Tenth Year of Service

RADIO ENGINEERING

Vol. X JULY, 1930 No. 7

IN THIS ISSUE

Sold only by subscription
$2.00 per year

The Journal of the Radio Industry

YOUR Reasoning Starts From One of These

WE ARE IN NEW TIMES NOW. A lot of thinking in dead-earnest is going on everywhere. And by *all* the parties concerned. Workers, executives, employers, customers. There is no one who is *not* concerned.

Let us take a look at the different parts of the subject, and note how they connect and depend on one another. What they are thinking so hard about is:

1. Pay; earnings, payrolls.

2. Jobs; safety, steadiness, permanence; possibilities of layoffs; or of calling back men now laid off.

3. Volume of work; chances of getting it back, keeping it up, or increasing it.

4. Costs. Margins. Profit.

5. Orders. What they depend on. How to make sure of getting them, under conditions existing now; and under conditions that are coming, before the turn-up, and after it.

6. Customers. Purchasing Power, and Willingness. Present attitude as compared with 1929. Probable attitude in 1931-1932.

7. Adjustments — (of product, costs, price, performance, or other satisfactions)—to meet Customers' present attitude; and probable attitude later.

8. Competition; as it is now; and as it may be, before the turn-up, and afterward. What Competitors are doing, and getting ready to do; or might do; (about 7, 6, 5, 4, 3, 2, 1, above).

9. The General upward turn of business as a whole. What can be done to ensure it, and to bring it about, soon. What conditions may precede it. When it will come. And what the conditions—(as to 8, 7, 6, etc.)—will be, after the turn-up and while the new prosperity is growing.

10. Own Company's Turn-up. Can it come earlier than the *general* turn-up? Can the Company start "swimming up stream" before the others do? Men of each live concern are figuring this, irrespective of the general trend. What they can do about 5, 2, 1, 4, 8, etc. How they can check their Own Company's dip, flatten its curve, turn it upward *soon;* and make sure that it shall have the strongest position during the prosperity that is coming.

* * *

And through it all, there is a new awakening to the fact that now, too often the REAL drag on profits and on success in competition, is the using of WRONG MATERIAL.

In the New Times, the New Thoroughness,—*reasoning* starts from the *foundation,*—recognition of the supreme importance of—

Thinking in the RIGHT MATERIAL.

NVF

Write today for FACT-SHEETS OF INDUSTRY No. 1,—giving practical knowledge which hitherto has not been readily accessible —Mailed FREE to any worker or executive. Limited Edition—Write NOW, stating work you do, your company's product or business, and whether request is for self. Address
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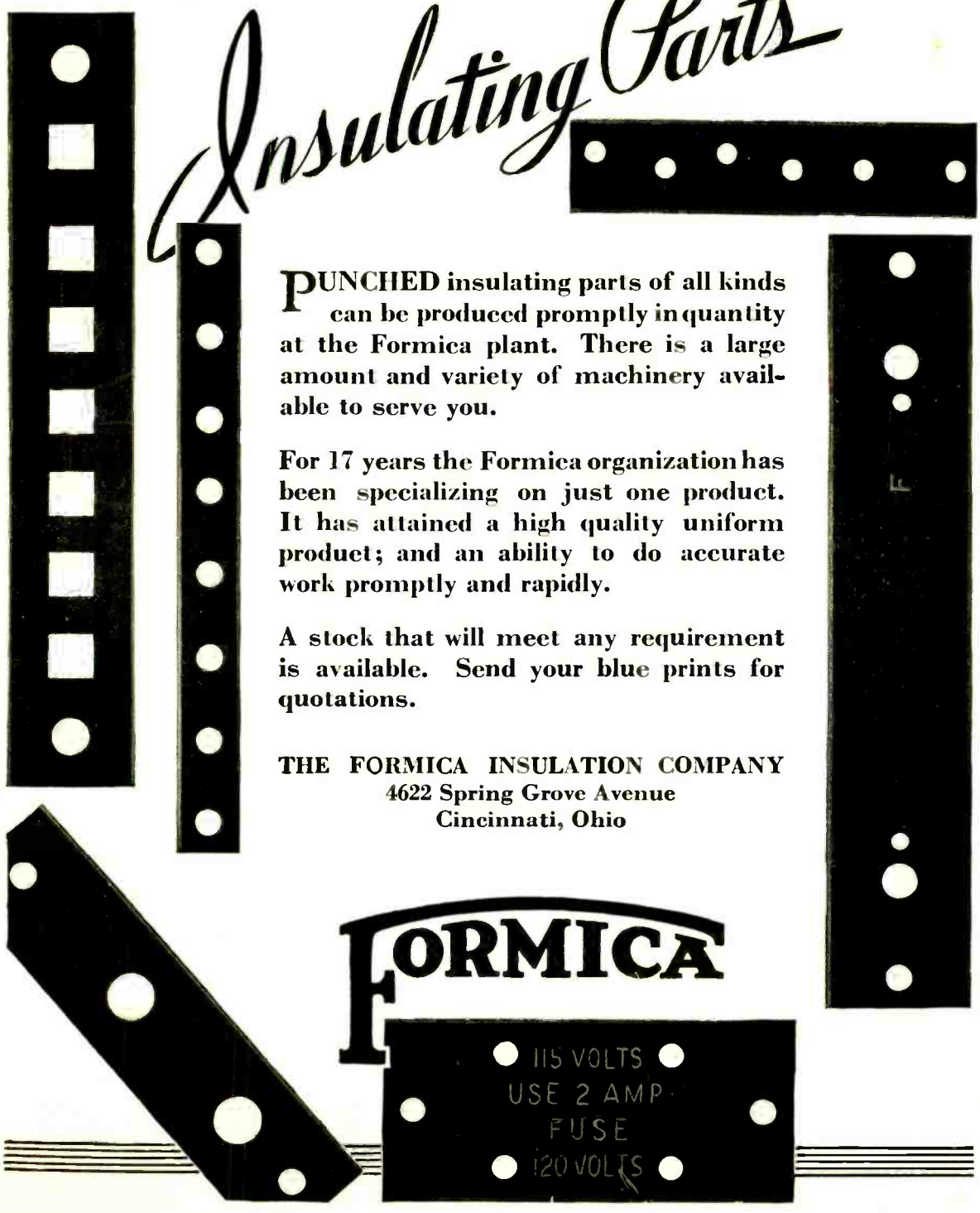

PUNCHED insulating parts of all kinds can be produced promptly in quantity at the Formica plant. There is a large amount and variety of machinery available to serve you.

For 17 years the Formica organization has been specializing on just one product. It has attained a high quality uniform product; and an ability to do accurate work promptly and rapidly.

A stock that will meet any requirement is available. Send your blue prints for quotations.

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Western Editor ULMER G. TURNER | *Editor* DONALD MCNICOL | *Associate Editor* AUSTIN C. LESCARBOURA

Vol. X | July, 1930 | Number 7

Contents

Radio Tube Makers Plan Replacement Policy

A QUESTIONNAIRE to manufacturers of the RMA group is being circulated to ascertain fully the present policies and opinions as to future policies of the tube makers. About forty representatives of tube manufacturers in the RMA Tube Group met at Atlantic City during the RMA convention and the principal subject of discussion was the replacement policy and measures to overcome the practices of some dealers and jobbers in returning tubes. Another meeting of the tube manufacturers will be held following completion of the questionnaire which has been circulated.

The questionnaire of the tube group follows:

Name of manufacturer.

Address.

Company's registered trade name.

What is your present tube guarantee?

What is your view of a guarantee on tubes under today's conditions?

What is your present method of dating or marking tubes by either factory, representative, jobber, or dealer so as to have some idea of the time the tubes have been in use by the customer?

On what tubes and under what conditions do you refuse credit?

Should express charges be paid by the manufacturer on customers' returned tubes and replacement shipments?

Should unserviceable tubes on which credit is not allowed, be returned to the customer.

What methods do you use or suggest to identify tubes once returned to the customer as serviceable—but which he may again return for credit?

What is your present replacement policy?

What are your ideas on a replacement policy that can be put into effect by all tube manufacturers under today's conditions?

Published Monthly by

Bryan Davis Publishing Co., Inc.

52 Vanderbilt Ave.

New York City

Publishing

AVIATION ENGINEERING

RADIO ENGINEERING

PROJECTION ENGINEERING

Publication Office—North Broadway—Albany, New York
Chicago Office—333 N. Michigan Ave.—Charles H. Farrell, Mgr.
Cleveland Office—10515 Wilbur Avenue—James C. Munn, Mgr.
St. Louis Office—505 Star Building—F. J. Wright
Kansas City Office—306 Coca Cola Building—R. W. Mitchell
San Francisco Office—318 Kohl Bldg.—R. J. Birch
Los Angeles Office—846 S. Broadway—R. J. Birch

Bryan S. Davis, *President*

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Entered as second class matter at the post office at Albany, N. Y., January 9, 1925, under the act of March 3, 1879.

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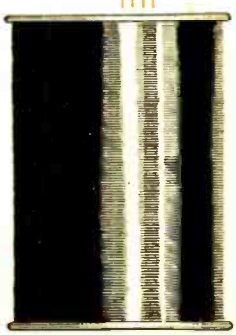
6. *Definite Inca Policy* of friendly service to the trade in a manner to merit ever-increasing patronage and good will.



Demand the Inca Trade-Mark on the Spool

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INCA MANUFACTURING DIVISION

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West. Rep., A.S. Lindstrom, 274 Brannan St., San Francisco, Cal.

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Symbolic of the best in the copper wire industry.

EDITORIAL

July, 1930

DONALD McNICOL, *Editor.*

TOO MANY MODELS?

TWO models in two-seat, and one model in one-seat cars—so runs the automobile industry in general. The automobile makers have sensibly worked away from a long list of models. This makes for less confusion of mind on the part of prospective purchasers, with consequent lessening of sales resistance.

At the RMA Show recently held at Atlantic City, a complaint voiced by numerous dealers present was that there are too many models in radio receivers. A dealer handling but one line, if he carries on display all of the manufacturer's models, at once is confronted by two difficulties. Display space is costly. The more models he has to display attractively the greater space required. With radio receiver stock, also, it is perhaps unavoidably true that difference in model does not signify only difference in appearance. Difference in model means difference in price, and also means difference in performance. Difference in performance means difference in quality, and where the production or reproduction of music is concerned "quality" is of first importance.

A sales situation which presents to intending purchasers a variety of cabinets, a variety of prices and a variety of qualities, contains elements worthy of study and analysis. Purely from the industrial viewpoint the object is sales. Whatever can be done to lessen sales resistance is worthy of thoughtful planning and trial.

If a dealer could move fifty per cent more stock per month, handling a line with, say, three models, than he can where there are a dozen models on display, it is plain what remains to be done.

It would be desirable from the dealer's viewpoint if an approach could be made to uniform quality, with difference in price according mainly with difference in assembly and housing.

▲

WILL THE STATES BEAT THE NATION TO IT?

IN foreign countries, including Canada, owners of radio receivers pay an annual tax to the national governments for the privlege of operating a receiver. In Canada this amounts to one dollar per year for each receiver. The proceeds from this tax presumably is expended in the interest of the radio service rendered the set owner.

In the United States there are legislators who believe that there should be a tax on radio receivers, the proceeds to go toward paying the cost of the Government's radio research and standardization activities, as in Canada. So far, however, little progress has been made in this direction. The States, recognizing opportunity, have begun to enact legislation which will bring revenue to the States from radio operation.

South Carolina, for instance, recently set up a law that imposes an annual license tax of fifty cents on each radio receiver costing $50.00 or less; $1.00 on each set costing between $50.00 and $200.00, and up to $2.50 each for sets in the higher price ranges.

To make the law operative the Act requires: that each and every person, firm and corporation engaged in the business of selling, bartering or exchanging radio receiving sets, shall keep a separate record of such sales especially showing the person to whom such sale is made. That such records required to be kept shall be subject to inspection by the State tax commission.

If there are to be taxes on radio receivers it would have been by far more sensible to have the proceeds therefrom go toward making the national government's radio activities self-sustaining, rather than have the proceeds applied to meet deficits in State appropriations for questionable undertakings in no way related to radio broadcast service.

▲

THE I. R. E. CONVENTION

WITH about eighteen years of constructive achievement to its credit the Institute of Radio Engineers is to hold this year its first international convention. Practically all of the radio and sound projection sciences as they stand today have been brought into application by men who are members of this international organization of engineers.

The 1930, Summer convention will be held in Toronto, Canada, August 18–21, inclusive. At this convention will gather the research engineers who have new developments to talk about; engineers with the manufacturing companies seeking to learn the trend of advance and development, and all engineers who have learned that to be up to the minute in radio it is necessary to attend meetings where new things are announced.

The Canadian members of the I. R. E. are preparing a convention that will no doubt establish a record.

In Recognition

of a notable contribution *to the Mechanic Arts . . .*

The Franklin Institute

awarded

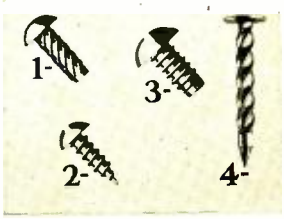
The Certificate of Merit

to the Inventor

of Self-tapping Screws

The award of The Franklin Institute's coveted Certificate of Merit to Mr. Heyman Rosenberg is only fitting recognition of his contribution to the mechanic arts. His Self-tapping Screws have greatly aided American industry, particularly in the development of mass production.

Enormous economies of assembly time and labor have been made possible by these unique Screws which are so hardened and threaded that they tap their own thread in metal as they are driven. Slow and expensive tapping, for 1500 years necessary to the assembly of metal products with screws, is no longer required for hundreds of assemblies.



TYPES OF SCREWS

1. *Hardened Metallic Drive Screws*... are simply hammered into drilled or formed holes. Used for making permanent fastenings to iron, brass and aluminum castings, steel, Bakelite, etc.

2. *Hardened Self-tapping Sheet Metal Screws—Type "A"*... are turned into drilled, pierced or punched holes with a screwdriver. They are used for joining sheet metal and making fastenings to sheet metal up to 14 gauge.

3. *Hardened Self-tapping Sheet Metal Screws—Type "Z"*... are turned into drilled, molded, punched or pierced holes with a screwdriver. Used for making fastenings to sheet metal up to 10 gauge; and to die castings, Bakelite, slate, ebony asbestos, etc.

4. *Hardened Screwnails*... driven like ordinary nails; hold like screws. Developed for fastening sheet metal securely to wood.

In the production of almost every kind of metal product...from cameras to airplanes . . . Self-tapping Screws have replaced machine screws and other devices. Notable assembly advantages have resulted . . . savings of thousands of dollars yearly have been effected. And better fastenings have been obtained.

Free trial samples of Self-tapping Screws will be gladly furnished . . . a description of your application brings them. As Vice-President of the Parker-Kalon Corporation, Mr. Heyman Rosenberg is available for assistance in solving difficult assembly problems.

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Dept. L, 190-198 Varick St., NewYork, N.Y.

