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FM

SEPTEMBER 1942

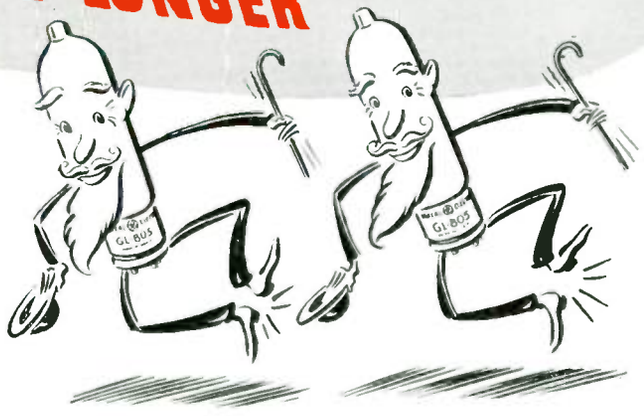
RADIO-ELECTRONIC ENGINEERING & DESIGN

CHIEF SIGNAL OFFICER

Radio-Electronic Products Directory

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

10 Suggestions to make your THORIATED-tungsten-filament tubes LIVE LONGER



HERE'S HOW you can easily remove many of the causes of premature tube failure

1 Don't overload the tubes. Use adequate protective devices such as a fuse or relay. Heavy overloads are apt to evaporate the thorium surface from the filament, and permanently damage the tube.

2 Normal operating temperature for thoriated-tungsten-filament tubes is obtained by operating them at the *rated* filament voltage. Care should be taken to operate them *at this voltage* (except for standbys and when reactivating). Occasionally, under or over voltage will give longer life, but such operation should only be carried out after first consulting the tube manufacturer.

3 Tubes that have been momentarily overloaded, or run at subnormal filament temperature, can quite frequently be reactivated by following this simple procedure: Operate the filament at the rated voltage for ten minutes or more with no voltage on the plate or grid. This process can be accelerated by increasing the filament voltage to 20 per cent above the rated value for a few minutes.

4 Increase the filament voltage progressively (only a small percentage at a time) when a tube no longer responds to reactivation. New filament transformers may be necessary for such operation.

5 For tubes of *250-watt plate dissipation or higher,* when the load on the tube is intermittent, keep the filament at 80 per cent of normal voltage during standby periods of *less than two hours*. This helps keep the cathode surface replenished, and makes it more quickly available when raised to normal filament voltage. If the standby period is *more than two hours*, the filament current should be shut off.

6 For tubes of less than 250-watt plate dissipation, filament voltage should be removed for standbys of more than 15 minutes.

7 For all types of thoriated-tungsten-filament tubes if the off period is less than five minutes, operate the filament at full voltage continuously, as excessive heating and cooling cycles tend to distort this type of filament.

8 Keep tubes well ventilated—with fans or blowers, if necessary.

9 Run at lowest possible anode current and voltage.

10 Minimize plate dissipation by careful tuning of the transmitter.

The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in five plants manufacturing naval equipment

These Suggestions Apply to Such Tubes As These G-E Thoriated-tungsten-filament types:

GL-146	GL-276A	GL-812	GL-849
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GL-159	GL-801	GL-814	GL-860
GL-169	GL-803	GL-833A	GL-861
GL-203A	GL-805	GL-834	GL-865
GL-204A	GL-806	GL-835	GL-1623
GL-211	GL-809	GL-838	GL-1628
GL-217C	GL-810	GL-845	
GL-242C	GL-811		

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☐ Please send me .....copies of "9 Ways to Make Your Tungsten-filament Tubes Last Longer," "How to Get Longer Life from Your Mercury-Vapor Tubes," and further information on the operation of thoriated tungsten filament tubes.

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Doing the Wartime job now, Preparing for Leadership when Peace has been won!

A RADIO PARTS JOBBER whose business had been built on sales to service men asked me how he could bolster his shrinking volume by getting into the electronic field.

When I asked him, "What is the electronic field?" he was uncertain. He only knew that it was "the coming thing".

Certainly no one will disagree with that. With every available research engineer at work on radio and radar development, additional possibilities are being opened up for electronic applications at a tremendous rate. Every week, volumes of notes are recording new ideas.

But — and this is a very significant "but" — they are being filed away and they will stay filed away until the War's end releases men and materials required for their application to public and industrial service.

Today, radio and radar equipment call for more tubes, more condensers, transformers, resistors, meters, sockets, and all other components and materials than our manufacturers can produce.

Military radio and radar are King Customers today for every added facility or new producer.

That the "electronic field" will come with Peace, no one will deny. But as long as the War lasts, there cannot be an electronic industry except as it relates to military radio and radar equipment.

With a realistic policy born of knowing the interests of military and civilian radio engineers and executives, RADIO-ELECTRONIC ENGINEERING is closely geared to wartime usefulness. This is the most effective preparation for leadership when Peace comes, for our present readers, carrying out the wartime radio and radar program today, will head the march of electronic progress when they are released from military service.

M. B. SLEEPER

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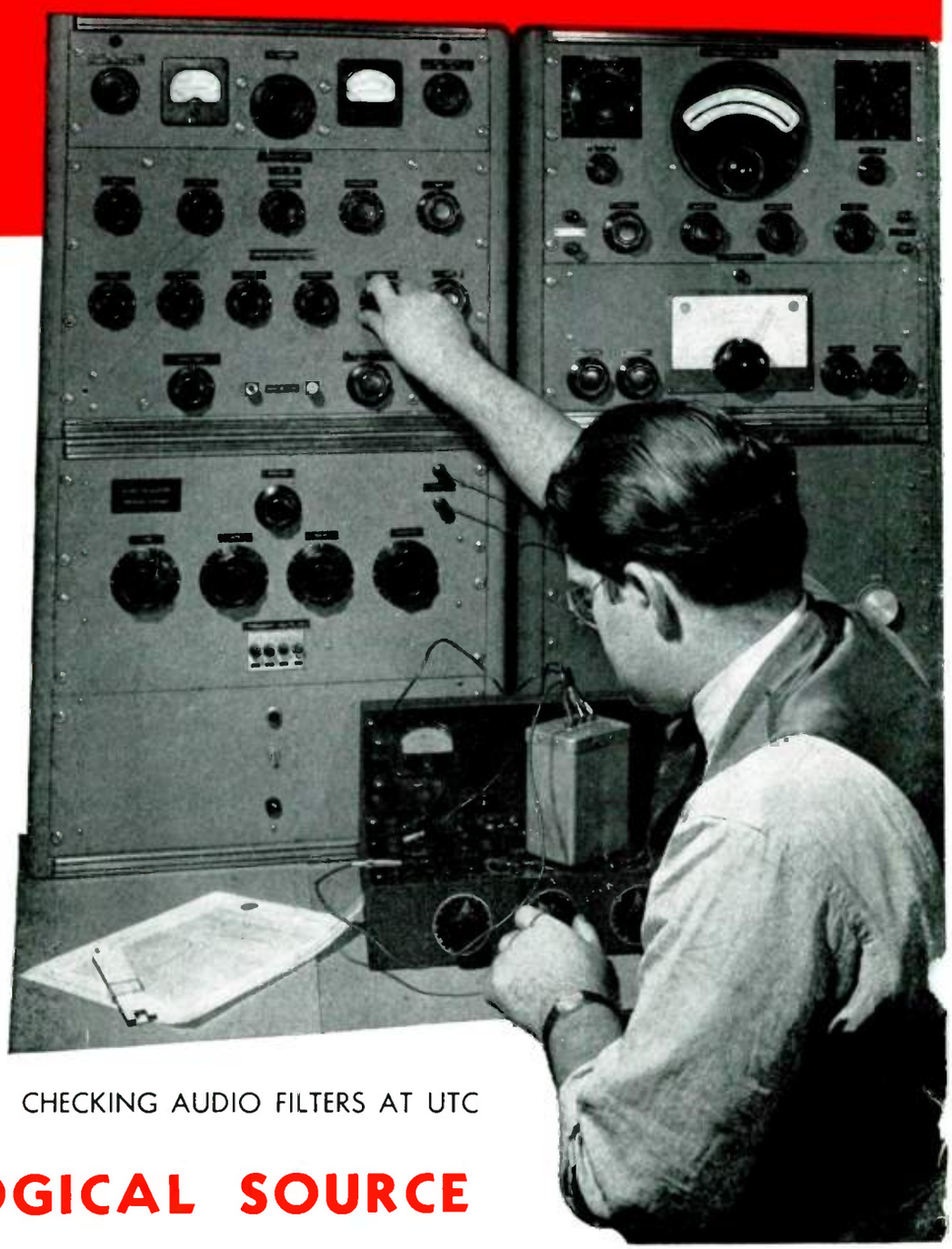

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CONTENTS

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COVER PICTURE

Major General Dawson Olmstead, as Chief Signal Officer of the U. S. Army, heads the greatest world-wide communications system that has ever been devised by man.

It includes all types of radio facilities for land, sea, and air, wire telegraph and telephone equipment, and radar apparatus for innumerable applications under all conditions of service, making the Signal Corps the largest customer of all times for radio-electronic equipment, components, and associated products.

Battle Flags!

All of us at the Hallicrafters are both proud and humble to have important assignments in defeating America's enemies. That our efforts have justified the award of the famous Army-Navy "E" flag is a great honor. We shall keep it proudly flying.

all of the hallicrafters

By-Product of Electronic Research:

THE PETRILLO SITUATION

A Social Problem Which Has Developed from One of the Products of Radio-Electronic Engineering

The presentation of these facts to the radio-electronic engineers was prompted by the words of Arthur Van Dyck, president of the Institute of Radio Engineers:

"The place of the engineer in society heretofore has been that of a servant creating things for society to use. Having created them, he turned them over to others to use, believing, in his own innocence and habits of truth-seeking and right thinking, that others would appreciate their possibilities for further advance, and would carry them on to right utilization. That was a mistake. Having created complex and more powerful agencies — with power for good and evil — the engineer did not see to it that they were thoroughly understood by other men, that utilization toward good was encouraged, and application to evil purposes suppressed."

No opinions concerning the Petrillo situation have been quoted, nor are any conclusions drawn or suggested, because the purpose of this article is to encourage each reader to study the situation and draw his own conclusions.

PRACTICALLY everyone concerned or affected directly or indirectly has had something to say in print about the recent decision of the American Federation of Musicians with respect to the manufacture, distribution, and use of electrical recordings.

The single exception seems to be the men whose trained minds and skillful hands produced the equipment about which this storm centers. These men, characteristically silent and aloof from public controversies are, of course, the engineers.

But who, in this case, has a better right to an opinion, and to give it voice? A few years ago, the phonograph record business had declined to such an extent that most of the companies which flourished in the period of Enrico Caruso were out of business. Stockholders of the Victor Talking Machine Company were fortunate that they could sell to Radio Corporation of America, before rigor mortis could set in, the still warm remains of what had been the greatest producer of them all.

Surely the engineers who, by applying the science of electronics to the recording and reproduction of sound, gave new and lusty life to that defunct business are entitled to a voice in current discussions.

An engineer's point of view is always different from those more stridently expressed. He does not take a position and then strive to establish and maintain it. By long training, he is a searcher for the truth, seeking to know the underlying principles, and to discover and relate all contributing factors, so as to evaluate them correctly in his expressed conclusion.

Concerning the AFM controversy, therefore, the engineer is not particularly interested in what the broadcasters, or the Department of Justice, or the FCC, or the Federation of Women's Clubs think about the AFM action.

The engineer wants to know the underlying principles. He wants to know just what the AFM is undertaking to do. The complaints, threats, comments, and criticisms are only byproducts. What is significant to the engineer is the cause of this commotion.

Let us, then, as engineers, examine the situation and record the facts in such a manner that each one can have a well-informed opinion, and thereby lend his support to whatever action he deems appropriate.

First, let us turn to THE INTERNATIONAL MUSICIAN, the AFM house organ, in which the Federation's plans are summarized in terms of resolutions. There we can read the words of the men who have initiated the action, and red-pencil the parts which are of special significance:

RESOLUTION 60

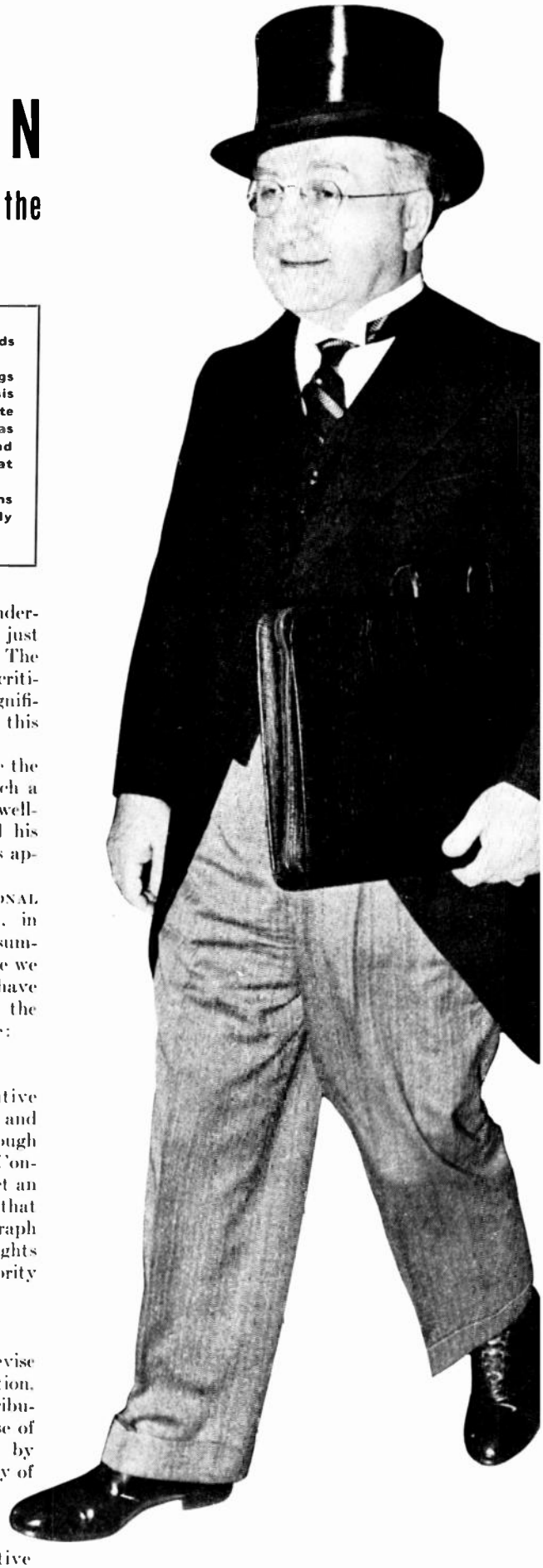
"That the International Executive Board be instructed to seek ways and means to ask the U. S. Congress, through communications from all locals to Congressmen from their districts, to enact an amendment to the copyright law in that the musicians performing for phonograph recordings may secure performing rights of said recordings and have sole authority as to how they may be used."

RESOLUTION 61

"That a committee be set up to devise ways and means to combat this situation, to eventually get control over the distribution of records. The manner or course of this action can best be determined by those who have made a life-long study of this."

RESOLUTION 63

"That the International Executive Board be hereby instructed by this convention to order all members of the Amer-



JAMES CAESAR PETRILLO GOES TO WORK

ican Federation of Musicians in the United States and Canada to discontinue the making of all electrical transcriptions for library services by Labor Day, September 1, 1941, and from that date on no members of the American Federation of Musicians be permitted to make electrical transcriptions for library service, and

"Be It Further Resolved, That the entire resources of the American Federation of Musicians be placed at the disposal of the International Executive Board to protect the interest of all members of the Federation insofar as this matter is concerned."

Resolution 64

"That on and after September 30, 1942, all users and distributors of Recorded Music for commercial purposes must be licensed by the American Federation of Musicians. Further, that necessary expense be allowed the President and Executive Board to carry this resolution to a successful conclusion."

Although it is not stated in these resolutions, it has been made clear by Federation spokesmen that the need for AFM action comes from the fact that the use of recordings by broadcast stations and public places of entertainment is displacing musicians and, thereby, causing widespread unemployment among the membership.

Resolution 65 is significant, therefore, because it explains, first, the immediate demands of the Federation by which they propose to obtain revenue from which musicians can be compensated for loss of employment and, then, exactly how the revenue thus obtained will be disbursed:

Resolution 65

"(a) That all licensed manufacturers of recordings issue special labels for recordings used on commercial phonographs or other music vending machines for public performance, and that the price of these recordings be raised accordingly; attention is called to the fact that the same master records would be used on the recordings and only the labels would be changed for use in juke boxes and other machines vending music;

"(b) That all new contracts with recording companies insert new clauses regarding strict regulation of use in keeping with the provisions of this resolution;

"(c) That the Federation enact appropriate legislation and rules and regulations to give effect to this resolution and provide for its enforcement with a view to strict control of the use of recordings in juke boxes and other machines vending music for public performance and to eliminate such recordings and machines as unfair competition to live music;

"(d) That the suggested rules and regulations attached to this resolution and marked 'Exhibit A' be adopted to be incorporated in legislation by the Federation to give effect to this resolution as hereinbefore provided."

