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FM

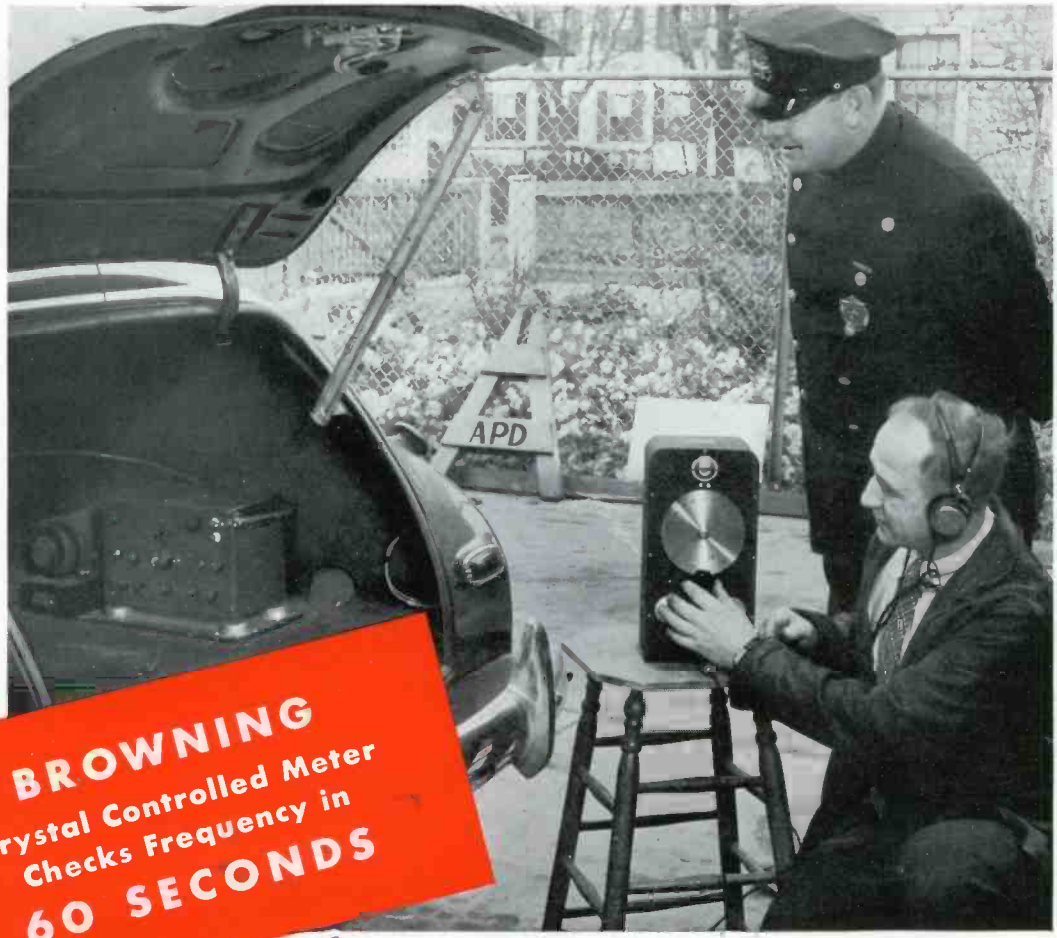
RADIO-ELECTRONIC ENGINEERING & DESIGN

DECEMBER 1942

LOUDSPEAKER'S AUTOGRAPH

Radio-Electronic Products Directory

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



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Crystal Controlled Meter Checks Frequency in 60 SECONDS

IMPROVES COMMUNICATIONS SERVICE

Off-frequency transmission is responsible for much of the interference trouble now experienced by police and public utility radio systems.

This interference can be eliminated very simply by checking car transmitters at regular and frequent intervals with a BROWNING FREQUENCY METER.

Using this instrument, less than 60 seconds are required to detect off-frequency transmission.

The BROWNING FREQUENCY METER permits the readjustment of an offending transmitter to even greater accuracy than is required by the FCC. Police, Government, and public utility officials in all parts of the United States attest to the accuracy and convenience of this instrument.

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This schedule is practical even with a reduced maintenance staff, for it takes only one minute per car.

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1 Band..$125	3 Bands..$165
2 Bands. 145	4 Bands.. 185

BROWNING LABORATORIES, INC. WINCHESTER MASSACHUSETTS

EASY DOES IT!

A difficult job being well done — easy does it! Modern warfare on seven oceans puts a premium on efficient, unfailing communications. National equipment is covering all seven of them.

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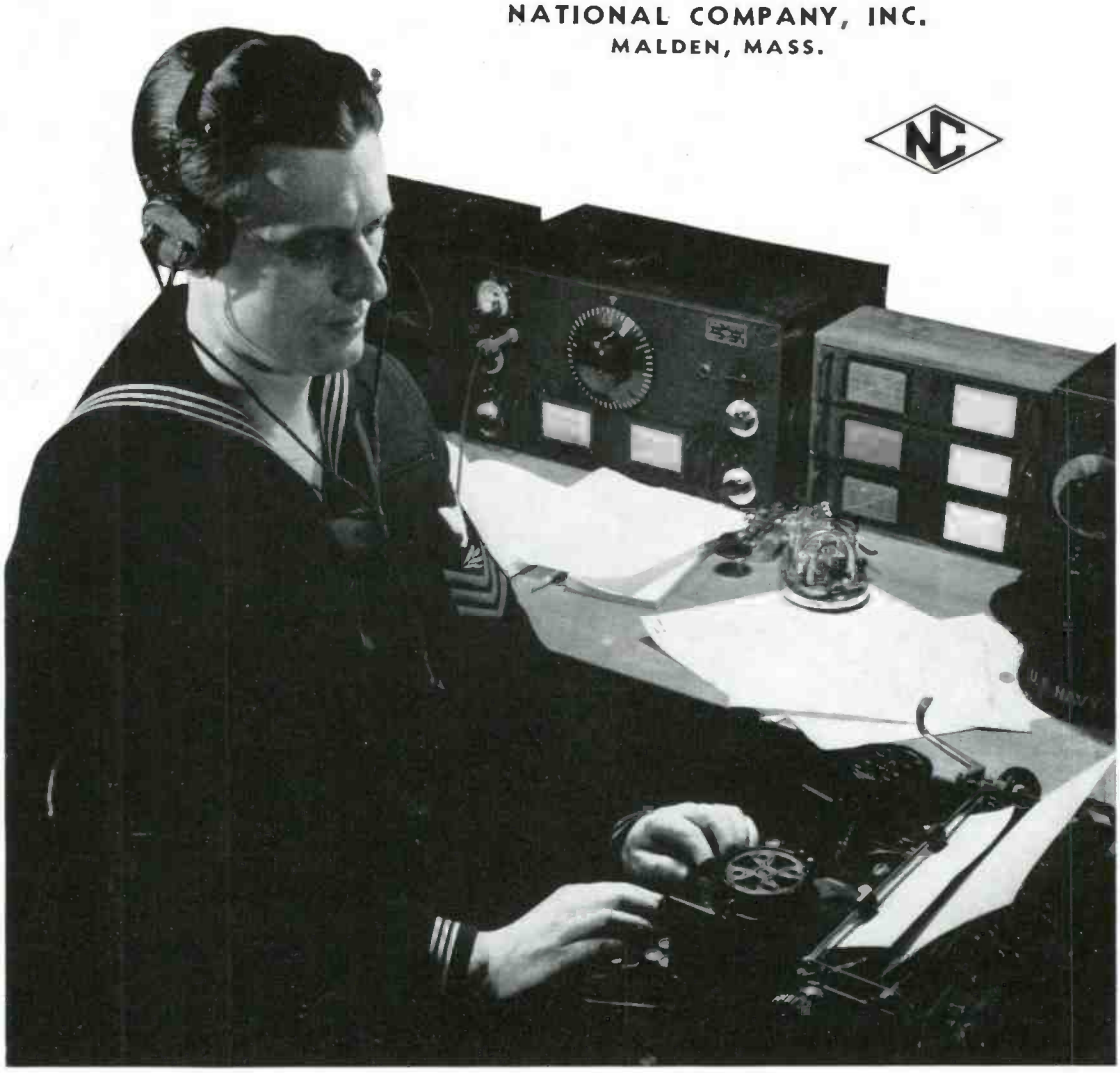
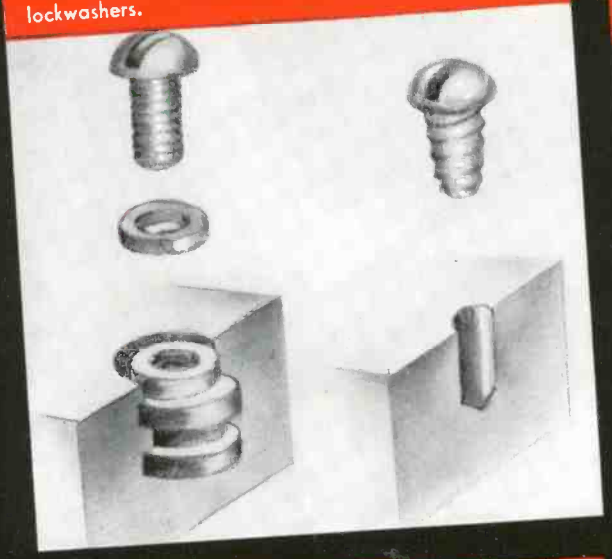


In the Battle of Design

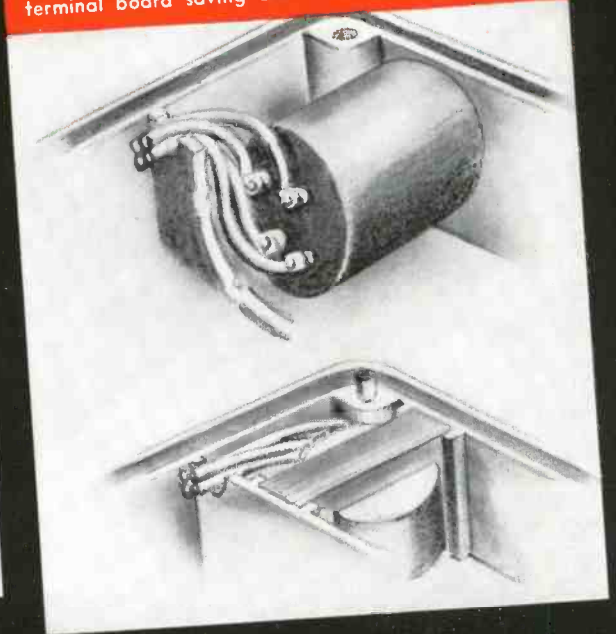
A waste of material or machine time in engineering design today is as damnable as sabotage. The battle of design will be won by refinements in existing components as well as by new inventions. Savings in small things add up . . . to big things. Here are some examples:

One of our engineers changed the construction of a plastic assembly from brass insert + lockwasher + brass screw to steel PK screw only. Approved by the Army, the savings represented 1,000,000 inserts and lockwashers.



In die cast structures, covers and nameplates were held on by screws. A UTC design modification added a round projection in the casting, which is spun over to hold the plate or cover. Saving: over 2,000,000 screws and lockwashers . . . over 2,000,000 tapping operations.

This structure employed a cased transformer fastened to a compartment wall with screws. A changed design permitted potting the transformer directly in the compartment. Saving . . . 1,000,000 terminals . . . 300,000 screws . . . 400,000 aluminum cans . . . plus terminal board saving and reduction in overall size.



One UTC design eliminated a threaded shank, lockwasher and nut by changing to a spun-over shoulder on the shank. Saving . . . 150,000 lockwashers and nuts . . . 150,000 threading operations.

These savings *added up*. Small in themselves . . . slight for each individual unit . . . their total is impressive. Today we need all possible savings . . . even those which seem impossible at first. Review your designs for Savings for Victory.

UNITED TRANSFORMER CO.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"

FM RADIO-ELECTRONIC ENGINEERING & DESIGN

COMBINED WITH: APPLIED ELECTRONIC ENGINEERING

VOL. 3 | DECEMBER, 1942 | NO. 1

CONTENTS

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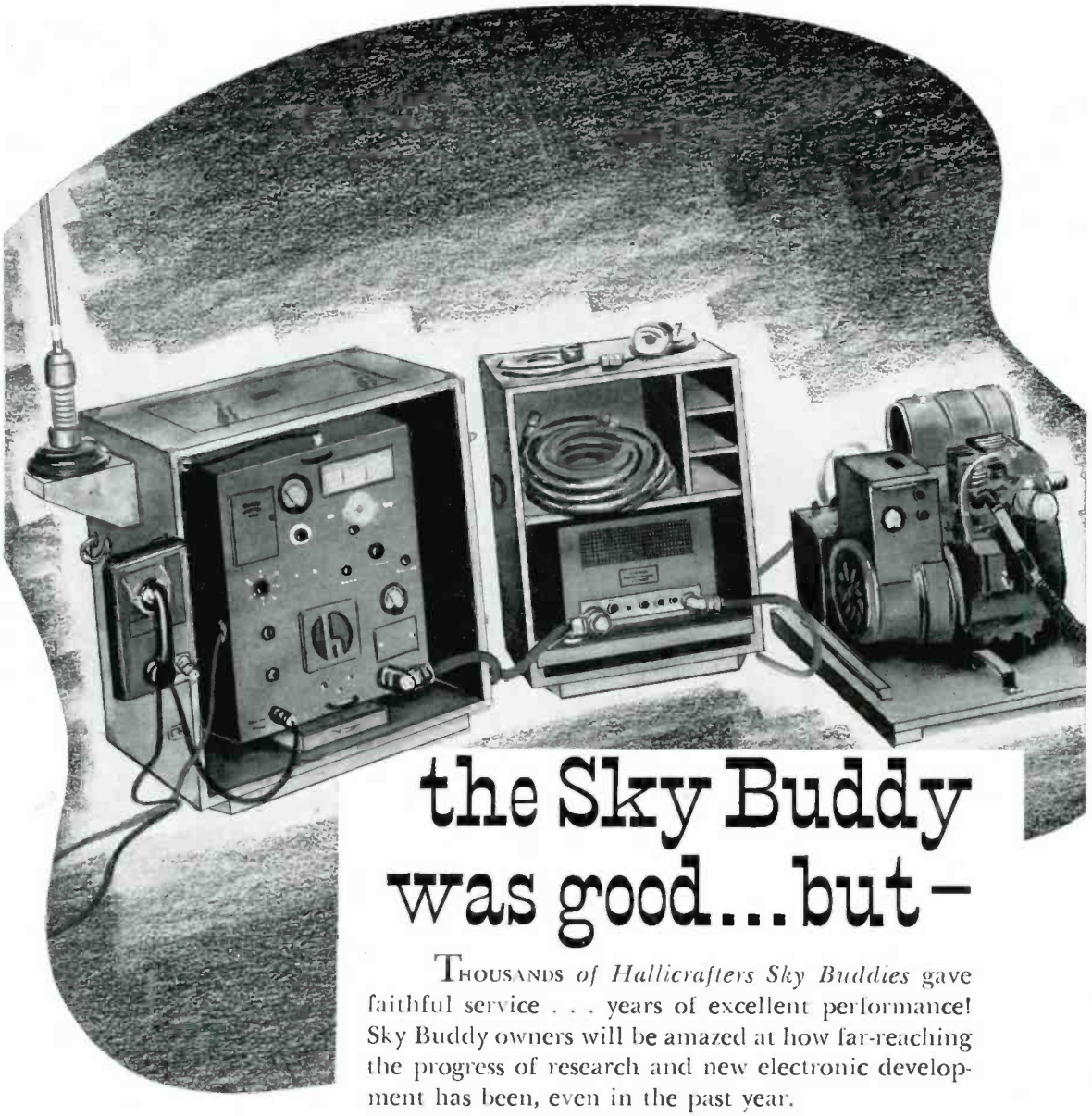
Advertising correspondence, copy, and cuts should be addressed to the advertising office at New York City.

When Peace comes, it will find the radio manufacturers well prepared to tackle the new problems and applications of radio and electronic applications. New laboratory equipment has been developed, and the meagre facilities with which pre-war engineering was done at many plants have now expanded enormously. This month's cover shows equipment used by Jensen Radio Manufacturing Company to run off the characteristic curves of loudspeakers. At the left is Jensen V. P. Hugh S. Knowles, in charge of engineering, and V. P. Thomas A. White, right, in charge of sales.



the Sky Buddy was good...but—

THOUSANDS *of Hallicrafters Sky Buddies* gave faithful service . . . years of excellent performance! Sky Buddy owners will be amazed at how far-reaching the progress of research and new electronic development has been, even in the past year.

When Hallicrafters are again permitted to sell communications receivers for civilian use your new Sky Buddy will have so many improvements, comparison with the old models will be a difficult accomplishment.

Illustration (top) partial view of Hallicrafters Signal Corps communications equipment.

the hallicrafters co.

CHICAGO, U. S. A.

keep communications open!