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HARDENED
Self-tapping Screws
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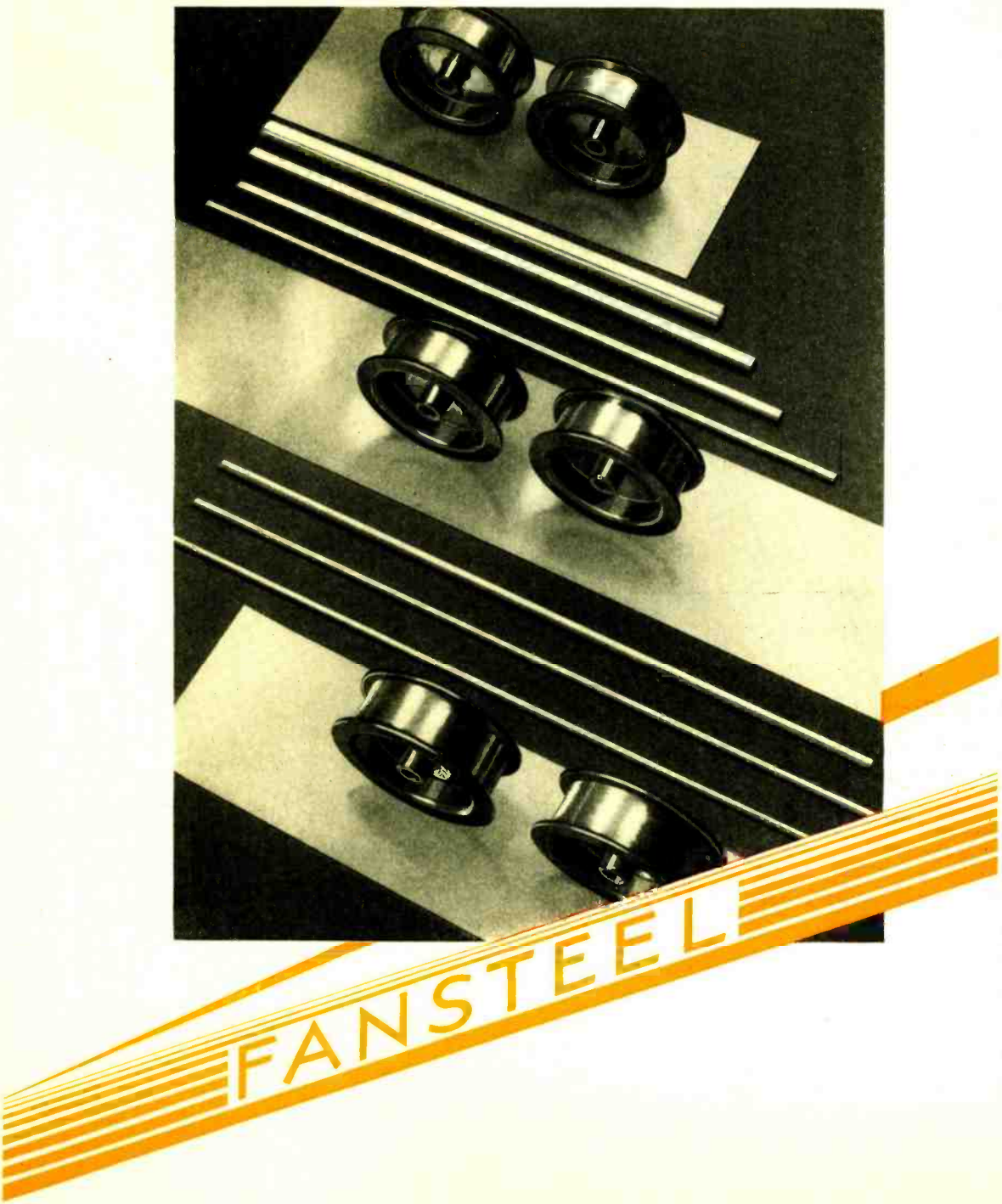
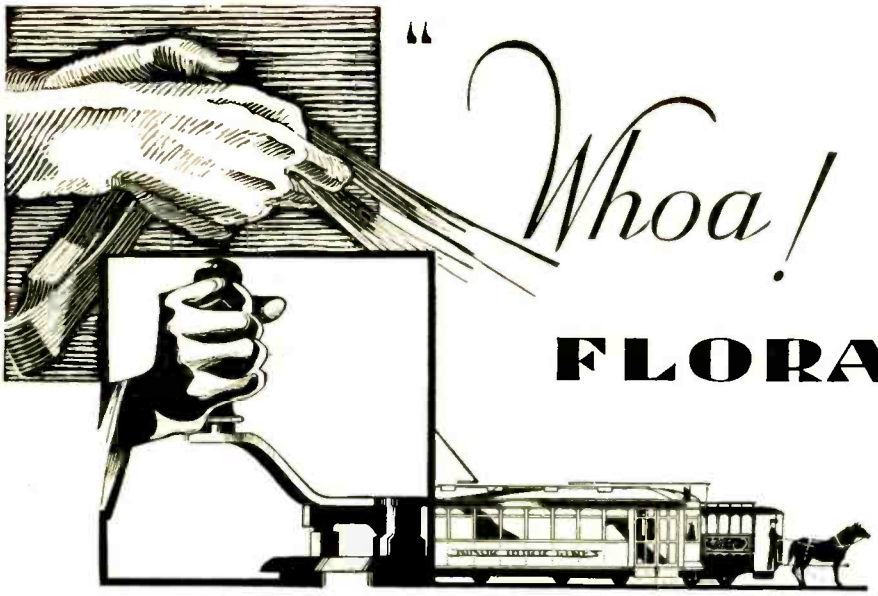




"Whoa! FLORADORA"

. . . and being a good ol' mare she threw herself in high whenever traffic became halfway profitable.

The controller box on the modern street car puts Floradora to shame.

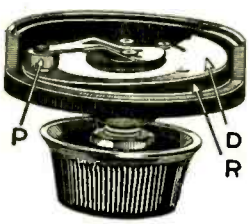
In your radio the control makes all the difference between raucous, crackly noises and smooth, velvety reception.

CENTRALAB performance explains why you will find these volume controls in millions of modern sets.

The tailor uses the same principle as Centralab. He does not want to ruin the garment by placing the iron on it so he places a cloth in between. Centralab controls can not ruin the resistance because the rocking disc is in between the pressure arm and the resistance.

Write Dept. 212-B for Free Booklet "Volume Control, Voltage Control and Their Uses"

This is the action of the usual wire wound control after it has been in use for some time . . . like dragging a stick over a cobblestone pavement.



This shows the exclusive rocking disc construction of Centralab volume control. "R" is the resistance. Contact disc "D" has only a rocking action on the resistance. Pressure arm "P" together with shaft and bushing is fully insulated.

Centralab

CRL

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Laminated Bakelite

Dependable Uniformity
in Electrical and Mechanical Properties

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LOW SURFACE LEAKAGE
CLEAN PUNCHING
MACHINEABILITY
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CORPORATION OAKS·PENNA
NEW YORK, CHICAGO, CLEVELAND, SAN FRANCISCO
Sheets, Tubes, Rods, Fabricated Parts

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WASHERS Everlock TERMINALS

PATENT APPLIED FOR

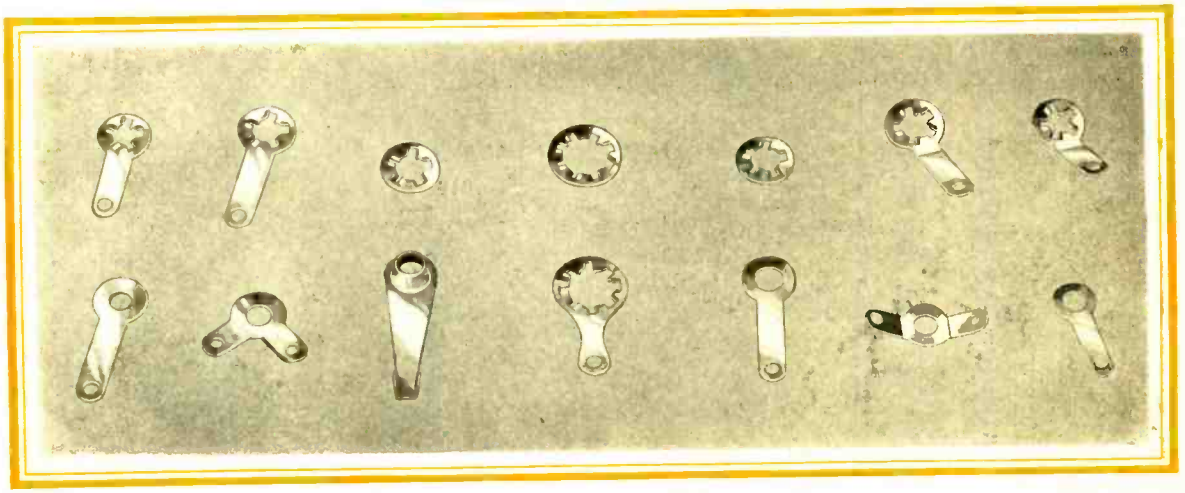
Everlock washers and terminals utilizing a new construction principle afford a positive and lasting contact.

All steel washers are hot solder coated after fabrication which prevents rusting.

Note particularly the locking construction. Here you have the secret of the tenacious grip —the positive lock— which is an exclusive Everlock feature.

Everlock terminals speed up production and lower costs.

They are hot solder coated after fabrication which makes them easier to solder and insures a positive connection that will not come loose.



Special hot solder coated terminals either plain, eyeleted, or lock-made to order.

Send us your specifications.

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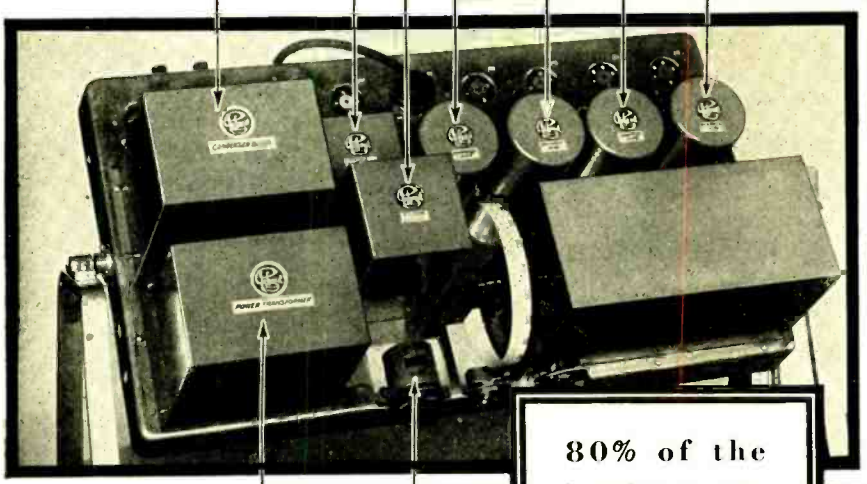
In the Modern Radio Receiver



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80% of the leading receiver manufacturers now use standard PARTS by POLYMET

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MOLDED MICA CONDENSER

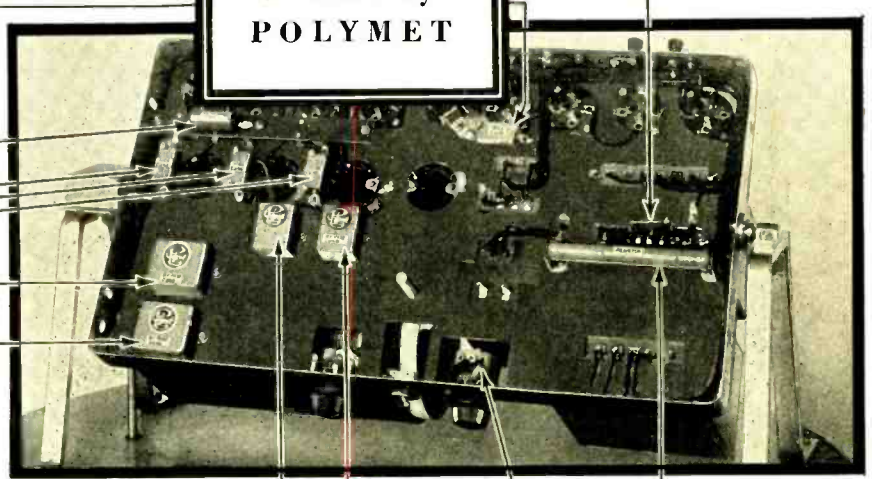
TUBULAR BY-PASS CONDENSER

MOLDED MICA CONDENSERS

BY-PASS CONDENSERS

DUAL VOLUME CONTROL

TAPPED WIRE-WOUND TUBULAR RESISTOR



On which of the above may we submit samples or quote you prices? Catalogs and "Engineering Manual" will promptly follow your letterhead request.

Polymet Manufacturing Corporation

839-C EAST 134th STREET NEW YORK

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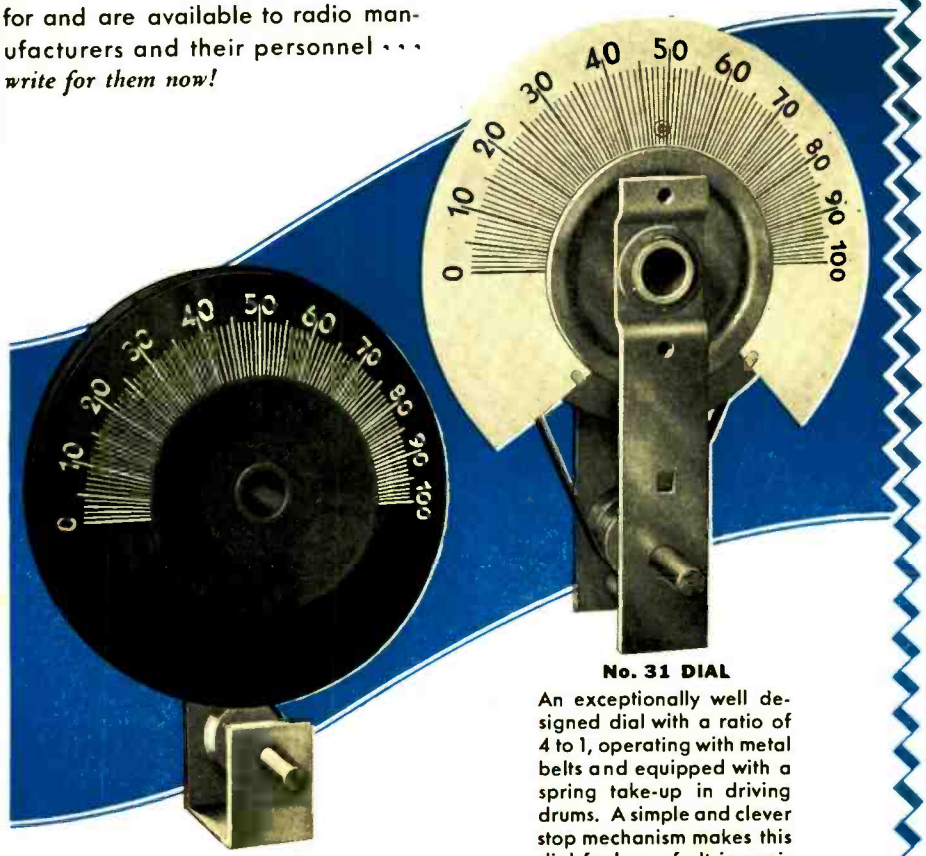
Standard in Radio World Since 1924.



No. 32 DIAL

This dial with a 6 to 1 ratio friction drive, is equipped with an etched scale made in varied colors. Special scale may read through 360° if desired. The cost is low.

No. 31 DIAL

An exceptionally well designed dial with a ratio of 4 to 1, operating with metal belts and equipped with a spring take-up in driving drums. A simple and clever stop mechanism makes this dial fool-proof. It is engineered for high-grade sets.

