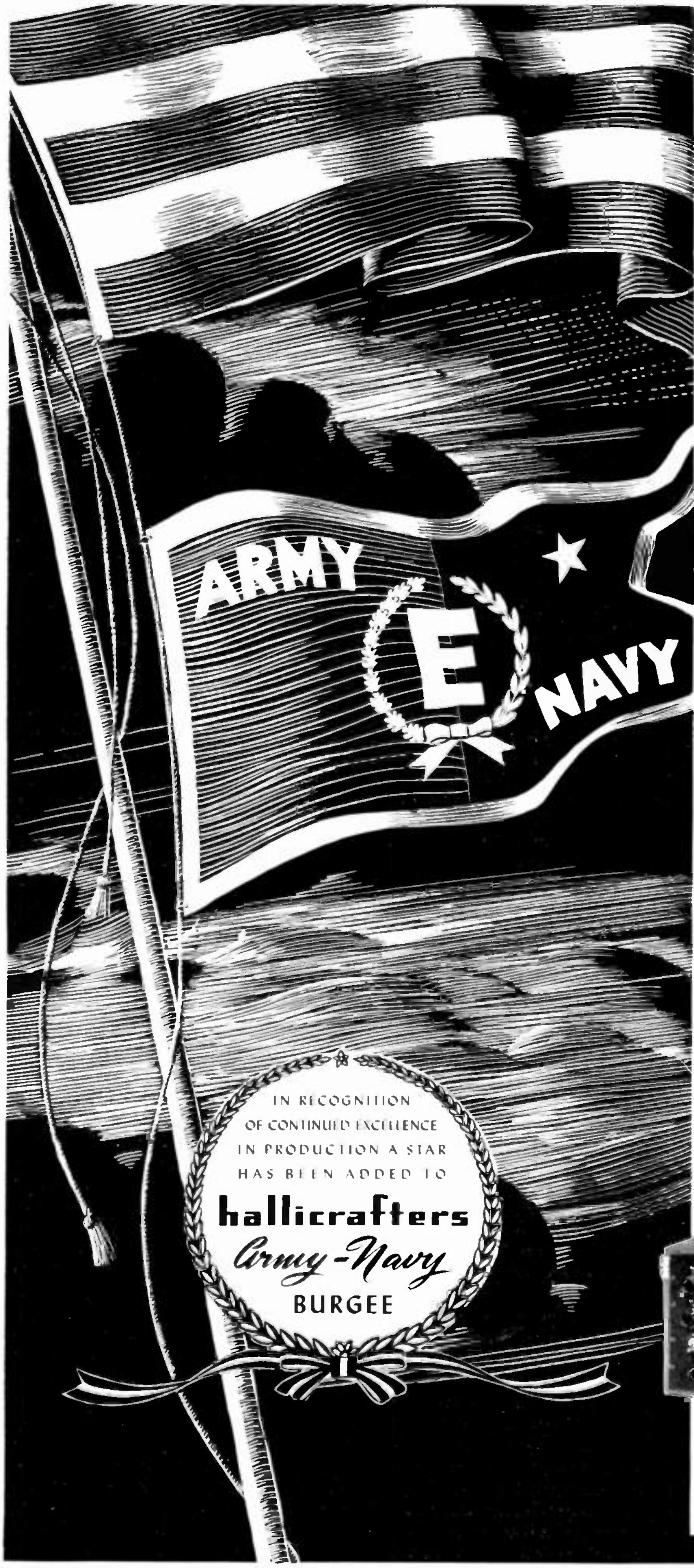

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SOME WAR AND POST-WAR RADIO PROBLEMS

A Constructive Discussion of Factors Which Affect the Future of the Radio Industry

BY JAMES LAWRENCE FLY *

SINCE its inception radio has fascinated the public in the same degree that it has captured the imagination of yourselves. The speed with which this war is carried on and the completeness of the reporting of it, the greater need for relaxation in a harried world, to use a well-worn phrase, the plain "morale-building" function of radio, have all made it a "must" in the civilian's life today. The initial fascination may be gone; but, in its place we have stable demand and acceptance. At the conclusion of this war my hunch is that the American people will be radio-hungry. The public has become dependent upon radio for news, amusement, and information, upon which they may base intelligent thinking on national and world issues. It will be enthusiastically receptive to refinements in the art.

When Peace Follows War ★ Before plunging into a post-war period we ought to pledge ourselves to ask the same questions we did when entering this present emergency period. The terms peace and war are merely reversed in the query. Sooner or later we must again ask ourselves: Can the radio industry survive the transition from war to peace? Can our post-war economy keep this vastly expanded industry, with its additional plants and its increased payroll, busy in the years to come? Can it meet the great potential public demand in a manner which will result in optimum benefits to the public? And, can the transitional period be bridged without undue dislocation?

For the answers I think we must turn to the facts with respect to post-war radio as they now appear.

First of all, there is the simple fact that, at the moment when radio manufacturing was converted to war production, a great transformation was taking place within the industry. Frequency modulation was a practical reality; some 500,000 receivers were FM-equipped and a ready market for millions of additional FM receivers was opening faster than you could supply them. Second, television, an art probably more fascinating to the public than the first loud speaker, had been given the green light, and there was, and is, good reason to expect tremendous growth in this field. Third, facsimile and other special radio service were already more than laboratory curiosities. Finally, international radio-communications, aviation services, police mobile units, and other communication services were occupying an increasingly important *role* in the radio spectrum and in manufacturers' production schedules.

Things to Come ★ In the American home, then, radio will progress. In addition to the ordinary reception with which we have long been familiar, there will be FM to bring us living music without distortion or interference; television to make us eye-witnesses as well as auditors of important events and dramatic presentations; and perhaps facsimile, so that reproductions on paper of news, photos, or other printed matter may be readily available for civilians.

THE address by James Lawrence Fly, Chairman of the FCC, before the Chicago Convention of the RMA is published here because of the constructive manner in which Mr. Fly presents the need for planning now to meet conditions which will prevail when the time comes for swift conversion to post-war production. Progress of the radio-electronics art has been so great that the industry cannot start where it stopped in 1941. Any planning, to be useful, must recognize that manufacturers will have to start at the point to which the art will have progressed when hostilities cease.

None of the opportunities existing in all these fields has been lost simply because your efforts have been diverted to war production. The opportunities remain, and what is more, there is dammed-up purchasing power there too. Our only hope should be that we have the power to open the flood gates carefully so that we will have an orderly flow of post-war civilian goods.

Since production schedules will surpass anything we have ever known before, judicious restraint must be exercised lest the flood sweep us before it.

The developments of the pre-war period are not the only phases of your business that, once resumed, require careful planning. Research during the war period has made, as you know, vast strides. In private and public research laboratories, and in the armed forces, advances have been made which will certainly revolutionize post-war civilian radio, result in a vastly improved service to the public, and incidentally keep you busier than you have ever been.

To paint a broad, familiar picture, let's look at a few of the latest developments. There's radar, important beyond belief in the Battle of Britain, now doing its part to give the United Nations air supremacy. Of course, there's another side to radar, certainly not as important as the Battle of Britain victory, but widely publicized, nevertheless. That is the battle waged in advertisements and releases concerning just who was responsible for the epochal radar achievement. As the *New York Times* has said:

"There are two ways of starting an argument. Ask some one, 'What will the new FCC rules mean?' If that doesn't do it, ask, 'Who invented radar?'"

Regardless of who deserves the credit, and in radar there is enough to go around, imagine the satisfaction that will come from building and perfecting this type of equipment to install in every ocean-going ship and large air transport. *This* radar equipment will protect human life against the hazards of world travel.

Aircraft Radio ★ Another field of potentially limitless radio growth is in connection with post-war aviation developments. If space can be found for them in the spectrum, airport-to-airport, plane-to-airport and even plane-to-plane communications might be carried on with facility. Already the Civil Aeronautics Board is inundated with applications for post-war air route authorizations. Those aviation developments will have in turn a tremendous effect on the development of radio.

What frequencies will be needed for aviation radio? What equipment will be required? Will the post-war world be one in which international radio problems can be solved, or will war continue with respect to frequency allocations and other international radio matters?

Contributions to Industry ★ Industry, too, will inevitably turn to radio equipment for some of its more important processes. Plywood, which once took hours or days to glue and dry, will be better dried in a few minutes by radiothermic equipment. Inspection of metals will be better, quicker, and more cheaply done by application of radio techniques. Diathermy and other applications of radio to medicine and the art

(CONTINUED ON PAGE 44)

* Chairman, Federal Communications Commission, Washington, D. C.

260–350-MC. CONVERTER FOR FM MONITOR

Used with the General Electric FM Station Monitor to Measure Characteristics of ST Transmitters

BY H. R. SUMMERHAYES, JR.*

THE constant advance of the art of radio communications has been characterized in recent years by the use of higher and higher frequencies. As the useful frequency range has been pushed upward, new circuit components and new techniques have been utilized to solve the new problems presented by these higher frequencies. Up to frequencies in the order of 300 mc., coils and tuning capacitors can usually be made to give sufficiently high impedances in tube circuits to enable reasonable amplification to be realized. However, at still higher frequencies the tube must be treated as an integral part of some sort of transmission-line-type structure or resonant cavity.

There is a border line of frequency somewhere in the region of 30 to 300 mc. where it becomes uncertain for any particular application as to which type of structure, lumped constant, or distributed constant, may be used to the best advantage. In this paper an application is described in which especially designed lumped-constant variable inductors are used to tune a 260- to 350-mc. mixing circuit. This application represents a border-line case where it is felt that the lumped-constant elements have been pushed to the maximum frequency of their usefulness and yet where they still exhibit the advantages of small size and ease of tuning over a range as compared with transmission-line structures.

* Engineer, General Engineering Laboratory, General Electric Company, Schenectady, New York.
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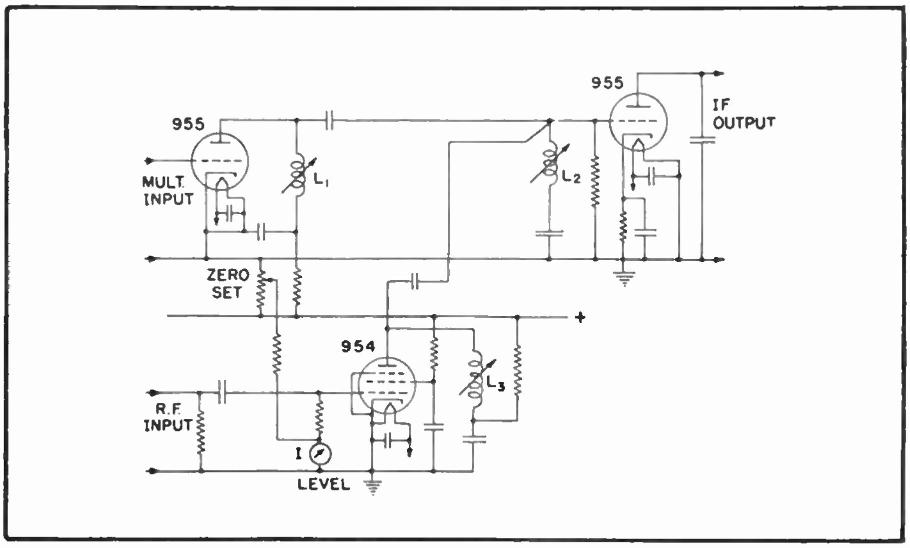


FIG. 2. CIRCUIT DETAIL OF THE 260- TO 350-MC. MIXING STAGE

The need for these special tuning inductors was encountered during the development of an ultra-high-frequency converter unit used in the 260- to 350-mc. frequency range.

The requirements for the converter unit will be listed and then a discussion of the design will follow with particular emphasis on the mixer stage and on the variable-inductance tuners. The specifications and performance of a commercial unit will be given.

Requirements ★ Frequency-modulation programs are often relayed from the studio to the main transmitter by low power ultra-high-frequency radio-relay stations. These are the so-called ST (studio-to-transmitter) stations. The Federal Communications Commission requires that monitoring facilities be provided at these stations to indicate the center frequency and the percentage modulation of the radiated signal. Since a frequency-modulation monitor capable of accomplishing these tasks in the 42- to 50-mc. high-frequency broadcasting band had already been developed, it was thought well to extend the usefulness of this unit by the addition of a frequency converter to enable monitoring these ultra-high-frequency studio-to-transmitter relay stations.

The studio-to-transmitter band extends from 330.4 to 343.6 mc. but the operating-frequency range of the converter unit was designed to extend over a broader range from 260 to 350 mc. so as to include television sound relaying and other services as well as the studio-to-transmitter service. The converter-monitor combination may be used as a companion unit to the G.E. type GF-8-A studio-to-transmitter transmitter which uses ± 75 kc. swing as 100 per cent modulation.

The design of the G.E. frequency-modulation station monitor establishes the 100 per cent modulation limit which can be monitored by the combined converter-monitor unit to be ± 75 kc. frequency swing. This is what is most commonly used in these studio-to-transmitter services at the time of writing although the FCC allows a maximum of ± 200 kc. swing to be used.

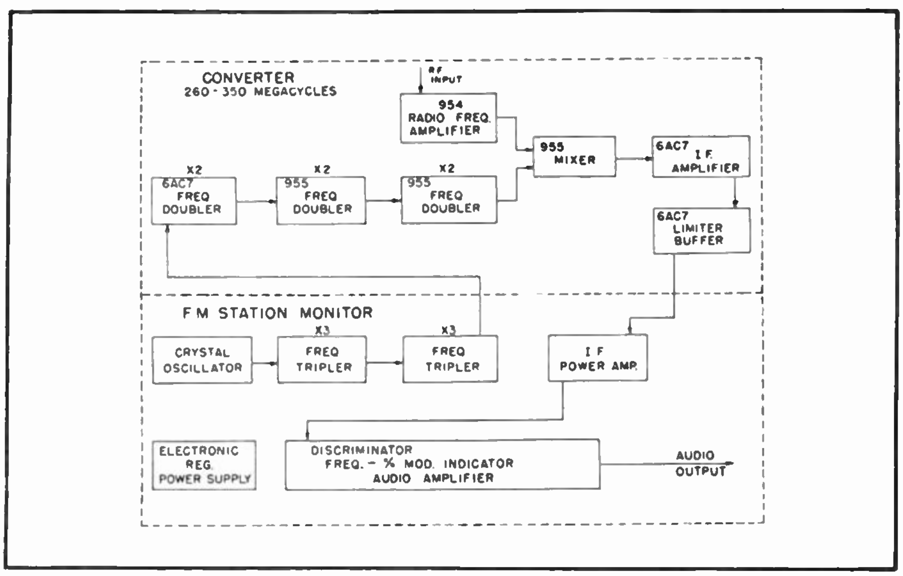


FIG. 1. BLOCK DIAGRAM OF 260- TO 350-MC. CONVERTER AND FM MONITOR

Considerations of the transmitter power available for monitoring and of the losses which would be encountered in a maximum of 1000 ft. of radio-frequency connecting cable led to a specification of 0.3 volt root-mean-square in 72 ohms as the minimum radio-frequency power available at the input to the converter.

The tolerance on the frequency of transmitters in this service as prescribed by the FCC is ± 0.01% of the assigned frequency. This requirement applied to the maximum frequency to be monitored, 350 mc., fixes the frequency indication required in the converter-monitor combination at − 35 to + 35 kc. full scale with respect to the assigned frequency. Fortunately, the frequency-discriminator circuit in the existing monitor has a linear-detection characteristic over a band broad enough to accommodate both the normal ± 75-kc. swing of the instantaneous frequency during modulation and also the permissible ± 35-kc. deviation of the mean frequency of the transmitter.

It was also desired to provide in the converter unit a means for measuring relative transmitter power.

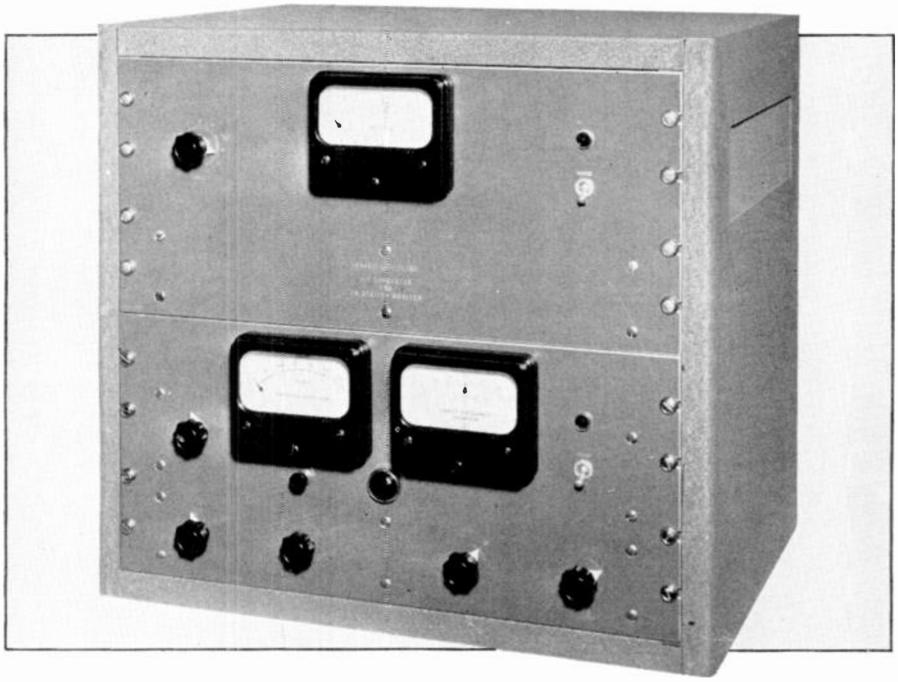


FIG. 6. FRONT VIEW OF THE CONVERTER UNIT AND FM STATION MONITOR AS THEY ARE COMBINED IN A SINGLE INSTRUMENT CABINET

Principle of Operation ★ The main function of the converter unit is essentially very simple. It is to convert the nominal frequency of the incoming frequency-modulated wave from its original value in the ultra-high-frequency region down to 5.4 mc. and to supply this signal to the monitor unit for measurement and indication. The frequency conversion is accomplished by heterodyning the incoming wave against the 72nd harmonic of a precision crystal oscillator which is adjusted to give exactly 5.4 mc. frequency difference between its 72nd harmonic and the nominal frequency of the particular transmitter to be monitored. The crystal oscillator used for this purpose already exists in the monitor unit where it is followed by two frequency-tripling stages, Fig. 1. From the second of these tripler stages, the ninth harmonic signal is supplied to the converter unit where there are three additional *L-C* frequency-doubling stages which bring the multiplied crystal frequency up to the required value for heterodyning with the incoming signal to be monitored.

The choice of three doubling stages to accomplish the frequency multiplication was determined by the available frequency range in the existing monitor stages, the range of frequency of the signals to be monitored, and the allowable degree of multiplication per stage consistent with sufficient output. The first two factors established the over-all multiplication to be approximately eight, and the last one favored the use of three doubler stages rather than two tripler stages. The ninth harmonic of the crystal frequency is transferred from the monitor unit to the adjacent converter unit by means of a short coaxial cable link joining a low-impedance tap on the tuned coil in the monitor to a low-impedance tap on a similar tuned coil at the input to the converter.

The first two doubler stages in the converter exhibit no unusual design problems; there is no difficulty in obtaining sufficiently high impedance to get good output with ordinary variable air capacitors and air-core inductance coils. A 6AC7 tube is used in the first doubler stage since the output frequencies here are relatively low (64 to 86 mc.). In the second doubler stage, a 955 acorn-type triode tube with a very small coil and a low minimum variable air capacitance in its plate circuit is made to tune without difficulty over the 127- to 172-mc. range. But in the next doubler stage where the frequency range in the plate circuit is 255 to 345 mc., the ordinary coil and capacitor tuning methods break down because their minimum inductance and capacitance are too high, especially when means are also provided here for mixing the input signal with the output of the final doubler. The design of the mixing stage will be considered in a succeeding section.

Following the mixer stage is a grid-rectifying type 955 acorn-tube detector which causes the 5.4-mc. intermediate-frequency signal to appear across its plate load. It is to be remembered in this connection that the process of heterodyning does not affect the bandwidth of the incoming frequency-modulated wave so that the frequency swing remains unchanged after conversion to 5.4 mc.

The plate circuit of the 955 detector is coupled to the grid of the next stage through a broad-band, tuned-intermediate-frequency transformer.

This next stage gives amplification sufficient to produce limiting action by simple overload of the grid circuit of the output tube. The intermediate-frequency signal is then coupled from the plate circuit of the output tube back into the monitor unit through a short length of low-capacitance cable in parallel with 350 ohms plate-load resistance. This impedance combination has a flat frequency characteristic over the required bandwidth at 5.4 mc.

In the monitor unit the functions of measuring and indicating percentage modulation and mean carrier frequency and of providing audio output are performed.[1]

RF Amplifier Stage ★ Other factors besides the very high-frequency requirement in the mixing stage add to the difficulty of the design. One of these factors is the requirement of indicating relative transmitter output level. As previously mentioned, the specified radio-frequency operating level for the converter is 0.3 volt root-mean-square across 72 ohms. The method which first presents itself for measuring the level of this signal is to terminate the incoming transmission line with a properly matched, tuned, radio-frequency transformer to step up the voltage to a value more suitable for measurement with a grid-rectifying-type vacuum-tube voltmeter. However, the gain of such a transformer is quite limited, due to the grid loading effects of dielectric losses, cathode lead inductance, and transit time. These factors all operate to decrease

[1] H. R. Summerhayes, Jr., "A frequency-modulation station monitor," *Proc. I.R.E.*, Vol. 30, pp. 399–404; September, 1942.

the high-frequency input resistance of tubes to values far below their low-frequency resistance. The input resistance of a type 954 acorn pentode at 350 mc. is probably in the order of 1000 ohms due to these factors. Thus, the maximum theoretical voltage gain is only in the order of $\sqrt{1000/72}$ or about 3.7 unless recourse is made to an elaborate bridge circuit for neutralizing input conductance. Furthermore, the physical size and shape of such an input transformer is such as to make its performance difficult to predict and even more difficult to measure.

Any mechanically reasonable tuning capacitor tends to have too high a minimum capacitance to tune with a mechanically reasonable inductance coil. Lead inductance gets to be more important than the coil inductance. The frequency range is approaching the border line beyond which it is no longer meaningful to talk about, or fruitful to use, lumped-constant circuit elements.

These considerations indicated that the testing procedure involved in lining up a properly matched, tuned step-up transformer over the required frequency range would be too costly to justify the relatively small voltage gain which could be realized. Thus, it was decided to omit the input transformer and to provide approximate radio-frequency signal-level indication by terminating the input cable in a 72-ohm resistor followed directly by a simple grid rectifying-type vacuum-tube voltmeter, Fig. 2. Since the zero-signal, initial electron velocity bias of this tube may be an appreciable part of the voltage to be measured and since this bias is affected by changes in cathode temperature and by ageing, a front panel control is provided for resetting the zero-level indication.

In addition to providing an indication of relative radio-frequency signal level, this tube also acts as a buffer or impedance changer for the incoming signal. This stage has a voltage gain of 0.5 from grid to plate.

Mixing Stage ★ It is now in order to consider the means of mixing the incoming radio-frequency signal and the crystal-oscillator multiplier signal and the means of coupling them into the detector. Here again in the mixing stage, as previously in the radio-frequency amplifier stage, we are confronted with a low tube-input resistance, this time due to the 955 detector-tube input. But even more hampering than this loading effect is the difficulty of tuning the combined capacitances of the tubes involved in the mixing process, i.e., the output capacitances of the multiplier and radio-frequency amplifier tubes and the input capacitance of the detector tube. The sum of these capacitances with some additional allowance for wiring capacitance is approximately 9 mmf. This has a reactance of only 50 ohms at 350 mc. The shunt inductance required to tune this capacitance is 0.023 microhenry and when it is realized that a single turn of No. 18 copper wire ½ in. in diameter has this much inductance, it is easy to visualize the difficulties in obtaining resonance. Clearly no such single-turn coil can be expected to tune the capacitances of all three tube elements since the distance between the tubes is necessarily such as to create inductive loop impedances of the same order of magnitude as that of the single tuning coil itself.

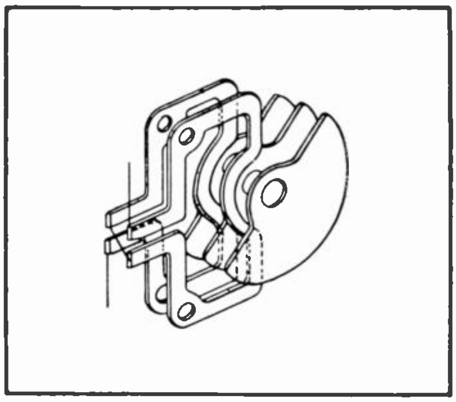


FIG. 3. PERSPECTIVE VIEW OF MAIN PARTS OF SPECIAL TUNING INDUCTOR

And yet, in spite of these limitations, it was felt that it would be much easier to accomplish the mixing by simply connecting together the tube elements rather than by a tuned mixing transformer or a tuned line. Analysis like the above and experiments indicated that this result could only be accomplished by tuning each tube capacitance separately with some sort of shunt inductance which must be variable in order to cover the required range. Accordingly, three specially designed variable inductors were used in the mixing stage, one of each connected as directly as possible from each tube element involved and thence through a tiny blocking capacitor to the metal chassis ground. The inductors are shown as L_1, L_2, and L_3 in Fig. 2, which is a schematic of the mixing stage.

The success of this solution was largely dependent upon the special design features of the inductors, features which result in extremely low minimum inductance and in relative ease of construction. A perspective view of the essential parts of one of the inductors is shown in Fig. 3. The design of these inductors is a modification and development of an earlier receiver-inductor design. The inductors consist essentially of a standard variable air capacitor in which the central portion of the stator plates has been removed, leaving only the outer edges. Thus, each stator plate forms a one turn coil. The inductance may then be progressively reduced by turning the rotor plates to increase the coupling, thereby introducing in effect a short-circuited secondary turn on each side of the stator inductance turn. Several stator turns may be connected in parallel to reduce inductance or in series to increase inductance. Fig. 3 illustrates the series connection.

At 350 mc., all three parallel connected inductors tune near minimum inductance, i.e., with the rotor plates rotated nearly all the way in. From 350 down to 300 mc. resonance is obtained by adjusting each inductor to the proper value. Although several combinations of settings of the three are possible, there is in general only one combination which gives a maximum output at any particular frequency. From 300 down to 260 mc., resonance is obtained by disconnecting one of the inductors, thus increasing the total inductance of the parallel combination. Adjustment of the two remaining ones will then give resonance in this lower part of the frequency range.