ARMY E NAVY

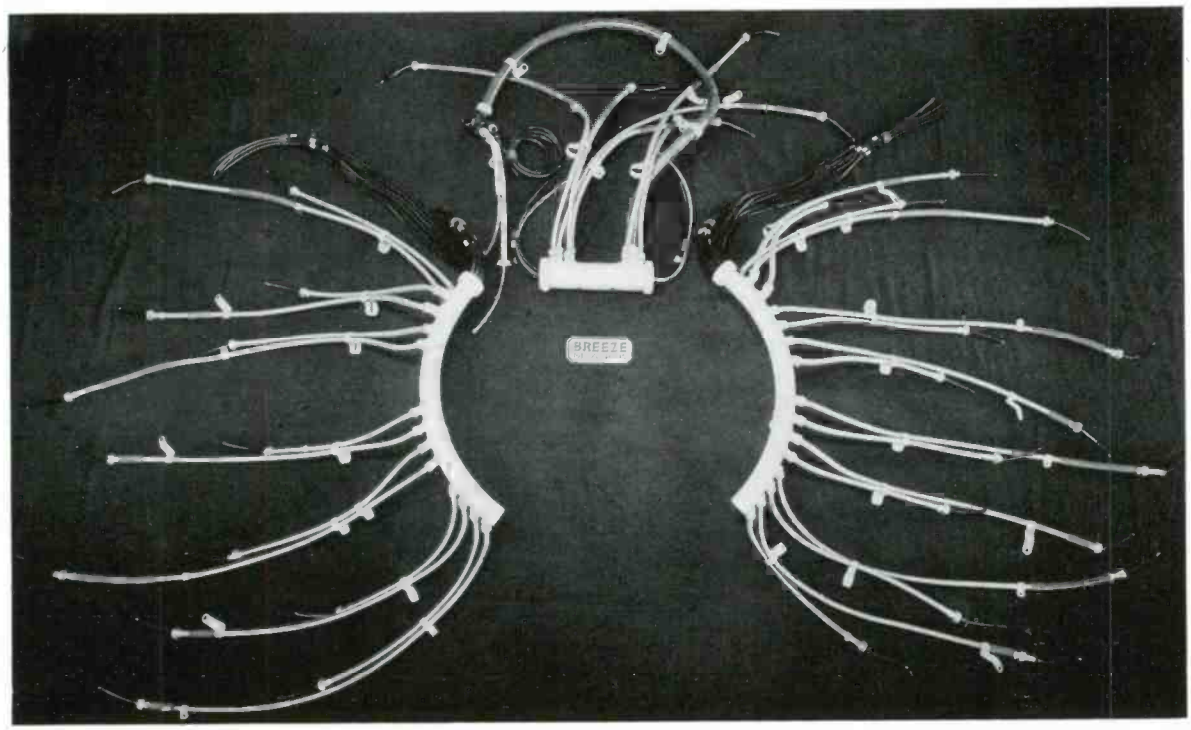


FIG. 1. SHIELDING HARNESS FOR THE 2,000 H.P. WRIGHT CYCLONE AIRCRAFT ENGINE. CLAMPS ARE SHOWN IN PLACE ON THE CABLES

AIRCRAFT IGNITION SHIELDING

Defying Mathematical Determination, Experience and Experiment Are the Only Design Approach

BY J. J. MASCUCH*

THERE was no such thing as a "task force" in the military aviation of World War I. Then, three planes comprised a "formation," but the term implied only limited coördination of effort in the air. Inter-plane communication was only such intelligence as could be conveyed by hand-waving or wing-dipping. Cloth strips were laid on the ground to signal to planes when the pilots could see their own airdromes.

For all practical purposes, when a pilot walked out of the hangar, he was on his own until he landed again.

Cloudy skies and darkness washed out flying completely, for standard instruments on planes at that time were seldom more than a gasoline gauge, a water temperature gauge out on the radiator cap, an oil pressure gauge, altimeter, revolution counter, and probably, but not always, a magnetic compass. However, pilots seldom flew far enough to need the compass, and preferred to rely on their own sense of direction if they did.

True, radio was used on some fronts for artillery observation. Equipped with a squared map of the target area, the pilot watched the exploding shells and tapped out, in code letters and numbers, his estimate of their relation to the target. For this purpose, he was provided with a jumbo key, strapped to his leg.

The radio transmitter, powered by celluloid-case storage batteries, was a broadly tuned spark-coil rig, assembled on a board and mounted in the fuselage.

The antenna was a trailing wire with a lead weight on the end. As often as not, pilots forgot to reel in their antennas before landing. When the loss of wires and weights exceeded the available supply, planes could not be used for artillery observation.

These notes give the background of military aircraft radio progress since 1919. Since then, all flying tactics and the tactical use of aircraft have been developed in step with the advance of the radio art. The progress of aircraft radio, in turn, has been paced by the improvements in the means and methods for preventing ignition interference.

The term "shielding" as applied to aircraft installations is a broad term requiring an equally broad application of all fields of engineering. No one branch of the profession has the answers relating thereto, and the title of "shielding expert" needs qualification. However, some men and industries have devoted years towards a better understanding of the causes and the elimination of radio interference on aircraft, with results that give a measure of satisfaction.

The present stage of development and application of the modern airplane is partly due to efficient communication. This takes on supreme importance on military aircraft. Few realize, for instance, that the operation of planes from carriers would, even under wartime conditions, be practically impossible without efficient plane-to-ship communication. The mortality of flying personnel and equipment lost from their small moving bases would be so great as to make the use of aircraft carriers impractical. Indeed it could easily be possible for a carrier to lose its entire complement of planes in one action without a single battle casualty. Further ex-

* Engineer, Breeze Corporations, Inc., Newark, N.J.

amples are unnecessary to prove the value of adequatesignal or voice communicating systems.

The installation of high-efficiency receivers requires good shielding and bonding to obtain satisfactory reception. The airplane's structure, equipment, wiring, controls, engine — in fact any metal mass making up the complete airplane — can cause radio interference, directly or indirectly, of sufficient magnitude to render a receiver useless. Modern radio equipment features extreme sensitivity for long-range communication.

It has been found that ultra-high frequencies are ideal for plane-to-ground radio contact when planes operate at extremely high altitudes. Each transmitter covers a given area and beyond that area does not cause interference. These high-sensitivity receivers are particularly susceptible to interference from the electrical systems of the aircraft as well as interference created by the static electrical discharges between any adjacent metallic structures of the ship which are not bonded together. It is essential, therefore, to completely enclose all electrical wiring in an electrostatic shield which is bonded to the airplane structure at predetermined intervals. Similarly, metal parts of the aircraft structure also must be bonded together.

Where shielding is employed for electrical wiring, its purpose is to prevent leakage of the field or to prevent the wires from picking up high-frequency energy from outside sources which, after distribution over the wiring system, may be radiated as if from a transmitter antenna. The engine ignition system is undoubtedly the worst offender as a source of radio disturbances, because ignition interference is the total result of a large number of spark transmitters radiating on varying high frequencies. This range of frequencies includes all those used in radios operating on short or ultra-short wave lengths. Here shielding contributes most importantly and takes its greatest abuse.

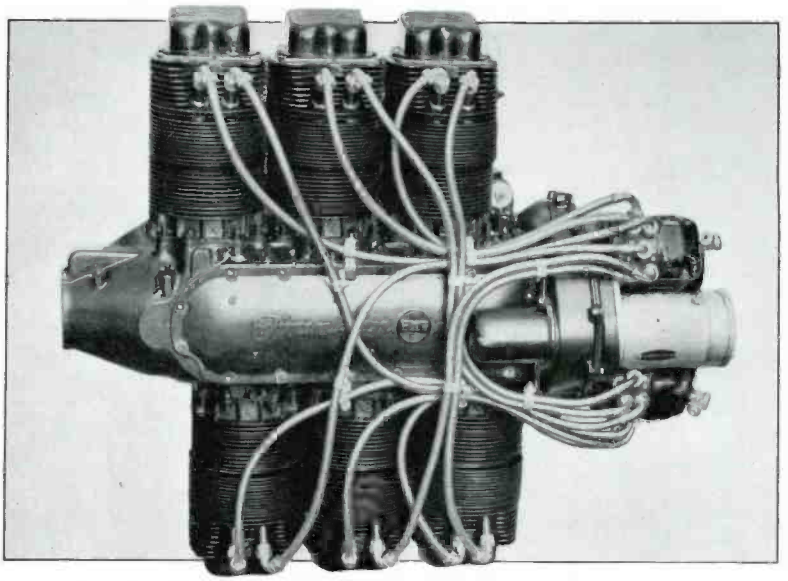


FIG. 3. A SIMPLER TYPE OF IGNITION SHIELDING IS USED FOR THE FRANKLIN ENGINE

Of the many types of shielding harness assemblies produced by Breeze Corporations, some typical examples are shown here. Figs. 1 and 2 illustrate the assemblies used for the ignition systems on Wright radial-cylinder engines. These, like the shielding for the Packard in-line engine, Fig. 4, are made up of bent aluminum tubing to which outlet fittings are welded. From the outlets, flexible, woven-wire conduits carry the leads to caps which fit over the spark plugs. At both ends of each length of conduit there are threaded ferrules bearing against rings swaged onto the ends of the conduit. The ferrules make closed shielded connections, as well as electrical contacts, between the conduit and the end fittings.

Ring clamps for holding the conduits in place can be seen in the illustrations. A somewhat different but essentially similar type of shielding is used for the Franklin air-cooled engine shown in Fig. 3.

It is the author's opinion that there are more problems to be solved in creating satisfactory ignition harnesses for aircraft engines than in any other type of shielding and bonding. Today, the ignition shielding harness is a complicated electrical set-up, greatly improved over the shield originally developed many years ago when low-sensitivity receivers of relatively short range were less responsive to this source of interference. To the uninitiated ignition shielding may appear as a relatively simple structure, but it is doubtful if any phase of aircraft design requires a greater amount of investigation or longer hours of careful design and engineering.

With respect to satisfactory radio reception, many factors concerning the radio installation have a bearing on the degree of shielding needed.

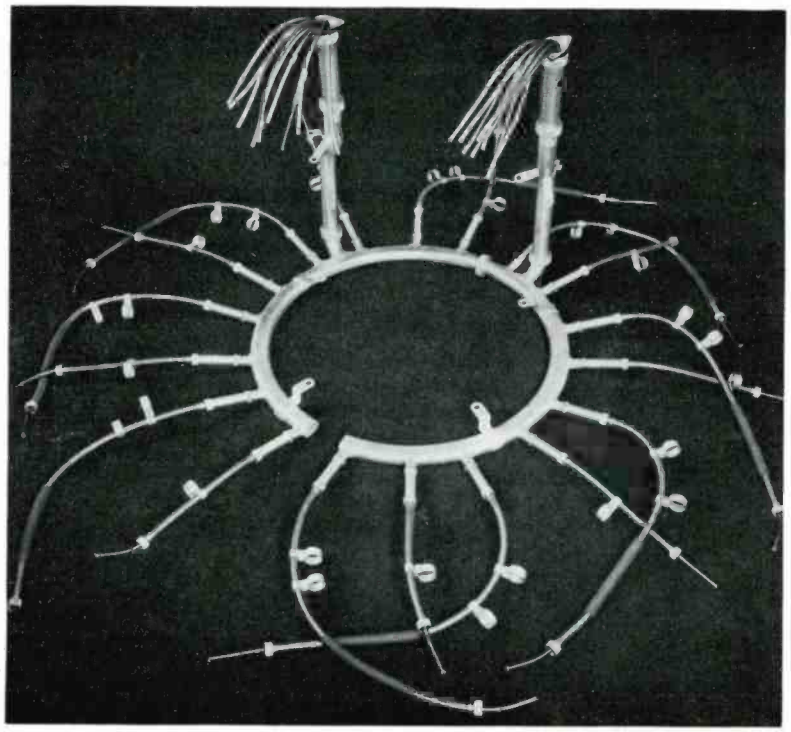


FIG. 2. SHIELDING ASSEMBLY USED ON THE IGNITION SYSTEM OF THE WRIGHT D-1820

Among these may be mentioned the operating frequencies, receiver sensitivity, position with respect to the engine, the radio's power source and its location, and whether or not it is entirely independent from the rest of the general electrical circuit.

The care which must be taken in the design of an efficient shielding system depends upon the ratio of the interfering signal or noise in the receiving antenna to the signal required. Therefore, for high sensitivity receivers able to operate on weak signals, the interference-sensitivity ratio (I/S) is greater, since the ignition interference voltage is a fixed value for a given antenna.

Generally, the higher the frequency to which the receiver is tuned, the greater is the I/S ratio. If the receiver has a fixed sensitivity, the I/S ratio will depend upon the receiving antenna length, type, its orientation, and proximity to the interfering source.

Other factors influencing the detailed design of the shielding are conduction, induction, skin-effect, and bonding or grounding. Conduction is the reciprocal of resistance. Therefore, to allow for efficient grounding and drainage of electrical charges, the shield should have as high a conductance as possible.

Electro-magnetic induction is extremely important, and any shield installation involving parallel wires must be watched for this effect and corrective measures taken to prevent the interaction of magnetic fields. At radio frequencies, the AC resistance and skin-effect are the main causes for this increased resistance. This effect has important bearing on material selections and their application. Bonding is covered more fully later on, but it can be said that proper bonding is not always obvious and, improperly done, renders an otherwise good shield ineffective.

The ignition harness takes a terrific beating through vibration, abrasion, moisture, dirt, oil, heat, electrical stress, cold, and pressure changes.

Shielding may improve the overall performance of the ignition system but must not have any adverse effects.

For instance, the presence of shielding increases the capacitance of the leads in relation to ground, and this results in increased magneto loads if voltage output at the spark plugs is to be maintained. Such increased capacitance also accelerates spark plug electrode wear, due to the increase in the energy of the spark surge.

Corrective measures must be taken against this, and cables designed to reduce this capacitance effect have been developed, such as those using stainless steel conductors. Non-inductive resistors have been tried in circuits adjacent to the spark plugs. The design of such resistors is not simple, considering the small size required, the high operating voltage, and the special conditions attending aircraft operation. Subjected to temperatures as high as 400° F., many resistor materials proved impractical.

Ignition shielding design must also take into consideration the effects of corona. Corona occurs when the potential of a conductor in air is of such value that the dielectric strength of the air is exceeded. Corona is always accompanied by the formation of the chemically active gas ozone. Corona also consumes energy which is dissipated at heat. As the density of air is reduced corona becomes more intense, because the dielectric strength of the air is reduced. In the presence of moisture, heat, and pressure changes, corona can produce harmful results to shielding.

The ozone reacts with the air to form nitric oxide which, in the presence of moisture, creates nitrous acid. This is harmful to ignition cable and shielding alike. Low air pressures under high-altitude flight conditions not only intensify the corona, thus aiding in the more rapid formation of harmful substances, but may be the cause of corona discharges, resulting in failure of the ignition cable.

Heat also contributes its bit by aiding in the reduction of air densities. It should be obvious at this point that the research field is broad when shielding is being designed.

Other problems of far reaching import face the engineers concerned with shielding ignition systems. A comprehensive discussion is difficult here for the now important reason of giving aid and comfort to the enemy.

The purpose of bonding metallic parts of the airplane together is to provide a low resistance path for equalization of potentials which may exist along its length.

Interference due to lack of proper bonding may not show up under ideal flight oper-

(CONTINUED ON PAGE 22)

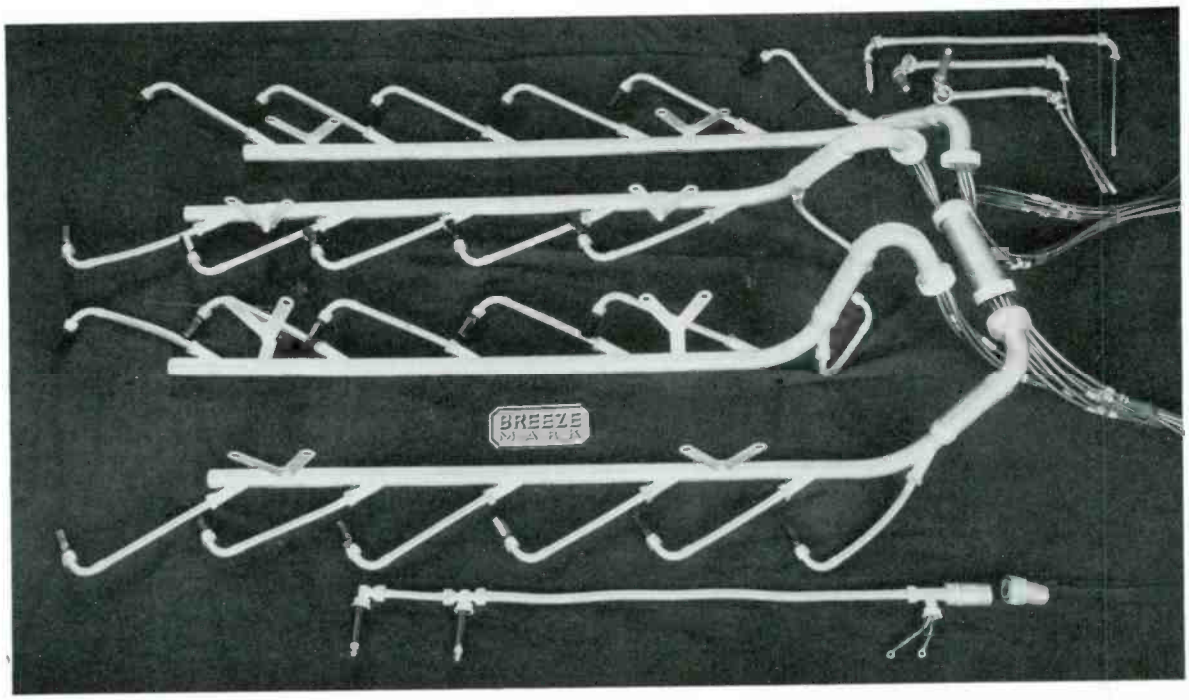


FIG. 4. THE TYPE OF SHIELDING DEVELOPED FOR AIRCRAFT IS EQUALLY EFFECTIVE FOR APPLICATION TO A PACKARD MARINE ENGINE

ENGINEERING IN WORLD WAR 2

In the Present Wartime Economy, Engineers Must Help Themselves to Find Their Proper Places

BY M. B. SLEEPER

UP TO 1939, the demand for engineers was so related to the supply that a successful student, upon graduation, was reasonably certain of being invited to join the engineering department of one of the larger corporations. Once employed, he was shuffled around in a way that exposed his individual abilities to the watchful eyes of superiors always alert to discover talent to strengthen their particular departments.