All three of the escutcheons shown in this column are etched

Our Art Department will be pleased to prepare sketches based on your ideas. This in no way obligates you.

Usually the etched escutcheon is made to your own specifications. We have, however, a selection of stock dies which may appeal to you. Ask us!

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A GREAT ORGANIZATION DEDICATED TO BUILDING THE FINEST RADIO TUBES POSSIBLE... EVEREADY RAYTHEON TUBES

NATIONAL CARBON COMPANY, Inc., has no ambition to sell *all* the tubes in the industry. But it has definitely succeeded, with Eveready Raytheons, in producing the finest tubes that infinite skill and boundless facilities can assemble.

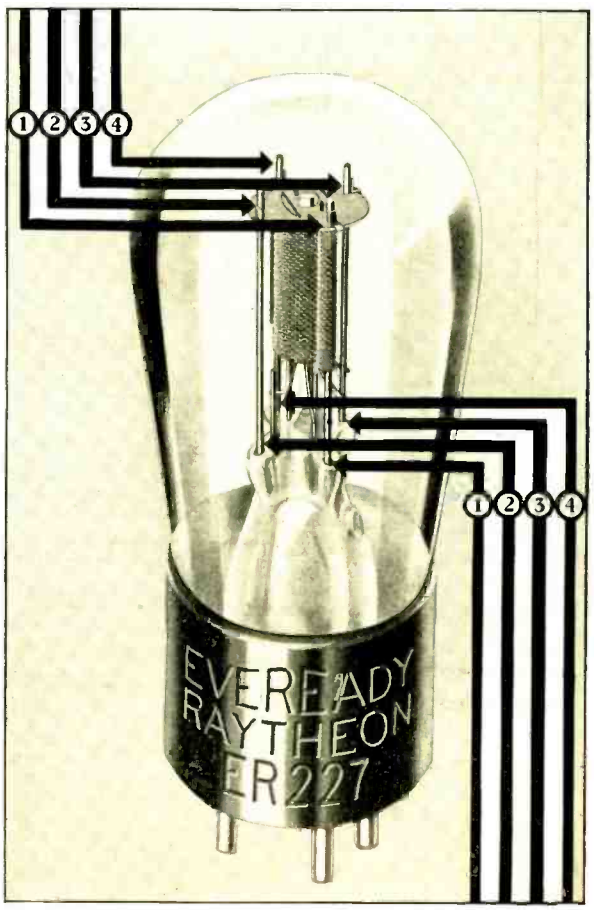
Eveready Raytheon superiority is based on the patented and exclusive 4-*Pillar construction*, whereby the tube-elements are anchored at *four* points instead of the conventional *two*. This feature has the obvious advantage of safeguarding the elements against misalignment caused by the jolts of shipment, handling and installation, and by vibration from dynamic speakers.

It has the additional advantage of placing a premium on precision in the assembly of Eveready Raytheon elements. The elements are assembled on jigs, and the great accuracy thus effected is certain to be maintained under all conditions of actual usage. The result is exceptional uniformity of tube-characteristics and performance.

Another feature of this sturdy construction is the added value it gives to the exacting inspections and tests which all Eveready Raytheon Tubes must undergo. Inspection of complete cathodes, for example, is made by X-ray, to guard against partial short-circuits in heater-coils, which are exceedingly difficult to detect under ordinary test conditions.

These rigid standards produce tubes of unusual quality. And the Eveready Raytheon 4-*Pillar construction* maintains this same quality in the tubes, from the time they are shipped until they have completed their term of usefulness in the radio-set of the consumer. With Eveready Raytheons, owners of your sets are assured of tubes with remarkably uniform characteristics, and with an exceptionally high standard of performance.

Eveready Raytheons come in all types, fit every standard A.C. and battery-operated receiver, and are sold by dealers everywhere. We are glad to co-operate on any tests you may wish to make with these tubes.



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General Offices: New York, N. Y.

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Unit of Union Carbide UCC *and Carbon Corporation*

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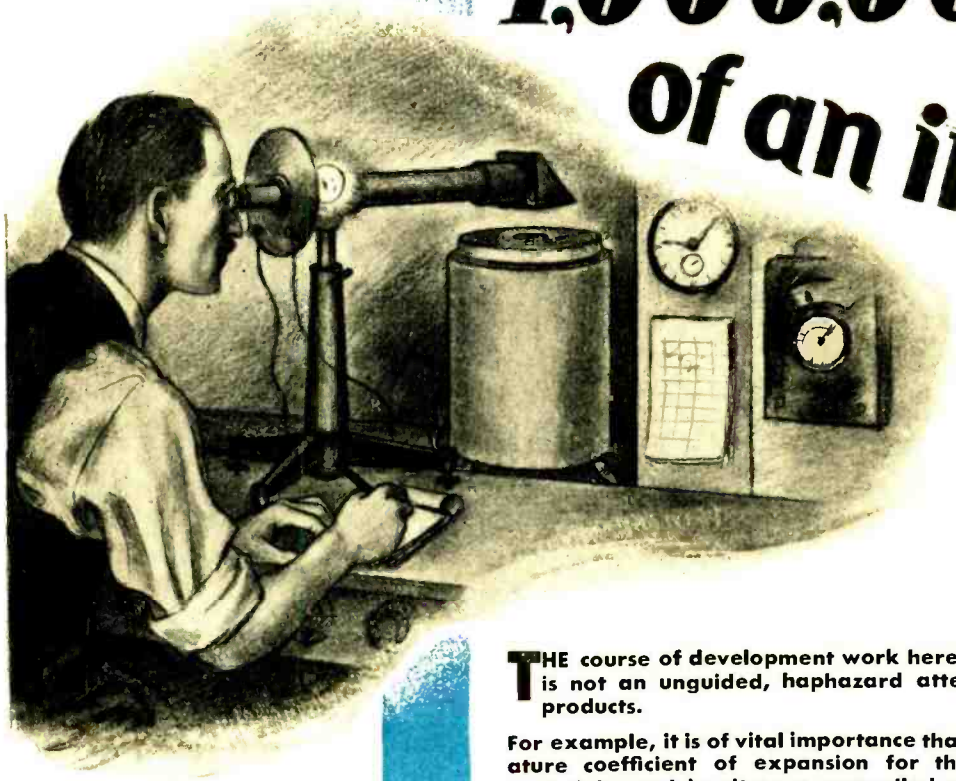
WE down to 1,000,000TH of an inch



*The Ward Leonard Interferometer is an apparatus for the determination of the thermal dilation of ceramic (and other) materials. The specimen under test separates two fused quartz plates which refract and reflect monochromatic light.

This action takes place in a carefully calibrated furnace. Heating is accurately controlled in accordance with a schedule.

Expansion of the specimen produces an apparent movement of interference fringes from the practically parallel surfaces of the quartz plates. Each fringe thus produced corresponds to ½ wavelength of the illuminating light. This length is accurately known and from it the percentage increase of specimen length is calculated.

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THE course of development work here at Ward Leonard is not an unguided, haphazard attempt to better our products.

For example, it is of vital importance that the exact temperature coefficient of expansion for the various ceramic materials used in vitreous-enamelled resistors be known.

The relative expansions of these materials determine, largely, the life and operating satisfaction of a vitreous-enamelled resistor.

To gain this knowledge we have had in operation for the past 3 years a special type of interferometer* which measures the expansion of heated materials with an accuracy of one one-millionth of an inch.

This measuring precision may, for special purposes, be increased to include measurements of one ten-millionth of an inch.

That we measure with this accuracy the materials used in our resistors means that you get the best resistors research development and manufacturing skill can offer. Let us quote you on your present and future requirements.

WARD LEONARD ELECTRIC CO.

31 South Street, Mount Vernon, N. Y.

IMPRESSIONS *and* EXPRESSIONS

By

AUSTIN C. LESCARBOURA

That Revolving Grid

SOMETHING really new in vacuum tubes has just made its appearance. Allen B. DuMont, Chief Engineer of the DeForest Radio Company, has read a paper before the Radio Club of America, describing a revolving grid for the vacuum tube. The grid may be revolved by electronic bombardment or by external electromagnetic influence. The main point is that it moves and introduces the element of time as a factor in vacuum tube operation.

What's it all about? Frankly, no one knows for sure, no more than anyone could have known the full significance of the original three-element tube or audion of Lee DeForest. But there are many guesses. For instance, the revolving grid converts a-c. into d-c., d-c. into a-c., and provides any frequency and almost any waveform. It obviously can replace the oscillating tube as a transmitting means. It can be employed for the most elaborate switching or commutating work. It can provide a radiovisor of the simplest kind, entirely sealed in a single glass bulb. Perhaps here is the basis for an entirely new group of electrical applications. Who knows?

▲

Higher Costs?

HERE it is July. Very little real radio production is in evidence. Most plants have yet to get under way on sets.

Our guess is that real production will get under way with a vengeance during August or September. And yet, it will not be the production which we have known in past years, particularly 1929. It will be limited production, carefully geared to orders received. It will be hand-to-mouth production. The manufacturers are not going to be caught short on orders and long on production, as in past years.

What will be the effect on production costs? Our guess is that production costs are going up. And plenty. Perhaps too much. One cannot manufacture as cheaply on a hand-to-mouth basis, as on a big production schedule. Nevertheless, it will probably be better in the whole run. There will be less dumping, and that is where the industry has heretofore sunk its profits.

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Tone Controls

NOT much new to be found among the season's new presentations, except the tone control. And that isn't so new, except in its merchandising aspects. Years ago we knew all about tone control. It remained for a relatively newcomer in the field to grab that idea as a wonderful merchandising pivot on which to swing a new line.

The tone control is really useful. It provides the proper tone blend for any selection. It meets all musical tastes. It balances the speaker to room acoustics. And lastly—and seldom mentioned in the literature of manufacturers—it mellows the entire reproduction to the point where static is pretty much robbed of its disagreeable intrusion. Static, after all, is a rather sharp, rasping interference. It is represented mainly by higher frequencies. With the tone control set at the bass end, the static is noticeably reduced by contrast with music or speech. The sting is removed. This feature alone is valuable to the radio set owner.

Thank goodness the designing engineers have taken this old trick off the shelves and put it to work. It will sell many sets this season.

▲

Short-Wave Improvements

THERE is a growing interest in short-wave reception which few manufacturers seem to notice. What with a growing exchange of broadcast programs between nations, together with the activities of several short-wave experimental transmitters both here and abroad, there are plenty of thrills for the man with a short-wave receiver.

Much of the trickiness of short-wave reception has been eliminated. Today it is possible to build a short-wave set with satisfactory a-c. operation. Tuning is reduced to relatively broadcasting proportions, so that anyone can tune in short-wave stations. There is a sufficient number of powerful signals on the air so that the short-wave beginner is assured of a sufficient number of programs immediately so as to feel his way along, instead of the needle-in-the-haystack atmosphere of earlier short-wave work.

We may be wrong—apologies to the composer of about the same sort of words for a popular air of the day—but we think many radio set designers are not so wonderful—from a merchandising standpoint. This year of all years, trying to make the public part with its money, should be the very year to introduce some thrills. Imagine a broadcast receiver incorporating a short-wave range as well as the usual range! It would go over big. The superheterodyne circuit particularly would lend itself to this arrangement. They are doing this very thing in Canada, with the superheterodyne. What an opportunity to clean up!

▼

Price-Slashing Antidote

A WELL-KNOWN merchandising organization recently found itself in an embarrassing predicament with its radio line. It does not manufacture its radio sets; rather, the sets are made up by another company, but put up in a distinctive cabinet with the first company's trade mark. At any rate, the manufacturing company dumped its own line, leaving the merchandising organization holding the bag in a similar line. Of course the usual move would have been to dump the works. That's the easiest way out—but not the best in the long run. What to do?

The company in question has a reputation to defend. To dump its radio sets would work a grave injustice against its other products. And so this company did one of the cleverest things seen in many a day in the radio industry. It took the sets which were not selling as they should at list price, turned them over to a manufacturer of phonograph turntables and motors, and had a phonograph feature incorporated in those sets. Then the sets were offered at the same list price as before—and they sold. Result, with an investment of perhaps $25.00, the merchandising organization saved money in the long run, and certainly saved its face.

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520B- 5000 Watt Oscillator, water cooled	187.50
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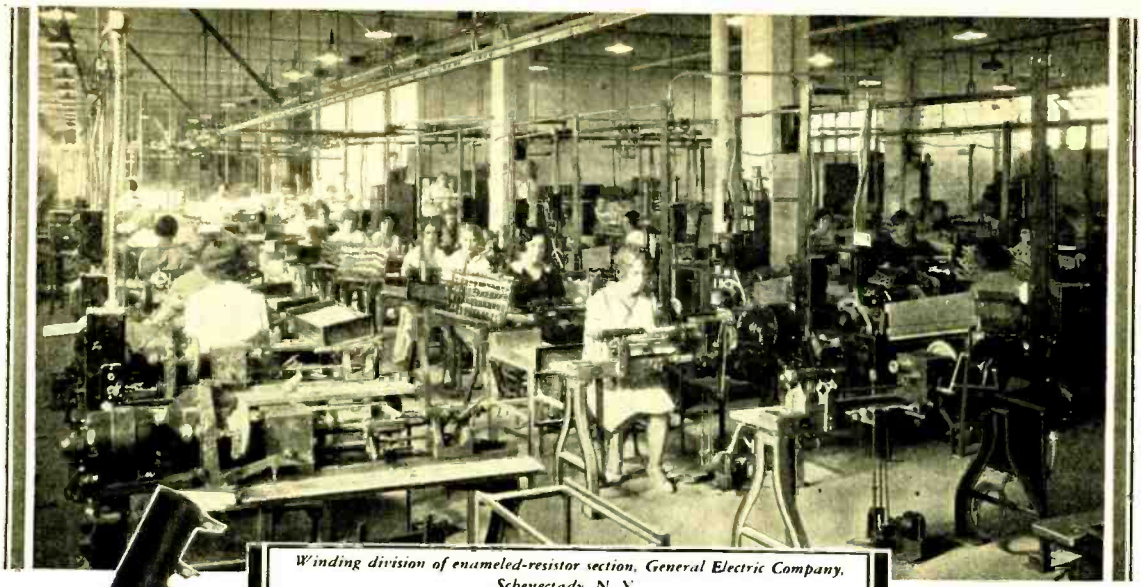

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GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

RADIO ENGINEERING

Production, Administration, Engineering, Servicing

July, 1930

The RMA Show

Manufacturers, Jobbers, Dealers, Engineers and Service Managers En Masse Attended the Convention

THE Show managers have no complaint with the number of radio men who attended the great Show at Atlantic City, June 2 to 6. It was reported that more than thirty thousand men identified with the industry were present.

One hundred and eighty manufacturers, including forty-six firms making radio receivers, had exhibits at the convention hall or in hotel space. It is true that a few of the leading manufacturers displayed no new models, or only the chassis of sets to be sold during the coming season, but many others kept the faith and placed their cards on the table.

The Atwater Kent Manufacturing Company displayed no new receiver models but announced a new and improved line for August 1. The General Electric Company had a good set in view but it was housed in a clapboard cabinet.

