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FM

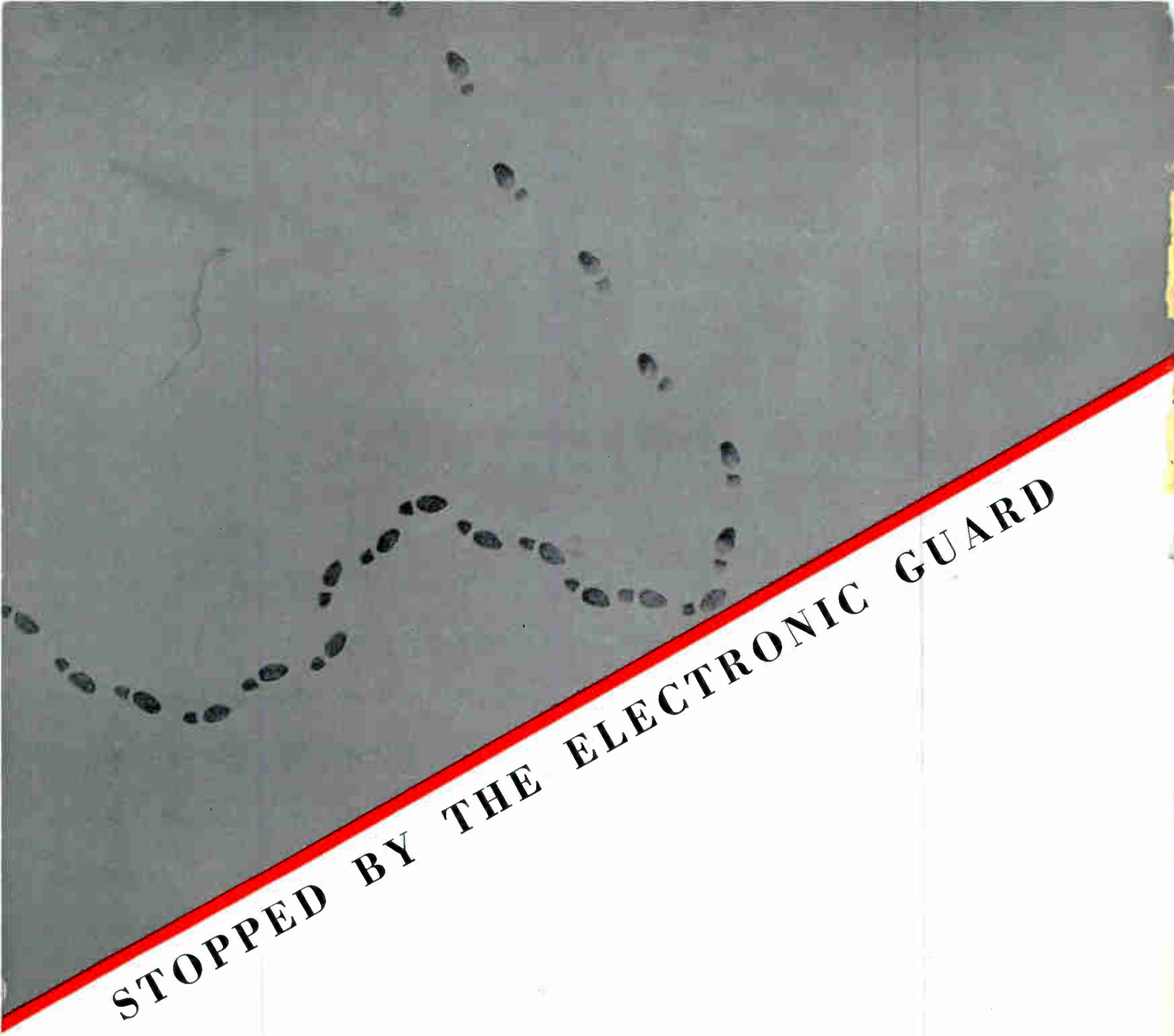
RADIO - ELECTRONIC ENGINEERING & DESIGN

NOVEMBER 1942

U. S. NAVY'S NO. 1 RADIO ENGINEER

Radio - Electronic Products Directory

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



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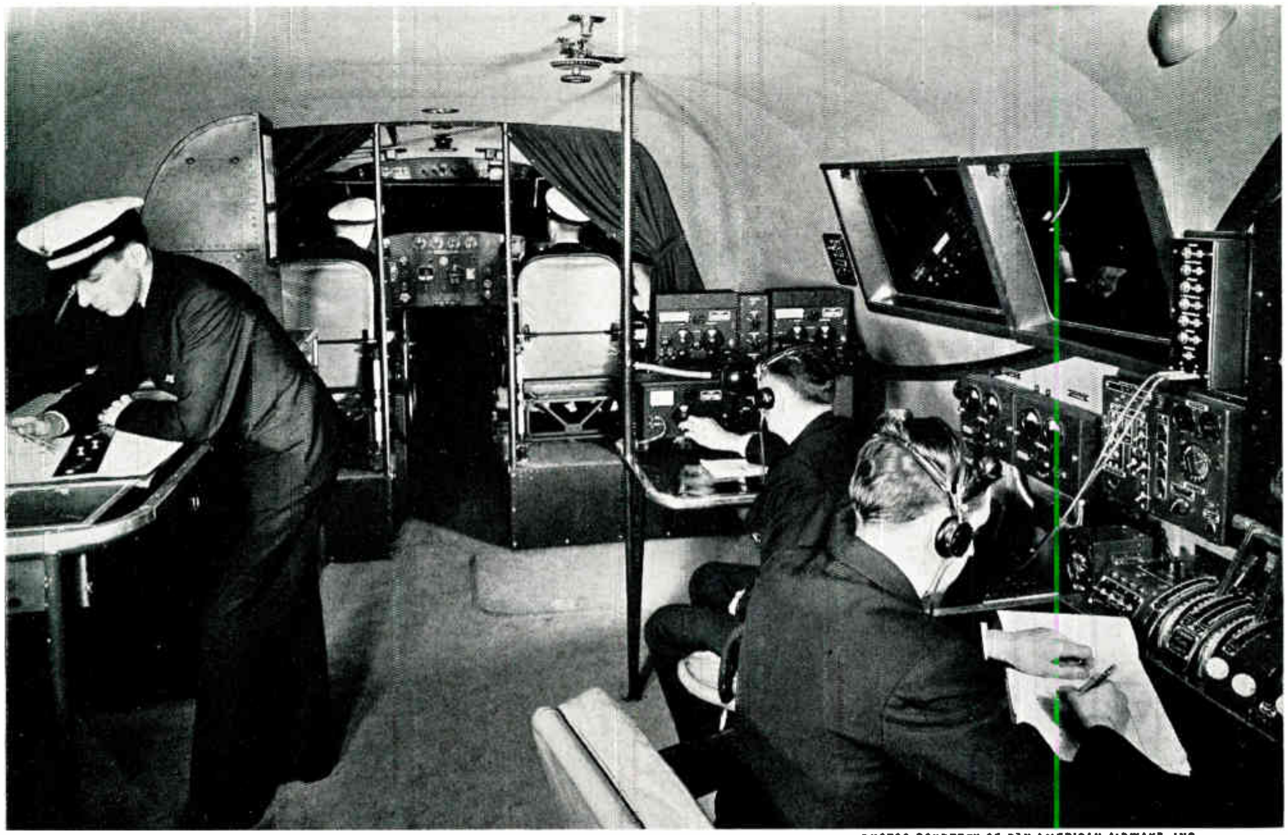
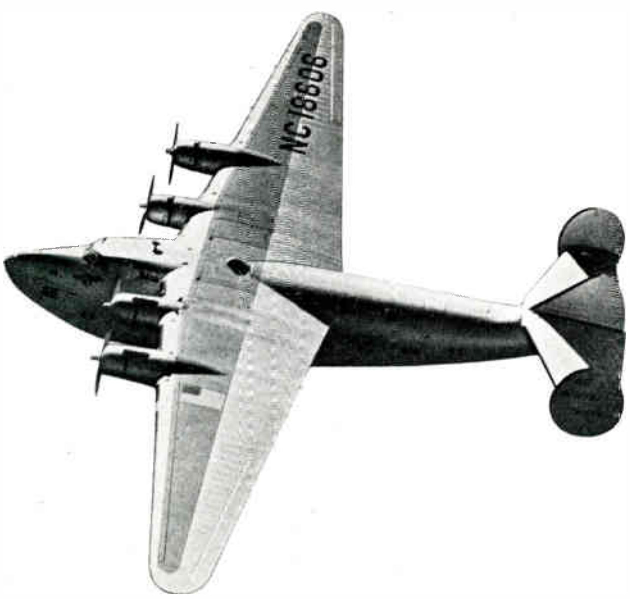


PHOTOS COURTESY OF PAN AMERICAN AIRWAYS, INC.

WHAT IS INSIDE A CLIPPER?



Well, take a look at the picture above. Most of a Clipper's equipment is unfamiliar to the uninitiated, but the clean efficiency revealed in every detail needs no description here. For in a Clipper, no detail is too small to be important, and no alibis are accepted. High as Pan American Airways' standards are, National parts "measure up."

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FM RADIO-ELECTRONIC ENGINEERING & DESIGN

COMBINED WITH: APPLIED ELECTRONIC ENGINEERING

VOL. 2 NOVEMBER, 1942 NO. 12

CONTENTS

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M. B. SLEEPER, *Editor and Publisher*

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

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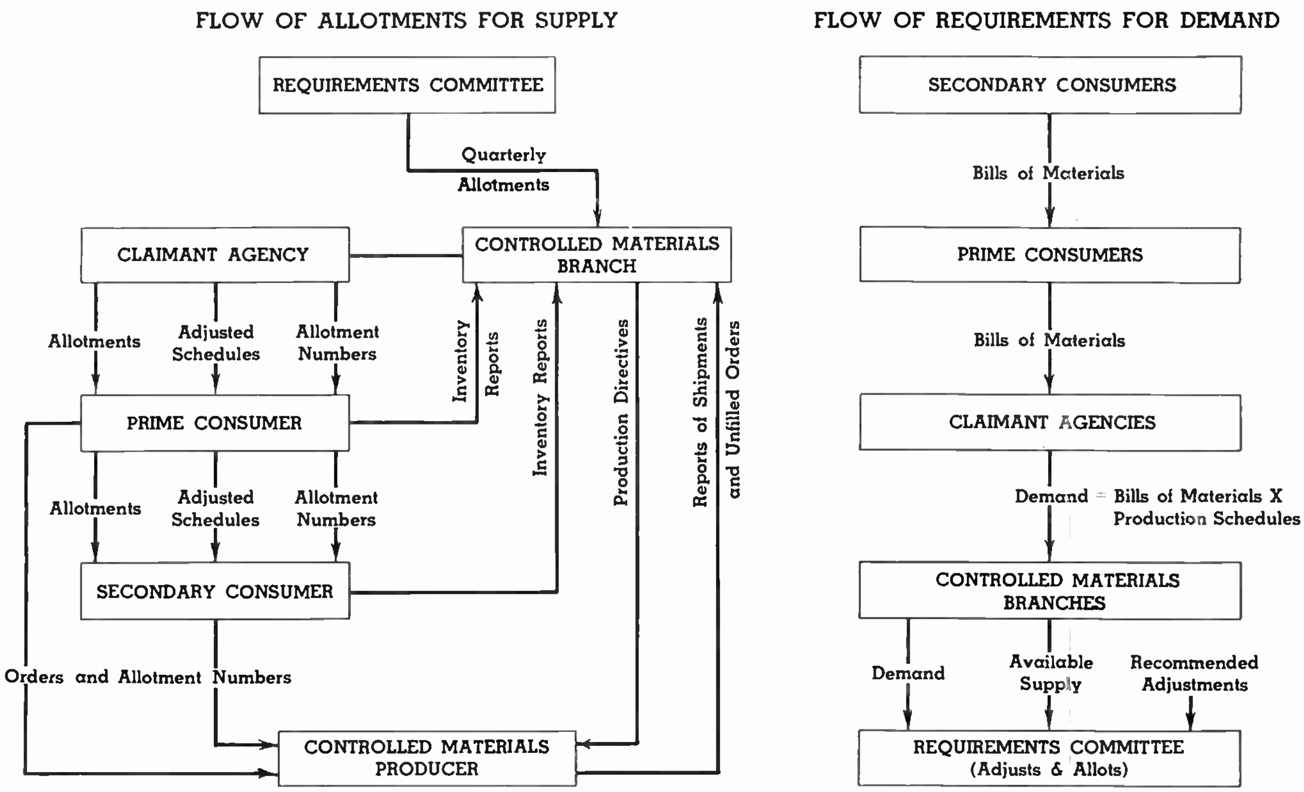
COVER PICTURE

Nearly 30 years ago, Commander Stanford C. Hooper hopefully undertook to use radio to replace signal flags for inter-fleet communication. Today, as consulting engineer for the Navy and its suppliers, Admiral Hooper looks back upon the time when, working with such concerns as Wireless Improvement, Simon, Federal, Dubilier, and Lowenstein, and the Radio Aides of the Bureau of Steam Engineering, he laid the foundation for the U. S. Navy's ultra-modern and highly efficient communications equipment and methods.


the Marines
in the Solomon Islands
could tell you about
hallicrafters
communications equipment

FLOW OF ALLOTMENTS FOR SUPPLY — FLOW OF REQUIREMENTS FOR DEMAND



ORGANIZATION CHART FOR THE WAR PRODUCTION BOARD'S PLAN FOR CONTROLLING CRITICAL MATERIALS

WPB'S NEW CONTROLLED MATERIALS PLAN

The CMP Is to Supplant PRP and Other Allotment Methods. Vertical Control of Steel, Copper, and Aluminum Will Be Extended to All Critical Materials on Timetable Schedule

A NEW, long-range plan for controlling the flow of critical materials into war production — the Controlled Materials Plan — is being put into operation by the War Production Board.

Evolved from existing distribution systems and from experience gained through their operation, the CMP has the approval of all governmental agencies participating in it. It was drafted after closely coördinated planning between the Army, Navy, Maritime Commission and Office of Civilian Supply, as well as representative consumers and producers of materials.

CMP Purpose ★ The main purpose of the plan is to make certain that production schedules are adjusted within material supplies available, so that production requirements can be met. This will be accomplished by:

1. Adjusting requirements for critical materials to the supply;

2. Making the quantity and type of materials needed available at the time required to meet approved programs.

Allotments of critical materials will be made through seven "Claimant Agencies," such as Army, Navy, Office of Civilian Supply, to prime contractors producing essential goods. Prime contractors, in turn, will divide the allotments with their subcontractors and suppliers.

The two accompanying charts show the flow of requirements for demand and the allotments for supply as they are distributed by the Controlled Materials Plan.

First Materials Affected ★ Carbon and alloy steel, copper and aluminum — the three most basic and critical materials — are the first Controlled Materials to be directly allotted under the plan which becomes effective, in its transitory stage, in the second quarter of 1943 and will be in full operation by July 1st.

Vertical Allotment ★ This method of distributing materials is, in effect, "vertical allotment." The Controlled Materials Plan will gradually replace the present priority system, including the Production Requirements Plan, which is on a horizontal basis.

Under PRP, each firm, large or small, prime contractor or subcontractor, submits his own requirements to WPB for approval, and receives an individual authorization to obtain materials.

CMP Plan ★ Under the new CMP, prime contractors will prepare and submit a breakdown of all materials required for the approved end-products on which they are working. The breakdown will comprise a Bill of Materials, specifying not only what materials are required, but when they must be received to carry out the authorized program.

In making up his Bill of Materials, each prime contractor will include both the materials he puts into production himself and those needed by his subcontractors and their suppliers. The Bill of Materials will cover requirements not only for Controlled Materials, but also for other scarce materials listed in the outline of the plan.

The Bill of Materials obtained from prime contractors will be assembled by each Claimant Agency and submitted to the WPB Requirements Committee, and to the respective Controlled Materials Branches, which will make the necessary adjustments to bring the whole program into balance with available supplies.

(CONTINUED ON PAGE 27)

WIDE-RANGE ULTRA-STABLE AF OSCILLATOR

Sine Wave or Square Wave Output Can Be Obtained from the Oscillator Circuit Described

BY MCMURDO SILVER*

THE audio frequency oscillator herein discussed was developed to satisfy the need for a dependable piece of test equipment capable of substantially continuous operation over relatively long periods of time when used in laboratory and production test work. In the course of the research involved, it was found that, by a simple alteration of the circuit, either sine wave or square wave output could be obtained, greatly enhancing the usefulness of the equipment.

Arrangement ★ The audio frequency oscillator, as illustrated in Figs. 1, 2, and 3, is mounted on a 7- by 19-in. panel, pierced for mounting on a standard relay rack. This panel carries a conventional box-type chassis, attached both directly to the panel through control shaft bushings as well as through the agency of the two end plates visible in Fig. 3. These end plates serve to stiffen the whole assembly, and to provide a means of carrying a dust cover which is slipped over them from the rear to enclose the equipment. They also operate to protect the components mounted above the chassis during the processes of assembly and wiring in manufacture.

Since the character of service which the original design was required to perform involved practically continuous operation, every effort was made to employ only easily obtainable components, of ample sizes and ratings to insure continuous operation without failure. Electrolytic capacitors are not ordinarily indicated for such operation. However, they were employed because of the extremely high values required in certain circuit positions, the lack of ready availability of the high values in other types of capacitors, and their extreme compactness.

It will be observed that the components are so mounted as to be capable of ready examination and replacement in the possible event of failure. Had time been available to permit procurement of plug-in electrolytic capacitors, the replacement problem could have been materially simplified, although so far, after many months of service, no capacitors or resistors have failed in a number of similar equipments in daily use for production test purposes.

Circuit ★ Examination of Fig. 4 indicates that this oscillator consists essentially of a two-stage amplifier using a 6SJ7 tube, T1, and a 6K6GT tube, T2, with the input and output associated with a Wein bridge. In the Wein bridge, the frequency-determining resistors R1-1, R1-2, R1-3 and R2-1, R2-2, R2-3, together with the two-gang tuning capacitor C1, determine the frequency coverage of each range, ranges being selected by the choice of any one of the three resistor combinations controlled by range switch SW-1. The two remaining arms of the Wein bridge consist of the feedback resistor R3, and the variable resistor R4, which in practice is a 3-watt, 120-volt candelabra base lamp.

It has been determined that the pureness of the wave form generated by this type of oscillator is to a considerable measure a function of the exactness of electrical match by the resistors R1 and R2 and the associated tuning capacitor C1. If these elements are substantially identical, the resultant output wave can be made to show 1% or less total harmonic distortion. For this condition to be obtained, it is necessary that the value of feedback resistor R3 be established within rather critical limits. This is most easily effected by varying its value while the wave form is observed on an oscilloscope.

The size and type of miniature lamp employed as resistor R4 will determine the constancy of amplitude vs. frequency of the oscillator circuit, the output of which it operates to flatten in the manner conventional to this type of oscillator. It is desirable that the time constant of the grid coupling condenser C4 and grid resistor R8 in combination be on the order of the lowest audio frequency to be generated.