The losses in the mixing stage cause the resonance to have a broad enough impedance maximum to include, without additional damping, both the local oscillator

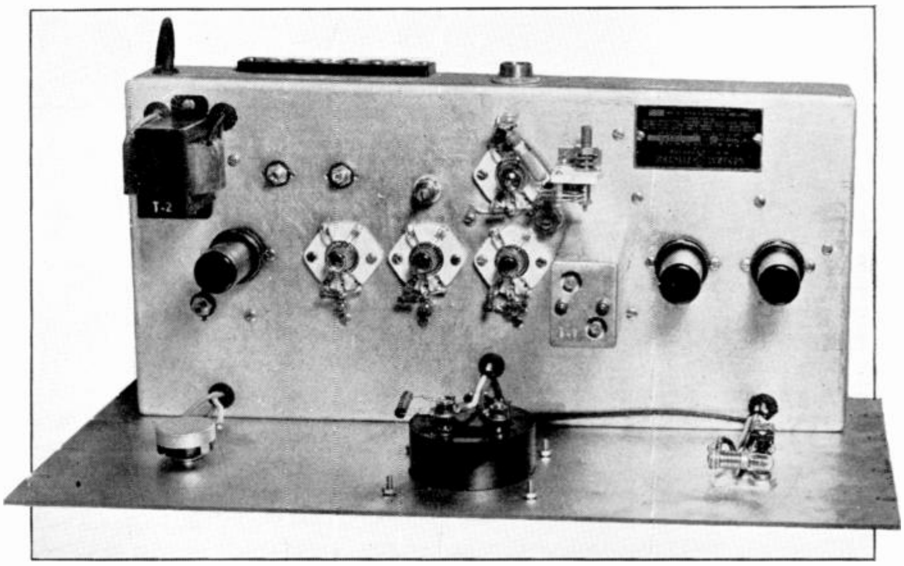


FIG. 4. TOP VIEW OF THE CHASSIS USED IN THE GENERAL ELECTRIC CONVERTER

signal and the incoming signal. However, this is not surprising since these signals are only separated in frequency by 1.5 to 2%.

The multiplier signal appearing at the detector grid has a peak value of 2.6 volts and the radio-frequency signal from the buffer amplifier tube appearing simultaneously at the detector grid has a peak value of 0.25 volt for 0.5-volt peak input to the radio-frequency amplifier stage.

Description of Commercial Unit ★ Figs. 4 and 5 show top and bottom views, respectively, of the chassis of the commercial converter unit. Fig. 6 shows a front view of the combined converter and monitor units mounted one above the other as they are supplied in a standard cabinet.

and precision of frequency indication for transmitter signals in the range of 42 to 50 mc. In this range the full-scale mean-frequency deviation indication is only ± 2 kc. which corresponds to ± 50 microamperes change in discriminator output average current. When the monitor unit is used in combination with a converter unit to indicate frequency drifts of ± 35 kc., the only change required in the frequency-discriminator circuit consists in a proportionate decrease in the full-scale current sensitivity of the indicating instrument from ± 50 microamperes to ± 875 microamperes. The stability of the discriminator circuit is, of course, represented by the same number of microamperes or cycles indication in each application but in the converter application, the

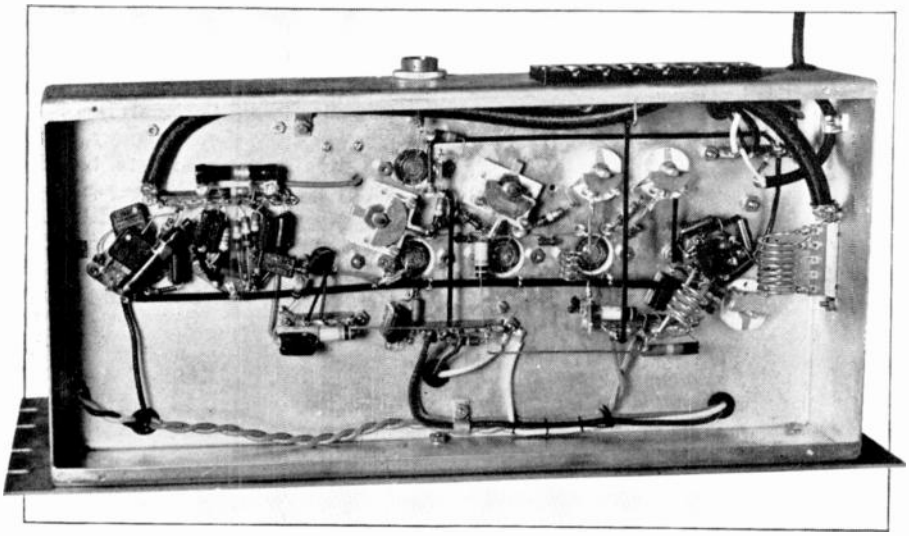


FIG. 5. UNDER SIDE OF THE CONVERTER UNIT FOR USE AT ST STATIONS

Plate power for the converter unit is obtained from the electronically regulated supply which is part of the monitor unit. The power-supply section in the monitor was originally designed with this objective in mind. The modifications necessary in the monitor to adapt it to this service are the addition of one regulator tube in the space provided, the change in the radio-frequency input connections, and the change of the sensitivity and the scale marking of the frequency indicating instrument.

The design of the original monitor unit was such as to insure adequate stability

stability in terms of percentage of full-scale frequency indication is 17½ times better than in the monitor application.

This results in extremely good stability of the frequency indication (about 1% of full scale) as far as this is affected by drifts in the constants of the discriminator circuit. Thus, it is only infrequently necessary to use the built-in calibrating crystal oscillator to check the discriminator-frequency indication.

The service record on those units installed prior to the inauguration of the priority system for the procurement of material has been entirely satisfactory.

FURTHER DISCUSSION OF THE IF CHARACTERISTICS OF FM RECEIVERS

THE following communication has been received from David Grimes, vice president in charge of engineering at the Philco Corporation. It is to be added to the expressions of opinion concerning specifications of IF frequencies and band-pass characteristics of FM receivers, published in the April issue of *FM Radio-Electronics*. Mr. Grimes introduces a consideration of great importance in the design of post-war equipment — namely, television receiving circuits. For that reason, his letter is of particular interest at this time:

In our opinion, the experience gained by the industry in the manufacture of FM receivers is as yet insufficient to warrant the selection of a standard intermediate frequency. The wide diversions of opinion expressed in the April issue of *FM Radio-Electronics* further indicates this.

The requirements with respect to gain, stability and transmission characteristics can be satisfied over a wide range of frequencies, and are accordingly minor considerations in determining the intermediate frequency.

The intermediate frequency should be chosen mainly on the basis of best utilizing the selectivity provided in the receiver ahead of the frequency converter to minimize interference from the following causes:

(1) Image signal response
(2) Signals separated by the intermediate frequency
(3) Direct transmission of signals at the intermediate frequency
(4) Harmonics of undesired signals beating with harmonics of local oscillator to produce interfering signals.

Secondary factors influencing choice of intermediate frequency are:

(1) Design of a dual IF system for combination AM-FM receivers.
(2) FM in conjunction with television receivers.

The selection of a high IF frequency is helpful in reducing possible interference from all the above causes, except direct transmission of signals of the IF frequency. With an IF of 4.3 mc. as used in current practice, the attenuation of interfering signals of IF frequency is much greater than the attenuation of other possible interfering signals, and this indicates that an IF frequency higher than 4.3 mc. would be desirable. To eliminate the possibility of FM signals the IF frequency apart, an intermediate frequency of 8 mc. or higher should be used.

Due to the similar transmission requirements of FM receivers and the sound channel of television sets, these sets will probably be combined in one unit in many designs. The use of the same local oscillator for picture and sound, and the wide transmission band required of the picture channel, together with its fixed frequency relationship to the sound channel, will probably require a still higher intermediate frequency up to possibly 16 mc. for the FM sound channel.

The IF amplifier should have a pass band of 150 kc., uniform within plus or minus 1 db, with as much attenuation outside this band as economics and the number of IF stages permit.

DAVID GRIMES,
Vice President in Charge of Engineering.

SPOT NEWS NOTES

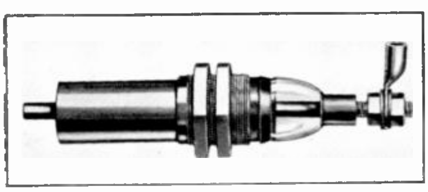
Items and comments, personal and otherwise, about manufacturing, broadcasting, communications, and television activities

6 Billion Dollars: That's the radio industry's backlog, according to a Dow-Jones survey published on June 2 by the *Wall Street Journal*. In increase over peace-time level and in dollar volume, radio is now following aviation in establishing all-time sales records.

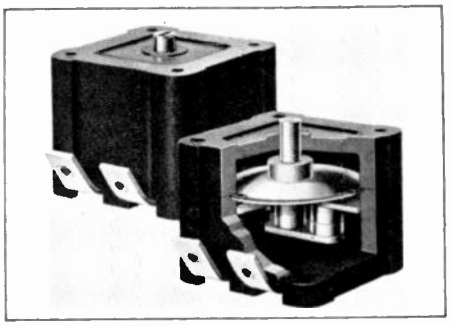
Television Anniversary: First year of operation was celebrated by DuMont station W2XWV on June 27th. Audiences from Bridgeport, Conn., to Philadelphia saw the special "Cavalcade of DuMont Stars" program on this occasion. W2XWV, on the air Sunday and Wednesday nights at 8:30, is the only New York television station now offering studio programs.

Lt. Comdr. Ralph T. Brengle: Former Head of Radio Procurement Section, Bureau of Ships, has been appointed Assistant Head of Radio Division, Bureau of Ships. His many friends in the radio industry remember him prewarwise as the head of Ralph T. Brengle Sales Company.

Aircraft Radio May Go FM: The belief that many aircraft radio communications failures could be eliminated through the use of FM is being expressed privately by an increasing number of engineers working in this field. In a report released by OWI, concerning all phases of air transportation, the section devoted to airways and navigation facilities stated that: "the immediate post-war problem of the airways, as seen by the Civil Aeronautics Authority, will be to rebuild the entire domestic airways system by substituting ultra-high frequency for the old standard intermediate frequencies ranging between 200 and 400 kc." The use of FM would minimize communication failures during storms, the combination of which account for such a large percentage of fatal accidents.

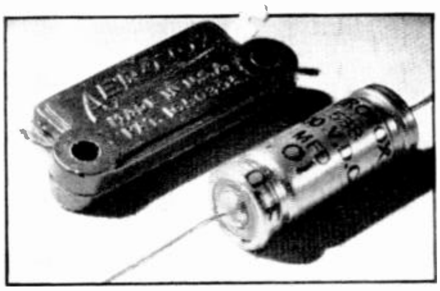


Gas-Tight Terminal: For coaxial cables, available in various sizes, are being produced by Victor J. Andrew Company. The seal is effected by fusing the glass insulator to the copper fitting with a metal alloy of suitable coefficient of expansion.



Sealed Switches: Sealed in Bakelite, Allied Control Company's type A3 and A5 switches are protected against dirt, dust, sand, and oil, the most common causes of switch failures. Contacts provide normally closed or normally open double-break, handling a non-induction load of 50 amps. at 24 volts DC, or 110 volts AC. Operating pressure of $1\frac{1}{2}$ to $3\frac{1}{2}$ lbs. gives a plunger travel of .006 to .012 in. with an over-travel of .05 to .07 in. Contacts hold at 10 G in any direction. Case measures $1\frac{5}{16}$ by $1\frac{5}{16}$ by $1\text{-}\frac{19}{32}$ ins. Weight of switch is 5 oz.

R.M.A. President Reëlected: Paul V. Galvin, head of Galvin Manufacturing Corporation, Chicago, has been reëlected president of the Radio Manufacturers Association. Total membership of R.M.A. is now 166, highest in the association's history.



Small Oil-Filled Condensers: Aerovox is now producing miniature oil-filled condensers of tubular design, 1 and $1\text{-}\frac{3}{16}$ in. long by $\frac{5}{16}$ and $\frac{7}{16}$ in. in diameter. Capacities are .001 to .01 mfd., rated at 300 to 800 D.C.W.

Radar: A statement from Bendix Aviation, cleared through the Navy Department, credits the work of L. A. Hyland, combined with that of Dr. A. Hoyt Taylor and Leo C. Young, both of the Naval Research Laboratory, as paving the way to present-day radar detecting and ranging equipment. Hyland used the dirigible Akron for reflection experiments, according to this account. The three co-workers applied for a patent on radio detection and ranging equipment on June 13, 1933. The patent issued on November 27, 1934, with 12 claims allowed. On leaving the Navy, Hyland organized the Radio Research Company, which later became the Radio Division of Bendix Aviation Corporation. The statement makes the generous acknowledgment that: "The ultimate development of radar in all its forms was accomplished by the coöperative efforts of American industry, the National Defense Research Council, and the technicians of the Navy and the Army, and the further pooling of this Country's developments with those of Great Britain."

Leslie G. Thomas: Vice president in charge of production at International Resistance Company, whose efforts to meet delivery schedules helped I.R.C. to add a star to their Army-Navy "E" flag. Leslie Thomas has been associated with the radio industry since the early 20's.

Signal Corps Renegotiations: Exactly \$234,591,090.42 have been saved by the Signal Corps since Pearl Harbor through contract negotiation and renegotiation. Savings through renegotiation from April 28, 1942 to April 30, 1943 total \$86,801,631.09. This includes more than $7\frac{1}{2}$ million dollars saved by license-free patent agreements. Sixty-seven companies have refunded \$47,010,668.

Radarettes: David Grimes, Philco's vice president in charge of engineering, has announced that the Company will award 60 scholarships, with pay, at Temple University to girls graduating from Philadelphia high schools. Upon completing the course, the "Radarettes" will serve as junior or senior engineers at the Philco laboratories.

Carl A. Frische: Named chief research director of Sperry Gyroscope Company, at the Garden City, Long Island, laboratory.

Home Recording Discs: An appeal for review of WPB Limitation Order L-265, insofar as it relates to home recording discs, has been made by Sidney S. Gould, president of RecorDisc Corporation. The situation, as presented in the appeal, seems to be one of those not-so-rare-but-no-less-unreasonable cases where all-inclusive rulings cause unnecessary hardship to those who were never intended to be affected. In this instance, the production of home recording discs has been, in effect, stopped be-

(CONTINUED ON PAGE 39)

NEWS PICTURE

ONE of the great problems confronting manufacturers of war materials is to bring to each factory worker the direct relation of his efforts to the effectiveness of our soldiers who are fighting battles so far from home. The routine of production and long hours dulls the realization that the products of the worker's efforts go straight into the hands of a soldier who will make use of them against his adversaries.

An interesting example of effort in this direction is this General Electric poster, displayed by James Heywood of the electronics department. Defective parts are mounted on the posters, and the reason for rejection is stated on the card at the left.

The meaning to our soldiers of defective parts is sharply dramatized by putting them right into Hirohito's hand. G.E. officials say that this method has resulted directly in lower percentage of rejections.

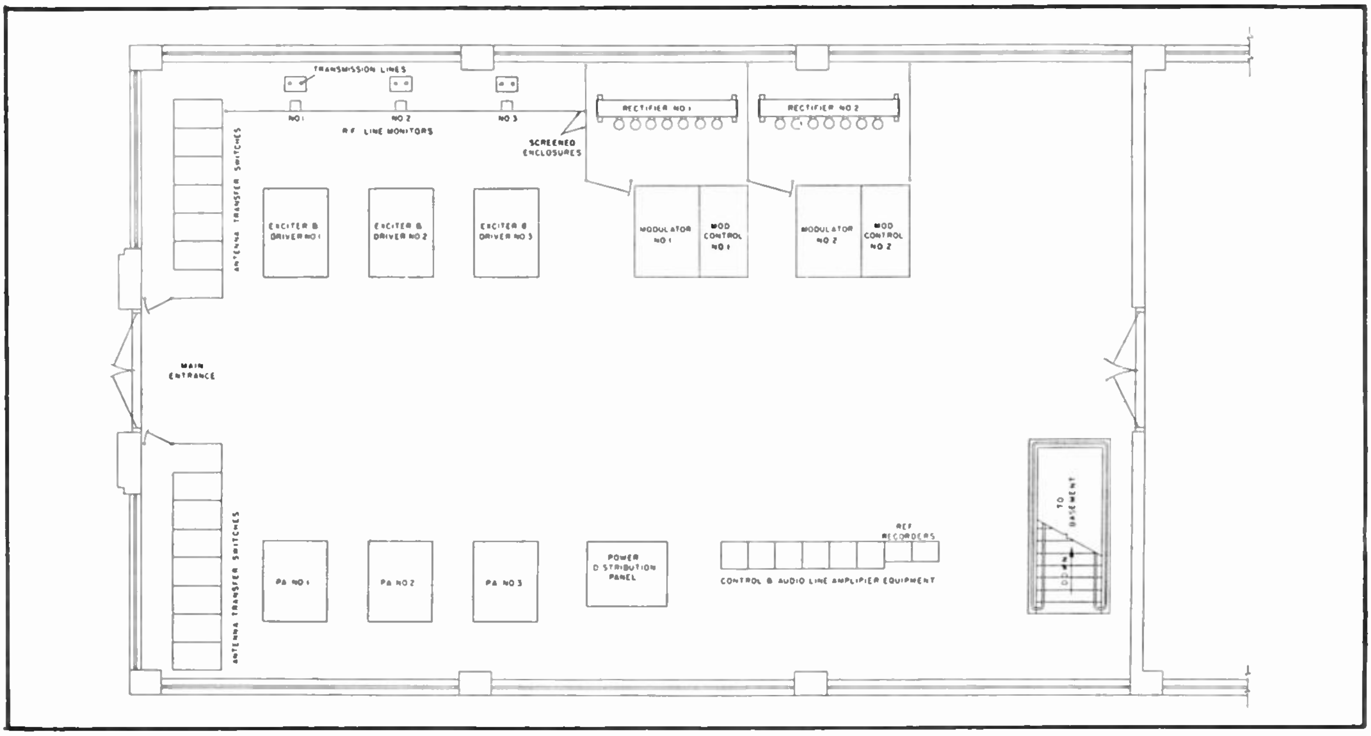


FIG. 1. LAYOUT OF THE TRANSMITTERS AND CONTROL EQUIPMENT AT THE CBS SHORT-WAVE BROADCASTING STATION

NEW 50-KW. CBS SHORT-WAVE TRANSMITTER

Columbia's International Broadcasting Station, on the Air 24 Hours a Day

BY H. ROMANDER *

INTERNATIONAL broadcasting is recognized as a prime factor in the conduct of the present global war since it provides means for rapid interchange of ideas with friendly nations and presents a unique medium for contacting peoples of enemy nations. Among the foremost shortwave radio broadcast stations in the U.S.A. are the CBS International Broadcasters located on Long Island, New York, which transmit around the clock in 23 languages and dialects to South America, Central America, the West Indies, Mexico, Europe, Africa and Asia.

Inaugurated as a part of the Columbia Broadcasting System January 1, 1942, the new station now operates regularly with three transmitters on the air simultaneously: two 50-kilowatt carriers provided by new equipment designed and manufactured by the Federal Telephone and Radio Corporation to meet CBS specifications, and the 10-kilowatt carrier of an older unit which was moved to Long Island from Wayne, New Jersey.

General Description ★ The transmitters operate with a total of 13 directive arrays,[1] using nine frequencies from 6 to 22 mc. The antenna design provides a gain as high as 16 db over a conventional half-wave antenna in free space, due to the directional characteristics, making the effective radiation equivalent to almost 2,000 kw.

The Columbia Broadcasting System station is located on the 1,200-acre site of the Mackay Radio and Telegraph Company's overseas shortwave commercial radio stations on Long Island. In one case, the CBS transmitters are operated on a Mackay antenna simultaneously with Mackay transmissions. This is practicable since the type of antenna employed functions efficiently with more than one transmitter, provided the frequencies are separated at least five per cent. Antennas, transmission lines, and special antenna switching gear were designed and built by Mackay Radio.

All the CBS transmitters are housed in a new, single-story wing, 40 by 60 ft., with basement, added to the existing Mackay transmitter building. Layout of the equipment on the two levels is shown in Figs. 1 and 2. From these illustrations it will be noted that three exciters and three 50 kw. final amplifiers are provided. The additional RF equipment allows the operators to preset the frequency of one RF section while the other two RF sections are being operated simultaneously. Instantaneous changeover to the preset frequency may then be accomplished by operating the specially designed antenna switch.

Design features of this shortwave station are similar in many ways to the new 50-kw. CBS medium-wave broadcast transmitter WABC,[2] the shortwave transmitters differing principally in the fact that they must be capable of rapid changeover while the medium-wave transmitter normally operates continuously on a single frequency. This means not only that all RF circuits must be designed for higher frequencies, with accompanying greater problems of insulation and reduction of radiation losses, but they must also be made quickly adjustable. In the shortwave transmitters, the frequency adjustment range is 16 mc., sixteen times the entire medium-wave broadcast channel.

Although the design and construction of the RF portions of these transmitters are quite different from those of the WABC 50-k.w. transmitter, the audio

* Federal Telephone and Radio Corporation, Newark, N. J.

[1] For information on antenna system, see "CBS International Broadcast Facilities," *Proceedings of the Institute of Radio Engineers*, March, 1942.

[2] "WABC-Key Station of the Columbia Broadcasting System," by E. M. Ostlund, *El. Com.*, Vol. 21, No. 1, 1942.

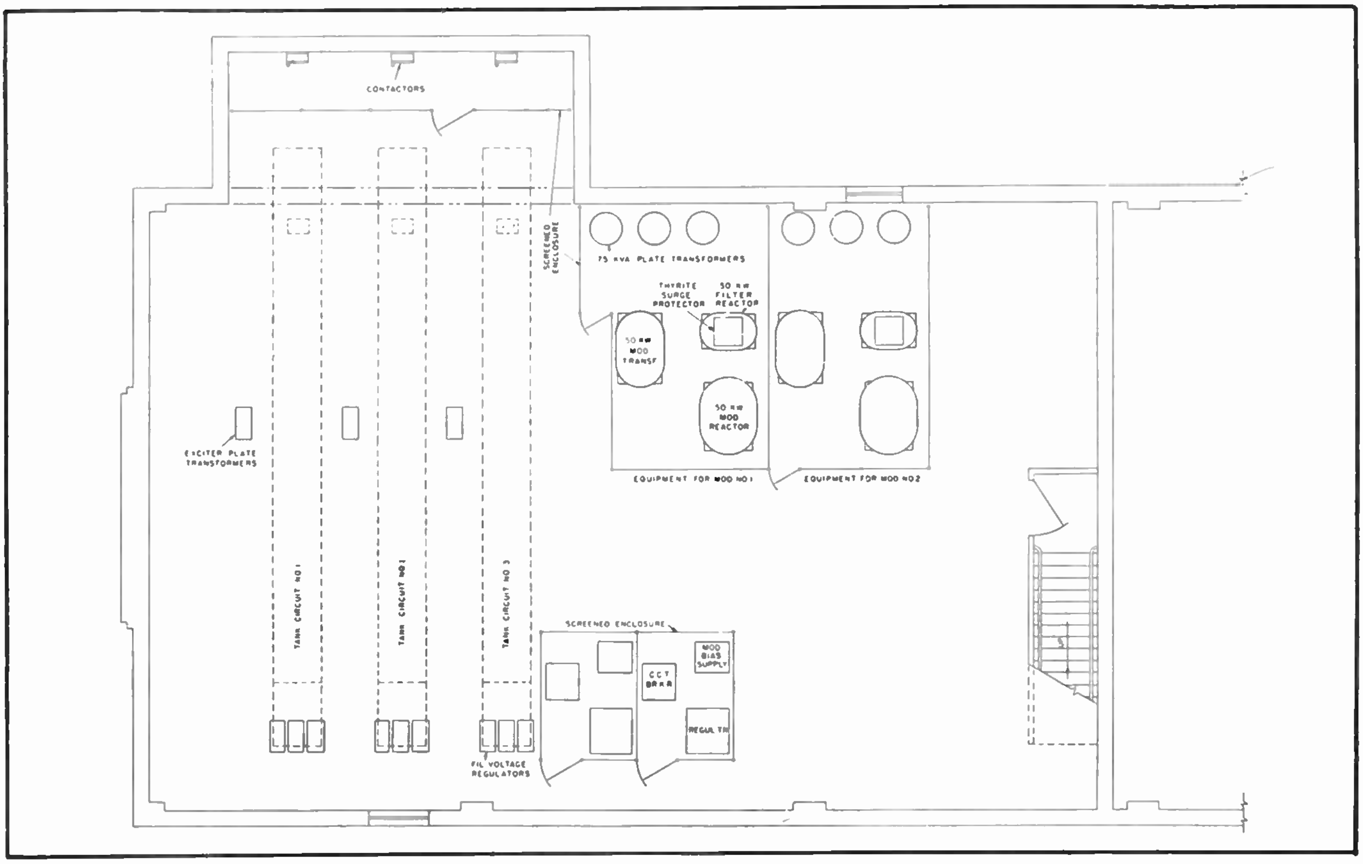


FIG. 2. PLAN OF THE BASEMENT. THIS SHOWS THE ARRANGEMENT OF THE PRESET, BUTTON-OPERATED CONTROLS FOR THE TUNING LINES WHICH EXTEND ACROSS THE BASEMENT FLOOR. THESE ARE LOCATED AT THE LEFT OF THE DRAWING

frequency, modulation, and power supply units are similar. Since the transmitters for both stations were built by the Federal Corporation, many of the same features of design that have proved so reliable and efficient at WABC were incorporated in the shortwave transmitters. The 12-kilovolt rectifier units in the two cases are identical. Except for a different

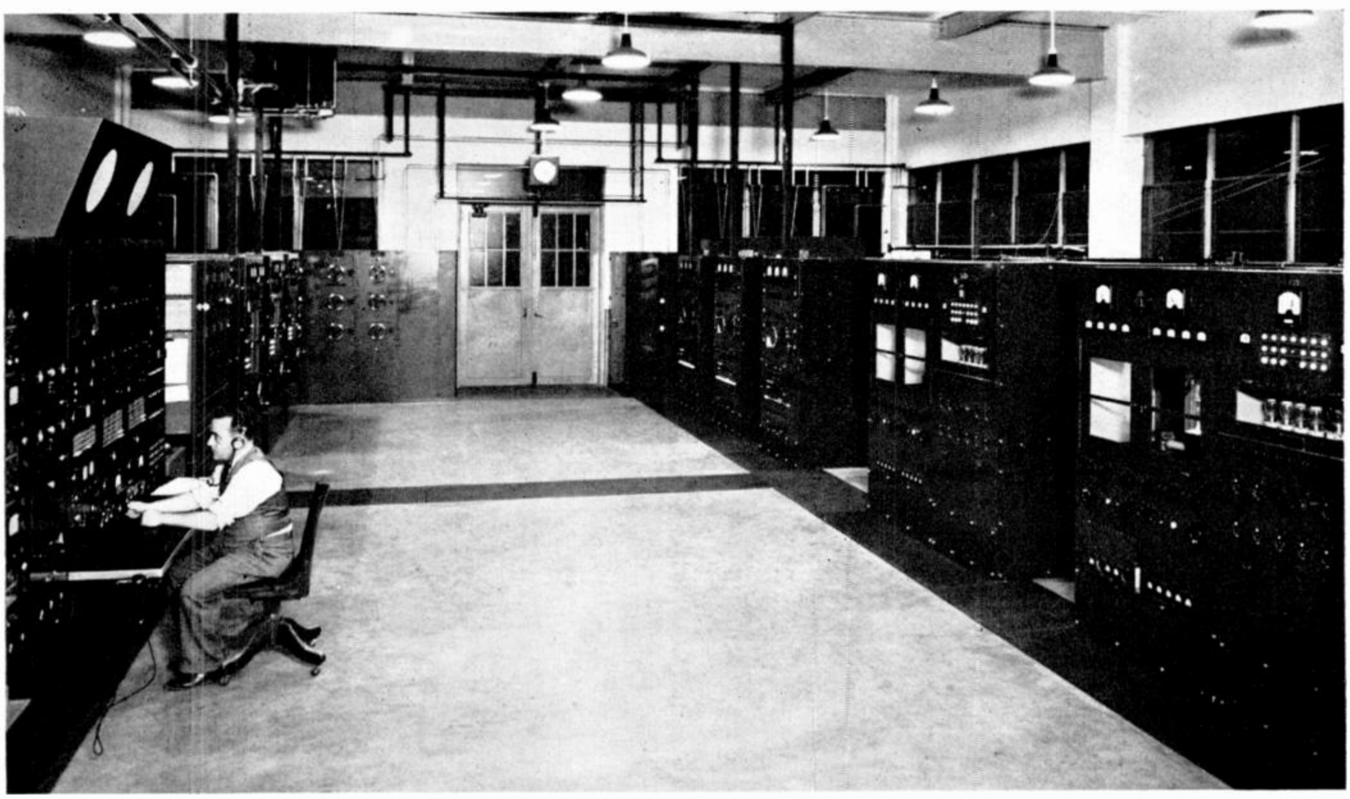


FIG. 3. THIS END OF THE GROUND FLOOR IS AT THE LEFT IN FIG. 1. 12,000-VOLT RECTIFIERS ARE IN AN ENCLOSED AREA BEHIND THE TWO MODULATOR UNITS DIRECTLY ACROSS THE ROOM FROM THE OPERATOR, SEATED AT CONTROL POSITION

arrangement of components, the audio amplifier-modulator units also are identical.