Exhibit "A"

"Suggested Legislation for Regulation of Machines Vending Music in Accordance with the Resolution Attached:

"That each Local of the A. F. of M. shall be required to elect an inspector, whose duty it will be to take care of checking, inspecting, and all incidental details relative to the regulation and control of machines vending music to the public, in accordance with Federation law; that said inspector shall be paid and serve such hours and under such conditions as the Board of Directors of the particular Local shall determine in its discretion;

"That owners and operators of said machines be required to apply to the said inspector in their jurisdiction for special, distinctive labels to be pasted on each and every recording, over the regular label, when the said recording is to be used in above-mentioned vending machines."

Suggested Price of Said Labels

"For all special labels for recordings retailing at 35¢	$ .65
For special labels for recordings retailing at 50¢	.50
Thus making cost of each recording	$1.00

"Records so labeled when in commercial use to be rented at $3.00 per week each, to establishments using machines in competition with live music, or between the hours of 8:00 P.M. and 6:00 A.M. Rental charge on recordings used between the hours of 6:00 A.M. and 8:00 P.M. to be $1.00 per week each.

"Operators using Phantom Voice, line type or remote control vending machines to keep accurate check of all records played and each playing to be paid for at the rate of 1½¢ per playing."

Suggested Disbursements of Amounts Collected

" 1% to Members making recordings
" 1% to Manufacturers for labels
" 5% to owners and operators to cover overhead expense in bookkeeping, etc.
"15% to Federation for legislating and distribution costs for Members' and Manufacturers' share
"63% to Locals for inspectors' salary and costs of enforcement
"15% to Locals for relief and unemployment fund"

100%

Licenses and Fines

"Special licenses to be issued to each owner or operator of said vending machine, free of charge.

"Any operator or owner refusing to comply with regulation to immediately be placed on unfair list and fee of not less than $50.00 to reinstate license.

"Vending machines not to be installed in places declared by Local Board of Directors to be unfair.

"It is further suggested that the President appoint a committee chairman for each state, the committee to be formed by one representative from each local, to formulate local laws and regulations to suppress the use of vending machines or to derive payment for the displacement of live music.

"Upon motion, the Board decides that all recording be discontinued, the date of such discontinuance to be left in the hands of the President with full power to act."

These resolutions call for the most careful study by every radio-electronic engineer, for their implications are serious, and far-reaching.

It should be noted that the AFM does not confine itself to matters related directly to its members. It is setting itself up as a body to exercise control over the distribution and use of products which its members do not even produce except to the extent that photographers, for example, participate in the production of magazines or books. Further, the AFM proposes to bring about the enactment of Federal, State, and local laws to implement its undertakings.

Viewing this picture from another angle, it is necessary to consider the whole purpose of making recordings. Obviously, it is a service to those who want to hear music. The public has registered its preference for hearing recordings from good orchestras and artists rather than most of such live talent as can be afforded by the majority of radio programs and places of public entertainment.

Mr. Petrillo has disclaimed personal responsibility for the demands, actions, and plans set forth in these resolutions, stating that the AFM is a democratic organization in which the will of the members is expressed by delegates to the Executive Board.

It is no secret that "democracy" in the AFM is pure fiction. As any member will explain, if he chooses to speak frankly, an expression of opinion opposing the Local officers may result in consequences as serious as indefinite suspension. To a musician, this means that he cannot earn a living at his profession unless, and until, he is reinstated.

As for Mr. Petrillo's personal responsibility, the union constitution empowers him to call strikes at his discretion, to assess fines upon any member up to $5,000, and to revise or suspend the constitution under which he is empowered to act on behalf of the Federation's 130,000 members throughout the United States of America. He can, moreover, suspend any member, and thereby deny him the right to earn his living by his profession.

For any individual, whether private citizen or public officer, to exercise such

control over citizens of this Country is in direct conflict with the rights guaranteed by the Constitution of the United States. Even though the powers vested in the president of the AFM are purely theoretical, and are never exercised in practice, the delegation of such authority over 130,000 members and, indirectly, the lives of their families, is exactly what our Constitution was intended to avoid in order to assure that our people would continue to exercise the democratic rights of free men.

From a practical point of view, however, it might be conceded that the manner in which the AFM constitution is administered is more significant to all concerned than the constitution itself.

It is necessary, therefore, to determine the personality which Mr. Petrillo brings to his position as president of the AFM, his background and antecedents, the character of his official acts, and his policies as expressed by his administration under the Federation's constitution.

Let us set down and examine his qualifications, just as we would record and study the record of the executive head of any large concern. That is a fair and informative way to judge the man. The facts are these:

NAME: James Caesar Petrillo.

BORN: Chicago, 1892.

PARENTS: Born in Italy.

EDUCATION: Nine years in public school. Unable to complete fourth grade. Never has achieved a working knowledge of English grammar. Says he read a book a few years ago, but didn't care much for it.

FAVORITE SPORTS: Baseball and prizefights. About golf he says: "I skip all the greens. I don't go out there to get myself aggravated, and them dam' greens aggravate me."

MILITARY RECORD: No record of military service.

EARLY BUSINESS EXPERIENCE: At age 14, he organized an 8-piece orchestra playing for dances at the Hod Carriers Hall and West Side Auditorium, Chicago. Subsequently he operated a cigar stand and assisted in managing a saloon. At 22, he was elected president of the independent American Musicians Union, of which he had been an active member. Defeated three years later, he joined the competing AFM Local 10. His first, and very successful, efforts were to organize the musicians in the Chinese restaurants. He became vice president of Local 10 and, in 1922, president, an office which he has continued to hold up to the present time. Since 1940, he has been national president of the AFM also.

RECORD AS LOCAL 10 PRESIDENT: He has built up Local 10 to a membership of 11,000. Local 10 is now housed in a $600,000 two-story building, where he has a handsomely furnished office with Oriental rugs and "the biggest dam' desk I could find at Marshall Fields." In 1937, the Local bought him the Uihlein estate on Lake Geneva, Wis., at a price of $25,000 and spent $17,000 to furnish it.

His activities required a bullet-proof car, also bought by the Local and a bullet-proof window in his office. He continues to maintain a bodyguard of 6 or 7 men, including some of his own relatives, paid by the Local.

He is paid a salary of $26,000 a year by Local 10, in addition to $20,000 a year from the AFM. Just what it costs the members of Local 10 to keep him in office is not known, since no financial statement is published, nor is any required by law. Of this matter he says: "When I need anything, I just let my boys know and they give it to me."

A certified audit was published once, after it had been rumored that he had been abducted, and that $50,000 was paid as ransom by Local 10. That was before the 1933 election, and the last time he was opposed for office. The audit, however, proved nothing, as it covered a period subsequent to the alleged payment.

His management of Local 10 has continued despite bombings and legal suits. His administration has called forth investigation by the Department of Justice and censure by the courts.

In 1937, he successfully routed John L. Lewis who offered a CIO charter to the competing American Musicians Union. Mr. Petrillo promptly brought most of the AMU members into Local 10. His ensuing animosity toward Mr. Lewis prompted him to demand that two Broadway shows, playing in Chicago, delete references to both Mr. Lewis and the CIO. This edict was withdrawn under fire from the press. He explained: "They said I was unconstitutional and all that stuff. I never had nothing like that in mind."

Measured by the cost of hiring musicians in the Chicago area, Mr. Petrillo's administration of Local 10 has been highly successful, for their wage scale is the highest in any of the 750 Locals of the AFM. He explains: "I done it by givin' the boys service."

What the net worth of his services to the members has been, the members don't know and Mr. Petrillo does not tell, for he makes no accounting of the Local's income or disbursements. Payment of dues is enforced inflexibly, but the members have no control over the funds they contribute. Any dissatisfaction expressed by a member in refusal to pay would result in his being denied the right to earn his living at his profession.

RECORD OF OFFICIAL ACTIONS: Mr. Petrillo's policies, his approach to public relations problems, the quality of his leadership, and his use of the powers delegated to him are indicated by the more significant of his official actions.

Early in his career as president of Local 10, he stopped the use of sound trucks in Chicago because they played recordings. He required the use of musicians conveyed in trucks.

Through his control of musicians in the broadcast stations, he brought into the AFM the men handling records — known in the stations as pancake turners — and obtained for them a weekly wage rate of $90.

In 1936, he stopped Local 10 members from making recordings. This ban, in effect for 18 months, cost the members $275,000, it was estimated. He then pursuaded the AFM to stop all recordings. This brought an offer of negotiation from the record and broadcasting companies, and resulted in their being required to employ 1,000 extra musicians at an added cost of $2,000,000 a year. This agreement continued until the AFM passed the new resolutions set forth here.

Swing musicians in Chicago frequently entertained themselves by joining small bands for after-hours jam sessions. Mr. Petrillo stopped that, asking; "Should the customers at them places pay for a seven-piece band and get twelve pieces?"

After he became president of the AFM, he ruled against Army bands on the air. This came about when Mutual had scheduled a series of programs originating at Fort Dix, to promote public interest in national defense. He insisted upon taking up this matter with Secretary Stimson, in order to set out terms and conditions. He was turned over to Army officers, with whom he had some difficulty for he said: "You know how them Generals are. Pin a couple of tin medals on 'em, and you can't do a thing wit' 'em." It was finally arranged that Army bands could play on the radio, provided he was notified in advance and gave his consent.

This was no carte blanche to the Army. Mr. Petrillo definitely controls the Army so far as its participation on radio musical programs is concerned. Under his instructions, Jake Rosenberg, head of the New York City Local, refused to permit Army musicians from "This Is the Army" to participate in the broadcast dedication of the Times Square Service Men's Center.

As evidence of his spirit of patriotism, he has required all AFM members taking part in any program, even in motion picture or recording studios or night clubs, to start and end with The Star Spangled Banner.

After the recent AFM resolutions on recordings were passed, it was charged that this action would interfere with National Defense plans by forcing many stations to close down. In reply, Mr. Petrillo stated simply that he did not consider radio stations essential to National Defense.

He is generally credited with originating the "stand-by" plan of having musicians paid to stand by and do nothing at

(CONTINUED ON PAGE 11)

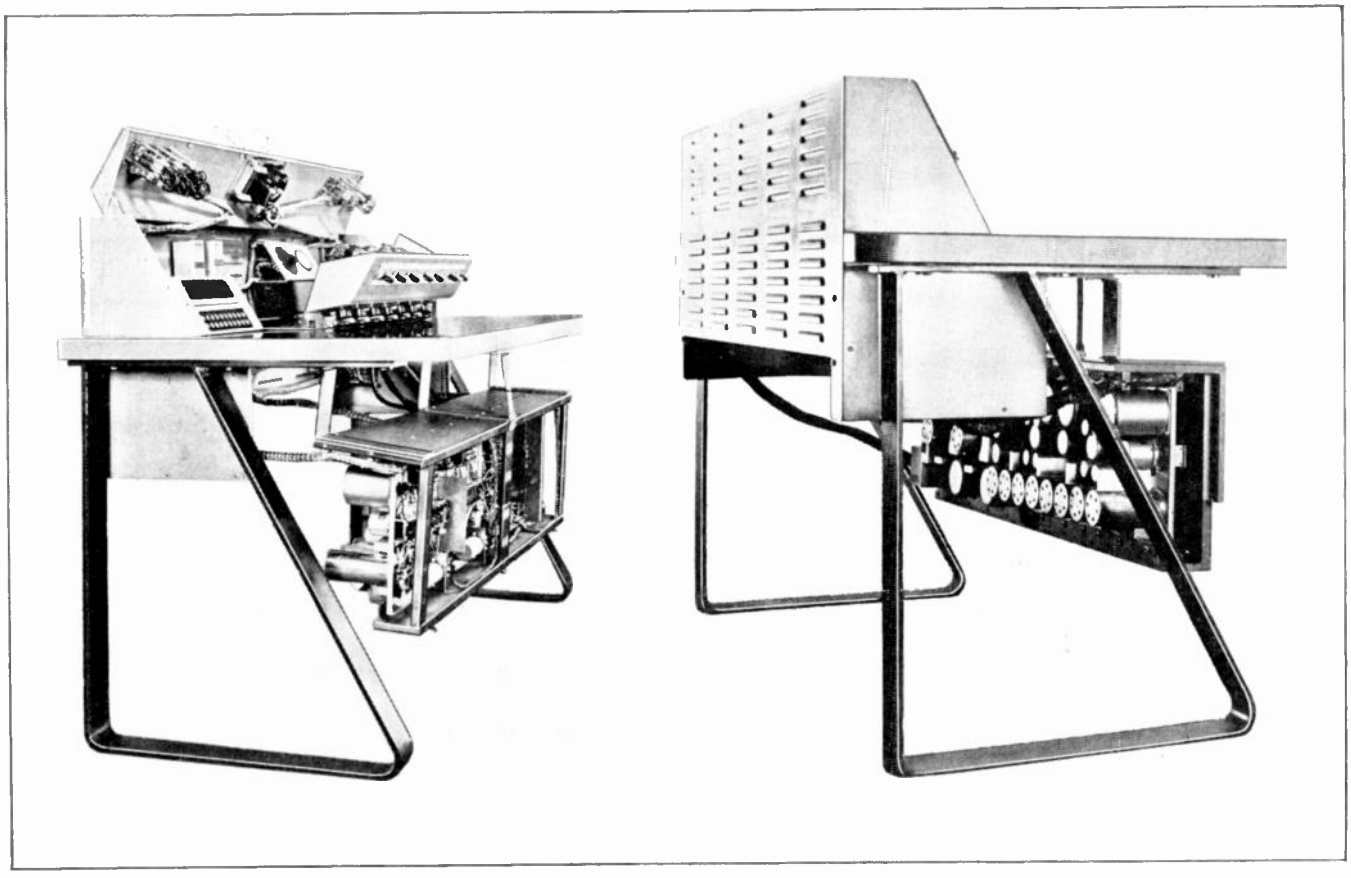


FIG. 1. TOP AND FRONT ARE HINGED ON WESTERN ELECTRIC 25A CONSOLE, AND AMPLIFIERS SWING DOWN FOR EASY INSPECTION

A SPEECH INPUT CONSOLE

A Highly Flexible Design Capable of Handling Two Main Channels Simultaneously

BY HENRY F. SCARR*

SEVERAL basically new ideas in speech input console design and operation have been built into the Western Electric 25A equipment. This console was designed by Bell Telephone Laboratories for use at broadcast stations using FM transmission or at AM stations planning to provide for FM at some future time. Accordingly, high-fidelity service for FM broadcasters is provided by the 25A's uniform, noise-free, and distortionless operation over a 15,000-cycle range.

The 25A design is greatly simplified as to mounting and installation, requiring only a minimum of effort to put the two fully assembled and wired units into service.

The main unit, shown in Figs. 1 to 4, houses two complete high-quality main amplifier channels, capable of simultaneous operation on different programs without interference or cross talk. Also in this desk console are pre-amplifiers, mixers, switching, indicating, monitoring, cue feeding, and other control apparatus, arranged and coördinated to provide maximum operating flexibility and convenience.

A compact power supply unit completes the 25A equipment. This is arranged for wall mounting, and is generally located away from the console. The power supply unit, mounted on a swinging frame for easy inspection and maintenance access, contains the power supply units for plate and filament power to all vacuum tubes, and also for the loudspeaker cut-off relays. Thus the need for any other auxiliary power supply is eliminated.

Built into the main housing of the console are eight microphone or low-level transcription input circuits and four microphone pre-amplifiers, with switching keys for ready selection of either of two low-level inputs for each pre-amplifier. These are shown diagrammatically in Fig. 5. Four of these circuits can be used simultaneously, with four in reserve available at a moment's notice, enabling the engineers to schedule programs of eight sources, or to dispatch two successive four-source programs. Optional addition of 20 jacks, lamps, or jack-sized keys for system control and indicating circuits give the 25A still greater utility.

Especially valuable to stations operating both AM and FM transmitters, or simultaneously originating both local and network programs, are the line facilities of this speech console. The two main amplifier channels, capable of simultaneous operation on separate programs, permit concurrent dispatch of audio signals to each of two transmitters or to out-going lines through the one console, each channel being governed by a separate master gain control for adjusting overall level. This set-up gains flexibility through two output switching keys which allow either of the two main channels to be fed to either of two outgoing lines.

A remote line input-circuit with a repeating coil feeds incoming line programs to a separate line mixer-control. Ready and rapid selection of remote or network programs is speeded by three remote line switching keys, usable in selecting any one of three lines, for monitoring incoming

* Speech Input and Sound System Specialist, Radio Division, Western Electric Company, 120 Broadway, New York, N. Y.