In order to obtain useful power output from this audio frequency oscillator, such output should not be taken directly from

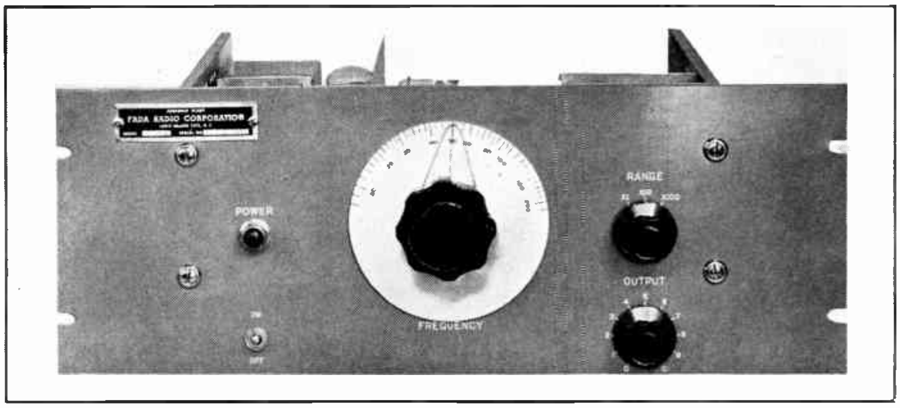


FIG. 1. SINE WAVE TO SQUARE WAVE SWITCH WAS ADDED AFTER PHOTO WAS TAKEN

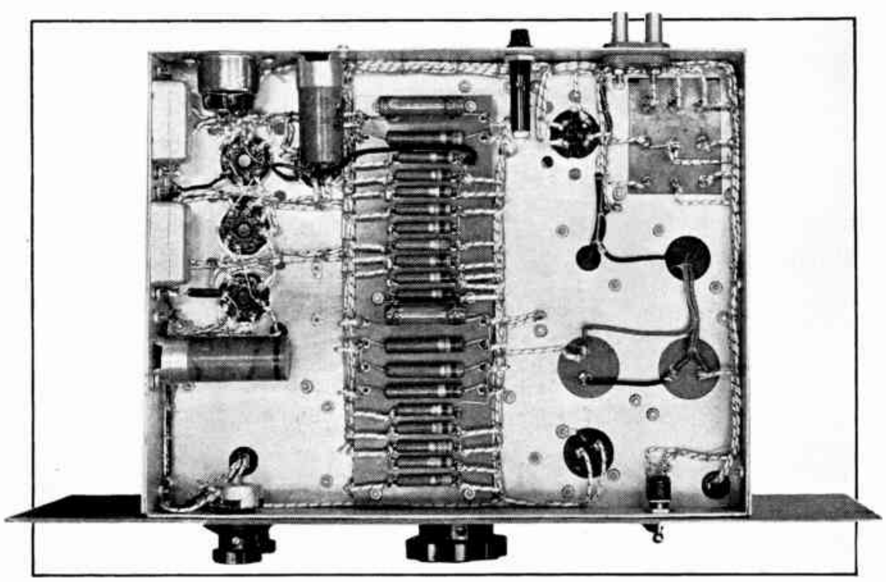


FIG. 2. UNDER SIDE OF OSCILLATOR CHASSIS SHOWS WIRING CENTERED AROUND THE RESISTOR MOUNTING BOARD

* Vice President in charge of Engineering, Fada Radio & Electric Co., Inc., Long Island City, N. Y.

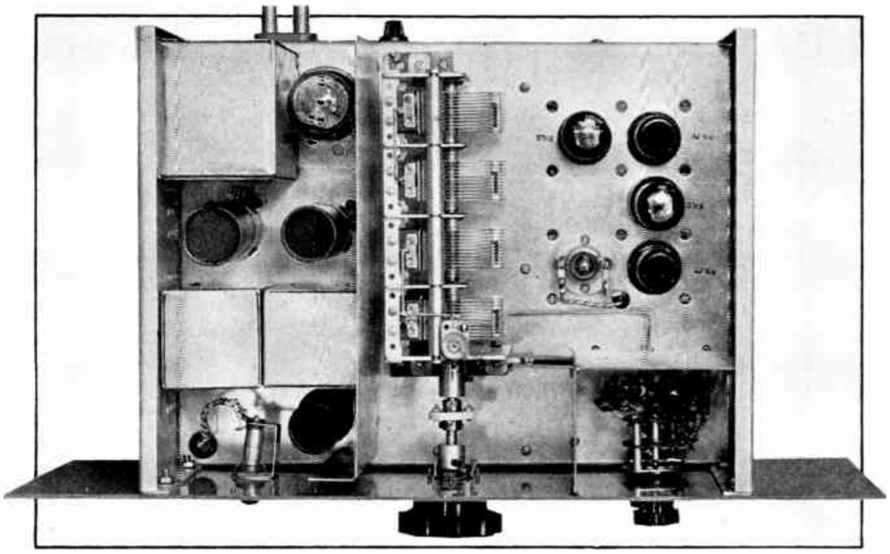


FIG. 3. CAREFUL SHIELDING IS NECESSARY FOR HIGHLY STABLE AF OSCILLATOR CIRCUIT

the plate circuit of T2, since variations in loading can operate to alter the frequency of the oscillator. For this reason it was found desirable to follow the Wein bridge oscillator, which embraces vacuum tubes T1 and T2, with voltage and power amplifier tubes T3 and T4. These are 6SJ7 and 6K6GT types respectively.

This permits the inclusion of an amplitude control in the form of potentiometer R13. Since vacuum tube T3 draws no power from the audio oscillator, but is voltage actuated, adjustment of the amplitude control has substantially negligible effect upon the generated audio frequency. Tube T3 in turn drives the power output amplifier T4 which, triode-connected, is capable of delivering approximately 1 watt of audio frequency power throughout the range of 20 to 20,000 cycles in the particular equipment under discussion. Power output could have been raised to 3 watts by pentode connection of T4. Harmonic distortion would rise negligibly in such case, due to the high percentage of inverse feedback. Frequency stability is excellent in a properly designed Wein-bridge oscillator, being easily made well below 1%.

The frequency response characteristic of the two-stage amplifier T3-T4 is considerably improved and harmonic distortion markedly reduced through the inverse feedback circuit C7, R22 and R14, the latter also functioning to provide automatic cathode bias for T3. The relationship of R14 and R22 is such as to provide approximately 67½% inverse feedback. This value is sufficient, in addition to that inherent in the oscillator circuit itself, to flatten the response of the audio amplifier substantially, and to reduce its harmonic distortion to a marked degree. Thus the overall harmonic distortion as observed in the output circuit of the four-tube system is on the order of 1% or less.

In order that low frequencies down to 20 cycles may be passed through the system without excessive attenuation, rather large values of coupling capacitors are employed at C5 and C8. These are 30 and 40 mfd. respectively.

Power for operation of the audio oscillator is derived from a 115-volt, 60-cycle AC. source, through the conventional power supply consisting of power transformer TR, the full wave vacuum tube rectifier T5, and a two-section filter made up of reactors L1 and L2 and capacitors C11, C12, and C13.

The particular equipment under consideration was required to deliver 1 watt output to a high impedance load throughout the frequency range of 20 to 20,000 cycles. Selection of 800 mmfd. for each unit of tuning capacitor C1 in the Wein bridge provided a 10:1 frequency range per band, or a total range of 20 to 20,000 cycles covered in three steps. Resistors of 10 megohms were used for the low-frequency band of 20 to 200 cycles, 1-megohm resistors for the second band of 200 to 2,000 cycles, and .1-megohm resistors for the third band of 2,000 to 20,000 cycles.

Examination of Fig. 4 will show that tracking between the two sections of C1 is effected by ceramic trimmer capacitor C2 connected across the upper section of C1 only, since the stray capacities in the

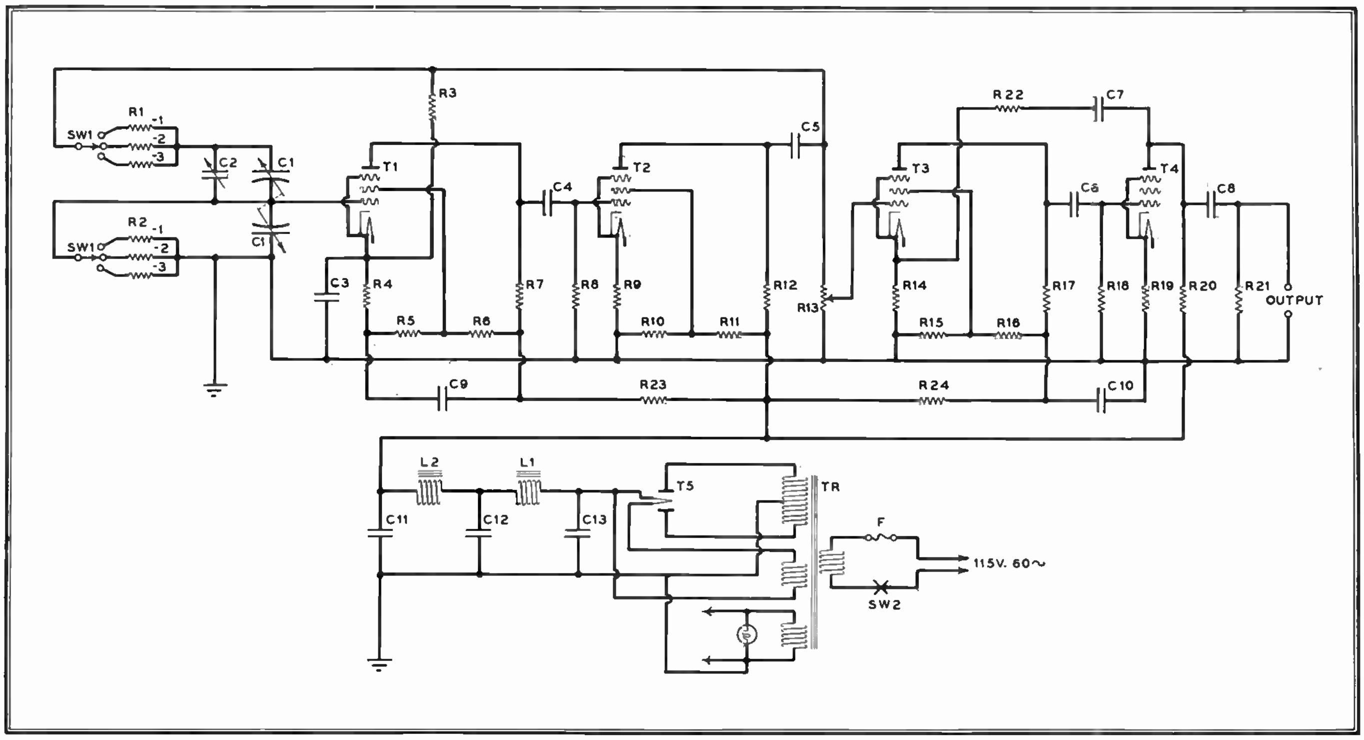


FIG. 4. SCHEMATIC DIAGRAM DOES NOT SHOW SINE WAVE TO SQUARE WAVE SWITCH DESCRIBED IN THE TEXT OF THIS ARTICLE

circuit render unnecessary a similar trimmer capacitor across the lower section of C1. The two-gang condenser is actually made from a four-gang broadcast receiver type of tuning capacitor having .400 mfd. per section.

A fourth range, from 20,000 to 200,000 cycles, could have been incorporated easily by providing a fourth position for gang switch SW1, to cut in .01-megohm resistors for R1 and R2.

It will be noted that output is taken at substantially 10,000 ohms impedance from the plate circuit of triode-connected output amplifier tube, T4, through the 40 mfd. electrolytic coupling capacitor C8, and 10,000-ohm terminating resistor R21. A low output impedance could have been obtained by short-circuiting load resistor R20 and connecting the left-hand terminal of C8 in Fig. 4 directly to the top end of cathode resistor R19, together with a suitable alteration in value of R21. It is obvious that this choice of high or low impedance output can be accomplished by an additional switch to perform the circuit switching functions suggested above, and would operate to increase the general utility of the equipment.

Square Wave Output ★ During the course of investigation, it was found that a very satisfactory square wave output could be obtained by increasing the value of feedback resistor R3 by approximately five to ten times the value indicated in Fig. 4. As this resistor was varied and the output observed upon an oscilloscope, it was found that at some critical and relatively high value of R3, the output wave form shifted from a quite pure sine wave to a steep-sided and flat-topped square wave.

Without going into the explanation of the reasons for this condition in great detail, suffice it to say that establishment of the required critical value of R3 results in a very satisfactory and generally useful square wave generator, variable over a frequency range equal to that of the audio frequency oscillator itself by the same frequency control dial. It is obvious that the incorporation of a suitable selector switch to cut in either the value of R3 required for sine wave output or that alternate value required for square wave output results in further increasing the general utility of the equipment.

The use of square wave generators for the variety of tests and investigations to which they are admirably suited has not yet received the wide-spread recognition and practical application which it deserves. Audio frequency amplifiers can be most advantageously tested with square wave input which will quickly reveal, in conjunction with the cathode-ray oscilloscope, the presence of various types of distortion, including the distortion due to transients, usually so difficult to determine.

The use of a square wave generator for

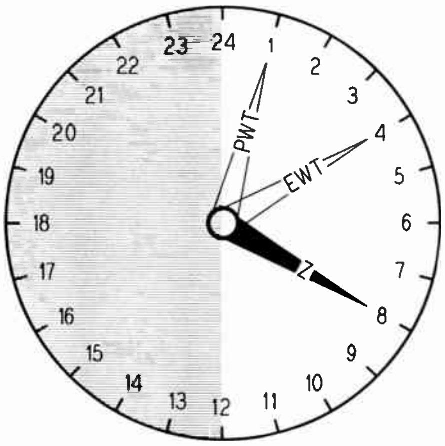
(CONTINUED ON PAGE 29)

MILITARY "Z" TIME

Official Clock Has 24 Hours, Referred to Greenwich Civil Time

TO COÖRDINATE the timing of its round-the-world and around the clock operations, the U. S. Army has adopted a date and time system related to Greenwich Civil Time. The new system, employed throughout the Army, is of special usefulness to the Signal Corps in handling message traffic. In fact, Army Regulations 105-5 designate "timekeeper" duty as a special Signal Corps function.

"Z" Time ★ The Army's new method has created the expression "Z" time because



EASTERN WAR TIME	EASTERN WAR TIME	GREENWICH CIVIL TIME
12-hour clock	24-hour clock	24-hour clock
1 A.M.	0100	0500Z
2 A.M.	0200	0600Z
3 A.M.	0300	0700Z
4 A.M.	0400	0800Z
5 A.M.	0500	0900Z
6 A.M.	0600	1000Z
7 A.M.	0700	1100Z
8 A.M.	0800	1200Z
9 A.M.	0900	1300Z
10 A.M.	1000	1400Z
11 A.M.	1100	1500Z
12 Noon	1200	1600Z
1 P.M.	1300	1700Z
2 P.M.	1400	1800Z
3 P.M.	1500	1900Z
4 P.M.	1600	2000Z
5 P.M.	1700	2100Z
6 P.M.	1800	2200Z
7 P.M.	1900	2300Z
8 P.M.	2000	2400Z
9 P.M.	2100	*0100Z
10 P.M.	2200	*0200Z
11 P.M.	2300	*0300Z
12 Midnight . .	2400	*0400Z

*Next day.

the letter Z is always transmitted after the numerals which show the day of the month and the time in terms of Greenwich Civil Time. If any other zone time is given, the Z must not be used.

The use of a 24-hour clock is the first step in the simplified method. This does away with reference to A.M. and P.M., as shown in the accompanying table. The hour is expressed by the first two numerals, and the minutes by the second two. When four numerals are not required, 0's are used so as to use four in every case. For example: six minutes past midnight must be written as 0006, while midnight is 2400. No punctuation is used.

In addition, the day of the month is always added in the new method of expressing time. Thus 151120 means that it is twenty minutes past eleven in the morning on the 15th of the month. If this is Greenwich Civil Time, the complete expression is 151120Z.

Purpose of Z Time ★ The need for Z time has arisen from the ambiguity of stating time without reference to the time zone. Messages may cross several zones in the course of transmission. Planes may operate in three or four different zones in a day's flight. Thus the use of local time is not practical in military operations.

When the use of universal methods were first discussed, it was necessary to decide on a universal reference for use in all time zones.

Long usage was the determining factor in making the decision. Astronomers at the Royal Observatory of Greenwich, a borough of London, many years ago reduced their observations of the stars to data for the use of geographers in mapping the globe, and for navigators.

As a result, all world maps in use today, both by the United Nations and Axis Countries, measure longitude from the zero meridian which runs through Greenwich. Moreover, the almanacs consulted by the navigators of our warships and bombers show the positions of the constellations in Greenwich Time.

For these reasons, it is most convenient to base all military operations of the United Nations on Greenwich Civil Time. It is now the duty of Signal Corps tactical officers to know the difference between local time and Greenwich Civil Time wherever they are stationed.

To take a specific example of the use of Z time: Suppose that some emergency supplies are being flown from Mitchel Field, Long Island, to Hamilton Field, near San Francisco. They are scheduled to arrive at 9:00 P.M., December 24th. In order to advise Hamilton Field of the arrival time, the information must be converted to Greenwich Civil Time.

Referring to the accompanying table and clock-face, 9:00 P.M. is 2100. Adding the day of the month, this becomes 242100. Now, to make this Z time, it is necessary to add 7 hours to the Pacific War Time, the difference from Greenwich Civil Time, as the clock-face shows.

This would make it 242800. Since the highest figure on the clock is 2400, this amount must be subtracted from 2800, and a calendar day added to 24. Thus the Z time in San Francisco is 250400Z.

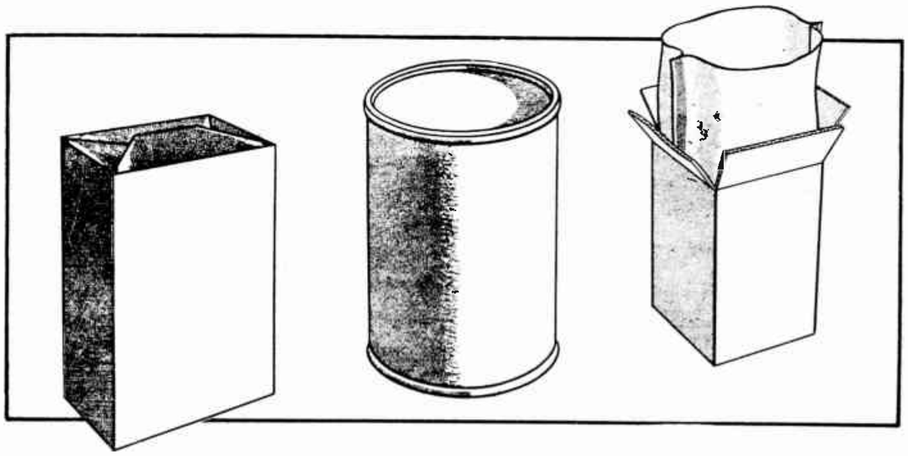


FIG. 1. WRAPPINGS OF LAMINATED PAPER PRODUCED BY REYNOLDS METALS COMPANY

PACKAGING FOR WAR

New Packaging Techniques Use Laminated Paper to Protect Military Apparatus and Components

THERE seems to be no end to the parade of new problems which confront radio-electronic engineers. Added to the multitude of performance requirements and design specifications of equipment itself, engineers now have the responsibility of protecting their finished products against all the exigencies of wartime shipping, warehousing, and distribution.

In other words, the stamp of approval affixed by the Army or Navy inspector at the factory means nothing unless, when the apparatus is unpacked for use at its ultimate destination, it can again pass those final factory tests.

Accordingly, data is presented here on the conditions which must be met, and some of the newly-developed methods for overcoming them.

Mechanical Damage ★ The art of packaging for protection against mechanical damage was highly perfected when the United States entered World War II. Manufacturers of corrugated cartons can generally supply specific information on the design of pads and fillers and the choice of board required to protect a given weight from mechanical injury.

A further factor of safety can be supplied by the use of wooden shooks and steel banding. However, war conditions introduce new hazards in the form of attack by heat and water, against which cartons and shooks are unavailing.

Hazards of Nature ★ En route to its destination, radio equipment and components may escape bombs and torpedoes, and yet be attacked with equal effectiveness by heat and water.

When a supply ship or transport puts out to sea from an American port, bound for Africa, to take a specific example, the cargo is not loaded with the care and caution which shippers can expect under peacetime conditions. Sometimes, as a result of changes in convoy timetables, cargo has to be loaded in practically nothing flat, and by men who are not altogether expert. Then the idea is to get everything aboard and trust that the goods were packaged wisely and packed expertly.

If so, all is well. If not, the failure to arrive in perfect condition may mean not only the waste of time and effort required to produce and transport the goods, but the loss of lives depending on the safe arrival of supplies when the tide of battle requires their use.

En route, heat, water, and dampness are enemies which ride with every cargo. Goods that should be kept dry and cool may, by mistake, be carried as deck cargo, subject to virtual immersion during heavy storms, and to heat that may raise the temperature inside unprotected cartons to 150° F. or higher under the tropical sun.

Landing at ports without dock facilities is a further hazard. Conditions may well be such that the best the crew can do is to get the cargo off the ship, no matter how, and steam away. Unloading may mean getting the goods off into shallow water where whatever sinks can be recovered at low tide.

Once ashore, warehouse facilities may not be available. In that case, goods are left in the baking sun where they may be subject to tropical downpours. Even under a protecting roof, the temperature cycle every 24 hours can do great harm to electrical apparatus of rugged mechanical construction.

Lessons from Soup ★ The first lessons in wartime packaging were learned from experience with dehydrated soup, fruit, and vegetables. Lack of metal for cans and the bulk and weight of glass jars ruled them out as containers. The urgent need of a substitute method of packaging finally led the way to the development of entirely new materials, among which was heat-sealing, laminated paper. This has proved so successful for shipments of dehydrated food, both in bulk and for emergency rations, that its use is now being extended to mechanical items.