The young engineer was not obliged to fit himself into the first job to which he was assigned. Rather, the company assumed the obligation of finding for him the place where he could do the best for himself and for the organization. If he failed to make good on his first assignment, he was given another. If, in the end, he resigned or was dropped, there was a feeling that his superiors, rather than the man himself, had failed.

The Military Takes Over ★ At least, that is the way it used to be. Today, such policies are still considered sound, but their liberal application has become restricted because all companies engaged in engineering effort are operating under a wartime economy.

First, in 1939, the demand for engineers rose to a point where it exceeded the supply. Then all companies able to produce equipment and munitions of war were called upon to abandon their peacetime products, and to take on contracts for many new items they had never built before, and to deliver them in quantities far beyond their former output levels.

This had the effect of making management the agent for the Government department issuing the contracts, and the company a virtual extension of the Government arsenals which, in time of peace, were able to supply the needs of the Armed Forces.

Under these new conditions, it was no longer practical to consider newly-employed engineers as potential organization material. The necessities of war called for hiring a great number of engineers for assignment to specific work in departments expanding to five, ten, twenty times their normal personnel, and starting them to work long before adequate facilities could be provided for them.

Entirely New Conditions ★ This has made a vast change in the conditions confronting young engineers in the larger organizations, and an even greater change in the smaller companies where complete conversion has been made from civilian to military production.

Under the pressure of wartime necessity, where the success of a man's work is measured by the time he takes to complete it and his ability to overcome the handicaps of limited facilities, it is no longer possible to maintain the policy of adjusting the assignment to the man. Instead, engineers are being called upon to adjust themselves to the jobs they are given.

This is not due to any arbitrary change of management policy. It is a matter of sheer necessity, resulting from the fact that there are not enough engineers to do the work demanded by the Army and Navy.

The situation is made more acute by the steady drain on engineering departments through enlistments and the draft. At the same time, our Armed Forces are making still greater demands upon the manufacturers for increased output of standard products and the accelerated development of new equipment.

A considerable part of this burden falls upon the shoulders of the young engineers. As citizens of the United States, they must recognize this challenge and meet it. It is not an extra responsibility put upon them by company management. It is an obligation put upon them by the men who lead our Armed Forces, to whom company management itself is responsible.

Therefore, if an engineer cannot adjust himself to his working conditions, if he feels that the laboratory facilities are inadequate, or if he cannot carry the responsibilities of his job and operate under his own steam without the assistance and encouragement he would like to have from others, instead of grousing and grumbling to his associates, he might better complain to the Contracting Officer to whom his company is answerable for the execution of the job on which he is working.

There is no telling what kind of an answer the complaint might bring, but it is possible that it would be something like this:

Your complaint about your present work and the treatment accorded you by your employer has been given the careful consideration which it deserves.

It is clear that you are not sufficiently resourceful to meet the demands put upon you, and that you are unable to carry your full share of responsibilities during this period of National Emergency.

Accordingly, recommendation has been made to the cognizant authorities that your draft deferment be cancelled, and that you be inducted into the Army at once. You will [illegible] *have the benefit of military discipline, and* [illegible] *s atmosphere will more quickly develo* [illegible] *e sense of self-confidence and self-relia* [illegible] *which, obviously, you now lack.*

[illegible] he privilege and duty of every [illegible] to make every effort to advance [illegible] [illegible] he organization of which he is a part. Right now, there are better jobs and higher salaries waiting to be filled by men who demonstrate their ability to carry greater responsibilities.

The man who makes the trouble for himself and everyone else is the one who neglects the job at hand while he complains about not having the one he wants.

In terms of military discipline, the rule is: "If a command seems unreasonable, carry it out and then complain about it afterward."

Better Jobs Ahead ★ The important point is to pick out the job ahead and to make whatever preparation is necessary to fill it successfully. Here, for example, is one way to go about it:

On the page opposite is shown a form used by the General Electric Company for an experiment in personnel rating.[1] A group of 17 people were rated over a period of years, and very complete charts were plotted to show the extent and the rate of their progress.

These rating sheets were made out at regular intervals for each person by his foreman, by one of two of his fellow workers, and by the supervisor over the foreman or an outsider.

The purpose was to determine the special abilities of the individuals so that they could be assigned to the work for which they were best fitted.

Today, most engineers are working without the benefit of rating systems by which the management can recognize their points of strength and weakness. That is because there is not enough manpower to handle this personnel work.

It may happen in consequence that a man who is an individual worker with special ability in the production end is called upon to supervise the work of several men in the research department. Or perhaps a man who is competent to replace his immediate superior is sidetracked on work of minor importance.

On the other hand, a man's desire to be transferred to other work may be born of wishful thinking and mere discontent over his present tasks.

(CONCLUDED ON PAGE 22)

[1] See: Personnel Rating, by G. J. Meyers, Jr., General Electric Review, June, 1942.

GENERAL RATING SHEET

Employee..... Age..... Service.....

Duties ..... Department.....

I—VALUE ON ASSIGNED WORK

Rate the employee on his productivity for the Company as compared with the opportunities presented by his job You should compare the things he does which are of value to the Company with the opportunities which he has.

	Exceptionally high		Excellent		Good		Fair		Poor	Unacceptable
Value on assigned work	10		9		8		7		6	5

II—CAPACITY FOR FUTURE GROWTH

Consider this employee's capacity for growth in the Company. Is the work he is now doing the limit of his capabilities or could he do work of increased scope and difficulty? Is he just about equal to the demands of his present position or has he capacity for increased responsibility? Age, health, mental ability, personality, character and record for accomplishments are all to be taken into account. Check one or more of the phrases which most accurately describe his capacity for future growth.

(.....) a—Should advance rapidly.

(.....) b—Shows promise of future growth beyond present job.

(.....) c—Could handle work of increased scope on present job.

(.....) d—Limited to present occupation.

(.....) e—Decreasing in efficiency.

(.....) f—Unsatisfactory for present occupation.

(.....) Fully qualified to replace his immediate superior.

(.....) Present job requires his full ability.

(.....) Very competent man but limited to present job on account of age.

(.....) Merits further consideration.

III—APTITUDE AND LEADERSHIP

Check the proper line to indicate the kind of work the employee could do successfully. More than one kind of ability may be checked. The position of the check-marks from left to right should indicate the degree to which he possesses administrative ability

	Marked capacity as an executive	Some supervising ability	Individual worker only
Sales.....			
Manufacturing.....			
Engineering.....			
Research.....			
Accounting and Finance.....			
Other..... (describe)			

(Over)

IV—PERSONAL TRAITS

	Exceptionally high		Excellent		Good		Fair		Poor	Unacceptable
a—KNOWLEDGE OF JOB:										
Mentality, Training and Experience.—Consider the extent to which he has and applies the mentality, training and experience to perform fully all the functions of his job.....	10		9		8		7		6	5
Analytical Ability.—Consider his ability to grasp essentials, reach sound conclusions, and plan necessary action in evaluating problems and analyzing data effectively....	10		9		8		7		6	5
b—ABILITY TO GET ALONG WITH ALL KINDS OF PEOPLE:										
Personal Requirements.—Consider his effectiveness in getting along with subordinates, equals and superiors by the application of tact, fairness, co-operativeness, and skill in presentation.....	10		9				7		6	5
Supervisory Ability (Executive responsibility.)—Consider the leadership displayed in organizing effort of others and in supervising, inspiring, selecting or developing others.....	10		9		8		7		6	5
c—ABILITY TO GET RESULTS:										
Initiative.—Consider his accomplishments through tenacity, resourcefulness, ingenuity and aggressiveness.....	10		9		8		7		6	5
Cost and Expense Consciousness (Monetary responsibility.)—Consider his ability to control and reduce expenses and costs by assuming responsibility for and making sound decisions affecting money, materials, economy of product, equipment, safety and service to customers.....	10		9		8		7		6	5
Dependability and Accuracy.—Consider his accuracy, thoroughness and reliability.....	10		9		8		7		6	5
Application.—Consider the degree and effectiveness of his mental and physical effort.....	10		9		8		7		6	5

COMMENTS

What outstanding characteristics will help his advancement?.....

.....

.....

What qualities will hinder his future development?.....

.....

.....

Give other pertinent facts which should be known concerning this employee.....

.....

.....

.....

.....

.....

.....

.....

.....

Date..... Rated by.....

FIG. 1. CONTROL CONSOLE FOR OPERATING THE 250-UFS-A OR -B EQUIPMENT

IMPROVED FM TRANSMITTER

New Link Equipment for Headquarters Stations Incorporates Refinements in FM Design

BY WILLIAM FINGERLE, JR.*

SINCE December, 1941, a great number of new emergency FM communications systems have been put into service. While the number cannot be disclosed, it has been so high as to permit the establishment of standardized systems which can be installed quickly, and at minimum expense.

Contributing to this important simplification is the new Link model 250-UFS headquarters transmitting and receiving unit, available in two types.

Design Features ★ The 250-UFS-A is designed for systems using the same frequency for the main station and the mobile units. In this type, only one receiver is furnished.

The 250-UFS-B, shown in Figs. 2 and 3, is intended for use in systems with two or more main stations operating on one frequency, with the mobile units on a second frequency. Therefore, two receivers are provided. Under this arrangement, the car transmitters are adjustable, so the operators call other cars on No. 1 frequency, and the main stations on No. 2, while the main stations talk to each other or to the cars on No. 1. Both frequencies can be tuned in at the main station receivers.

The same control console, Fig. 1, is used for either type of installation. Provision is made in the control circuit of the 250-UFS-B to open the squelch of the mobile frequency receiver, and to afford positive muting of the main station receiver, so as to assure reception on the former without interference from the other main stations in the system.

Figs. 2 and 3 show the various elements in the headquarters unit. At the bottom of the cabinet are the relays and control circuits, with the transmitter power supply above. Next are the two receivers, then the 50-watt exciter and, finally, the 250-watt output stage. If required, the output can be raised as high as 400 watts.

Transmitter Specifications ★ The phase-shift method is used to obtain frequency modulation. This permits direct crystal control with a simplified circuit requiring no critical adjustments. Maximum frequency deviation is ± 15 kc., operating in the 30- to 42-mc. band. Other specifications are:

POWER INPUT: Standby, 225 watts with one receiver; transmit, 1,100 watts from 115 volts, 60 cycles.

POWER OUTPUT: 250 watts nominal; 400 watts maximum.

AUDIO RANGE: 300 to 3,000 cycles, with high-frequency pre-emphasis.

CONTROL: Remote control over 2-wire line, using self-contained relays. Provisions are made for coördinated receiver control.

OUTPUT IMPEDANCE: Any — usually fed into concentric line.

OVERALL SIZE: Cabinet dimensions, 21 ins. wide, 15 ins. deep, 78 ins. high.

TUBE COMPLEMENT:
Two 7C7
Two 7A8
One 7C5
One 6L6
Two 807
One 250TH or 454H
Two 816 or 866 Jr.
Two 866/866A

Transmitter Details ★ Front and rear doors on the cabinet, fitted with protective switches, give complete access to the transmitter, power supplies, receivers, and control circuits.

Across the top of the cabinet are five meters for reading the line voltage, intermediate power amplifier plate current, and the grid and plate current and plate voltage of the final stage. The meter panel is protected by a glass window, and is illuminated by a 40-watt lumiline lamp.

Directly below this panel are the filament and plate control switches, with their associated pilot lights.

At the front of cabinet, down below, is the relay panel to which the 115-volt AC line and the remote control telephone pair are connected.

Frequency generation, modulation, and the necessary frequency multiplication are accomplished in the exciter unit. This delivers 50 watts at the carrier frequency. A 7-in. panel carries the complete elements of this circuit.

The output is amplified to the 250/400-watt level by a triode amplifier mounted directly above the exciter. Power for the final amplifier plate is supplied from a single-phase, full-wave rectifier rated at 2,000 volts, 300 milliamperes. The rectifier panel is the second up from the bottom of the cabinet. Two 866/866A tubes, with

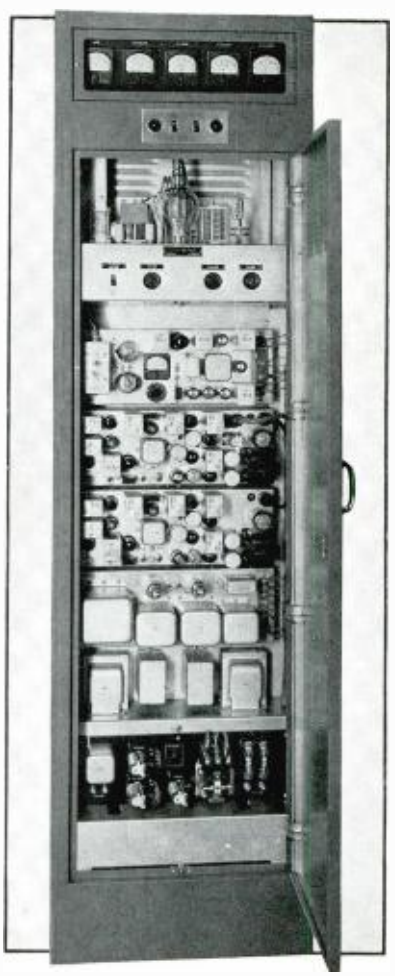


FIG. 2. FRONT VIEW OF THE 250-UFS-B UNIT

*Assistant Chief Engineer, F. M. Link, 125 W. 17th Street, New York City.

a 2-section choke input filter, furnish the high voltage.

The power amplifier employs a single 250TH or 45411 tube, connected in a conventional grid-neutralized triode circuit. This provides excellent efficiency and high stability. All tuning controls are brought out to the front edge of the shelf on which the circuit components are mounted, making them easily accessible for adjustment. This can be seen in Fig. 2.

Eight tubes are used on the exciter chassis, of which 6 are of the low-drain type. Their functions in the circuit are as follows:

7C7 Crystal oscillator
7A8 Balanced Modulators (2)
7C7 First frequency quadrupler
7C5 Second frequency quadrupler
6L6 Frequency doubler
807 Intermediate power amplifier (2)

From the above, it will be seen that the crystal frequency is multiplied 32 times to obtain the final operating frequency.

A meter and meter switch are provided on the exciter chassis to read the grid current at each stage. This is for convenience in making the initial adjustments. The settings of the controls are straight-forward, and small errors in the adjustments do not affect the output frequency, quality, or modulation level in any way.

The filament transformer on the power supply section supplies 6.3 volts AC for the filaments of the exciter tubes and the 816 or 866 Jr. rectifiers. These rectifier tubes can be used interchangeably. They furnish 410 to 475 volts at 250 milliamperes to the output tubes of the exciter.

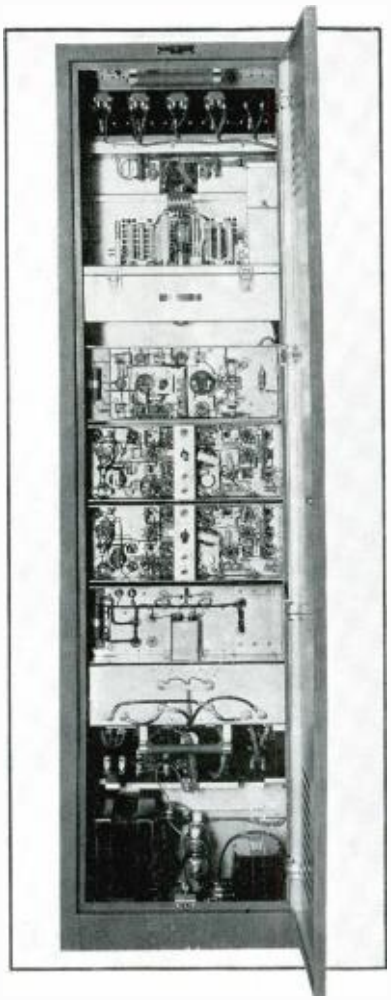


FIG. 3. REAR OF THE 2-RECEIVER UNIT

Receiver Details ★ The associated receiver, Type 12-UF Ed. 3, is a twelve-tube, crystal-controlled single-frequency unit, operating from 115 volts, 60 cycles. Its characteristics are matched to the main station transmitters and to those used in the cars. The circuit can be adjusted to any frequency in the 30-to-42 mc. band. Frequency deviation is ± 15 kc., and the audio response ± 3 db. from 300 to 3,000 cycles, with a sharp cut-off filter to attenuate frequencies above 3,000.