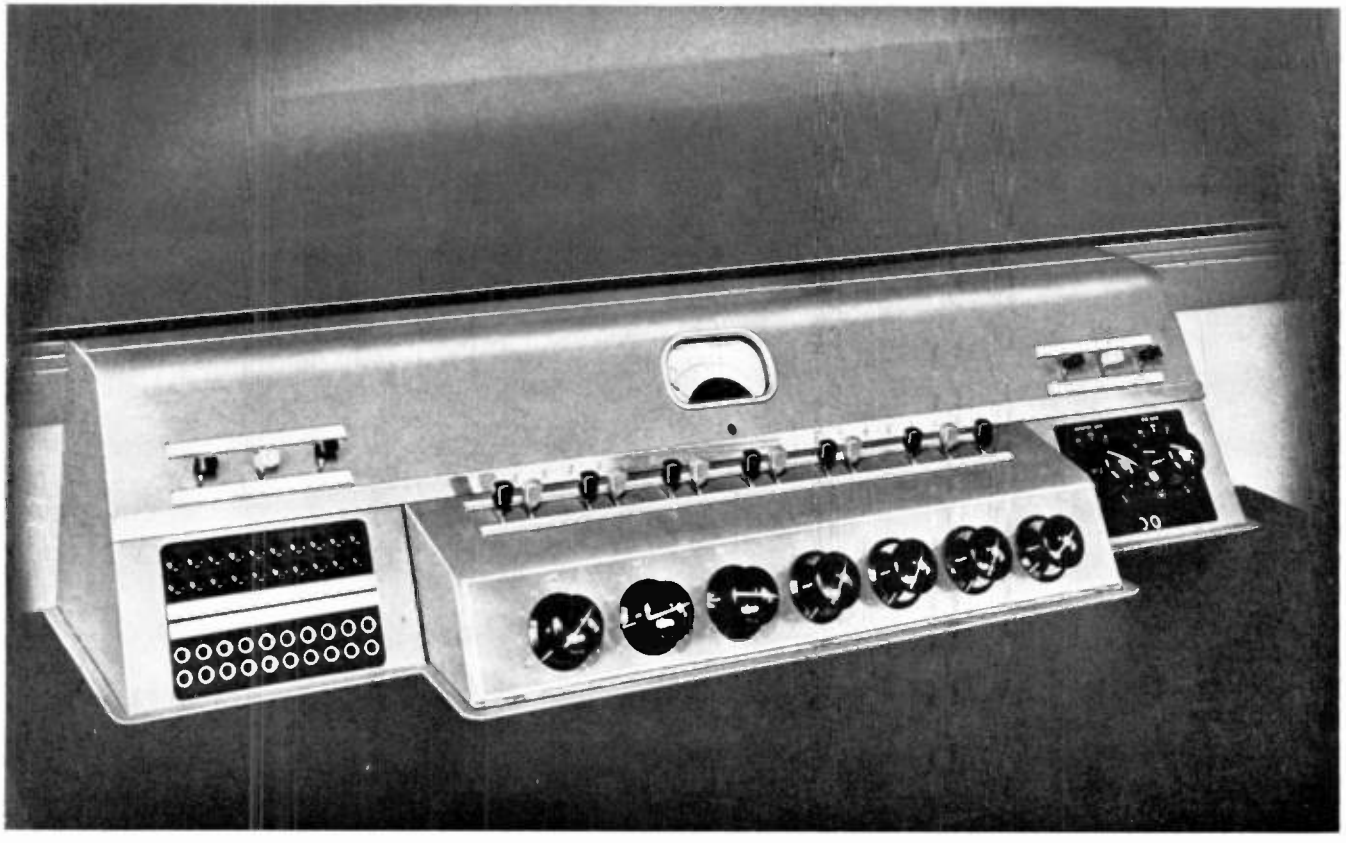
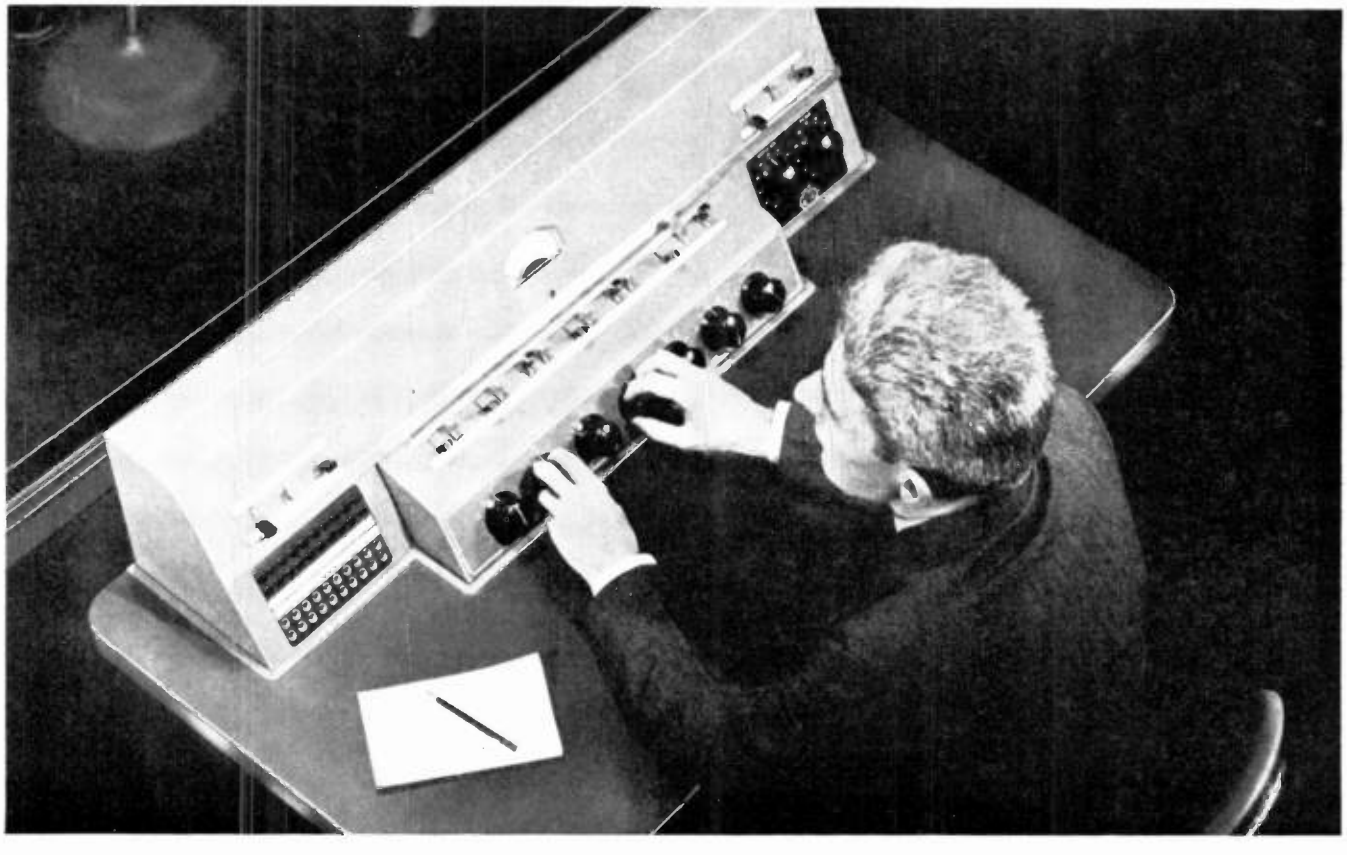


FIG. 2, ABOVE. The seven control knobs across the lower front are, from left to right, line mixer, four microphone mixers, and master gain controls for each of two channels. Talk-back key and line mixer transfer key are above the line mixer. Above each microphone mixer is the associated input key and mixer transfer key. Three keys above the master gain controls are volume indicator transfer key and the output key for each channel. Three keys at the left switch three lines from cue feed or monitoring to program receiving position. Knobs at right control gain.

FIG. 3, BELOW. Carefully planned design has put every control within easy, natural reach. Rear ventilation carries heat from tubes away from the monitoring operator.



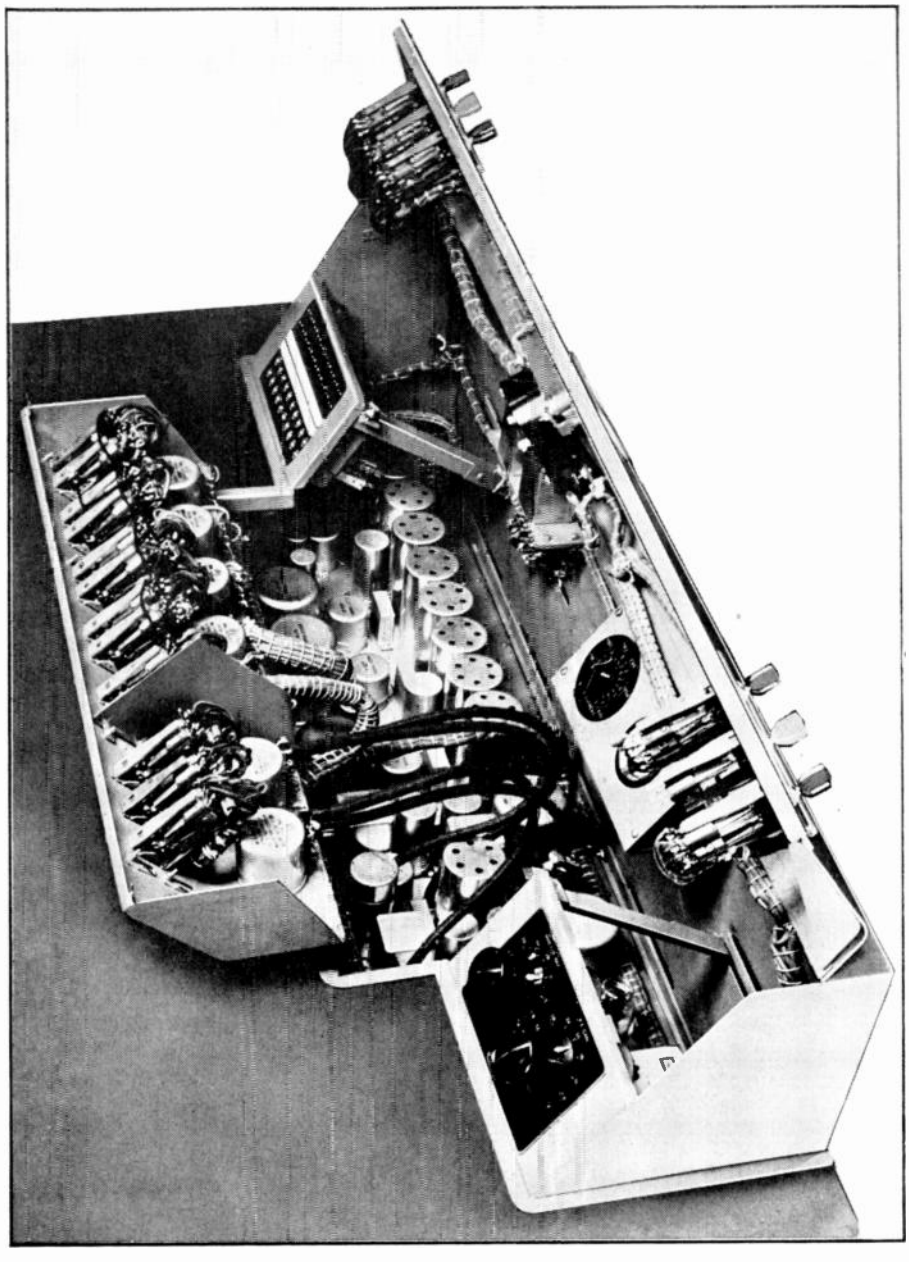


FIG. 4. EVERY PART OF THIS SPEECH INPUT EQUIPMENT IS INSTANTLY ACCESSIBLE

programs, or for connecting to the mixer input. Patching jacks, with which four additional remote lines can be substituted on a line-for-line basis, make available a total of seven input lines or trunks.

With five mixer potentiometers for individual level adjustment on the line input circuit and on the four microphone input circuits, the 25A makes extensive provision for blending. These potentiometers operate on either of the two main amplifier channels through a five-channel mixer circuit with individual mixer transfer keys for association with either main amplifier channel input.

Mounted on the console is a volume indicator for visual monitoring of program level to the transmitter line, with a switching key for connecting it to the output of either of the two main channels. In addition, headphone jacks for each channel are mounted on the housing for occasions when both channels are being used and monitored simultaneously, making headphone monitoring necessary on one of the channels. A built-in monitor amplifier which may be connected to either main channel is included for aural monitoring.

The important operations of cueing are thoroughly controlled. The monitor amplifier feeds cue programs into a studio speaker and the remote line circuits, while a monitor transfer key gives access to programs on either of the two main channels or to the cue transfer key. This key switches between the conditions of monitoring on the remote lines, receiving cue from master control, and feeding cue to remote lines. Operation of a loudspeaker in the same room with a live microphone is automatically prevented by loudspeaker cut-off relays for the booth and two studio loudspeakers. Contacts are also provided for operating equipment outside the system, such as studio warning signs, buzzer cut-offs, and other auxiliaries.

Other important features include an additional circuit with a gain control and a channel switching key to feed either main channel output to a separate local amplifier system external to the speech input equipment. This is invaluable for sound re-enforcement in large audience studios and similar applications. Normal operation of the amplifier tubes can be checked quickly by a plate-metering circuit with a meter and rotary tap switch for individual plate current measurement.

When this equipment was in the planning stage, emphasis was put upon the convenience afforded by low height and small overall size. Accordingly, the dimensions of the console were held down to 36 ins. overall height and a width of 49½ ins. Overall depth is 26½ ins. — of which only

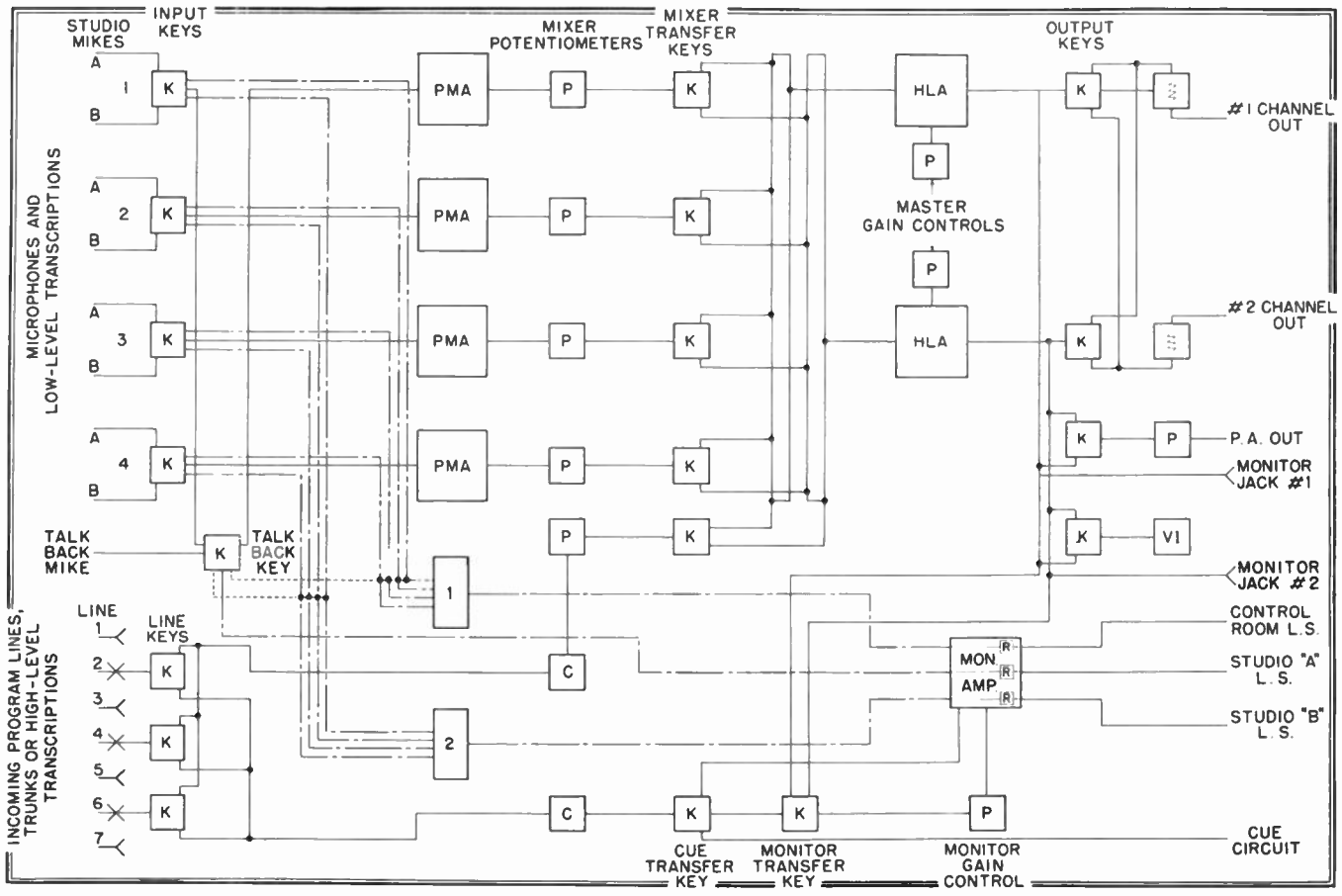


FIG. 5. BLOCK DIAGRAM OF WESTERN ELECTRIC 25A EQUIPMENT WHICH PROVIDES VERSATILE CONTROL OF STUDIO FACILITIES

12½ ins. at the rear is the control cabinet. The table top stands 27⅝ ins. from the floor. The separate power supply unit is 15 ins. high, 22¾ ins. wide, and 8¼ ins. deep.