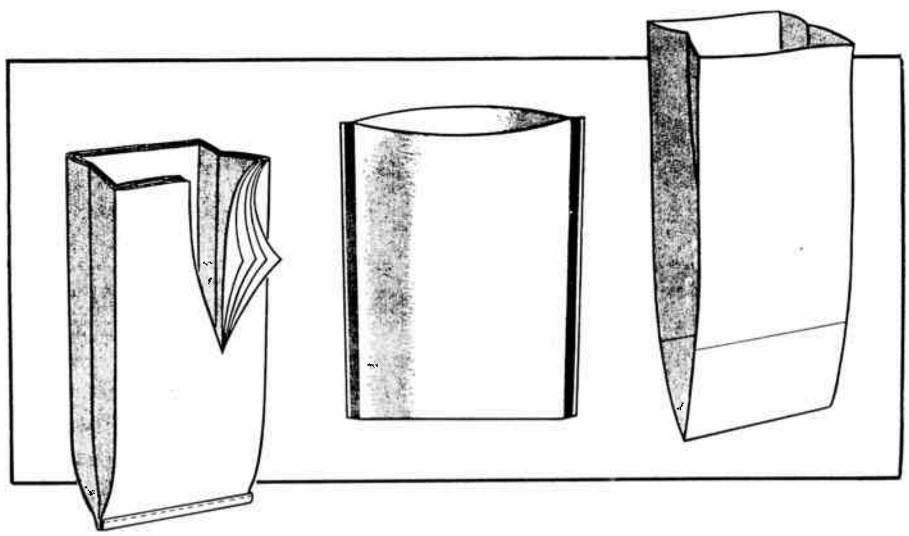
Laminated Paper for Protection ★ Within a comparatively short time, Government specifications have been worked out for laminated paper containers that assure safe passage to such perishable products as dehydrated beets, sweet potatoes, cream of tomato soup, epsom salts, sulfa drugs, and vitamin products.

Generally, the laminated material consists of 1) a dense kraft paper which provides strength and body, 2) a layer of asphaltic compound, 3) a solid sheet of alloyed lead, 4) a moisture-proof adhesive, 5) a layer of cellophane and, finally, 6) a coat of heat-sealing compound.

It may sound as if the result would be a stiff, heavy sheet that would crack if it is bent sharply. Actually, this 6-ply material is only .008 in. thick, and can be bent re-

(CONTINUED ON PAGE 22)

FIG. 2. LAMINATED AND PLAIN ENVELOPES USED MOISTURE VAPOR-PROOF PACKAGING



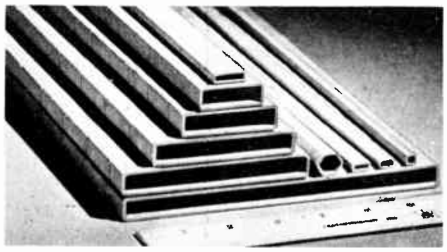
SPOT NEWS NOTES

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

Engineers Take Notice: John V. L. Hogan, introducing Prof. Louis Alan Hazeltine, said: "An engineer is a man who takes the word Science and puts two vertical lines through the first letter."

Prof. Hazeltine: Recalling radio activities during the last war, in an address to the members of the Radio Club of America, described radio amateurs as "those who tried anything, hoping that something wonderful would happen — and it frequently did." Referring to his own experiences and those of some of the other oldtimers, he said: "A pioneer is a man who gets shot by the Indians."

Army-Navy Award: To Clarostat Manufacturing Company, Inc., of Brooklyn, presented by Major H. R. Battley, of the U. S. Army Air Force. In the ceremonies preceding a company dinner and dance, John, Jacob, and Stephen Mucher represented the management, and Samuel Nastri, of CIO Local 430, was spokesman for the workers. Master of ceremonies was Austin Lescaboura.



Paper Tubes: Of Kraft paper, fish paper, red rope, acetate, or combination materials, with tolerances to .002 in., are being produced by Paramount Paper Tube Co., Glasgow Avenue, Chicago. Sizes range from 3/16 to 4 ins. square, or in rectangular cross section.

New Factory: Dedicated on November 20th at Lansdale, Pa., by National Union Radio Corporation.

Stop Nuts: A new wall chart, showing various basic uses for self-locking stop nuts is now available on request from Elastic Stop Nut Corp., Union, N. J. Designers of radio equipment will find this chart exceedingly useful.

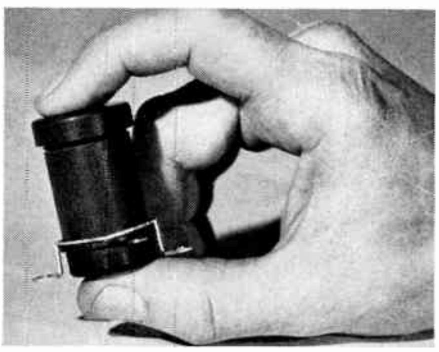
Labels for Metal: Using a new adhesive, Ever-Ready Label Corp. is producing labels that can be applied permanently to chassis and other metal surfaces. These are being used for instructions, warnings, inspection data, and many other purposes. Labels with standard wordings are also available.

Zero Welding: Using acetone cooled with dry ice to cool the electrodes, Ford's Willow Run plant is speeding the welding of thin aluminum parts. Best electrode temperatures range from 20° F. for .032-in. aluminum down to 0° F. for .060-in. sheet. Time saving is effected by eliminating pick-up from electrodes.

John G. Porter: Is now in charge of all sales promotion activities of G.E. transmitter and electronic tube divisions of the Radio, Television, and Electronics Department at Schenectady, according to an announcement by Harry J. Deines, Advertising Manager. Mr. Porter is a graduate of the University of Illinois, '28. He has been with G.E. at Schenectady since 1934.

Static Leak-Off: By developing a rubber compound of high carbon-black content, B. F. Goodrich is now able to manufacture tires of relatively low electrical resistance. These are being used on airplane tail wheels, so that static charges collected in the air will leak off to ground when the plane lands. This prevents shocks to passengers and sparks which might cause gasoline explosions. The new rubber compound is applicable to other machines which collect static charges.

Instrument Jewels: Because the "Vee" jewels for instrument pivots imported from Europe were not ground with a truly spherical surface, General Electric began in 1929 to make jewels from fused-hard glass. This competition spurred on producers in France, Germany, and Switzerland to improve their equipment and methods, and G.E. abandoned their efforts. Since 1939, however, with foreign reserve stocks exhausted, production of glass jewels was resumed, and now G.E. not only manufacture Vee jewels for their own instruments but supply hundreds of thousands to other instrument makers.



NEW GENERAL ELECTRIC RELAY FOR AIRCRAFT BREAKS 30 AMPS. UNDER THE MOST EXTREME CONDITIONS OF SERVICE

Television Patents: The acquisition of the American patents held by Gaumont-British Picture Company of America, Cinema-Television, Ltd., and Baird Television, has been announced by E. N. Rauland, president of Rauland Corporation, Chicago. Military and industrial applications of light-sensitive devices are an important aspect of this patent acquisition. Rauland has also taken over the engineering staffs and laboratory facilities of the concerns listed.

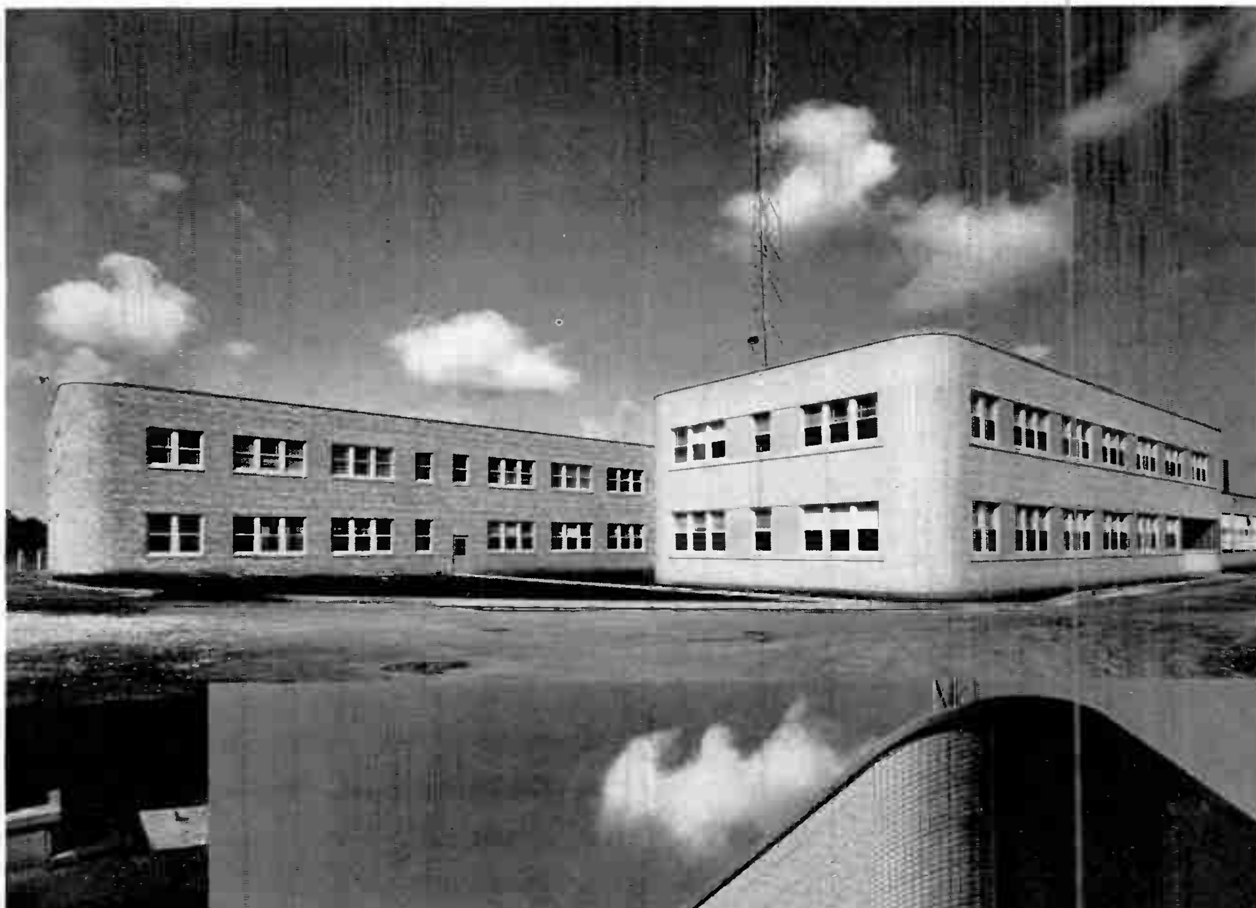
Lignin: Name of substitute for phenol fibre sheets, developed by Western Electric engineers. Made of sulphite water waste from wood pulp mills, Lignin sheet has replaced two-thirds of phenol fibre consumption by W.E. plants. Lignin is also used as a plastic for molded telephone parts.

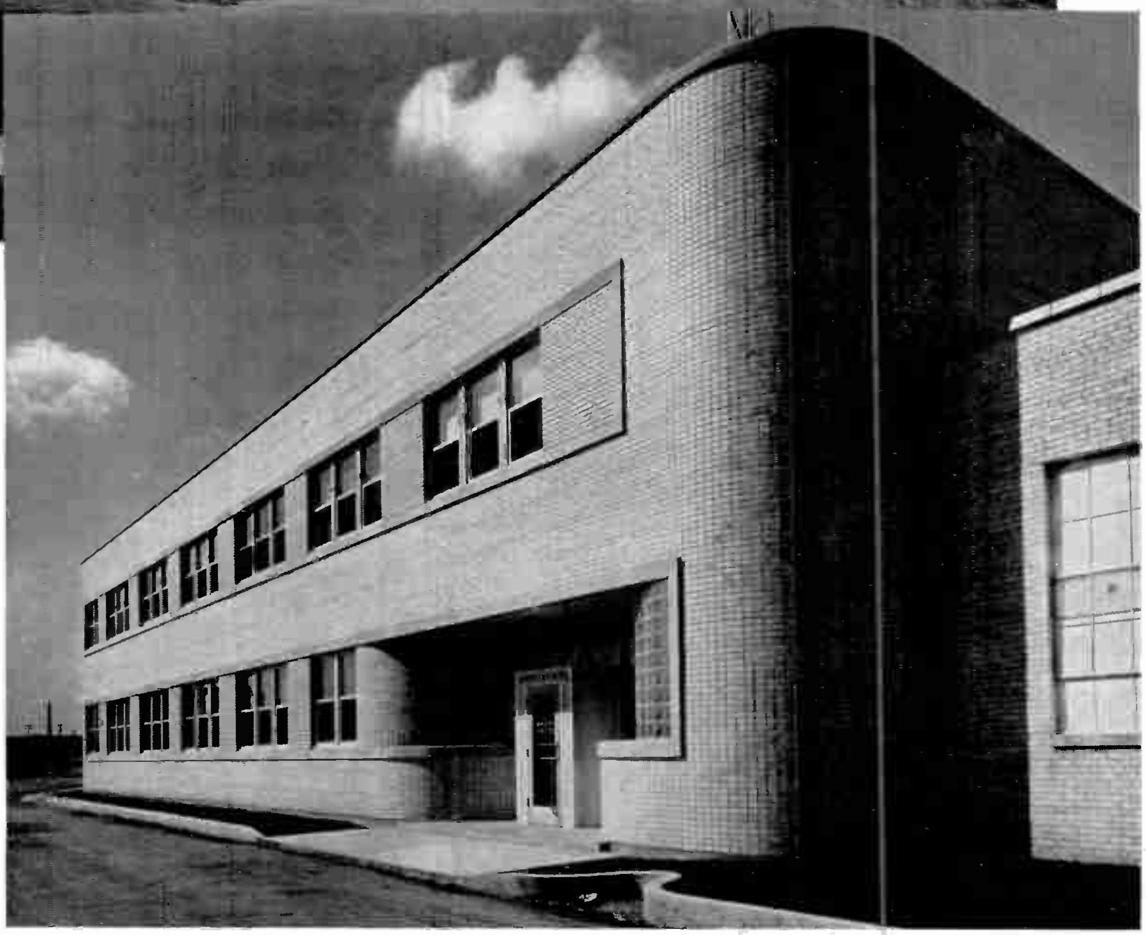
New Company: Recently organized is Aircraft Parts Development Corporation, Summit, N. J. This concern will carry new projects through their development stages to the point of finished designs for production, and will also design special manufacturing tools or machines, if required. Facilities include a well-equipped tool room, powered metal experimental laboratory, and a pilot thermo-plastic plant. President is Dan C. Hungerford, former vice president of Elastic Stop Nut Corporation.

Nameplate Materials: Tentative approval has been given by the Bureau of Ships for the use of plastic nameplate material manufactured by Farley & Loetscher Corp., Mica Insulator Company, Formica Insulation Company, Southwestern Engraving Company, Ansonia Clock Company, Metal Decorating & Mfg. Company, and Daystrom Corp. When nameplates of plastic material are used in place of metal plates, the original dimensions should be increased by 1/32 in. on each side, to prevent splitting at screw holes.

Paul V. McNutt: Director of War Manpower Commission has listed 97 areas of unemployment as those in which more contracts should be placed. Report also listed 66 areas of labor shortage, and 64 where shortage is impending. New York City and 6 adjoining communities were found to require greater volume of war contracts

(CONTINUED ON PAGE 31)





NEWS PICTURE

ONE of the effects of the War is the definite shift of the radio-electronic industry from the East, centering around New York, to the Middle West, with Chicago as its hub. The greatest expansion in research facilities, however, has been in the East. Now, Chicago is putting in its bid for that field, too. Illustrated here is a new building erected to house the research and development facilities of the Galvin Manufacturing Company, producers of Motorola equipment. Erected adjacent to their main plant, this U-shaped building contains over 32,000 square feet of space which will be used for laboratories, testing and measuring equipment, and an experimental model shop. Devoted exclusively to military developments now, it will be available for peacetime research later on.

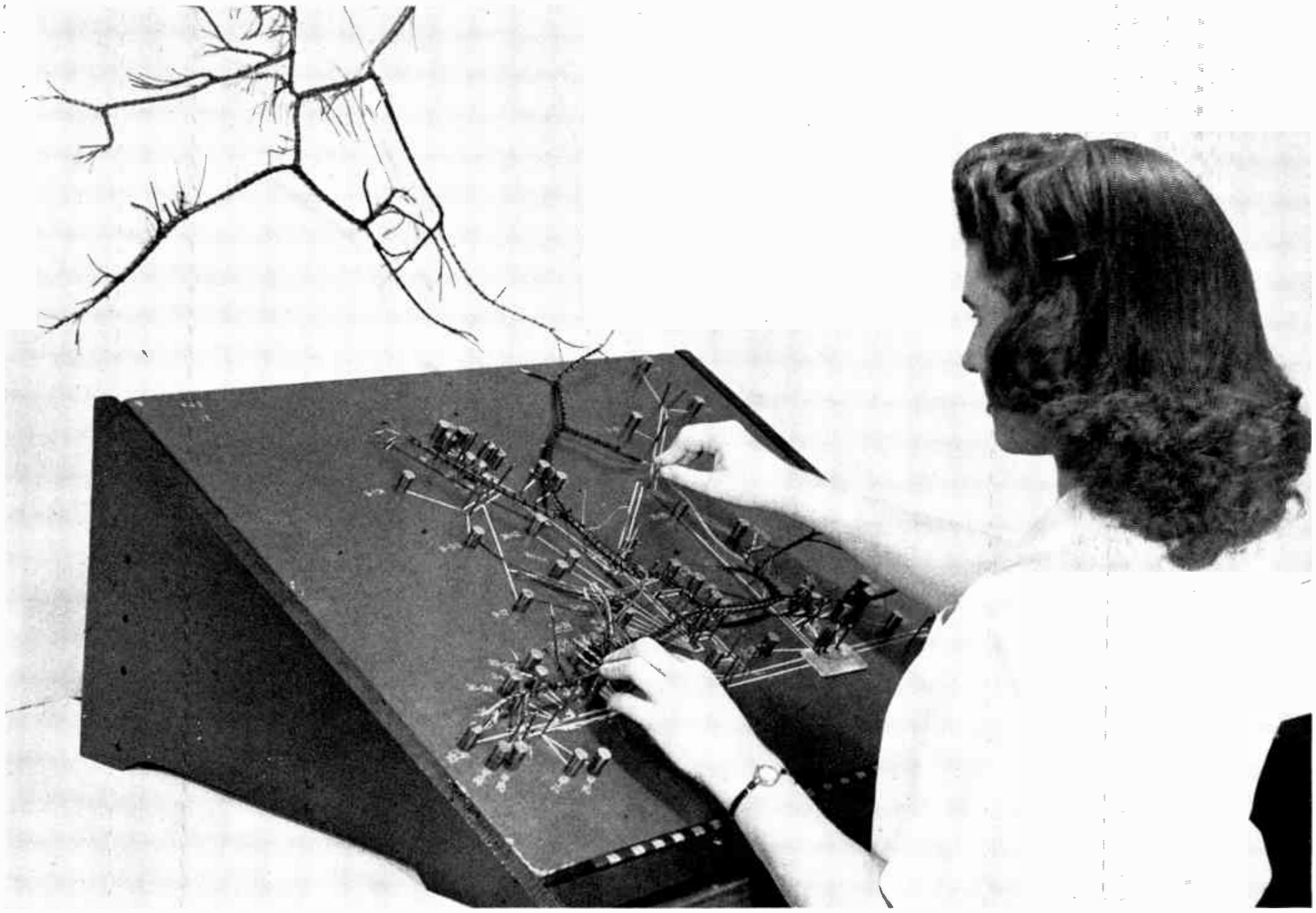


FIG. 1. THE CABLING BOARD USES SPRING BINDING POSTS TO CONNECT THE WIRES TO THE CONTACTS ALONG THE BOTTOM EDGE

PRODUCTION METHOD OF CHECKING CABLES

By Using This Cabling Board and Test Fixture, Each Wire Can Be Checked Instantly

BY M. HOWELL*

A MISTAKE in one wire of an elaborate laced-cable harness can cause so much wasted time that it is not safe to put a harness into a transmitter or receiver unless each conductor has been checked. This is particularly true if the harness includes wires for multi-point connectors.

The task of checking the wires one-by-one, however, is slow and in many cases so confusing that some production managers prefer to assume that cables are correct, and rip them out if a mistake is found after the conductors have been soldered into the chassis.

At Colonial Radio Corporation, we undertook to save both the time consumed by checking each wire separately, and to save also the time lost in ripping out a cable in case an error had been made. The very successful result of our efforts is shown in the accompanying illustrations.