The essential specifications are:

POWER INPUT: 65 watts from 115 volts, 50–60 cycles AC.

POWER OUTPUT: Approximately 1 watt into 500 ohms.

OVERALL SIZE: Receiver is carried on a relay rack panel 7 ins. high by 19 ins. long.

TUBE COMPLEMENT: Two 6AC7
Two 6K8
One 6S87
One 6SJ7
Two 686
One 6SL7GT
One 6K6GT
One 6V6GT
One 80

Two quartz crystals are employed in a double IF system, giving excellent band pass characteristics with a very favorable image ratio. Frequency stability is well within FCC requirements under all variations of humidity and ambient temperature.

Three tuning meter jacks are located on the receiver chassis. The first is for measuring the grid current of the first limiter, thus indicating resonance in all the preceding stages. The second is for measuring the grid current of the last limiter, while the third is to permit adjustment of the balance in the discriminator circuit. The first two jacks are for plugging in a 0–1 milliammeter. The last requires a 50 or 100 microammeter, preferably of the zero-center type.

In addition, there is a monitor jack on the control saddle at the rear. This is connected across the 500-ohm output to permit aural monitoring if the receiver loudspeaker is located remotely.

Since the 250-UFS-A and -B models are completely self-contained, the only external connections are those to the power source, antenna and ground, and to the console and remote control.

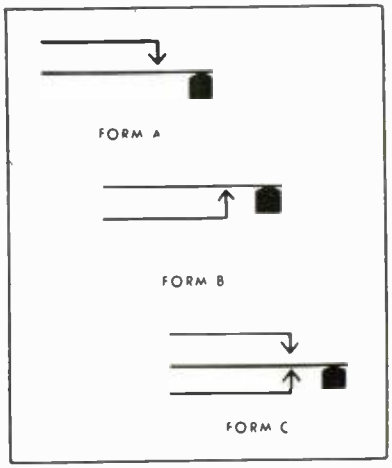


FIG. 1. THREE TYPES ARE AVAILABLE

NEW RELAY FITS SMALL SPACE

A new relay which offers many possibilities to designers of military equipment has been brought out by C. P. Clare and Company, Chicago.

The 6-spring type illustrated here is extremely small, measuring only 1½ by 1¼ by 13/16 in., and weighs approximately 1⅔ ounces. All metal parts are plated to withstand the 200-hour salt spray test for Navy equipment. Insulation is tested against breakdown at 1,000 volts AC.

Any of the three spring arrangements shown in Fig. 1 can be used in combinations up to a total of 12 springs. The contacts provided are either of No. 18 gauge silver, rated at 1 ampere, 50 watts, or No. 18 palladium, rated at 2 amperes, 100 watts.

The assembly is extremely rigid, so as to make these relays able to withstand the shock and vibration of aircraft service. The pile-up screws are tightened under pressure, and are secured into the heel-piece by a coating of Glyptal.

Windings are made to individual specifications, for operation on voltages from 1.5 to 60, DC.

Because of their small size and weight, these relays can be used for many applications where standard relays would not fit.

FIG. 2. UP TO 12 SPRINGS CAN BE USED ON THIS RELAY. OVERALL LENGTH IS 1-½ INS.

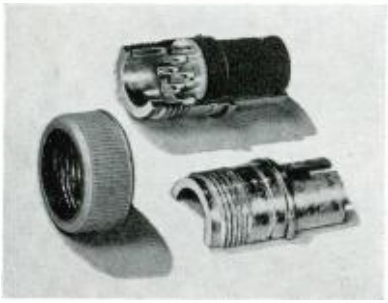
SPOT NEWS NOTES

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

$4,080,000,000: Amount of present unfilled orders for Government radio equipment.

Plastics Data: Celanese Celluloid Corporation has just issued a 64-page book on sheets, rods, tubes, films, molding materials, plasticizers, cements, dopes, and glazing materials. Valuable information, well indexed, covers mechanical and electrical characteristics and data on applications.

Industrial Cork: With ground cork compounds taking the place of cork sheet and rubber in many special radio design applications, the new booklet published by Armstrong Cork Company, Lancaster, Pa., will be found valuable. Check list of different cork compounds, using Neoprene, Thiokol, Buna, and sponge rubber, show characteristics and applications.



New Connectors: Separable cable connectors introduced by Harwood Company, 747 N. Highland Avenue, Los Angeles, feature split-shell socket that eliminates one coupling nut and one barrel. Split construction simplifies and speeds soldering of cable wires. Types range from 10 S to 48. All conform to A-N specs.

Mistake: Contrary to published news items, FM Broadcasters, Inc. has not been dissolved, but continues as the trade association of the FM stations. Confusion resulted from filing of dissolution papers by FM Radio Broadcasting Co., Inc., a New York corporation which applied for an FM license, but later joined with Muzak Radio Broadcasting Station, Inc., operating W47NY.

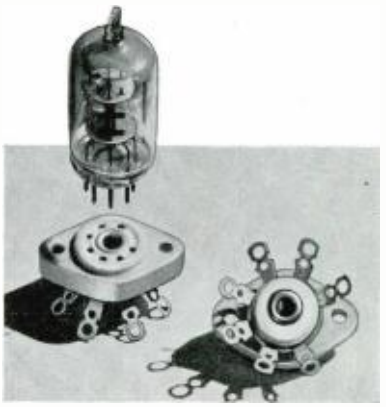
TEAMWORK: Now commissioned as an Ensign, Bill Fleischman, Chicago representative for Radio Electronic Engineering, is at Princeton University, getting ready to take off for parts unknown. However, he will return to the same job when the War is over, for Mrs. Fleischman will carry on his work while he is away.

Marian Fleischman has had an active part in the Chicago advertising and publishing field for the past seven years and now, as a salesman in her own right, she will earn the admiration and respect of the radio-electronic industry in that area. We join her in wishing Bill God-speed and a safe return.

HF Iron Cores: As a result of progress in powdered iron technique, Stackpole Carbon Company, St. Marys, Pa., is now producing molded cores that can be used for frequencies of 150 to 175 mc. Samples of standard shapes and engineering data are available.

Expansion: Increased volume of Signal Corps and Navy contracts necessitate move by Freed Radio Corporation to new factory at 200 Hudson Street, New York City, adjacent to Holland Tunnel Entrance. Change will permit installation of new production machinery, additional laboratory and engineering facilities, and greatly increased space for apparatus assembly. Present production includes FM transmitters and receivers, aircraft radio equipment, measuring instruments, and electronic devices. Company is under the management of Arthur Freed who, with the late Joseph D. R. Freed, established the Freed-Eisemann line of home radios in 1921.

Miniature Ceramic Socket: Bureau of Ships has approved a new socket, of grade



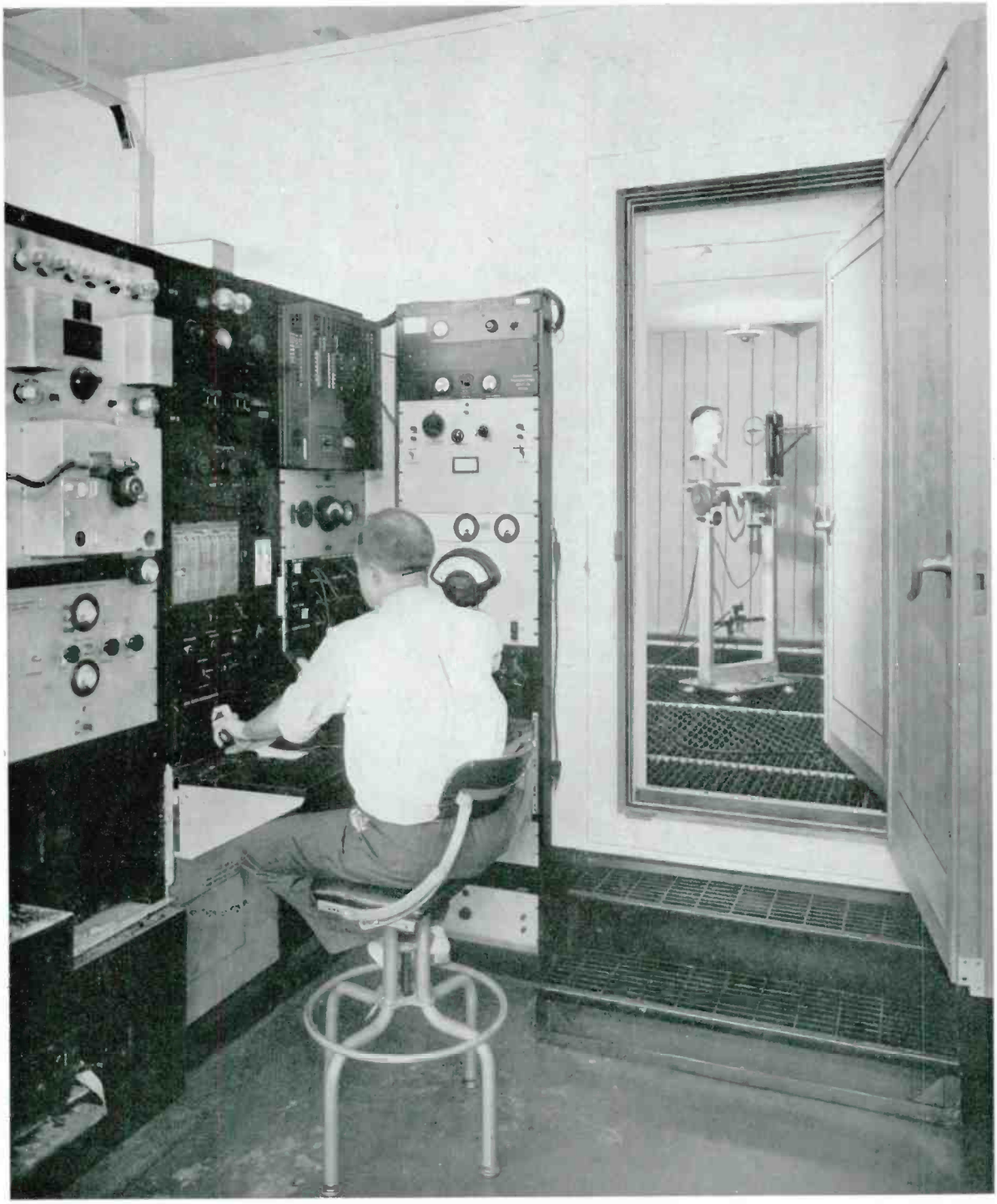
G Steatite, made by E. F. Johnson Company, Waseca, Minn., for 9000 series of tubes, and series 1S4, 1S5, 1T4, and 1R5. Assigned number is CEJ-49401.

High School Radio Training: Thirty-nine states now have U. S. Army Signal Corp civilian training centers for elementary radio instruction in 133 public schools and colleges. Most of the classes are being held in vocational high schools. Only states not represented are Connecticut, Maine, New Hampshire, Rhode Island, Vermont, New Jersey, Michigan, Montana and Nevada. California, with 17 training centers, leads the list.

Screw Data: A 96-page catalog on screws, nuts, and washers, with highly useful technical data for designers, draftsmen, and purchasing agents, is available from Manufacturers Screw Products, 292 W. Hubbard Street, Chicago. Weights, dimensions, and AN specifications are included.

(CONTINUED ON PAGE 27)

NEW CONTINENTAL RADIO PLANT IN CHICAGO HAS 50,000 SQ. FT. OF SPACE



NEWS PICTURE

THE radio telephone equipment used for the history-making transmissions from Arlington, Va., to Paris and to Honolulu in 1915 was a product of Bell Telephone Laboratories research. At that time, the Laboratories were operating as the engineering department of Western Electric Company, at 463 West Street, New York City.

Today, organized as a separate corporation, activities at Bell Labs spread across the whole field of communications research as broadly as the new Murray Hill buildings stretch over their 250 acres of countryside at Summit, N. J. The set-up for one out of the many research projects under way there is illustrated above.

Here, in a highly damped, sound-proof room, the distribution of sound around a model head is being investigated. The elaborate equipment indicates the thoroughness with which research work is carried out at the Murray Hill Unit.

STANDARD U. S. NAVY DRY BATTERIES

THERE are 25 types of dry batteries which have been given standard Navy numbers. Characteristics and dimensions are given in the table below, with scale drawings on the page opposite. It should be noted that type 19026 is drawn to a scale of 1″ = 32″, while all the others are 1″ = 8″.

All the batteries are rectangular in shape except those of which a top view is given. Some of the batteries have sockets for terminals. In these cases, if the socket is on the top of the battery, it is drawn above.

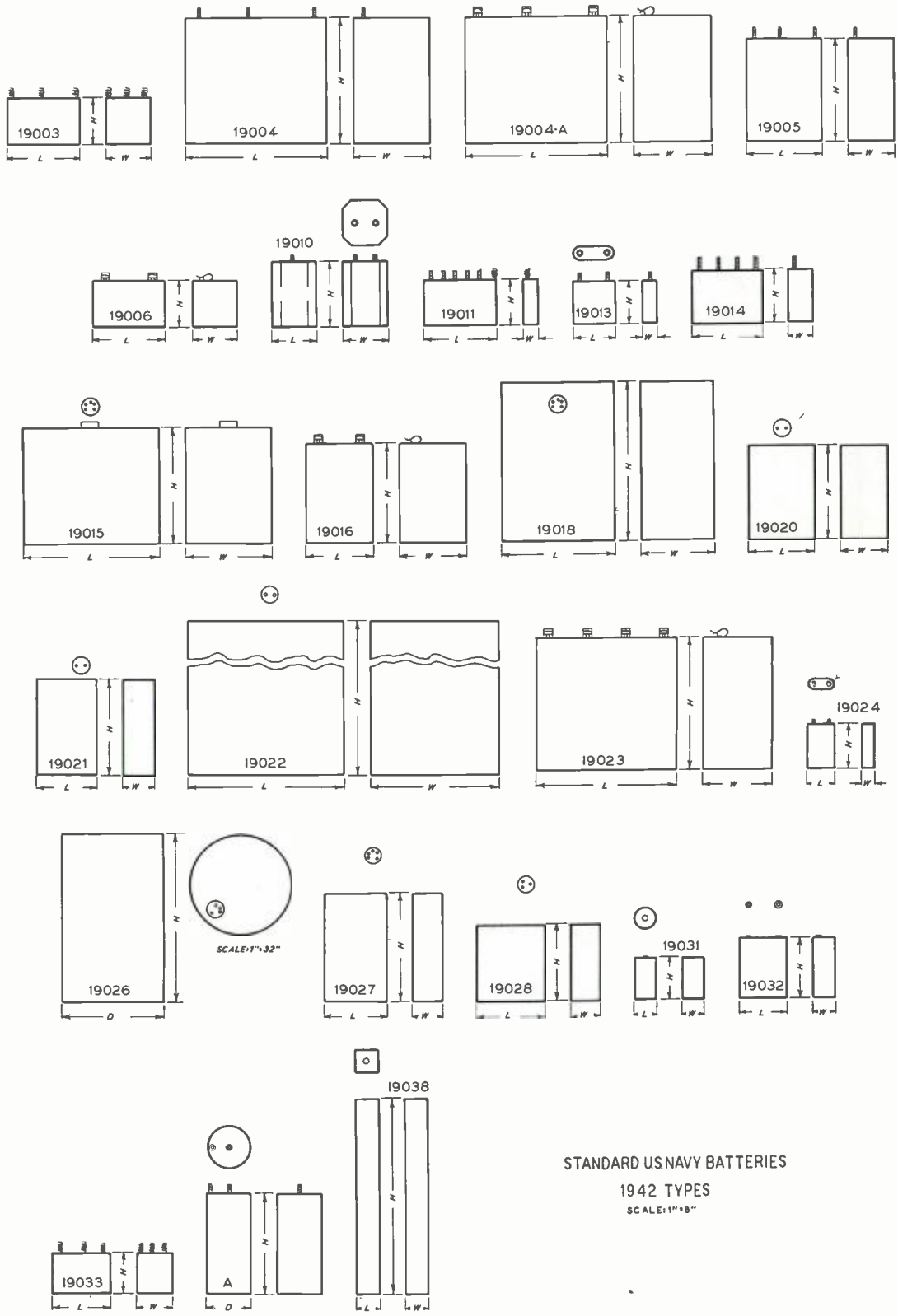
Battery type 19032 has snap terminals, as indicated by the circles above the side view. Since the shapes of the snaps are different, it is impossible to connect them in reverse.

Current practice is strongly against the introduction of any new types of battery packs, for the reason that the present variety should be adequate to meet the requirements of new equipment if packs or batteries now available are combined.