Although extremely useful in small installations, large stations will find the 25A an even greater boon. A number of these consoles, one installed in each studio control room or in a control room common to two studios will, with the help of master coördinating equipment, provide complete speech input facilities for an entire station.

This speech input console should bridge a long-standing gap in broadcasting apparatus, for it is more flexible than table-top units, and less expensive than custom-built equipment.

THE PETRILLO SITUATION

(CONTINUED FROM PAGE 7)

radio stations when a program is considered to replace but not require AFM musicians.

For example, he refused to permit 160 boys and girls to broadcast from the National Music Camp over NBC unless an equal number of AFM musicians were paid to stand by during the program. These boys and girls, averaging fifteen years of age, were amateurs, and not eligible for AFM membership for which the minimum age is 16. On many other occasions, in other cities, he has stopped children from going on the air because: "When amateur musicians occupy the air it means less work for professionals."

Mr. Petrillo's only recorded failure was his attempt to organize the Boston Symphony Orchestra.

It is surprising that, since its founding in 1881, this group of musicians has maintained an open-shop status. Of such artists as Spaulding, Iturbi, and Zimbalist, Mr. Petrillo said: "They're mine! They're musicians and they belong to me. Since when is there a difference between Heifetz and a fiddler in a tavern?"

However, Koussevitzky and the musicians of the Boston Symphony seemed to feel that Mr. Petrillo had nothing to offer and contrary to his pronouncement that, "They're washed up. They're through!" they have continued to play with notable success before audiences that have made no demand for AFM influence upon the Orchestra.

The last opposition to Mr. Petrillo within the AFM ranks appears to have been in 1938 when Joe Weber, then president of the AFM, felt the pressure of Mr. Petrillo's plans to become president. At that time, Mr. Weber made the statement in the union's paper that: "The best interests of the union are best served by attending to business quietly and not dispensing hot air." Mr. Petrillo, at that time only president of Local 10, was referring to himself as "the tail that wags the dog."

In 1940, Mr. Weber retired as president of the AFM, and Mr. Petrillo took over the office. Now he says of his activities: "Not for the dough. I don't need it any more. I just live for my boys."

Here is the picture of a situation which has been built up, to a very large extent, on the products created by the research and development work carried on by radio-electronic engineers. It records the social significance not of what these engineers undertook to bring about, but of an end-result of their labors.

If the record is good or bad, if it adds up to a credit or a debit balance in the final score of scientific contribution, each engineer should decide for himself.

It is extremely important for every man of sufficient mental development to qualify as an engineer to give the most careful thought to the end-uses and end-results of his work. In the world of today, that engineer is shirking responsibility who considers the products of his efforts an end in themselves.

Now, in preparation for guiding the civilian application of highly significant military developments, every engineer should ask: "What was done with my work after it passed from my hands?" That will show the way to answering the question: "How can I be most effective in guiding the course of what I shall help to produce next, to assure its use for the greatest public service, and to guard against its being used selfishly by one group in the disservice of others?" — *M. B. Sleeper.*

SPOT NEWS NOTES

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

Immediate Employment Problem: Signal Corps and Air Service have launched a campaign to enlist 100,000 skilled mechanics and technicians before October 15th. They are needed to operate and service equipment which is now being delivered to the Armed Forces in tremendous volume. Age limit is 18 to 44 inclusive. Special inducement is rapid promotion and pay increases, featuring rate of $138.00 a month and allowances for master sergeant. Radio manufacturers who do not take immediate steps to increase percentage of women workers will be in trouble by fall.

Significant: Civilians who left their families at home to join various Army and Navy office and laboratory staffs are now selling or renting their homes, and moving their families. This points to a spreading conviction that their War jobs are not temporary, but will last over a period of years. Executives of radio plants are slower to grasp this idea and to modify their policies accordingly.

RMA Parts Sections: To permit more intensive study of radio parts situation, Chairman Ray F. Sparrow of the RMA Parts Division has appointed the following chairmen who will head up ten Parts Sections:

Capacitors, R. C. Sprague, Sprague Specialties Co.
Coils, Monte Cohen, F. W. Sickles Co.
Fixed Resistors, Ernest Searing, International Resistance Co.
Instruments, Harold Oleson, Weston Electrical Inst. Co.
Sockets, E. E. Hannigan, Cinch Mfg. Co.
Switches, Robert A. O'Reilly, Oak Mfg. Co.
Transformers, George Blackburn, Chicago Transformer Co.
Variable Condensers, A. Bloom, General Instrument Co.
Variable Resistors, H. E. Osmun, Centralab.
Wire, John G. Searls, Essex Wire Corp.

A-N Award: To Hallicrafters, with the citation: "The high and practical patriotism of the men and women of the Hallicrafters Company is inspiring. Their record will be difficult to surpass, yet the Army and Navy have confidence that it was made only to be broken." Formal presentation by Army and Navy officers was held on September 9th, at Hallicrafters' main plant.

Dr. Lynde P. Wheeler: Single nominee for president of Institute of Radio Engineers for 1943 is chief of technical information section in FCC's engineering department.

Turning 'Em Out: Among latest graduates of Capital Radio Engineering Institute to join broadcast stations are Zack Yates, now at WTAR, and Robert Royal, now at WPTF.

RMA Transmitter Group: G. W. Henyan, chairman, with Walter A. Evans of Westinghouse and W. P. Hilliard of Bendix Radio will represent this division on the RMA board of directors. Other members of Transmitter Division are B. Ray Cummings of Farnsworth, T. A. Smith of RCA Mfg. Company, Charles M. Srebroff of Radio Engineering Laboratories, and C. J. Burnside of Westinghouse.

The Line of Action Is
FORWARD!

WHEN the Germans and Japs tell their own people that Americans are soft, they refer particularly to the mental attitude of resting at ease in beliefs and habits we've always had, of not seeing the value of a new idea if it means giving up an old one, of refusing to step up our own performance by applying things that others have done to the improvement of our own methods or products.

To make this a short War, we must have the toughness of the American pioneers who, while overcoming the adversities of the wilderness, and conquering their enemies, had the ingenuity, flexibility, and strength to create a better way of living than they had in the older countries of Europe.

Clear, keen thinking gave them victory because their actions were backed by confidence that came from knowing that they would prevail because their plans were sound and right. Always watching ahead, they were never caught unprepared.

If we develop the toughness needed to make this a short War, then, when it is over, we shall have the firmness of purpose to use effectively, in the service of better and happier living, the tremendous efforts in scientific research and engineering which we shall have made to win the Peace.

Production Code: Is the new name for what was called the Allocations Classifications System, under which priority ratings are indicated.

Sales Managers Club: Jerome Kahn, President of Standard Transformer Corporation, has been elected chairman of the Sales Managers Club, Western Group. He will carry on the job so successfully administered during the year past by S. N. Shure, of Shure Brothers. Paul H. Tartak, president of Oxford Tartak Radio Corporation, was elected vice-chairman, and H. A. Staniland, of Quam-Nichols Company, treasurer. Kenneth Prince, Chicago attorney, is secretary.

Priority Ratings: As of August 10th, the official sequence of priority ratings is: AAA, AA-1, AA-2, AA-2X, AA-3, AA-4, etc.; A1a, A1b, etc.; A-2, A-3, etc.; B-1, B-2, etc. However, with experiments being made on a "vertical" plan for allocating materials, in contrast to the prevailing horizontal system, there's no telling what further revisions will be made, or when.

Ancient History: Securities Exchange Commission has issued a report on profits, dividends, assets, and other pertinent facts concerning 10 radio manufacturers, comparing 1939 and 1940 operations. Copy can be obtained by application to SEC office, Philadelphia.

A-N Award: To American Lava Corporation of Chattanooga, as "your Nation's tribute to the spirit of patriotism and production effort of your plant and your employees. . . . This symbol is accorded only to those plants which are exceeding all production expectations in view of facilities at their command."

Chairman Fly: Says that constructive studies and suggestions being considered by the WPB and FCC-BWC convinced him that the broadcasting industry would benefit "in terms of conservation and renewed assurances of continuity and stability." Did he mean that these Government agencies have found a way to settle the AFM problem?

Vertical Allocation Plan: (1) Prime contractor obtains from all sub-contractors information showing, on form CPC-2, required materials and schedule of deliveries. (2) Prime contractor assembles this data on form CPC-1, together with statement of materials and production schedule of parts he will make himself. (3) This is submitted to contracting agency, and preference ratings assigned high enough to assure deliveries on exact dates specified. Vertical Plan is being tried now with Stromberg-Carlson, Collins Radio, and Aircraft Radio Corp.

Glen Boundy: Chief engineer of WWVA is the eleventh man from that station to enter the Service, and the seventh to be commissioned. He is at Ft. Monmouth, as a 1st Lieutenant in the Signal Corps.

2,272,839: Is the U. S. patent number of John Hays Hammond's phase-modulation system of radio transmission and reception. Special purpose of this invention

(CONTINUED ON PAGE 22)

NEWS PICTURE

Brigadier General A. A. Farmer, Commanding Officer of the Philadelphia Signal Depot and Officer in Charge of the Philadelphia Signal Corps Procurement District, is doing highly effective work in creating a more-production-for-War spirit among workers in defense plants.

This photograph was taken when he addressed 7,000 Philco employees and their families, and congratulated them for efforts which had won official recognition in the form of the Army-Navy "E" flag.

In every plant where this award has been given, each worker has received an Army-Navy pin as an award of merit for his services in the Battle of Production.

Philco is producing radio equipment for planes, ships, and tanks, as well as shells and fuses and industrial storage batteries.

A HIGHLY VERSATILE VACUUM TUBE VOLTMETER OF EXCEPTIONALLY COMPACT DESIGN

VT VOLTMETER DESIGN

High Overloads Cannot Damage This Constant-Zero Instrument Which Uses Balanced, Degenerative Amplifiers

BY JERRY B. MINTER*

MOST engineers in radio-electronic laboratories or broadcast stations would include a vacuum tube voltmeter in a list of essential, most-often-used electrical instruments. It has earned its reputation largely because it is highly versatile, and can do all that magnetic meters can do, and much that they can't.

The model 62 Measurements Corporation vacuum tube voltmeter was designed to add still more features of usefulness to those provided by more conventional types. First of all, its construction is compact and light in weight. This instrument is only 4¾ ins. wide by 8½ ins. deep, and 6 ins. high, and weighs only 6 lbs. All operating voltages are supplied from a 115-volt, 60-cycle line, without the use of batteries.

As the schematic diagram shows, two 6C5 tubes are used in a stabilized, balanced circuit, with 100% degeneration, giving constant zero setting without any shift when the range-switch is changed. This is a great advantage and convenience, for the zero adjustment holds without resetting over a long period of time.

The range, covering 1, 3, 10, 30, and 100 volts is selected by pushbuttons because they can be operated more quickly than a multi-point rotary switch. Either AC or DC can be measured by shifting the switch on the top of the case. A third position of this switch permits reversal of the DC polarity at the instrument, without changing the test probes.

A further convenience is the type of probe provided with this instrument. In the accompanying illustration, it is plugged in the back of the case. The probe is connected by a very light 4-wire cable about 3 ft. long. A 6H6 diode rectifier tube with the base removed, a blocking condenser, and two resistors are contained in the probe unit.

For measuring AC, as the diagram shows, one diode plate is in the measuring circuit, connected to the grid of a DC amplifier. The other diode plate is used to balance out the initial velocity potential of the measuring diode. Since the initial velocity potentials of the two diodes are bucked against each other rather than against some fixed potential, a high order of stability is attained with respect to line-voltage fluctuations.

It is practically impossible to burn out this instrument, or to even damage the pointer from accidental overloads. The practice is certainly not recommended, but within the writer's experience, several thousand volts were applied briefly to one of these meters without causing any ill effects.

On DC measurements, the current drain is less than 10^{-9} ampere. This makes it adaptable, in conjunction with a photo-electric tube, for use on wide-range light intensity measurements. It can be used as a direct-reading Ph meter, with a glass electrode. Connected to a 90-volt battery, resistances from .1 to 100,000 megohms can be measured.

When the meter is first put into operation, the zero setting should be checked. With the switch on either DC position, the DC terminals shorted, and the 1-volt range button depressed, it should be possible to set the pointer at zero by adjusting the knob at the right of the pilot lamp. This is a potentiometer R5 in the diagram. This balances the DC amplifier only.

Another adjustment, accessible with a screwdriver, is at the top rear of the case. This is potentiometer R3, for balancing the diodes. This balance must be made with the switch in the PROBE position.

Usually, any slight variation between the AC and DC setting can be corrected with the knob on the front panel. If there is more than .1-volt variation at the 1-volt range, the screwdriver adjustment must be reset.

Once the correction has been made on the 1-volt range, the other ranges will be exactly right. It is advisable to keep a 10-megohm resistor across the DC terminals. Otherwise, the pointer will go off scale. As a measure of precaution, it is suggested that the 100-volt range button be depressed when changing connections.

The accuracy of this vacuum tube voltmeter is limited chiefly by the indicating meter. This is 2% of full scale. The instrument is adjusted accurately before shipment at full scale on each range.

When checking the accuracy of calibration against an RMS standard, the voltage source should have less than 1% harmonics. The meter reads approximately 4% low at 60 cycles because of the .01 mfd. diode blocking condenser. On DC, the calibration is linear, and on AC the readings show the RMS value of a sine wave or 71% of the peak value of a complex wave.

The input capacity of the probe, when not plugged into the carrying jacks is

(CONTINUED ON PAGE 21)

* Vice president and chief engineer, Measurements Corporation, Boonton, N. J.

THE RADIO-ELECTRONIC MARKETS

A Realistic Appraisal of the Present Limitations and Future Possibilities of This Field

BY M. B. SLEEPER

THE blue-sky generalities about the brave new world of electronics which are being heard in all quarters today would be marvelous window dressing for the kind of stock-promotion which cost the American public millions of dollars in the early days of radio broadcasting.

Right now, there is talk about "getting into the electronics field" that paraphrases the opportunist planning of 1920 when everyone who had machine tools or assembly benches was looking for an opening in the radio business.

If significant future plans are to be made tentatively now, it is necessary to have a definite understanding of the exact nature and scope of the radio-electronic field, based on an exact knowledge of present limitations as well as future possibilities. With such a realistic approach, vague and wishful thinking can be avoided, and definite future plans can be laid.

The Tail or the Dog ★ Such is the magic of the word "electronics," and so little is it understood that many business men today have the idea that vacuum tubes and their associate transformers, coils, and condensers will soon replace all kinds of pre-war machines and devices, introduce new processes and services, and reduce the cost or improve the quality of innumerable materials and products.

This misconception is due to the fact that engineers so commonly use the misnomer "electronic devices" when they are referring to "electronic-controlled devices."

Thus, when non-technical business men hear of electronic devices for improving the quality or reducing the cost of paper, they think of new paper manufacturing machines. To them, this represents the scrapping of present equipment valued at thousands of dollars, and replacing it with something that produces paper "electronically."

That is not what the radio-electronic engineer means at all, for the improvement in paper manufacture is effected by paying a consulting engineer perhaps $1,000 to plan the application of a $250 electronic control device to the machinery already in use.

This typical example makes clear another vital point. Many people planning to get into the electronic field do not realize that "electronic devices" are only new controls for existing machinery — simply new tails capable of wagging old dogs!

In other words, an electronic control device added to a $50,000 machine may double its present output, and thereby cut the cost of the goods it produces by 50%. Yet this tremendously important service may represent a sale of less than $500.

Right now, there is much confusion between the value of the service performed by electronic control devices and the dollar volume to be realized from such sales!

Many of the industrial applications of electronic control devices will cost more for engineering services than for the apparatus required. Furthermore, the number of possible applications to a given type of machine or process is so small, in many cases, that they will be handled by radio-electronic engineering firms which operate or have available small machine shops and laboratories. Many such companies will be set up after the War, equipped with tools and apparatus which will be offered for sale by war-production plants.

In contrast to this, radio and television equipment, produced in huge volume, is not a mere means to an end, but the end itself. This simple explanation makes clear the fact that however great the *usefulness* of new applications of electronic control devices in industry, the *volume of sales* in that section of the radio-electronic field will be small in comparison to the sale of radio and television equipment.

Present and Future Markets ★ The chart on pages 16 and 17 were prepared as an aid to evaluating the present and future markets for radio-electronic equipment.

All the materials, production equipment, components, and engineering services are shown as clearing through the fundamental circuits originally developed for radio or television communication or remote control. Even the electron microscope, although it employs a unique electronic application, depends for its operation on circuits first applied to radio service.