Cabling Board ★ A special cabling board was made for each type of harness. For those harnesses required in large quantities, we made several identical boards. They are of the conventional sort except that the ends of the wires are connected to spring binding posts, such as the Eby type 62M posts. Such a board is shown in Fig. 1, with a detailed view in Fig. 2.

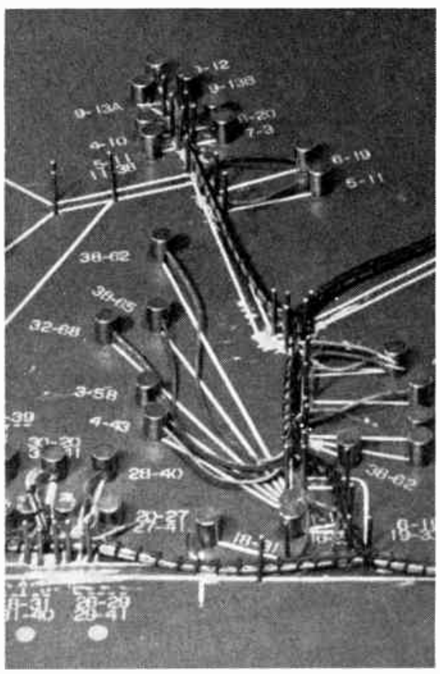


FIG. 2. DETAILED VIEW OF THE BOARD

On the underside of the board, one set of binding posts, representing one end of each wire in the cable, is connected to contact springs in a row across the bottom of the board. The other set of posts is connected to a common ground wire.

In use, the operator receives all the wires cut to exact length, stripped, tinned, and color coded. Opposite each binding post is a number, or numbers, indicating the wire or wires to be attached to that post. This can be seen in Fig. 2. Lines painted on the boards, with pins at the bends, guide the operator in running wires between the binding posts. The wires are put on in a definite succession, so that they will come out the proper side of the cable when it is completed. With all the wires in place, they are laced in the conventional manner, using a curved needle.

* Engineer, Colonial Radio Corp., Buffalo, N. Y.

Finally, when the lacing is complete, the operator picks up the entire board, and carries it to the corresponding checker.

Wire Checker ★ The checker, into which the cabling board fits, looks much like a picture frame. This frame, Fig. 3, has a row of buttons which make contact with the row of springs on the cabling board. The buttons are connected to a 6-volt transformer and a row of pilot lamps in such a manner that a separate lamp indicates continuity for each wire in the cable. This circuit is shown in Fig. 4. If all the lamps light, the wiring is correct, and no conductor has been left out.

After this test has been made, the board is removed from the checker, and the harness is lifted off the board. The finished harness is then ready to install, and a new one is started on the cabling board.

If the make-up of the harness is such that wires might be reversed, an additional check can be made. In this case, it is necessary that the order of the spring contacts on the checker be the same as the order of the pilot lamps. The test is made by inserting a thin strip of Bakelite or fibre between each spring and contact button, to open the circuit. If the circuits are opened one after another along the row, the lights should go out in the same order. If a light is cut off out of turn, then two wires have been reversed.

One checker can be used for a number of similar cabling boards, or for different types of harness, by using multiple rows of lamps, one row for each type.

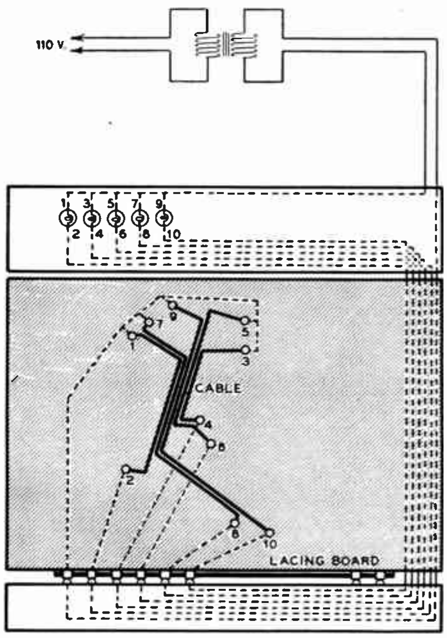


FIG. 4. CONNECTIONS OF THE TEST FIXTURE

Results of Testing ★ Boards and checkers such as these, some taking up to 88 wires, are now in use. Although the initial cost is comparatively high, these fixtures have paid for themselves many times over in labor saving and increased quality. Not only is it easier and faster to lace wires in the open, but the wiring is neater and more uniform than when the wires are laced after they have been soldered in the set. There is a tendency to greater accuracy, too, since the work of each operator is checked before the cable is removed from the board.

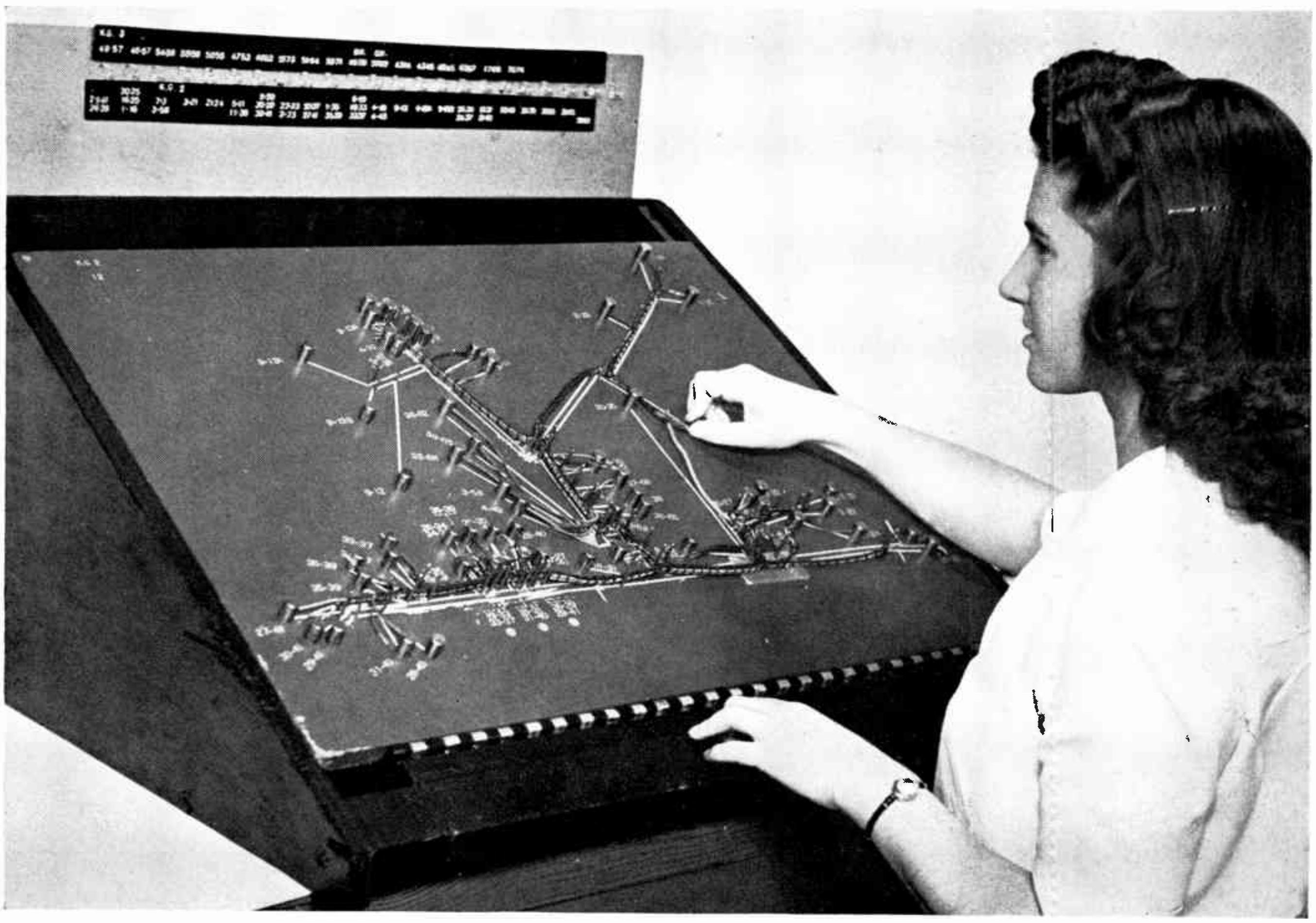
Mistakes are caught before they get into the radio equipment, where they would entail trouble-shooting and repair. All ends are brought out opposite their proper terminals, decreasing the chances of mistakes when the wires are soldered to their respective lugs.

During months of actual use, we have found that wiring time has been cut almost in half by the method described. Out of thousands of harnesses made in this way, not a single defective one has been passed by the checker.

NEW MANAGER FOR STATION W85A

Emerson Markham, in charge of farm and science broadcasting for G.E. has also been appointed manager of FM station W85A, to succeed John R. Sheehan, who has joined the OWI office in New York City. This announcement was made by Robert S. Peare, manager of G.E. broadcasting. Station W85A maintains a schedule from 3:00 to 10:00 P.M.

FIG. 3. WHEN THE CABLING BOARD IS PUT INTO THE TEST FIXTURE, A LIGHT GOES ON FOR EACH WIRE IF THERE ARE NO ERRORS



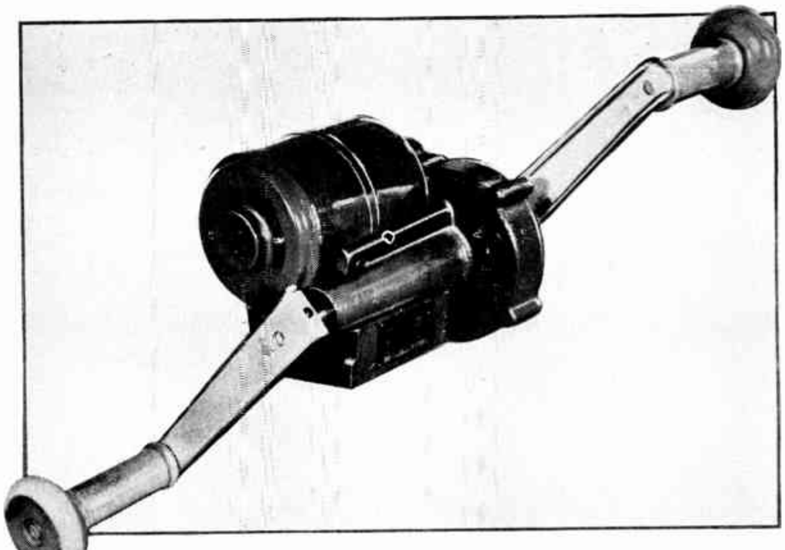


FIG. 1. THIS 100-WATT GENERATOR DELIVERS AC OR ONE OR TWO DC VOLTAGES

HAND-DRIVEN GENERATORS

30-Watt and 100-Watt Types for Operating Radio Equipment and for Emergency Storage Battery Charging Service

BY R. W. CARTER*

THE use of hand-driven generators dates back many years, but the quantity, until the present time, was too limited to warrant the refinement of their design to the point of reducing weight to the very minimum for a given output.

Such a development program was completed recently by the Carter Motor Company, using the familiar Magmotor as a basic design. Two types of hand-driven generators were evolved, one of 100 watts output, weighing 40 lbs. complete with tripod stand and seats, as shown in Figs. 1 and 2, and one delivering 30 watts, weighing 6 lbs net, illustrated in Fig. 3.

*Vice president, Carter Motor Company, 1608 Milwaukee Ave., Chicago.

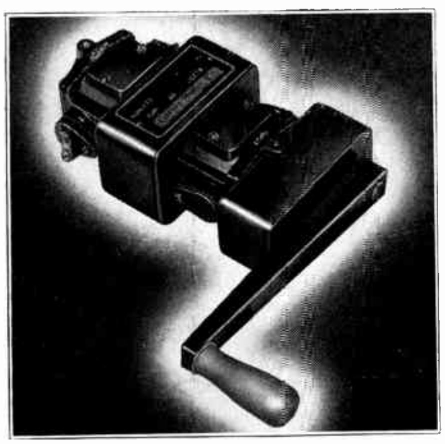


FIG. 3. 6-LB. GENERATOR DELIVERS 30 WATTS

These are believed to be the only hand-driven types, using Alnico permanent magnet fields, ever built in this Country. The basic design has been in use for many years in police radio service for storage battery-driven motor-generators. Applied to hand-driven generators, it has the advantages of 1) high output per pound, and 2) great voltage stability at varying speeds of operation. That is because the field strength is independent of the speed of rotation, while the field of the conventional generator is directly proportional to the speed. The output of the latter, therefore, drops off sharply as the cranking rate is reduced.

100-Watt Generator ★ The 100-watt type is made to deliver AC or DC of one voltage, or two DC voltages for supplying both filaments and plates of radio equipment. The AC model is suitable as a standby supply for operating various types of emergency radio installations. By designing portable equipment for the dual-voltage DC generator, maximum efficiency can be obtained, since no dropping resistor is required for the filament voltage.

The gears are helical-cut, to assure smooth, quiet operation. Further noise reduction is obtained by using a Bakelite fabric idler gear. Complete protection from dust is provided by the housing.

When mounted on the stand, the overall height is 48 ins. This brings the cranks up high enough that the operator can use his shoulder and back muscles, and not his forearms only, as is the case with a low stand. This reduces fatigue greatly, and allows the smooth crank motion necessary to maintain constant voltage.

The stand has seats for two operators, although one man can turn the generator if it is not used continuously for long periods of time. The entire assembly can be taken down quickly and prepared for transportation without taking anything apart except the crank handles. This feature is important, as it reduces the possibility of losing parts in the field. The brushes, which are the only wearing parts, can be expected to last indefinitely, since their life in the standard Magmotor is over 5,000 hours under continuous duty.

30-Watt Generator ★ The 30-watt model is suited to a variety of applications, most important of which is charging 2-volt or 6-volt storage batteries in the field. It is also used for life-saving devices, and small rescue signal transmitters.

The generator is 8 ins. long, 3 11/16 ins. wide, and 2½ ins. high, making an extremely compact unit. The 7-in. crank, operating with an enclosed ratchet, can be detached instantly. Enclosed construction gives complete protection to the brushes, armature, and bearings. The gear train is housed in a box the same size as the frame itself, in order to eliminate any protrusions. This can be seen in Fig. 3.

Since this small, light-weight generator has been made available on a production basis, a considerable number of new applications will undoubtedly be found for it.

The voltage regulation on this small generator is extremely good, and it can be operated at full output with no more than a normal effort by an inexperienced operator. Thus it opens up a wide field for special apparatus run from storage batteries or vibrator power supplies.

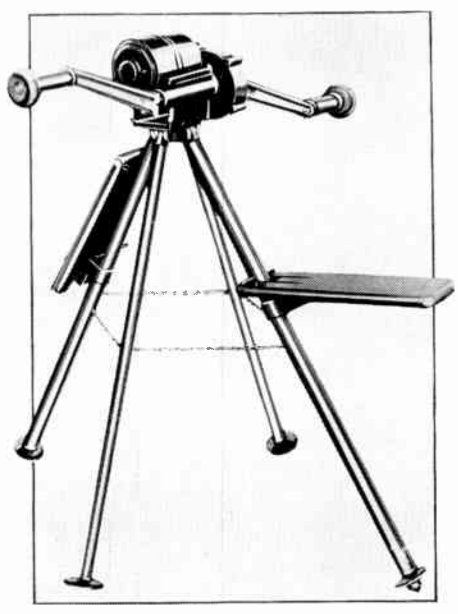


FIG. 2. COMPLETE 100-WATT UNIT WEIGHS 40 LBS.

NEW RADIO-ELECTRONIC DESIGN PRACTICE

Part 2. Causes and Prevention of Failures and Disintegration from Exposure to Extremes of Temperature and Humidity in the Tropics

BY M. B. SLEEPER

JUDGING from reports coming back to the United States, the fact that communications are being maintained in some parts of the world today is due to the energetic efforts of the men in charge of the radio equipment, rather than because the equipment was originally designed to withstand tropical heat and dampness.

Nature's Strategy ★ Briefly, Nature's strategy is this: First, dampness collects inside the apparatus. Then a little dirt lodges in cracks or corners. This affords support to the growth of fungi. And then the insects take over. In short, whatever isn't eaten away by the fauna sprouts flora!

The writer recalls a letter received by Pilot Radio Corporation some years ago from a listener on the Gold Coast of Africa, one of those sections of the world that is visited by prolonged, annual rainy seasons. During these spells, he reported, the inside of his set fairly dripped with condensed moisture. In order to maintain short-wave reception under this condition, he removed the back plate of the radio cabinet, and set a kerosene lantern near it. When the signals began to fade, he used this method to dry out the components, and restored them to their normal values.

Another letter to the same Company described the conditions in southern

(CONTINUED ON PAGE 22)

NAME OF COMPONENT PART	Drying Time	Oven °C	Impregnating Substance	Bath Time	Bath °C	REMARKS
High-voltage, high impedance coils			Ceresin	1 hour	140°	When cool dip in Superior Compound
Open core IF and Audio chokes and transformers, with paper insulation	24 hours	75°	WE Superior Compound	Dip	150°	Seal off air bubbles when cool *
Above parts with Bakelite or fiber insulation	24 hours	105°	WE Superior Compound	Dip	150°	Seal off air bubbles when cool *
Audio transformers, paper insulation	24 hours	75°	WE Superior Compound	Dip	150°	Dip winding out of case, seal off air bubbles, then pot in case *
Potted type transformers	24 hours	75°	WE Superior Compound	Dip	150°	Dip winding out of case, seal off air bubbles, then pot in case *
High voltage power type transformers	24 hours	105°	WE Superior Compound	Dip	150°	Dip winding out of case, seal off air bubbles, then pot in case *
Ceramic type wire wound resistors			Rust Ban 327	30 minutes	140°	Heat until bubbles cease. As resistors cool, dip in Rust Ban. Wipe off excess when cool
IRC Type WW4 resistors	24 hours	105°	Superior Compound	Dip	150°	Seal bubbles when cool *
High resistance Bakelite molded resistors	24 hours	75°	Superior Compound	Dip	140°	Seal bubbles when cool and identify
New molded mica condensers $R < 10^9$ ohms			Ceresin	30 minutes	140°	Let remain in Ceresin until cool
Old molded mica condensers leakage $R < 10^9$ ohms			Ceresin	3 hours	150°	Check for leakage when cool
New paper tubular condensers $R > 10^9$ ohms			Superior Compound	Dip	150°	Make sure wax covers each end
Old paper tubular condensers $R < 10^9$ ohms 1st treatment			Ceresin	1 hour	140°	Tie wire leads against tube to prevent leads breaking from foil
Old paper tubular condensers $R < 10^9$ ohms 2nd treatment			Superior Compound	Dip	140°	See that wax completely fills space at each end
Condensers sealed in cans $R > 10^9$ ohms			Superior Compound	Dip terminals	150°	Seal air bubbles *
Switches and jacks for high voltage or high impedance circuits	12 hours	105°	Superior Compound	Dip Insulation	150°	Dip insulation and seal air bubbles *

*Seal off air bubbles by applying tip of hot soldering iron.