Inasmuch as operating practice on broadcasting stations does not permit long station breaks, the shortwave transmitters were constructed for fast and simple frequency shifts. In providing a coördinated design to accomplish this result in a foolproof manner, two unique design features of special interest were evolved; both are described hereinafter. One is the plate line and harmonic suppressor on which frequency changes are accomplished by motor-driven shorting bars arranged to stop at any of six preset points in much

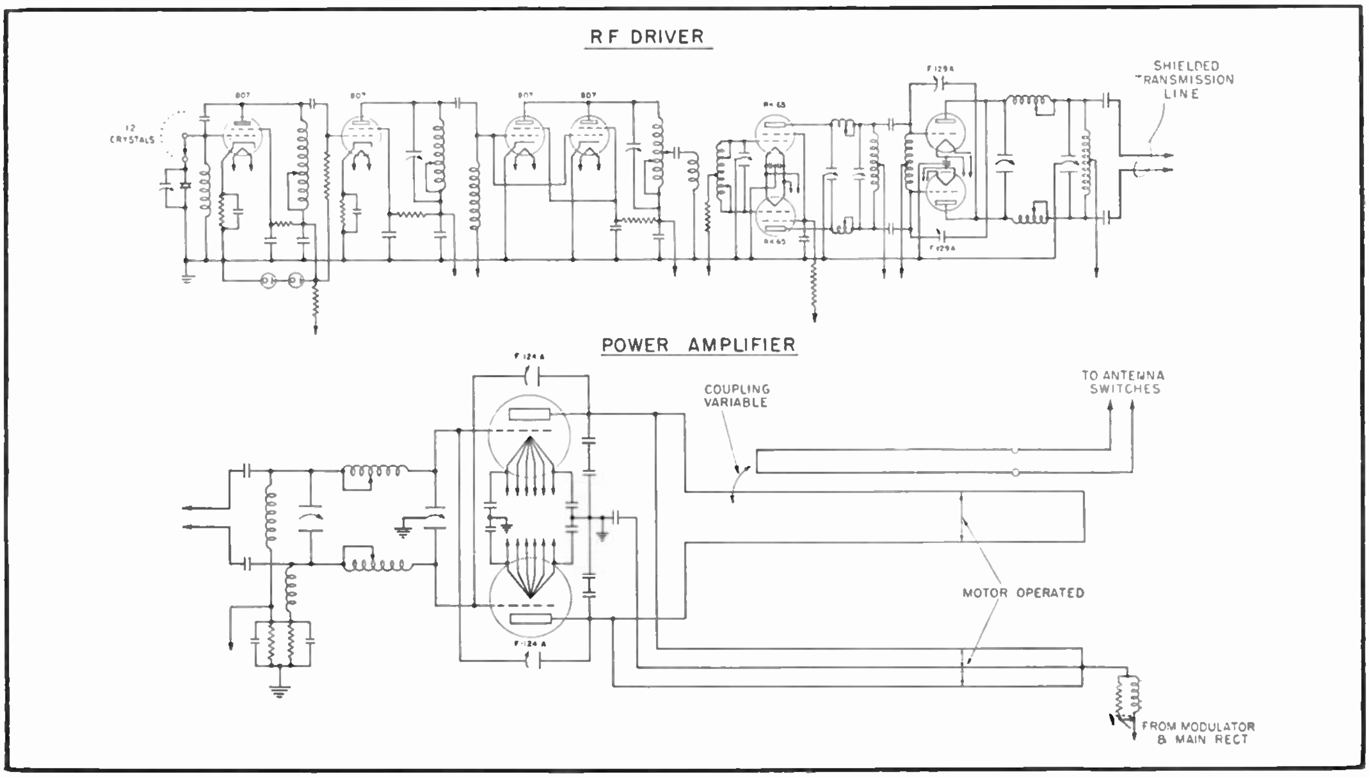


FIG. 4. THIS IS A SIMPLIFIED SCHEMATIC DIAGRAM OF THE RF DRIVERS AND POWER AMPLIFIERS SHOWN IN FIGS. 5 AND 6

the same manner as a push-button, motor-driven automatic tuner on a radio receiver operates. The motor tuner requires 1½-horsepower motors and the tuning lines extend underneath almost the entire width of the station floor, as shown in Fig. 2. The other feature is antenna switching gear which permits instantaneous change-over of any of the three RF power amplifiers to any of the 13 antenna arrays used with the 50-kw. transmitters. These and other wave-changing controls are so well coördinated that it is possible to shift frequency on any of the three 50-kilowatt RF units in five minutes.

Station Layout ★ A general view of the wing housing the CBS equipment is shown in Fig. 3. By referring to the station plan, Fig. 1, the units visible in the illustration can be identified. In the left foreground can be seen the racks holding the line amplifiers, gain controls, and monitoring equipment necessary for simultaneous operation of three transmitters. Included are frequency monitors, RF modulator monitors, a tone generator, and a noise level and distortion meter. Control of the application of power to all RF equipment and to the modulators and main rectifiers is obtained from a single panel on the rack assembly.

Beyond the rack assembly are the power distribution switchboard, followed by the three 50-k.w. power amplifiers. The two halves of the antenna distribution switchboard are arranged across the far end of the wing with the interconnecting transmission lines carried up over the doorway. In the right foreground are the two modulator units, and beyond these are the three RF exciter units.

The two 12,000-volt rectifiers are located on racks mounted within fenced enclosures immediately to the rear of each modulator unit. The filter capacitor units are also mounted within these enclosures. Chokes and transformers are located in the basement directly below each unit. These power supplies provide plate power to the water-cooled final amplifier and modulator tubes.

All large transformers, reactors, circuit breakers, and voltage regulators are located in the basement. Separate enclosures surround each group of high tension equipment associated with a power supply or modulator, and special locks and interlocks are provided for the enclosure doors so that an enclosed area can be entered only when the equipment is not energized. Operating personnel are, therefore, completely protected from accidental contact with high voltage circuits.

Radio Frequency Units ★ Fig. 4 is a simplified schematic diagram of the RF circuits. For the most part these circuits follow conventional design practice. All but the 50-k.w. stages are contained within single units referred to as the RF drivers; the three final amplifiers are housed in separate units.

Two-conductor, balanced transmission lines connect the outputs of the RF drivers to the grid circuits of the power amplifiers. These lines are completely shielded by copper pipes of rectangular cross-section. The three lines, in their shields, are shown in Fig. 3 running to the ceiling from the tops of the RF drivers on the right across to the final amplifiers. Interconnecting transmission lines are provided between the driver units so that any RF driver may be used to excite any power amplifier. Each driver unit is capable of delivering 5 k.w. to the power amplifier grids.

RF Drivers ★ A view of the three RF drivers is shown in Fig. 5. The crystal-controlled oscillator and the frequency doubler stages are contained in one unit which, like a filing cabinet drawer, may be pulled out from the front of the RF driver for servicing. Controls are provided on the front panel to permit frequency changes of all circuits except the driver output stage plate circuit, the inductance of which may be changed by manipulation of coil-shorting bars accessible from a side door.

Plate and bias supply rectifiers, automatic filament voltage regulators, and all filament transformers associated with the RF driver are contained within the unit with the exception of the transformer for the 3-phase, full-wave rectifier supplying 5,000 volts to the output stage and 2,500 volts to the buffer stage. The entire unit is ventilated by a blower which draws air in through a filter on the side and circulates it around all parts of the transmitting equipment which require forced draft ventilation.

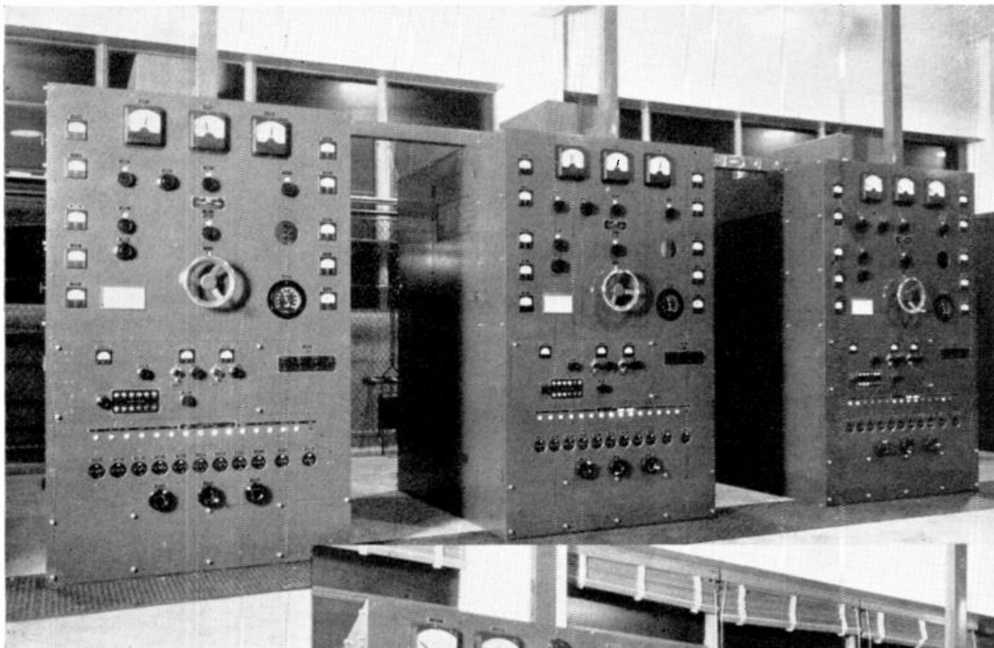


FIG. 5. THE THREE RF DRIVER UNITS INCLUDE THE CRYSTAL-CONTROLLED OSCILLATORS AND FREQUENCY DOUBLER STAGES

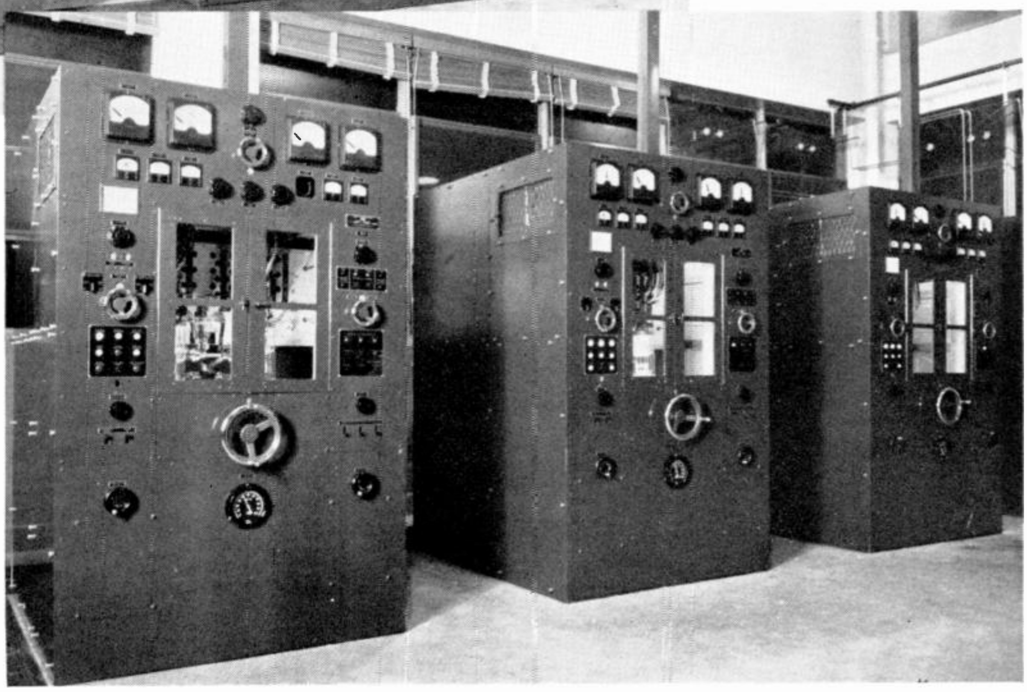


FIG. 6. THREE POWER AMPLIFIERS EACH HAVE TWO WATER-COOLED TRIODES. FIXED VACUUM CONDENSER UNITS ARE EMPLOYED TO NEUTRALIZE THE PA CIRCUITS

Power Amplifier ★ Two Federal F-124-A, water-cooled triodes are employed in each power amplifier in a balanced circuit using a pi-network input and a plate circuit designed to take advantage of the high efficiency and flexibility of parallel linear conductors. A view of the power amplifiers is shown in Fig. 6.

The principal characteristics of the F-124-A tube are as follows:

Filament: Six terminals — 13.6 volts per terminal to a common internal connection — 68.5 amperes per strand.

Amplification Factor	42
Mutual Conductance	14,000 micromhos
Anode Dissipation	40 kw.
Direct Inter-Electrode Capacitances:	
Plate-to-grid	29 mmf.
Grid-to-filament	37 mmf.
Plate-to-filament	5 mmf.
Overall Dimensions:	
Length	25$^{15}/_{16}$ ins.
Diameter	12½ ins.

Neutralization of the power amplifier is accomplished by a combination of fixed vacuum capacitor units, shunted by variable capacitors for fine adjustment. Adjustment of each grid circuit coil is varied in steps by means of taps to selector switches which short out various portions of the coils.

As previously stated, a 50-kw., high frequency broadcast transmitter must be designed to provide efficient operation on a wide band of frequencies. In the lower power stages of the Long Island transmitters, frequency changes are made either with taps or shorting bars on the inductances, finer tuning being accomplished with variable capacitors. The inductance for the plate circuit of the power amplifier consists of a 3-in. diameter copper pipe for each anode, both pipes running parallel for a distance of approximately 35 ft. with a center-to-center separation of 12 ins. The resonant frequency of the circuit formed by this inductance loop shunted by the tube capacitance is varied by the shorting bar moved along the horizontal portion of the loop. Thus, each transmitter is continuously adjustable in frequency over its entire range of 6 to 22 mc. Hence, with the proper crystals, the transmitters will operate on any predetermined frequency in this range.

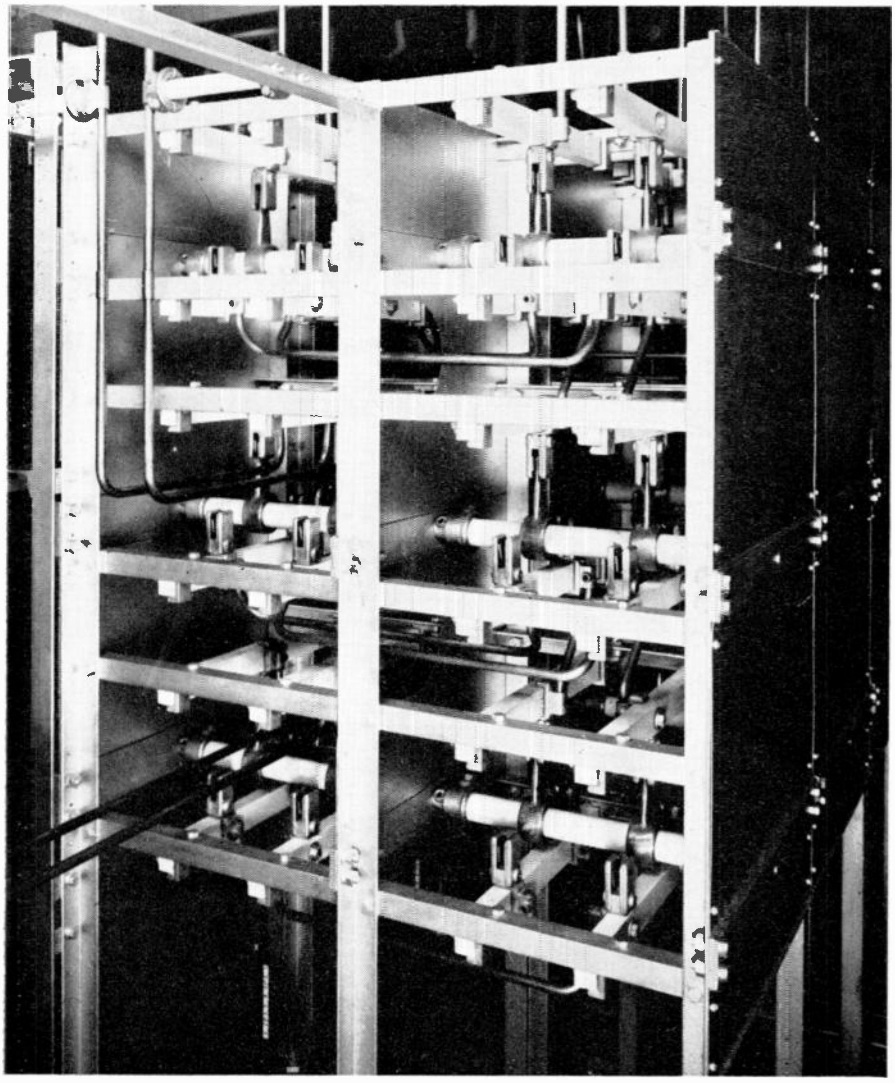


FIG. 8. ANTENNA SWITCHES CONNECT THE THREE 50-KW. TRANSMITTERS TO ANY THREE OF THE THIRTEEN ANTENNAS. POTENTIAL IS 14,000 VOLTS RMS

The copper pipes of each plate line extend directly below the F-124-A vacuum tubes through a hole in the floor to the basement and there continue horizontally across the basement area. Ceramic stand-off insulators support the pipes at intervals along their entire length. One set of supports is shown in Fig. 7. A second line, made up of three parallel pipes, is mounted directly below the plate line to provide harmonic suppression. Inductance of the harmonic suppression line is also varied by means of a shorting bar. When this line is tuned to the fundamental frequency, a short circuit, in effect, for even order harmonics exists from each plate to ground, via the center conductor.

The plate and harmonic lines are contained in separately shielded compartments composed of aluminum frames and panels completely enclosing each set of lines. Each panel is equipped with an interlock switch so that if the panel is removed, the plate power will be turned off automatically.

Contact to the pipes is made through sets of "V"-type sliding shoes held firmly against the copper conductors by spring action fingers which are mounted, in each case, on a heavy copper plate. The copper plate is supported on ceramic stand-off insulators fastened to a dolly. This complete assembly is termed a carriage. It can be moved axially along the horizontal length of the conductors by means of a motor-driven lead screw or worm. A harmonic line carriage with its lead screw is shown in Fig. 7. A similar carriage for the plate line is operated from a screw directly below the plate conductors.

The three-phase, reversible, two-speed motors driving the lead screws are located at the ends of the lines away from the power amplifier anodes and are connected to the worms through V-belt couplings. The harmonic line and the plate line motors are interconnected electrically so that the two carriages travel over the lines simultaneously. Flexible shafts, attached to the opposite ends of the worms, drive counters on the front panel to permit the operator to read the exact location of each carriage.

Automatic tuning of the tank lines is controlled from the panels of the power amplifier units by means of channel selector switches and motor start-stop push buttons. A channel selector switch has six positions corresponding to six stops or positioning switches located along the carriage tracks. Each of the six positioning stops may be preset to any point along the line so that a channel may be set to any frequency within the range of the transmitter. When the channel selector switch is set to select one of the positioning stops, it also determines the direction in which the motors must turn to drive the carriages to the desired stop. Hence, when the motor start button is depressed, the carriages travel at high speed in the proper direction; power to the plates of the amplifier tubes is cut off automatically by an interlock relay during the traveling time and the motors stop when the carriages arrive at the proper point on the lines.

A non-locking vernier switch is also provided on the panel for each set of lines to permit non-automatic operation of each carriage back and forth at half-speed, with the plate power on, for fine adjustment. With this vernier adjustment, it is possible to tune the lines to additional frequencies beside the six preset frequencies, if necessary. Pilot lights on the panels light to show the motors are running.

Safety limit switches are located at each end of the lines to remove voltage from the motors and thus prevent overtravel if one of the position switches should fail to stop the carriages. Pilot lights associated with these switches, when lighted, inform the operator of the tripping of a safety switch. He can then return the carriage from the end of the line to a selected position by pressing the motor start button or by using the vernier switches.

The plate and harmonic line piping provides a convenient means of bringing cooling water to and from the tube anodes. The water connections of the pipes are such that water flows in series through the two tube jackets. Ceramic piping is employed for some distance before the water enters and after it leaves the transmitter in order to provide insulation for the modulated DC voltage. The cooling water is provided by Mackay Radio from its centralized group of water pumps and force-draft, radiator type of heat exchangers.

Inductive coupling is employed between the plate line and the antenna switching system. Each inductive loop consists of two pipe conductors about thirty feet long mounted horizontally above and parallel to the plate line. The end nearest the tubes is shorted, with the mid-point of the shorting strap grounded, while the far end connects to the antenna transmission line through the special antenna switching assembly.

Coupling is varied by moving the two pipes forming the coupling loop horizontally so that at maximum coupling each pipe is directly over the two sections of the plate line. At minumum coupling, the two pipes are only two or three inches apart. In other words, variation in coupling is accomplished by changing the position of the coupling loop conductors in relation to the plate line conductors and by varying the area within the coupling loop. The coupling loop is varied by means of a handwheel on the front panel of the power amplifier unit.

Antenna Switching Mechanism ★ Design of a switching mechanism that would permit the outputs of the three 50-kw. power amplifiers to be connected to any three of the thirteen antennas efficiently was one of the major problems in the construction of the station. Since the potential at this point is 14,000 volts, RMS, or more, during modulation peaks, a high degree of insulation is required. Voltage breakdown tests were made to determine the comparative merits of various insulator designs under practical operating conditions,[3] and, as a result of the tests, special insulators and fittings were developed. Fig. 8 shows the interior of a portion of the antenna switching assembly, giving an idea of the large insulation spacing and oversize contacts necessary to assure high efficiency at frequencies up to 22 mc.

Since a switch is required for each power amplifier and one for each antenna, thirty-nine switch units make up the total assembly. Each switch is a four-pole, two-position device equipped with a handwheel for manual operation. A section of the switch panel is shown in Fig. 9. Each horizontal row connects to a particular amplifier while the vertical columns subdivide the antennas. As the nameplate at the top of each column clearly indicates the area covered by the antenna and its operating frequency, operation is extremely simple. Foolproof connection is assured by a system of mechanical and electrical interlocks which prevent switching the antennas with power on and also prevent connection of more than one amplifier at a time to an antenna. When an amplifier is properly switched to an antenna, a pilot light indicates that the antenna is in use.

Several of the antennas, directional to Europe, may have their directional beams rotated 180° so that they become directional to Mexico and Central America intead of to Europe. This is accomplished by means of remote-controlled switches at the antennas which reverse the connections to the transmission lines, interchanging the functions of the radiators and reflectors.

Modulators ★ Each of the two modulators employs two Federal F-125-A water-cooled triodes operating class AB_1. These tubes have similar physical dimensions to the Federal F-124-A tubes used in the final amplifiers, but the modulator tubes were designed specifically for audio frequency operation. The two tubes provide ample power to plate modulate the final amplifier.

The principal characteristics of the F-125-A tube are as follows:

Filament: Six terminals — 13.6 volts per terminal to a common internal connection — 65.5 amperes per strand.

Amplification Factor	4.75
Mutual Conductance	15,800 micromhos
Anode Dissipation	40 kw.
Overall Dimensions:	
Length	26¾ ins.
Diameter	12½ ins.

The modulator is driven by two Federal F-132-A triodes in push-pull, transformer-coupled to the grids of the modulator stage. These tubes also were designed by Federal especially for audio frequency operation. A view of the final audio amplifier and modulator tubes is shown in Fig. 10. Three stages of push-pull audio amplification precede this stage to provide amplification sufficient for taking audio signals directly from the line at a level of approximately 0 db.

Fig. 11 illustrates the audio amplifier and modulators. Audio frequency response from 40 to 10,000 cycles is plus or minus 0.5 db with reference to the 1,000-cycle level. Harmonic distortion has been kept down to less than five per cent from 50 to 75,000 cycles at 100% modulation. These performance characteristics are in accordance with the most modern practices in the broadcasting art.

Power Frequency Equipment ★ Power for the entire CBS station is obtained from 2,300-volt, 3-phase feeders brought from an outdoor transformer substation located about 1,000 yards from the transmitter building. These feeders terminate in the portion of the building occupied by Mackay Radio, from which 2,300-volt and 460-volt feeders are run to the CBS premises. After passing through a main breaker, the 2,300-volt service is fed through fused cutouts to the oil circuit breakers of the two main rectifiers now installed. All 2,300-volt primary equipment is located in the basement, including instrument transformers for metering the 2,300-volt circuits.