Some manufacturers seemed to have the notion that displaying in June the next Fall's models gives competitors opportunity to make or remake plans for production. Yet, if manufacturing is to proceed in an orderly way during the summer months the June Show should disclose to jobbers and dealers what is under way so that the distributors may know what to expect and talk about back home. If all were orderly the September Shows should be for the purpose of enabling jobbers and dealers to show what is ready for sale to the public.

A review of the Show cannot help but bring to light a number of generally outstanding trends. Foremost is the preponderance of electrodynamic speakers and screen-grid tubes.

In circuits, the screen-grid tuned radio-frequency principle appears to be the most popular, a good many sets using five tuned radio-frequency circuits. In the audio end, push-pull amplification is still popular, with two type 45 tubes.

Volume and Tone Controls

Although some manufacturers advance the idea that the terms "volume control" and "tone control" are catch phrases, there was evidence at Atlantic City that some of the best of the new receivers will have these features added for 1930-31. And, there were several ingenious and meritorious "controls" on exhibition.

After making the rounds at Atlantic City many of the visitors left with the conviction that at the September shows Atwater Kent, General Electric, Westinghouse, RCA-Victor, Majestic and others will have surprises to spring.

Officers 1930-1931, Radio Manufacturers' Association

Technical Meetings

That the engineers were present in force was apparent from the fact that the members of the Institute of Radio Engineers staged several important sessions. At the first session the scheduled speaker failed to appear but Dr. Lee deForest, president of the Institute was equal to the occasion, promptly organizing an impromptu discussion of the engineering of loudspeakers, which was participated in by Dr. Irving Wolf, A. Ringel, R. H. Marriott, R. H. Langley, Donald McNicol, and others. About two hundred engineers attended these technical sessions.

The Show Management

Great credit is due to the following for the able and energetic manner in which they attended to the vast amount of convention detail: H. B. Richmond, Jess B. Hawley, B. G. Erskine, Morris Metcalf, C. C. Colby, R. H. Manson, E. W. Holland, M. F. Flanagan, Bond Geddes, G. C. Irwin and George Lewis.

Notables Present

Among the notables of the industry who were present at the convention might be mentioned: Atwater Kent, Dr. Lee deForest, Dr. J. H. Dellinger, L. E. Whittemore, Dr. F. A. Kolster, Fred Williams, Dr. P. G. Weiller, H. C. Gawler, Harry G. Sparks, L. S. Brach, Armstrong Perry, Gen. C. McK. Saltzman, A. Crosley, and no end of others.

The Canadians

Canada was well represented by manufacturers, engineers and dealers. Among those noted were: A. M. Patience, C. C. Meredith, R. A. Hackbusch, Dugald Hepburn, J. D. Ford. and Weston Wrigley, all from Toronto. There were many others from Montreal, Winnipeg and other centers.

Novelties

The shore line was patrolled by a large sloop, on the sail of which was painted in large letters the announcement that the Majestic crowd were on hand. Overhead, at night, the sky was patrolled by an airplane displaying in red lights the news that Bosch Radio was watching. Everything stopped at 7 p. m., while groups extending a mile along the boardwalk listened to the daily recital of the tribulations of the Fresh Air Taxicab Company, "Incorpolated." Artistically arranged loudspeakers were mounted at intervals of a hundred feet along the walk.

Exhibits

It would fill a book to report the entire list of exhibits, but in our rounds we took particular notice of the following entries. The Acme Electric and Manufacturing Company, Cleveland, Ohio, had in operation a multiple coil winder that had no trouble holding a crowd of watchers. The Amperite Corporation, New York, exhibited a bulb, self adjusting line voltage control. The Crowe Name Plate and Mfg. Co., Chicago, had an extensive display of the latest forms of name plates and dials, which attracted much attention. The Gilby Wire Company, Newark, N. J., displayed a new resistance wire which has a uniform resistance of one thousand ohms per inch. The Oren H. Smith Company, Chicago, displayed a line of Ellis microphone accessories of up-to-date design. The Cardonic Manufacturing Company, Holland, Mich., were kept busy demonstrating their line of condenser speakers. The Duovac Radio Tube Corporation, Brooklyn, N. Y., exhibited a full line of detector and amplifier tubes. The All American-Mohawk Corpn., North Tonawanda, N. Y., displayed its line of Lyric receivers. The Arcturus Radio Tube Company, Newark, N. J., had a booth stocked with specimens of the Company's tubes. The Cable Radio Tube Corporation, Brooklyn, N. Y., made a fine showing of SPEED tubes. The Clarostat Manufacturing Company, Brooklyn, N. Y., exhibited a line of resistors. Cornish Wire Co., New York, had a diversified line of radio wire products. The Dongan Electric Mfg. Co., Detroit, Mich., had shelves stacked with chokes, transformers and condensers. Other displays which called forth much favorable comment were those of: The Electrad Company, Inc., New York; General Radio Company, Cambridge, Mass; The Hygrade Lamp Co., Salem, Mass.; The Insuline Corpn., of America, New York; International Resistance Company, Philadelphia, Penn.; Jensen Radio Mfg., Co., Chicago; The Polymet Mfg. Corp., New York; Racon Electric Co., New York; The Rola Company, Cleveland, Ohio; Stevens Mfg. Corpn., Newark, N. J.; Supreme Instruments Corpn., Greenwood, Miss.; The Triad Mfg. Co., Pawtucket, R. I.; Valley Appliances, Inc., Rochester, N. Y., and Wright DeCoster Co., Inc., Minneapolis, Minn.

A. Atwater Kent Talks of Prospects

A. Atwater Kent, who was at the convention, said:

"I have no doubt about the future of radio. My belief in its future, which impelled me to expand my production facilities, is stronger than ever.

"The outstanding feature in 1928 was the all-electric receiver. Nineteen twenty-nine saw the introduction and adoption of the screen-grid principle. This year will bring many refinements and improvements. The number of radio users is increasing. Owners of old equipment are replacing it with new instruments.

"There are now better facilities for broadcasting and better facilities for hearing worthwhile programs on the air. There is a greatly increased number of purposes for which radio is employed. Broadcast programs are improving. The millions of persons constituting the great radio audience may now hear the best in music almost any hour. Public events, lectures, news of the day have become an important part of our daily use of radio. There are better programs of a wider range on the air now than ever before.

"The variety and high quality of these broadcasts have resulted in speeding the day when there will be a radio in every home, through which different members of the family may hear programs in which they are especially interested.

"The horizon of radio activity has broadened so rapidly that we have been kept busy adjusting our perspective of its ever-widening possibilities.

"While my direct interest has been in manufacturing and musical broadcasting, I have felt for some time that the use of radio in other fields, education for example, has marvelous practical potentials. I feel that we should not permit the attractiveness and pleasure of entertainment broadcasting to absorb us to the point of exclusion or neglect of education, information and cultural development through the use of radio.

"Broadcasting stations are finding a growing interest in educational and business programs. The universities and other institutions of learning are broadcasting instruction to supplement the work of the class room. The National Departments of Agriculture and Commerce are presenting information in an interesting way which means dollars and cents to farmers and business men. This practical use of radio has, I think, grown in the same ratio as its cultural use.

"The public is cognizant of the amazing development in the past, just as it is aware of radio's potential expansion. It realizes that the great growth of radio has been made possible by the willingness of manufacturers, broadcasters and others to spend millions for development and promotion. Likewise, it indicates its appreciation of the past and its faith in the future by the purchase of radios in steadily increasing volume. It is up to those of us in the radio field to justify this appreciation and to take upon our shoulders the burdens that come with the added expansion."

New R M A Directors

To fill vacancies on the R M A directorate, the following were elected: J. Clark Colt, president of the U. S. Radio and Television Corporation, and Robert J. Emmert, president of the General Motors Radio Corporation.

Morris Metcalf, president-elect, Radio Manufacturers' Association Reviews State of the Industry

MORRIS METCALF
President RMA

THE radio industry is entering what has every indication of being one of the most outstanding years of its history because a definite step toward stabilization has been made. In fact it would appear that a state of stabilization had been reached. That such a step has been taken is attested by the fact that the manufacturers of radio receivers and accessories are materially raising the standard of quality of their products. They are including in their apparatus features to create individuality. In view of this it is apparent that the average price of radio equipment for the ensuing year will be slightly higher than during past seasons.

The past year has seen the elimination of a few radio manufacturing establishments. It is generally considered that those who remain, having weathered the storm of depression, are sufficiently stable so that products made by them today will be substantial merchandise two, three, or five years from now.

High quality and low price do not go hand in hand. The moderate prices of the last two seasons were consistent with the type of merchandise provided and served as a means to supply radio to a much greater audience than would otherwise have been able to afford products of higher quality which were naturally higher priced.

Enter, the Mechanical Engineer

It is possible to obtain what appears to be good radio reproduction with a set that is comparatively low in price, but at the same time the manufacturers realize that whereas that product will probably give fair satisfaction, there can be no guarantee that the results will be lasting. Radio has been built by radio engineers in the past, with little regard for the mechanical engineering side of the picture. Today there is a decided trend toward the inclusion of the mechanical engineer as a part of the radio manufacturer's staff. With the increased use of the engineer versed in the study of mechanics together with his colleague, the radio engineer, there is no question but that the set of the future will be far superior to the receivers that were produced under the old system.

Individuality in apparatus means that the producers of radio equipment have reached the conclusion that they have a certain clientele. Through contact with their distributing agencies and their dealers they have sensed the desires of their customers and have proceeded to include in their equipment such things as are suggested to them through these mediums. None of the features are radical, but at the same time they will be indicative of the resourcefulness of the individual manufacturers in providing what they believe their customers will want.

No Price Reduction for Good Receivers

It is self-evident that if the quality of a product is increased, there will be a corresponding increase in the cost of the article. In view of the conservative policies that the manufacturers are adopting this year as compared to a year ago the price will be further warranted by the lower productions and consequent distribution of overhead charges and must be distributed over a smaller lot of receivers. At the same time it is not thought that the average price of radio merchandise for the coming fall will greatly exceed that of last year, but will be only consistent with the new policies that have been adopted.

Remote control will not comprise one of the features that lends individuality. Even the more advanced types of remote control units are not particularly suitable and it seems to be the opinion of the manufacturers that the device is more of a novelty than a radio development. At the same time there is no doubt that a few models of receivers will be provided with remote control units for those who are desirous of obtaining them. But the fact will remain that it will not be stressed for sales promotion purposes. There will be a tendency towards the inclusion of automatic volume control on the higher priced sets. This device renders such a service to users that it will be demanded by the discriminating as its merits become known.

The Pentode Tube

So far as the use of the pentode tube is concerned, the engineers of the various manufacturrs are not in accord with any presentation of pentode tube sets this season. The experiences of a year ago when the shield grid tube was introduced have not been forgotten and it is the opinion of the engineering group that the study of the shield grid tube should progress further before any attempt is made to utilize a tube having an additional elecrrode. The executives of the manufacturing group are in agreement with their engineers and have definitely committed themselves to following the dictates of the specialists.

Automobile Radio

Automobile radio is one of the novel features this year. While it is not exactly new for the reason that several individuals have worked with it for a number of years, it is only within the last year that steps have been taken to make its use general. Since that time several manufacturers and laboratories have entered the field in earnest and the adaptation of the radio to the automobile is rapidly becoming popularized. The best sales argument so far as automobile radio is concerned is demonstration. Adverse propaganda during the last few months has installed into the minds of many persons the fear that a radio in the car will cause carelessness in driving and be distracting to the driver. It is only necessary for the prospect to take one ride in a car so equipped and he at once sees the fallacy of this opinion.

The principal difficulty in the handling of automobile radio is the finding

The Audion At Work

The Inventor of the Audion Broadcasts a Story About the Tube's Development and Uses

By Dr. Lee De Forest

IN the beginning the vacuum tube was used as a radio-frequency amplifier, then as a voice amplifier for loudspeakers. From this development of the amplifier tube it was logical that it should next be applied to solve the problems of the talking pictures. For indeed, the talking picture is the outgrowth, the child of radio.

Other devices developed for radio were taken over bodily into the talking picture studio. The microphone is identical with that employed as a pickup in the talkie studio. You do not see the microphone in the picture as thrown on the screen, but it was there when the picture was made, just outside the line of vision of the camera.

In addition to the broadcast microphone, the talking picture engineer has borrowed the large, powerful amplifier; taken it over almost without change. This audion amplifier is much like those used in good receivers, but more elaborate, larger and more powerful. Its purpose is to increase the weak telephone currents from the microphone until they can operate the sound-recording apparatus, which in the case of disc transcription, such as Vitaphone, is a sapphire needle which cuts the wax disc. If photographically recorded on film, the apparatus consists of a special type lamp, whose light fluctuates in accordance with the amplified telephone currents. And in the theatre, the amplifiers and loudspeakers derive directly from radio.

Thus, it is apparent that the audion amplifier, similar to that used in radio, is necessary in recording and projecting talking pictures.

Television

In the future we will receive television pictures over the electric light or telephone wires, though for the next few years television will be by radio. This marvelous new development, which has at last been realized, is made possible by means of the vacuum tube. Even now, if one resides within 50 miles of a good television station like the Jenkins transmitter in Jersey City, or those in Pittsburgh or Chicago, he can receive nightly very good pictures by radio. The Jenkins station actually transmits both the picture and the voice of the speaker. Usually these are transmitted from talking picture films which are reeled off at the transmitter and received by radio in a small shadow-box. Rapid progress is being made by countless radio engineers at work on television problems.

Lee DeForest, left, discussing the construction of a 50-watt tube, with Allen B. DuMont

Today television is about where radio was in 1922. But its progress will be rapid from now on, just as was that of the radio industry after that date. However, television presents many peculiar problems, exceedingly intricate and difficult of solution. Although radiovision is a reality today and will be in thousands of homes by next Christmas—yet the television of our dreams is a long way off, and when this comes into our homes it will be by way of wires and not by radio.

Other Uses of the Tube

Many other industrial uses of the vacuum tube may be briefly mentioned. For example, the elevator companies are using this oscillating radio tube for automatically leveling the elevator car at floors. In combination with the electric eye or photoelectric cell the radio tube amplifier serves as a smoke indicator in plant stacks, also for lighting in schools or factories when daylight fades, or a cloud hides the sun, and to turn them off again when daylight brightens outside.

The tube amplifier is used with extremely sensitive microphones to listen to stresses and strains in materials and manufactured products; also by surgeons and physicians for diagnosis of heart murmurs by comparison with existing standard phonograph records. Also it is used for the surgeon's cold cauterizing knife.

The radio tube is used in railway signals, for traffic control, remote control of torpedo boats, airplanes, radio compasses and beacons, landing systems for airplanes in fog and blind flying, and to determine altitude. It is also used in ship navigation for location of channels and fog signaling.

In medicine the high-frequency tube oscillator controls body temperature, and artificially produces fever to eliminate disease germs. In physics the tube is used as a voltmeter of great sensitivity, and to measure electrical currents to a millionth or a billionth of an ampere; in astronomy to measure the light and heat of stars and distances to a hundred millionth of an inch. Also in chemistry, mining, metallurgy and alarm systems is the vacuum tube useful. Indeed, there is little that the average man sees, hears or buys that is not controlled, regulated or affected in some important respect by a vacuum tube.

Forward-looking engineers see in the tube in its various forms a device that in time is likely to revolutionize the industries to the advantage of wage earners.

Properties of Modulated Signals and Modulation Devices

An Engineering Presentation of the Fundamental Methods of Modulation by Means of Vacuum Tubes.