So as to give a clear picture of present and future radio-electronic markets, the various services have been divided into four numbered groups:

Group 1 ★ The longer the War lasts, the greater will be the peacetime market for home radio and phonograph equipment. Stocks of new sets are not sufficient to meet normal holiday demands this year, and replacement parts are becoming increasingly scarce. The average life of a radio set, if it is kept in good repair by an experienced serviceman, is five years. With 57,000,000 sets in use in 1941, the post-war replacement market will increase at the rate of more than 10,000,000 sets for every year that the War continues!

When sets are put into production again, they will not be $9.95 models, either. Almost without exception, they will provide tuning for both AM and FM broadcasting and foreign short waves.

Furthermore, the almost fantastic development of radar equipment has brought television around the corner, ready to come in on the homestretch of nation-wide home entertainment.

Also, it must be remembered, a large part of the broadcast station equipment will require replacement when Peace comes. This will be added to the volume of sales for new FM and television transmitters.

Total sales, then, in the public service radio field, can be estimated conservatively as providing a billion-dollar-a-year market for several years as soon as men and materials are released from military priorities.

Group 2 ★ For the duration of the War, our military requirements will consume all the materials, components, and finished equipment that industry can produce. Right now, production is falling farther and farther behind our projected needs. The 6,000,000 small panel meters needed for the 1942 fiscal year is set at four times that figure for 1943. Requirements for small mica and paper condensers run into the billions. Schedules on trimmer condensers, transformers, molded Bakelite and ceramic parts, connectors, metal stampings and screw machine parts, tubes, and sockets call for production running into fantastic quantities.

If there were any radio-electronic components left over for any use other than military equipment, and there are not, no labor could be found to fabricate them into finished equipment.

Group 3 ★ The only radio-electronic equipment that is not going into the service of our Armed Forces is, nevertheless, serving military ends or essential wartime needs.

These are such Group 3 applications as aircraft communications, some of the commercial services, emergency communications for police and public utilities, and a few of the sound equipment and recording items.

Under peacetime conditions, the reopening of activities in this Group which

(CONTINUED ON PAGE 31)

COMPARISON OF THE RADIO-ELECTRONIC MARKETS

RAW MATERIALS

Acoustics Products
Alloys
Aluminum
Brass
Bronze
Carbon
Cements
Chemicals
Cord
Copper
Fabrics
Felt
Finishes
Fluxes
Gases
Glass
Iron
Lead
Magnesium
Mica
Molybdenum
Nickel
Palladium
Paper
Plastics
Platinum
Resins
Rubber
Silver
Solder
Solvents
Steel
Tantalum
Tin
Tungsten
Waxes
Wire
Wood
Varnishes
Zinc

PRODUCTION, TESTING & LABORATORY EQUIPMENT

Benches
Bins
Cabinets
Cleaning
Conveyers
Dies
Drafting—
Instruments
Materials
Furnaces
Heaters
Lighting
Machinery—
Coil Winding
Drying
Impregnating
Machine Shop
Model Shop
Molding
Sanding
Screw Machines
Stampings
Tool Room
Tube Production
Winding
Wire Drawing
Ovens
Plating
Soldering Irons
Strippers
Tools
Analyzers
Bridges
Hydrometers
Indicators—
Frequency
Sound Level
Meters—
Electric
Frequency Modulation
Ohm
Output
Q
Oscillators
Oscillographs
Signal Generators
Signal Tracers
Standards
Tachometers
Testers—
Battery
Continuity
Tube Checkers

COMPONENTS, ACCESSORIES & ASSOCIATED APPARATUS

Adapters
Amplifiers
Antennas
Attenuators
Baffles
Batteries
Blanks
Cabinets—
Wooden
Metal
Cases
Castings
Chargers
Chassis
Chassis Holders
Chokes—
AF
Power
RF
Circuit Breakers
Cable—
Coaxial
Drive
Flexible
Insulated
Coils
Cones
Connectors
Controls—
Remote
Tuning
Converters
Couplings
Crystals
Cuttingheads
Dial Belts
Dials
Dynamotors
Eliminators—
Battery
Interference
Engines, Gas
Escutcheons
Filters—
Electric
Noise
Generators
Hardware
Headphones
Horns
Insulators
Inverters
Iron—
Cores
Laminations
Jacks
Keys—
Switching
Telegraph
Knobs
Lamps
Loudspeakers
Magnets
Masts
Meters
Microphones
Mixers
Motor-Generators
Motors—
Phonograph
Tuning
Needles
Oscillators
Panels
Pick-Ups
Plugs
Potentiometers
Power Supplies
Racks
Records
Record Changers
Rectifiers
Relays
Remote Controls
Resistors
Rheostats
Screw Machine Parts
Shafts
Shafts, Flexible
Shields
Shock Absorbers
Sockets
Speakers
Springs
Stampings
Store Equipment
Switches
Terminals
Terminal Strips
Time Switches
Tools
Towers
Transformers—
AF
Power
RF
Trunks
Tubes—
Ballast
Cathode Ray
Electric Eye
Hearing Aid
Photo-Electric
Receiving
Rectifying
Transmitting
Voltage Regulator
Turntables
Vibrators
Wire

ENGINEERING

Consultants
Electronic Laboratories
Industrial Engineers
Testing Laboratories
U. S. Bureau of Standards

EDUCATIONAL

Book Publishers
Colleges, Schools
Correspondence Schools
Government Schools
Technical Magazines

ORGANIZATIONS

Inst. of Radio Engineers
Ntl. Electronic Dist. Assn.
Radio Manufacturers Assn.
Sales Managers Club
The "Reps" N A B A R R L

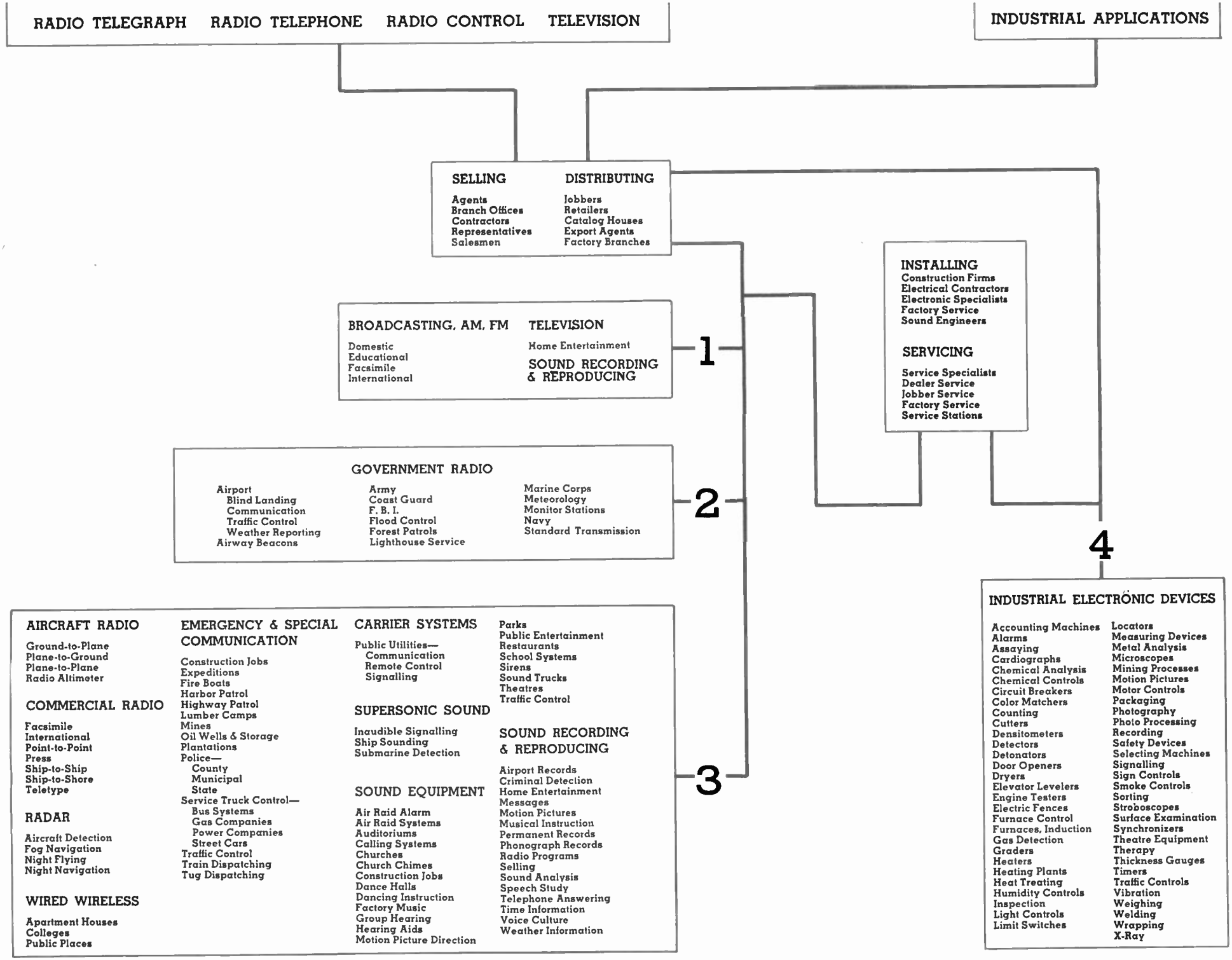
ALL RADIO AND ELECTRONIC EQUIPMENT EMPLOYS ONE OR MORE OF THESE FUNDAMENTAL RADIO CIRCUITS:

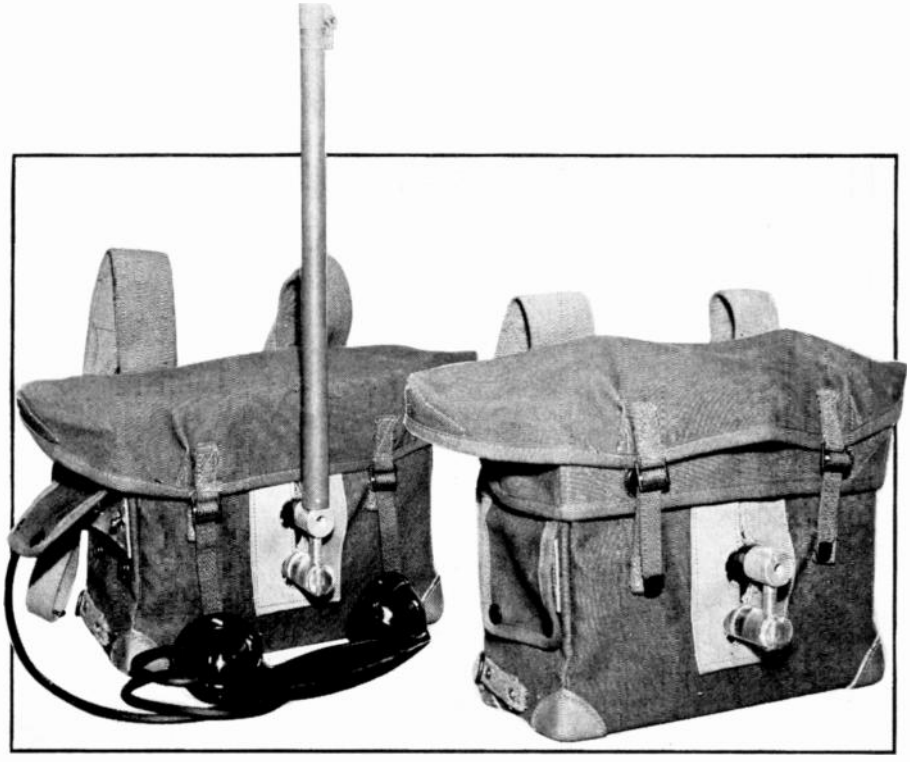
RECTIFIER AMPLIFIER

MIXER RELAY TRIGGER

OSCILLATOR MODULATOR

CATHODE RAY
PHOTO-ELECTRIC


RADIO TELEGRAPH
RADIO TELEPHONE
RADIO CONTROL
TELEVISION
INDUSTRIAL APPLICATIONS
SELLING
Agents
Branch Offices
Contractors
Representatives
Salesmen
DISTRIBUTING
Jobbers
Retailers
Catalog Houses
Export Agents
Factory Branches
INSTALLING
Construction Firms
Electrical Contractors
Electronic Specialists
Factory Service
Sound Engineers
SERVICING
Service Specialists
Dealer Service
Jobber Service
Factory Service
Service Stations
BROADCASTING, AM, FM
Domestic
Educational
Facsimile
International
TELEVISION
Home Entertainment
SOUND RECORDING & REPRODUCING
1
GOVERNMENT RADIO
Airport
Blind Landing
Communication
Traffic Control
Weather Reporting
Airway Beacons
Army
Coast Guard
F. B. I.
Flood Control
Forest Patrols
Lighthouse Service
Marine Corps
Meteorology
Monitor Stations
Navy
Standard Transmission
2
4
INDUSTRIAL ELECTRONIC DEVICES
Accounting Machines
Alarms
Assaying
Cardiographs
Chemical Analysis
Chemical Controls
Circuit Breakers
Color Matchers
Counting
Cutters
Densitometers
Detectors
Detonators
Door Openers
Dryers
Elevator Levelers
Engine Testers
Electric Fences
Furnace Control
Furnaces, Induction
Gas Detection
Graders
Heaters
Heating Plants
Heat Treating
Humidity Controls
Inspection
Light Controls
Limit Switches
Locators
Measuring Devices
Metal Analysis
Microscopes
Mining Processes
Motion Pictures
Motor Controls
Packaging
Photography
Photo Processing
Recording
Safety Devices
Selecting Machines
Signalling
Sign Controls
Smoke Controls
Sorting
Stroboscopes
Surface Examination
Synchronizers
Theatre Equipment
Therapy
Thickness Gauges
Timers
Traffic Controls
Vibration
Weighing
Welding
Wrapping
X-Ray
AIRCRAFT RADIO
Ground-to-Plane
Plane-to-Ground
Plane-to-Plane
Radio Altimeter
COMMERCIAL RADIO
Facsimile
International
Point-to-Point
Press
Ship-to-Ship
Ship-to-Shore
Teletype
RADAR
Aircraft Detection
Fog Navigation
Night Flying
Night Navigation
WIRED WIRELESS
Apartment Houses
Colleges
Public Places
EMERGENCY & SPECIAL COMMUNICATION
Construction Jobs
Expeditions
Fire Boats
Harbor Patrol
Highway Patrol
Lumber Camps
Mines
Oil Wells & Storage
Plantations
Police—
County
Municipal
State
Service Truck Control—
Bus Systems
Gas Companies
Power Companies
Street Cars
Traffic Control
Train Dispatching
Tug Dispatching
CARRIER SYSTEMS
Public Utilities—
Communication
Remote Control
Signalling
SUPERSONIC SOUND
Inaudible Signalling
Ship Sounding
Submarine Detection
SOUND EQUIPMENT
Air Raid Alarm
Air Raid Systems
Auditoriums
Calling Systems
Churches
Church Chimes
Construction Jobs
Dance Halls
Dancing Instruction
Factory Music
Group Hearing
Hearing Aids
Motion Picture Direction
Parks
Public Entertainment
Restaurants
School Systems
Sirens
Sound Trucks
Theatres
Traffic Control
SOUND RECORDING & REPRODUCING
Airport Records
Criminal Detection
Home Entertainment
Messages
Motion Pictures
Musical Instruction
Permanent Records
Phonograph Records
Radio Programs
Selling
Sound Analysis
Speech Study
Telephone Answering
Time Information
Voice Culture
Weather Information
3



LEFT: READY FOR OPERATION. RIGHT: HANDPIECE AND ANTENNA STOWED AWAY

2-WAY AM PACK SET

Designed to Give Extra-Long Service on Self-Contained Batteries

FRED BUDELMAN*

THE new ultra-high frequency portable radio transmitter-receiver shown in the accompanying illustrations is a complete assembly designed for two-way radio telephone communication in the 30 to 40-mc. band. The set is furnished complete with tubes, crystal, handset, telescopic antenna, knapsack, batteries and all the necessary accessories for accomplishing two-way communication in the field.

General Description ★ This pack set, known as the Link model 695-B, is especially designed for open field service where the telescopic antenna can be stretched at all times to its maximum length for best efficiency. However, for short distance communication, the set may be operated with the antenna fully collapsed or with one section extended without further adjustments. The set can be operated either while being carried on the back of the operator or resting on any flat surface. A canvas knapsack with shoulder straps is provided to facilitate carrying. When the set is used as a fixed station, it is advisable to operate it on its side on a flat surface with the antenna mounting side up to increase the mechanical stability. Provision is made to mount the antenna in two directions so that it may always be in a vertical position. The transmitter-receiver is housed in a single compact spray-proof unit. Following are the essential specifications:

Frequency ranges: 30–33, 33–36 or 36–40 megacycles. Type of emission: Amplitude modulated radio telephone.
Transmitter circuit: Crystal stabilized.
Transmitter power output: ½ watt.
Modulation capability: 100%
Receiver circuit: Super-regenerative.
Receiver output: Telephone receiver intensity.
Audio response: 200 to 3000 cycles.
Tube complement: Two 1T4, one 1S5, two 3Q4, two 3A5.
Power supply: Plate 90 v. (two) No. 428 Eveready Minimax batteries.
Filament (nine) No. 950 Eveready 1.5-v. unit cells.
Battery life: 70 hrs. transmitting and receiving or 200 hrs. receiving alone.
Antenna: 12½-ft. collapsible.
Weight: 18 lbs. complete with antenna, handset and knapsack.
Mounting: Special knapsack with shoulder straps and provisions for carrying handset and collapsible antenna.