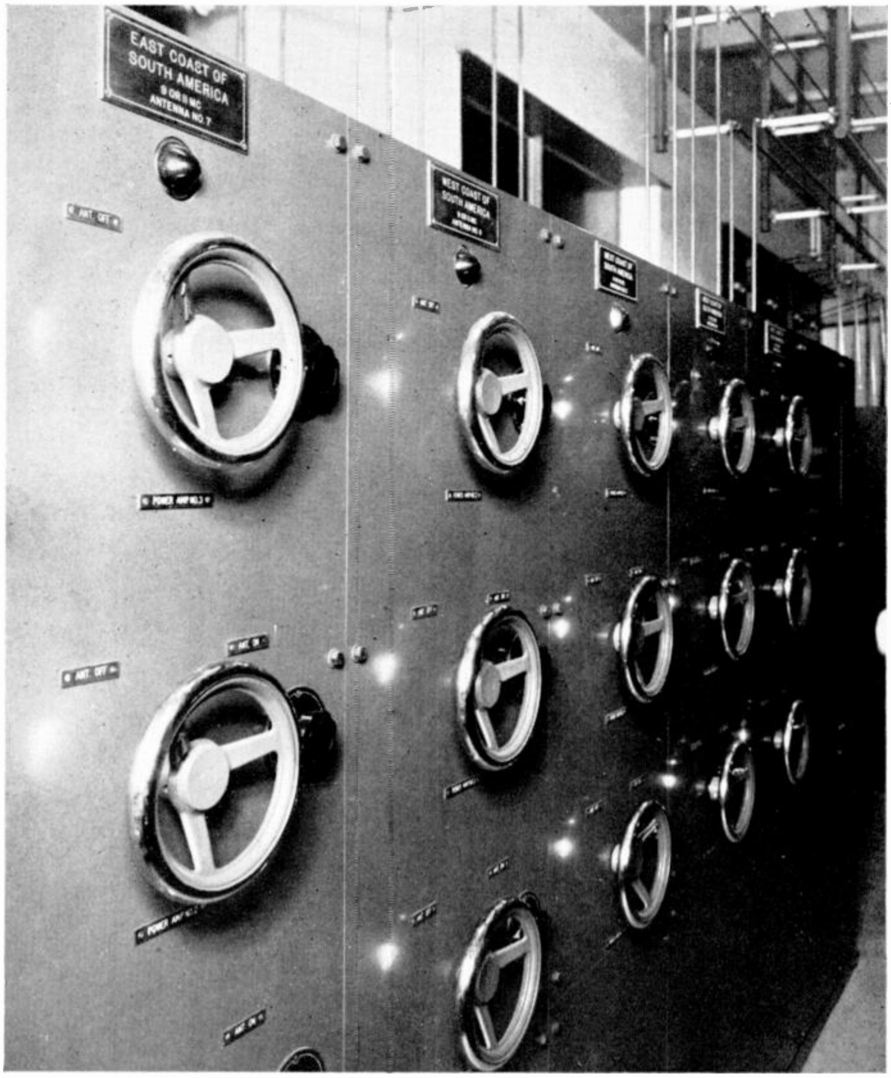


FIG. 9. FRONT VIEW OF ANTENNA SWITCHING PANEL. INTERLOCKS PREVENT OPERATION WITH POWER ON, OR CONNECTING AN ANTENNA TO TWO AMPLIFIERS

[3] "Radio Frequency High Voltage Phenomena," by Andrew Alford and Sidney Pickles, *El. Com.*, Vol. 18, No. 2, 1939; *Elec. Engg.*, Vol. 59, March 1940.

The 460-volt, 3-phase feeders go directly into a power control unit located on the main floor near the power amplifiers shown at the left in Fig. 3. A 460-volt bus in this unit feeds a group of switches controlling the AC power to the F-124-A and F-125-A tube filament supply circuits and the tuning motors of the power amplifier units. This bus also feeds an automatic voltage regulator supplying regulated 460 volts to a group of switches controlling AC power to the F-129-A filaments and the 5,000-volt rectifiers. The same bus also runs to a 460/230-volt transformer supplying regulated 230 volts to the low power circuits.

All switches on the power control units are of the circuit-breaker type with magnetic trip-out coils which open the switch on overload. This is also true of all switches located in the individual power circuits of the various units so that the use of fuses for overload protection has been avoided.

A three-phase, full-wave rectifier circuit is employed in the main rectifier, requiring six Federal F-357-A hot cathode, mercury vapor rectifier tubes. A seventh tube (in a standby position) is included and is ready to be switched into service in case one of the active tubes fails. The voltage from this rectifier is controlled by a motor-operated induction voltage regulator in the primary circuit to the rectifier transformer bank. Control of the regulator may be either manual or automatic as desired, the rectifier output voltage thus obtained ranging from 8,000 to 12,500 volts DC. When the regulator is automatically operated, it will return to its lowest voltage position whenever the primary circuit breaker is opened so that, when the rectifier is switched on, it will start at its lowest voltage and slowly climb to any pre-determined value at which point the voltage will be maintained automatically. A single-phase, choke-input

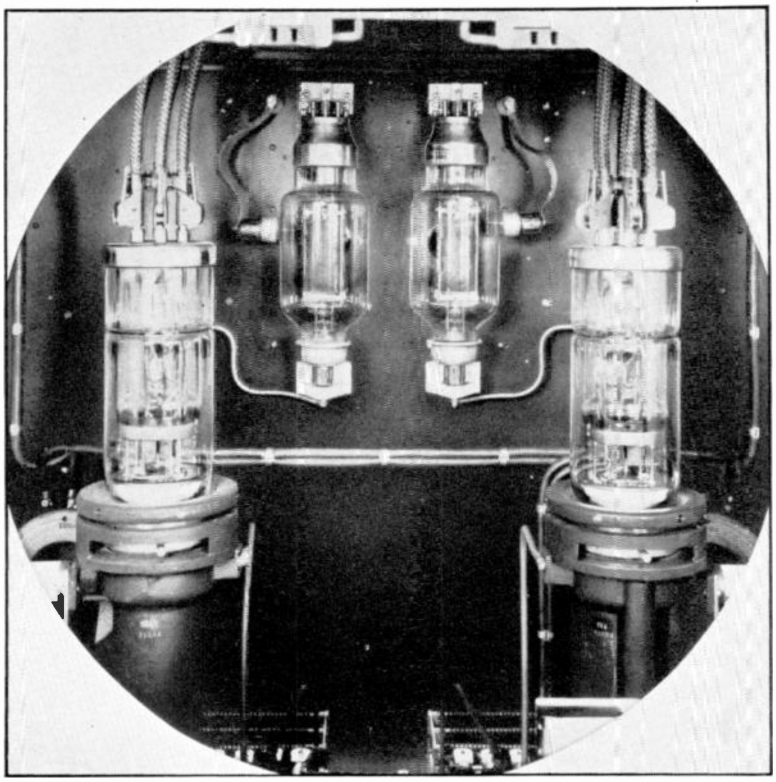


FIG. 10. CLOSE-UP VIEW OF THE MODULATOR AND FINAL AUDIO AMPLIFIER TUBES

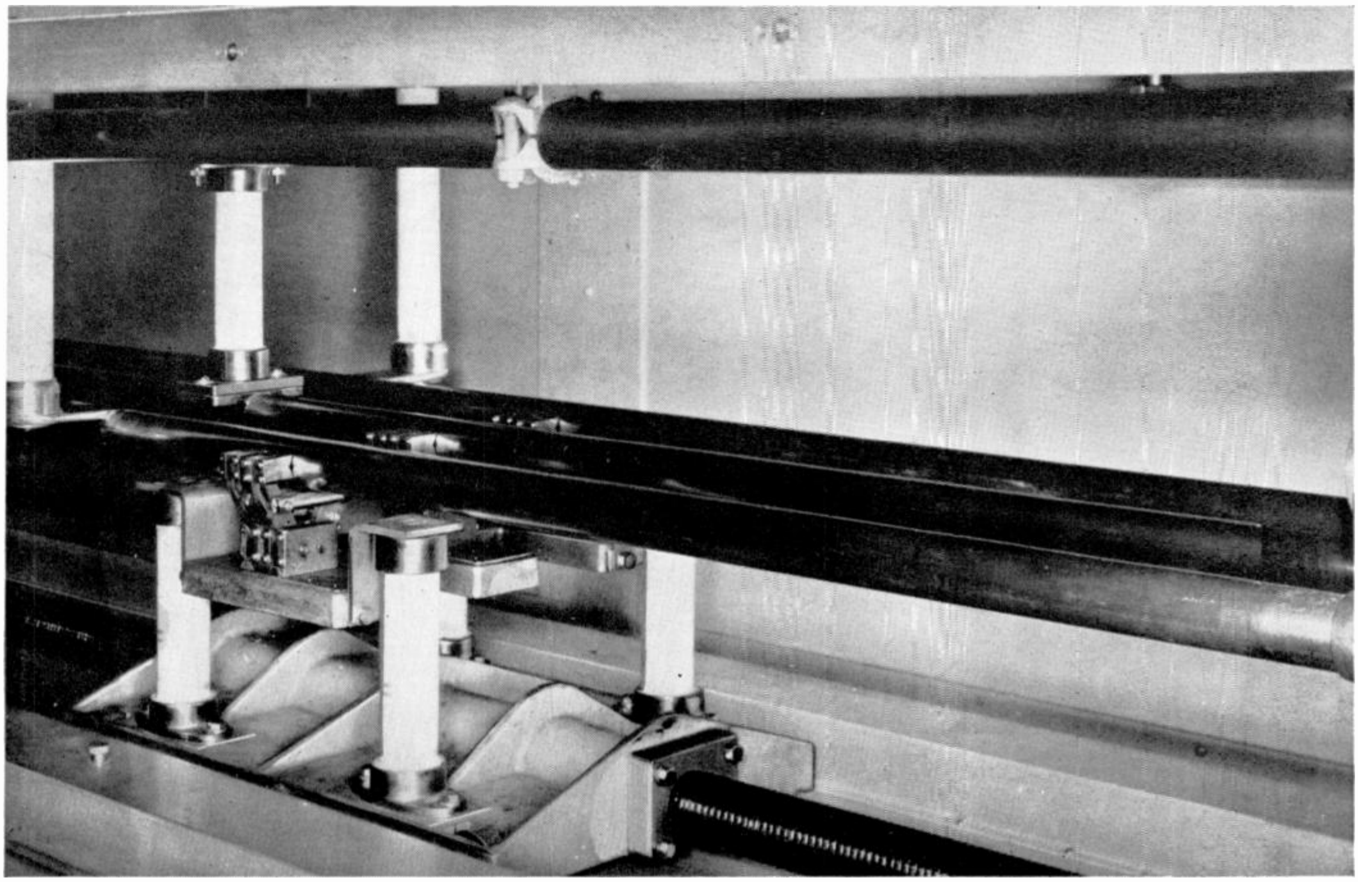


FIG. 7. THE MOTOR-DRIVEN HARMONIC LINE TRUCK IS ADJUSTED REMOTELY TO PRESET POSITIONS, AS SHOWN HERE

filter in the DC output circuit has a relatively large capacitance to avoid undesirable coupling effects between the modulator and power amplifier.

The high voltage transformer bank is connected in delta-delta to permit operation at reduced power in the event that one of the transformers must be removed because of failure. Individual transformers are immersed in oil in separate steel tanks.

Control System ★ The control system has as its principal objective operation of an RF driver-power amplifier with any main rectifier-modulator. Fig. 12 illustrates the basic arrangement. Control facilities include provisions for a future third main rectifier-modulator which may also connect to any power amplifier.

Selection of any modulator and rectifier to be associated with any power amplifier is made at the power amplifier where push buttons operate the desired selector relays. These relays make a number of connections to the control circuits of the selected modulator, including door interlocks, power amplifier overload relays, the carrier cut-off circuit, and control of the main rectifier. After selection has been made, control of the power circuits to all RF and modulator units may be effected either at the units themselves or at the control panel over the operator's desk. Electrical interlocking is employed to prevent accidental connection of two modulators to the same power amplifier.

The carrier cut-off device employed causes a momentary interruption to the carrier if the carrier current either rises or falls more than a few per cent from a preadjusted value. This is accomplished by balancing the voltage from a radio frequency rectifier against a voltage proportional to the main rectifier output, the differential operating a relay. Thus, if breakdown should occur in any radio frequency circuit, the excitation will be repeatedly interrupted until the trouble is cleared or the operator shuts down the equipment.

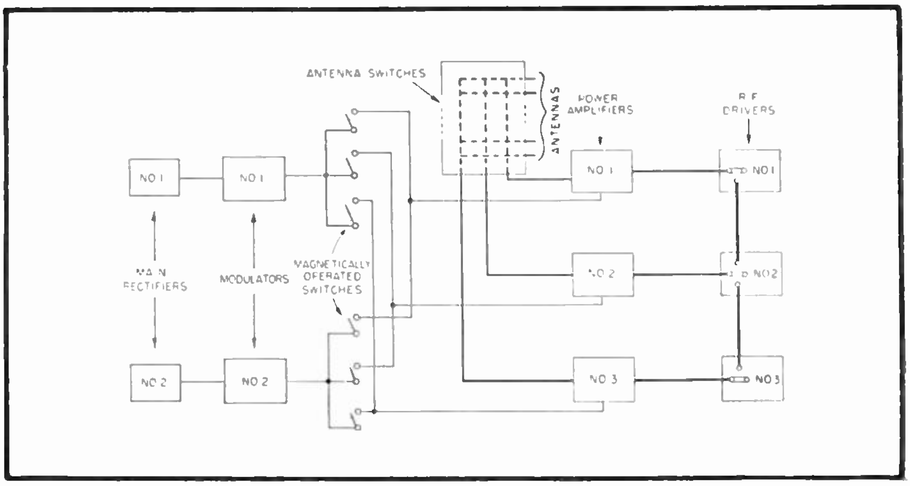


FIG. 12. BLOCK DIAGRAM OF RADIO FREQUENCY AND MODULATOR SELECTOR SYSTEM

Conclusion ★ The CBS International Broadcasters are operating nearly 24 hours a day and 100% of the station's time is now devoted directly to the war effort. On November 7, 1942, the United States Government leased, for the duration of the war, the facilities of this station as well as those of all other shortwave broadcasting stations throughout the nation. Two-thirds of the total air time of the CBS transmitters is utilized by the Office of War Information for information broadcasts to all parts of the world. For approx-

(CONTINUED ON PAGE 35)

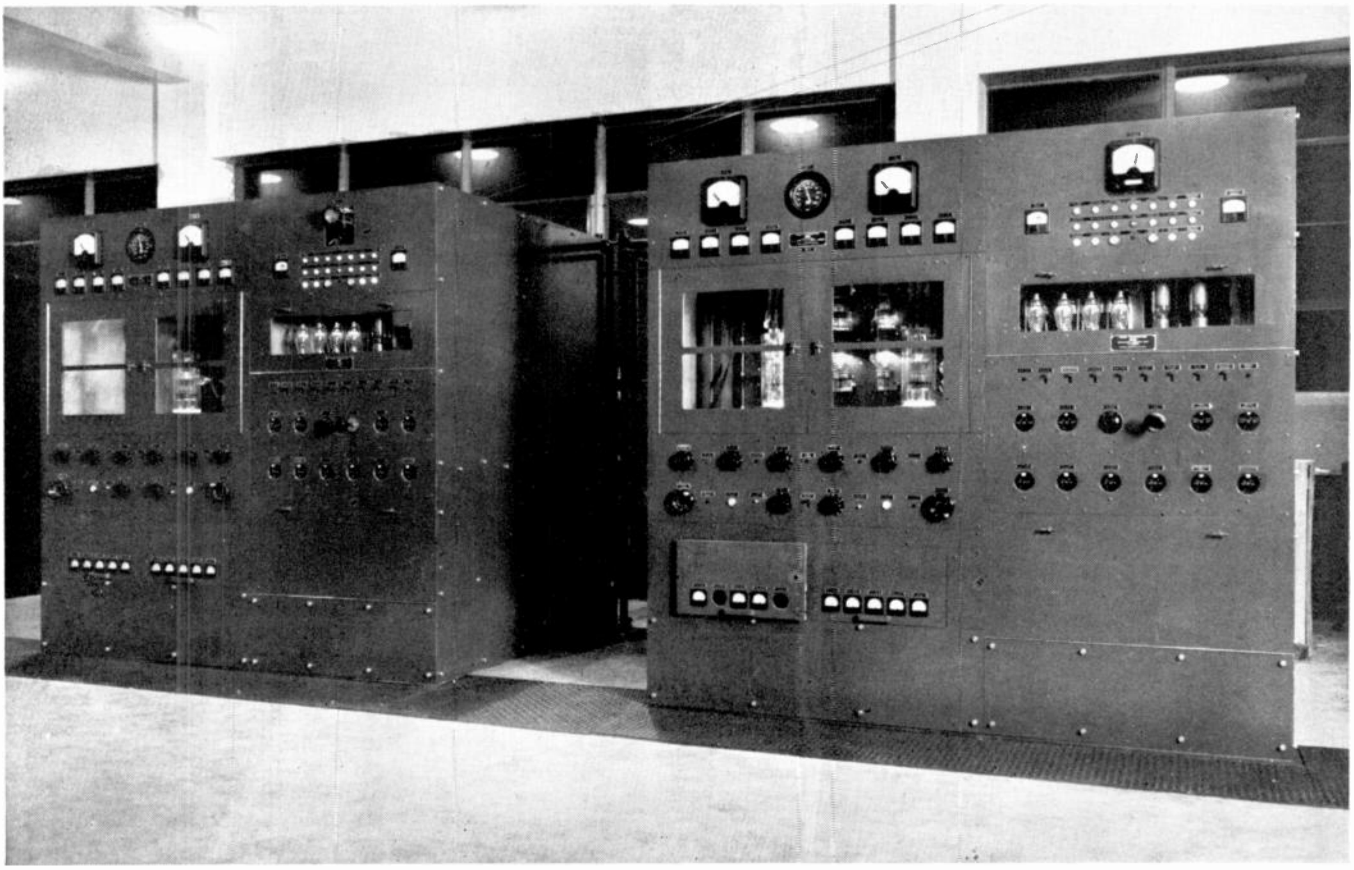


FIG. 11. VIEW OF THE TWO AUDIO AMPLIFIER AND MODULATOR UNITS BEHIND WHICH THE 12,000-VOLT RECTIFIERS ARE LOCATED

METHODS OF HERMETIC SEALING

A Symposium on the Various Means for Meeting the Requirements of Immersion Tests on Condenser and Transformer Cases—Part 1

INTRODUCTION

BY PAUL NACHEMSON*

WARTIME field conditions impose the severest tests on the durability of all military equipment. This is particularly true of relatively delicate precision communications equipment used ashore, afloat, and in the air.

In the design of such equipment it is necessary to employ a wide diversity of materials, and to integrate them into highly precise assemblies which must conform to the most exacting standards of performance.

To accomplish this successfully requires more than careful observance of good engineering practice. It involves a knowledge of the highly diversified conditions which obtain in the field, and an understanding of the preventative measures required to meet the ravages of natural forces, physical, chemical, and organic.

The physical forces against which we must contend are variations of temperature, pressure, and humidity. Chemical action may destroy materials or alter insulation characteristics, cause corrosion, or set up electrolysis between dissimilar metals.

Organic forces we must combat are those represented by fungus growths or the entry of microcosmic animal life. In some cases, larger forms of insect life and members of the rodent family exhibit a predilection for some of the materials used to fabricate our equipment. That these can be most detrimental is obvious, and the need for guarding against them correspondingly essential.

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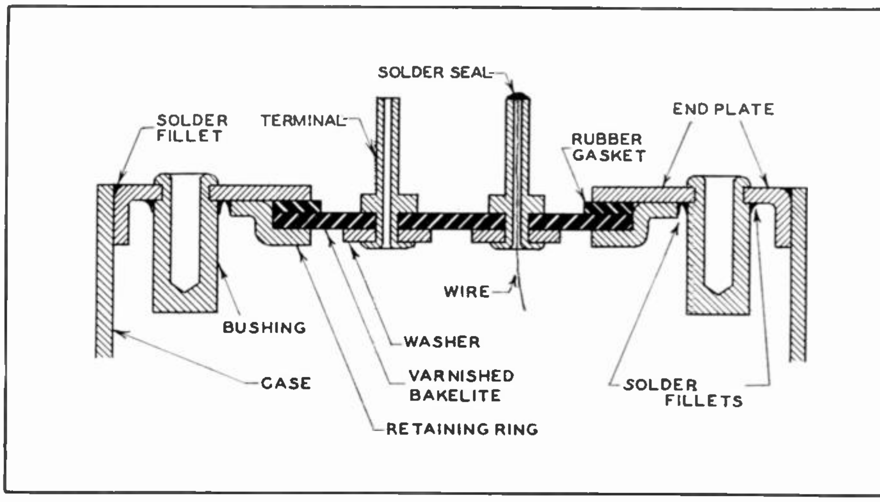


FIG. 2. ENLARGED CROSS-SECTION OF SEALED END-PLATE CONSTRUCTION

Each of the primary forces mentioned above can be divided into secondary factors which, in turn, cause specific adverse reactions. Today, more than ever before, every possible precaution must be taken against these destructive effects.

Need for Hermetic Sealing ★ The use of hermetic sealing for transformer and condenser cases is relatively new in radio components design.

The most common application, which has proved highly successful, is to small oil-filled paper condensers. By this method, failures of these components have been almost reduced to the vanishing point.

Hermetic sealing of larger condensers and small transformers has now come into extensive use on ship radio equipment. More recently, such construction is required for transformers and chokes in aircraft equipment, and in some cases for ground installations.

The principal purposes of such construction are:

1. To eliminate the effects of atmospheric pressure changes.

2. To prevent corrosion due to salt water vapor or the breakdown of insulation under the influence of humidity.

3. To serve as a barrier against the entry of living matter, both vegetable and animal.

Experience shows that perfect hermetic sealing is not a simple matter, as the standard immersion tests prove. In other words, what appears to be a perfect seal may prove to have the most amazing capacity for permitting the passage of water.

The perfect seal is one wherein the housing would comprise a completely fused receptacle of one homogeneous material, entirely devoid of osmotic or capillary characteristics. Manifestly, the need of bringing out insulated connections from

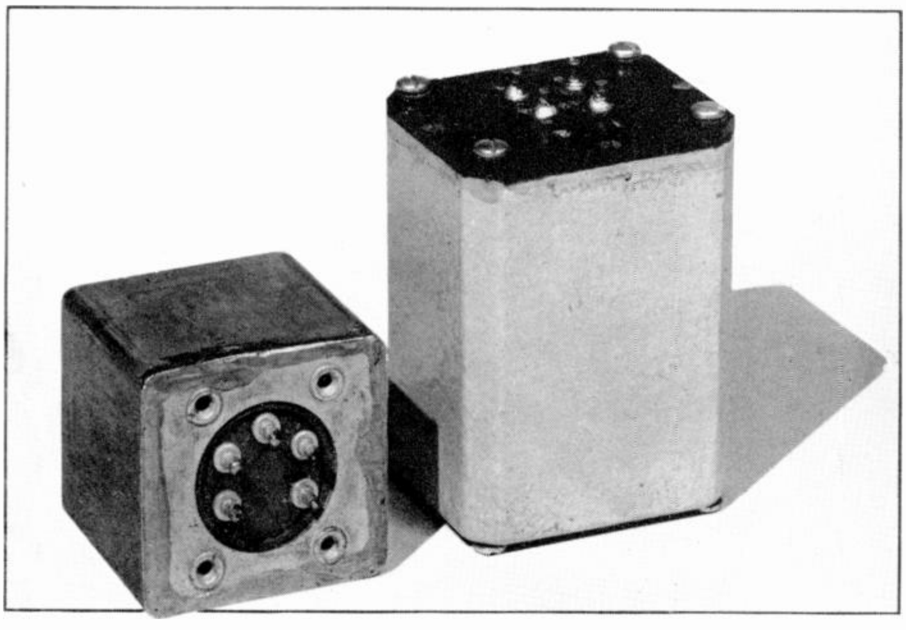


FIG. 1. LEFT, A TRANSFORMER CASE SEALED AS IN FIG. 2, PHOTOGRAPHED IMMEDIATELY AFTER SOLDERING. RIGHT, CAST STEEL CASE CONSTRUCTION

the interior precludes the possibility of such construction. This difficulty is further aggravated by the almost invariable need of electrostatic or electromagnetic shielding, which indicates the use of metallic housings.

There are manifold difficulties to be surmounted. For one thing, considerable elasticity is necessary at the juncture of dissimilar materials, in order to counteract the difference in coefficients of expansion which introduce great stresses under the influence of variations in temperature.

This elasticity is also required to compensate for differences in external and internal pressures under wide variations of barometric pressure, such as are encountered in aircraft apparatus.

Finally, materials and methods for sealing which may appear to be satisfactory do not stand up under the rigors of immersion test cycles.

No confidence can be placed in any type of seal until it has been actually proved by submission to these tests.

There are two types of immersion tests now in use. The salt water test is used on apparatus for service at sea, and also for some ground equipment going into the tropics. Airborne components are given immersion tests in fresh water.

Salt Water Immersion Test ★ Under the salt water test, a hermetically sealed container must be unaffected during immersion over a temperature range from 0° C. to +75° C. This is determined in the following manner:

Two immersion baths are required, one at a temperature of 0° C. and the other at +75° C. Both must be saturated solutions of sodium chloride in water. Each bath must be of sufficient volume so that its temperature will not be altered appreciably when the article under test is transferred from one bath to the other.

In the case of transformers, the ohmic resistance of the windings, and the leakage resistance between windings and to the case must be measured accurately before the test is started.

The test procedure consists of submerging the unit in the +75° bath for two hours, and then in the 0° bath for two hours. It should then be washed in clear water and air-dried at 25° C. Rated potentials must be applied to the terminals for two hours, during which time the metal case should be grounded.

This procedure must be repeated for five complete cycles. Finally, after the part has been allowed to reach room temperature, the resistance readings must be taken and compared with those made prior to the test.

The ohmic resistance of transformer windings should not change more than 5%, and the leakage resistance must not be less than 75 megohms.

Fresh Water Immersion Test ★ Ordinary tap water is used for immersion tests on aircraft components. First, the unit must be put through five cycles of temperature change from room temperature (approximately +20° C.) down to −55°, up to +85°, and back to room temperature.

Immediately thereafter, the unit must be submerged in tap water at approximately +20° C. Then the bath must be varied through five cycles of temperature change from +20° C., up to +71°, and back to +20°. After the fifth cycle, the unit must remain submerged for 24 hours.

Finally, after the case has been washed clean and dried, the following test is required:

The windings must be tested for breakdown by applying an AC voltage of not more than 100 cycles and an RMS value of 4 times the maximum peak voltage between the windings and between the windings and any metal parts or ground.

The test voltage must be 500 volts in any case, and if the operating voltage exceeds 500 volts, the test voltage must be 1,000 volts more than twice the operating voltage. The voltage must be applied for not less than 1 minute on each test.

Any leakage of potting materials during this test is cause for rejection.

SEALED TERMINAL PLATES

All things considered, one of the simplest ways to obtain hermetic sealing is through the use of phenolic terminal plates sealed onto metal cases. Two examples are illustrated in Fig. 1.

The case at the left is of drawn steel, similar to those in common use for unsealed transformers. It was photographed before the paint finish was applied, to show the soldered end-plate.

The other is a cast iron case, such as is used for heavy electromagnetic shielding. These examples show two distinct types of sealing.

Drawn Steel Cases ★ The case shown at the left in Fig. 1 has terminals mounted in a phenolic plate carried on a steel end-plate which is soldered to the case. This is a practical method since the material of the case is light enough that it can be soldered without the application of so much heat that the contents would be damaged.

Fig. 2 shows an enlarged cross-section of the terminal arrangement. First, the terminals are press-fitted into a Bakelite disc that has been baked, varnished with Kauri No. 74, and then baked again to exclude all moisture. Then the terminals are curled over washers to make a perfect seal.

A steel retaining ring and mounting bushings, if required, are soldered to the steel end-plate. Then a rubber gasket and the Bakelite terminal board are put in the retaining ring, and the ring is formed over as shown in Fig. 2.