By Ralph P. Glover

THIS excellent article on modulation should be studied as a continuation of the article under the same title and by the same author, in the May issue of RADIO ENGINEERING.

These two technical articles constitute an outstanding contribution to the standard literature of radio engineering.

Instead of dealing, as most other writers on this subject do, with the peak amplitude of the unmodulated carrier, Mr. Glover keeps to the fore the factor of the mean amplitude of the wave. —*Editor.*

As pointed out in the previous article (May issue), the degree of modulation has a pronounced bearing on broadcast coverage and on the useful output of detectors and other modulation devices. For these reasons, the determination of the modulation coefficient or percentage modulation[14] is a measurement of great importance. Overall measurements of radio receiver performance lose much of their significance if the modulation coefficient cannot be accurately determined or readily reproduced from time to time.

Fig. 7 shows the r.m.s. field intensity, in microvolts per meter, necessary to give a power output of 50 mw. from a certain broadcast receiver at various modulation coefficients. This corresponds to the usual measurement of receiver sensitivity at a single frequency for a number of values of m. It will be seen that at 30 per cent modulation, an input field of 7.2 microvolts per meter resulted in standard output, while at 20 per cent modulation, 14 microvolts per meter were required. The importance of an accurate method of measuring the modulation coefficient, especially in receiver development work, will be readily apparent.

Fig. 8 represents the variation of power output of the receiver with the modulation coefficient for a constant r.m.s. input field intensity of 7.2 microvolts per meter. This curve indicates the effectiveness of highly modulated signals in producing increased power output of the receiver.

Methods of Measuring Modulation

There are three general classes of methods of measuring the modulation coefficient. The first infers the effect of a given modulating e.m.f. on a high-frequency circuit of known characteristics. The second class methods use the measured increase in peak voltage of the modulated wave over the amplitude of the unmodulated carrier. Those methods belonging to the third class take into account the total amplitude variation of the wave. While these classifications are arbitrary, it is believed that all present-day methods of measuring modulation fall definitely under one of the three headings.

It is obvious that the methods of the first two classes can only be used where the generating apparatus is under the control of the person making the measurements. Neither of these methods is suitable for determining the degree of modulation of signals from a distant transmitter. Methods of the second class provide no clue as to the amount of distortion present and there is no assurance that the result is the *effective* value of the modulation coefficient. Those methods falling in the third class correctly indicate the amount of modulation regardless of distortion; require no control of the wave source and are most suitable for general purpose use. We should bear in mind, however, that all of the above methods are quite useful and give correct results within their own inherently limited field of application. These limitations will be considered in conjunction with the operation of the various devices which fall under these classifications.

"Inferred" Methods

In the previous installment it was pointed out that, with a correctly operating plate-modulated oscillator, the amplitude of tank current or high-frequency output voltage is proportional to the instantaneous plate voltage. The mean amplitude of the modulated wave will then be proportional to the steady battery potential. Constant amplitude, single frequency modulation is assumed throughout this discussion. If the modulating e.m.f. introduced into the plate circuit is a sine wave, the amplitude of the high-frequency wave will vary above and below the mean value equally by an amount which is proportional to the peak value of the modulating e.m.f. Under these conditions, the modulation coefficient is theoretically given by the expression

$$m = \frac{\sqrt{2}\,E_2}{E_b}$$

where E_2 is the r.m.s. value of the modulating e.m.f. and E_b is the steady battery potential.

This method is quite useful in conjunction with small laboratory oscillators. It has been used quite successfully in the type 403 General Radio Standard Signal Generator, a schematic wiring diagram of which is shown in Fig. 9. The coupling transformer in the oscillator plate circuit has three windings. The primary and secondary windings transfer the modulating voltage to the plate circuit, while the tertiary winding merely acts as a potential transformer, giving a step-down rario to a low range meter which indicates the modulating voltage. Such devices will give quite accurate results if the following conditions are fulfilled:

(1) The modulating voltage must be of sine-wave form.

(2) The modulating voltage must not swing the total plate voltage off the linear portion of the plate voltage-tank current characteristic.

(3) Plate batteries must be maintained at the proper voltage or due account taken of voltage drops after the batteries have been in use for some time.

It might be mentioned that this method always indicates a slightly greater degree of modulation than is actually present in the high-frequency wave. This is due to the fact that the tank circuit tends to smoothe out amplitude variations unless its decrement is fairly great. In the language of the

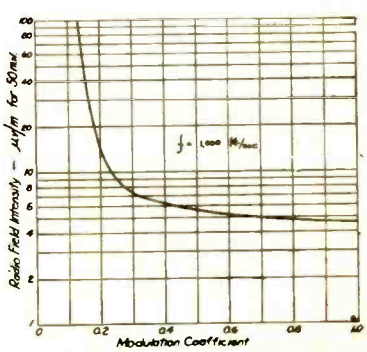


Fig. 7. Radio field intensity input vs. modulation coefficient for constant output of the receiver.

[14] *It should be remembered that Percentage Modulation* = 100*m*.

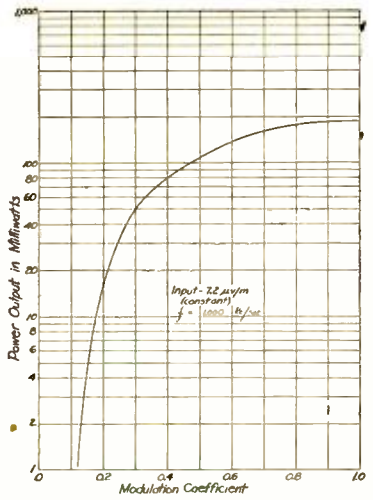


Fig. 8. Power output of a receiver vs. modulation coefficient for constant field intensity input.

waveband theory, the amplitudes of the side-bands are reduced relative to the carrier due to the selectivity of the tuned circuit. This effect is usually of small importance, especially with low modulation frequencies.

Methods Employing the Carrier Peak

Perhaps the most representative method of this group is one in which the modulation coefficient is calculated from measured peak values of the wave before and after modulation.[15] A peak voltmeter such as indicated in Figs. 10 and 11, is commonly used. The peak voltmeter is too familiar a laboratory tool to require further discussion.[16] If the modulation is sinusoidal and the peak value of the unmodulated carrier is also the mean amplitude of the modulated wave, we may calculate the modulation coefficient from the equation

$$m = \frac{E_{max} - E_o}{E_o}$$

where E_{max} and E_o are the peak values of the modulated wave and the unmodulated carrier, respectively.

The method suffers from several important limitations which, in extreme cases, may lead to large errors. Unless the modulator is properly designed and adjusted, the carrier amplitude may have different values for the unmodulated and modulated cases. This may be avoided, usually, by using proper plate modulation. Another common difficulty which frequently invalidates the results of measurements by this method, is to be found in the fact that if the modulator is operating with considerable distortion, the wave amplitude variations may not be equal for both halves of the modulation cycle. The result will then be decidedly larger or smaller than the true modulation coefficient.

The conditions, then, for which this method will give a correct indication of the modulation coefficient are:

(1) The mean amplitude of the modulated wave must be the same as the peak value of the unmodulated carrier.

(2) The modulation voltage must be of a form which is symmetrical during both half-cycles and the modulator must operate so that the increase in amplitude on one half of the low-frequency cycle is equal to the decrease in amplitude on the other.

Methods Which Account for Total Amplitude Variation

To facilitate the measurement of the degree of modulation where the signal is not under the control of the operator, Van der Pol and Posthumus have devised a method which makes use of the maximum and minimum amplitudes of the wave.[17] The method may be applied to the measurement of modulation on the signals of a distant transmitter and has the advantage that distortion of the wave envelope has little effect on the accuracy of the results.

Fig. 12 shows the connections and apparatus required. It is interesting to note that triodes with plate and grid tied together are used in the measuring circuit and that no plate batteries are needed. Separate filament current supplies are necessary, however. The action of the circuit may be explained briefly, as follows. The first diode functions as a straight rectifier and demodulator for any modulated high-frequency e.m.f. connected across the input terminals. The filament will therefore assume positive potentials with respect to the terminal T_2 which are proportional to the instantaneous amplitudes of the input e.m.f. If the switch S is thrown to the right, a pulsating positive potential due to the rectified signal will be applied to the plate of the second tube, which merely acts as a balance-indicating device. If the potentiometer arm is adjusted so that no potential is available to the circuit, plate current will flow in the second tube. If, on the other hand, the voltage from the potentiometer is increased just to the point where the plate current drops to zero, then the steady voltage indicated by the voltmeter will be very closely equal to the maximum or peak value of the wave. The reversing switch is then thrown to the other position, connecting the filament of the balance-indicating tube to the filament of the rectifier. Current will flow in the balance circuit if the filament is less positive than the plate for any portion of the low-frequency cycle. If the battery potential is reduced until the current just vanishes, the minimum amplitude will be indicated by the reading of the voltmeter for this condition. The modulation coefficient is then computed from

$$m = \frac{E_{max} - E_{min}}{E_{max} + E_{min}}$$

The value of m may be obtained to within about 2 per cent according to the authors, if the following conditions are obtained:

(1) The modulation must be constant during the readings. (This precaution applies especially to measurements on distant transmitters.)

(2) The high-frequency input should be of the order of 20 volts.

(3) Small contact potential differences in the tubes should be compensated for by the addition of small steady voltages (of the order of 1 volt) in the plate circuits.

The Cathode Ray Oscillograph

The use of the cathode ray or Braun tube for obtaining the maximum and minimum amplitudes from the dimensions of standing fluorescent figures, has been described recently by Rodwin and Smith[18] and by Von Ardenne[19]. For such details as the arrangement of apparatus and the technique involved, the reader should consult the bibliography. In general, the procedure consists in applying the modulated e.m.f. under examination to one pair of deflector

[15] *Use of the Electron Peak Voltmeter for the Measurement of Modulation, Jolliffe, Proc. I. R. E., April 1929; p. 660.*

[16] *The Thermionic Vacuum Tube, Van der Bijl. p. 367.*

[17] *Telephone Transmitter Modulation Measured at the Receiving Station, Van der Pol and Posthumus, Ex. Wireless and W.E., March 1927.*

[18] *Radio-Frequency Oscillator for Receiver Investigations, Rodwin and Smith, Proc. I.R.E., Feb. 1928; p. 161.*

[19] *Measuring Percentage Modulation, Von Ardenne, Radio Broadcast, April 1930; p. 354.*

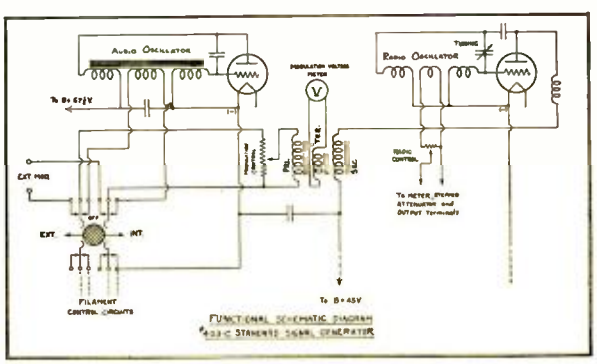


Fig. 9. Functional diagram, General Radio type 403-C standard signal generator. The modulation coefficient is inferred from the known value of modulating voltage introduced into the oscillator plate circuit.

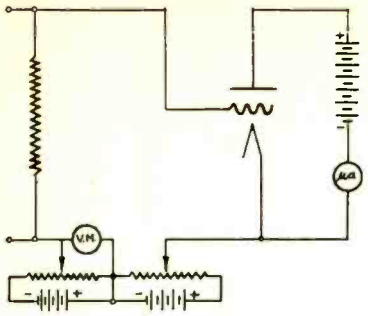


Fig. 10. Schematic diagram of a simple peak voltmeter.

plates and modulation voltage (obtained either from the low-frequency e.m.f. itself or by demodulation of the wave) to the other pair. A stationary figure, generally trapezoidal, will then glow on the target. A typical form is shown in Fig. 13. The long and short parallel sides are respectively proportional to the maximum and minimum amplitudes. No calibration of the Braun tube is required; the scaled lengths of the sides may be substituted directly in the preceding expression for the modulation coefficient. The difficulties involved in obtaining good patterns, together with the general unsatisfactoriness of the scaling operation, probably makes the method suitable only in very special circumstances.

A Method Based on Detector Action

A very convenient and rapidly operated apparatus, which has the additional feature of being practically direct reading, has been developed by K. W. Jarvis.[20] A schematic diagram is given in Fig. 14. The first tube acts as a demodulator, while the second tube functions as an audio-frequency voltmeter. A switching arrangement permits the first tube to act as a radio-frequency voltmeter so that the high-frequency input may be adjusted to a given predetermined value. The resulting audio voltage developed in the demodulator plate circuit is indicated on the audio voltmeter plate microammeter. Calibration is made of percentage modulation against the reading of this meter.

A comprehensive discussion of this device is beyond the scope of this article. For a detailed development of the vacuum-tube theory which applies and for circuit constants, the reader should consult the reference mentioned. The accuracy is conservatively stated by the author to be within 5 per cent. A recent check of the apparatus in conjunction with a properly operating plate-modulated oscillator, however, indicated that under conditions of fair waveform, the results are well within 1 per cent. The device is particularly desirable where much routine testing is to be done, due to the direct-reading feature.

[20] *Radio Receiver Testing Equipment, K. W. Jarvis, Proc. I. R. E., April 1929; p. 664.*

Root-Mean-Square Value of a Modulated Wave

Our discussion of the properties of a modulated wave has heretofore dealt with the maximum, minimum and peak amplitudes, since these values are involved in modulation measurements and are sufficient to define a wave of given radio and modulation frequencies. However, the engineer usually prefers to work with root-mean-square (r.m.s.) voltages and currents and it is therefore desirable to obtain an expression for the r.m.s. value of the wave in some useful form.

Van der Bijl[21] gives the following expression for the r.m.s. voltage in terms of the modulation coefficient and the carrier peak voltage before modulation

$$E_{RMS} = \sqrt{\frac{A^2}{2}\left(1 + \frac{B^2}{2}\right)}$$

where A and B are the carrier peak before modulation and the modulation

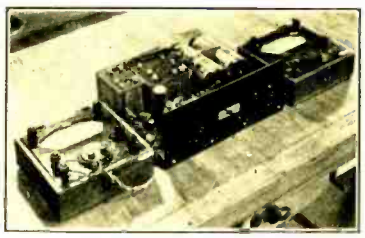


Fig. 11. A simple type of peak voltmeter suitable for modulation measurements.

coefficient, respectively. Van der Bijl's formula tacitly assumes ideal modulation, so we may rewrite the expression as

$$E_{RMS} = \sqrt{\frac{E_o^2}{2}\left(1 + \frac{m^2}{2}\right)}$$

where E_o is the mean amplitude of the wave.

In the usual run of experimental work, the mean amplitude is of little significance. We are more than likely to think in terms of peak and r.m.s. values, a habit acquired from daily work with ordinary sine waves. As will be proven in the appendix, the ratio of r.m.s. to peak voltage for a generalized sinusoidally-modulated wave is

$$k = \frac{E_{RMS}}{E_{MAX}} = 0.707\,\frac{\sqrt{\frac{m^2}{2} + 1}}{1 + m}$$

which reduces to the familiar sine-wave constant, 0.707 if m is zero. The ratio k will be referred to as the *peak factor*[22] of the wave. A table of values of k follows.