The power supply in this unit is self-contained. The batteries are enclosed in metal compartments on the bottom cover, as the accompanying illustrations show. Electrical connection between the power supply and the transmitter-receiver is by means of a nondetachable 5-conductor flexible cable. Tuning adjustments, tubes, crystals, fuse and meter jack are accessible by removal of the top cover of the case.

The total number of tubes employed is seven: four for the transmitter and three for the receiver. The tube types and their uses are as follows:

Transmitter:
1 Type 3A5: Crystal oscillator and doubler.
1 Type 3A5: Doubler and power amplifier
2 Type 3Q4: Push-pull modulators.

Receiver:
1 Type 1T4: RF amplifier.
1 Type 1T4: Super-regenerative detector
1 Type 1S5: Audio output

The changeover from receiving to transmitting is accomplished by means of a transfer relay controlled by a push-to-talk button on the handset. The relay acts to put filament voltage on the receiver or transmitter tubes, as the case may be.

The transmitter is crystal stabilized. The fundamental crystal frequency is multiplied four times in order to obtain the final operating frequency. A metering jack is provided in the PA plate circuit for adjustment of all stages.

The receiver is of the super-regenerative detector type. A stage of RF amplification increases the sensitivity of the receiver and helps to decrease the radiation effect of the detector and the reaction between detector and antenna. A switch is incorporated in the set to permit tuning the receiver to the same frequency as the associated transmitter without an external carrier signal.

Accessories ★ Each 695-B equipment includes, in addition to the transmitter-receiver described above, all accessories to complete the ready-to-use field set. These are:

Push-to-talk handset with flexible cable and four prong male plug.
12½-ft. collapsible antenna.
Canvas knapsack or reinforced leather handle.
One complete set of batteries.
Instruction book.

Circuit Description ★ In the design of a portable pack set the electrical performance, weight, mechanical structure and battery life are all equally important. Great effort has been spent in the 695-B pack set to conserve current drain, simplify the electrical circuit and rigidify the mechanical construction without sacrificing other desirable features. The transmitter and receiver circuits are independent of each other except for a common power source, a ⅜-wavelength antenna, and the modulation transformer.

Transmitter Section ★ The transmitter utilizes the first section of a type 3A5 double-triode connected as a conventional crystal stabilized oscillator. The low drift AT cut crystal is ground to ¼ the final frequency. This is raised to the final output frequency by means of two RF doublers. Since the output frequency ranges are either 30–33, 33–36, or 36–40 mc., the crystal frequencies will lie between 7.5 to 8.25, 8.25 to 9 and 9 to 10 mc. respectively. The second section of the first type 3A5 tube acts as a frequency doubler and its output

*Chief Engineer Link Radio Corp., 125 W. 17th St.

is inductively coupled to drive the grids of the final doubler stage which also utilizes a type 3A5 tube having the two triodes connected in parallel. All transmitter RF stages act as high efficiency Class C radio frequency amplifiers with grid leak bias.

The PA tank is inductively coupled to a high impedance $\frac{3}{8}$-wavelength collapsible antenna. A variable condenser is connected in series with the antenna to resonate the antenna circuit. It has been shown by experience that a $\frac{3}{8}$-wave antenna provides uniform operating results without retuning whether the set is being carried on the back or placed on the ground and that much less detuning and loss of range is caused by proximity of persons to the set or antenna. Since the characteristics of the type 3A5 tubes are designed for zero grid bias operation, no excessive plate current flows in these tubes when the oscillator stops oscillation. Only one meter jack in the final tank circuit is necessary for the adjustment of all three transmitter stages.

High level amplitude modulation is employed in the transmitter. The modulation system consists of 2 type 3Q4 push-pull modulators. The voice input is derived from a standard telephone handset. Microphone transformer supplies the audio intelligence directly to the type 3Q4 grids. No change of current should be observed on the tuning meter when talking into the microphone.

Receiver Section ★ The receiver is of the super-regenerative self-quenching detector type. A type 1T4 acts as the detector. The quench-frequency is determined mainly by the parallel combination of the grid leak resistor and grid condenser.

The detector is preceded by a tuned RF stage utilizing a type 1T4 tube as an RF amplifier. Its grid circuit is inductively tuned and inductively coupled to the antenna in the RF transformer. Its plate circuit is inductively coupled to the detector tuned circuit. The output of the detector contains a great deal of high frequency noise as well as a high level of the quench-frequency voltage. A low-pass filter is incorporated to remove these unnecessary components and to prevent blocking of the 1S5 audio amplifier by the high frequency squelch voltage.

The type 1S5 audio amplifier is transformer coupled to the earphone of the handset. It should be noted here that the iron-core transformers are all identical, even though used for different purposes. This feature reduces the number of spare parts required for adequate field service.

Power and Control Circuits ★ Four different voltages are employed in this set; the 90-v. plate supply, the 1.5-v. filament and microphone supply, the 3-v. relay supply and the 4.5-v. grid bias supply. The plate supply consists of two Eveready Minimax No. 482 45-volt batteries. The filament, microphone and relay supplies use 9 Eveready No. 950 1.5-v. unit cells. The grid bias voltage for the modulator grids is made up of a special 4.5-v. bias cell assembly which does not wear out and needs no replacement. A $\frac{1}{4}$-ampere fuse is inserted in the high voltage end of the plate power supply to prevent any damage to the set in case of abnormal current drain due to short circuit or other unexpected troubles. Since all the tubes used are the direct quick heating filament type there is no warm up period. Plate voltage is permanently connected to the transmitter-receiver circuit and a switch is provided in the filament circuit to turn the set on and off. An electrical interlock with the handset plug prevents the filaments from being lit when the switch is turned on unless the handset is plugged into the socket. This prevents discharge of the batteries if the ON-OFF switch is accidentally turned ON.

The relay provides push-to-talk control of the change-over from receiving to transmitting. It has six contacts arranged as two SPDT switches. The relay coil derives its energy from the 3-volt battery made up of one unit cell in series with 8 others of the same type connected in parallel. The 8 parallel 1.5-v. cells also supply power to the transmitter-receiver filaments and microphone. When the coil is not energized, that is, the button is released on the handset, the relay remains in the receiving position.

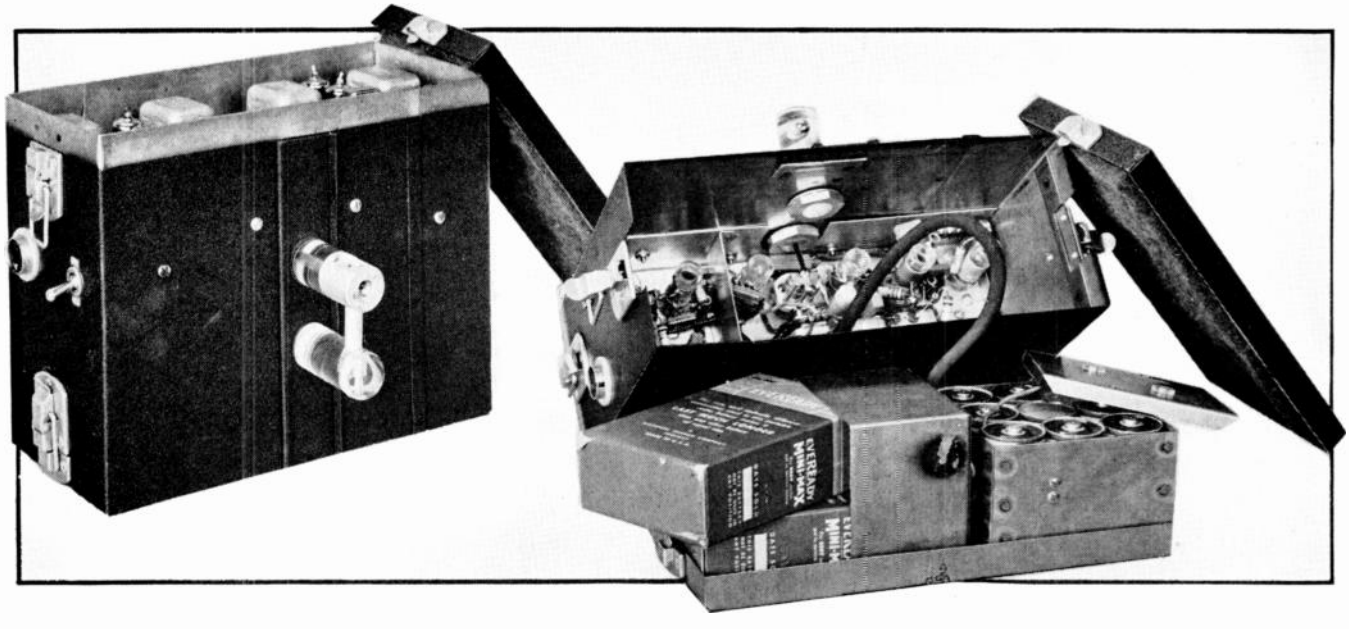
A SPDT toggle switch connects the filament of the 3A5 oscillator triode in parallel either with the rest of the transmitter tube filaments or the receiver tube filaments. When the switch is in the TUNE position the oscillator filament is lit while receiving. This causes the crystal to oscillate and provides a weak signal harmonic of the crystal frequency with which to tune the receiver. When the switch is in the TRANS position the oscillator filament is in parallel with the rest of the transmitter tube filaments.

Reference Index: Vacuum Tube Reviews

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

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

CONSTRUCTIONAL DETAILS OF THE LINK 695-B BATTERY-OPERATED PACK SET, BATTERY COMPARTMENT MOUNTS UNDERNEATH

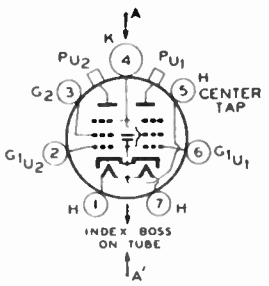


VACUUM TUBE REVIEW

A reference index of tubes listed in previous issues of Radio-Electronic Engineering will be found on page 19. A revised index is published each month

832-A

Push-Pull Beam Power RF Amplifier



PLANE OF ELECTRODES OF EACH UNIT IS PARALLEL TO PLANE THROUGH AXIS OF TUBE AND AA'

832-A is a heater-cathode type of transmitting tube containing in one envelope two beam power units. This tube is designed primarily for use as a push-pull RF power amplifier with maximum ratings at frequencies as high as 200 mc., and with reduced ratings at frequencies as high as 250 mc. Its total plate dissipation is 15 watts for Class C telegraph service. Neutralization is unnecessary in adequately shielded circuits.

The exceptional efficiency of the 832-A at ultra-high frequencies is made possible by the balanced and compact structure of the beam power units, excellent internal shielding, and close electrode spacing. The internal leads are short and heavy in order to minimize internal lead inductance. The terminal arrangement provides splendid insulation and is designed to facilitate symmetry of circuit layout.

The heaters are arranged to allow operation from either a 12.6 or a 6.3-volt supply.

CHARACTERISTICS AND RATINGS

Unless otherwise specified, values are for both units:

Heater:	
Voltage, AC or DC, per unit	6.3 volts
Current, per unit	0.8 amp.
Transconductance for plate current of 30 milliamps., approx.	3,500 μmhos
Grid-screen mu factor	7
Direct interelectrode capacitances, each unit:	
Grid-plate, with external shielding, maximum	0.05 μμf.
Input	7.5 μμf.
Output	3.8 μμf.
Screen-cathode capacitance, including internal screen bypass condenser, approx.	65 μμf.
Bulb	T-16
Socket	See INSTALLATION

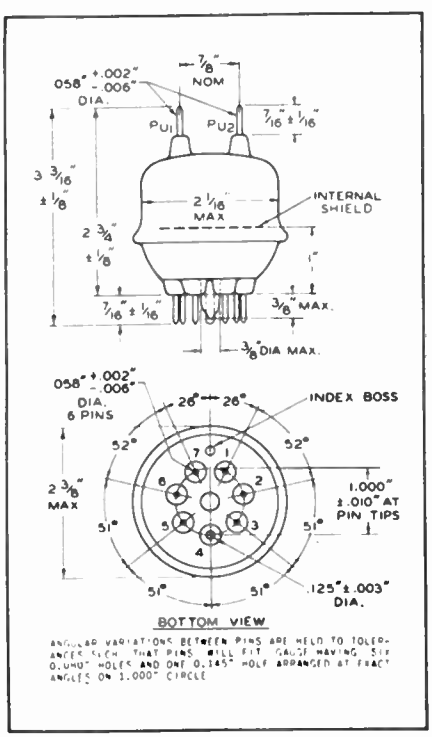
MAXIMUM CONTINUOUS COMMERCIAL SERVICE RATINGS AND TYPICAL OPERATING CONDITIONS

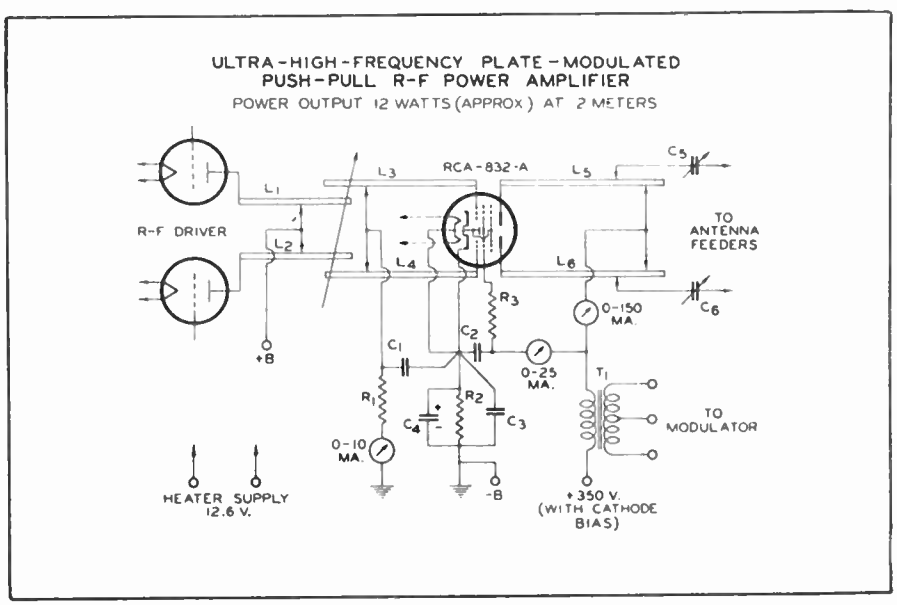
Following maximum ratings are absolute values. Unless otherwise specified, values are for both units.

As GRID-MODULATED PUSH-PULL RF POWER AMPLIFIER, CLASS C TELEPHONY

Carrier conditions per tube for use with a maximum modulation factor of 1.0:

DC plate, max.	750 volts	
DC screen, grid 2, max.	250 volts	
DC grid, grid 1, max.	−100 volts	
DC plate, max.	55 ma.	
Plate input, max.	22 watts	
Screen input, max.	3.4 watts	
Plate dissipation, max.	15 watts	
Typical operation with modulation factor of	0.8	0.9 volts
DC plate	500	750 volts
DC screen	200	200 volts
DC grid	−55	−60 volts
Peak RF grid-to-grid	100	100 volts
Peak AF grid	14	16 volts
DC plate	44	29 ma.
DC screen	3	2 ma.
DC grid, approx.	0	0 ma.
Driving power, approx.[1]	0.1	0.1 watt
Power output, approx.	8	8.5 watts





NOTE: Adjust coupling of L_1, L_2 and L_3, and L_4 for optimum grid excitation.

C_1 500 μμf.
C_2 500 μμf.
C_3 500 μμf.
C_4 25 mfd.
C_5 3 to 35 μμf.
C_6 3 to 35 μμf.
R_1 10,000 to 20,000 ohms, 1 watt.
R_2 300 ohms, 5 watts.
R_3 7,500 ohms, 5 watts.
L_1 Dimensions dependent upon type of driver tube. Approximately same as L_5, L_6.
L_2 Same as above.
L_3 ¼" diameter copper tubing, approx. 10" long, spaced 1" between centers.
L_4 Same as above.
L_5 ¼" diameter copper tubing, approx. 12" long, spaced 1" between centers.
T_1 Modulation transformer.