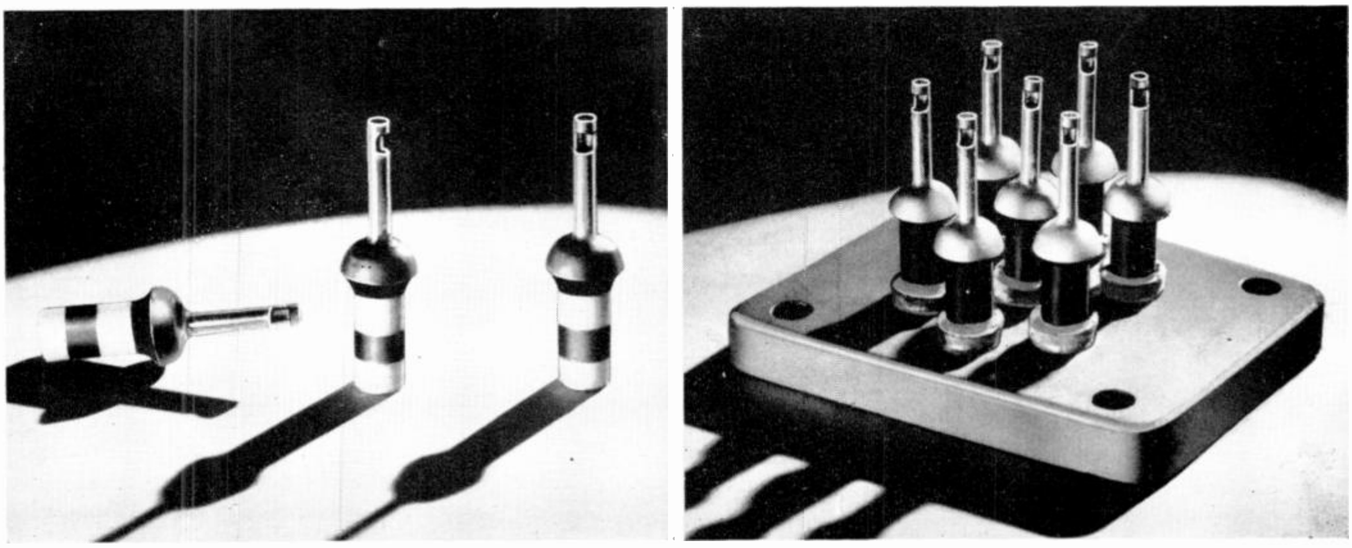


FIG. 3. LEFT, THE WESTINGHOUSE SOLDER SEAL CERAMIC BUSHINGS HAVE METALIZED BANDS TO RECEIVE THE SOLDER. RIGHT, AN END-PLATE TO WHICH BUSHINGS HAVE BEEN SOLDERED, READY FOR MOUNTING

The last step is to solder the end-plate to the case, and to solder-seal the lead wires at the ends of the contact pins.

This type of construction withstands the salt-water immersion test. It would probably meet the tap-water test for aircraft components, although the close mechanical arrangement of the terminals might fail to provide adequate insulation at very low barometric pressure.[1]

Cast Steel Cases ★ A more simple type of seal can be used for cases of cast steel because the wall thickness is sufficient to take tapped holes for screws.

The case at the right in Fig. 1 is of this sort. Here the edges of the case were ground smooth and perfectly flat. Then holes were drilled and threaded for 4–36 screws at the center of each side, and for 8–32 screws at each corner.

The former screws are inserted permanently to hold the phenolic end-plate, while the latter are for mounting screws which also keep the end-plate in position.

The terminal plate is baked, varnished with Kauri No. 74, and baked again, and the terminals are curled over as in Fig. 2. After the transformer or choke has been fastened to the shell and the potting has been completed, Kauri No. 74 or an equivalent sealing material is put on both the end of the case and around the edge of the terminal plate. All 8 screws are used to clamp the terminal plate while the varnish dries. About 48 hours should be allowed for this. After that time, the mounting screws can be removed whenever necessary.

This method of sealing is also capable of standing up under the salt-water immersion test.

There is another method of handling cast steel cases which is worth exploring. This is to dip-tin the case at the open end, and then solder on a steel end-plate designed as in Fig. 2. Experience in soldering cast iron parts which have been dip-tinned indicates that perfect joints can be made without excessive heating, although the writer has not actually tested this method for sealing transformers.

[1] See "Reproduction of Flight Conditions" by John Zaleski, *FM Radio-Electronics*, May, 1943.

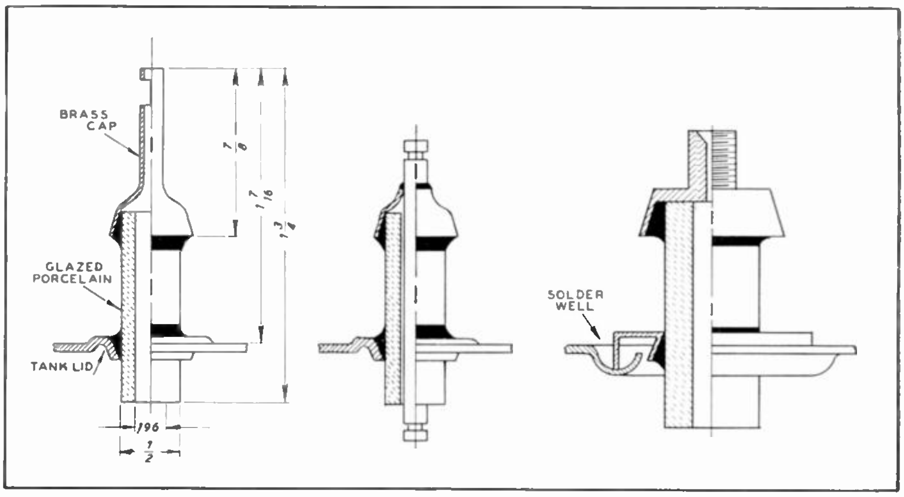


FIG. 5. ACTUAL SIZE OF THREE TYPES OF CERAMIC BUSHINGS. ONE AT THE LEFT IS SOLDERED TO A MOUNTING RING, THEN SOLDERED TO THE CASE

SOLDER SEAL CERAMIC BUSHINGS

BY W. H. HAMMOND*

THE Westinghouse Company has for many years used solder seal bushings in such apparatus as power capacitors, as well as large condenser-type transformer bushings, ranging up to 34.5 kv.

In the past year, this line of bushings has been broadened to include such items as porcelain terminal discs, with a plurality of leads, which can be soldered to covers, and terminal studs which, in turn, can be soldered in the discs.

Bushings, complete with terminal caps, as small as 5/16 in. in diameter and ranging in height from 11/16 in. to 3 ins., are also available. Typical examples are shown in Figs. 3, 4, and 5. Other diameters, heights, and designs are available, dependent upon the application and electrical characteristics required, for radio transformers, capacitors, and coaxial cable assemblies.

Essentially, these solder seal bushings are of ceramic material, prepared with metallic bands at the points where soldering is required. This can be seen in Fig. 3, while Fig. 5 shows solder applied at the bands.

These bushings are furnished complete with the hardware, ready to mount in covers which have been perforated and prepared for the soldering process. The covers, of course, must be of material that will take solder. If desired, the Westinghouse Company will perform the soldering operation, and deliver the completed covers.

Two general methods are employed to solder-seal the bushings into the covers:

1. When the metal cover is .025 in. or less in thickness, the bushings can be soldered directly to the cover. In that case, a tinned bushing, complete with the terminal cap, is inserted in the cover. A ring of wire solder is dropped over the terminal, onto the solder-well in the cover plate.

Flowing can then be accomplished by induction heating or with the use of a thermostatically-controlled soldering iron. Suitable jigs, depending upon the number

(CONTINUED ON PAGE 35)

*Industrial Division, Westinghouse Electric & Manufacturing Company, 40 Wall Street, New York.

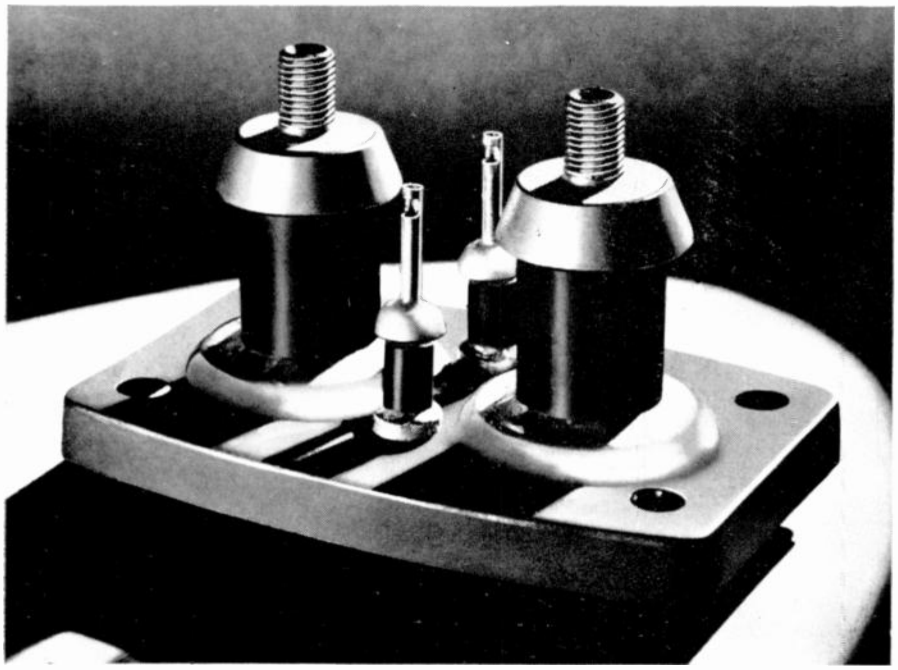


FIG. 4. TWO TYPES OF CERAMIC BUSHINGS ARE USED HERE. DETAILS OF BOTH ARE ILLUSTRATED IN ACTUAL SIZE AT FIG. 5, ABOVE

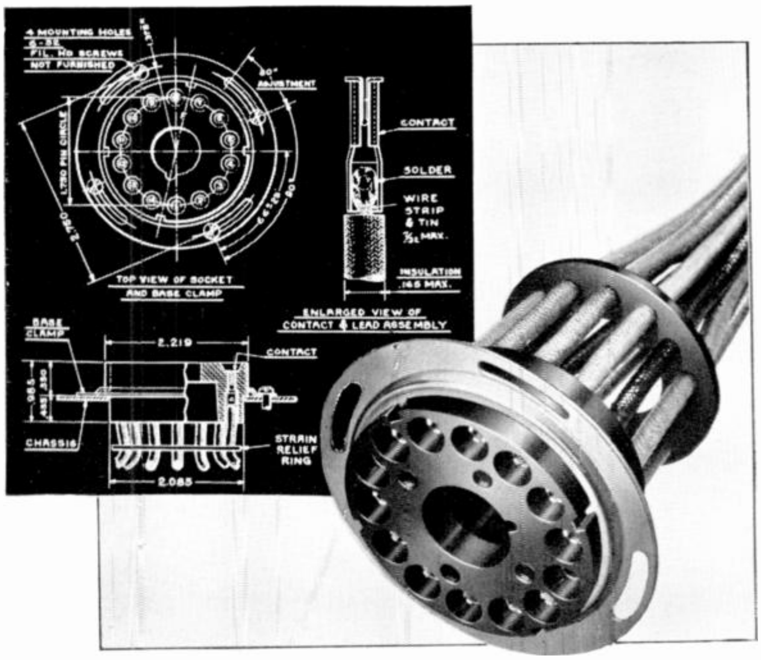


FIG. 1. AN IMPROVED TYPE OF SOCKET FOR CATHODE-RAY TUBES FACILITATES WIRING

DESIGNERS' ITEMS

Two Products Which Represent Useful Refinements of Design

SOCKETS for cathode-ray tubes have more or less followed the conventional design types employed for ordinary tubes, with the result that they have had characteristic weaknesses which called for correction.

Recently, the Franklin Manufacturing Company undertook to produce a new type in which the old faults would be eliminated. Fig. 1 above shows the result of those efforts.

The socket base, of one-piece molded construction, encloses the contacts so as to provide maximum protection against temperature and humidity conditions. This also gives an additional leakage path to prevent flash-over between pins, particularly at high altitudes on airborne equipment. To accomplish this, the base is made .985 in. thick, or about twice the thickness of ordinary tube sockets.

The contacts are positioned permanently in the base by a shoulder on the lower part, and by being curled over at the top.

A base clamp, with four slotted holes, is provided for mounting with screws on a radius of 1.375 ins. The lower part of the socket base which extends through the panel requires a 2.085-in. hole.

To carry the strain on the soldered joints at the contacts, a relief ring is located behind the base.

These sockets are furnished without cables, or made up completely with the color-coded cables, ready for mounting and wiring, as shown in Fig. 1.

Another interesting product is the number tape shown in Fig. 2. This is a cellophane adhesive tape, transparent at the edges, with a white stripe in the center, on which a number is repeated.

Applicable to many uses, it is finding a special purpose for identifying wires which are made up into cables. Each roll carries one number, but rolls can be obtained with any individual numbers which are specified.

When wires are cut for cabling, each wire can be identified by rolling around the ends the number tapes corresponding to the terminals to which it is to be connected.

Wires in Fig. 2 have been cut for one of the conductors in a quantity of cables, and their ends have been wrapped with the tape.

The very simple reel is fitted with a razor blade for cutting off short lengths of tape. This was changed, however, because the exposed corners of the blade were found to be dangerous. Then the blade was removed, and the operator provided with a knife, so that the tape could be cut where it passed over the wooded block at the front.

When identification markers of this sort are used, the numbers are first laid out on the wiring diagram, and then on the detail drawings of the cables. Finally, they are transferred to the diagrams in the corresponding instruction book. Under this system, both manufacture and service are simplified greatly.

NOTICE TO OUR READERS

FM RADIO-ELECTRONICS has a new address, as appears on the Contents Page of this issue.

Both the editorial and advertising offices have been moved to the 14th floor at 240 Madison Avenue, between 37th and 38th Streets, in New York City. The ownership and management will remain unchanged, and the Magazine will be printed by The Rumford Press, at Concord, N. H., as in the past.

The new address, in the very convenient Murray Hill section where a great number of publication and advertising agency offices are located, is directly below the Grand Central Station.

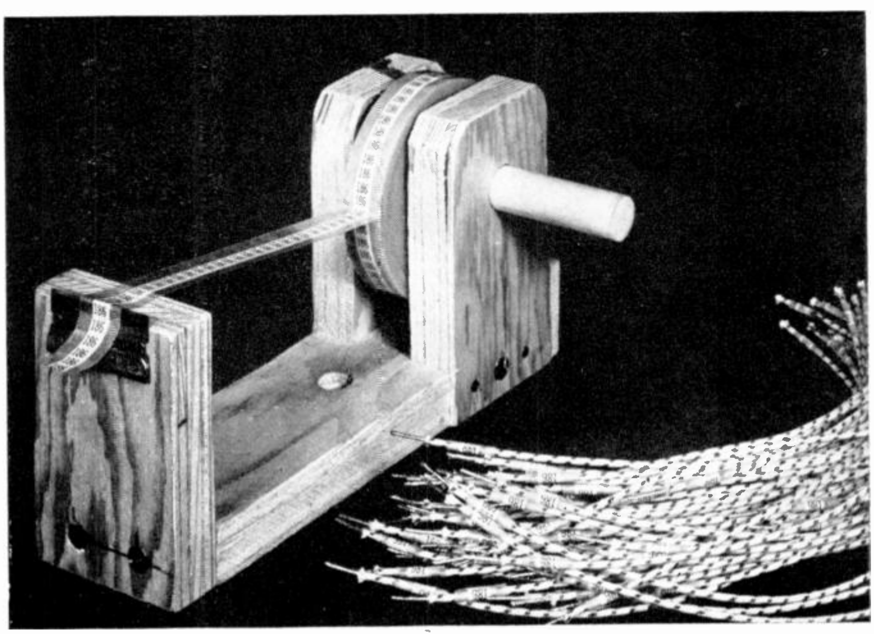


FIG. 2. NUMBER TAPE FOR IDENTIFYING THE ENDS OF CABLED WIRES. CORRESPONDING NUMBERS ARE SHOWN IN INSTRUCTION-BOOK DIAGRAMS

FIG. 1. PITTSBURGH POLICE AND CITY OFFICIALS AT THE INAUGURATION OF THE RECORD-BREAKING FM INSTALLATION. MAYOR SCULLY IS AT THE MICROPHONE. ONE HEADQUARTERS STATION COVERS ALL OF ALLEGHENY COUNTY

FM SUCCEEDS WHERE AM FAILED

FM Police System Exceeds Expected Performance in Area Known as Country's Worst

BY WM. M. GAMBLE*

PITTSBURGH has always claimed to be the birthplace of radio broadcasting. There may be some difference of opinion about that, there is no denying the fact that this area has the worst radio receiving conditions of any section in the United States.

Probably this is due to the mountains which surround the City, and their abundant mineral and ore deposits. Furthermore, the City itself is a nest of hills and valleys, and that seems to make bad matters still worse, as far as radio reception goes.

The need for police radio communication has long been recognized. This has been emphasized by the number of vital War industries located here, calling for the use of every modern means to assure their protection.

During the last six years, we have experimented with 2-way AM communications equipment, but the results did not justify its installation. An engineering survey, calling for the use of two transmitters and five relay pick-up receivers, showed that even such a system would not be entirely satisfactory for talk-back service.

We have had a 1-way system in operation on low-frequency for 12 years. This has served 42 communities surrounding the City, the Allegheny County police and detectives, the Pennsylvania Railroad police, FBI, and the State Police.

However, the need for 2-way communication was shown conclusively during the flood of 1936, when we used an experimental 2-way installation in one patrol car.

Our specific problem was to cover the 56 square miles of the City, in which there is a population of 700,000, with dependable 2-way service. On the basis of an FM survey, the City officials became convinced that it would be practical to install an FM system. The necessary appropriation was made, and permission to purchase the equipment was granted as a measure of War necessity.

We now have in operation a single headquarters station, using a Link type 250 UFS transmitter adjusted to an output of 400 watts on 39.9 mc. Fifty of our patrol cars are equipped with Link FMTR 2-way mobile assemblies, with the 35 UFM transmitters working on 39.38 mc.

The photograph in Fig. 1 was taken during the dedication ceremonies when the system was put into operation. This shows a portion of the radio operating room. From left to right are: the writer; George E. A. Fairley, Director of Public Safety; Assistant Superintendent Andrew Charles; Superintendent of Police Harvey J. Scott; the Honorable Mayor Scully at the microphone; James Hughs, Secretary to the Mayor, and Officer Benjamin Milcarek.

The headquarters station, Fig. 2, is at an elevation of 1,210 ft. above sea level, in the central part of the City. The antenna is supported on a 100-ft. mast which can be seen at the right in Fig. 2. We are using a vertical half-wave coaxial doublet, fed by a 7/8-in. gas-filled coaxial line from the transmitter.

The entire installation has proved to be highly satisfactory. In fact, it has surpassed all our expectations of performance. It is providing complete 2-way coverage in areas which were formerly dead spots for our 1-way AM transmitter.

A field survey has demonstrated that the FM system not only covers the City area but furnishes successful 2-way communication over the entire Allegheny County, an area of 747 square miles.

On the basis of these results, we have made application for 25 more patrol car units to complete the equipment of our

*Chief Radio Operator, Department of Public Safety, Bureau of Police, Pittsburgh, Pa.

FIG. 2. SOME OF THE PITTSBURGH POLICE PATROL CARS LINED UP FOR INSPECTION AFTER THE INSTALLATION OF 2-WAY FM EQUIPMENT. THEY PROVIDE COMPLETE COVERAGE NOW, EVEN WHERE AM COULD NOT REACH

police cars and of those used by the Fire Department Battalion Chiefs. Our river patrol boat, which performs important duties in protecting the riverfront, is fitted with a 2-way installation that works perfectly. We were a little dubious about this at first, because we expected that it would be cut off at some points from headquarters, but our fears were unfounded.

Eventually, the surrounding boroughs and townships will install similar car equipment, to tie in with the Pittsburgh system. This will largely eliminate the need of additional main stations in this area.

The radio station personnel is made up of seven assistants, Charles L. Kirch, William E. Horlbeck, N. R. Szwarc, Howard Moyer, George McLachlan, Regis O'Donnell, and Howard Wacker, with the writer in charge as chief operator.

There are two radio operators on duty at all times, working in 8-hour turns.

At the headquarters building, shown in Fig. 2, we are setting up a completely equipped service shop in which repairs and all routine service work can be handled. This will be done on a very thorough and carefully planned schedule, so that we can anticipate and forestall normal replacement needs, and thereby conserve our equipment.

BOOK REVIEW

DYNAMIC ANALOGIES: Harry F. Olson, E.E., Ph D. 196 pages, profusely illustrated, $5\frac{3}{4}$ by $8\frac{3}{4}$ ins., cloth bound. Published by D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York City.

By making comparisons with familiar electrical circuit theory, the design of mechanical and acoustical systems can be made clear in a most useful and fascinating manner. Dr. Olson, who is Acoustical Research Director of RCA's Princeton Laboratories, has set forth in his book the methods by which comparisons with electrical circuits, our most familiar types of vibrating systems, can be used to analyze the actions of mechanical and acoustical structures and assemblies.

Throughout the book, illustrations are used to show pictorially the elements of resistance, inductance, and capacity as they appear in electrical, acoustical, mechanical-rectilineal, and mechanical-rotational systems.

To show the analogies, the following pictorial representations are employed for resistance, inductance, and capacity:

1. Acoustical values, respectively, a passage partly barred by shutters, an open passage, and a partly-open chamber.
2. Mechanical-rectilineal values, respectively, two flat surfaces in contact, a rectangle, and a spring.
3. Mechanical-rotational values, respectively, a brake drum and friction shoe, a fly-wheel, and a broken shaft joined by a spring.

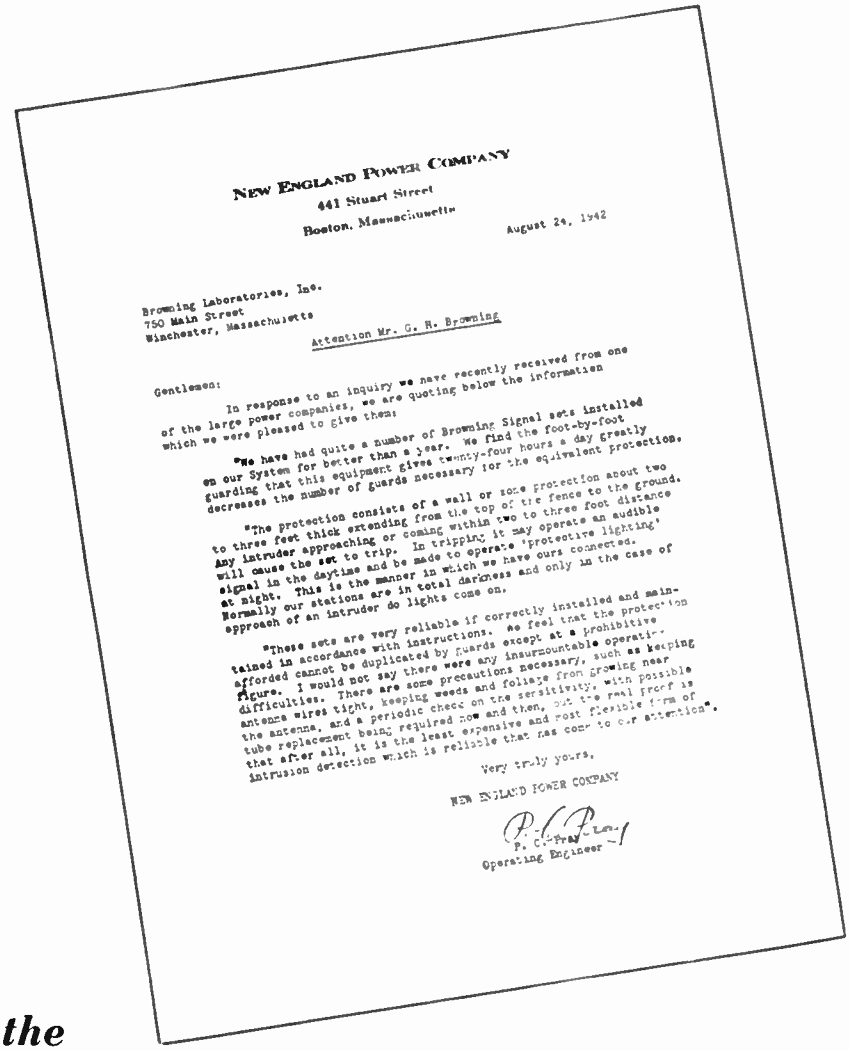
The first chapter is wisely devoted to definitions, many of which may be unfamiliar to electrical and mechanical engineers alike. This is followed by a chapter which discusses and explains the relationships between electrical values and analogous mechanical and acoustical values.

Analogies involving one degree of freedom, and two and three degrees of freedom are set forth in the two chapters following. Next, in order, are those on corrective networks, wave filters, transients, driving systems, generating systems, and theorems.

Examples of applications in the concluding chapter illustrate the practical value of using the methods described in the solution of such familiar problems as the design of automobile mufflers, electric razors, direct-radiation loudspeakers, rotational vibration dampers, machine vibration isolators, shock-proof instrument mountings, and automobile spring suspension systems.

There is endless food for thought in this book, and much that is directly applicable to the work of radio engineers who are concerned with apparatus design. That is particularly true of aircraft radio equipment, and mobile apparatus, since their mechanical design must take into account and provide against the effects of severe and continued vibration.

Dr. Olson's book deserves a place in every electrical and mechanical engineering library.



NEW ENGLAND POWER COMPANY
441 Stuart Street
Boston, Massachusetts

August 24, 1942

Browning Laboratories, Inc.
750 Main Street
Winchester, Massachusetts

Attention Mr. G. H. Browning

Gentlemen:

In response to an inquiry we have recently received from one of the large power companies, we are quoting below the information which we were pleased to give them:

"We have had quite a number of Browning Signal sets installed on our System for better than a year. We find the foot-by-foot guarding that this equipment gives twenty-four hours a day greatly decreases the number of guards necessary for the equivalent protection.

"The protection consists of a wall or zone protection about two to three feet thick extending from the top of the fence to the ground. Any intruder approaching or coming within two to three foot distance will cause the set to trip. In tripping it may operate an audible signal in the daytime and be made to operate 'protective lighting' at night. This is the manner in which we have ours connected. Normally our stations are in total darkness and only in the case of approach of an intruder do lights come on.

"These sets are very reliable if correctly installed and maintained in accordance with instructions. We feel that the protection afforded cannot be duplicated by guards except at a prohibitive figure. I would not say there were any insurmountable operating difficulties. There are some precautions necessary, such as keeping antenna wires tight, keeping weeds and foliage from growing near the antenna, and a periodic check on the sensitivity, with possible tube replacement being required now and then, but the real proof is that after all, it is the least expensive and most flexible form of intrusion detection which is reliable that has come to our attention".

Very truly yours,

NEW ENGLAND POWER COMPANY

P. C. Pray
Operating Engineer

Report on the

BROWNING SIGNAL SYSTEM

Product of

BROWNING LABORATORIES RESEARCH

The effectiveness of the Browning Signal System has been proven during two years' service in guarding vital areas against intruders. Unaffected by climatic conditions, it creates a continuous "wall" that cannot be *approached* without giving a general alarm and actuating a location indicator. Information is available to officials of public utilities and war plants.

BROWNING LABORATORIES, Inc.

751 MAIN STREET — WINCHESTER, MASS.

RADIO-ELECTRONIC PRODUCTS DIRECTORY

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

★ Indicates advertiser in this issue of Radio-Electronic Engineering

Additions This Month

10 NEW LISTINGS

44 NEW MANUFACTURERS' NAMES

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.