[21] *The Thermionic Vacuum Tube, Van der Bijl; p. 328.*

[22] *This should not be confused with the* **form factor**, *which is ordinarily understood to be the ratio of r.m.s. to average or mean amplitude.*

m	*k*
0.0	0.707
0.1	0.64
0.2	0.6
0.3	0.56
0.4	0.53
0.5	0.5
0.6	0.48
0.7	0.46
0.8	0.45
0.9	0.44
1.0	0.43

This relationship is extremely important and very convenient, especially in vacuum-tube work. In computations on radio-frequency amplification, it is usual to work with r.m.s. values, yet the peak amplitude determines the grid-current point. It is not unusual to find detector characteristic curves giving audio output voltage against either peak or r.m.s. radio-frequency input for some stated degree of modulation. The constant given above is useful for bringing the data together in comparable form.

Use of the Peak Factor in Modulation Measurements

An examination of the equation for k shows that it is a function of the modulation coefficient only. This at once suggests that the degree of modulation can be determined by obtaining the ratio of r.m.s. and peak voltages. The value of m corresponding to the measured peak factor will be correct provided the modulation is sinusoidal.

As can be seen from the table, the peak factor decreases rather slowly for values of m above about 0.5, necessitating a high degree of accuracy in obtaining k. This scheme, in spite of this disadvantage, is quite useful as a check, particularly when the other method of modulation measurement is based on peak voltage. The peak voltmeter may be arranged to measure the r.m.s. voltage by adjusting the grid bias to some suitable value for which calibration has been obtained. Care should be exercised to obtain operation over a quadratic characteristic so that the true r.m.s. voltage will be indicated.

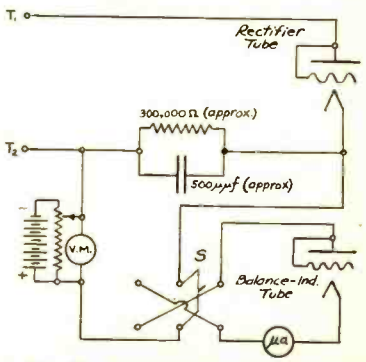
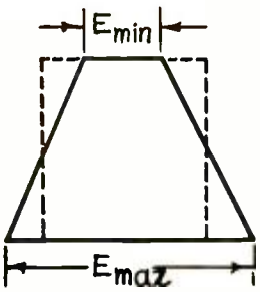


Fig. 12. Apparatus for measuring the peak and minimum amplitudes of a modulated wave.



$$m = \frac{E_{max} - E_{min}}{E_{max} + E_{min}}$$

Fig. 13. A typical standing figure of a modulated wave as portrayed by the cathode-ray oscillograph. (m=.5 in this particular case)

The Peak Factor Applied to Vacuum-Tube Voltmeter Design

In vacuum-tube voltmeter design it is customary to start out with the assumption of the maximum r.m.s. voltage to be measured. The condition is then imposed that the grid shall remain negative for all instantaneous values of voltage corresponding to this full-scale value. Thus, in the case of a sine wave, the least permissible grid bias is 1.414 times the full-range r.m.s. voltage. However, an examination of the table indicates that for a completely-modulated wave, (m = 1.0) the bias should be not less than 2.31 times the desired full-scale reading. Some additional bias is usually provided to allow for slight distortion. Some attention to this requirement in the design of general-purpose vacuum-tube voltmeters will often extend the usefulness of the instrument and prevent needless alterations and recalibrations.

APPENDIX

Derivation of the Peak Factor of a Modulated Wave

Van der Bijl's expression for the r.m.s. value of a modulated wave is given without proof. Since this derivation is necessary in establishing the peak factor, it will be given in detail.

Let a generalized, sinusoidally-modulted wave be expressed by

$$e = E_o (1 + m \sin \alpha t) \sin \omega t \qquad (1)$$

The root-mean-square or effective value of a wave of any form whatsoever is the square root of the mean of the instantaneous squared values throughout a complete period. Hence, in the case of a modulated wave, operations must extend over a complete period of the modulation frequency. The r.m.s. voltage then becomes

$$E_{RMS} = \sqrt{\frac{\alpha}{2\pi}\int_0^{\frac{2\pi}{\alpha}} e^2\, dt} \qquad (2)$$

or

$$E_{RMS}^2 = \frac{\alpha}{2\pi}\int_0^{\frac{2\pi}{\alpha}} E_o^2 (1 + m \sin \alpha t)^2 \sin^2 \omega t\, dt$$

which reduces to

$$E_{RMS}^2 = \frac{\alpha}{2\pi} E_o^2 \int_0^{\frac{2\pi}{\alpha}} \underbrace{(m^2 \sin^2 \alpha t \sin^2 \omega t}_{1} + \underbrace{2 m \sin \alpha t \sin^2 \omega t}_{2} + \underbrace{\sin^2 \omega t)}_{3}\, dt \qquad (3)$$

The first term of the integral may be rewritten as

$$m^2 \int_0^{\frac{2\pi}{\alpha}} \sin^2 \alpha t \sin^2 \omega t\, dt \qquad (4)$$

By simple trigonometry (4) becomes

$$\frac{m^2}{4}\int_0^{\frac{2\pi}{\alpha}} (1 - \cos 2\alpha t - \cos 2\omega t + \cos 2\alpha t \cos 2\omega t)\, dt \qquad (5)$$

But α is very small compared with ω, so that as a very close approximation we may say

$$\cos 2\alpha t \cos 2\omega t = \cos 2\omega t$$

Substituting in (5) and performing the integration, we get

$$\frac{m^2}{4}\int_0^{\frac{2\pi}{\alpha}} (1 - \cos 2\alpha t - \cos 2\omega t + \cos 2\omega t)\, dt$$

$$= \frac{m^2}{4}\int_0^{\frac{2\pi}{\alpha}} (1 - \cos \alpha t)\, dt$$

$$= \frac{m^2}{4}\left[t + 2\alpha \sin 2\alpha t\right]_0^{\frac{2\pi}{\alpha}}$$

$$= \frac{m^2}{4}\left(\frac{2\pi}{\alpha} + 0\right)$$

$$= \frac{\pi m^2}{2\alpha} \qquad (6)$$

The second term of the integral is

$$2m \int_0^{\frac{2\pi}{\alpha}} \sin \alpha t \sin^2 \omega t\, dt \qquad (7)$$

But

$$\sin \alpha t \sin^2 \omega t = \frac{1}{2}\left[\cos(\omega t - \alpha t) - \cos(\omega t + \alpha t)\right] \sin \omega t$$

The expression within the brackets is very closely zero, and hence

$$2m \int_0^{\frac{2\pi}{\alpha}} \sin \alpha t \sin^2 \omega t\, dt = 0 \qquad (8)$$

The last term of (3) is

$$\int_0^{\frac{2\pi}{\alpha}} \sin^2 \omega t\, dt = \frac{t}{2} - \frac{1}{4\omega} \sin 2\omega t\Big]_0^{\frac{2\pi}{\alpha}} \qquad (9)$$

Let $\omega = n\alpha$ where $n >> 1$

(9) then becomes

$$\frac{t}{2} - \frac{1}{4n\alpha} \sin 2n\alpha t\Big]_0^{\frac{2\pi}{\alpha}} = \frac{\pi}{\alpha} \qquad (10)$$

Collecting (6), (8) and (10)

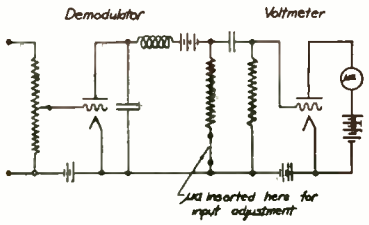


Fig. 14. Schematic diagram of a modulation meter which depends on detector action for its operation.

$$E_{RMS}^2 = E_o^2 \frac{\alpha}{2\pi}\left(\frac{\pi m^2}{2\alpha} + \frac{\pi}{\alpha}\right)$$

$$= \frac{E_o^2}{2}\left(\frac{m^2}{2} + 1\right)$$

or

$$E_{RMS} = \sqrt{\frac{E_o^2}{2}\left(\frac{m^2}{2} + 1\right)} \qquad (11)$$

which is in accordance with the result stated by Van der Bijl.

The maximum voltage of a modulated wave is

$$E_{MAX} = E_o (1 + m)$$

The peak factor has been defined as the ratio of r.m.s. to maximum voltage, or

$$k = \frac{E_{RMS}}{E_{MAX}} = \frac{\sqrt{\frac{E_o^2}{2}\left(\frac{m^2}{2} + 1\right)}}{E_o (1 + m)}$$

$$= \frac{1}{\sqrt{2}} \frac{\sqrt{\frac{m^2}{2} + 1}}{(1 + m)}$$

$$\therefore k = 0.707 \frac{\sqrt{\frac{m^2}{2} + 1}}{1 + m}$$

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Public-Address and Centralized Radio Equipment

Superiority of Balanced net work Systems of Volume control described in easily understood terms

*By E. W. D'Arcy**

VII. Volume Controls

THE author has received numerous inquiries requesting more information on volume controls and in response to this widespread interest has changed the schedule somewhat and for this article will deal with the subject of volume controls.

It is obvious that the proper volume control to use in any given instance is dependent largely on the nature of the generator and load with which it is being used. We shall therefore divide this subject into separate discussions on several typical cases.

Inductive Generators

The most common case that comes up for consideration under this heading is that of an electric phonograph pickup.

The nature of its impedance is purely inductive and therefore its impedance varies proportionately with freqency. The impedance curve of the common type of low impedance pickup is shown in Fig. 37. It can be quite readily seen that a volume control to operate between this pickup and its load, if we consider it from the standpoint of a power device, may be one of many compromises.

If, on the other hand, consideration of the nature of this pickup can be altered to consider it as a source of potential and not power, a pickup volume control can be evolved that is both distortionless and efficient.

* *Chief Engineer, D'Arcy Laboratories.*

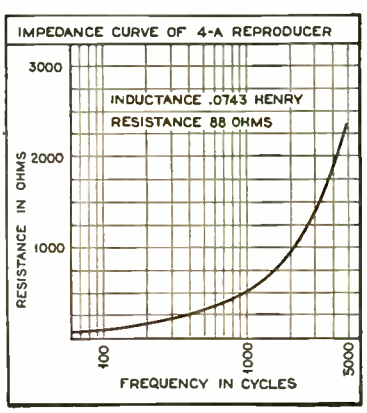


Figure 37.

A potential divider of the correct value fits the requirements exactly. A primary requirement for satisfactory operation is that of a sufficiently high resistance to insure that a minimum amount of current is drawn by the potentiometer. The effect of a potentiometer, of too low a resistance, is clearly illustrated in Fig. 39.

Possibly a good rule to follow in this respect is to design the potentiometer to have a resistance at least three times the highest impedance of the pickup at its determined upper cut-off frequency.

The transformer's input impedance should also be sufficiently high to insure a minimum of current drain. A suggested input impedance would be in proportion to the values given on the graph.

By examination of the shunt resistance method of volume variation we can easily determine why the apparent lack of clarity and definition of several types of phonograph combinations manufactured.

Function of Frequency

As has been determined the effect upon the ear of loudness is carried largely by the lower frequencies, while musical definition and speech clarity are dependent upon the higher frequencies. It is fairly obvious therefore that when the shunt has reduced the volume to any noticeable extent the "highs" are lost.

A curve of a balanced network operating between an inductive generator such as a reproducer and a potential load as furnished by an input transformer is given in Fig. 40. This particular illustration is used to demonstrate the effect of a constant output impedance device working into a potential load such as furnished by the input transformer.

A variation takes place in this particular instance which does not occur when the generator is a carbon microphone or tube. As a matter of fact when networks of this kind are operated from a "resistive" generator the distortion caused by the network is not noticeable and for this reason they are used extensively in telephone practise.

Where reproducers are used in connection with other equipment such as feeding through mixer circuits, the volume controls must be of such nature as to furnish satisfactory volume variation for several different types of generators, as carbon microphones, condenser microphones, telephone lines, and in some cases radio. As a rule any one of these sources of energy may be fed into the same position as the reproducer by means of jacks or switches.

Volume control requirements in this case are influenced largely by the most important source of supply, which in the case of broadcasting stations, motion picture recording and public address systems are identical.

Where several circuits are fed into the same amplifier and combined, as in mixer circuits, individual variation of the volume from any separate line should be possible without affecting the output of any of the other circuits. Some type of balanced network is necessary in order to obtain satisfactory results.

In motion-picture projection where sound-on-film as well as magnetic pickups are used, it is desired to have

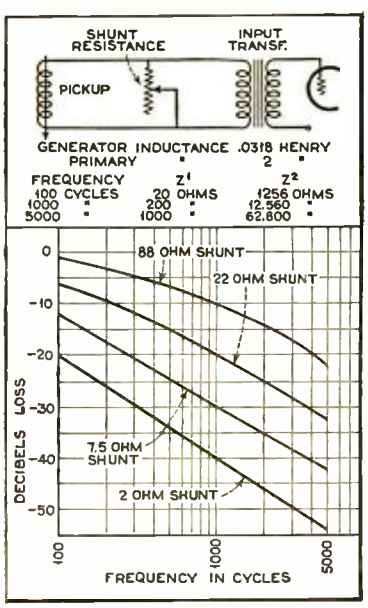


Figure 38.

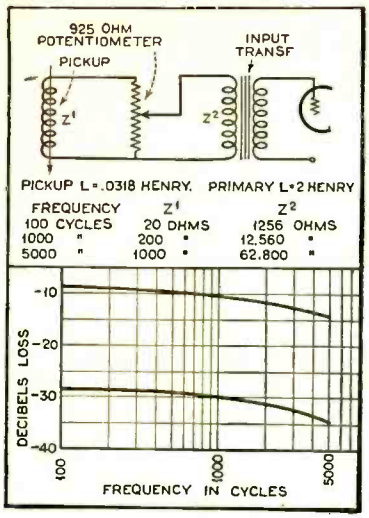


Figure 39.

all pickup circuits at as low an impedance as is practical. This to avoid the shunt capacitance effect of leads with resultant attenuation of the highs, as well as the better design of equipment possible at the lower impedances. A volume control must be designed more on the line of power transmission than potential generation. Construction of a combined volume control and fader should therefore be developed around the conventional balanced network.

The output from sound-on-film can be classed as resistive rather than inductive and therefore no distortion will occur due to the network.

Magnetic pickups when operated into the same fader position will show some attenuation of the extreme highs and lows. This attenuation is so small however as not to be noticeable since it is only approximately 2 decibels.

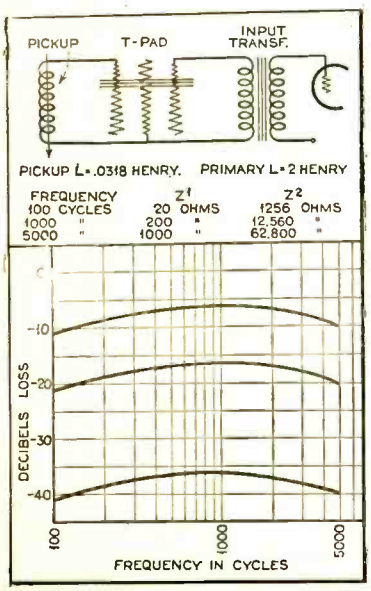


Figure 40.

Fortunately, the only thing of a purely inductive nature which is used in practise happens to be the reproducer and some types of loudspeakers. If tube circuits had an impedance of the same characteristic considerable difficulty would be experienced in obtaining satisfactory operation of many of our more common speech circuits.