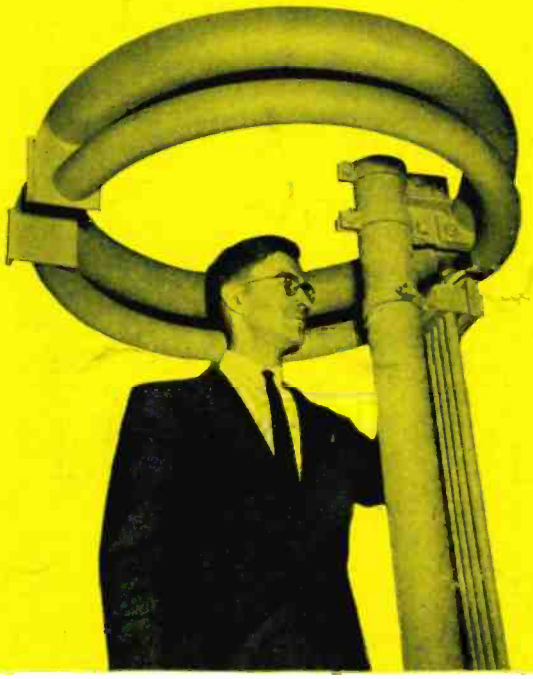
The soundness of this policy is obvious when it is realized that, once a new pack is added to the list, it must be stocked at all Naval stations, and supplies of fresh batteries maintained at all times.

ELECTRICAL AND MECHANICAL DIMENSIONS OF U. S. NAVY BATTERIES, 1942 TYPES

NAVY NO.	EQUIV. S.C.NO.	CLOSURE	TERMINAL VOLTAGE A	B	C	NO. & TYPE OF CELL	NO. & TYPE OF TERMINAL	DIMENSIONS L. OR D.	W.	H.	O.A.H.	WEIGHT LBS.
19003	—	Wax top		− + 12 + 22½		15 No. 5	Three 6-in. Pigtails	4¼	2⅝	2¾	3	1.5
19004	—	Wax top		− + 22½ + 45		30 No. 8	Three Binding Posts	8¼	4½	7⅜	7 15 16	13
19004A	—	Wax top		− + 22½ + 45		30 No. 8	Three Spring Clips	8¼	4½	7⅜	7 15 16	13
19005	BA36	Wax top		− + 22½ + 45		30 No. 5	Three Binding Posts	4⅜	2 11/16	6	6⅝	3
19006	—	Wax tcp		− + 22½		15 No. 5	Two Spring Clips	4¼	2⅝	2¾	3½	1.5
19010	BA35	Paper top	− + 1½			4 No. 9	Two Binding Posts	2⅝	2⅝	3 15 16	4 9 32	1.38
19011	BA34	Wax top			+ − 1½ − 3 − 4½ − 6 − 7½	5 No. 5	One Pigtail Five Binding Posts	4¼	⅞	2¼	3¼	.65
19013	BA31	Wax top			+ − 4½	3 No. 5	Two Binding Posts	2½	⅞	2 9 16	3	.25
19014	BA27	Wax top			+ − 1½ − 3 − 4½	3 No. 2	Four Binding Posts	4 1/16	1½	3 3 16	3 15/16	.88
19015	BA32	Metal can	− + 3	− + 144	+ − 4½ − 13½	6 No. 8 108 No. 5	Five-Contact Socket	8	5	6 13 16	7 7/32	12.5
19016	—		− + 4½				Two Spring Clips	3 59/64	3 15 16	5 7 16	5 15/16	
19018	—	Paper top	± − 1½ − 3	+ 156	− 7½		Five-Contact Socket	6 9 16	9 3 8	4¼		
19020	—	Paper top	− + 6			8 No. 9	Two-Contact Socket	3 13 16	2 21 32	5 11/32		2.5
19021	—	Paper top		− + 45		30 No. 78	Two-Contact Socket	3 9 16	1⅞	5⅝		1.9
19022	—	Paper top	− + 3			96 No. 8	Two-Contact Socket	9⅛	7¼	13⅛		40.5
19023	—	Wax top		− + 22½ + 45 + 59½		33 No. 9	Four Spring Clips	8¼	4 3 32	7 11/16	8 9 32	
19024	—	Wax top			− + 3	2 No. 5	Two Binding Posts	1 19 32	25 32	2 21 32	2 29/32	.25
19026	—	Metal can	− + 7½	− + 300			Four-Contact Socket	25¼		40⅛		
19027	—	Paper top	− + 3	− + 135½	− 6	6 No. 78 90 No. 716	Five-Contact Socket	1¾	3⅝	6⅜		
19028	—	Paper top	− + 3	+ 90		4 No. 5 60 No. 716	Three-Contact Socket	4	1¾	4½		
19031	BA30	Metal jacket	− + 1½			1 No. 2	Flashlight	1 21/64		2 27/64		.21
19032	BA51	Paper top		− + 67½		45 No. 716	Two Snaps	2 11/16	1 5/16	3⅝		.75
19033	BA2	Wax top		− + 22½		15 No. 4	Two Pigtails	3 7/16	2 3/32	2 19/32	2 27/32	1.15
A	BA17	Wax top	− + 1½			1 No. 6	Two Binding Posts	2⅝		6	6½	2.25
19038	BA38	Paper top		− + 103½		69	Flashlight	1 11/32	1 11/32	11½	11⅝	1.2



What do THEY think of FM?



This new antenna by G. E., with circular bays, eliminates the usual complex, costly structure, yet radiates energy uniformly. It is an example of General Electric engineering leadership in FM equipment.

G.E. WENT TO THEM AND FOUND OUT!

AMONG owners of frequency-modulation receivers, a large majority like the quality of FM reception. For example, 85 per cent say it is better than regular broadcast reception, and 91 per cent would recommend it to their friends!

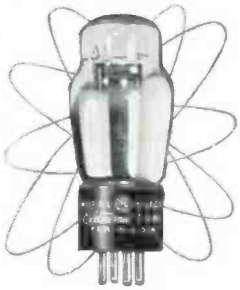
These are facts and figures taken directly from a survey made for General Electric in 14 cities by an independent research organization. Among owners of General Electric FM receivers, the approval registered was even greater.

FM Receivers
NO OTHER

The research organization went directly to private homes for its findings. It sought and obtained answers from both FM and non-FM owners of high, medium, and low cost sets. The answers took on a pattern of telling significance.

Seventy-eight per cent of the non-FM owners rated virtual freedom from static and better tone quality as the outstanding FM advantages. Eighty per cent of FM owners emphasized these same advantages also.

Today G. E. is building FM transmitting and receiving equipment for war purposes only, with the same precision and skill that characterize all of its electronic devices. When peace comes, General Electric FM equipment will be more than ever the best that money can buy! . . . For detailed information on the FM survey, write for booklet, entitled "What the Consumer Thinks of FM," to Radio, Television, and Electronics Department, General Electric, Schenectady, N. Y.



FM Broadcast Apparatus • FM Broadcasting • FM Police Radio • FM Military Radio

MANUFACTURER OFFERS SO MUCH FM EXPERIENCE

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60-AZ-6918

FM 17

DESIGN OF SELENIUM RECTIFIERS

Part 2. Data on the Design of Metallic Plate Rectifiers for Electronic Circuit Applications

BY J. E. YARMACK *

Forced Draft Ventilation Unit ★ The extended current rating of selenium rectifier plates with forced draft or fan cooling and the speed of air constituting the forced ventilation require further consideration. A rather conservative relationship of current rating to air velocity has been established and successfully used for the 4⅜ in. diameter No. 7 plate (Table V).

As an example, let us design a three-phase, full-wave rectifier supplying a DC output of 600 amperes at 6 volts. Because of the low required output voltage, as compared to the full r.m.s. voltage permissible for the No. 7 plate, the center tap circuit is most economical and gives greatest efficiency. With the fan delivering air at a speed of 120 feet per minute, the 7.5-ampere (Table I) loading of this plate can be increased 2.5 times (Table V), thus making it 18.7 amperes per plate. Practical consideration of possible 10% overload suggests that this unit should have 36 plates in parallel for the total current output of the unit. This makes the value N (Fig. 8) equal to 2.22 and the initial and aged dv equal to 1.6 and 2.4, respectively. The total connection of the rectifier is, therefore, 6–1–36. The new V_{ac} for half of the transformer secondary voltage is 6.1 volts and, for the fully aged condition, 6.9 volts. A view of this equipment is shown in Fig. 12.

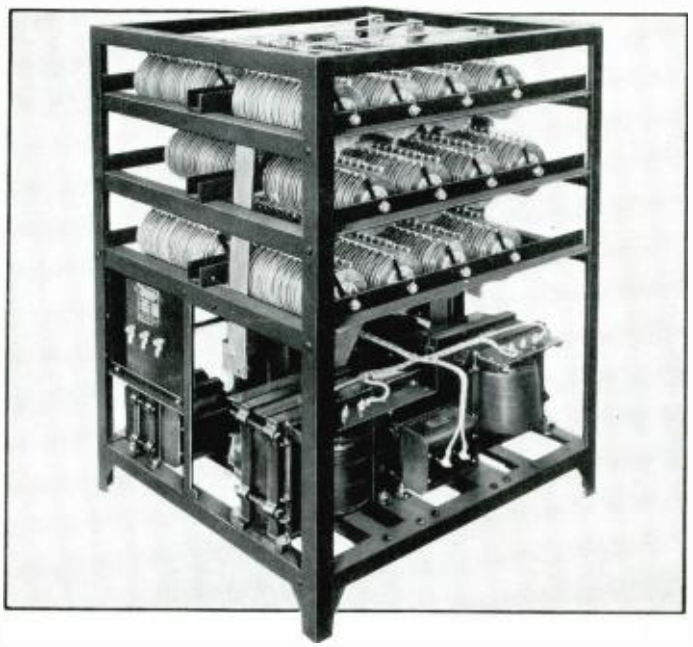


FIG. 10. RECTIFIER WITH 24 STACKS OF 25 PLATES IN PARALLEL FOR 220V., 3-PHASE

Voltage Regulation ★ The inherent voltage regulation of the selenium rectifier is in the neighborhood of 10–20%. In computing the regulation, one must determine the no-load value of dv and then the no-load output voltage. In the case of the first example of a 4-ampere, 16-volt rectifier, the dv value from Fig. 5 is 0.4. The DC output voltage, therefore, at no load is:

$$V_{ac} = \frac{23.6 - 2 \times 2 \times .4}{1.15} = 19.1,$$

$$\text{Regulation} = \frac{19.1 - 16}{16} \times 100 = 19.4\%.$$

Similarly, the regulation of the three-phase, 325-ampere, 13-volt unit (Fig. 10) is computed by reading F_v for N equal to zero in Fig. 8. Substituting 0.3 for the value of dv in formula (3). and taking 11.8 volts for V_{ac}, the no-load voltage is found to be 15 volts, and the voltage regulation is, therefore, 15.4%.

Efficiency ★ The efficiency of selenium rectifiers varies with the type of circuit and the nature of the load. The single-phase circuits with fully loaded plates in respect to voltage and current, when feeding either resistive or inductive loads, give an efficiency of approximately 64%. The same circuits, when used for battery charging, give an efficiency some 14% higher due to the greater value of the rectified voltage. The three-phase circuits give efficiency values in the neighborhood of 83% and, for all practical purposes, remain the same irrespective of the type of load. For all circuits and loads, however, the efficiency of selenium rectifiers increases with decrease of load down to approximately 25% of full value, and thereafter falls off rapidly. The efficiency itself depends on the combined losses in the selenium rectifier from forward and reverse currents, and, in formula form, it is:

$$\frac{V_{dc}I_{dc}}{(V_{dc}I_{dc}) + W_f + W_r} \times 100 = \% \text{ efficiency}, \qquad (8)$$

where W_f are losses due to forward current and W_r are losses due to the reverse current.

The computation of exact efficiency for all sizes of plates. and various loads and circuits is rather involved and constitutes an extensive subject in itself.

In order to illustrate the simplified method of efficiency computation and the effect of dv changes on its value, let us compute the efficiency of the 325-ampere, 13-volt, three-phase unit illustrated in Fig. 10.

Forward losses per plate in the three phase bridge circuit are

$$w_f = \frac{\sqrt{2}I_{dc}dv}{3},$$

where $\sqrt{2}$ is a conversion factor for approximating the peak value of the AC wave in terms of effective value of dv. Divisor 3 results from the fact that in the three-phase bridge circuit each plate is utilized $2 \times 1/6$ times in each cycle. Accordingly, when the values above are substituted in the formula for forward losses:

$$w_f = \frac{325/100 \times \sqrt{2} \times 1.07}{3} = 1.64$$

watts per plate, or $W_f = 6 \times 100 \times 1.64 = 984$ watts for all 100 plates in six arms.

The reverse losses are approximately one third of forward losses computed for the normal rating of the plate used in this unit:

$$W_r = \frac{1}{3} \times \frac{6 \times 100 \times .8 \times \sqrt{2} \times 1.8}{3} =$$

136 watts.

The new input wattage W, therefore, is:

$$W = (I_{dc} \times V_{dc}) + W_f + W_r$$

$$= (325 \times 13) + 984 + 136 = 5345 \text{ watts.}$$

$$\text{Efficiency} = \frac{4225}{5345} \times 100 = 79.2\%.$$

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

FIG. 11. SELENIUM RECTIFIER USED TO OPERATE TELAUTOGRAPH EQUIPMENT

Similarly, assuming a possible 50% change in *dv*, the efficiency of this rectifier with stacks fully aged is computed as 72%.

The foregoing designs illustrate the importance of the quantity *dv*, which is dependent on the forward resistance and current density of the plates as well as the ambient temperature under operating conditions. Its changing values under varying conditions greatly influence the efficiency, regulation, and aging of selenium rectifiers. The ambient temperature and current density relationships affecting the value of *dv* are illustrated in Fig. 13. The arrows on the curves indicate that the resistance of the plates decreases with increase of temperature. As the plates cool off the resistance again increases, and *dv* is greater at the new lower temperatures than during the rising temperature phase of the heating cycle. This phenomenon diminishes with lower current densities to a point where the resistance is the same at corresponding temperatures of the heating and cooling portions of the cycle.

Ambient Temperature of 35° C. and Above ★ Almost invariably more than one selenium plate type appears suitable for given output requirements. The type of circuit or nature of loading as well as the cost, however, restricts the choice.

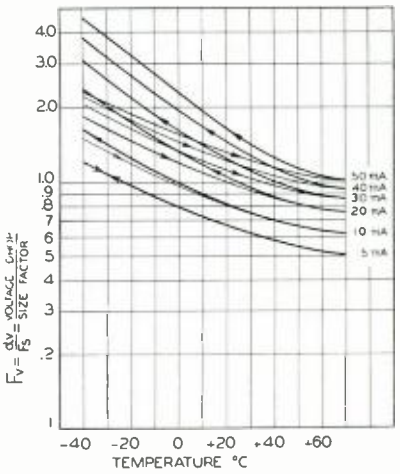


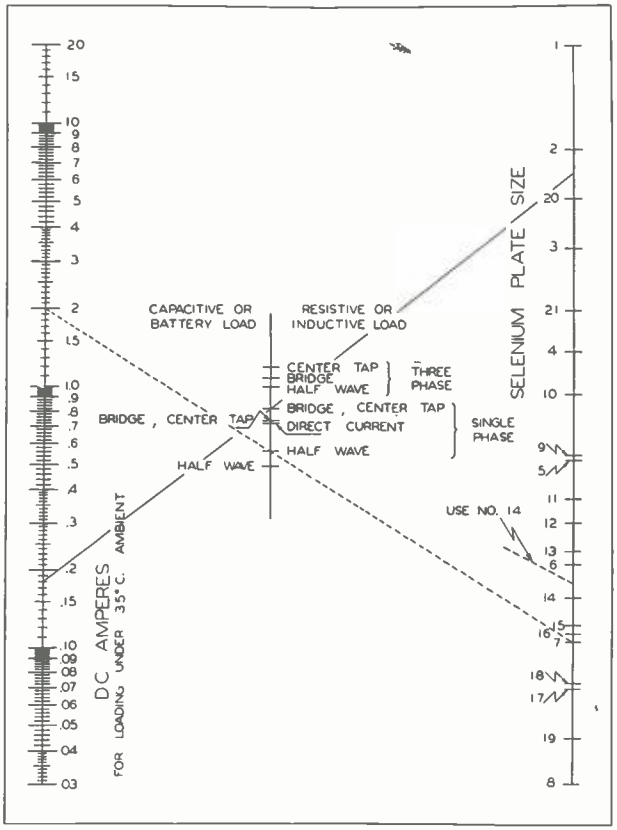
FIG. 13. FV AT VARYING CURRENT DENSITIES AGAINST AMBIENT TEMPERATURE

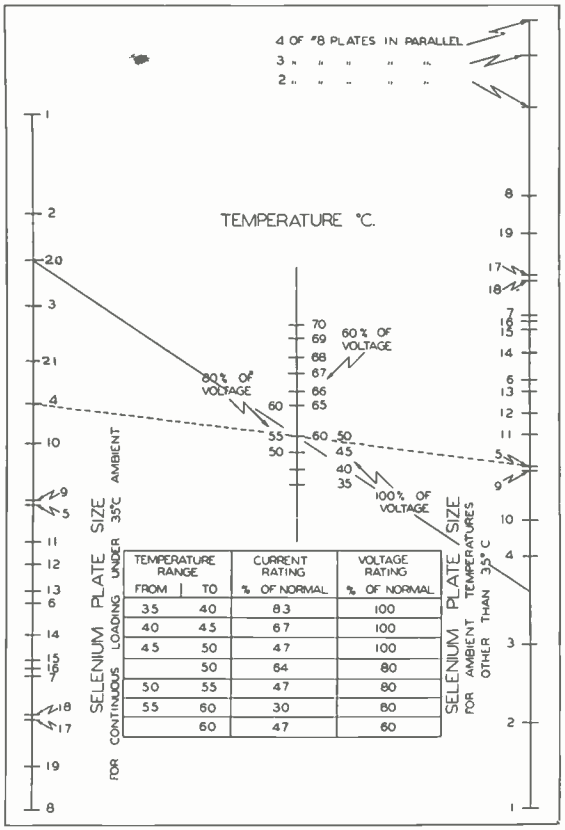
The Alignment Chart (Fig. 14) has been found useful in selecting plate types for specified output currents. If a straight

TABLE V *

Multiplying Factor for Normal Plate Ratings, k_3	1	1.5	2	2.5	3	3.5	4	4.5
Air Speed in Ft. per Minute	0	60	90	120	160	200	310	400
Cubic Feet per Minute per Plate	0	.5	.8	1.1	1.4	1.7	2.8	3.7

* Relation of factor k_3 by which normal rating of No. 7, i.e. 4¾ diameter selenium plates can be increased, and the speed and amount of air necessary.