ANTENNAS, Mobile Whip & Collapsible

Birnbach Radio Co., 145 Hudson St., N. Y. C.
Brach Mfg. Corp., L. S., Newark, N. J.
Camburn Elec. Co., 484 Broome St., N. Y. C.
Galvin Mfg. Corp., Chicago, Ill.
★ Link, F. M., 125 W. 17th St., N. Y. C.
Premax Products, 4214 Highland Ave., Niagara Falls, N. Y.
★ Radio Eng. Labs., Inc., L. I. City, N. Y.
Snyder Mfg. Co., Noble & Darien Sts., Phila.
Tech. Appl. Co., 516 W. 34 St., N. Y. C.
Ward Products Corp., 1523 E. 45 St., Cleveland, O.

ANTENNAS, Tower Type

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

ATTENUATORS

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

BEADS, Insulating

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

BINDING POSTS, Plain

Amer. Hdware Co., 476 B'way, N. Y. C.
Radex Corp., 1308 Elston Ave., Chicago

BINDING POSTS, Push Type

Amer. Radio Hdware Co., 476 B'way, N. Y. C.
Eby, Inc., H. H., W. Chelten Ave., Phila.

BOOKS on Radio & Electronics

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

BRIDGES, Percent Limit Resistance

★ Radio City Products Co., 127 W. 26 St., N. Y. C.
Shallcross Mfg. Co., Collingdale, Pa.

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

CABLE, Coaxial, Solid Dielectric

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

CABLE, Microphone, Speaker & Battery

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

CASES, Wooden Instrument

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

CASTINGS, Die

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

CERAMICS, Bushings, Washers, Special Shapes

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

CHOKES, RF

Aladdin Radio Industries, 501 W. 35th, Chicago
Alden Prods. Co., Brockton, Mass.
American Communications Corp., 306 B'way, N. Y. C.
Barber & Williamson, Upper Darby, Pa.
Coto-Coil Co., Providence, R. I.
D-X Radio Prods. Co., 1575 Milwaukee, Chicago
Gen. Winding Co., 420 W. 45 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.
Ilsco Copper Tube & Prods., Inc., Station M., Cincinnati
Jefferson Elec. Co., Bellwood, Ill.
Jones, Howard B., 2300 Wabansia, Chicago
Littlefuse, Inc., 4753 Ravenswood, Chicago
Patton MacGuyer Co., Providence, R. I.
Sherman Mfg. Co., H. B., Battle Creek, Mich.
Stewart Stamping Co., 621 E. 216 St., Bronx, N. Y.
Zierick Mfg. Co., 385 Girard Ave., Bronx, N. Y. C.

CLOTH, Insulating

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

COIL FORMS, Phenolic, Cast without Molds

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

COILS, Radio

See Transformers, IF, RF

CONDENSERS, Fixed

Aerovox Corp., New Bedford, Mass.
American Condenser Corp., 2508 S. Michigan, Chicago
Art Radio Corp., 115 Liberty, N. Y. C.
Atlas Condenser Prods. Co., 548 Westchester Ave., N. Y. C.
Automatic Winding Co., E. Newark, N. J.
Bud Radio, Inc., Cleveland, O.
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, 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., 1160 Howe St., Chicago
Industrial Cond. Corp., 1725 W. North Av., Chicago
Insuline Corp. of America, Long Island City, N. Y.
Johnson Co., E. F., Waseca, Minn.
Kellogg Switchb'd & Supply Co., 6650 Cicero, Chicago
Magnavox Co., Fort Wayne, Ind.
Mallory & Co., P. R., Indianapolis, Ind.
Micamold Radio Corp., Brooklyn, N. Y.
Muter Co., 1255 S. Michigan, Chicago
Noma Electric Corp., 55 W. 13 St., N. Y. C.
Polymet Condenser Co., 699 E. 139 St., N. Y. C.
Potter Co., 1950 Sheridan Rd., N. Chicago
RCA Mfg. Co., Camden, N. J.
Sangamo Elec. Co., Springfield, Ill.
Sickles Co., F. W., Chicopee, Mass.
Solar Mfg. Corp., Bayonne, N. J.
Sprague Specialties Co., N. Adams, Mass.
Teleradio Engineering Corp., 484 Broome St., N. Y. C.

CONDENSERS, Gas-filled

Lapp Insulator Co., Inc., Leroy, N. Y.

CONDENSERS, High-Voltage Vacuum

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

CONDENSERS, Small Ceramic Tubular

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

CONDENSERS, Tubular Ceramic Transmitting

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

CONDENSERS, Variable Receiver Tuning

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

CONDENSERS, Variable Transmitter Tuning

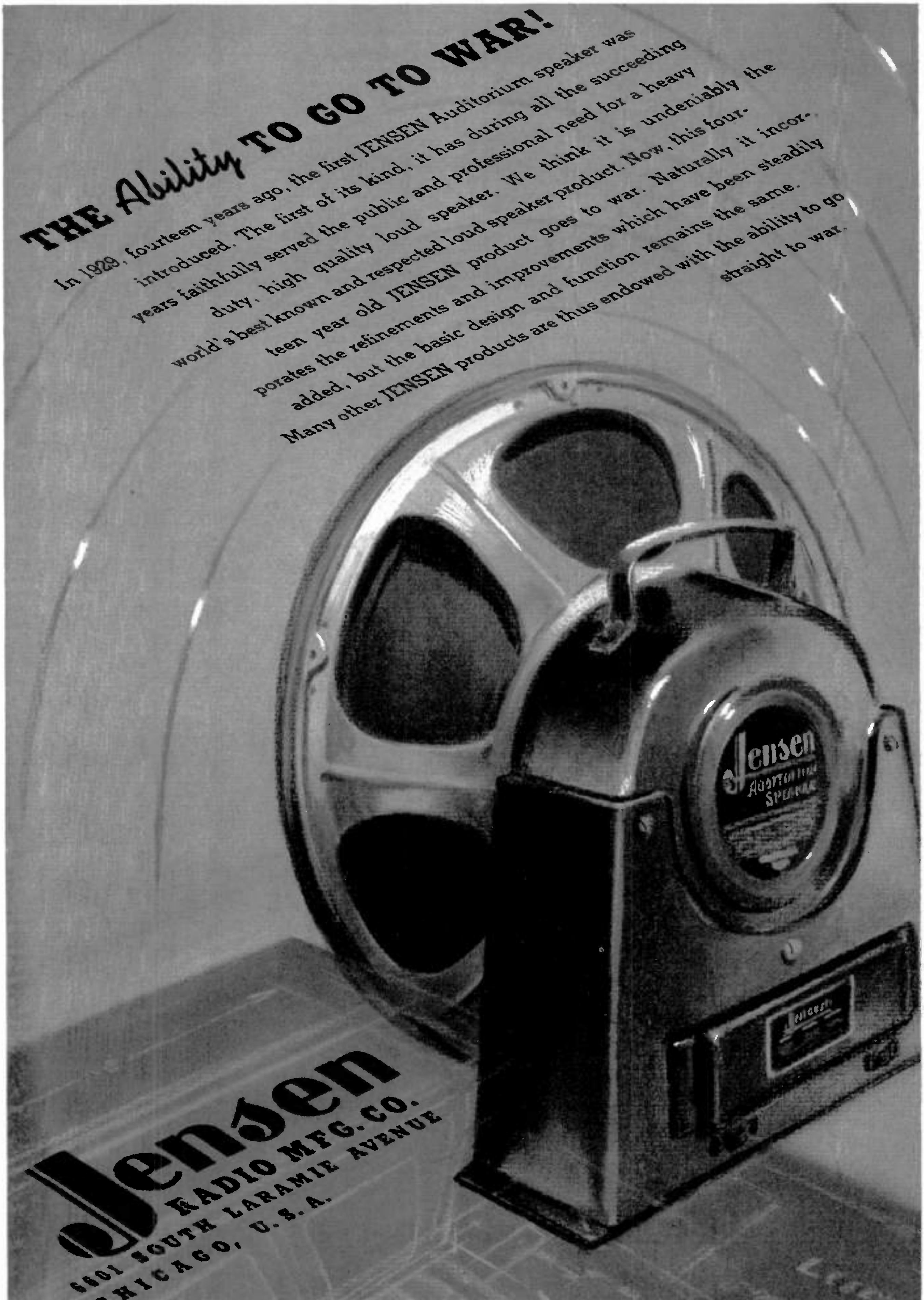
Barker & Williamson, Upper Darby, Pa.
Bud Radio, Cleveland, O.
Cardwell Mfg. Corp., Allen D., Brooklyn, N. Y.
Hammarlund Mfg. Co., 424 W. 33 St., N. Y. C.
Insuline Corp. of Amer., L. I. City, N. Y.
Johnson, E. F., Waseca, Minn.
Millen Mfg. Co., James, Malden, Mass.
★ National Co., Malden, Mass.
Radio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

CONDENSERS, Variable Trimmer

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

CONNECTORS, Cable

Aero Electric Corp., Los Angeles, Calif.
Airadio, Inc., Stamford, Conn.
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
Astatic Corp., Youngstown, O.
Atlas Sound Corp., 1442 39th St., Brooklyn, N. Y.
Birnbach Radio, 145 Hudson St., N. Y. C.
Breeze Mfg. Corp., Newark, N. J.
Brush Development Co., Cleveland, O.
Bud Radio, Cleveland, Ohio
Cannon Elec. Development, 3209 Humboldt, Los Angeles
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.
Harwood Co., 747 N. Highland Ave., Los Angeles
Insuline Corp. of Amer., L. I. City, N. Y.
Jones, Howard B., 2300 Wabansia, Chicago


THE Ability TO GO TO WAR!
In 1929, fourteen years ago, the first JENSEN Auditorium speaker was introduced. The first of its kind, it has during all the succeeding years faithfully served the public and professional need for a heavy duty, high quality loud speaker. We think it is undeniably the world's best known and respected loud speaker product. Now, this fourteen year old JENSEN product goes to war. Naturally it incorporates the refinements and improvements which have been steadily added, but the basic design and function remains the same. Many other JENSEN products are thus endowed with the ability to go straight to war.
Jensen
RADIO MFG. CO.
6601 SOUTH LARAMIE AVENUE
CHICAGO, U.S.A.

Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago
Mallory & Co., P. R., Indianapolis, Ind.
Monowatt Electric Co., Providence, R. I.
★ Radio City Products Co., 127 W. 26 St., N. Y. C.
Remler Co., Ltd., 2101 Bryant St., San Francisco
Selectar Mfg. Co., L. I. City, N. Y.
★ Universal Microphone Co., Ltd., Inglewood, Calif.

CONTACT POINTS

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

COUPLINGS, flexible

Cardwell Mfg. Corp., Brooklyn, N. Y.
Johnson Co., E. F., Waseca, Minn.
Millen Mfg. Co., James, Malden, Mass.
★ National Co., Inc., Malden, Mass.

CRYSTAL GRINDING EQUIPMENT

Felker Mfg. Co., Torrance, Calif.

CRYSTAL HOLDERS

REC Mfg. Co., Holliston, Mass.

CRYSTALS, Quartz

Bausch & Lomb Optical Co., Rochester, N. Y.
Bliley Elec. Co., Erie, Penna.
Collins Radio Co., Cedar Rapids, Iowa
Crystal Prod. Co., 1519 McGee St., Kansas City, Mo.
Crystal Research Labs., Hartford, Conn.
DX Crystal Co., W. Carroll Ave., Chicago
Electronic Research Corp., 890 W. Washington Blvd., Chicago
Federal Engineering Co., 37 Murray St., N. Y. C.
★ General Electric Co., Schenectady, N. Y.
General Radio Co., Cambridge, Mass.
Harvey-Wells Communications, Southbridge, Mass.
Higgins Industries, Santa Monica, Calif.
Hipower Crystal Co., 2035 W. Charleston, Chicago
Hunt & Sons, G. C., Carlisle, Pa.
Jefferson, Inc., Ray, Westport, L. I., N. Y.
Kaar Engineering Co., Palo Alto, Cal.
Meck Industries, John, Plymouth, Ind.
Miller, August E., North Bergen, N. J.
Monitor Piezo Prod. Co., S. Pasadena, Calif.
Peterson Radio, Council Bluffs, Iowa
Precision Piezo Service, Baton Rouge, La.
Premier Crystal Labs., 63 Park Row, N. Y. C.
Radell Corp., Guilford Ave., Indianapolis, Ind.
RCA Mfg. Co., Camden, N. J.
★ Scientific Radio Products Co., Council Bluffs, Ia.
Scientific Radio Service, Hyattsville, Md.
Standard Piezo Co., Carlisle, Pa.
Valpey Crystals, Holliston, Mass.
Zeiss, Inc., Carl, 485 Fifth Ave., N. Y. C.

DIALS, Instrument

Crowe Name Plate Co., 3701 Ravenswood Ave., Chicago
General Radio Co., Cambridge, Mass.
Gits Molding Corp., 4600 Huron St., Chicago
Mica Insul. Co., 198 Varick St., N. Y. C.
★ National Co. Inc., Malden, Mass.
★ Rogan Bros. 2003 S. Michigan Ave., Chicago

DISCS, Recording

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

DYNAMOTORS — See Motor-Generators

ENGRAVING MACHINES

★ Auto-Engraver Co., 1776 B'way, N. Y. C.

ETCHING, Metal

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

FACSIMILE EQUIPMENT

Alden Products Co., Inc., Brockton, Mass.

FASTENERS, Separable

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

FELT

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

FIBRE, Vulcanized

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

FILTERS, Electrical Noise

Avia Products Co., 737 N. Highland Ave., Los Angeles
Com. Equip. & Eng. Co., N. Parkside Ave., Chicago
Freed Radio Corp., 200 Hudson St., N. Y. C.
Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Tobe Deutschmann Corp., Canton, Mass.

FINISHES, Metal

Airose 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

Bendix Radio, Towson, Md.
★ Browning Labs., Inc., Winchester, Mass
General Radio Co., Cambridge, Mass.
Lavoie Laboratories, Long Branch, N. J.
★ Link, F. M., 125 W. 17 St., N. Y. C.
★ Measurements Corp., Boonton, N. J.

FREQUENCY STANDARDS, Primary

General Radio Co., Cambridge, Mass.

FREQUENCY STANDARDS, Quartz Secondary

Garner Co., Fred E., 43 E. Ohio St., Chicago
Hewlett-Packard Co., Palo Alto, Calif.
Millen Mfg. Co., Inc., Malden, Mass.

FUSES, Enclosed

Dante Elec. Mfg. Co., Bantam, Conn.
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.
Quaker City Gear Wks., Inc., N. Front St., Phila.
Thompson Clock Co., Bristol, Conn.

GEARS & PINIONS, Non-Metallic

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

GENERATORS, Gas Engine Driven

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

GENERATORS, Hand Driven

Burke Electric Co., Erie, Pa.
Carter Motor Co., 1608 Milwaukee, Chicago

GENERATORS, Standard Signal

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

GENERATORS, Wind-Driven, Aircraft

General Armature Corp., Lock Haven, Pa.

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.
Consolidated Radio Prod. Co., W. Erie St., Chicago

- Elec. Ind. Mfg. Co., Red Bank, N. J.
- Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago
- Murdock Mfg. Co., Chelsea, Mass.
- Permoflux Corp., W. Grand Ave., Chicago
- Telephonics Corp., 350 W. 31 St., N. Y. C.
- Trimm Radio Mfg. Co., 1770 W. Berteau, Chicago
- ★ Universal Microphone Co., Inglewood, Cal.
- Utah Radio Prod. Co., 842 Orleans St., Chicago

HORNS, Outdoor

- Graybar Elect. Co., Lexington Ave. at 43 St., N. Y. C.
- ★ Jensen Radio Mfg. Co., 6601 S. Laramie Ave., Chicago
- Operadio Mfg. Co., St. Charles, Ill.
- Oxford Tartak Radio Corp., 915 W. Van Buren St., Chicago
- Racon Electric Co., 52 E. 19 St., N. Y. C.
- RCA Mfg. Co., Camden, N. J.
- University Laboratories, 225 Varick St., N. Y. C.

INDUCTION HEATING EQUIPMENT

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

INDUCTORS, Variable Tuning

- Barker & Williamson, Upper Darby, Pa.

INSTRUMENTS, Radio Laboratory

- Ballantine Laboratories, Inc., Boonton, N. J.
- General Radio Co., Cambridge, Mass.
- Hewlett Packard Co., Palo Alto, Calif.
- ★ Measurements Corp., Boonton, N. J.

INSULATORS, Ceramic Stand-off, Lead-in, Rod Types

- America Lava Corp., Chattanooga, Tenn.
- Corning Glass Works, Corning, N. Y.
- Electronic Mechanics, Inc., Clifton, N. J.
- Isolantite, Inc., Belleville, N. S.
- Johnson Co., E. F., Waseca, Minn.
- Lapp Insulator Co., Inc., Leroy, N. Y.
- Locke Insulator Co., Baltimore, Md.
- Millen Mfg. Co., Malden, Mass.
- ★ National Co., Inc., Malden, Mass.

IRON CORES, Powdered

- Aladdin Radio Industries, Inc., 501 W. 35 St., Chicago
- Crowley & Co., Henry, W. Orange, N. J.
- Ferrocart Corp. of Amer., Hastings-on-Hudson, N. Y.
- Genl. Aniline Wks., 435 Hudson St., N. Y. C.
- Gibson Elec. Co., Pittsburgh, Pa.
- Mallory & Co., P. R., Indianapolis, Ind.
- Pyroferric Co., 175 Varick St., N. Y. C.
- Stackpole Carbon Co., St. Marys, Pa.
- Western Electric Co., 195 Broadway, N. Y. C.
- Wilson Co., H. A., Newark, N. J.

IRONS, Soldering

- Acme Electric Heating Co., 1217 Washington St., Boston
- Amer. Electrical Heater Co., 6110 Cass Ave., Detroit
- Drake Elec. Wks., Inc., 3656 Lincoln Ave., Chicago
- ★ Electric Soldering Iron Co., Deep River, Conn.
- ★ General Electric Co., Schenectady, N. Y.
- Hexacon Elec. Co., Roselle Park, N. J.
- Vasco Electrical Mfg. Co., 4116 Avalon Blvd., Los Angeles
- Vulcan Electric Co., Lynn, Mass.

JACKS, Telephone

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

KEYS, Telegraph

- Amer. Radio Hardware Co., Inc., 476 Broadway, N. Y. C.
- Bunnell & Co., J. H., 215 Fulton St., N. Y. C.
- Mossman, Inc., Donald P., 6133 N. Northwest Hy., Chicago
- Remler Co., Ltd., 2101 Bryant St., San Francisco
- Signal Electric Mfg. Co., Menominee, Mich.
- Telephonics Corp., 350 W. 31 St., N. Y. C.
- Winslow Co., Inc., Liberty St., Newark, N. J.

KNOBS, Radio & Instrument

- Alden Prods. Co., Brockton, Mass.
- American Insulator Corp., New Freedom, Pa.
- Chicago Molded Prods. Corp., 1025 N. Kolmar, Chicago
- General Radio Co., Cambridge, Mass.
- Gits Molding Corp., 4600 Huron St., Chicago
- 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

LABELS, Removable

- Avery Adhesives, 451 3rd St., Los Angeles

LABELS, Stick-to-Metal

- Ever Ready Label Corp., E. 25th St., N. Y. C.

LABORATORIES, Electronic

- ★ Browning Labs., Inc., Winchester, Mass.
- Hazeltine Electronics Corp., 1775 B'way, N. Y. C.
- Sherron Metallic Corp., Flushing Ave., Brooklyn, N. Y.

LUGS, Soldering

- Burndy Engineering Co., 459 E. 133rd St., N. Y. C.
- Cinch Mfg. Corp., W. Van Buren St., Chicago
- Dante Elec. Mfg. Co., Bantam, Conn.
- Ideal Commutator Dresser Co., Sycamore, Ill.
- Ilsco Copper Tube & Prods., Inc., Station M, Cincinnati
- Krueger & Hudepohl, Third & Vine, Cincinnati, O.
- Patton-MacGuyer Co., 17 Virginia Av., Providence, R. I.
- Sherman Mfg. Co., Battle Creek, Mich.
- Thomas & Betts Co., Elizabeth, N. J.
- Zierick Mfg. Co., 385 Girard Ave., Bronx, N. Y. C.

LUGS, Solderless

- Aircraft Marine Prod., Inc., Elizabeth, N. J.
- Burndy Eng. Co., 107 Eastern Blvd., N. Y. C.

MACHINES, Impregnating

- Stokes Machine Co., F. J., Phila., Pa.

MACHINES, Screwdriving

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

MAGNETS, Permanent

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

MAIL ORDER SUPPLY HOUSES

- Allied Radio Corp., 901 W. Jackson Blvd., Chicago
- ★ Burstein-Applebee Co., Kansas City, Mo.
- Harrison Radio Corp., 12 W. B'way, N. Y. C.
- Lafayette Radio Corp., 901 W. Jackson Blvd., Chicago
- ★ Sun Radio Co., 212 Fulton St., N. Y. C.

MARKERS, Wire Identification

- Brand & Co., Wm., 276 4th Ave., N. Y. C.
- Ntl. Varnished Prod. Corp., Woodbridge, N. J.

METAL, Thermostatic

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

METERS, Ammeters, Voltmeters, Small Panel

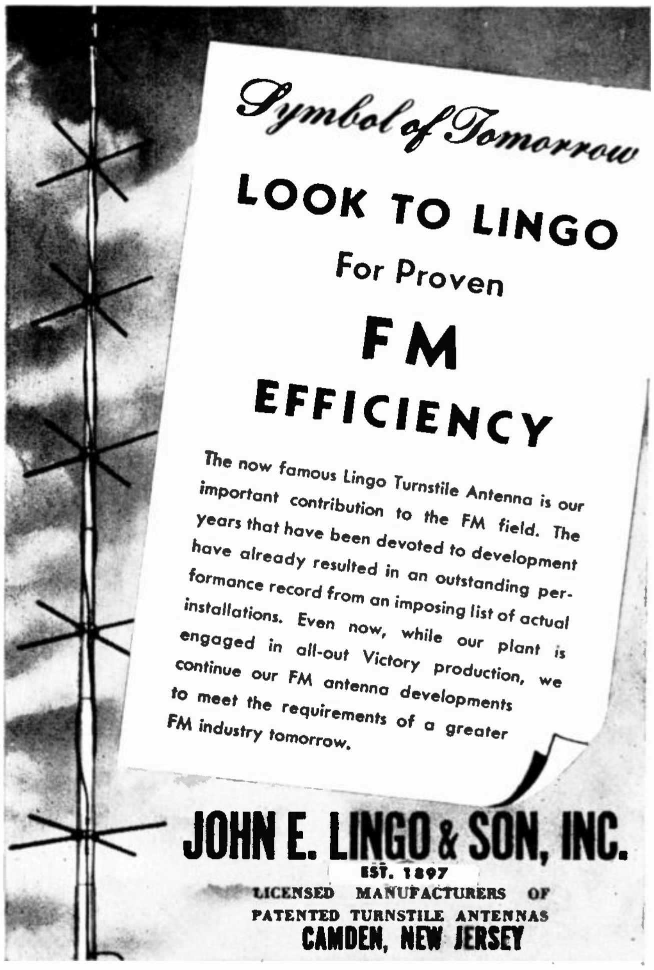
- Cambridge Inst. Co., Grand Central Terminal, N. Y. C.
- De Jur-Amsco Corp., Shelton, Conn.
- ★ General Electric Co., Bridgeport, Conn.
- Hickok Elec. Inst. Co., Cleveland, O.
- Hoyt Elec. Inst. Works, Boston, Mass.
- Readrite Meter Works, Bluffton, O.
- Roller-Smith Co., Bethlehem, Pa.
- ★ Simpson Elec. Co., 5218 W. Kinzie, Chicago
- ★ Triplett Elec. Inst. Co., Bluffton, O.
- Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
- Weston Elec. Inst. Corp., Newark, N. J.
- Wheelco Inst. Co., 847 W. Harrison St., Chicago

METERS, Q

- Boonton Radio Corp., Boonton, N. J.

METERS, Vacuum Tube Volt

- Ballantine Laboratories, Inc., Boonton, N. J.
- Ferris Instrument Corp., Boonton, N. J.
- General Radio Co., Cambridge, Mass.
- Hewlett-Packard Co., Palo Alto, Calif.
- ★ Measurements Corp., Boonton, N. J.
- ★ Radio City Products Co., 127 W. 26 St., N. Y. C.



METERS, Vibrating Reed

Biddle, James G., 1211 Arch St., Phila.
★ Triplett Elec. Inst. Co., Bluffton, O.

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, Ill.

MICROPHONES

Amer. Microphone Co., 1015 Western Av., Los Angeles
Amperite Co., 561 B'way, N. Y. C.
Astatic Corp., Youngstown, O.
Brush Development Co., Cleveland, O.
Electro Voice Mfg. Co., South Bend, Ind.
Kellogg Switchboard & Supply Co., 6650 S. Cicero, Chicago
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
Telephonics Corp., 350 W. 31 St., N.Y.C.
Turner Co., Cedar Rapids, Ia.
★ Universal Microphone Co., Inglewood, Cal.

MONITORS, Frequency

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

MOTOR-GENERATORS, 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 Armature Corp., Lock Haven, Pa.
★ General Electric Co., Schenectady, N. Y.
Jannette Mfg. Co., 558 W. Monroe, Chicago
Knapp-Monarch, St. Louis, Mo.
Leland Electric Co., Dayton, O.
Ohio Electric Co., 74 Trinity Pl., N. Y. C.
★ Pioneer Gen-E-Motor, 5841 W. Dickens Av., Chicago
Redmond Co., A. G., Owosso, Mich.
Russell Co., Chicago, Ill.
Small Motors Inc., 1308 Elston Ave., Chicago
Webster Co., Chicago, Ill.
Westinghouse Elect. Mfg. Co., Lima, O.
Wincharger Corp., Sioux City, Iowa

MOTORS, Very Small Types

Utah Radio Prod. Co., 842 Orleans St., Chicago

MOUNTINGS, Shock Absorbing

Lord Mfg. Co., Erie, Pa.
Pierce-Roberts Co., Trenton, N. J.
U. S. Rubber Co., 1230–6th Ave., N.Y.C.

MYCALEX

★ General Electric Co., Schenectady, N. Y.
Mycalex Corp. of Amer., Clifton, N. J.

NICKEL, Sheet, Rod, Tubes

Eagle Metals Co., Seattle, Wash.
Pacific Metals Co., Ltd., San Francisco, Calif.
Steel Sales Corp., 129 S. Jefferson St., Chicago
Tull Metal & Supply Co., J. M., Atlanta, Ga.
Whitehead Metal Prod. Co., 303 W. 10th St., N. Y. C.
Williams and Co., Inc., Pittsburgh, Pa.

NUTS, Self-locking

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

OSCILLOSCOPES, Cathode Ray

Du Mont Laboratories, Inc., Allen B., Passaic, N. J.
★ General Electric Co., Schenectady, N. Y.
General Radio Co., Cambridge, Mass.
Millen Mfg. Co., Malden, Mass.
RCA Mfg. Co., Inc., Camden, N. J.
★ Radio City Products Co., Inc., 127 W. 26 St., N. Y. C.