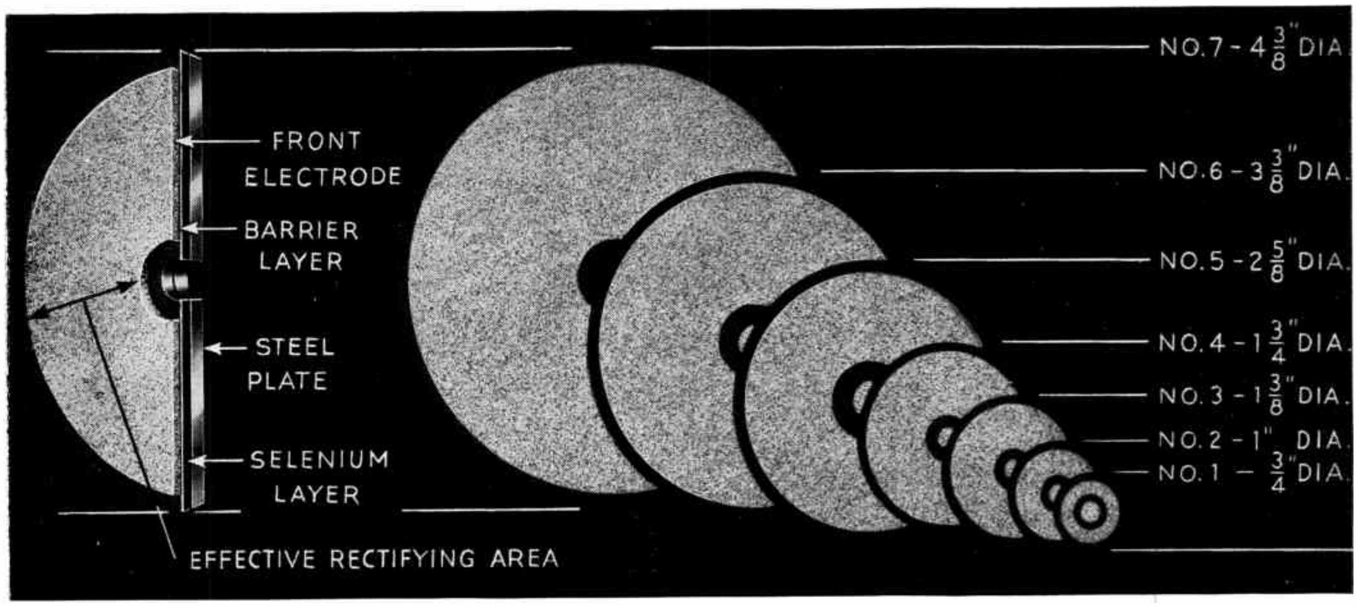


FIG. 1. LEFT, CROSS-SECTION OF SELENIUM RECTIFIER. RIGHT, THE SEVEN BASIC SIZES OF SELENIUM RECTIFIER PLATES

DESIGN OF SELENIUM RECTIFIERS

Part 1. Data on the Design of Metallic Plate Rectifiers for Electronic Circuit Applications

BY J. E. YARMACK*

SELENIUM rectifiers, because of their advantageous characteristics, are being used in an increasing number of applications where DC current is required, and only rectified AC is available. New electronic developments, too, are creating additional applications for selenium rectifiers.

The capacities and ratings of these devices are not limited to any narrow range. On the contrary, combinations of plates in one of the seven standard sizes can be worked out, by means of the data presented here, to handle small or heavy loads on intermittent or continuous duty, under practically any operating conditions.

Selenium Plates ★ The rectification of alternating currents by means of the selenium rectifier takes place wholly within the constituent plate or plates, seven sizes of which are shown in Fig. 1. The rectifying medium of this electronic device consists of selenium. The principle of operation is similar to that of other dry plate rectifiers, i.e., low resistance in the forward direction and high resistance in the reverse direction. A metal plate serves as back electrode. Over it, a layer of selenium is deposited, thin enough to give minimum internal losses, but sufficiently thick to withstand high inverse voltage. A soft metal of low-melting temperature is then applied over the selenium layer to form a front electrode. Finally, by means of controlled processes, a barrier layer is formed between the selenium and the front electrode.

Selenium Rectifier Stacks ★ Rectifier stacks are produced by assembling selenium rectifier plates (40 plates are usually maximum) on a center stud with contact discs or washers interspersed between plates. Series and parallel arrangement can readily be provided as required by inserting insulators between plates and introducing terminal lugs into the stack.

A stack consisting of forty plates may be connnected in several different ways; for example, as a bridge circuit unit having ten plates in a series and one plate in parallel (4–10–1), or one plate in series and ten in parallel (4–1–10). The same stack may also be connected as a half-wave rectifier having all forty plates in series to take care of voltage and one plate in parallel to take care of current (1–40–1). Further, the forty-plate stack may also be assembled as a doubler (2–10–2), two of which make a bridge circuit rectifier with ten series and two parallel plates in each arm of the bridge.

For the three-phase half-wave circuit the total number of plates must be a multiple of three to allow a total connection such as 3–6–2 for a thirty-six plate single stack unit. Similarly, this latter stack, if connected as 6–6–1, becomes either a bridge or center tap three phase rectifier.

Rating of Plates ★ Current ratings of selenium plates are a function of their effective rectifying areas and heat-dissipating capacities. Table I lists seven basic plates, ranging from ¾ in. to 4⅜ ins. in diameter; it also shows ratings of the basic plates in various rectifier circuits. The ampere capacities shown in this Table are based on an ambient temperature of 35° C., and were determined experimentally. The requirements of a selenium rectifier, in respect to current, are always met by selecting the proper size of plates and their number in parallel, if the total rating of the rectifier exceeds the rating of an individual plate.

The ratings of the plates shown in Table I can be increased by providing additional cooling. Doubling the spacing between plates assembled in a single stack increases the heat-dissipating ability of the stack; the rating of plates is then 25 to 50% higher than those shown in Table I. Table II lists six selenium plates having the same effective rectifying areas as those listed in Table I, but their current ratings are higher because of wider spacing.

By providing cooling fins, the forward current carrying capacity of the plates can be raised still further. Table III contains eight additional plates with fins, the current ratings of which are from two to two and one-half times greater than the plates of the same rectifying areas listed in Table I. With the extended ratings of the plates, whether by means of wide spacings or

*Engineer, International Telephone & Radio Manufacturing Corporation, East Newark, N. J.

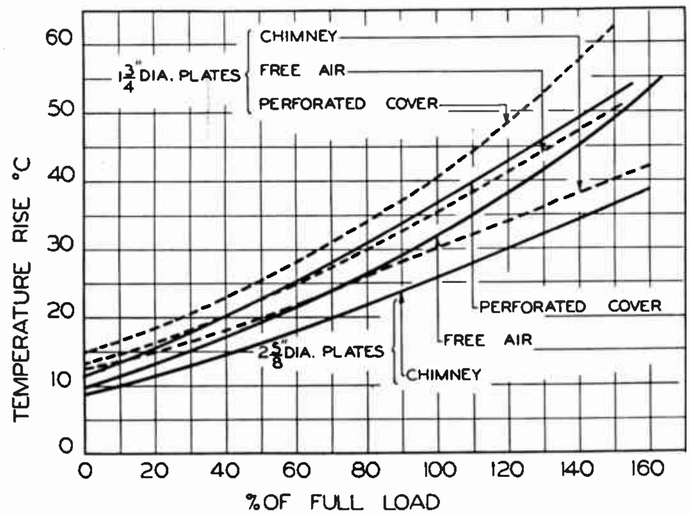


FIG. 2. CHARACTERISTICS OF TWO SELENIUM RECTIFIERS UNDER THREE DIFFERENT COOLING CONDITIONS OF OPERATION

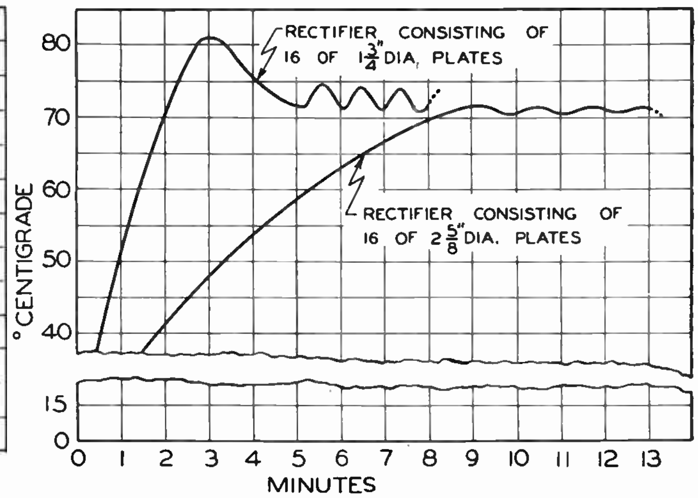


FIG. 4. TIME-TEMPERATURE CHARACTERISTICS, ILLUSTRATING THE PERFORMANCE OF RECTIFIERS WITH BI-METAL STRIPS

cooling fins, the internal losses of selenium rectifiers are greater; consequently, their efficiency is slightly reduced and the voltage regulation is adversely affected.

Tables I, II, and III also give the maximum permissible reverse r.m.s. voltages per plate. The voltages thus indicated have ample safety margin. If, however, the reverse voltage be increased beyond safe limits, the rectifying layer between the selenium and the front electrode alloy breaks down. The maximum specified voltage must not, therefore, be exceeded. Tables I, II, and III include ratings of selenium plates in DC circuits.

Rectifier stacks with narrow or wide spacing, as well as those with fins, are ordinarily cooled by convection. Large size selenium rectifiers, however, often utilize forced draft ventilation in order to save space and to economize in rectifying elements. The normal plate rating can thereby be increased twofold, and sometimes threefold. If, however, extended loading of plates with the aid of forced ventilation is not desired, substantially greater current output, as compared with free air conditions, can be obtained by mounting the stacks in a chimney-like enclosure, Fig. 2. As will be noted from the illustration, the least favorable condition is that of mounting the stacks in a cabinet provided with perforated covers.

The current rating of selenium rectifiers is limited only by the final plate temperature resulting from heating. The stacks can be heavily overloaded, provided the maximum safe operating temperature of 75° C. is not exceeded. When this temperature is reached, the load must either be reduced to normal, or provision made for cutting the rectifying elements out of service as in the two half-wave rectifiers illustrated in Fig. 3. These are widely used in business machines. Each element in these machines is equipped with a pair of bi-metal strips connected by means of an adjustable screw. If, by chance, the keypunch of the duplicator happens to be jammed and causes the temperature of the stacks to reach a range of 70 or 80° C., the bi-metal strips separate, thus breaking the circuit. The plates then cool off and the bi-metal strips close again, Fig. 4.

Intermittent Service ★ Considerable gain in the current capacity of selenium rectifiers can be obtained when they are used in intermittent service, in which case the duty cycles must be definitely established. The variety of these intermittent applications is great and their complete discussion here would be too lengthy. One formula, however, is frequently used for periodic loadings:

$$I_m = I_{max.} \sqrt{\frac{A}{A+P}}, \qquad (1)$$

where I_m is the continuous current rating, $I_{max.}$ the maximum current drawn periodically, A the operating period, and P the inoperative interval. Both A and P should be in the same time units. Experience has shown that this formula can be used only if A is less than the selenium plate time constant T, which may be defined by:

$$t_1 = t_2\left(1 - e^{\frac{A}{T}}\right) \qquad (2)$$

and which varies from 5 to 8 minutes, depending on the plate size (t_1 and t_2 are instantaneous and final plate temperatures, respectively). When operating periods are separated by inoperative intervals of such length that the rectifier again cools practically to normal ambient temperature, much greater plate overloads are practicable.

Design of Stacks by Direct Values ★ After choosing the size of plate with proper current-carrying capacity, the internal voltage drop of the plate is considered. Fig. 5 illustrates the average, experimentally determined, internal voltage drop for seven plates in either bridge or center tap, single phase circuits. The voltage drop per plate, designated as dv, is one-half of the differ-

TABLE I *

Plate Type No.	Diameter of Plates	Maximum Number of Plates per Stack	Max. R.M.S. Reverse Voltage per Plate	Single Phase Rectifiers: Half Wave	Single Phase Rectifiers: Bridge	Single Phase Rectifiers: Center Tap	Three Phase Rectifiers: Half Wave	Three Phase Rectifiers: Bridge	Three Phase Rectifiers: Center Tap	Rating of Plates Used as D.C. Valves	
	Inches		Volts	D.C. Amperes						Amperes	Volts
1	¾	36	18	.04	.075	.075	.10	.11	.13	.06	15
2	1	36	18	.075	.15	.15	.20	.225	.27	.12	15
3	1⅜	36	18	.15	.30	.30	.40	.45	.55	.23	15
4	1¾	40	18	.30	.60	.60	.80	.90	1.1	.45	15
5	2⅝	40	18	.60	1.2	1.2	1.6	1.8	2.2	.90	15
6	3⅜	40	16	1.2	2.4	2.4	3.2	3.6	4.5	1.8	12
7	4⅜	40	14	2.0	4.0	4.0	5.3	6.0	7.5	3.1	12

* Current and voltage ratings of seven basic selenium plotes when used in narrow spacing assemblies and with resistive and inductive loads. For battery-charging and condenser loads, these ratings are reduced by 20 percent. Conditions: Continuous duty; 35° C. ambient temperature.

TABLE II *

Plate Type No.	Diameter of Plates	Maximum Number of Plates per Stack	Selenium Plate No. Used (See Table I)	Max. R.M.S. Reverse Voltage per Plate	Single Phase Rectifiers: Half Wave	Single Phase Rectifiers: Bridge	Single Phase Rectifiers: Center Tap	Three Phase Rectifiers: Half Wave	Three Phase Rectifiers: Bridge	Three Phase Rectifiers: Center Tap	Rating of Plates Used as D.C. Valves: Amperes	Rating of Plates Used as D.C. Valves: Volts
	Inches			Volts	D.C. Amperes						Amperes	Volts
20	1	28	2	18	.11	.22	.22	.29	.33	.4	.17	15
21	1⅜	28	3	18	.23	.45	.45	.6	.67	.82	.34	15
10	1¾	28	4	18	.39	.78	.78	1.0	1.1	1.4	.58	15
11	2⅝	28	5	18	.78	1.6	1.6	2.1	2.3	2.8	1.2	15
14	3⅜	28	6	16	1.5	3.1	3.1	4.1	4.6	5.8	2.4	12
18	4⅜	28	7	14	2.6	5.2	5.2	6.9	7.8	9.7	4.0	12

* Current and voltage ratings of six selenium plates (similar to Table I, except No. 1 plate omitted) when used in wide spacing assemblies and for resistive and inductive loads. For battery-charging and condenser loads, these ratings are reduced by 20 percent. Conditions: Continuous duty; 35° C. ambient temperature.

ence between the root mean square values of voltages read on the input and output side of the rectifier. These quantities are plotted as ordinates against the arithmetical values of output current in amperes plotted as abscissa.

The output voltage of a selenium rectifier is determined by the input voltage V_{ac} less the total voltage drop within the rectifier. The computation of the necessary alternating current voltage to be impressed on the selenium rectifier involves consideration of the voltage drop per plate and the number of plates through which the current flows.

Using the data given in Tables I, II, and III, and the internal voltage drop per plate illustrated in Fig. 5, any single phase selenium rectifier can be designed and the necessary alternating current voltage computed by the following formula:

$$V_{ac} = k_1 V_{dc} + k_2 n dv, \qquad (3)$$

where V_{ac} is the input voltage, k_1 the form factor to convert the arithmetical value to the root mean square voltage value (Table IV), V_{dc} the required direct current output voltage, k_2 the number of arms through which current must pass in the circuit for each half-cycle, n the number of plates in series per arm, and dv the voltage drop per plate for the circuit employed. The constants k_1 and k_2 vary depending upon whether a bridge or center tap connection, a single- or three-phase circuit is employed.

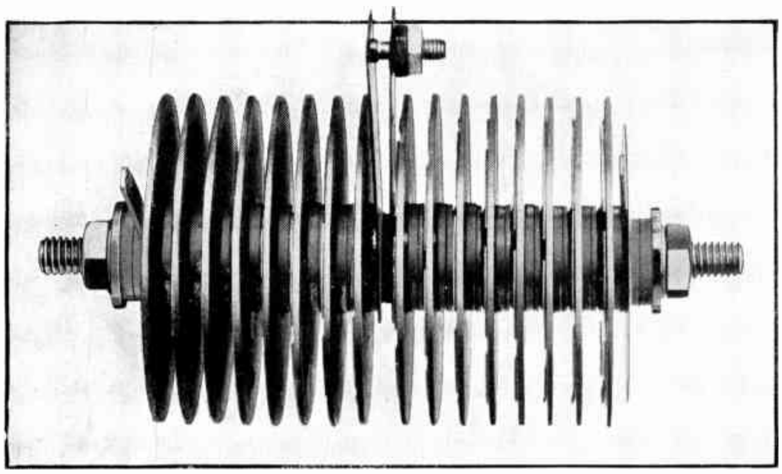


FIG. 3. TWO HALF-WAVE RECTIFIERS FOR OPERATING MAGNETS IN ACCOUNTING MACHINE

As an example, let us design a bridge type unit required to deliver 4 amperes at 16 volts continuously under the maximum ambient temperature of 35° C. in a single-phase circuit. Selenium plate No. 7, 4⅜" in diameter, listed in Table I and rated at 4 amperes, will serve the purpose. Using equation (3) and corresponding constants from Table IV:

$$V_{ac} = 1.15 \times 16 + 2ndv.$$

The number of plates in series, i.e., quantity n, necessary at this stage, can be computed by the following formula:

$$n = \frac{k_1 V_{dc}}{V_p - 2dv}. \qquad (4)$$

V_p for Plate No. 7 is 14, and dv, as read off characteristic No. 7 in Fig. 5, is 1.29; hence,

$$n = \frac{1.15 \times 16}{14 - 2 \times 1.29} = 1.6 \text{ or } 2 \text{ of No. 7}$$

plates in series.

V_{ac}, therefore, at the start of service, is equal to 23.6 volts. With the aging of the selenium rectifier, the forward resistance increases and the inverse resistance also slightly increases. Based on lengthy experience in the design and application of these rectifiers, it can be stated that the only variable in equation (3) is dv, which may increase as much as 50% under most adverse conditions. An additional tap, therefore, should be provided in the transformer winding to give the V_{ac} required for the aged condition:

$$V_{ac} = 1.15 \times 16 + 2 \times 2 \times 1.29 \times 1.5 = 26 \text{ volts.}$$

TABLE III *

Plate Type No.	Size of Cooling Fins	Maximum Number of Plates per Stack	Selenium Plate No. Used (See Table I)	Max. R.M.S. Reverse Voltage per Plate	Single Phase Rectifiers: Half Wave	Single Phase Rectifiers: Bridge	Single Phase Rectifiers: Center Tap	Three Phase Rectifiers: Half Wave	Three Phase Rectifiers: Bridge	Three Phase Rectifiers: Center Tap	Rating of Plates Used as D.C. Valves: Amperes	Rating of Plates Used as D.C. Valves: Volts
	Inches			Volts	D.C. Amperes						Amperes	Volts
9	2⅝ D.	28	4	18	.58	1.1	1.1	1.5	1.7	2.1	.87	15
12	3⅜ D.	28	5	18	.90	1.8	1.8	2.4	2.7	3.3	1.4	15
13	4⅜ D.	28	5	18	1.1	2.2	2.2	2.9	3.3	4.0	1.7	15
15	4⅜ D.	28	6	16	1.8	3.5	3.5	4.6	5.2	6.5	2.7	12
16	4⅜ D.	24	6	16	1.9	3.8	3.8	5.0	5.6	7.0	2.9	12
17	6 × 6	28	6	16	2.7	5.4	5.4	7.2	8.1	10.0	4.1	12
19	6 × 6	28	7	14	3.7	7.4	7.4	9.8	11.1	13.3	5.7	12
8	8 × 8	28	7	14	5.0	10.0	10.0	13.0	15.0	18.0	7.5	12

* Current and voltage ratings of eight selenium plates (Nos. 4, 5, 6 and 7) equipped with cooling fins of different sizes, and used for resistive and inductive loads. For battery-charging and condenser loads, these ratings are reduced by 20 percent. Conditions: Continuous duty; 35° C. ambient temperature.

Designs by Relative Values ★ The foregoing example and reference to Fig. 5 characteristics apply only to the single phase, bridge, and center tap designs with either inductive or resistive loads. With condenser and battery charging loads, even in the above-mentioned circuits, intermittent loading on the selenium plates occurs with periodic values of the forward current

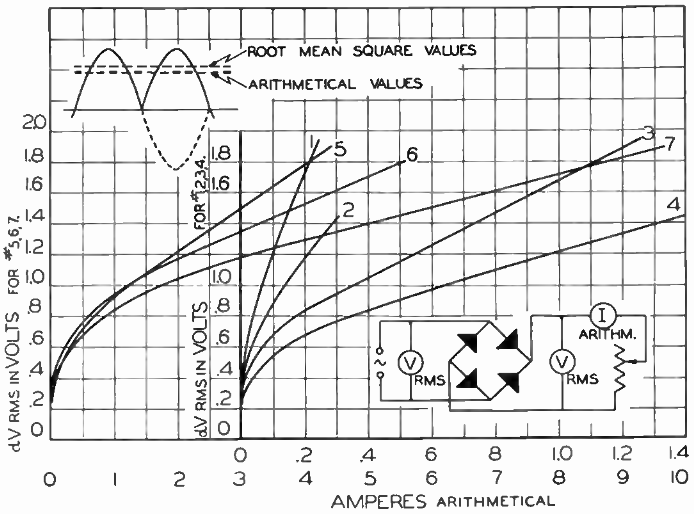


FIG. 5. CHARACTERISTICS OF BASIC PLATES OF ¾, 1, 1¾, 2⅝, 3⅜, 4⅜ INS. DIAM.

greater than the periodic values for the same DC output feeding resistive or inductive load. Voltage drops per plate are, therefore, greater in the former case. Applications occur, however, where the voltage drop per plate is smaller than the values shown in Fig. 5. An example is the three-phase circuit where the rectified current is practically at the peak value of the applied alternating current. The output current density per plate in these circuits is considerably higher than in the case of a single-phase bridge circuit. Furthermore, the type of load, whether it be resistive, inductive, capacitive, or battery charging, has practically no effect on the voltage drop per plate.