TEMPERATURE RANGE FROM	TO	CURRENT RATING % OF NORMAL	VOLTAGE RATING % OF NORMAL
35	40	83	100
40	45	67	100
45	50	47	100
	50	64	80
50	55	47	80
55	60	30	80
	60	47	60

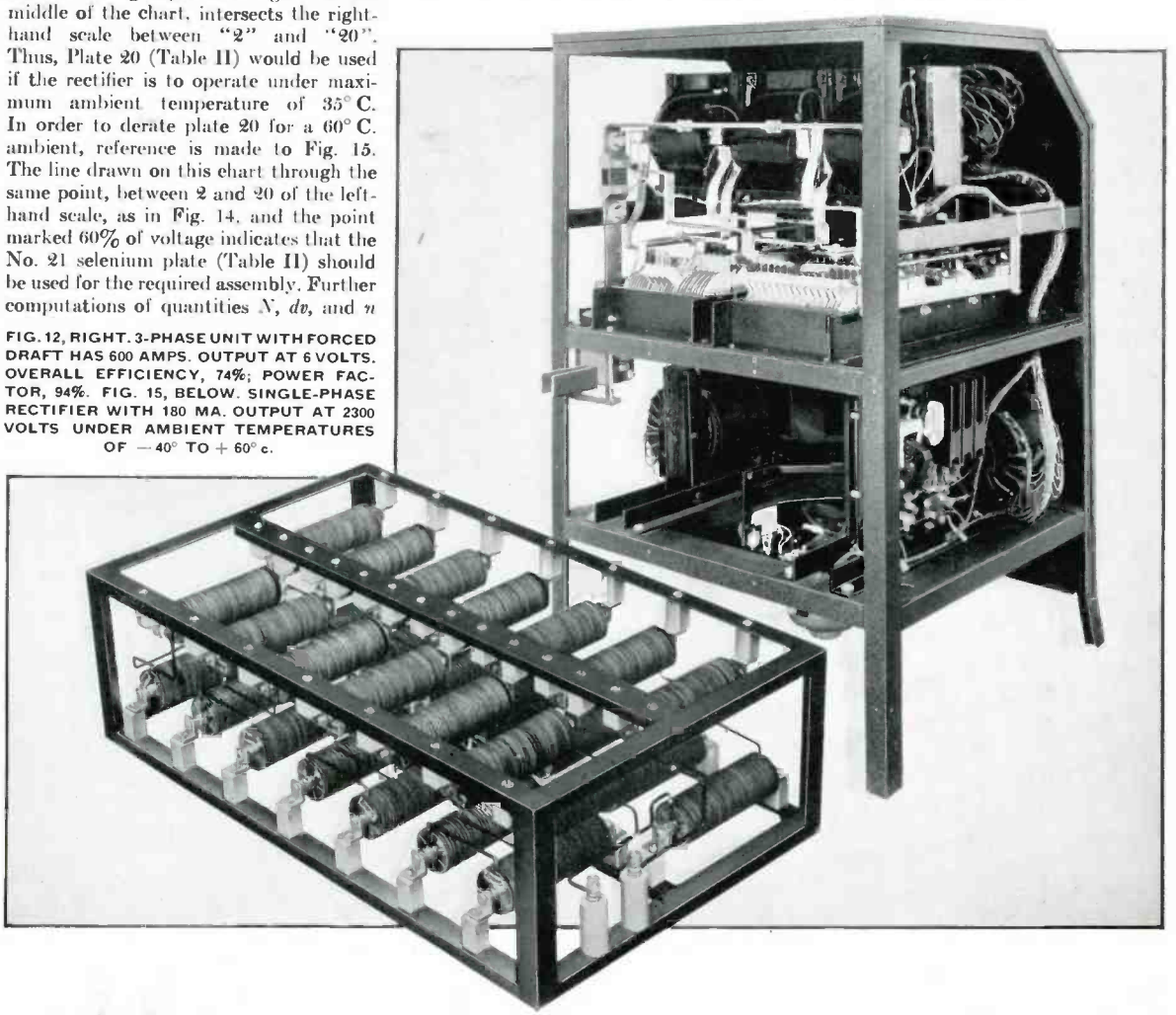
FIG. 14, LEFT. RECTIFIER TYPE FOR GIVEN OUTPUT, LOAD, AND CIRCUIT. FIG. 15, RIGHT. RELATION TO AMBIENT TEMPERATURE

edge is laid connecting the required direct current output with the type of circuit and the nature of load, the intersection of the straight edge on the plate size scale gives the type number of the required rectifier plate. If the intersection falls between two plate type numbers, the plate having the higher current rating should be chosen.

For ambient temperatures higher than 35° C., the plate type number for a 35° C. ambient should first be found. Referring to Fig. 15, a straight edge connecting the 35° C. ambient temperature plate type number with the desired higher ambient value of the temperature scale intersects the right-hand scale, indicating the required higher ambient plate type number. Again, if the intersection is between two plate type numbers, the plate type number with the higher current rating should be used. It will be noted that, by decreasing the voltage rating, a small increase in current rating is allowable.

As an example, let us design a high-voltage, low-current rectifier of the type illustrated in Fig. 16 for either resistive or inductive load. Referring to Fig. 14, the line drawn through the 0.18 reading on the left-hand scale, and the point marked "single phase bridge" in the middle of the chart, intersects the right-hand scale between "2" and "20". Thus, Plate 20 (Table II) would be used if the rectifier is to operate under maximum ambient temperature of 35° C. In order to derate plate 20 for a 60° C. ambient, reference is made to Fig. 15. The line drawn on this chart through the same point, between 2 and 20 of the left-hand scale, as in Fig. 14, and the point marked 60% of voltage indicates that the No. 21 selenium plate (Table II) should be used for the required assembly. Further computations of quantities N, dv, and n result in the design of a rectifier with total connections of 4–224–1, arranged in 28 stacks, each consisting of 32 1⅜" plates in series.

FIG. 12, RIGHT. 3-PHASE UNIT WITH FORCED DRAFT HAS 600 AMPS. OUTPUT AT 6 VOLTS. OVERALL EFFICIENCY, 74%; POWER FACTOR, 94%. FIG. 15, BELOW. SINGLE-PHASE RECTIFIER WITH 180 MA. OUTPUT AT 2300 VOLTS UNDER AMBIENT TEMPERATURES OF −40° TO + 60° c.



Bibliography ★ This article is based on a paper presented at meetings of the A.I.E.E., Southwest District, Oct. 10, 1941, and Northeast District, May, 1942. See Electrical Communication, Vol. 20, No. 4.

1. "Selenium Rectifier Characteristics, Application and Design Factors," by C. A. Clarke, *El. Com.*, Vol. 20, No. 1, 1941.
2. "Selenium Rectifiers for Closely Regulated Voltages," by J. E. Yarmack, *El. Com.*, Vol. 20, No. 2, 1941; *Electronics*, Sept., 1941.
3. "The Characteristics and Applications of the Selenium Rectifier," by E. A. Richards, *Journal I.E.E.*, Vol. 88, Part II, No. 5, October, 1941.
4. "Le Redresseur au Sélénium et ses applications dans la technique des courants faibles," by E. Frey, *Bul. Technique*, Berne, No. 5, 1941.
5. "Some Industrial Applications of Selenium Rectifiers," by S. V. C. Scruby and H. E. Giroz, *El. Com.*, Vol. 17, No. 4, 1939.
6. "Rectifier Power Plant for Transmission Systems," by R. Kelly, *El. Com.*, Vol. 18, No. 1, 1939.
7. "Selenium Rectifier for Signaling," by J. E. Yarmack and C. G. Howard, *Railway Signaling*, Vol. 32, No. 12, December, 1939.

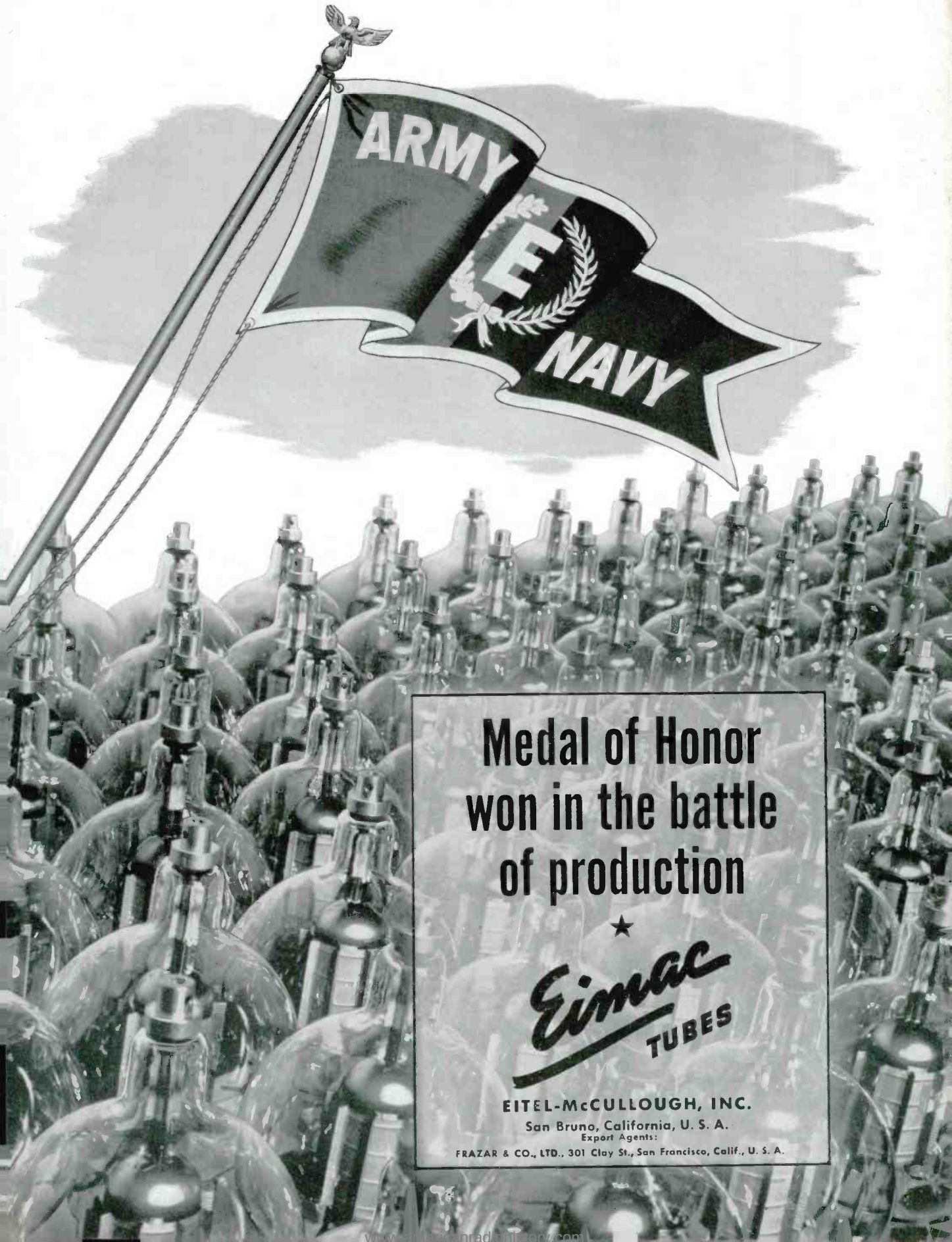
BOOK REVIEW

Plastics, by J. H. Dubois. 291 pages, 31 illustrations, 37 tables, cloth bound, 8½ by 5⅝ ins. Published by American Technical Society, Drexel Avenue at 58th Street, Chicago, Ill.

To say that the author has covered the subject of plastics thoroughly sounds trite, but the statement is borne out by the fact that 15 pages are required to index the information presented in this book.

The 14 chapters cover phenolic plastics; urea or amino plastics; cellulose plastics; acrylic, vinyl, and styrene plastics; cast phenolic and protein plastics; other plastic materials; cold-molded plastics and shellac; laminated plastics; compression and transfer molding; injection molding and continuous extrusion; finishing and decorating plastic products; design of molded products.

J. H. Dubois is well qualified as an authority on the subject of plastics, because of his long association with General Electric's plastics department. Anyone concerned with molded products will find much useful information and data in this volume, covering the latest techniques of materials and methods.



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AIRCRAFT IGNITION SHIELDING

(CONTINUED FROM PAGE 7)

ation, but such interference will be more severe when the airplane is operated in bad weather where potential gradients are irregular, such as are encountered in thunderstorm areas. Where the airplane passes into gradient levels of widely varying potential, the metallic structures are trying at all times to equalize their electrostatic charges with that of the surrounding atmosphere.

Under these circumstances, a large mass of metal may assume a charge greater than a lesser mass. In their attempts to equalize their own potentials, a flow of current results with attending spark discharges, if the path is one of high resistance. The disturbance created by such spark discharges is small, but the interference thus generated is easily equal in field intensity at the receiving antenna to that of the signal to which the receiver is tuned, and may prevent reception of the desired signal.

In addition, transmitters require a highly tuned resonant circuit utilizing a balance between the structure of the aircraft and the antenna circuit proper. It can readily be seen, therefore, that the varying resistance of improperly bonded aircraft parts can upset the necessary balance, thus bringing about unsatisfactory operation of the transmitter system.

Bonding must be frequent even on long lengths of continuous metal such as a length of conduit. Thus the potential gradient of any unit length of such conduit is maintained close to that of ground. Were the potential allowed to exceed a safe value, such a length of conduit might resonate at the transmitter frequency, making two-way communication difficult. It is highly important that these high absorption factors be eliminated.

Bonding contributes an additional benefit quite apart from any considerations based on communications. This is its effect on slowing down the process of electrolytic corrosion. There is a tendency for a free element to pass into solution as an ion, and the relative tendency of the metals to form ions has been set down in what is known as the electromotive series. The rate at which an ion passes into solution is greater for acid and salt solutions, such as sea water, than some other fluids. This rate is further increased under the pressure of different potential gradients. Thus bonding effectually reduces the rate of such corrosion. Years ago, before the general use of bonding, instances occurred where metal aircraft only a few months old were pronounced unsafe for flying, due to the severity of this condition.

It may be interesting to know how accurately the foregoing interference considerations can be determined by engineering computations. Bluntly and in few words: "Not at all." It is true that attempts are made, and indeed preliminary work is necessary, if the job is to be started on the right foot. However, the last analysis must be the experimental testing of an actually complete installation.

Men responsible for shielding and bonding projects need not be concerned over this state of affairs, however. After all, simple airframes are still being proof-tested and sometimes with results that redden the faces of responsible engineers. The field of radio communications is still a relatively new field in its potential possibilities.

The only satisfactory practice is to shield completely all electrical equipment and associated wiring throughout the aircraft and then to bond everything properly. It is better to start with a complete job and let experimentation dictate the removal of unnecessary shielding and bonding in terms of the degree of efficiency desired.

All generators must be filtered by connecting by-pass condensers from the positive to the negative terminals as close to the generators as possible. Under certain conditions a certain amount of interference is radiated through the ignition booster coil. If a flight test indicates that this condition is present, it can be corrected by placing a condenser from the positive low-voltage terminal to ground.

After the complete installation has been made, the shielding effectiveness can then be determined only by operating the receiver and transmitter with the aircraft in actual flight under the varying conditions to be met in service. Such a flight test should be conducted somewhat along the following lines:

1. All radio equipment must be complete and in operating condition.

2. With the airplane in flight, engines must be run at normal cruising speed.

3. Receivers should be adjusted for maximum sensitivity and tuned for maximum response in the most sensitive portions of the bands. Receivers should not be tuned to any signal during this test, as signals of high level tend to override and thus minimize interference.