OVENS, Industrial & Laboratory

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

PANELS, Metal Etched
(See Etching, Metal)

PANELS, Phenolic, Cast without Molds

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

PILOT LIGHTS

Alden Prods. Co., Brockton, Mass.
Amer. Radio Hardware Co., Inc., 467 B'way, N. Y. C.
Dial Light Co. of Amer., 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.
Gothard Mfg. Co., Springfield, Ill.
Herzog Miniature Lamp Works, 12–19 Jackson Av., Long Island City, N.Y.C.
Kirkland Co., H. R., Morristown, N. J.
Mallory & Co., P. R., Indianapolis, Ind.
Signal Indicator Corp., 140 Cedar St., N. Y. C.

PHOSPHOR BRONZE

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

PLASTICS, Cast without Molds

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

PLASTICS, Extruded

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

PLASTIC SHEET, for Name Plates

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

PLASTICS, Injection Molded

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

PLASTICS, Laminated or Molded

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

PLASTICS, Materials

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

PLASTICS, Transparent

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

(CONTINUED FROM PAGE 24)

and locations of the studs, make for economy in this operation.

Induction heating is generally preferable, particularly for substantial production runs. If the parts are to be heated with an iron, thermostatic control is recommended because excessive heat may result in improper adhesion to the ceramic bushing. Heat must be controlled in the neighborhood of 650° C. Such an iron as the American Beauty No. 3158, of 300 watts capacity, is suitable for this purpose.

2. When using the larger bushings, or when inserting small bushings in heavy-gauge covers, bushings supplied with metallic rings should be used. A circular well is formed in the cover, and then solder is flowed into the well, around the sealing ring.

Two types of terminals are available, both of which can be seen in cross-section in Fig. 5. The first is the hollow type, permitting the lead wire to be drawn through and soldered at the top after assembly of the case and the cover plate. The second has a solid stud, to which the lead wire must be soldered before the cover plate is secured to the case.

It is necessary, of course, to select the correct type of terminal and mechanical construction for each particular application, so that the finished units will meet the requirements of either one of the immersion tests.

Assistance in this matter can be obtained through the Industrial Division of the Westinghouse Company.

EDITOR'S NOTE: *Part 2 of this paper will present detailed information on the use of glass seals produced by the Corning Glass Works.*

DESIGN PLANNING FOR AIRCRAFT RADIO, Part 2

The second part of *Design Planning for Aircraft Radio*, by Burt Zimet, originally planned for this issue, will appear next month. The delay, occasioned by the extreme pressure under which all radio engineers are working today, made this postponement necessary. However, the illustrations and manuscript are now at hand, and publication is assured in our July issue.

This series will present the most complete and valuable design data on aircraft radio equipment that has ever been published, and should be preserved by every radio engineer engaged in this field of radio development.

CBS SHORT-WAVE TRANSMITTER

(CONTINUED FROM PAGE 21)

imately eight hours a day, broadcasts are continued to South America to be rebroadcast over the CBS network there. This latter service is conducted in coöperation with the Office of Coördination of Inter-American Affairs.

With almost continuous operation for more than a year, the efficiency and reliability of the CBS transmitters have been amply demonstrated. Under war conditions, breakdown would be costly in strategic materials and highly burdensome to train personnel; the long life as well as efficiency of the Federal tubes, specially designed for this type of service, thus are proving highly advantageous.

These transmitters were built after more than three years of research and study. Their features — facilities for rapid and continuous frequency change, highly efficient directional antennas, a unique antenna distribution switching mechanism, a control system permitting maximum flexibility and efficiency in the connection and interconnection of the various units, as well as many factors of safety and efficiency — represent the culmination of this research by designers and builders with wide experience in the shortwave broadcast field.

Of outstanding importance are the motor-tuned plate and harmonic lines and the special antenna switching equipment, particularly since they represent new contributions to the development of high-powered, shortwave broadcasting facilities. These two latter features, in fact, have proven particularly useful under present emergency conditions necessitat-

(CONTINUED ON PAGE 37)

Celanese Celluloid Corp., 180 Madison Ave., N. Y. C.
du Pont de Nemours & Co., E. I., Arlington, N. J.
Plax Corp., Hartford, Conn.
Printloid Corp., 93 Mercer St., N. Y. C.
Rohm & Haas Co., Washington Sq., Philadelphia

PLATING, Metal on Molded Parts
Metaplast Corp., 205 W. 19 St., N. Y. C.

PLUGS (Banana), Spring Type
Amer. Radio H'dw're Co., 476 B'way, N. Y. C.
Birnbach Radio Co., 145 Hudson St., N. Y. C.
Eastman Kodak Co., Rochester, N. Y.
Eby, Inc., Hugh H., Philadelphia, Pa.
Franklin Mfg. Corp., 175 Varick St., N. Y. C.
General Radio Co., Cambridge, Mass.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Ucinite Co., Newtonville, Mass.

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

PLYWOOD, Metal Faced
Haskelite Mfg. Corp., 208 W. Washington St., Chicago

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.

RECTIFIERS, Instrument & Relay
Selenium Corp. of Amer., 1800 W. Pico Blvd., Los Angeles

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

REGULATORS, Voltage
Acme Elec. & Mfg. Co., Cuba, N. Y.
Amperite Co., 561 Broadway, N. Y. C.
Ferranti Elec., Inc., 30 Rockefeller Plaza, N. Y. C.
★ General Elec. Co., Schenectady, N. Y.
H-B Elec. Co., Philadelphia
Sola Electric Co., 2525 Clybourn Av., Chicago
★ United Transformer Corp., 150 Varick St., N. Y. C.

RELAYS, Small Switching
Allied Control Co., Inc., 223 Fulton St., N. Y. C.
Amperite Co., 561 Broadway, N. Y. C.
G-M Laboratories, Inc., 4313 N. Knox Ave., Chicago
Guardian Elec. Co., 1400 W. Wash. Blvd., Chicago
Potter & Brumfield Co., Princeton, Ind.
Sigma Instruments, Inc., 76 Freeport St., Boston, Mass.
Struthers Dunn, Inc., 1326 Cherry St., Philadelphia
Ward-Leonard Elec. Co., Mt. Vernon, N. Y.

RELAYS, Small Telephone Type
Amer. Automatic Elect. Sales Co., 1033 W. Van Buren St., Chicago
Clare & Co., C. P., 4719 W. Sunnyside Ave., Chicago
Guardian Elec. Co., 1400 W. Wash. Blvd., Chicago
Wick Organ Co., Highland, Ill.

RELAYS, Stepping
Advance Elect. Co., 1260-A W. 2nd St., Los Angeles
Automatic Elect. Co., 1032 W. Van Buren St., Chicago
Autocall Co., Shelby, O.
Guardian Elect. Mfg. Co., 1620 W. Walnut St., Chicago
Presto Elect. Co., N. Y. Ave., Union City, N. J.
Struthers Dunn, Inc., Arch St., Phila.

RELAYS, Time Delay
Amperite Co., 561 Broadway, N. Y. C.
Haydon Mfg. Co., Inc., Forestville, Conn.
Industrial Timer Corp., Newark, N. J.
Sangamo Elec. Co., Springfield, Ill.
Ward-Leonard Elec. Co., Mt. Vernon, N. Y.

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

RESISTORS, Fixed
Acme Elec. Heating Co., Boston, Mass.
Aerovox Corp., New Bedford, Mass.
Allen-Bradley Co., Milwaukee, Wis.
Atlas Resistor Co., 423 Broome St., N. Y. C.
Carborundum Co., Niagara Falls, N. Y.
Centralab, Milwaukee, Wisconsin
Clarostat Mfg. Co., 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
Sensitive Research Inst. Corp., 4545 Bronx Blvd., N. Y. C.
Shallcross Mfg. Co., Collingdale, Pa.
Speer Resistor Corp., St. Marys, Pa.
Sprague Specialties Co., N. Adams, Mass.
Stackpole Carbon Co., St. Marys, Pa.
Utah Radio Prod. Co., 842 Orleans St., Chicago
Ward-Leonard Elec. Co., Mt. Vernon, N. Y.
White Dental Mfg. Co., 10 E. 40th St., N. Y. C.
Wirt Co., Germantown, Pa.

RESISTORS, Fixed Precision
Instrument Resistors, Inc., Little Falls, N. J.
Intern'l Resistance Co., Philadelphia
Ohmite Mfg. Co., 4835 Flournoy St., Chicago
Shallcross Mfg. Co., Collingdale, Pa.

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

RESISTORS, Variable
Aerovox Corp., New Bedford, Mass.
Allen-Bradley Co., Milwaukee, Wis.
Amer. Instrument Co., Silver Spring, Md.
Atlas Resistor Co., N. Y. C.
Biddle Co., James G., Arch St., Phila., Pa.
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
Kellogg Switchboard & Sup. Co., 6650 S. Cicero Ave., Chicago
Lectrohm, Inc., 5125 W. 25 St., Cicero, Ill.
Mallory & Co., P. R., Indianapolis, Ind.
Ohio Carbon Co., Cleveland, Ohio
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago
Shallcross Mfg. Co., Collingdale, Pa.
Stackpole Carbon Co., St. Marys, Pa.
Utah Radio Prods. Co., 820 Orleans St., Chicago
Ward-Leonard Elec. Co., Mt. Vernon, N. Y.
Wirt Co., Germantown, Pa.

RESISTORS, Variable, Ceramic Base
Hardwick, Hindle, Inc., Newark, N. J.
Lectrohm, Inc., 5125 W. 25 St., Cicero, Ill.
Ohmite Mfg. Co., 4835 Flournoy St., Chicago

SCREW MACHINE PARTS, Brass, Steel
Ward Products Corp., E. 45 St., Cleveland, O.

SCREW MACHINE PARTS, Non-Metallic
Continental-Diamond Fibre Co., Newark, Del.

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.

CBS SHORT-WAVE TRANSMITTER

(CONTINUED FROM PAGE 35)

ing fast changes of frequencies and rapid connection to various directional beams. Further, the motor-tuned lines not only speed tuning, but they provide the unique feature of a 50-kw., high frequency transmitter whose frequency is continuously variable with maximum output efficiency. Enthusiastic reports received daily on CBS broadcasts from network stations and foreign listeners give convincing testimony to the high technical capabilities of the station.

All tests and experiments were conducted jointly by CBS, Federal, and Mackay Radio engineers, who together made available a wealth of information on powerful high frequency radio equipment. For their close coöperation in the solution of the many design and installation problems involved in this project, grateful acknowledgment is due Mr. E. K. Cohan, Director of Engineering and Mr. A. B. Chamberlain, Chief Engineer, as well as to Mr. F. J. Bleil and other engineers of the Columbia Broadcasting System.

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

assays the contribution of each to the total volume of postwar sales. Radar, described as the most astonishing of radio-electronics developments, "is destined to be a revolution in navigation of all kinds," since it has peacetime uses of the greatest importance in both ships and airplanes.

The business of radio communications equipment is taken for granted, and is disposed of with the statement that radar and radio communications account for the bulk of the war billions being spent for all electronics applications.

The potential of television and FM "is so big that it must be considered as a separate industry." And of the former: "Television can come faster than the pessimistic expect, if the industry sits down some time before the war is over and plans it that way."

In the foregoing paragraphs, only a few of the points covered in the FORTUNE article have been touched upon, to bring out the importance of the complete text to every manufacturer, sales manager, and advertising agency executive who is concerned now or for the future with the progress of either field of electronics applications.

Added significance is given by the fact that the source is outside the industry itself, uninfluenced by the need of arriving at some predetermined conclusion. For the convenience of those who want to send for this July issue, the address of the publishers is: Time Incorporated, Time & Life Building, Rockefeller Center, New York 20, N. Y.

M. B. SLEEPER, *Editor*

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.
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

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

SHAFTING, Flexible

Breeze Corps., Inc., Newark, N. J.
Mall Tool Co., 7708 S. Chicago Ave., Chicago

Steward Mfg. Corp., 4311 Ravenswood Ave., Chicago
Walker-Turner Co., Inc., Plainfield, N. J.
White Dental Mfg. Co., 10 E. 40 St., N. Y. C.

SHEETS, Electrical

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

SHIELDS, Tube

★ Goat Metal Stampings, Inc., 314 Dean St., Brooklyn, N. Y.

SOCKETS, Cathode Ray Tube

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

SOCKETS, Tube

Aladdin Radio Industries, 501 W. 35th St., Chicago
★ Alden Prods. Co., Brockton, Mass.
Amer. Phenolic Corp., 1830 S. 54th Av., Chicago
Amer. Radio 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.

SOCKETS, Tube, Ceramic Base

Johnson Co., E. F., Waseca, Minn.
★ National Co., Inc., Malden, Mass.
Nat'l Fabricated Products, W. Belden Ave., Chicago
Ucinite Co., Newtonville, Mass.

SOLDER, Self-fluxing

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

SOLDER POTS

★ Elec. Soldering Iron Co., Inc., Deep River, Conn.
Lectrohm, Inc., Cicero, Ill.

SPEAKERS, Cabinet Mounting

Cinaudagraph Speakers, Inc., 3911 S. Michigan Ave., Chicago
Crescent Industries, Inc., Belmont Ave., Chicago
★ Jensen Radio Mfg. Co., 6601 S. Laramie St., Chicago
Magnavox Co., Fort Wayne, Ind.
Utah Radio Prod. Co., 842 Orleans St., Chicago

SPEAKERS, Outdoor Type

★ Jensen Radio Mfg. Co., 6601 S. Laramie St., Chicago
University Labs., 225 Varick 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.
Standard Spring & Mfg. Co., Ind., 236-42 St., Brooklyn, N. Y.

STAMPINGS, Metal

Bud Radio, Inc., E. 55 St., Cleveland, O.
Goat Metal Stampings, Inc., 314 Dean St., Brooklyn, N. Y.
Insuline Corp. of Amer., Long Island City, N. Y.
Par-Metal Prod. Corp., Long Island City, N. Y.
Stewart Stamping Corp., 621 E. 216 St., N. Y. C.

STEATITE, See Ceramics

SUPPRESSORS, Parasitic

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

SWITCHES, Aircraft Push

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

SWITCHES, Key

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

SWITCHES, Micro

Allied Control Co., Inc., E. End Ave., N. Y. C.
Aero Electric Co., 3167 Fulton Rd., Cleveland
Micro Switch Corp., Freeport, Ill.

SWITCHES, Rotary Gang, Bakelite Wafer

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

SWITCHES, Rotary Gang, Ceramic Wafer

Oak Mfg. Co., 1267 Clybourn Ave., Chicago
Ohmite Mfg. Co., 4835 Flournoy St., Chicago
Shallcross Mfg. Co., Collingsdale, Pa.

SWITCHES, Time Delay

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

TERMINAL STRIPS

Cinch Mfg. Corp., W. Van Buren St., Chicago
Curtis Devel. & Mfg. Co., N. Crawford Ave., Chicago
Franklin Mfg. Corp., 175 Varick St., N. Y. C.
Jones, H. B., 2300 Wabansia, Chicago

TEST CHAMBERS, Temperature, Humidity, Altitude, Salt Spray

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

TRACING PAPERS, CLOTH, CELLOPHANE

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

TRANSFORMERS, Constant-Voltage Power

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

TRANSFORMERS, IF, RF

Aladdin Radio Industries, 501 W. 35th St., Chicago
Amer. Transformer Co., Newark, N. J.
Automatic Windings Co., E. Passaic, N. J.
★ Browning Labs., Inc., Winchester, Mass.
Cambridge Thermionic Corp., Concord Ave., Cambridge, Mass.
Caron Mfg. Co., 415 S. Aberdeen, Chicago
D-X Radio Prods. Co., 1575 Milwaukee, Chicago
Essex Specialty Co., Inc., Broad St., Newark, N. J.
Gen'l Winding Co., 420 W. 45 St., N. Y. C.
Greyhound Equip. Co., 1720 Church Ave., Brooklyn, N. Y.
Guthman & Co., 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.
Radex Corp., 1308 Elston Ave., Chicago
Sickles Co., F. W., Springfield, Mass.
Super Elec. Prod. Corp., Jersey City, N. J.
Teleradio Eng. Corp., 484 Broome St., N. Y. C.
Triumph Mfg. Co., 4017 W. Lake, Chicago

TRANSFORMERS, Receiver Audio & Power

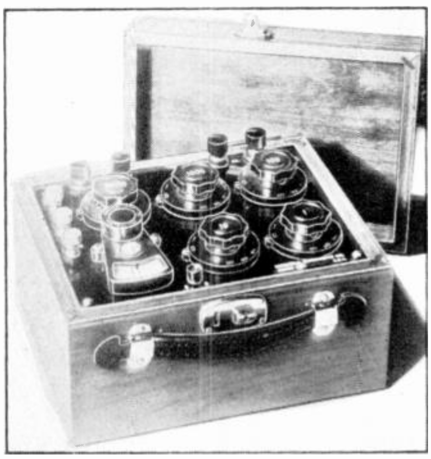
Acme Elec. & Mfg. Co., Cuba, N. Y.
Amer. Transformer Co., Newark, N. J.
Amplifier Co. of Amer., 17 W. 20th St., N. Y. C.
Audio Devel. Co., N. Minneapolis, Minn.
Chicago Transformer Corp., 3501 Addison St., Chicago
Cinaudagraph Speakers, Inc., 3911 S. Michigan, Chicago
Dinion Coil Co., Caledonia, N. Y.
Dongan Elec. Co., 74 Trinity Pl., N. Y. C.
Electronic Trans. Co., 515 W. 29 St., N. Y. C.
Ferranti Elec., Inc., 30 Rockefeller Plaza, N. Y. C.
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.
Newark Transformer Co., Newark, N. J.
New York Transformer Co., 51 W. 3rd, N. Y. C.
Norwalk Transformer Corp., S. Norwalk, Conn.
Raytheon Mfg. Co., Waltham, Mass.
Standard Transformer Corp., 1500 N. Halsted, Chicago
Super Elect. Prod. Co., Jersey City, N. J.
Superior Elec. Co., Bristol, Conn.
Thermador Elect. & Mfg. Co., Riverside Dr., Los Angeles
Thordarson Elec. Mfg. Co., 500 W. Huron, Chicago
Utah Radio Prods. Co., 820 Orleans St., Chicago
★ United Transformer Co., 150 Varick St., N. Y. C.

SPOT NEWS NOTES

(CONTINUED FROM PAGE 12)

cause, by name and nature of use, they have been arbitrarily put into the same category as the recording discs used for commercial and professional purposes. This, despite the fact that the former are manufactured from non-restricted materials available on the open market, although the latter employ critical materials, such as shellac, which put them logically in the restricted group. It seems certain that Ray Ellis and his associates of the WPB Radio & Radar Division will display the consideration which has won them such high regard in the industry, and afford relief to the users of discs which employ only non-restricted materials.

Molded Paper Condensers: Miniature type illustrated, produced by Micamold Radio Corporation, measures ¾ in. long, 7/16 in. wide, by 7/32 in. thick. Rated at 120 volts D.C.W., capacities range up to .01 mfd. These units are offered for use where government specifications include immersion tests.



Wheatstone Bridge: A resistance bridge well-suited for accurate production checking of resistors, particularly those of low values, is manufactured by Industrial Instruments, Inc. The model illustrated has 4 dials, each of 9 positions, covering 9 x 1, 9 x 10, 9 x 100, and 9 x 1,000 ohms. The ratio resistances have a guaranteed accuracy of plus-or-minus .05%, and the resistance coils in the decades of the bridge are guaranteed to be accurate plus-or-

(CONTINUED ON PAGE 41)

TUBE MANUFACTURING MACHINES

Hilton Eng. Labs., Redwood City, Calif.
Elsler 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.
Nat'l Union Radio Corp., Newark, N. J.
Rauland Corp., Chicago, Ill.
RCA Mfg. Co., Camden, N. J.
Sylvania Elect. Prod., Inc., Emporium, Pa.

TUBES, Current Regulating

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

TUBES, Photo-Electric

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 & Northrop Co., Philadelphia
Nat'l Union Radio Corp., Newark, N. J.
Photobell Corp., 123 Liberty St., N. Y. C.
RCA Mfg. Co., Camden, N. J.
Rectron Corp., 2159 Magnolia Av., Chicago
Westinghouse Lamp Div., Bloomfield, N. J.
Western Elec. Co., 195 B'way, N. Y. C.
Weston Elec. Inst. Corp., Newark, N. J.

TUBES, Receiving

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

TUBES, Transmitting

Amperex Electronic Prods., Brooklyn, N. Y.
★ Eitel-McCullough, Inc., San Bruno, Cal.
Electronic Enterprises, Inc., 65 Sixth Av., N. Y. C.
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.
Sylvania Elect Prod., Inc., Emporium, Pa.
Taylor Tubes, Inc., 2341 Wabansia, Chicago
United Electronics Co., Newark, N. J.
Western Elec. Co., 195 B'way, N. Y. C.
Westinghouse Lamp Div., Bloomfield, N. J.

TUBES, Voltage-Regulating

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

TUBING, Laminated Phenolic

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

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

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

VARNISHES, Insulating, Air-Drying

John C. Dolph Co., Newark, N. J.
Irvington Var. & Ins. Co., Irvington, N. J.
Stille-Young Corp., 2300 N. Ashland Av., Chicago
Zophar Mills, Inc., 112-26 St., Bklyn., N. Y.

VARNISHES, Insulating, Baking

John C. Dolph Co., Newark, N. J.
Irvington Var. & Ins. Co., Irvington, N. J.
Stille-Young Corp., 2300 N. Ashland Av., Chicago
Zophar Mills, Inc., 112-26 St., Bklyn., N. Y.

VIBRATION TEST EQUIPMENT

Vibration Specialty Co., 1536 Winter St., Philadelphia.

VIBRATORS, Power Supply

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

VOLTMETERS, Vacuum Tube

Ballantine Labs., Inc., Boonton, N. J.
General Radio Co., Cambridge, Mass.
Hewlett Packard Co., Palo Alto, Calif.
Measurements Corp., Boonton, N. J.
★ Radio City Prod. Co., Inc., 127 W. 26 St., N. Y. C.

WAXES & COMPOUNDS, Insulating

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

WELDING, Gas, Aluminum & Steel

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

WIRE, Bare

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

WIRE, Hookup

Bentley, Harris Mfg. Co., Conshohocken, Pa.
Gavitt Mfg. Co., Brookfield, Mass.
Lenz Elec. Mfg. Co., 1751 N. W. Av., Chicago
Rockbestos Prod. Corp., New Haven, Conn.
Whitney Blake Co., New Haven, Conn.

WIRE, Magnet

Acme Wire Co., New Haven, Conn.
Amer. Steel & Wire Co., Cleveland, O.
Anaconda Wire & Cable Co., 25 B'dway, N. Y. C.
Ansonia Elec. Co., Ansonia, Conn.
Belden Mfg. Co., 4633 W. Van Buren, Chicago
Collyer Ins. Wire Co., Pawtucket, R. I.
Crescent Ins. Wire & Cable Co., Trenton, N. J.
Elec. Auto-Lite Co., The, Port Huron, Mich.
General Cable Corp., Rome, N. Y.
★ General Elec. Co., Bridgeport, Conn.
Holyoke Wire & Cable Corp., Holyoke, Mass.
Hudson Wire Co., Winsted, Conn.
Rea Magnet Wire Co., Fort Wayne, Ind.
Rockbestos Prods. Corp., New Haven, Conn.
Roebling's Sons Co., John, Trenton, N. J.
Wheeler Insulated Wire Co., Bridgeport, Conn.

WIRE, Rubber Covered

Crescent Ins. Wire & Cable Co., Trenton, N. J.
General Cable Corp., Rome, N. Y.
Hazard Ins. Wire Works, Wilkes-Barre, Pa.
Simplex Wire & Cable Co., Cambridge, Mass.

WOOD, Laminated & Impregnated

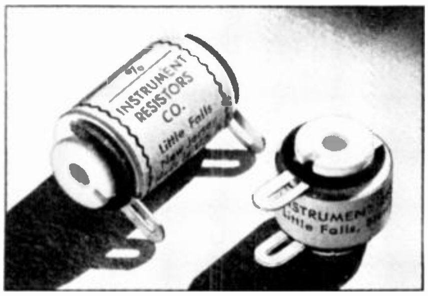
Canfield Mfg. Co., Grand Haven, Mich.
Formica Insulation Co., Cincinnati, O.

WOOD PRODUCTS, Cases, Parts

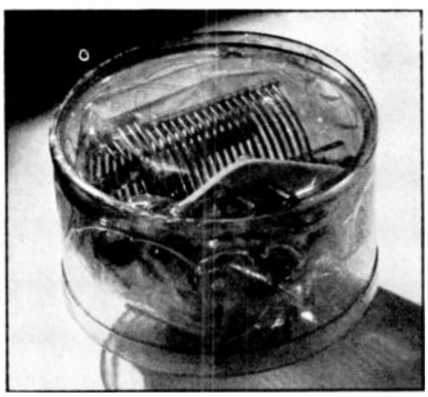
Hoffstatter's Sons, Inc., 43 Ave. & 24 St., Long Island City, N. Y.
Tillotson Furniture Co., Jamestown, N. Y.

(CONTINUED FROM PAGE 39)

minus .1%. The galvanometer, of the moving-coil type, has a sensitivity of 1. microampere per division. Three standard flashlight cells make up the 4½-volt battery. Resistances can be checked with considerable speed by the use of this bridge, making it suitable for use by inspectors.



Precision Resistors: The wire-wound resistors illustrated, produced by Instrument Resistors Company, are specifically designed for minimum weight and volume. Type P-2, wound up to 500,000 ohms, measures 9/16 in. long by 9/16 in. diameter, and is rated at ½ watt. Type P-4, wound up to 1 megohm, is 1 in. long by 9/16 in. diameter, and is rated at 1 watt. There is a No. 6 mounting hole through the center.



Tropic Packaging: Rigid, transparent Lumarith containers, sealed around the covers with moisture-proof tape, are being used to deliver radio spare parts to tropical battle fronts in factory-fresh condition. These containers, manufactured by the Celanese Celluloid Corporation, are designed for protection against water, grease, fungous growths, poison gas, and extremes of temperature and humidity.

Ralph R. Beal: Research director of RCA Laboratories, addressing the Institute of Finance of the New York Stock Exchange: "With post-war television broadcast stations connected into networks, events of the nation will pass in review on the screens of home receivers. . . . Post-war television will use electronic camera tubes which will be greatly improved in sensitivity. This will make it possible to pick

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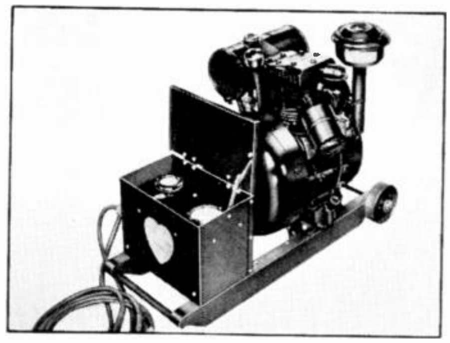
SPOT NEWS NOTES

(CONTINUED FROM PAGE 41)

up scenes with ordinary amounts of illumination. . . . And then we have theatre television with its possibilities as a post-war service. . . . Television will provide permanent new employment for an unusually wide range of arts, trades, and professions."