As Plate-Modulated Push-Pull RF Power Amplifier, Class C Telephony

Carrier conditions per tube for use with a maximum modulation factor of 1.0:

DC plate, max.	600	volts
DC screen, grid 2, max.	250	volts
DC grid, grid 1, max.	−100	volts
DC plate, max.	68	ma.
DC grid, max.	6	ma.
Plate input, max.	22	watts
Screen input, max.	3.4	watts
Plate dissipation, max.	10	watts
Typical operation:		
DC plate	425 600	volts
DC screen voltage:		
from a fixed supply of	200 200	volts
from series resistor of [2]	14,000 25,000	ohms
DC grid voltage:		
from fixed supply of	−60 −65	volts
from grid resistor of [3]	25,000 25,000	ohms
Peak RF grid-to-grid	140 150	volts
DC plate	52 36	ma.
DC screen	16 16	ma.
DC grid, approx.	2.4 2.6	ma.
Driving power, approx.	0.15 0.16	watt
Power output, approx.	16 17	watts

As Push-Pull RF Power Amplifier and Oscillator, Class C Telegraphy

Key-down conditions per tube without modulation [4]:

DC plate, max.	750	volts
DC screen, grid 2, max.	250	volts
DC grid, grid 1, max.	−100	volts
DC plate, max.	90	ma.
DC grid, max.	6	ma.
Plate input, max.	36	watts
Screen input, max.	5	watts
Plate dissipation, max.	15	watts
Typical operation:		
DC plate	500 750	volts
DC screen voltage:		
from fixed supply of	200 200	volts
from series resistor of	21,000 37,000	ohms
DC grid voltage:		
from fixed supply of	−65 −65	volts
from grid resistor of [3]	25,000 23,000	ohms
from cathode resistor of	730 1,000	ohms
Peak RF grid-to-grid	150 150	volts
DC plate	72 48	ma.
DC screen	14 15	ma.
DC grid, approx.	2.6 2.8	ma.
Driving power, approx.	0.18 0.19	watt
Power output, approx.	26 26	watts

[1] At crest of AF cycle with modulation factor indicated.

[2] Connected to modulated plate-voltage supply.

[3] The grid circuit resistance should never exceed 25,000 ohms total per tube, or 50,000 ohms per unit. If additional bias is necessary, use a cathode resistor or a fixed supply.

[4] Modulation essentially negative can be used if the positive peak of the AF envelope does not exceed 115% of the carrier conditions.

INSTALLATION AND APPLICATION

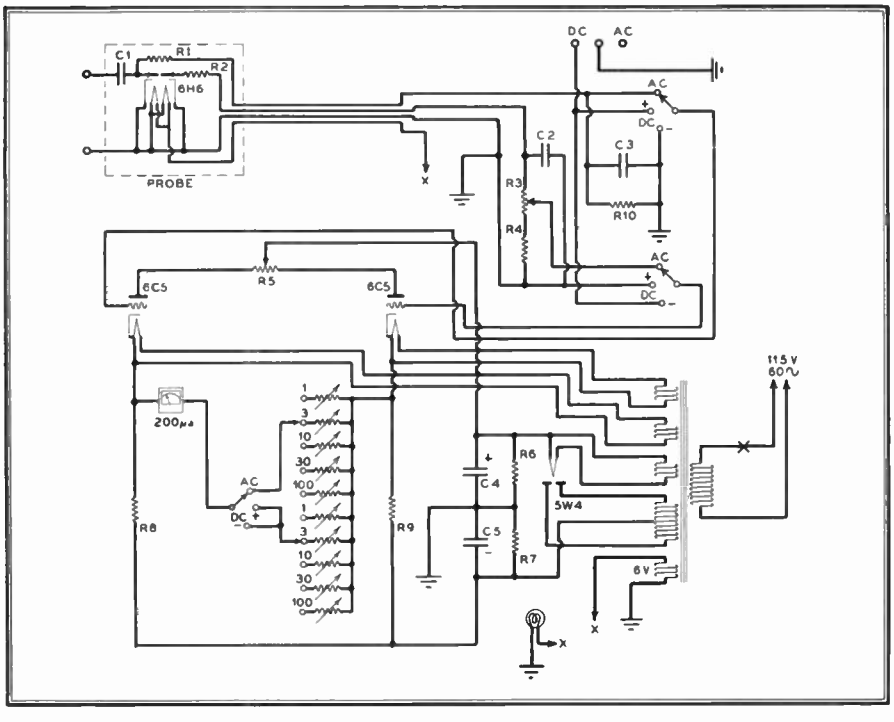
The notes on Installation and Application given for the 829-A tube apply without change or modification to the 832-A tube, and for that reason are not repeated here.

VT VOLTMETER DESIGN

(CONTINUED FROM PAGE 14)

about 7 mmf. Since a 10-megohm diode leak is provided, the input impedance is approximately .5 megohms at the lower frequencies.

that usually present in other types of vacuum tube voltmeters at these frequencies. Another probe is available for ultra-frequency measurements. It has a capacity of 2 mmf., with a resonant frequency of 1,000 mc., and can be used at over 500 mc.



SCHEMATIC WIRING DIAGRAM OF MEASUREMENTS CORPORATION MODEL 62 VT METER

If the binding posts of the probe are shorted at their base, the resonant frequency of the resulting circuit is 350 mc. The probe is suitable for use on frequencies well beyond 100 mc. There is, of course, some loading, but it is less than

NEW CHIEF OF B. OF A.

REAR ADMIRAL JOHN S. McCAIN, who is to become chief of the Navy's Bureau of Aeronautics, was 41 when he first went to the Naval Air Station in Pensacola, Fla., for aviation training. He was 42 when he pinned on his first wings. Admiral Ernest J. King was then chief of the Bureau of Aeronautics, carriers were then emerging from the blueprint stage, and several officers about his age had decided to take a fling into the new branch of aviation.

He has never been a desk aviator. That is illustrated by the fact that few people in the Bureau at Washington actually know him personally, but they know him from his long record of efficient air operations.

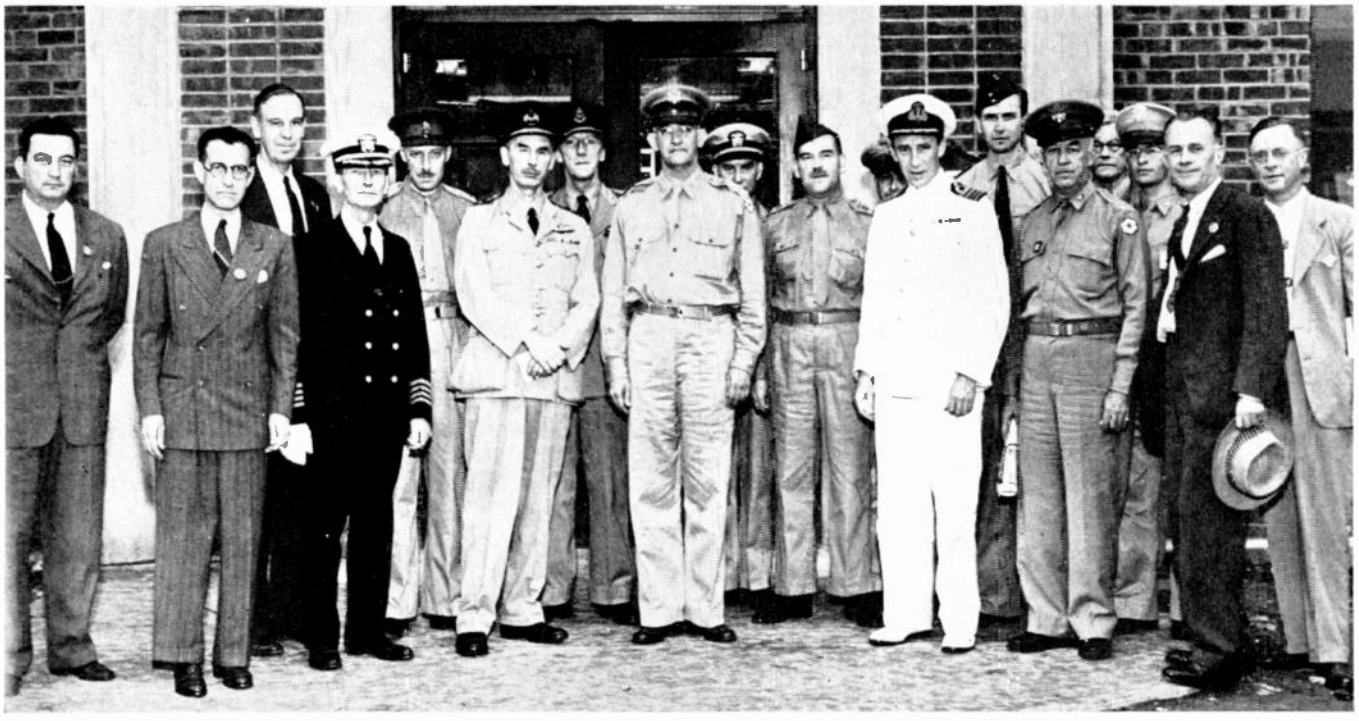
As soon as he left Pensacola, he took charge of the fleet base at Coco Solo, Canal Zone, and also commanded attending craft. In 1937, after a year at Coco Solo, he was given command of the carrier Ranger. From that ship he went to take charge of the Naval Air Station at San Diego, Calif., and from that post became commander of the aircraft scouting force.

He has now left an unnamed spot in the Pacific, and is expected to reach Washington the latter part of October.

Born in Teoc, Tenn., August 19, 1884, Rear Admiral McCain attended school in Carrollton, Tenn., and the University of Mississippi before appointment to the Naval Academy in 1902.

He holds the Victory Medal, Mexican Campaign Medal and the American Defense Service Medal. Although he has been on wide-spread locations, he lists his home as Carrollton. He is married, and has three children. One, Lt. John S. McCain, Jr., is a naval officer.

Rear Admiral McCain comes to the bureau to succeed Rear Admiral John H. Towers, who recently was named a Vice Admiral and put in command of the air force of the Pacific Fleet.



BRITISH & AMERICAN OFFICERS visiting GE's radio shops at Schenectady. Left to right: W. D. Maroney, Dr. W. R. G. Baker, R. C. Robinson, Capt. J. S. Evans, Brig. Gen. R. F. H. Nalder, Air Com. O. G. W. G. Lywood, Capt. A. F. Lang, Brig. Gen. R. D. Colton, Lt. Comdr. E. B. Patterson, Col. W. D. T. Harries, Maj. P. E. Ketterer, Capt. F. J. Wylie, Sq. Ldr. F. Williams, Col. C. Badeau, W. V. B. Van Dyck, Capt. J. E. McCaw, G. W. Henyan, and C. H. Baade

(CONTINUED FROM PAGE 12)

is to prevent interference from another transmitter on the same frequency. Signals can be received only on FM receivers.

Esther Fischer: At WKAT is the first woman radio engineer to be employed in a Florida station. She got the job a week after she finished her course and passed her operator's examination.

Name Changed: By vote of the stockholders, Hygrade Sylvania Corp. name has been changed to Sylvania Electric Products, Inc.

Intent: Of new Price Adjustment Board boils down to (1) maintenance of the system of private enterprise, (2) recognition of the fact that solvency and financial prudence in business management are essential to efficient operation, (3) enabling business, as far as possible, to emerge from the War in good condition. It is not planned to reopen 1941 profits for study except in unusual cases. Treasury definitions for tax purposes concerning advertising and other costs will govern.

Worn out Transmitter Tubes: Of 250-watt plate dissipation or more are being salvaged by G.E. Stations are asked to ship them to Schenectady, marked "Defective Apparatus for Salvaging." If proper cartons are not on hand, G.E. will furnish them. Purpose is to reclaim strategic metals.

Expensive Failure: Failure of power supply from Long Island Lighting Company on August 25th shut down WEAF from 10:42 to 10:48, again from 10:53 to 10:58, and then from 11:02 to 12:45. Station will rebate $1475, less discounts, to advertisers.

Frederick S. Barton: Chief of British Air Commission's radio division at Washington was nominated for vice presidency of I.R.E., a post which usually goes to a foreigner who has distinguished himself in radio.

At Newport, Vt.: Roy A. Weagant, 1919 winner of the Morris-Liebmann award and pioneer radio engineer and inventor, passed away on August 23, at the age of 61. A graduate of McGill University, he was chief engineer of Marconi Wireless Telegraph Company from 1915 to 1920, and consulting engineer at RCA for the four years following. In 1924, he became chief engineer of deForest Radio. Subsequently, he returned to RCA as a consultant and patent expert. He is survived by his widow, Isobel L. Reichling Weagant.

Seagoing All-Wave Radio: Officers and crew members lost their best source of entertainment at sea when the Navy and Merchant Marine found that radiation from all-wave receivers could be picked up by submarines at distance of 25 miles. Now, Scott Radio Laboratories have designed a non-radiating set, approved by FCC engineers, which tunes 530 to 1,600 kc., 6.55 to 9.55 mc., and 9.2 to 15.6 mc., yet keeps well below the limit of 400 microwatts across any load at any operating frequency. Set can be used with a single speaker, or with ship's public address system.

$60,000,000 Loan: Floated by RCA Mfg. Company through Bankers Trust Company of New York and 34 participating banks, for a period of 3 years, to finance War contracts, under regulation of Federal Reserve System which authorizes Army, Navy, and Maritime Commission to guarantee loans made to facilitate War production.

More FM Licenses: WDRC, Inc., at Hartford, Bamberger Broadcasting Service, New York City, and WBNS, Inc., Columbus, have applied for licenses to cover their FM construction permits so that they can continue to operate their FM transmitters under the special August 4th FCC order.

James S. Knowlson: Will be key man in making decisions on distribution of materials between military and civilian end-uses, under the new WPB set-up that takes priority allocations away from Army and Navy.

Parts Price Ceiling: Radio parts will be put under OPA March 31st price ceiling, according to announcement by Chief Maurice C. Lee of OPA Electrical Section, Machinery Division, at Chicago conference of parts manufacturers. General impression is that this is a new if-and-and-but regulation that will be a headache until regulations have jelled into something definite enough for all to understand.

Near technical perfection is achieved through use of scientific instruments but the trained eyes of skilled workmen inspect completed units before they are passed along to the pumps

An important reason why Eimac tubes set the modern pace in communications

In the fabrication of plates, sealing of stems and leads, winding of grids...every tiny part must pass the rigid inspection of trained individuals, precision testing devices. At the end of each production line sits a group of hardboiled inspectors. All this checking and testing takes place before Eimac tubes reach the vacuum pumps. That's one of many reasons why Eimac tubes possess such uniformity of characteristics . . . why their performance records have made them first choice among world's leading engineers.

Follow the leaders to

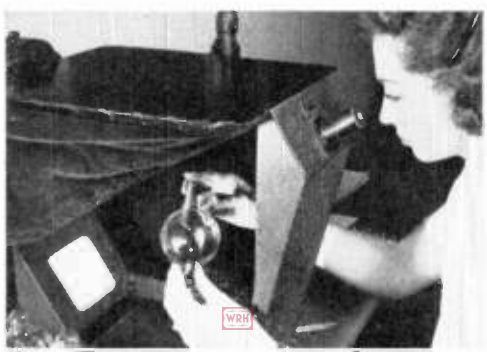
Eimac TUBES

Manufactured by **EITEL-McCULLOUGH, INC., SAN BRUNO, CALIFORNIA, U. S. A.**

Export Agents: Frazar & Co., 301 Clay St., San Francisco, California, U. S. A.

Bead tester utilizes polarized light in search for stress points in glass beads which seal leads to bulbs

Polariscope is here used to inspect glass bulbs for flaws or strain which may occur during the shaping operations



General inspection bench where completed filament stems and assemblies are thoroughly checked for faulty construction

RADIO-ELECTRONIC PRODUCTS DIRECTORY

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

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

ANTENNAS, Mobile Whip
Galvin Mfg. Corp., Chicago, Ill.
Link, F. M., 125 W. 17th St., N. Y. C.
Premax Products, 4214 Highland Ave., Niagara Falls, N. Y.
Radio Eng. Labs., Inc., Long Island City, N. Y.
Ward Products Corp., 1523 E. 45 St., Cleveland, O.

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

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

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

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

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

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

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

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

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

CLIPS & MOUNTINGS, Fuse
Alden Prods. Co., Brockton, Mass.
Dante Elec. Mfg. Co., Bantam, Conn.
Isco Copper Tube & Prods., Inc., Station M, Cincinnati
Jefferson Elec. Co., Bellwood, Ill.
Jones, Howard B., 2300 Wabansia, Chicago
Littlefuse, Inc., 4753 Ravenswood, Chicago
Patton MacGuyer Co., Providence, R. I.
Sherman Mfg. Co., H. B., Battle Creek, Mich.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

GEARS & PINIONS, Metal

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

GEARS & PINIONS, Non-Metallic

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

GENERATORS, Gas Engine Driven

Kato Engineering Co., Mankato, Minn.