Inasmuch as a wide variety of circuits and types of loading is encountered, a method for rating the 21 rectifier types according to relative values of output current and voltage drop per plate has been developed. Figs. 6, 7, 8, and 9 illustrate the relationships N and F_v for various types of circuits and loads.

The use of these characteristics involves, first, determination of the value N, which is obtained by dividing the actual ampere load per plate by the ampere rating of the basic plate employed. With this value determined, the value F_v is read from one of the characteristics and then multiplied by the plate size factor F_s to obtain the actual voltage drop per plate, dv, for the plate selected.

Fig. 6 illustrates the relationship of F_v to the value N for half-wave, center tap and bridge, single phase circuits when loaded with either resistive or inductive load; also for half-wave, three-phase circuits for all types of loads. Fig. 7 gives a similar relationship of F_v to the value N for half-wave, center tap and bridge circuits, all single-phase for capacitive or battery charging applications. Fig. 8 shows the relationship of F_v to N for three-phase bridge and center tap circuits for all types of loads. Finally, Fig. 9 shows the relationship of F_v to N for direct current and blocking circuit applications.

To illustrate this method of design, let us compute a three-phase selenium rectifier capable of delivering 325 amperes at 13 volts for the filament supply of a television transmitter tube. An additional requirement is that the rectifier deliver not more than 488 amperes at approximately 2 volts into the tube when cold.

Several plates in Tables I, II, and III should be tried; however, plate No. 13, rated at 3.3 amperes will be most economical. The total current of 325 amperes can be safely handled by 100 plates connected in parallel.

$$I_{dc} = \frac{325}{100} = 3.25 \text{ amperes per plate.}$$

This plate loading with 1.8-ampere rating for basic plate No. 5 used in type No. 13 will give:

$$N = \frac{3.25}{1.8} = 1.8.$$

From Fig. 8, $F_v = 1.07$ and $dv = 1.07 \times 1 = 1.07$.

In aging, the dv value may increase 50%, and thus becomes 1.6. Substituting the known quantities in formula (4):

$$n = \frac{.74 \times 13}{18 - 2 \times 1.6} = .65; \text{ or 1 plate in series.}$$

The foregoing proves that the entire rectifier should consist of a total connection of (6–1–100), where the first number (6) designates the number of arms of the three-phase circuit, the second number (1) indicates the number of plates in series, and the third number (100) gives the number of plates in parallel. The total of 600 plates of type No. 13 may be conveniently assembled into 24 stacks, each having 25 plates in parallel.

Using formula (3) and the design constants of Table IV:

$$V_{ac} = .74 \times 13 + 2 \times 1 \times 1.07 = 11.8 \text{ volts}$$

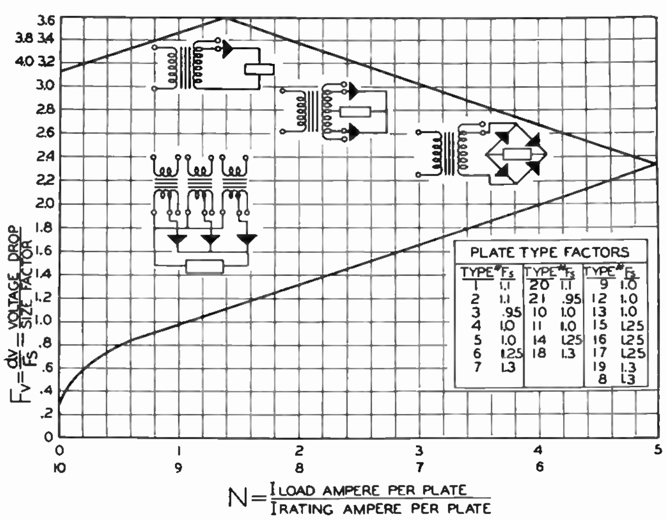


FIG. 6. CHARACTERISTIC SHOWING RELATION OF FV AND N FOR VARIOUS RECTIFIER CIRCUITS AND TYPES OF LOADS

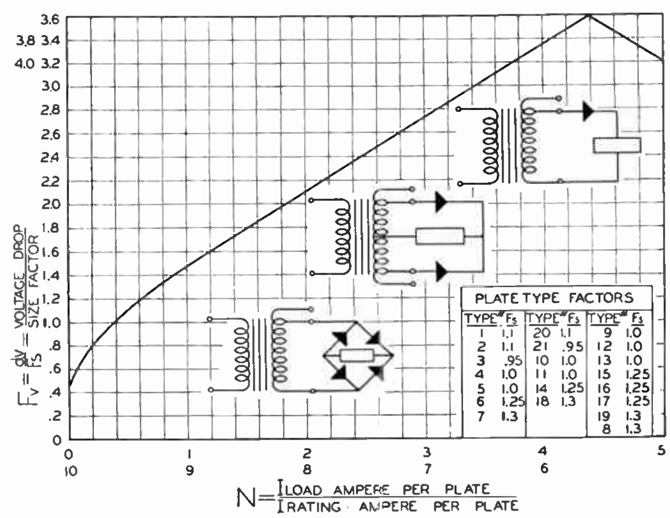


FIG. 7. SHOWING FV AND N IN RECTIFIER CIRCUITS FOR BATTERY-CHARGING APPLICATION OR CONDENSER LOADS

when rectifying elements are new;

$V_{ac} = .74 \times 13 + 2 \times 1 \times 1.6 = 12.8$ volts

when they are fully aged.

In order to meet the requirements of approximately 2 volts with the current output of 488 amperes:

$$I_{dc} = \frac{488}{100} = 4.88 \text{ amperes per plate;}$$

$$N = \frac{4.88}{1.8} = 2.7;$$

from the characteristic of Fig. 8,

$$F_v = 1.37.$$

For the new stacks, therefore, $dv = 1.37 \times 1 = 1.37$, and for fully aged stacks:

$$dv = 1.37 \times 1.5 = 2.06.$$

Using formula (3) and these two values of dv, the new and aged V_{ac} will be found to be 4.2 and 5.6 volts, respectively. The 50% limit for the current requirement is actually met by the external limiting reactances in each phase of the three-phase circuit. The complete assembly of this rectifier is shown in Fig. 10.

The ordinary single-phase bridge type rectifier for resistive loading can also be designed through the use of relative values. Fig. 11 illustrates a 2-ampere, 120-volt Telautograph unit.

With two No. 9 plates in parallel, or one ampere per plate:

$$N = \frac{1}{.6} = 1.67;$$

from the characteristic of Fig. 6,

$$F_v = 1.2;$$
$$dv = 1.2 \times 1.0 = 1.2;$$

hence,

$$n = \frac{1.15 \times 120}{18 - 2 \times 1.2 \times 1.5} = 9.6, \text{ or } 10$$

plates in series.

The total connection of the rectifier is then 4–10–2. Practical considerations suggest four stacks, two of which make one bridge with ten plates in each arm of the bridge. Again, from formula (3), corresponding constants of Table IV and the above dv value, V_{ac} is found to be 162 volts when new and 174 volts when aged.

Ratings (Tables I, II, and III) of selenium rectifier plates, functioning as blocking valves in direct current circuits, are higher in current and lower in voltage value than they are in half-wave alternating circuits. The higher current rating is acceptable inasmuch as the forward resistance ordinarily decreases when only forward current passes through the selenium rectifier plates. The reverse current of the blocking unit, on the other hand, is higher and the safe voltage limit is, therefore, more conservatively established than for alternating current circuits. As an example, a 30-volt 4.5-ampere blocking unit consists of a total connection of 1–2–5 No. 5 plates. The value N for this unit is equal to one, and dv is .84, Fig. 9.

Experience has shown that for constant current battery charging and condenser loading, the current rating should be only 80% of the values tabulated in Tables I, II, and III. In the design of the rectifier for charging a 60-cell battery at the rate of 0.4 ampere, with 2.4 volts per cell, plate No. 4 may be selected. The value of N is .67. The new dv, as read off the characteristic of Fig. 7, is 1.25 and, after aging, it becomes 1.87. The number of plates in series is determined either by

$$n = \frac{V_b}{V_p} \text{ or} \qquad (5)$$

$$n = \frac{V_b/\sqrt{2}}{V_p - 2dv} \qquad (6)$$

depending on which is greater.

$$V_{ac} = \frac{V_b}{\sqrt{2}} + k_2ndv \qquad (7)$$

$$= \frac{60 \times 2.4}{\sqrt{2}} + 2 \times 8 \times 1.25 = 122$$

volts.

An additional tap to give 132 volts for the fully aged condition of the stacks should be provided.

Part 2 of Mr. Yarmack's article will appear in the December issue.

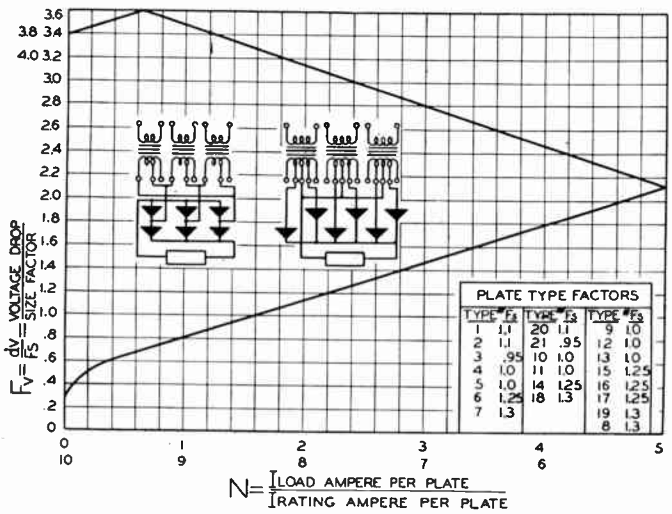


FIG. 8. RELATION OF FV AND N FOR 3-PHASE, CENTER TAP, AND BRIDGE RECTIFIER CIRCUITS FOR ALL TYPES OF LOADS

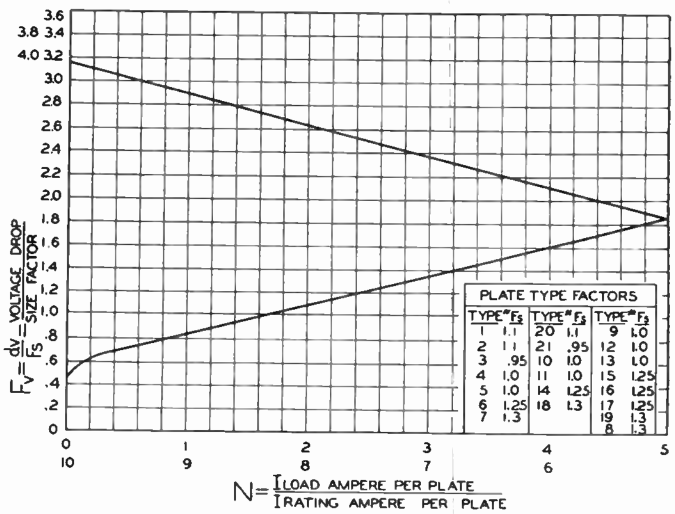


FIG. 9. CHARACTERISTIC ILLUSTRATING RELATION OF FV AND N FOR DIRECT CURRENT AND BLOCKING CIRCUIT APPLICATIONS

TABLE IV *

Number of Phases	Circuit Type	k_1	n	k_2
1	Half Wave	2.3	$\frac{V_{ac}}{V_p}$	1
1	Bridge	1.15	$\frac{V_{ac}}{V_p}$	2
1	Center Tap	1.15	$\frac{2V_{ac}}{V_p}$	1
3	Half Wave	.855	$\frac{\sqrt{3}V_{ac}}{V_p}$	1
3	Bridge	.74	$\frac{V_{ac}}{V_p}$	2
3	Center Tap	.74	$\frac{2V_{ac}}{V_p}$	1

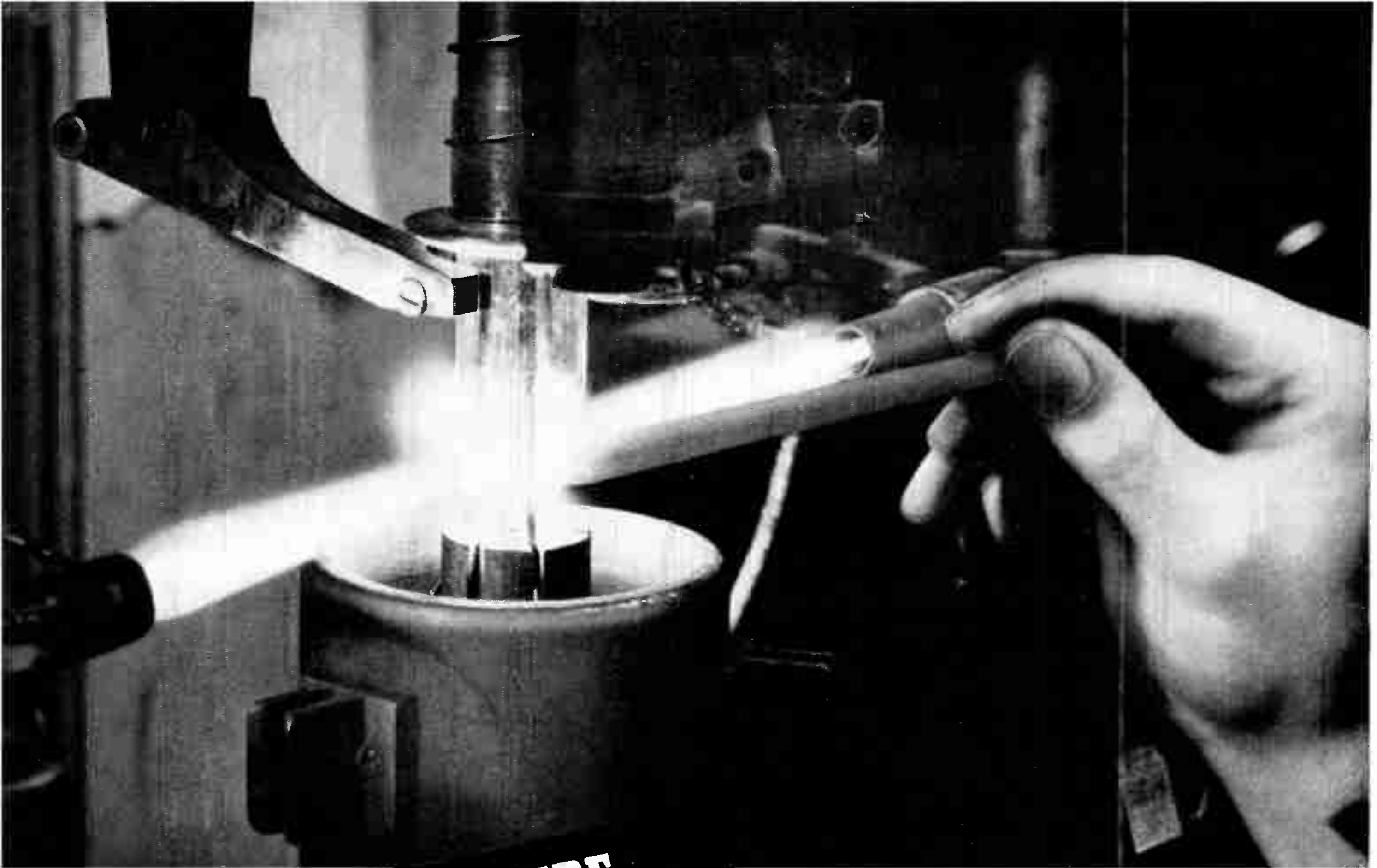
* Selenium Rectifier Design Constants: k_1 = form factor; n = number of plates in series; k_2 = circuit factor; V_p = maximum voltage per plate; V_{ac} = phase voltage, except three phase bridge where it is line voltage.

FLEXIBLE HEATING ELEMENT

A low-power flexible heating element, known as Glasohm, available by the inch, foot, or yard, is now being manufactured by Clarostat Manufacturing Company, Brooklyn, N. Y.

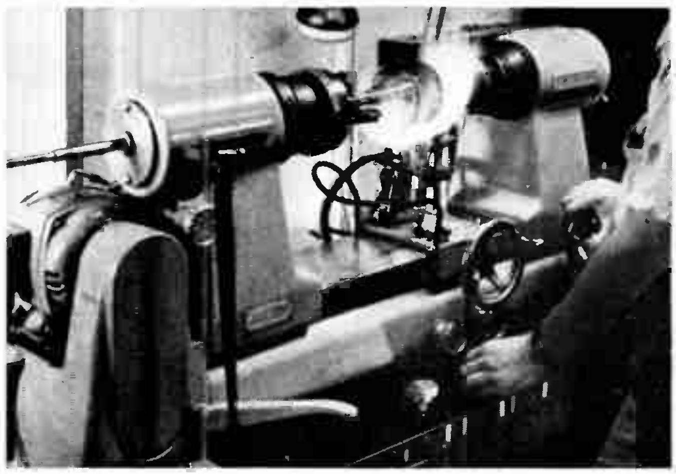
In this material, a resistance wire is wound on a core of glass fibre, and is protected by a glass fibre braided covering. The glass fibre, while providing the desirable properties of unbreakable and practically indestructible glass, is almost as flexible as silk, so that the resistance wire can be bent readily and fitted snugly into parts to be heated, or jammed into very tight spots. In either case, it provides an efficient means of heating.

It is equally suited for temperature-controlled crystal ovens, the heating of aviation and marine instruments, localized heating for chemical apparatus and laboratory equipment, and similar applications.



Glass tubing becomes finished filament stem with leads sealed in position on this special upright lathe.

VACUUM TUBE *Performance* IN THE MAKING...



Glass bulbs are annealed after tube is fully assembled. This operation relieves stress and strain in the glass itself which may have been induced during manufacture.

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Mexico: "You can't conceive of the degree of humidity here, and its effects. I put my clothes and shoes in a closet, at night, where an electric bulb burns constantly. If I left them out, by morning my clothes would be heavy with dampness, and my shoes would be green with mold. We drove some fence posts into the ground," the letter continued, "and before the fence was finished, the posts began to sprout leaves and branches."

Protection of Components ★ A highly interesting report of great practical value to those concerned with the protection of components against moisture has been written by D. H. Gardner and J. S. Watt,[1] of the Humble Oil and Refining Company. The information contained in this report was drawn from experiences with electronic equipment used in geophysical exploration in swampy and tropical areas of South American countries and in Java, Borneo, and New Guinea.

Methods found by Gardner and Watt to be effective for protecting components from moisture are summed up in the accompanying Table. In many cases, it will be noted, they first expelled the moisture from the components by baking them at a moderate temperature, and then sealed them in Superior Compound or Ceresin against subsequent occlusion of moisture.

The Western Electric Superior Compound, recommended in the Table, has been reported on favorably by other investigators. At 140° C. it flows as a thin fluid, with excellent penetrating properties. When cool, it does not crack or become brittle, but forms a rubbery mass. Yellow Ceresin, similar to beeswax but superior for impregnating purposes, is made by purifying ozocerite, a wax-like mineral mixture of hydrocarbons.

Rust Ban, also referred to in the Table, is a grease used to prevent rust. It is a product of the Humble Oil Company.

Transformer Failures ★ There is a tendency for some engineers to discount the need of using closed metal cases fitted with terminal boards for the protection of small transformers and chokes, particularly those used in AF circuits. Of course, it is not always easy to obtain the closed metal cases, while those fitted with flexible leads are more readily available.

The need for the complete metal closure is clear, however, when the action under humid conditions is understood. As explained by Dr. P. H. Dike, of Leeds & Northrup Company, in his exposition on precision resistors,[2] potting compounds do not prevent the penetration of moisture. They merely retard it.

[1] Difficulties Encountered with Electronic Equipment in Humid Climates, by D. H. Gardner and J. S. Watt, Humble Oil & Refining Company, Houston, Texas.

[2] The Effect of Atmospheric Humidity on Unsealed Resistors, Causes and Remedy, published in The Review of Scientific Instruments, July, 1936. Reprints available from Leeds & Northrup Company, Philadelphia, Pa.

Probably the most frequent cause of failure in transformer coils wound with fine wire is an open circuit resulting from corrosion at a point where an imperfection in the enamel insulation exposes the wire to attack by moisture. Mechanical failures due to injury to the wire during the process of winding almost always show up on the first test after impregnation, and are caught before the coil ever gets into service. The foregoing also applies to failures which occur at the leads.