Carlton Mellick: Newly appointed sales manager of Goat Metal Stamping, Inc., Brooklyn manufacturers of tube shields and stampings for radio-electronic parts. Previously, he served in Washington as special representative for the Tin Conservation Division.

WAACS for Signal Corps: The first of several thousand women are now taking pre-induction training in radio and teletype operating. The course, of 3 or 6 months duration, is under the jurisdiction of the Civil Service, with pay at the annual rate of $1,020 for the first 3 months period, and $1,440 during the second.



High-Capacity Charger: Versatile gasoline-driven generator brought out by Hunter-Hartman Corporation for charging 6-, 12-, or 24-volt storage batteries at 10 to 300 amps. can also serve as emergency DC lighting plant, with 1 to 3 kw. output. Engine of 6 HP has magneto, self-starter and rope starter, air-cleaner, gasoline filter, and remote stop control. When in use, 5-in. wheels are raised from the ground to prevent creeping.

New R.M.A. Committee Chairmen: Recent appointments by R.M.A. board of directors:

(CONTINUED ON PAGE 43)

"SAFETY-ZONE" CAMPAIGN WINS COMMENDATION

A NEW type of work-hours conservation plan was presented to the 1,500 employees of Pioneer Gen-E-Motor at a rally held at the Company's Chicago plant.

CONGRATULATES DAVID BRIGHT FOR EFFORT TO CUT ABSENTEEISM

"Stay in the Safety Zone" is the slogan of the campaign which David Bright, Pioneer's president, explained to the workers. The purpose is to reduce by at least 50% the time lost as a result of illness and accidents suffered outside of working hours.

Statistics revealed at the meeting show that time lost from such causes reached the astonishing total of 2,250,000,000 working days in 1942. The Safety Zone campaign is being used to call attention to the causes of avoidable illness and accidents, and common-sense precautions.

Widespread attention has been attracted by this plan, and among the invited guests at the rally were Governor Dwight H. Green of Illinois; Col. P. G. Armstrong, Illinois Selective Service Director; Major General H. S. Aurand, Commanding Officer of the 6th Service Command; Admiral John Downes, Commandant of the 9th Naval District; and W. H. Gallienne, British Consul in Chicago.

(CONTINUED FROM PAGE 42)

Chairman, transmitter division — Walter Evans of Westinghouse, succeeding G. W. Henyan of General Electric

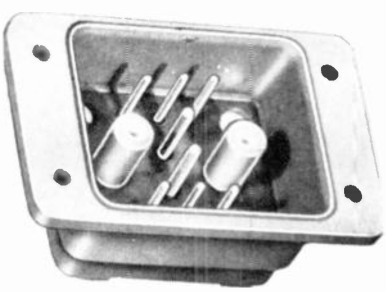
Chairman, set division — Ray C. Cosgrove, succeeding Ray H. Manson of Stromberg-Carlson

Chairman, amplifier and sound division — Thomas A. White of Jensen Radio, succeeding James P. Quam of Quam-Nichols

Vice presidents — the three chairmen named above, and W. P. Hilliard of Bendix Radio

Elected to parts division — Robert C. Sprague of Sprague Specialties, George Blackburn of Chicago Transformer, A. Blumenkrantz of General Instrument, and Floyd C. Best of Chicago Telephone Supply.

Paul L. Chamberlain: Manager of General Electric's transmitter sales: "What we anticipate in the field of post-war broadcasting is the replacement by FM stations of many low-power AM stations which are now handicapped by interference and inadequate signal strength. This will probably mean higher power and more clear channels for the remaining AM stations."



Special Connectors: New Cannon plug and receptacle, for connecting adjoining assembly units, has recessed plug flush with mounting rim, as illustrated, and projecting socket. There are two contacts carrying 30 amps., 6 carrying 15 amps., and two coaxial contacts with Isolantite insulation. Receptacle weighs .276 lb., plug .266 lb.

Amateur Licenses Reinstated: All amateur radio operators' licenses which expired since December 7, 1941 have been reinstated and extended for 3 years from date of expiration, according to an FCC announcement. Licenses expiring between June 1, 1943 and December 7, 1944 will also be extended for 3 years. Action was taken because amateurs in the Armed Forces or away from home on war work will have difficulty in applying for renewals, and to make it easier for amateurs to resume operation when war ban is lifted.

It is expected that the number of amateur stations which will come on the air after the War will far exceed the pre-war total, as a result of the Army and Navy training courses.

COL. H. C. ADAMSON, WHO WAS WRECKED IN THE PACIFIC WITH CAPT. EDDIE RICKENBACKER, TELLS OF THEIR ADVENTURE OVER G.E.'S SCHENECTADY FM STATION W85A

SOME WAR AND POST-WAR RADIO PROBLEMS

(CONTINUED FROM PAGE 7)

of healing will continue to progress. Riveting, welding, soldering, the processing of plastics, and a variety of other industrial processes will increasingly involve developed radio equipment.

New Home Radios ★ But, let's not foster the idea that from now on people are going to live in a "Buck Rogers" world composed of living-rooms resembling the radio control room of a battleship. All these developments must take careful planning. They just cannot be assembled in one Martian mechanism that forgets the listeners and viewers or requires an engineer to adjust the complex gadgets. The public must be served with the best and widest possible service, but this does not mean a series of contrivances such as Gene McDonald's "Crystal Gazer's Post-war Dream." The spot announcement-dimmer, the soprano-chaser, hot and cold running water, and the kitchen sink can be eliminated, and must be avoided if we are not to be like the Stephen Leacock hero who mounted his horse and galloped off in all directions. At the same time radio services that can be unified *must* be unified. The public will not tolerate the idea of a heavy investment in several forms of radio service, or of a living room full of radio boxes. Surely whatever radio has to offer should be in an efficient, unified service and concentrated in one corner of the living room.

Long Range Planning ★ For twenty years this industry, just like every other industry, has been completely occupied with short-range planning — with getting ready for next year's model. Soon you will have an opportunity to plan — and to get off the endless treadmill of short-range planning. Ask yourselves, and this is the thrust of my message here today, this question: "Along what lines should radio develop over the next decade?"

In warning against illusions, which after all with this audience is more entertaining than necessary, I do not want to under-emphasize for a moment the necessity of keen foresight and sound judgment. While we do not want to be accused of being visionaries, we must earn the credit of being men of practical vision. We may not be able to see the thing around the corner, but with all of the facts in our hands we should be able to form a fair judgment as to what the thing will look like when it is around the corner.

We stand today upon a vantage ground provided by a series of important but somewhat fortuitous events. Frequency modulation, television and facsimile operation are all ready to move ahead on the present green light; great public interest has been stimulated in these developments; any tendency of the various competing manufacturing interests or services to move out on divergent lines — thus drawing the public into the well of heavy and irretrievable investment — has been halted; vast progress is actually being made along important lines of research and development, which provide the means for the improvement and expansion of these and other services; opportunity is now given to bring together the best heads of the engineering industry and to appraise the developments which have come and are continuing to come from current research, and to formulate the general plans by which these can be placed into actual operation with optimum benefits to the public and to the industry itself. Not only the public, but also the industry will suffer from a series of expensive and divergent false starts.

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Challenge to Engineers ★ No group of producers and engineers have ever had placed upon them a more serious challenge. We must not plan anything that will fall outside the realm of sound engineering and good judgment. But if we can tell during the next year what general lines radio services should and will follow five or even ten years from now, we should be derelict in our greatest duty to ourselves and to the public were we to fail to plan now. This is an opportunity unparalleled in the history of the radio industry and paralleled in very few industries at any time. We have the most significant sort of opportunity and our duty can only be deemed comparable thereto.

When peace comes these problems must be solved. Shall we run headlong into them and solve them on the spur of the moment, or shall we devote what time we can to lay a groundwork in advance? A look at the allocation pattern today should serve as a reminder that planning is well worth the effort. The sad experience of prior years resulted in more careful planning in the FM and television bands. We laid out these bands with as much forethought and ingenuity as could be mustered. After this war, we must do better still, and ensure that all phases of radio will be reëstablished on a firm and spacious foundation, broad enough and soundly enough designed to make possible indefinite advances along the lines of improved public service.

The Government's Rôle ★ A great deal has been said and written, in recent years, about government-industry coöperation; and industry has itself quite rightly insisted that such coöperation is necessary. Fortunately this association in recent years has demonstrated its capacity to take the lead. Post-war radio planning, it seems to me, is a field in which such coöperation will be especially fruitful, for neither government nor industry can do the job alone.

To take a simple but important example, there is the allocations problem. Not the least challenging of our ultra modern developments is the opening of the limitless ranges of the higher frequencies. Yet the development of varied and extensive uses of radio continues to keep the demand ahead of the supply. We cannot, in the foreseeable future, come any nearer to the complete satisfaction of the frequency demand than the greyhound comes to the mechanical rabbit. Yet there is the problem, and we must keep after it. Even the most hard-bitten anarchists who oppose government activity of almost any kind whatever must agree that allocation of frequencies, like traffic regulations, cannot be privately made or enforced. But making allocations without regard to the equipment available and the demands of

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various services is like groping in the dark. Likewise, the design of equipment without foreknowledge of allocations is a wasteful process. Neither the Commission nor the industry can operate in a vacuum.

The Right Kind of Planning ★ All I say here does not mean that I have lost sight of the fact that there is a war to be won. I wholly agree with Ray Ellis that the war comes first. It would indeed be shameful for any engineer to delay for a single hour the development of any combat equipment just in order to do a bit of post-war planning. But that is certainly not necessary. No one is suggesting, or has ever suggested, that anyone start now to design post-war models. On the contrary, I am suggesting that we start now to devise long-range proposals which will have the effect of improving all post-war models when the time comes to design them. Today we must try to lay out the general pattern — the broad outlines — within which future designs and services will fit. Conflict and confusion, false startings, and waste to the public and the industry must be avoided. When we plunge forward, let us have the best direction markers which may be available.

Radio planning is linked with more general post-war problems. When peace comes, for example, a large number of men now in the armed forces will be demobilized, and among them will be many skilled radio technicians. That means, from the industry's point of view, that technical skills will not be a bottleneck. From a more general point of view, it means that the expanding radio industry will be an important bulwark against post-war unemployment. Again, the so-called scarce materials which are now so hard to get are nevertheless being produced in hitherto unprecedented quantities. When peace comes, there will not only be a sufficiency of such materials but quite probably an excess over pre-war production. That means plenty of materials for post-war radio, and it also means that radio will be an important factor in preventing a glut in the post-war materials market.

Much depends upon how soundly plans are laid, as a few figures will indicate. On the eve of the defense program, this was not yet a half-billion dollar industry, in terms of annual production. Today, it is a two or a three-billion-dollar industry, and it may be bigger still. By foresight and planning it can remain a two or three-billion-dollar industry, and as a result the radio public will be that much better served. I therefore urge upon you the importance of careful, thorough, long-range planning for the future expansion and progress of radio service. That planning will take industrial statesmanship of a high order. I am confident that such statesmanship will be forthcoming.

WHEN YOU

CHANGE YOUR ADDRESS

PLEASE GIVE US YOUR OLD ADDRESS AS WELL AS YOUR NEW ADDRESS.

IF YOUR COPIES ARE UNDELIVERED BECAUSE YOU DID NOT NOTIFY US IN ADVANCE, WE SHALL NOT BE ABLE TO REPLACE YOUR LOST COPIES.

FM RADIO-ELECTRONICS
240 Madison Ave., New York 16, N. Y.

RADIO-ELECTRONICS

and

INDUSTRIAL-ELECTRONICS

A very realistic appraisal of the electronics market, published in FORTUNE for July 1943, draws a clear distinction between radio-electronics and industrial-electronics.

Beginning with the startling statement that the total sales of electronics equipment this year will exceed the peacetime volume of the automobile industry, this article points out that radar and radio communications account for the bulk of the war billions, compared to which industrial-electronics sales volume is "tiny" because, "Industrial-electronics isn't a mass market." Rather, it is one with many highly specialized limited applications.

This may not be romance, but it is useful information.

Of radio-electronics, however: "Television, along with the new FM radio, can conceivably build a business that will far outdo radio's $1 billion in 1941. This potential is so big, in fact, that it must be considered as a separate industry."

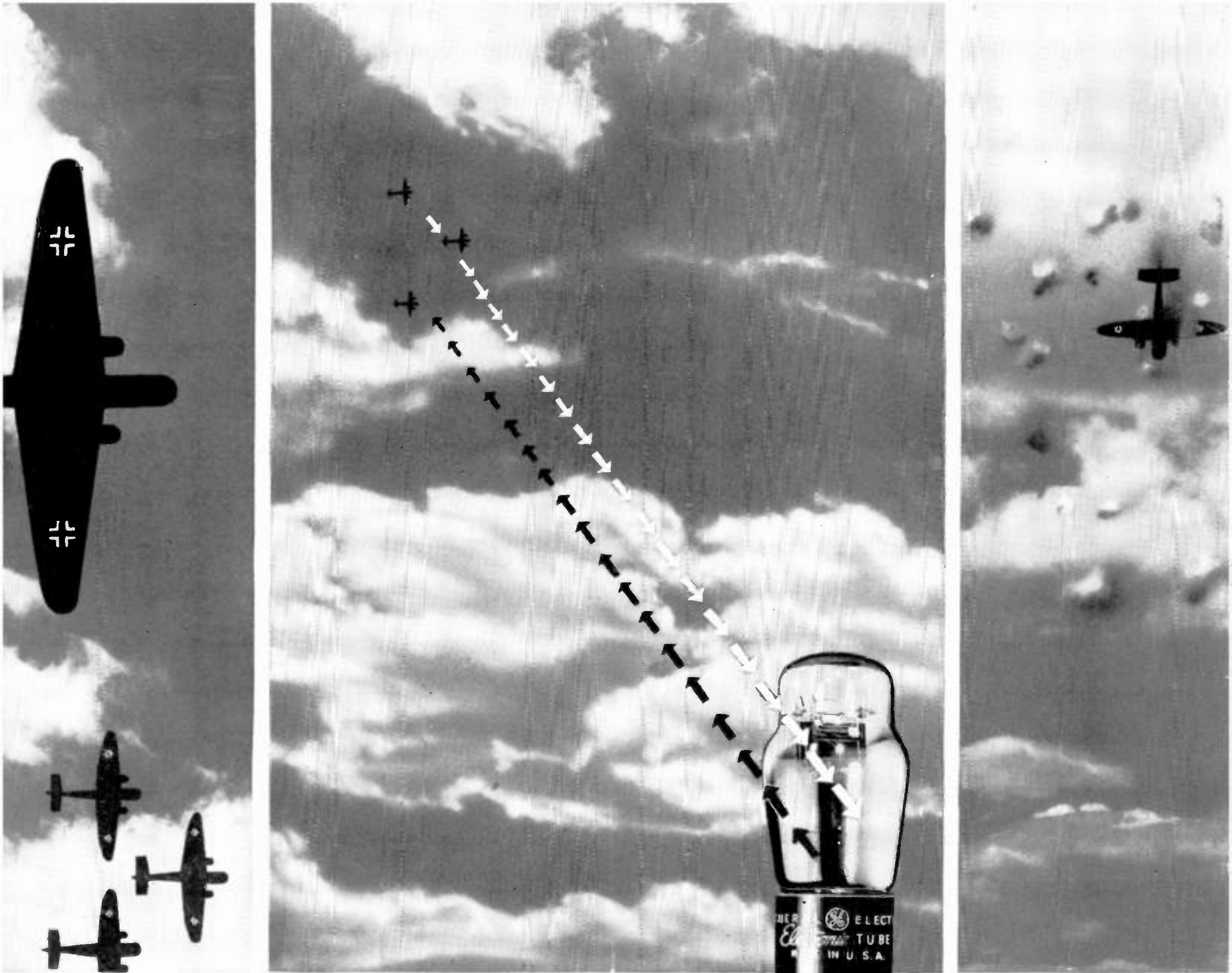
This distinction between radio-electronics and industrial-electronics applies equally to magazines which serve these two fields.

That is, the readers of industrial-electronics publications are primarily interested in mechanical devices operated by electron tubes. The number of such readers is legion, but their total purchasing power is relatively limited.

On the other hand, readers of *FM* RADIO-ELECTRONICS are manufacturers and users of radio equipment in which electron tubes are employed in association with radio components and related materials. The number of our readers is relatively small, but they comprise the 5,000 civilian and military engineers who control the purchases in all branches of the radio-electronics industry.

Purchases by the group comprising the readership of *FM* RADIO-ELECTRONICS, according to a recent Dow-Jones report, will amount to approximately $6 billion in 1943.

Presented for the information of advertisers who are planning to modify present schedules, and for those who are making up new budgets.



1. Enemy planes rise from distant airfields.

2. Radar sends out beam of ultra-high-frequency waves, reflected back to instruments which determine planes' location, speed, and direction.

3. Interceptor planes then surprise and destroy the advancing enemy.

The facts about RADAR

"The whole history of Radar has been an example of successful collaboration between Allies on an international scale."

THE NEW YORK TIMES, MAY 16

THIS amazing electronic invention that locates distant planes and ships despite darkness and fog is a great co-operative achievement of Science and Industry.

In this country and in the British Isles, over 2000 scientists and engineers, some working alone, some in the Army and the Navy, many in research laboratories of colleges and industrial firms, joined eagerly in the search for Radar knowledge.

Team-work that succeeded. Once this electronic device had been perfected, industry after industry rallied to the nation's call to manufacture Radar. General Electric is proud to have played a large part, with other manufacturers, in supplying to the Army and Navy this key weapon whose peacetime applications hold so high a promise.

As early as the Twenties, G-E engineers and scientists were developing the kind of high-frequency tubes, circuits and apparatus that make Radar possible. Thus long before Pearl Harbor, G.E. was able to build Radar equipment.

Post-war applications will be many. Radar will guard and guide the flight of great commercial transports. Planes will land blind. Transoceanic liners will slip safely into fog-bound harbors — all with Radar detection equipment.

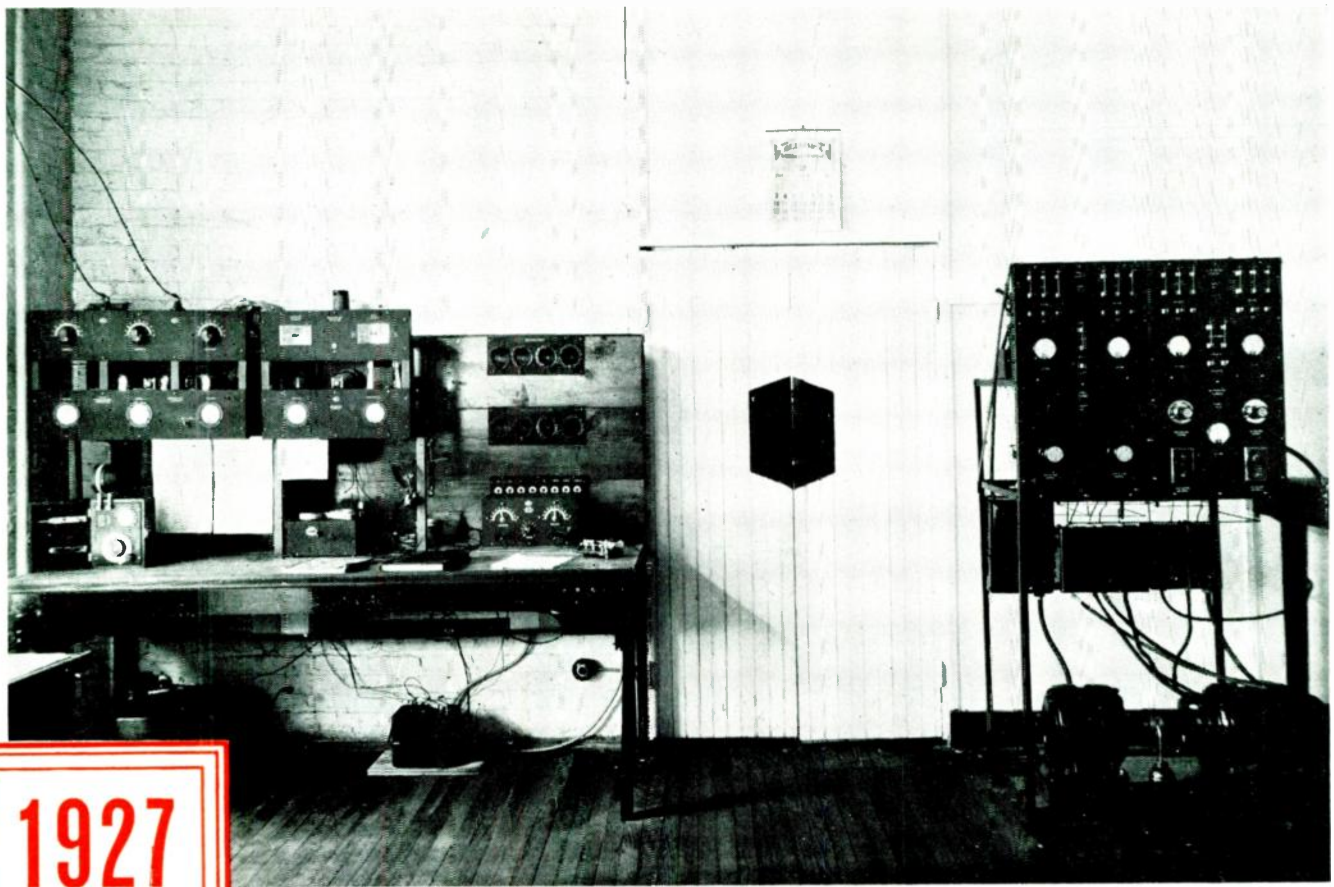
In addition to Radar, General Electric is supplying to the Army, Navy, and Marines radio transmitters, antennae and receivers, carrier-current equipment, all kinds of electronic measurement equipment, and monitors. *Electronics Department, General Electric, Schenectady, N.Y.*

Tune in General Electric's WORLD TODAY and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over C.B.S. . . . On Sunday evening listen to the G-E Mazda Lamp program over N.B.C. network.

GENERAL ELECTRIC

180-85

G-E employees are now purchasing over $1,000,000 in War Bonds weekly



1927

REL *International Short Wave Station*

REL has consistently held a leading place in all phases of radio development. For example, one of the very first U. S. short wave broadcast stations, reported from all over the globe, was W2XV, built and operated by REL.

This transmitter, located on the site of the present REL Plant No. 1, was put into service early in 1927, and continued on regular schedule for several years, using 15.1, 30.2, and 60.4 meters. The designs of many subsequent installations, built for service in the U. S. and foreign countries, were based on experience gained from the original apparatus illustrated here.

After the first year, this equipment was replaced by a transmitter mounted on steel racks and panels, a type of construction deemed impractical for high-frequency circuits until REL showed that it could be done successfully.

The transmitter incorporated another innovation: a crystal control mounted within a constant-temperature chamber, a feature which, later on, the FCC required in every station.

This is another instance where REL's efforts have shown the way which others have followed.

LOOK TO REL FOR PEACETIME LEADERSHIP

Engineering improved equipment for War today, REL is planning further improvements for Peace tomorrow. Among these will be REL "packaged" FM broadcast stations, low in cost and easy to erect, for communities which now lack adequate, enjoyable, static-free radio entertainment.

REL

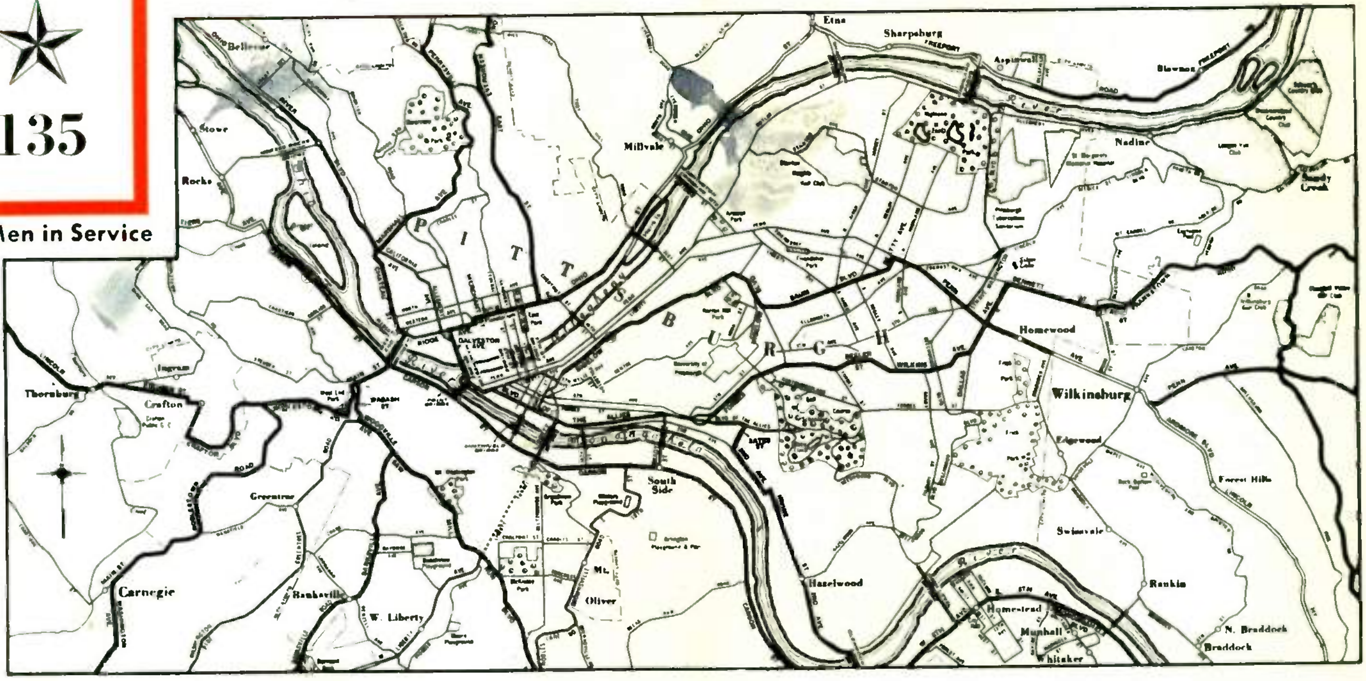
RADIO ENGINEERING LABS., Inc.
Long Island City 1 New York

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

RUMFORD PRESS
CONCORD, N. H.

135

Link Men in Service



PITTSBURGH and PART of the POLICE RADIO SERVICE AREA

"SURPASSING ALL EXPECTATIONS"

DIRECTOR George E. A. Fairley of the Department of Public Safety, Pittsburgh says:

"Our Link FM Police Radio System is surpassing all expectations. Long known as a radio graveyard, Pittsburgh has the worst receiving conditions of any city in the United States, but a single Link 250-UFS headquarters transmitter is completely covering the City proper and the 747 square miles of Allegheny County. Two-way communication includes all sections previously considered dead spots."

No better proof than this could be given of the ability of LINK engineering and LINK FM equipment to surmount the most difficult operating conditions.

Radio Headquarters at Pittsburgh

This single LINK FM headquarters station is giving results previously unheard of in the mountainous area of Allegheny County. It will eventually serve the majority of the outlying boroughs and townships who will only require one or more two-way car installations for complete coverage. Thus LINK engineering eliminates additional headquarters stations and gives the utmost in system economy.

The best-equipped police and fire departments ARMY E NAVY *use F. M. Link equipment exclusively*

FM BY Link

Fred M. Link

Engineer • Manufacturer

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