"Resistive" Generators

Under this classification the author has placed the carbon microphone and any other transformer of energy which more closely approaches its characteristics than those of an inductive type generator.

The output of a vacuum tube amplifier could be classified under this heading as it has an output whose impedance does not vary to any large extent with frequency. An idea of the extent of impedance variation can be obtained by consulting the graph shown in Fig. 42. An equalized telephone transmission line falls into this classification somewhat.

For the above mentioned reasons a volume control to operate in conjunction with equipment of this kind can be designed on the supposition of operation between impedances which do not vary with frequency.

In other words a symmetrical, balanced network will function admirably as its impedance can be kept constant independently of the loss at which it is set.

Networks of this kind can be used in mixer circuits with assurance of distortionless control of volume, except as previously mentioned there may be some small amount of distortion in the case of magnetic pickups.

In the case of mixer circuits the supposition is not true that the impedance of the source and load are of the same nature, but it is true that the generator in the cases previously mentioned possesses an impedance which does not vary with frequency. Therefore when a balanced network is used the impedance of the generator viewed from the load does not vary with variation in attenuation. The load in this case can be considered a purely potential one, and insofar as the generator is concerned it is operated at some point between practical infinity and the load which it is designed for.

A stickler for this thing called *impedance matching* therefore would terminate the generator through the pad into a purely resistive load and then amplify the voltage drop occurring across the load.

Loudspeaker Volume Controls

The graph shown in Fig. 43 illustrates the impedance variation of a representative magnetic speaker. Variation of the output impedance of a standard output transformer designed for this speaker is plotted on the same chart.

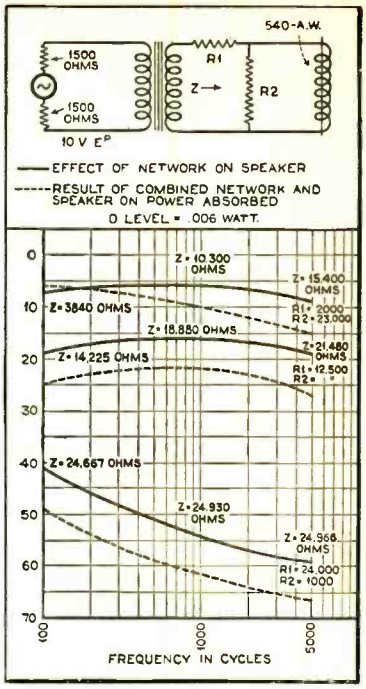


Figure 41.

The fact that a loss of frequencies occurs due to the inductive nature of the load furnished by the speaker is fairly obvious from the curves plotted in this figure. The results of calculations of this loss are given in the graph plotted in Fig. 42.

It is obvious that if a volume control is matched to the output impedance of the transformer no further loss will occur in the speaker than if the control were not used.

As a matter of fact it is possible to

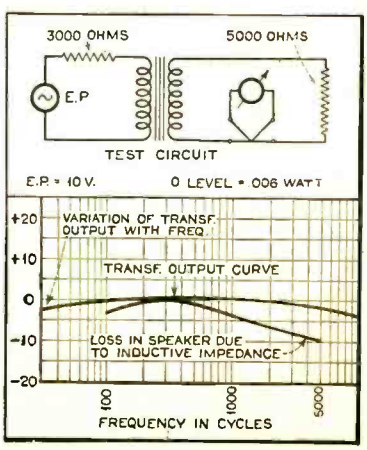


Figure 42.

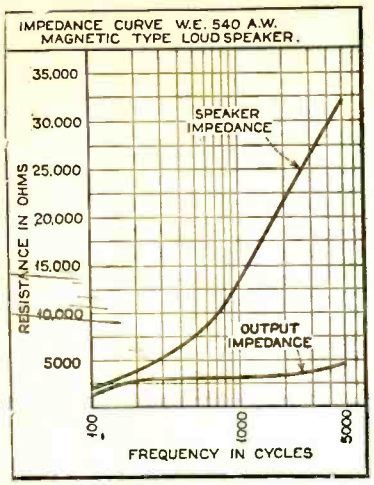


Figure 43.

design a volume control on this assumption along the lines of the conventional balanced network, and obtain distortionless control of volume.

The impedance presented to the output transformer is not the same at different settings of volume, however, as the reflected impedance of the speaker through the network varies at different settings of volume proportional to variation of the impedance of the speaker.

The impedance variation of a dynamic voice-coil has been plotted in Fig. 44. As can be observed from this graph a much better response will be given by a speaker of this character than by a magnetic speaker. A conventional, balanced network will function perfectly with a speaker of this type.

Due to the low impedance presented by the voice coil of this speaker a very economical construction of a balanced network is possible.

In Fig. 41 an analysis of the result of attempting to control the volume in a current consuming device such as a loudspeaker by means of a potentiometer is given.

A system of this kind is very impractical. This in addition to the distortion presented by the volume control, due to the variation in impedance at different settings of volume, which when several speakers are used on the same circuit makes establishment of a previously determined maximum volume level impossible.

Minimum loss in frequency range is only possible if some attention be paid to the type of volume control used. It seems to the author rather humorous that in many cases the manufacturer of an excellent product, who has spent years of development and work

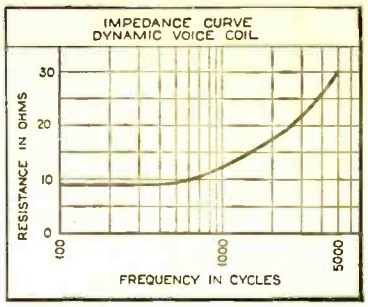


Figure 44.

perfecting a product to give uniform frequency response, sells it to the ultimate user who immediately destroys the excellent characteristics of the device by using an improper volume control.

The author feels that due to the many points of superiority possessed by balanced networks over other systems of volume variation that their early adoption by the sound projection industry is inevitable.

Hoping that this has cleared some of the misunderstanding which has been evidenced in selecting volume controls for different purposes the author brings this discussion to a close.

NEWSPAPER MEN WORRY ABOUT INROADS MADE BY RADIO

Radio and its influence on the press was examined as members of the American Newspaper Publishers' Association met in annual convention in New York, April 24, to consider the news and business problems of the nation's journals.

The problem of the relations of newspapers and broadcasters claimed close attention of more than 500 publishers who attended the meeting.

Radio can never supplant newspapers, it was generally agreed, but the basis of how to deal fairly and reasonably with the new invention, which is at once a source of news and of commercial competition, is a problem, the report of the association's committee on radio pointed out. The report adopted, after its presentation by Elzey Roberts, of "The St. Louis Star," noted that publishers will do well to question whether the policy with regard to their new-found competitor has not been too lax.

Points to Radio Limitations

Pointing out that the inherent limitations of radio will never permit it to supplant newspapers, the resolutions pointed out that the radio chains do not maintain news-gathering organizations and that they benefit by the extensive and expensive facilities which newspapers and press associations have built up. The very generosity of the press and its zeal in wanting to get news to the public quickly have curtailed some branches of legitimate newspaper revenue, it was added.

Radio has largely eliminated extras on prize fight news results and has in some places shown a curtailment of interest in baseball news, it was said. The fact that radio has the limitation that it must present its programs when the broadcasters choose and not when the listeners choose to have it, was cited.

"It would be interesting to determine," the report said, "what part of radio advertising is sold solely on the strength imparted to it by its competitive medium." The report conceded that "there is news in radio programs and that it is the unquestioned duty of the press to supply that news. It does not necessarily follow that a newspaper should take upon itself the task of popularizing trade names in radio programs because certain firms are spending money with a competitive medium, radio, for that purpose.

Point Railroads as Example

"It did not occur to the railroads of twenty-five years ago," the report continued that the development of automobiles, buses, and concrete roads would practically put out of business their suburban patronage in many communities. Yet just this thing has been done. We read frequently of more trains being discontinued on branch lines and for commuting purposes. Imagine the railroads doing nothing to protect themselves against this competition, but instead building the concrete roads and supplying the buses with gasoline, and you will have something of a comparison with newspapers supplying radio stations with news and free publicity on trade names, which make their advertising medium salable at such high rates."

Vacuum Tubes Now Turned out with Precision, at High Speed

One Grid Every Four Seconds —One Thousand Stems Per Hour

By A. Ernest Lyle

THE past two decades have been eventful in the history of the radio tube; growing from a scientific curiosity in 1910, with undeveloped possibilities, it has become, in a few short years, of paramount importance to every phase of modern endeavor. Where we least expect it, we find the radio tube quietly at work, increasing enjoyment, lengthening leisure hours, or watching over our safety. In the realms of entertainment, communication, transportation and even in business and industrial interests, the radio tube has assumed a great and ever increasing importance.

The industry associated with this versatile product has had a correspondingly marvelous expansion. Embracing perhaps a few hundreds of people in 1920, it has grown until today it rightfully takes its place among the greatest industries in the nation. Manufacturing a decade ago less than a quarter million of tubes per year, it now supplies from one hundred to one hundred and twenty million tubes in the same space of time.

Ours is an age of speed and no where, perhaps, is that better demonstrated than in this phenomenal industrial growth. Further evidence is manifested daily in new records being made. Increased speed is attained in transportation, — travel quickened by land, sea and air. Advancements are made in communication, — vast distances traversed by human intelligence in greatly decreased time. And always behind the scenes we find the radio tube playing its highly important part.

In industry too, are new speed records being created and though not generally as spectacular as those in other fields, they are economically of even greater importance.

Perhaps in no other fields have more rapid strides been made to speed up production than in incandescent lamp and radio tube industries. Automatic tube making equipment has been developed to the stage where it now enters into practically every phase of tube manufacture. At the leading radio tube plants, strong emphasis has been placed upon efficient, high-speed automatic equipment for each operation.

One Grid Every Four Seconds

Formerly, one of the most costly tube parts to manufacture was the grid. Hand wound upon a copper mandrel, one grid at a time, it was then welded and carefully and slowly removed from the mandrel. The speed of this operation varied with different operators and different types of grids, but averaged about one grid per minute. Each grid was inspected and the surplus wire removed, causing the loss of considerable time and material. This part is now manufactured by high-speed automatic machinery which winds exactly the correct number of turns, welds these turns firmly in place, cuts the grid to the proper length and expels it from the machine ready for use. All this without any manual labor and at the rate of one grid every four seconds.

Plates Made Quickly

Plates were also made in numerous operations. First the strip nickel was cut to length and each half of the plate formed, after which the two halves were fitted and stitched or welded together. Here also the manual labor has been replaced by high speed equipment. The strip nickel is now automatically fed into the die, the plates formed, stitched together, sized and delivered complete.

Filaments Uniformly Produced

Filaments have also undergone extreme changes in the making. They are now manufactured by a continuous process in which the pressure of the inert gas used, the heat of the baking ovens and the speed of the coating are all automatically regulated and kept constant, insuring a uniformly active filament. An automatic machine now obviates all uncertainties of length and eliminates contamination through handling. It cuts the filament to the proper length, scrapes the ends free from the coating material, and delivers perfectly clean and uniform filaments ready to be welded to the stem or connector.

Next in the sequence of operations is the working of the glass parts. Formerly hand machines, each requiring an operator, produced two thousand flares per day. Now the hot cut automatic flare machine produces fifteen thousand flares daily and five or six such machines can be handled by one operator.

One Thousand Stems Per Hour

Then, the fabricating of the stem. But a short time ago only the best operators could produce a thousand complete stems each day, while the latest automatic stem making unit will deliver this number of perfectly formed stems each hour.

In the mounting departments operators assemble and weld the plate, grid and filament securely in place. While the mounting operation at present still uses hand labor, fair success has been achieved in the development of automatic fabrication and undoubtedly high speed mounting machines will be regularly employed in the near future.

In sealing in the glass envelope over the stem parts rapid strides have been

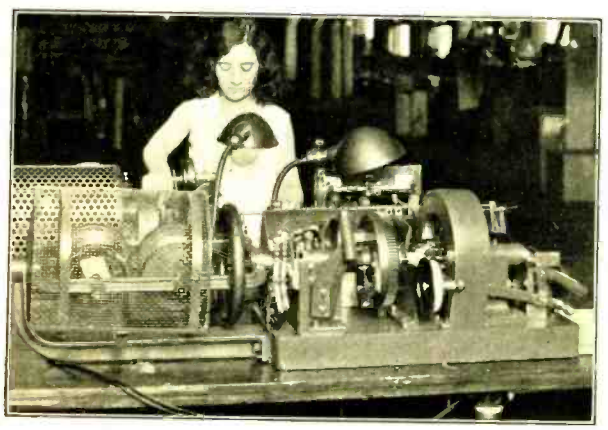


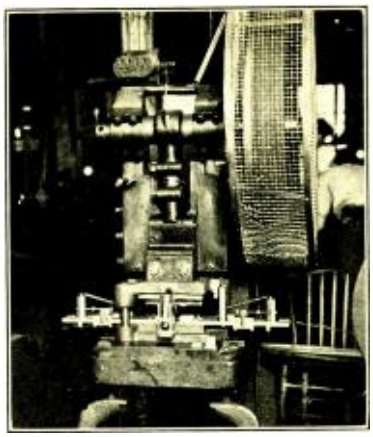
Fig. 1. Grid winding machine which winds, welds, cuts, and delivers, ready for use, 8,000 grids per day.

made towards greatly increased production on high speed units.

Exhausting Air in Eight Seconds

Probably in no other branch of tube making have there been so many rapid changes as in the automatic exhaust units. An idea of these improvements may be gained by contrasting the speed of the latest machines, from which a tube is exhausted in five to eight seconds, with the older methods of pumping tubes for ten to twenty minutes.

Then followed improvements in attaching the base to the glass bulb, replacing four or five of the old type basing reels and doing away with as many more auxiliary operators, each new ninety head automatic baser, straightener and lead wire cutting machine produces a perfectly aligned tube in three seconds as against twenty-five seconds and uncertain alignment under the old methods.



Automatic plate die which cuts, forms, stitches, and sizes 30,000 plates per day.

In the final operation, that of testing, automatic equipment also plays a very important part. It not only speeds up the operation, but also safeguards the quality of the finished tube by removing the human equation.

No where has the march of progress been more pronounced than at the "Cable" plants. In this organization SPEED is not only a name, but is an inspiration. Everlastingly quickening production, increasing efficiency—above all keeping quality high and constantly striving for its improvement—searching for new and better ways of performing necessary operations—experimenting, testing, discarding, patiently and steadily working, each member strives toward a common goal —Speed and perfect tubes.

An Audio-Frequency Amplifier that Gives Good Results

By R. W. Tanner

ABOUT a year ago, while experimenting with short-wave receivers, it was found that audio howling and motor-boating was far more serious than in regular broadcast receivers, especially when operated from B substitutes. With transformer or impedance coupling, these noises could generally be eliminated by shunting the grid of the first tube with a resistor under 100,000 ohms, or, in the case of resistance coupling, by reducing the resistance of the first a-f. grid leak to the same value. This is a very inefficient method in view of the fact that most of the higher audio frequencies are shunted to ground—this in addition to a large reduction in amplification.

It was felt that in a system of amplifying the output of the detector was needed which would be practically free from these noises. Considerable research resulted in a new type of audio-frequency amplifying transformer, details of which are given in Fig. 1.