Therefore, after the moisture has been driven out of a coil during the process of impregnation, and the complete transformer has been potted, it is necessary to prevent the reëntry of moisture into the coil, through the potting compound, by the use of a closed metal case.

Flexible leads, running to the windings, offer a ready path by which moisture is forced into the potting compound by recurring cycles of atmospheric pressure changes.

Editor's Note: Part 3 of this article will present a further discussion of specific failures of components and methods of protection against humidity, fungi, and insects.

PACKAGING FOR WAR

(CONTINUED FROM PAGE 9)

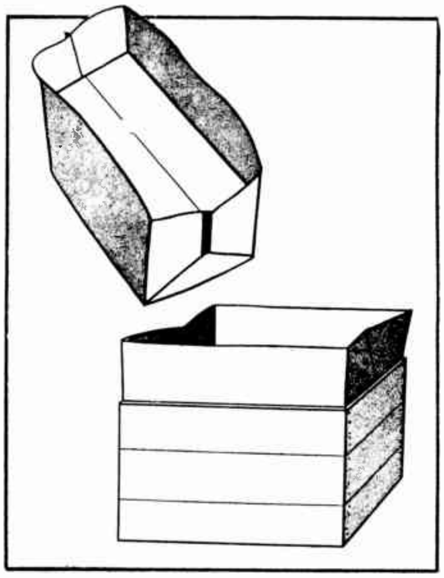

FIG. 3. LAMINATED LINERS FOR SHOOKS

peatedly after creasing without causing it to crack or break open between laminations.

Properly used and sealed, this paper makes an air-tight covering that can carry the package to Garcia. It provides protection against water, moisture vapor, insects, light, and even foreign odors. Furthermore, it affords the heat-insulating properties of the familiar thin-metal, paper-backed wall coverings.

Definitions ★ In any discussion of packaging materials, it is important to differentiate between those that are water-proof and those that are moisture vapor-proof.

Water-proof — A water-proof material is one which resists the penetration of water. The degree to which a material is water-proof is indicated by its ability to hold water or retard its entrance.

Moisture Vapor-proof — A moisture vapor-proof material is one which resists the penetration of moisture vapor. The degree to which a material is moisture vapor-proof is indicated by its ability to resist the passage of moisture vapor when one side is subjected to a humid atmosphere while the other side is exposed to a dry atmosphere.

Note: A material that is accepted as water-proof may not be moisture vapor-proof. This is readily understood when moisture vapor is considered as a gas. A membrane, such as Pliofilm, may be effective as a water-proof covering, but it may be penetrated readily by moisture vapor.

Laminated Paper Packages ★ Some of the types of packaging worked out by Reynolds Metals Company, manufacturers of laminated paper products, are shown in the accompanying illustrations. In all cases except the canister, Fig. 1 center, the kraft paper is on the inside, so that the heat-sealing compound is in position for sealing when the package is closed. The canister package is made of laminated paper inside or between chip walls, wound spirally. End closures are formed of the same combinations of materials, or of metal.

The types of packages shown are adaptable to small items, such as spare parts and instruments, or to radio receiving sets and low-power transmitters. If pre-formed envelopes or bags are used, or if the material is used as wrapping paper, sufficient overlap is required for heat-sealing the seams.

As the illustrations show, the applications range from bags and envelopes to covering for individual cartons and linings for shooks which may contain several cartons. For example, the style shown in Fig. 1, left, might be the wrapping for a box containing a single meter, or for a carton containing a receiver or small transmitter. Components furnished in spare parts cases can be sealed in the laminated paper envelopes. Experience shows that tropical dampness alters the electrical characteristics of bakelite-case condensers and carbon resistors seriously, and often renders them unfit for use. With the protection of laminated paper wrapping, even though dampness enters the spare parts case, the components will be unharmed.

The use of water-proof and moisture vapor-proof packaging for radio and electronic equipment is a vitally important matter, and one which should be given attention in anticipation of complaints which will certainly be made because of the inadequate methods which have been widely employed by this industry.

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American Brass Co., Waterbury, Conn.
Dow Chemical Co., Dowmetal Div., Midland, Mich.

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

CHOKES, RF
Aladdin Radio Industries, 501 W. 35th, Chicago
Alden Prods. Co., Brockton, Mass.
American Communications Corp., 306 B'way, N. Y. C.
Barker & Williamson, Upper Darby, Pa.
Coto-Coil Co., Providence, R. I.
D-X Radio Prods. Co., 1575 Milwaukee, Chicago
General Winding Co., 254 W. 31 St., N. Y. C.
Guthman & Co., Edwin, 400 S. Peoria, Chicago
Hammarlund Mfg. Co., 424 W. 33 St., N. Y. C.
Johnson Co., E. F., Waseca, Minn.
Lectrohm, Inc., Cicero, Ill.
Meissner Mfg. Co., Mt. Carmel, Ill.
Miller Co., J. W., Los Angeles, Cal.
Muter Co., 1255 S. Michigan, Chicago
National Co., Malden, Mass.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago
Radex Corp., 1328 Elston Av., Chicago
Sickles Co., F. W., Chicopee, Mass.
Teleradio Eng. Corp., 484 Broome St., N. Y. C.
Triumph Mfg. Co., 4017 W. Lake St., Chicago

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

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

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

CONDENSERS, Fixed
★ Aerovox Corp., New Bedford, Mass.
American Condenser Corp., 2508 S. Michigan, Chicago
Art Radio Corp., 115 Liberty, N. Y. C.
Atlas Condenser Prods. Co., 548 Westchester Av., N. Y. C.
Automatic Winding Co., East Newark, N. J.
Bud Radio, Inc., Cleveland, O.
Cardwell Mfg. Corp., Allen D., Brooklyn, N. Y.
Centralab, Milwaukee, Wis.
Condenser Corp. of America, South Plainfield, N. J.
Condenser Prods. Co., 1375 N. Branch, Chicago
Cornell-Dubilier Elec. Corp., S. Plainfield, N. J.
Cosmic Radio Co., 699 E. 135th St., N. Y. C.
Crowley & Co., Henry L., W. Orange, N. J.
Deutschmann Corp., Tobe, Canton, Mass.
Dumont Elec. Co., 34 Huhert St., N. Y. C.
Electro-Motive Mfg. Co., Willimantic, Conn.
Erie Resistor Corp., Erie, Pa.
Fast & Co., John E., 3123 N. Crawford, Chicago
General Radio Co., Cambridge, Mass.
Girard-Hopkins, Oakland, Calif.
H. R. S. Prods., 5707 W. Lake St., Chicago
Illinois Cond. Co., 3252 W. North Av., Chicago
Industrial Cond. Corp., 1725 W. North Av., Chicago
Insuline Corp. of America, Long Island City, N. Y.
Johnson Co., E. F., Waseca, Minn.
Kellogg Switchb'd & Supply Co., 6650 Cicero, Chicago
Mallory & Co., P. R., Indianapolis, Ind.
Micamold Radio Corp., Brooklyn, N. Y.
Muter Co., 1255 S. Michigan, Chicago
Potter Co., 1950 Sheridan Rd., N. Chicago
RCA Mfg. Co., Camden, N. J.
Sangamo Elec. Co., Springfield, Ill.
Solar Mfg. Corp., Bayonne, N. J.
Sprague Specialties Co., N. Adams, Mass.
Teleradio Engineering Corp., 484 Broome St., N. Y. C.

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

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

CONDENSERS, Variable Receiver Tuning
Alden Prods. Co., Brockton, Mass.
American Steel Package Co., Defiance, Ohio
Barker & Williamson, Ardmore, Pa.
Bud Radio, Inc., Cleveland, O.
Cardwell Mfg. Corp., Allen D., Brooklyn, N. Y.
General Instrument Corp., Elizabeth, N. J.
Hammarlund Mfg. Co., 424 W. 334d St., N. Y. C.
Insuline Corp. of Amer., L. I. City, N. Y.
Meissner Mfg. Co., Mt. Carmel, Ill.
Millen Mfg. Co., Malden, Mass.
National Co., Malden, Mass.
Radio Condenser Co., Camden, N. J.
Reliance Die & St'p'g Co., 1260 Clybourn Av., Chicago

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

CONDENSERS, Variable Trimmer
★ Aerovox Corp., New Bedford, Mass.
Alden Prods. Co., Brockton, Mass.
American Steel Package Co., Defiance, O.
Bud Radio, Inc., Cleveland, O.
Cardwell Mfg. Corp., Allen, Brooklyn, N. Y.
Centralab, Milwaukee, Wis.
General Radio Co., Cambridge, Mass.
Guthman, Inc., E. 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.
Alden Prods., Brockton, Mass.
Amer. Microphone Co., 1915 S. Western Av., Los Angeles
Amer. Phenolic Corp., 1830 S. 54th St., Chicago
American Radio Hardware Co., 476 B'way, N. Y. C.
Andrew, Victor J., 6429 S. Lavergne Av., Chicago
Atlas Sound Corp., 1442 39th St., Brooklyn, N. Y.
Birnbach Radio, 145 Hudson St., N. Y. C.
Breeze Mfg. Corp., Newark, N. J.
Brush Development Co., Cleveland, O.
Bud Radio, Cleveland, Ohio
Cannon Elec. Development, 3209 Humboldt, Los Angeles
Eby, Inc., Hugh H., Philadelphia
Electro Voice Mfg. Co., South Bend, Indiana
Franklin Mfg. Corp., 175 Varick St., N. Y. C.
General Radio Co., Cambridge, Mass.
Insuline Corp. of Amer., L. I. City, N. Y.
Jones, Howard B., 2300 Wabansia, Chicago
Mallory & Co., P. R., Indianapolis, Ind.
Radio City Products Co., 127 W. 26 St., N. Y. C.

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

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

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

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

FELT
American Felt Co., Inc., Glenville, Conn.
Western Felt Works, 4031 Ogden Av., Chicago

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

FILTERS, Electrical Noise
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Tobe Deutschmann Corp., Canton, Mass.

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

FREQUENCY METERS
★ 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 Corporation, Boonton, N. J.

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

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

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

NEW LISTINGS EACH MONTH

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

MEMO TO THE ENGINEERING DEPARTMENT

WITH all the stress and strain of wartime engineering and production in plants producing military radio-electronic equipment, a little humor is sometimes the most effective way of emphasizing serious matters.

After promising to alter identifying names, we were given permission to publish this memorandum issued by the newly-appointed comptroller of one of the oldest manufacturers of radio apparatus in this country, issued to the vice president in charge of engineering and to the chief engineer:

Here's the way you two slave-drivers will use the whip on me, plus any other additional ways you diabolical engineers can think up:

I will be the fall guy you will come to when you want something in production. I am supposed to put it in here and make it come out there.

1. I will issue all production orders. Do not under any consideration give any orders for production unless there is a production order made out by me. I will follow through all production on the basis of that order.
   If anything is produced without such an order, I will know you have been cheating, and you will be made to stand in corners with dunce's caps.
2. On any new job, I must sit in when lists of materials are made up, so that we don't put watches together and have parts left over, or find ourselves short.
3. Any changes in the parts lists are to be made out on a parts change order. No verbal orders, shouted or screamed. Cold turkey on black and white paper.
4. Tuesday night, we will plan an estimated schedule of production on *all* jobs. It's my job to see Joe pulls rabbits out of hats, and keeps to schedules.
5. Any squawks about production falling down, see the great Hampton. He will press buttons and things, and everyone will be happy.
6. *Don't* see me if the wrong zizz-wheels are put in, or Joe Zilch takes pokes at Navy inspectors.
7. If you suspect materials are not coming in fast enough, holler "Murder," and try and find me.
8. Don't ship or give orders to ship anything unless the great God Kingston knows all the lurid details.
9. Let me know of any new contract that comes in, or any change affecting old ones, either in dollars or units, so I can give the right answers on the quiz programs.

Any resemblance between this and a production program is a great surprise to me.

WALLACE

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

GEARS & PINIONS, Metal

Continental-Diamond Fibre Co., Newark, Del.
Gear Specialties, Inc., 2650 W. Medill, Chicago
Perkins Machine & Gear Co., Springfield, Mass.
Thompson Clock Co., H. C., Bristol, Conn.

GEARS & PINIONS, Non-Metallic

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

GENERATORS, Gas Engine Driven

Kato Engineering Co., Mankato, Minn.

HEADPHONES

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

HORNS, Outdoor

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

INSTRUMENTS, Radio Laboratory

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

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

Isolantite, Inc., Belleville, N. S.
Lapp Insulator Co., Inc., Leroy, N. Y.

IRONS, Soldering

Hexacon Electric Co., Roselle Park, N. J.

KNOBS, Radio & Instrument

Alden Prods. Co., Brockton, Mass.
American Insulator Corp., New Freedom, Pa.
Chicago Molded Prods. Corp., 1025 N. Kolmar, Chicago
General Radio Co., Cambridge, Mass.
Imperial Molded Prods. Corp., 2921 W. Harrison, Chicago
Kurtz Kasch, Inc., Dayton, O.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Millen Mfg. Co., James, Malden, Mass.
Nat'l Co., Inc., Malden, Mass.
Radio City Products Co., 127 W. 26 St., N. Y. C.
Rogan Bros., 2001 S. Michigan, Chicago

LABORATORIES, Electronic Research

★ Browning Labs., Inc., Winchester, Mass.

LIGHTS, Pilot or Indicator

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

LUGS, Copper

Burndy Engineering Co., 459 E. 133rd St., N. Y. C.
Dante Elec. Mfg. Co., Bantam, Conn.
Ideal Commutator Dresser Co., Sycamore, Ill.
Ilsco Copper Tube & Prods., Inc., Station M, Cincinnati
Krueger & Hudepohl, Third & Vine, Cincinnati, O.
Patton-MacGuyer Co., 17 Virginia Av., Providence, R. I.
Sherman Mfg. Co., Battle Creek, Mich.

MACHINES, Impregnating

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

MACHINES, Numbering

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

MACHINES, Riveting

Chicago Rivet & Machine Co., Bellwood, Illinois

MACHINES, Screwdriving

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

MAGNETS, Permanent

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

METAL, Thermostatic

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

METALS, Pressed Powder

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

METERS, Ammeters, Voltmeters, Small Panel

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

MICA

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

MICROPHONES

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

MONITORS, Frequency

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

MOTOR-GENERATORS, Dynamotors, Rotary Converters

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

MOUNTINGS, Shock Absorbing

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

MYCALEX

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

NUTS, Self-Locking

Elastic Stop Nut Corp., Union, N. J.
Palnut Co., Inc., Irvington, N. J.

Standard Pressed Steel Co., Jenkintown, Pa.

OVENS, Industrial & Laboratory

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

PILOT LIGHTS

Amer. Radio Hardware Co., Inc., 467 B'way, N. Y. C.
Signal Indicator Corp., 140 Cedar St., N. Y. C.

PHOSPHOR BRONZE

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

PLASTICS, Extruded

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

PLASTICS, Laminated or Molded

Acadia Synthetic Prods., 4031 Ogden Av., Chicago
Alden Prods. Co., Brockton, Mass.
American Cyanamid Co., 30 Rockefeller Plaza, N. Y. C.
American Insulator Corp., New Freedom, Pa.
American Molded Prods. Co., 1753 N. Honore, Chicago
Auburn Button Works, Auburn, N. Y.
Barber-Colman Co., Rockford, Ill.
Brandywine Fibre Prods. Co., Wilmington, Del.
Catalin Corp., 1 Park Av., N. Y. C.
Celanese Celluloid Corp., 180 Madison Av., N. Y. C.
Chicago Molded Prods. Corp., 1024 N. Kolmar, Chicago
Continental-Diamond Fibre Co., Newark, Del.
Dow Chemical Co., Midland, Mich.
Durez Plastics & Chemicals, Inc., N. Tonawanda, N. Y.
Extruded Plastics, Inc., Norwalk, Conn.
Formica Insulation Co., Cincinnati, O.
★ General Electric Co., Plastics Dept., Pittsfield, Mass.
General Industries Co., Elyria, O.
Imperial Molded Prods. Co., 2921 W. Harrison, Chicago
Industrial Molded Prods. Co., 2035 Charleston, Chicago
Kurz-Kasch, Inc., Dayton, O.
Macallen Co., Boston, Mass.
Mica Insulator Co., 196 Varick, N. Y. C.
Monsanto Chemical Co., Springfield, Mass.
National Vulcanized Fibre Co., Wilmington, Del.
Northern Industrial Chemical Co., Boston, Mass.
Radio City Products Co., 127 W. 26 St., N. Y. C.
Richardson Co., Melrose Park, Chicago
Rogan Bros., 180 N. Wacker Dr., Chicago
Rohm & Haas Co., Philadelphia
Stokes Rubber Co., Joseph, Trenton, N. J.
Surprenant Elec. Ins. Co., Boston
Synthane Corp., Oaks, Pa.
Taylor Fibre Co., Norristown, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

PLASTIC, Sheet for Name Plates

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

PLUGS & JACKS, Spring Type

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

PLUGS & JACKS, Telephone Type

Alden Prods. Co., Brockton, Mass.
American Molded Prods. Co., 1753 N. Honore, Chicago
Chicago Tel. Supply Co., Elkhart, Ind.
Guardian Elec. Mfg. Co., 1627 W. Walnut, Chicago
Jones, Howard B., 2300 Wabansia Av., Chicago
Mallory & Co. Inc., P. R., Indianapolis, Ind.

PRESSES, Plastic Molding

Kux Machine Co., 3930 W. Harrison, Chicago

PRESSES

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

RECTIFIERS, Current

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

REGULATORS, Temperature

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

REGULATORS, Voltage

Acme Elec. & Mfg. Co., Cuba, N. Y.
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

Amperite Co., 561 Broadway, N. Y. C.
G-M Laboratories, Inc., 4313 N. Knox Ave., Chicago
Struthers Dunn, Inc., 1326 Cherry St., Philadelphia
Ward Leonard Electric Co., Mt. Vernon, N. Y.

RELAYS, Small Telephone Type

Amer. Automatic Elect. Sales Co., 1033 W. Van Buren St., Chicago
Clare & Co., C. P., 4719 W. Sunnyside Ave., Chicago
Guardian Electric Co., 1625 W. Walnut St., Chicago
Wick Organ Co., Highland, Ill.

RELAY TESTERS, Vibration

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

RESISTORS, Fixed

Acme Elec. Heating Co., Boston, Mass.
★ Aerovox Corp., New Bedford, Mass.
Allen-Bradley Co., Milwaukee, Wis.
Atlas Resistor Co., 423 Broome St., N. Y. C.
Centralab, Milwaukee, Wisconsin
Clarostat Mfg. Co., Brooklyn, N. Y.
Cont'l Carbon, Inc., Cleveland, O.
Daven Co., 158 Summit St., Newark, N. J.
Dixon Crucible Co., Jersey City, N. J.
Erie Resistor Corp., Erie, Pa.
Globar Div. Carborundum Co., Niagara Falls, N. Y.
Hardwick, Hindle, Inc., Newark, N. J.
Instrument Resistors Co., Little Falls, N. J.
Intern'l Resistance Co., Philadelphia
Lectrohm, Inc., Cicero, Ill.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Ohmite Mfg. Co., 4835 W. Flournoy, Chicago
Precision Resistor Co., Newark, N. J.
Sensitive Research Inst. Corp., 4545 Bronx Blvd., N. Y. C.
Shallcross Mfg. Co., Collingdale, Pa.
Sprague Specialties Co., N. Adams, Mass.
Stackpole Carbon Co., St. Marys, Pa.
Ward Leonard Elec. Co., Mt. Vernon, N. Y.
White Dental Mfg. Co., 10 E. 40th St., N. Y. C.
Wirt Co., Germantown, Pa.

RESISTORS, Fixed Precision

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

RESISTORS, Variable

★ Aerovox Corp., New Bedford, Mass.
Allen-Bradley Co., Milwaukee, Wis.
Amer. Instrument Co., Silver Spring, Md.
Atlas Resistor Co., N. Y. C.
Centralab, Milwaukee, Wis.
Chicago Tel. Supply Co., Elkhart, Ind.
Cinema Eng. Co., Burbank, Cal.
Clarostat Mfg. Co., Brooklyn, N. Y.
Cutler-Hammer, Inc., Milwaukee, Wis.
DeJur Amsco Corp., Shelton, Conn.
Electro Motive Mfg. Co., Willimantic, Conn.
General Radio Co., Cambridge, Mass.
G-M Labs., Inc., Chicago, Ill.
Hardwick, Hindle, Inc., Newark, N. J.
Instrument Resistors, Inc., Little Falls, N. J.
Intern'l Resistance Co., Philadelphia
Mallory & Co., P. R., Indianapolis, Ind.
Ohio Carbon Co., Cleveland, Ohio
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago
Precision Resistor Co., Newark, N. J.
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

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

RIVETS, Plain

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

SCREW MACHINE PARTS, Non-Metallic

Continental-Diamond Fibre Co., Newark, Del.