4. The main line switch or circuit breaker should be in the "on" position.

5. All electrical apparatus within the airplane should be operated either independently or simultaneously.

Should interference occur, a probe antenna should be used to locate the source. For locating electro-magnetic fields, the loop probe should be used; and for electrostatic fields, it is best to use a straight wire. When the ignition system is suspected of creating noise, exact determination can be made in the following manner:

With the receiver adjusted for maximum sensitivity and detuned from any signal, the observer should listen carefully for any form of interference prior to starting the engine. Assuming none present, the engine is then started and when idled it should be switched from one magneto to the other. Should only one magneto give quiet operation, the other, with its set of plugs, is the offender. With the noisy combination in operation, if the interference occurs once during a revolution, there is a leak at one spark plug; or if continuous, the trouble is associated with the magneto. If interference is found only at higher engine speed, the generator is probably at fault. As a check on the generator, the field switch should be operated "off" and "on."

From the foregoing, it can be seen that shielding and bonding are not an incidental consideration, but rather are complicated and complex in design and functioning. Solving the problems is hard work, not readily appreciated by those whose interest really begins after the job has been done successfully.

FM for Aircraft Communication

THIS analysis of man-made radio interference on aircraft, which J. J. Mascuch has so ably presented, may be a highly effective argument for the use of FM vs. AM for aircraft communications.

In 1941, General Electric Company conducted a series of tests on the comparative efficiency of FM and AM equipment for plane to ground communication. The results were highly favorable to FM. These tests were not specifically concerned with electrical interference.

No further data has been released on this subject from any source. However, it is known that some engineers believe there should and will be a general shift from AM to FM for post-war aircraft radio.

The use of FM would probably not eliminate the need for ignition shielding, but it would minimize the effect of failures in the shielding system. These, as Mr. Mascuch pointed out, are most liable to occur under conditions when radio communication is most needed.

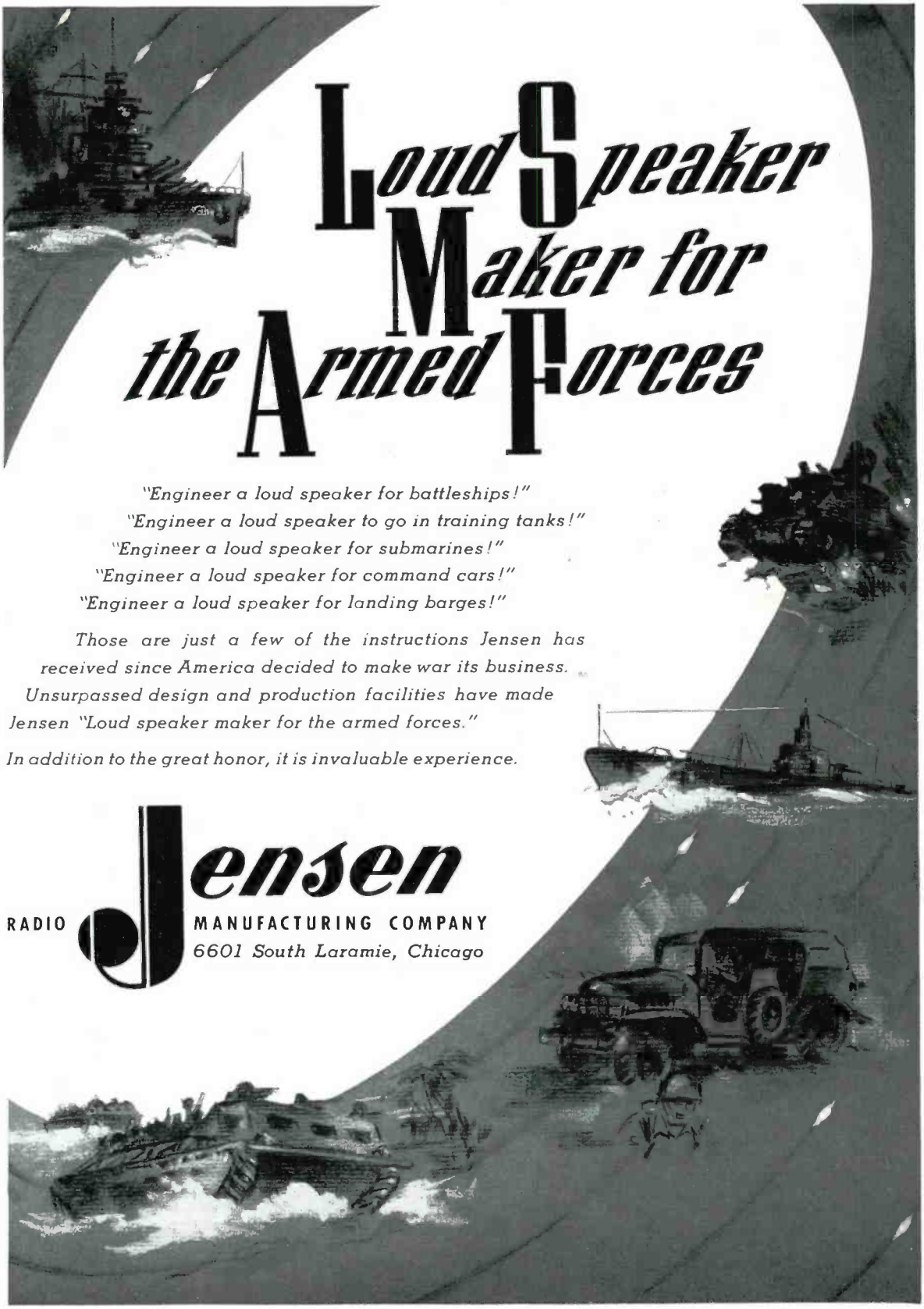
It seems probable that experience now being gained under War conditions will lead to the adoption of FM as soon as the conversion can be effected. — Editor

ENGINEERING IN WORLD WAR 2

(CONTINUED FROM PAGE 8)

In any case, the rating sheet reproduced here, used for self-examination, enables any engineer to analyze his special abilities, to the end that he can determine the kind of work for which he is best fitted, and to which he can contribute most effectively.

A request for advancement or transfer to another department, supported by ratings from his associates and his immediate superior on such a form as this, would carry far more conviction than a request in the form of a complaint over his present status.



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★ Lingo & Son, John E., Camden, N. J.
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Littlefuse, Inc., 4753 Ravenswood, Chicago
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ADDITIONS THIS MONTH

25 New Items Are Listed

110 New Names Have Been Added

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.

BOOK REVIEW

AIRCRAFT ELECTRICITY, by Lieut. Norman J. Clark and Howard E. Corbitt. 350 pages, 202 illustrations and charts, cloth bound, 6¼ by 9¼ ins. Published by The Ronald Press, 15 East 26th Street, New York City. Price $3.50.

Radio engineers in the employ of civilian contractors producing aircraft radio equipment seldom have the benefit of operating the apparatus they design under actual flying conditions. It is rare that they even see the products of their work installed in planes. Except in unusual situations, their knowledge of aircraft radio equipment is obtained second-hand during conferences with Government engineers whose activities are confined largely to the laboratories.

As a result, civilian engineers have little opportunity to become acquainted with aircraft methods and practices, the general technique of design and installation, and the related electrical equipment used in planes.

To these men, Messrs. Clark and Corbitt, in their new book, have made an important contribution. Lieut. Clark, U.S.N.R., was electrical engineer at Lockheed Aircraft, and Howard Corbitt is electrical engineer for Lockheed Overseas Corporation, so that they are in a position to write from first-hand knowledge.

Their book contains three classes of information: 1) photographs and drawings of electrical and radio equipment and installation methods, 2) dimension drawings and data on standard parts such as connectors, conduit fittings, and electromechanical equipment and, 3) curves and formulas for determining various design characteristics.

PROTECTING STEEL PARTS AGAINST SALT-WATER CORROSION

THE following letters shed further light on the very important matter of protecting steel parts from corrosion under conditions of military service:

To the Editor,

The article entitled "New Radio Electronic Design Practice," Pages 15 and 22, October, 1942, issue of RADIO-ELECTRONIC ENGINEERING, has been read with interest.

Particular note has been taken of the third paragraph under the sub-heading entitled "Corrosion Due to Rust," page 22, wherein it is suggested that enamel or wrinkle finishes are not adequate to prevent rust and that all parts finished in such manner "must have a foundation of cadmium followed by a primer coat of zinc chromate, on which the wrinkle finish is applied."

The writer has had occasion to specify and supervise the application of a number of different finishes of this character. He believes that zinc chromate primer will not adhere properly to cadmium plate and consequently may not be applied between cadmium plating and a final baked-on finishing lacquer.

This matter was recently checked with Pittsburgh Plate Glass Co., Sherwin-Williams Paint Co., and Murphy Varnish Co., and it was determined that no one of these sources could supply a zinc chromate primer guaranteed to have proper adherence when applied to a cadmium-plated metal surface. It is believed that zinc chromate primer may be applied to a copper-plated surface or to a properly cleaned steel surface.

It is likewise believed that no generally available zinc chromate primer can be applied to a cadmium-plated surface with any expectation that it will do other than flake off in very short order.

It is the writer's respectful belief that a correction of what is believed to be an unquestionably inadvertent error might advantageously be passed on to RADIO-ELECTRONIC ENGINEERING readers, some of whom may learn to their distress that commercial zinc chromate primers are unsuitable for application to cadmium-plated surfaces as primers.

Cordially,

McMURDO SILVER, *Vice President*,
Special Equipment Division
Fada Radio and Electric Company, Inc.
Long Island City, N. Y.

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
Avia Products Co., 737 N. Highland Ave., Los Angeles
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.
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.

GENERATORS, Standard Signal
Boonton Radio Corp., Boonton, N. J.
Ferris Instrument Co., Boonton, N. J.
General Radio Co., Cambridge, Mass.
Measurements Corp., Boonton, N. J.

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

HEADPHONES
Brush Development Co., Cleveland, O.
Conn. Tel. & Electric Co., Meriden, Conn.
Carrier Microphone Co., Inglewood, Cal.
Cannon Co., C. F., Springwater, N. Y.
Carron Mfg. Co., 415 S. Aberdeen, Chicago
Chicago Tel. Supply Co., Elkhart, Ind.
Connecticut Tel. & Elec. Co., Meriden, Conn.
Elec. Industries Mfg. Co., Red Bank, N. J.
Kellogg Switchboard & Supply Co., 6650 S. Cicero Av., Chicago
Murdock Mfg. Co., Chelsea, Mass.
Telephonics Corp., 350 W. 31 St., N. Y. C.
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.
Johnson Co., E. F., Waseca, Minn.
Lapp Insulator Co., Inc., Leroy, N. Y.

IRON CORES, Powdered
Crowley & Co., Henry L., West Orange, N. J.
Gibson Elec. Co., Pittsburgh, Pa.
Mallory & Co., P. R., Indianapolis, Ind.
Stackpole Carbon Co., St. Marys, Pa.
Western Electric Co., 195 Broadway, N. Y. C.
Wilson Co., H. A., Newark, N. J.

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

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

KEYS, Telegraph
Bunnell & Co., J. H., 215 Fulton St., N. Y. C.
Signal Electric Mfg. Co., Menominee, Mich.

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

LABELS, Removable
Avery Adhesives, 451 3rd St., Los Angeles

LABELS, Stick-to-Metal
Ever Ready Label Corp., E. 25th St., N. Y. C.

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

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

LUGS, Solderless
Aircraft Marine Prod., Inc., Elizabeth, N. J.

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.

MARKERS, Wire Identification
Brand & Co., Wm., 276 4th Ave., N. Y. C.

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

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

METERS, Vibrating Reed
Biddle, James G., 1211 Arch St., Philadelphia
Triplett Elec. Inst. Co., Bluffton, O.

MICA
Brand & Co., Wm., 276 Fourth Av., N. Y. C.
Insulation Mfgrs. Corp., 565 W. Wash. Blvd., Chicago
Macallen Co., Boston, Mass.
Mica Insulator Corp., 196 Varick, N. Y. C.
New England Mica Co., Waltham, Mass.
Richardson Co., Melrose Park, 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
★ General Electric Co., Schenectady, N. Y.
General Radio Co., Cambridge, Mass.
RCA Mfg. Co., Camden, N. J.

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

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

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

NICKEL, Sheet, Rod, Tubes
Whitehead Metal Prod. Co., 303 W. 10th St., N. Y. C.

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

OVENS, Industrial & Laboratory
★ General Elec. Co., Schenectady, N. Y.
Trent Co., Harold E., Philadelphia

PILOT LIGHTS
Alden Prods. Co., Brockton, Mass.
Amer. Radio Hardware Co., Inc., 467 B'way, N. Y. C.
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.
Hersog 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.
Rothard Mfg. Co., N. 9th Ave., Springfield, Ill.
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.

PLASTIC, Sheet for Name Plates
Mica Insulator Co., 200 Varick St., N. Y. C.

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.

PLASTICS, Transparent
Celanese Celluloid Corp., 180 Madison Ave., N. Y. C.
du Pont de Nemours & Co., E. I., Arlington, N. J.
Rohm & Haas Co., Washington Sq., Philadelphia

PLUGS (Banana), Spring Type
Eastman Kodak Co., Rochester, N. Y.

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

PLUGS, Telephone Type
Alden Prods. Co., Brockton, Mass.
American Molded Prods. Co., 1753 N. Honore, Chicago
Chicago Tel. Supply Co., Elkhart, Ind.
Guardian Elec. Mfg. Co., 1627 W. Walnut, Chicago
Insuline Corp. of Amer., Long Island City, N. Y.
Johnson Co., E. F., Waseca, Minn.
Jones, Howard B., 2300 Wabansia Av., Chicago
Mallory & Co., Inc., P. R., Indianapolis, Ind.

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

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.

PROTECTING STEEL PARTS AGAINST SALT-WATER CORROSION

(CONTINUED FROM PAGE 25)

To the Editor,

Several days ago, Mr. McMurdo Silver, of Fada Radio and Electric Company, Inc., sent us copy of letter he wrote you, with respect to the use of Zinc Chromate Primer over Cadmium Plate.

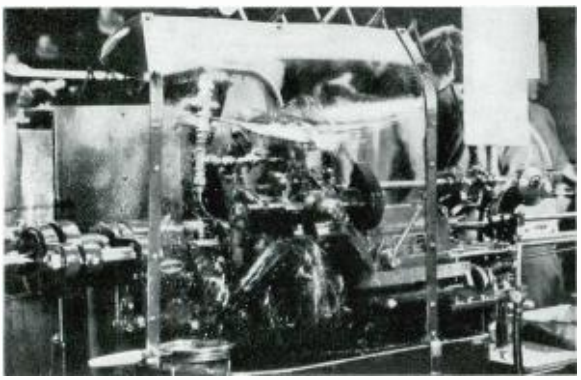
We wish to confirm his statement.

Cadmium plate is a most precarious surface from the standpoint of adhesion. While adhesion over it can be improved if the cadmium-plated part is boiled in caustic soda solution, even this will not give anything like an ideal result, and the practice would obviously not be possible or advisable in many instances of production, or nature of the parts.

In our experience, this extra and somewhat hazardous method has been the only approach to bettering the normally indifferent properties of adhesion.

Trusting that this comment may be of value, we are

Very truly yours,
PAUL KENNEDY, *Vice President*
Murphy Varnish Company
Newark, N. J.



CRYSTAL-CLEAR LUMARITH PLASTIC, WIDELY USED FOR VARIOUS RADIO DESIGN APPLICATIONS, SERVES AS OIL SHIELD ON THIS SCREW MACHINE AT KOLLSMAN INSTRUMENT CO.

SPOT NEWS NOTES

(CONTINUED FROM PAGE 12)

Yankee Net Sold: General Tire & Rubber Company, Akron, Ohio, has concluded a deal to purchase Yankee's four AM and two FM stations. Application has been made to the FCC for permission to make the transfer. John Shepard, 3rd, will continue as manager under 5-year contract.

Thomas H. Corpe: New sales manager of Elastic Stop-Nut Corporation is former assistant general sales manager of Lockheed Aircraft Corporation.

Military Contracts: For radio equipment are being adjusted to changing requirements and to production schedules of related material. This has resulted in cancellations and extended deliveries on some items, but with new contracts being awarded, the backlog of the industry is increasing. Encouraging fact is that these adjustments are chiefly the result of shift from defensive to offensive warfare by United Nations.

Miniature Motor: Weighing only 6 ounces and measuring 1 by 1 by 2 ins. is being produced by Delco Appliance Division of General Motors, Rochester, N. Y. Designed and lubricated for high altitudes at −50°, it is adaptable to many remote-controlled mechanisms. Speeds range from 5,000 to 12,000 RPM, operating on 6, 12, or 24 volts DC.

Machining Aluminum: Data in everyday use concerning aluminum alloys and methods of machining, drilling and threading are given in a new 48-page book available from the Aluminum Company of America, Pittsburgh. Included is information on automatic screw machine practice for the three alloys most commonly used, and data on the characteristics of commercial alloys.