HEADPHONES

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

HORNS, Outdoor

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

INSTRUMENTS, Radio Laboratory

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

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

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

IRONS, Soldering

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

KNOBS, Radio & Instrument

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

LABORATORIES, Electronic Research

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

LIGHTS, Pilot or Indicator

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

LUGS, Copper

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

MACHINES, Impregnating

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

MACHINES, Numbering

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

MACHINES, Riveting

Chicago Rivet & Machine Co., Bellwood, Illinois

MACHINES, Screwdriving

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

MAGNETS, Permanent

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

METAL, Thermostatic

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

METALS, Pressed Powder

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

METERS, Ammeters, Voltmeters, Small Panel

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

MICA

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

MICROPHONES

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

MONITORS, Frequency

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

MOTOR-GENERATORS, Dynamotors, Rotary Converters

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

MOUNTINGS, Shock Absorbing

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

MYCALEX

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

NUTS, Self-Locking

Elastic Stop Nut Corp., Union, N. J.
Palnut Co., Inc., Irvington, N. J.
Standard Pressed Steel Co., Jenkintown, Pa.

OVENS, Industrial & Laboratory

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

PILOT LIGHTS

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

PHOSPHOR BRONZE

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

PLASTICS, Extruded

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

PLASTICS, Laminated or Molded

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

PLASTIC, Sheet for Name Plates

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

PLUGS & JACKS, Spring Type

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

PLUGS & JACKS, Telephone Type

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

PRESSES, Plastic Molding

Kux Machine Co., 3930 W. Harrison, Chicago

PRESSES

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

RECTIFIERS, Current

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

REGULATORS, Temperature

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

REGULATORS, Voltage

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

RELAYS, Small Switching

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

RELAYS, Small Telephone Type

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

RELAY TESTERS, Vibration

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

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

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Intern'l Resistance Co., Philadelphia
Ohmite Mfg. Co., 4835 Flournoy St., Chicago

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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.
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Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago
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Stackpole Carbon Co., St. Marys, Pa.
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Ward Leonard Elec. Co., Mt. Vernon, N. Y.
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Lamson & Sessions, Cleveland, O.
National Screw & Mfg. Co., Cleveland, O.
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Parker Co., Charles, The, Meriden, Conn.
Parker-Kalon Corp., 198 Varick, N. Y. C.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Mfg. Co., Chicago
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Southington Hardw. Mfg. Co., Southington, Conn.
Standard Pressed Steel Co., Jenkintown, Pa.
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Standard Pressed Steel Co., Jenkintown, Pa.

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Gibson Co., Wm. D., 1800 Clybourn Av., Chicago
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Muehlhausen Spring Corp., Logansport, Ind.
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Micro Switch Corp., Freeport, Ill.

SWITCHES, Rotary Tap, Bakelite Base
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Ferranti Elec., Inc., 30 Rockefeller Plaza, N. Y. C.
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Gen'l Radio Co., Cambridge, Mass.
General Trans. Corp., 1250 W. Van Buren, Chicago
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Jefferson Elec. Co., Bellwood, Ill.
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Superior Elec. Co., Bristol, Conn.
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Dumont Labs., Allen B., Passaic, N. J.
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Nat'l Union Radio Corp., Newark, N. J.
RCA Mfg. Co., Camden, N. J.

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

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Bradley Labs., New Haven, Conn.
Cont'l Elec. Co., Geneva, Ill.
De Jur-Amsco Corp., Shelton, Conn.
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Electronic Laboratory, Los Angeles, Cal.
Emby Prods. Co., Los Angeles, Cal.
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Weston Elec. Inst. Corp., Newark, N. J.

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Hytron Corp., Salem, Mass.
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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.

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Hytron Corp., Salem, Mass.
RCA Mfg. Co., Camden, N. J.

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Formica Insulation Co., Cincinnati, O.
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Mica Insulator Co., 196 Varick, N. Y. C.
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Richardson Co., Melrose Park, Chicago
Synthane Corp., Oaks, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Wilmington Fibre Specialty Co., Wilmington, Del.

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Brand & Co., Wm., 276 Fourth Av., N. Y. C.
Endurette Corp. of America, Cliffwood, N. J.
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WIRE, Magnet
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Ansonia Elec. Co., Ansonia, Conn.
Belden Mfg. Co., 4633 W. Van Buren, Chicago
Electric Auto-Lite Co., The, Port Huron, Mich.
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THE RADIO-ELECTRONIC MARKETS

(CONTINUED FROM PAGE 15)

are now cut off will more than offset the cessation of wartime demand for others.

Group 4 ★ Lack of materials and engineering personnel have stopped off all activities in the field of industrial electronic applications except for those that are directly concerned with machines and processes used to manufacture essential military products.

Meanwhile, inventions and improvements now confined to military use and classified as confidential or secret are being made which will have enormously important industrial applications when our Country goes back to peacetime activities.

It must be emphasized that these inventions are of significance to the industries which use them, and to the public which will consume the finished products, but they will represent only a minor market, compared to Groups 1 and 3, for radio-electronic materials, components, and apparatus.

For example: the manufacturers of wrapping machines may revise some of their standard models in order to use a simple electronic control device through which the capacity of the machines will be increased 20%. However, it would be impractical for a manufacturer of radio-electronic equipment to go into building wrapping machines.

This point of difference should be understood clearly. Otherwise, the inestimable value which will come to the consuming public from post-war industrial electronic control applications will be confused with the limited dollar-volume represented by this part of the total radio-electronic market.

NEW ADDRESS FOR FM MAGAZINE

ALONG with many of our subscribers, FM Radio-Electronic Engineering Magazine has changed its address, although the telephone number remains LE 2-8070.

We are still in the Murray Hill section of New York City, for our new quarters are at 21 East 37th Street, between Park Avenue and Madison Avenue. On one side of us is the New Deal's National Democratic Club, and on the other is the ultra-conservative Union League Club.

We shall have to be careful of our politics, therefore, and of our conduct, too, for Mr. J. P. Morgan can look in on us from his famous brownstone mansion right across the street. We are obliged to him for providing us with an interesting view of the Morgan Library and the grounds surrounding it.

No. 21 is distinguished from all the other buildings on this block by a shining brass handrail which runs up the entrance steps.

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MOST of the research and development work being carried on at the Browning Laboratories is of a confidential or secret character, but there's no need for secrecy about the Browning Electronic Boundary Protection installations. The reason is that if a saboteur knew all about the system, there would be no way for him to get into an area so protected without disclosing his presence immediately!

With a Browning installation on guard, he must either stay away or be "eliminated" as a servant of our enemies.

There are no lights that the saboteur can circumvent, nothing that he can crawl under or over or put out of commission. The Browning Electronic Boundary Protection is rated as FOOL-PROOF. This is true in theory, and has proved to be the case in practice, where Browning equipment is guarding vital public utility installations.

Furthermore, these systems have been in use long enough to show that, in addition to their many other advantages, the maintenance cost is extremely low.

Inquiries are invited from public utility and police officials concerned with the protection of any area, either outdoors or indoors, against the approach of saboteurs.

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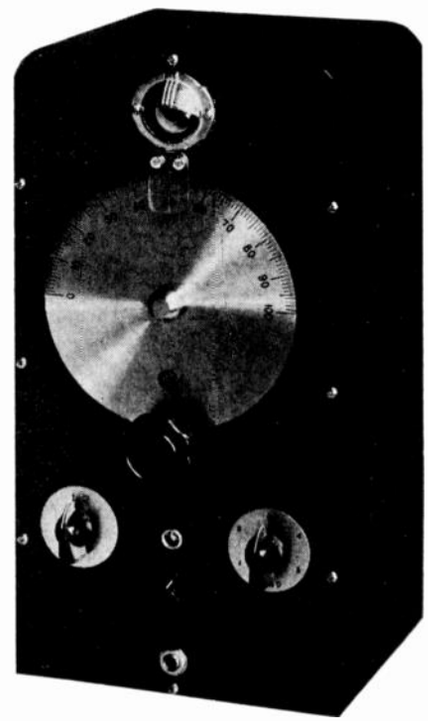

Available with One to Four Bands
Priced $125 to $185

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

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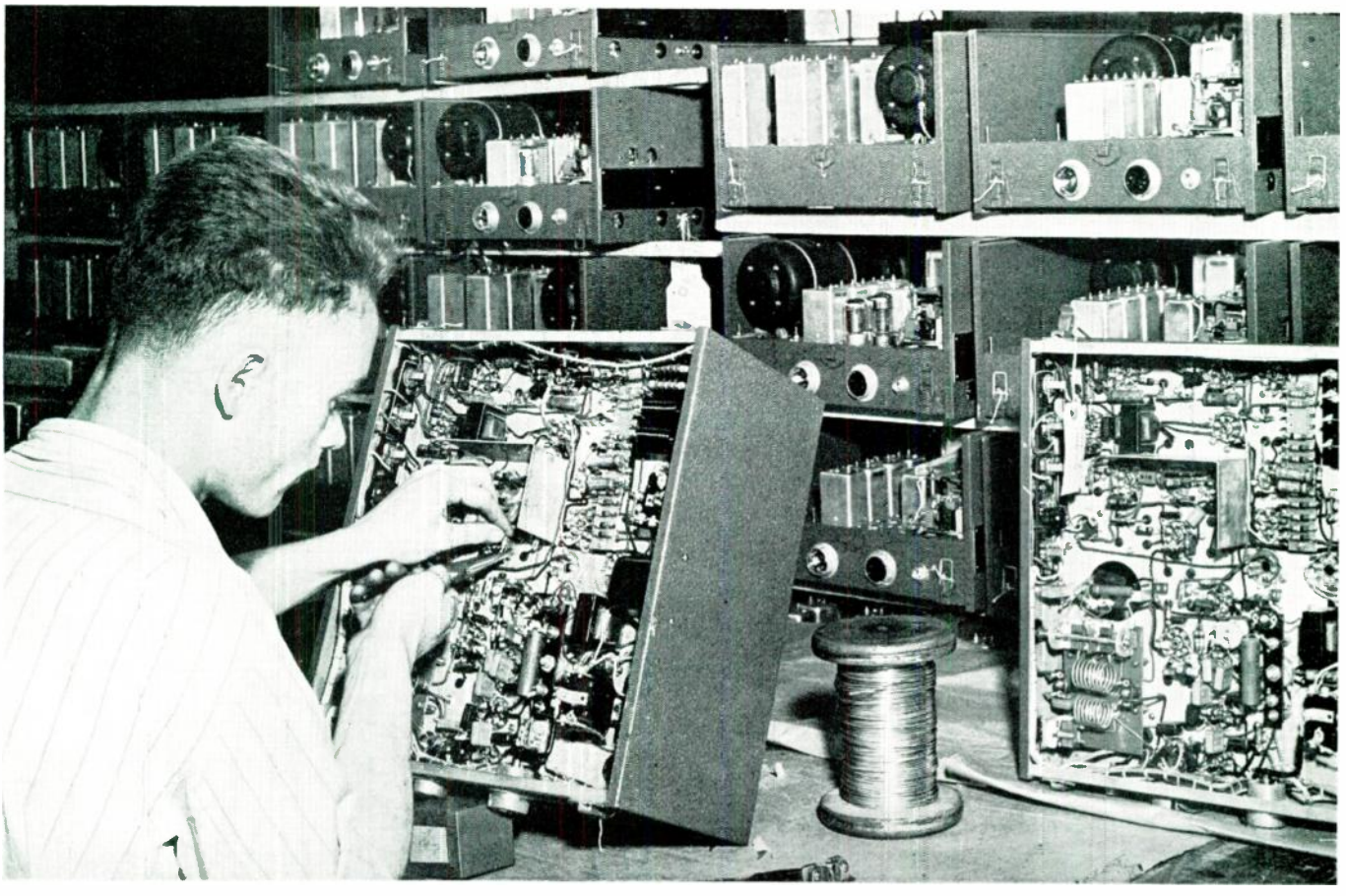
Battle of Production



NO SOLDIER uses his rifle with greater care and accuracy than the men on the production line at REL use their fighting tools.

Our men know that the products of their work are pitted against the skill of Axis workers. They realize that they must protect our soldiers against the failure of communications, come heat or cold, in tropic rains or desert dryness — for REL equipment is now in use on every fighting front.

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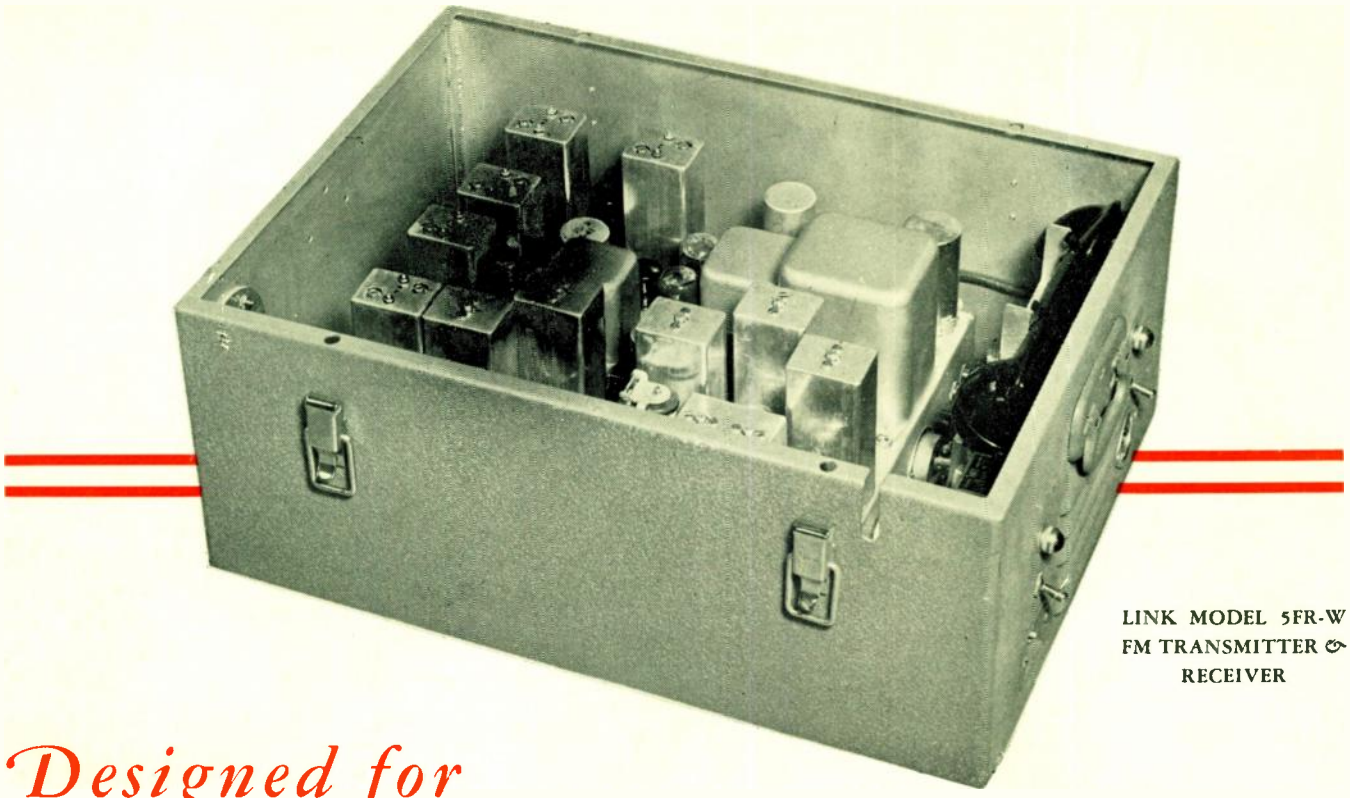

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FM TRANSMITTER &
RECEIVER

Designed for
ECONOMY of MATERIALS

ANTICIPATING THE NEED for conservation, F. M. LINK engineers conducted an exhaustive study of output power requirements for FM emergency transmitters, to determine the possibility of employing reduced power with the resultant economy of cost and consumption of critical materials.

This investigation showed conclusively that, in many cases, the high output of the standard LINK models 25UFM and 35UFM was not needed, and that substantially lower power could be used without sacrificing dependability of communications.

In the course of this study, it was also revealed that in many of these applications installation could be simplified greatly by building into the transmitter-receiver unit a power supply operable from 6 volts DC or 115 volts AC.

Base upon these findings, LINK models 5FRX and 5FRX-W, illustrated above, were designed and put into production.

These models, meeting the need for wartime conservation, are proving highly successful in many emergency applications, and exact data is now available on service conditions under which they can be used in place of the higher-power, standard F. M. Link emergency units.

Both models 5FRX and 5FRX-W contain the standard LINK 11UF receiver, thus affording the same receiving characteristics of the more expensive units. The transmitter also provides the same fine speech quality and crystal frequency control, but with reduced output. Both of these models can be operated from a 6-volt battery or 115 volts AC.

Model 5FRX has an external operating control and speaker, for mobile installations. Model 5FRX-W has the controls and speaker built into the weather-proof case, with side brackets to mount an antenna. Thus it is a self-contained unit for fixed station use, although it can be used for mobile service as well. More detailed information is available to those in charge of existing or projected emergency communications systems.

THE BEST-EQUIPPED POLICE AND PUBLIC UTILITY EMERGENCY RADIO SYSTEMS USE LINK FM EQUIPMENT EXCLUSIVELY

"The Difficult we do Immediately—
The Impossible takes a little longer"

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