WPB'S CONTROLLED MATERIALS PLAN

(CONTINUED FROM PAGE 5)

Claimant Agencies ★ The Claimant Agencies are: Army, Navy, Maritime Commission, the Aircraft Scheduling Unit, Lend-Lease, Board of Economic Warfare, and Office of Civilian Supply.

The Aircraft Scheduling Unit, located at Wright Field, is the Claimant Agency for all aircraft production.

The Office of Civilian Supply, Claimant Agency for all producers not otherwise represented, will assemble its statement of requirements with the aid of recommendations by the various WPB industry branches.

Each Claimant Agency will break down its submission of requirements into materials for (1) production; (2) construction and facilities; (3) maintenance, repair and operating supplies. Requirements for construction and facilities, including industrial machinery and equipment, will be channeled through the Construction and Facilities Branch of the Office of Program Determination.

When requirements have been brought into balance with supply and the programs of the various Claimant Agencies are approved, the WPB Vice Chairman on Program Determination — who also is chairman of the Requirements Committee — will allocate, with the advice of the Requirements Committee, authorized quantities of the Controlled Materials to each.

The Claimant Agencies, in turn, will distribute these broad allotments among prime contractors by means of "Allotment Numbers," which will constitute a right to receive delivery. The prime contractors will pass on the Allotment Numbers as necessary to their subcontractors and suppliers.

Materials other than Controlled Materials will continue to be distributed through the priorities system. Each company receiving an Allotment Number carrying an allocation of Controlled Materials also will receive a preference rating for use in obtaining other materials. A preference rating accompanied by an Allotment Number will be higher than other ratings of the same category, but will not take precedence over higher ratings. For example, AA-3, plus an Allotment Number, is higher than AA-3, without the number, but not as high as AA-2X. The preference ratings also will avoid conflicts which might otherwise occur in the production and delivery of manufactured items.

Control of Materials ★ In order that sufficient amounts of materials in the form desired may be available, responsibility for directing the production of Controlled Materials rests in the Controlled Materials Branches of WPB. For instance, the Iron and Steel Branch is responsible for steel, the Copper Branch for copper, etc. Production Directives, specifying the quantities and forms and shapes of material to be produced during a stated period of time, will be sent to most producers of Controlled Materials monthly. If orders beyond a specified capacity to produce are received, a producer must refuse them and notify the appropriate Controlled Materials Branch. If a consumer with an Allotment Number cannot place his order satisfactorily, he should appeal to and will be assisted by the Branch.

Program Plan ★ The aim of the plan is to use every bit of critical material in the place where it will do the most good toward winning the war. Each governmental agency participating in the plan, therefore, is being required to present programs for approval which will lead to the maximum production of the things needed most from the material available in any given period of time.

Each of the Claimant Agencies will be responsible for constructing a program making the best possible use of the materials allotted to it toward winning the war. At the same time, the plan provides centralized control over the division of materials among the agencies and appropriate accounting so that no agency nor contractor can over-draw its allotment.

As CMP goes into effect, the job of cutting out all non-essential production, military and otherwise, will be completed.

Under CMP, each Claimant Agency will program the quantities of end-products — guns, planes, Liberty ships, railroad cars, bedsprings, and other items most urgently needed for each quarterly period. From the Bills of Materials for each of these items the Agency will make up a consolidated estimate of its total requirements. These detailed estimates for the second quarter of 1943 must be submitted by January 1, 1943. At the same time, similar estimates must be submitted for the remaining quarters of 1943 and the first quarter of 1944, together with general estimates for the first half of 1944 so that the Requirements Committee will have at all times a general picture of requirements eighteen months in advance.

When the allotments are made by the Requirements Committee, they will be transmitted to prime contractors through the Claimant Agencies. Manufacturers working on items such as tanks, ships, and aircraft, which are generally contracted for by or through a Claimant Agency, and are called Class A products, will receive their allotment with an allotment number directly from the Agency. Producers of Class B products, such as generators, hardware, kitchenware, electrical appliances, parts frequently incorporated in other products, and civilian items generally, will receive their allotments from their WPB industry branches, which in turn will receive allotments

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

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

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

SCREWS, Hollow & Socket Head
Allen Mfg. Co., Hartford, Conn.
Central Screw Co., 3519 Shields, Chicago
Federal Screw Prod. Co., 224 W. Huron St., Chicago
Parker-Kalon, 198 Varick, N. Y. C.
Standard Pressed Steel Co., Jenkintown, Pa.

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

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

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

SOCKETS, Tube
Aladdin Radio Industries, 501 W. 35th St., Chicago
Alden Prods. Co., Brockton, Mass.
Amer. Phenolic Corp., 1830 S. 54th Av., Chicago
Amer. Radio Hardware Co., 476 B'way, N. Y. C.
Birnbach Radio Co., 145 Hudson, N. Y. C.
Bud Radio, Inc., Cleveland, O.
Cinch Mfg. Co., 2335 W. Van Buren St., Chicago
Cont'l-Diamond Fibre Co., Newark, Del.
Eagle Elec. Mfg. Co., Brooklyn, N. Y.
Eby, Inc., H. H., Philadelphia
Federal Screw Prods. Co., 26 S. Jefferson, Chicago
Franklin Mfg. Corp., 175 Varick, N. Y. C.
Hammarlund Mfg. Co., 424 W. 33 St., N. Y. C.
Johnson Co., E. F., Waseca, Minn.
Jones, Howard B., 2300 Wabansia, Chicago
Micarta Fabricators, Inc., 4619 Ravenswood, Chicago
Millen Mfg. Co., James, Malden, Mass.
Miller Co., J. W., Los Angeles, Cal.
Nat'l Co., Malden, Mass.
Remler Co., San Francisco, Cal.
Smith Co., Maxwell, Hollywood, Cal.

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

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

SOLDER POTS
Lectrohm, Inc., Cicero, Ill.

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

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

SPRINGS
Accurate Spring Mfg. Co., 3817 W. Lake, Chicago
American Spring & Mfg. Corp., Holly, Mich.
American Steel & Wire Co., Rockefeller Bldg., Cleveland, O.
Barnes Co., Wallace, Bristol, Conn.
Cuyahoga Spring Co., Cleveland, O.
Gibson Co., Wm. D., 1800 Clybourn Av., Chicago
Hubbard Spring Co., M. D., Pontiac, Mich.
Hunter Pressed Steel Co., Lansdale, Pa.
Instrument Specialties Co., Little Falls, N. Y.
Muehlhausen Spring Corp., Logansport, Ind.
Peck Spring Co., Plainville, Conn.
Raymond Mfg. Co., Corry, Pa.

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

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

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

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

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

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

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

TRANSFORMERS, Constant-Voltage Power
Raytheon Mfg. Co., Waltham, Mass.
Sola Electric Co., 2525 Clybourn Ave., Chicago

TRANSFORMERS, IF, RF
Aladdin Radio Industries, 501 W. 35th St., Chicago
Amer. Transformer Co., Newark, N. J.
Automatic Windings Co., E. Passaic, N. J.
Caron Mfg. Co., 415 S. Aberdeen, Chicago
D-X Radio Prods. Co., 1575 Milwaukee, Chicago
General Winding Co., 254 W. 31 St., N. Y. C.
Guthman & Co., 400 S. Peoria St., Chicago
Hammarlund Mfg. Co., 424 W. 33 St., N. Y. C.
Meissner Mfg. Co., Mt. Carmel, Ill.
Millen Mfg. Co., James, Malden, Mass.
Miller Co., J. W., Los Angeles, Cal.
Nat'l Co., Malden, Mass.
Sickles Co., F. W., Springfield, Mass.
Super Elect. Prod. Corp., Jersey City, N. J.
Teleradio Eng. Corp., 484 Broome St., N. Y. C.
Triumph Mfg. Co., 4017 W. Lake, Chicago

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

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

through the Office of Civilian Supply.

Each Claimant Agency may allot for each month up to 105 per cent of its monthly allotment. This over-allotment is intended to stimulate increased production from producers of Controlled Materials. Claimant Agencies also are authorized to make allotments for future quarters on the basis of declining percentages of allotments established for the current quarter. These percentages are: for the quarter immediately following the one for which a definite allotment has been made, 80 per cent; for the next following quarter, 60 per cent; for all later quarters, 40 per cent.

Small Orders ★ The plan will be flexible enough to permit limited amounts of material to be given out without allotment numbers. Special provision, for instance, is made for allotments of Controlled Materials to warehouses so that they may handle small orders without Allotment Numbers.

Inventory Control ★ A new form of inventory control is to be established with the requirement that every primary or secondary producer whose inventory of any Controlled Materials is in excess of a specified amount must submit an inventory statement showing his position at the end of each calendar quarter not more than 15 days later.

CMP Timetable ★ A timetable for the transition from existing systems to full operation of the Controlled Materials Plan is provided. The first Bills of Materials will be assembled by the Claimant Agencies during November and December, and on January 1st the Agencies will submit their first estimate of requirements to the branches handling Controlled Materials, with copies to the Requirements Committee.

By January 15th, the Controlled Materials Branches will have analyzed the requirements and made preliminary reconciliation to the extent possible between requirements and supply. At the same time, the Claimant Agencies and prime consumers will be developing information necessary in making final allotments, to be in readiness for distribution of allotments to them by the Requirements Committee.

On February 1st, the Requirements Committee will make allotments of Controlled Materials to Claimant Agencies for the second quarter of 1943. During February and early March, distribution of allotments will be made by Claimant Agencies to prime consumers, who in turn will divide their allotments with their secondary consumers and suppliers.

By March 15th, users of Controlled Materials will have placed authorized orders for April delivery and for later months, as authorized. Subsequently the Controlled Materials Branches will watch placement of orders on mills and mills' shipments, and give assistance in placing orders to authorized users of Controlled Materials who are unable to obtain mill acceptance of authorized orders.

On July 1st, CMP will be in full operation. Until that time existing procedures, including preference rating orders and PRP certificates and individual material allocations under M orders will continue in effect for consumers who have not been able to qualify under CMP.

Those remote secondary consumers who have not obtained their allotments under CMP in time to meet requirements for the second quarter of 1943 will be authorized to continue purchases under PRP equal to their first quarter authorizations.

To prevent duplication, each company operating under PRP will be required to cancel authorizations made under PRP in equal amount for CMP allotments and the total authorizations outstanding at any time will not be permitted to exceed available supply. Orders bearing CMP Allotment Numbers will be given preference at mills over PRP orders and other rated orders not under CMP.

CMP will be supplemented by detailed regulations and instructions to be announced at a later date.

ULTRA-STABLE AF OSCILLATOR

(CONTINUED FROM PAGE 8)

checking audio frequency and video frequency circuits, as well as broad-band amplifiers in television and FM equipment, the checking of AVC time constants in radio receivers, recovery time, and even the function of automatic keying for transmitter testing, are only the obvious applications of square wave generators.

The adaptability of this method of examining many different types of circuits is rapidly increasing the use of the square-wave generation.

Circuit Constants, Fig. 4

R1-1, R2-1 10 meg. matched to .5%, 1 watt
R1-2, R2-2 1 meg. matched to .5%, 1 watt
R1-3, R2-3 .1 meg. matched to .5%, 1 watt
R3 3,500 ohms, 1 watt
R4 G.E. 3-watt lamp, 120 volts
R5 35,000 ohms, 1 watt
R6 75,000 ohms, 1 watt
R7 50,000 ohms, 1 watt
R8 .5 meg., 1 watt
R9 500 ohms, 2 watts
R10 50,000 ohms, 2 watts
R11 10,000 ohms, 2 watts
R12 10,000 ohms, 10 watts, wire-wound
R13 25,000-ohm potentiometer
R14 5,000 ohms, 1 watt
R15 25,000 ohms, 1 watt
R16 50,000 ohms, 1 watt
R17 50,000 ohms, 1 watt
R18 .5 meg., 1 watt

(CONTINUED ON PAGE 31)

TUBE MANUFACTURING MACHINES
Hilton Eng. Labs., Redwood City, Calif.
Eisler Eng. Co., 7518 13th St., Newark, N. J.

TUBES, Cathode Ray
Dumont Labs., Allen B., Passaic, N. J.
Farnsworth Tele. & Radio Corp., Ft. Wayne, Ind.
★ General Elec. Co., Schenectady, N. Y.
Hygrade Sylvania Corp., Salem, Mass.
Nat'l Union Radio Corp., Newark, N. J.
RCA Mfg. Co., Camden, N. J.

TUBES, Current Regulating
Amperite Co., 561 Broadway, N. Y. C.
Champion Radio Works, Danvers, Mass.
Hytron Corp. & Hytronic Labs., Salem, Mass.
RCA Mfg. Co., Camden, N. J.

TUBES, Photo-Electric
Bradley Labs., New Haven, Conn.
Cont'l Elec. Co., Geneva, Ill.
De Jur-Amsco Corp., Shelton, Conn.
De Vry, Herman A., 1111 W. Center, Chicago
Electronic Laboratory, Los Angeles, Cal.
Emby Prods. Co., Los Angeles, Cal.
★ General Elec. Co., Schenectady, N. Y.
General Scientific Corp., 4829 S. Kedzie Av., Chicago
G-M Labs., 4313 N. Knox Av., Chicago
Leeds & Northrup Co., Philadelphia
Nat'l Union Radio Corp., Newark, N. J.
Photobell Corp., 123 Liberty St., N. Y. C.
RCA Mfg. Co., Camden, N. J.
Rehtron Corp., 2159 Magnolia Av., Chicago
Rhamstine, J., Detroit, Mich.
Westinghouse Lamp Div., Bloomfield, N. J.
Weston Elec. Inst. Corp., Newark, N. J.

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

TUBES, Transmitting
Amperex Electronic Prods., Brooklyn, N. Y.
Eitel-McCullough, Inc., San Bruno, Cal.
Federal Telegraph Co., Newark, N. J.
★ General Elec. Co., Schenectady, N. Y.
Heintz & Kaufman, S. San Francisco, Cal.
Hytron Corp., Salem, Mass.
Nat'l Union Radio Corp., Newark, N. J.
Raytheon Prod. Corp., 420 Lexington Av., N. Y. C.
RCA Mfg. Co., Camden, N. J.
Taylor Tubes, Inc., 2341 Wabansia, Chicago
United Electronics Co., Newark, N. J.
Westinghouse Lamp Div., Bloomfield, N. J.

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

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

TUBING & SLEEVING, Varnished Cambric, Glass-Fibre, Spaghetti
Bentley-Harris Mfg. Co.,Conshohocken, Pa.
Brand & Co., Wm., 276 Fourth Av., N. Y. C.
Endurette Corp. of 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 Insulator Co., 196 Varick St., N. Y. C.

VARNISHES, Insulating, Air-Drying
John C. Dolph Co., Newark, N. J.
Irvington Var. & Ins. Co., Irvington, N. J.
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.
Zophar Mills Inc., 112–26 St., Bklyn., N. Y.

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

WAXES & COMPOUNDS, Insulating
Zophar Mills, Inc., 112–26 St., Bklyn., N. Y.

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

WIRE, Hookup
Garett Mfg. Co., Brookfield, Mass.
Lenz Electrical Mfg. Co., 1751 N. Western Ave., Chicago

WIRE, Magnet
Acme Wire Co., New Haven, Conn.
American Steel & Wire Co., Cleveland, O.
Anaconda Wire & Cable Co., 25 Broadway, N. Y. C.
Ansonia Elec. Co., Ansonia, Conn.
Belden Mfg. Co., 4633 W. Van Buren, Chicago
Electric Auto-Lite Co., The, Port Huron, Mich.
★ General Elec. Co., Bridgeport, Conn.
★ General Elec. Co., Schenectady, N. Y.
Lenz Electrical Mfg. Co., 1751 N. Western Ave., Chicago
Holyoke Wire & Cable Corp., Holyoke, Mass.
Rea Magnet Wire Co., Fort Wayne, Indiana
Rockbestos Prods. Corp., New Haven, Conn.
Roebling's Sons Co., John, Trenton, N. J.

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

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

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

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

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

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

GENERAL ELECTRIC CO.
Boston: 140 Federal St., Hubbard 1800
Chicago: 840 S. Canal St., Wabash 5611
Cleveland: 4966 Woodland Ave., Endicott 4464
New York: 570 Lexington Ave., Wickersham 2-1311
Philadelphia: 1405 Locust Ave., Pennypacker 9000
San Francisco: 235 Montgomery St., Douglas 3740

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

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

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

SHURE BROTHERS
Chicago: 225 W. Huron St., Delaware 8381
Columbus: 85 E. Gay St., Adams 8928
New York: 136 Liberty St., Worth 2-6550
Philadelphia: 1343 Arch St., Rittenhouse 9778
San Francisco: 234 Ninth St., Hemlock 2625
Washington: 3308 Fourteenth St., N. W., Columbia 3938

SPOT NEWS

(CONTINUED FROM PAGE 10)

because of labor surplus. Buffalo and Massena, N. Y., are already short of labor.

End-Use Symbols Ended: WPB's elaborate end-use symbol system on contracts has been abandoned. Use of these symbols is no longer required.

No Ceiling on Condensers: Because of production expansion required to meet demand for fixed condensers, OPA has removed price ceiling until January 1, 1943. It is expected that expansion will be completed by that time, and that prices can then be stabilized again.

Non-Radiating Receivers: War Shipping Administration has announced the purchase of 2,600 non-radiating broadcast and short-wave receivers to be installed on ships operated by Maritime Commission. Programs received on master sets will be distributed by speaker systems. Contract was placed with E. H. Scott of Chicago, by whom the non-radiating receiver was developed. Design has been approved by F.C.C.

WPB Radio Committee: New 7-man advisory committee to discuss broad, general policies with WPB Radio-Radar Branch has been formed, with Ray C. Ellis, Deputy Director of this Branch, as chairman. Members are: W. P. Hilliard of Bendix Radio, Baltimore; A. S. Wells of Wells-Gardner, Chicago; E. E. Lewis of RCA, Camden; W. F. Hosford of Western Electric, Chicago; Percy L. Schoenen of Hamilton Radio, New York; Max F. Balcom of Sylvania, Emporium; and Monte Cohen of F. W. Sickles, Springfield, Mass. This committee will handle matters related to military production, not civilian radio or replacement parts.

New RMA Members: Latest Manufacturers added to RMA membership are Aircraft Accessories Corporation, Kansas City, Kans.; Federal Telephone and Radio Corporation, Newark, N. J.; J. F. D. Manufacturing Co., Brooklyn, N. Y.; Press Wireless, Inc., 1475 Broadway, New York City. Member companies now total 150, compared with 109 a year ago.

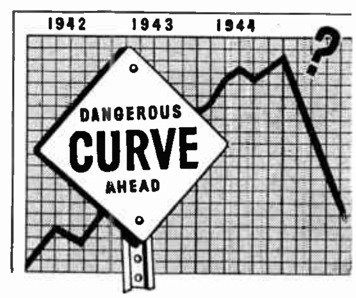
New Address: Eicor, Inc., is now in a new and large plant at 1501 W. Congress Street, Chicago, where production of dynamotors, DC motors, converters, and power plants will be increased greatly.

(CONTINUED FROM PAGE 29)

R19 500 ohms, 2 watts
R20 2,500 ohms, 10 watts, wire-wound
R21 10,000 ohms, 1 watt
R22 3,000 ohms, 1 watt
R23 10,000 ohms, 1 watt
R24 4,000 ohms, 1 watt

C1 .0008 mfd. each side, comprising 4-gang condenser of .0004 mfd. per section
C2 50 mmfd. trimmer
C3 50 mmfd. mica
C4 .1 mfd., 400 volts paper
C5 30 mfd., 450 volts electrolytic
C6 .1 mfd., 400 volts paper
C7 16 mfd., 450 volts electrolytic
C8 40 mfd., 450 volts electrolytic
C9 10 mfd., 450 volts electrolytic
C10 10 mfd., 450 volts electrolytic
C11 16 mfd., 450 volts electrolytic
C12 16 mfd., 450 volts electrolytic
C13 16 mfd., 450 volts electrolytic
T1 6SJ7 T3 6SJ7 T5 80
T2 6K6GT T4 6K6GT

SPECIAL REWARD TO OUTSTANDING RCA WORKERS WAS TRIP TO ORDNANCE TRAINING CENTER. BRIG. GEN. J. S. HATCHER, ON TANK, WAS GUIDE FOR THESE LUCKY VISITORS



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