Lt. William Eddy: Seems to have stirred up much comment by his remarks about FM in the course of a talk before a Chicago trade association meeting. He expressed the opinion that the importance of FM has been over-rated, and that when manufacturers build sets responsive to a wider audio range, standard AM broadcasting will sound practically as good as FM. Important point missed by Lt. Eddy is that the public, as well as the Army, Navy, and police, find the greatest advantage of FM lies in elimination of noise, to which AM sets are made still more responsive if audio range is widened.

Radio Data: In a pocket-size edition, Allied Radio Corporation, Chicago, has published a collection of formulas and data most frequently used by radio engineers, designers, and draftsmen. A copy will be sent without charge to those writing for it on their company letterheads.

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

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

RELAYS, Time Delay
Haydon Mfg. Co., Inc., Forestville, Conn.
Industrial Timer Corp., Newark, N. J.
Sangamo Elect. Co., Springfield, 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, Flexible
Clarostat Mfg. Co., Inc., Brooklyn, N. Y.

RESISTORS, Variable
★ Aerovox Corp., New Bedford, Mass.
Allen-Bradley Co., Milwaukee, Wis.
Amer. Instrument Co., Silver Spring, Md.
Atlas Resistor Co., N. Y. C.
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
Hardwick, Hindle, Inc., Newark, N. J.
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.

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.
Pheoli Mfg. Co., Chicago
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Mfg. Co., Waterbury, Conn.
Shakeproof, Inc., 2501 N. Keeler Av., Chicago
Southington Hardw. Mfg. Co., Southington, Conn.
Standard Pressed Steel Co., Jenkintown, Pa.
Whitney Screw Corp., Nashua, N. H.

SCREWS, Self-Tapping
American Screw Co., Providence, R. I.
Central Screw Co., 3519 Shields Av., Chicago
Continental Screw Co., New Bedford, Mass.
Federal Screw Prod. Co., 224 W. Huron St., Chicago
Parker-Kalon Corp., 198 Varick, N. Y. C.
Republic Steel Corp., Cleveland, O.
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
Emby Prods. Co., Inc., 1800 W. Pico Blvd., Los Angeles
Federal Tel. & Radio Corp., S. Newark, N. J.
★ Benwood Linze Co., St. Louis, Mo.

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

SHEETS, Electrical
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

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

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
Johnson Co., E. F., Waseca, Minn.
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
Cinaudagraph Speakers, Inc., 3911 S. Michigan Ave., Chicago
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.

STAMPINGS, Metal
Goat Metal Stampings, Inc., 314 Dean St., Brooklyn, N. Y.
Insuline Corp. of Amer., Long Island City, N. Y.

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

SWITCHES, Aircraft Push
Square D Co., Kollsman Inst. Div., Elmhurst, N. Y.

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

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

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

SWITCHES, Rotary Gang, Ceramic Wafer
Oak Mfg. Co., 1267 Clybourn Ave., Chicago
Ohmite Mfg. Co., 4835 Flournoy St., Chicago
Shallcross Mfg. Co., Collingsdale, Pa.

SWITCHES, Time Delay
Haydon Mfg. Co., Inc., Forestville, Conn.
Industrial Timer Corp., Newark, N. J.
Sangamo Elect. Co., Springfield, Ill.

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

TEST CHAMBERS, Temperature, Humidity, Altitude
Kold-Hold Mfg. Co., 446 N. Grand Ave., Lansing, Mich.
Mobile Refrigeration, Inc., 630–5th Ave., N. Y. C.
Tenney Engineering, Inc., Montclair, N. J.

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, 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.
Thermador Elect. & Mfg. Co., Riverside Dr., Los Angeles
Thordarson Elec. Mfg. Co., 500 W. Huron, Chicago
Utah Radio Prods. Co., 820 Orleans St., Chicago
★ United Transformer Co., 150 Varick St., N. Y. C.

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

TUBES, Cathode Ray
Dumont Labs., Allen B., Passaic, N. J.
Farnsworth Tele. & Radio Corp., Ft. Wayne, Ind.
★ General Elec. Co., Schenectady, N. Y.
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.

VIBRATION TEST EQUIPMENT
Vibration Specialty Co., 1536 Winter St., Philadelphia

VIBRATORS, Power Supply
Amer. Telev. & Radio Co., St. Paul, Minn.
Mallory & Co., Inc., P. R., Indianapolis, Ind.
Turner Co., Cedar Rapids, Ia.

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

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
Garitt Mfg. Co., Brookfield, Mass.
Lenz Electrical Mfg. Co., 1751 N. Western Ave., Chicago
Rockbestos Prod. Corp., New Haven, Conn.

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.
Holyoke Wire & Cable Corp., Holyoke, Mass.
Hudson Wire Co., Winsted, Conn.
Rea Magnet Wire Co., Fort Wayne, Indiana
Rockbestos Prods. Corp., New Haven, Conn.
Roebling's Sons Co., John, Trenton, N. J.

WOOD, Laminated & Impregnated
Camfield Mfg. Co., Grand Haven, Mich.
Formica Insulation Co., Cincinnati, O.

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

Notice to Engineers and Purchasing Agents

Effective with the January issue, an added index will be published, showing in alphabetical order all the items listed in the Radio-Electronic Products Directory.

This is in response to requests from readers who have suggested that they do not always know under what heading to find the items they want. So they would like to have an index of all items that they can scan quickly.

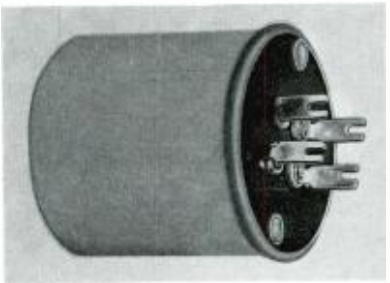
Accordingly, this reference index will appear in the January and future issues.

SPOT NEWS NOTES

(CONTINUED FROM PAGE 27)

CMP: Washington's nickname for the Controlled Materials Plan is, "C——, more papers!"

Capt. John E. Murnane: Former communications officer of the New Jersey State Police is now Captain in the Barrage Balloon Division, Camp Tyson, Tenn. John E., Junior, is an air cadet at Princeton.



Weatherproof Transformers: Special protection against heat and humidity is feature of complete line of small transformers for radio and sound equipment introduced by Thermador Electrical Manufacturing Company, Los Angeles.

5 Post-War Problems: As seen by FCC Chairman Fly are: 1) planning for expansion of FM and television, 2) disposal of surplus war radio equipment, 3) employment for war-trained radio engineers, technicians, and factory workers, 4) expansion of electronic applications and, 5) readjustment, reorganization, and reconversion of plants now devoted to military radio-electronic production.

Plastic-Covered Flexible Conduit: To reduce weight and to afford protection against abrasion, heat, gasoline, and oil, Searle Aero Industries, Inc., of Orange, California, is producing flexible metal conduit with plastic covering instead of rubber. Plastic is either transparent or opaque, does not become brittle at sub-zero temperatures. Sizes from 3/16 to 1¼ ins. inside diameter.

Hazards of War: Frequently the speed with which men in Government agencies get things done depends upon the number of years they are willing to risk spending in jail when the War is over. Which is another way of saying that cutting red tape is often as dangerous as snipping barbed wire. It takes a brave man to do either job.

Panel Light Dimmer: Uses polaroid discs to adjust illumination from panel or signal lamps, thus eliminating variable resistor. Control is obtained by rotating one disc. Manufactured by American Radio Hardware Company, 476 Broadway, New York City.

Merger: Federal Telephone and Radio Corp. is the name of the new company into which the International Telephone and Radio Mfg. Corp. and the Federal Telegraph Co. have been merged. Address is East Newark, N. J.

Wrong Answer: Like other lawyer-theorist-reformers, Chairman Fly sees problems and finds answers which fit into his preconceived picture of what he thinks conditions should be, even though they aren't. Latest is his discovery that small stations are in danger of folding up because of drop in advertising revenue. It doesn't fit his plan to see that the most serious threat is Baby Face Petrillo, whom he isn't willing to tackle. Instead, Chairman Fly talks about the very thing that makes every self-respecting business man shudder, namely, subsidies in the form of payment for time now donated to Government agencies, or tax deductions, either of which is a wrong answer.

DR. C. H. BACHMAN AT THE EYE-PIECE OF NEW ELECTRON MICROSCOPE DEVELOPED BY GENERAL ELECTRIC. ENLARGEMENT IS 10,000 TIMES. VOLTAGE VARIATIONS DO NOT AFFECT MAGNIFICATION

RADIO-ELECTRONIC PRODUCTS DIRECTORY

EVERY ISSUE OF "RADIO-ELECTRONIC ENGINEERING" IS A DIRECTORY ISSUE

THIS department has proved so useful that it is now called the "Procurement Bible." Engineers, production managers, purchasing agents, and Government officials use it constantly. It's their only source of information that is kept up from month to month.

As fast as new companies are formed, or old companies add new products, their names appear in the Products Directory. This information is gathered from many sources. It comes from the manufacturers themselves, from representatives, readers, and over the grapevine.

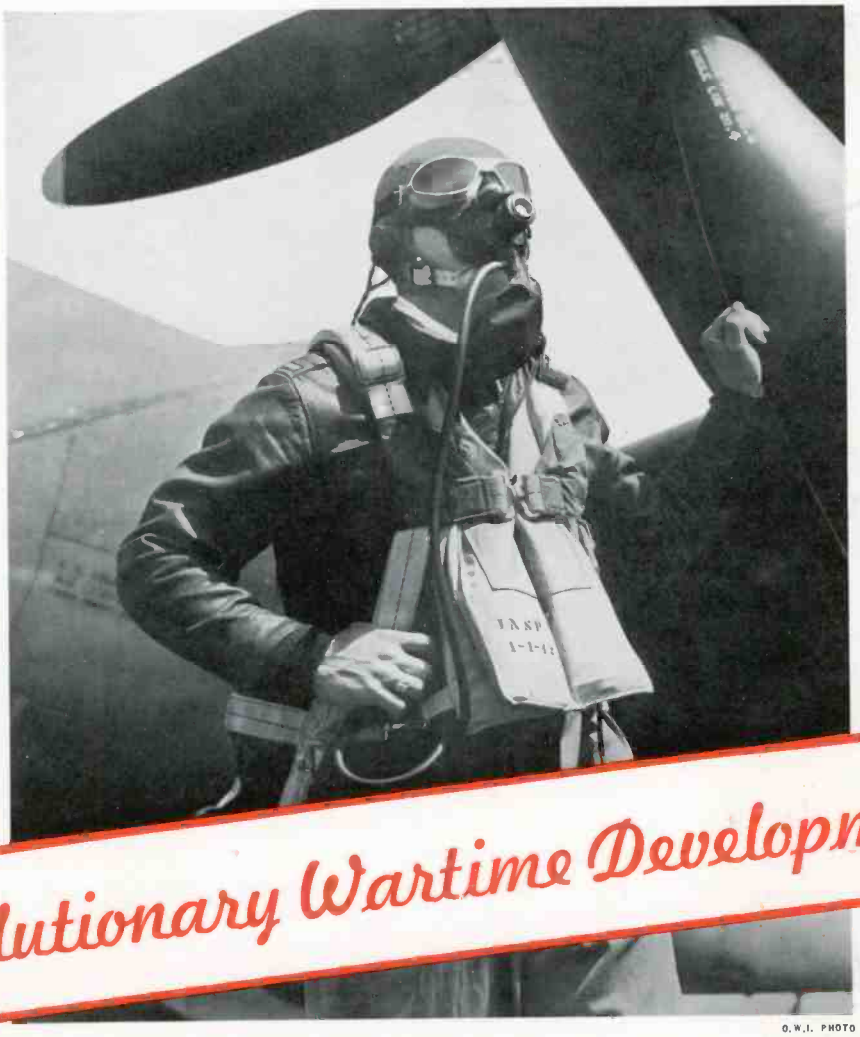
The Products Directory in *Radio-Electronic Engineering* is an important and much used service because conditions in the industry continue to change so rapidly that an annual directory is inadequate soon after it appears.

This month, for example, there are 25 more products listed, and 110 manufacturers' names have been added.

That is one of the reasons why *Radio-Electronic Engineering* is generally rated as having the highest "attention value" among engineers and executives throughout the radio-electronic industry. Over 700 copies go to Government officials alone every month.

RADIO-ELECTRONIC ENGINEERING & DESIGN

FM



Revolutionary Wartime Developments

O.W.I. PHOTO

STRANGE looking gear has been developed for this high-altitude combat pilot. Equally strange, to broadcast station managers and engineers, is the radio apparatus this man will take aloft.

So much more astonishing, then, will be the post-War broadcasting equipment, incorporating developments now clamped tightly under the lid of military secrecy.

Now it is only possible to say that, when the radio industry can return to normal activity, the majority of the present installations will be replaced.

That is because there has been as much progress in the radio art during the past twelve months as there would have been in ten or fifteen years under peacetime conditions.

At the time all new radio construction was stopped, REL held the leading position among manufacturers of FM station equipment. Fortunately, our experience in the development and production of new types of military installations is preparing us to resume and maintain that position after the War is over.

Until that time, we can only say: *"Look to REL for Peacetime Leadership."*

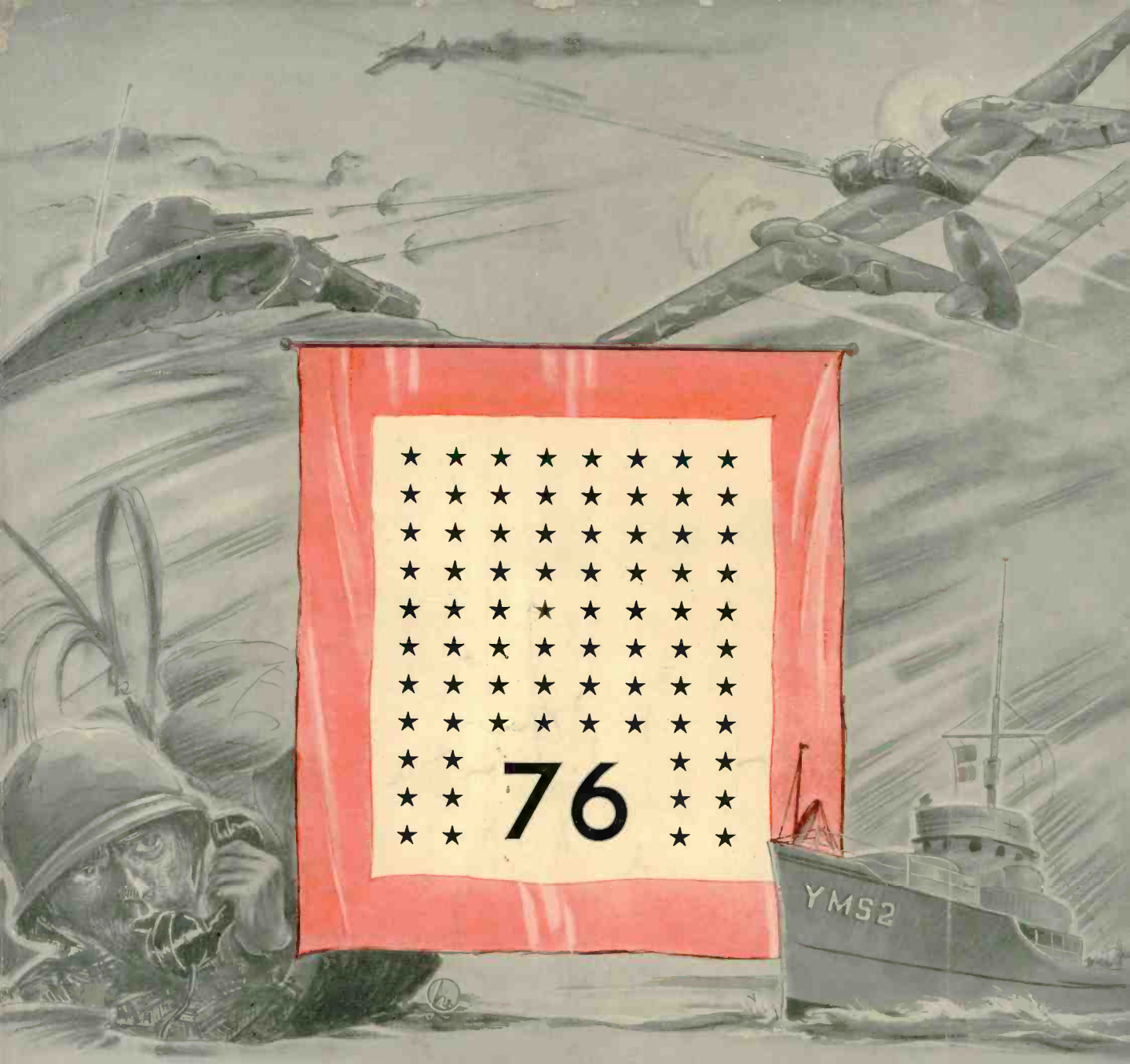
REL

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

Sales Offices:

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

RUMFORD PRESS
CONCORD, N. H.



We are proud of our Gang serving in the Armed Forces. You may be sure that they and all their pals —wherever they are—will never lack for the Link radio communication and electronic equipments which we are building in ever-increasing number for them.

FM BY Link

Fred M. Link

Engineer • Manufacturer

125 WEST 17th ST., NEW YORK, N.Y.

Telephone: CHELSEA 2-3838