The B position is fed to the plate through an impedance L, the value depending upon the type of tube used. This may be replaced by a resistor, and is to be preferred in the case of a detector. L_1 is the grid impedance. It will be observed that the plate tap is made at the junction of two capacities connected in series across L_1. If the resistance of L_1 is zero, the potentials across C and C1 will be opposite in phase, in which case the opposite potentials will be of equal magnitude when C equals C1. The potential at the mid-tap of the two capacities will then be zero with respect to the preceding grid. Feedback to the grid will occur, positive when C exceeds C1, and negative when C1 exceeds C. It is apparent then that by making C1 somewhat the larger of the two, audio howling, due to unavoidable magnetic coupling, may be compensated for.

As C and C1 are in series, the effective capacity across L_1 is:

$$\text{Effective capacity} = \frac{1}{\frac{1}{C} + \frac{1}{C1}}$$

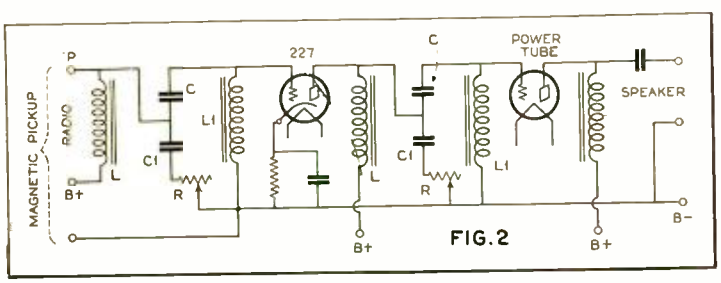


FIG. 2

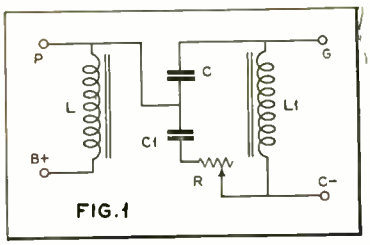


FIG. 1

By properly proportioning C, C1 and L_1, a rising characteristic may be obtained at any frequency within the audio spectrum. The resistor R is employed for the purpose of reducing the magnitude of the peak frequency to a satisfactory value and may well be variable.

The voltage step-up is:

$$\text{Voltage step-up} = \frac{C+C1}{C}$$

By making C1 variable in steps (the minimum capacity should not be smaller than C) with a variable resistor at R, it is possible to peak an amplifier to suit the ear of the individual or to overcome any deficiencies in the loudspeaker.

Fig. 2 shows a two-stage amplifier designed by the writer for use with either a radio or magnetic pickup. The values of C1 and R may be fixed in the first stage if desired and made variable in the second. In practice, the variables are permanently adjusted when installed.

While this system was developed mainly for use in short-wave receivers, it may readily be used in regular broadcast sets with improved results.

The public is fast becoming tone conscious. Some prefer the "highs" and some the "lows." The amplifying system herein described will give the listeners what they desire.

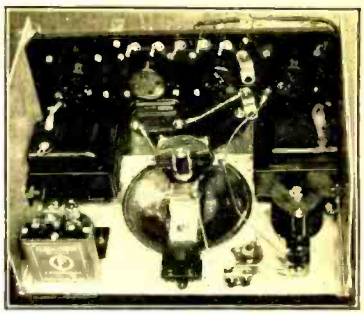
The author will be glad to answer inquiries about this amplifier.

The Short-Wave Set Sheds Its Overalls

Recent Engineering Developments Answer Popular Demand and Produce Practical and Simple Short-Wave Receivers for Lay Use.

By Austin C. Lescarboura

Mem. I.R.E. Mem. A.I.E.E.



Interior of compact short-wave receiver, showing tuning condensers, audio transformers and other details. Note tube sockets, in which tubes are held upside down.

IN developing the usual broadcast receiver to its present high standard of engineering and merchandising perfection, the radio industry has provided most homes with the greatest benefits known to our civilization. In fact, it may be, and is frequently, asked whether or not our industry has reached the climax of its activities, and, henceforth, is doomed to rest on its laurels and retrench on the scope of its labors. In other words, is the radio industry serving a dwindling market, now that so many homes are already equipped with broadcast receivers?

Of course radio sets wear out. While the wear and tear is much less rapid and noticeable than that of the usual automobile, the fact remains that filter condensers and resistors weaken in time and finally break down, while such moving parts as tuning condensers, volume controls, switches and so on eventually outlive their usefulness. The public, because it fails to detect this wear and tear until the set simply refuses to function, is under the impression that its radio investment is good for many years to come, whereas three to five years of average use represents a fair return on the radio investment. Quite aside from wear and tear, and far surpassing it as a factor in the repeat sale, there is the factor of obsolescence, which has been an important element in the repeat sale. However, from now on the obsolescence rate is apt to be much lower than in the past, since the relative state of perfection today is such as to keep the average radio set buyer satisfied even when confronted with additional refinements in the latest sets.

And yet, speaking about approaching saturation, it is well to note that the broadcast receiver is only a modest part of what radio has to offer to the home. There is radio television which, from all indications, is steadily progressing toward the commercial stage, even admitting that the existing technique leaves much to be desired by way of entertainment value. There is the home talkie field, combining the present home movie projector with the radio set amplifier and loudspeaker, so that suitable sound pictures may be obtained. There is facsimile radio, whereby broadcast stations, during the small hours of the morning when there is nothing else to do, may transmit facsimile signals and operate facsimile recorders in the homes, switched on automatically at the proper time. Lastly, there is short-wave reception, which affords more thrills than even the early days of broadcasting. And it is with this last-mentioned possibility that we are concerned in the deliberations that follow.

Short-Wave Operation Simple

Short-wave reception, until recently, has been surrounded with much mystery and awe. The layman has been told in vague terms that short waves are highly tricky; that special tubes are required to handle short waves; that the tubes must be unbased, and that dozens of tubes must be so mutilated and tried before satisfactory reception is obtained; that tuning must be done with fiddlesticks a yard long, due to the super-sensitive character of short-wave circuits; that only an expert can tune in short-wave signals, and then only after spending hours, days, weeks and months. All of which, we know, is plain piffle—but tell it to the layman, not to engineers who know better!

Furthermore, the public is generally under the impression that short-wave traffic comprises mainly dots and dashes of radiograms, which are meaningless to one who does not know the code. The public does not seem to realize that the short-wave band is loaded with music and speech from dozens of stations the world over, presenting not only the thrill of traveling via radio to many lands, but also a fair degree of entertainment and enlightenment. Indeed, for the listener-in not located within ready reach of the network stations, the short-wave field offers the best programs available anywhere, especially since the networks operate several short-wave transmitters regularly for all their programs.

There is a real place for the short-wave station not only in the isolated home, which must employ a far-reaching radio set to bring in desirable programs, but also in the metropolitan home anxious to get away from a purely local atmosphere grown boresome. Slowly but surely the public is being made short-wave conscious, and it now comes down to the matter of capitalizing on the interest already created, which is certain to grow as short-wave receivers find their way into an ever-increasing number of homes.

From a purely engineering standpoint, the short-wave receiver no longer presents the problems it once did. Short-wave reception has been *debunked*, just as radio-frequency amplification was *debunked* some seven years ago. Such problems as socket-power operation, body capacity, simplified tuning, sufficient separation on the tuning dial, interchangeable coils, satisfactory tubes and so on, have been solved by now.

Make Up of Short-Wave Receivers

Basically, the present-day short-wave receiver employs a regenerative detector preceded by a tuned or an untuned screen-grid r-f. amplifier. There is a considerable gain in employing a tuned screen-grid stage ahead of the detector, even though it may introduce some complications by way of tuning. At least one short-wave set builder has essayed two stages of tuned screen-grid r-f. amplification ahead of the regenerative detector, and has produced a super-sensitive receiver of remarkable possibilities, as explained further on. However, for most purposes, and especially in view of the steadily increasing power of relay or rebroadcasting short-wave transmitters, the simple regenerative detector, together with a stage of screen-grid amplification, preferably tuned, constitutes the best product from the mass production and profitable merchandising standpoint.

Until a short time ago, it was part of the dogma of short-wave mysticism that battery power had to be used. Socket-power operation was inconceivable at that time. Yet socket-power has come into the short-wave reception field, and today the majority of the receivers on the market are being operated on a-c. It is now possible to obtain silent, steady, altogether satisfactory operation on a-c., utilizing the better grade

a-c. tubes. From the merchandising standpoint, it is well to provide the two types of short-wave receivers—battery and a-c. operated, since a very large market is to be found in the rural home and even abroad, far removed from electric light lines. For the urban or suburban home, accustomed to a-c. operation, the use of batteries for the short-wave set constitutes a serious sales resistance point, and the manufacturer would be foolish to insist on battery operation when a-c. operation is feasible and practical, even though it may increase the list price of the offering.

Short-wave adaptors, applicable to the usual broadcast receiver so as to make use of the usual audio amplifier and loudspeaker, have never taken hold in the manner expected. For one thing, most adaptors have been too simple and too crude, frequently with only the regenerative detector, which is really insufficient for satisfactory loudspeaker rendition under normal conditions. Little wonder, therefore, that the public, picking up only the domestic short-wave stations, has been disgusted with most short-wave adaptors and has passed the word around. However, in merchandising theory, the short-wave adaptor is the right answer to home short-wave reception. It makes use in large part of existing equipment. It reduces the additional investment called for. It makes use of an excellent audio amplifier and loudspeaker. It requires a minimum of space in the home living room.

The short-wave adaptor should be developed to a higher state of refinement. Thus it should have at least an untuned screen-grid r-f. stage ahead of the detector, and preferably a tuned stage. Also, it might be well to include a first audio stage, which might be termed a pre-amplifier stage, following the detector, so as to feed an input more nearly approaching that of the usual broadcast set detector, to the regular audio amplifier. In most short-wave adaptors now on the market, the output from the detector is so weak that it cannot operate the usual audio amplifier satisfactorily.

It is a mistaken idea that the short-wave adaptor must be sold for $35.00 list or less. There is no reason why the list price cannot be set at $75.00. The advantages of short-wave reception, and the wonderful thrills that can be obtained from the usual broadcast set provided with this accessory, makes price a secondary consideration. Therefore, the engineering and production fraternity should look ahead to a higher list price and work out adaptors capable of doing some real good work. The efforts until now have been entirely too crude, too incomplete, too modest in results.

A survey of public opinion on the question of adaptor or separate receiver, indicates that both types of short-wave receiving equipment are desired. There are set owners who do not care to attach anything to their broadcast receivers. They prefer an entirely separate receiver, especially since it may be employed in the den, in the attic, down in the basement, or elsewhere, where father or son may repair for some DXing, while other members of the family are satisfied with the programs from the purely local stations.

Fortunately, the adaptor and the separate receiver are not so far apart in engineering and production design. More or less the same parts and general design may be employed for both types, thereby reducing costs while just about doubling the potential market.

In the matter of tuning, it is generally appreciated that wide separation on the tuning dial is achieved by using a large number of inductances or plug-in coils. Most sets use anywhere from four to six, covering the short-wave spectrum from 15 to 200 meters. One manufacturer covers only the 15 to 110 meter band with six coils, but obtains excellent separation.

Plug-in Coils Amateurish

Now from the lay standpoint, the separate, plug-in coils are frankly a nuisance. They serve to give the short-wave set an experimental atmosphere which is dreaded in the average home, especially where the programs themselves are the primary interest. In this regard, much engineering skill can be brought to bear on a problem that should not be difficult. One short-wave set manufacturer has placed his various coils inside the metal cabiner, on a shelf, thus keeping them out of sight yet close at hand for ready changing. But that is still a long way from the ideal. In our opinion, what is necessary to make the short-wave set highly popular is some sort of turntable arrangement, like the lens turret on multi-lens motion picture cameras, whereby one coil after another may be shifted into position by revolving a platform on which they are mounted. In this manner the lay operator could tune throughout the range of the first coil, then swing the next coil into position, again tuning throughout that range, followed by the third coil, and so on. Since a plurality of coils is essential for proper separation on the tuning dial, then the process of switching coils should be reduced to the simplest, most convenient terms.

In the matter of tuning, it would be highly desirable to have a "broad" and "sharp" tuning switch, if possible. All of us who have fished about in the short-wave band know how easy it is to slide past an important signal, without even detecting it. If, through the introduction of circuit resistance or some other means, it would be possible to broaden the tuning while exploring the short waves, this feature would aid materially in lay operation.

Shielding Remedies Difficulties

Body capacity and tricky operation are no longer a source of trouble. The use of proper shielding eliminates the need of tiddlesticks. The writer recalls some of his early experiences with short-wave reception of signals from G5SW of Chelmsford, England. The home-made receiver, with exposed parts mounted on a long board, was so critical as regards body capacity that the operator and the audience did not dare shift postures while signals were tuned in, for fear of throwing the circuit out of balance. Tuning had to be accomplished by tuning controls a foot away from the variable condensers, using hard-rubber rods. Little wonder that deep mysticism and awe grew about short-wave reception, and that its pleasures have so long been denied the average broadcast listener grown somewhat bored with regular broadcast reception.

There is also a mistaken idea among the laity and even among engineers that the short-wave receiver must space its components widely apart. In fact, the best short-wave circuit is supposed to be that where wide parts are widely separated, yet with the wiring running from point to point so as to have the shortest distances possible. One leading radio company has gone just the opposite way, and produced a radio set of extreme compactness, measuring only 5x6x9 inches, including two stages of audio amplification in addition to the regenerative detector and screen-grid r-f. amplifier. The circuit design of this new receiver is by no means revolutionary, the outstanding advantages being simplicity and economy of space effected without sacrificing performance. The circuit includes one stage of aperiodic radio-frequency, using the screen-grid tube; a space charge detector, also employing a screen-grid tube, and a two-

Details of a sectional unit short-wave receiver, showing unique belt drive between tuning drum and tuning condenser, exceptional spacing between various components and shielding, as well as double shielding between units.

stage transformer-coupled audio amplifier employing the -01A or -12A type tubes. A separate C bias lead is included, so that any other type of output tube may be employed without necessitating changes in the wiring circuit of the receiver. The entire assembly, including tubes, coils and battery cable, weighs only 7½ pounds. Utilizing four plug-in coils which fit on top of the cabinet, the receiver has a tuning range of 14 to 195 meters. Other coils bring the wavelength range up to 1000 meters if desired. The unusually small dimensions of the receiver are made possible by the ingenious mounting assembly, in the form of a bakelite sub-panel, located three-fourths of an inch below the top of the cabinet. The sockets from which the vacuum tubes are suspended upside down are incorporated in this sub-panel. The two audio transformers are mounted on the two end plates of the aluminum case, while the two midget variable tuning condensers as well as the variable resistance regeneration control are attached to the front panel. The resistances and remaining 2½ mfs. of by-pass condensers occupy the remaining space at the rear of the cabinet. For further simplification the leads of the battery coil cable are soldered directly to their proper positions in the wiring, eliminating all binding posts and connections.

Receivers May Be in Sections

In contrast to the foregoing compact short-wave receivers, there is the receiver in sectional unit form just introduced for buyers seeking superlative short-wave reception. This receiver comprises a number of aluminum box units, each with hinged top and sloping front panel. The cases, placed side by side, afford double shielding between units, so essential in high-frequency receiver design. Each r-f. stage, and there are two available, is in a separate compartment. The detector stage is also in a separate compartment, while the three audio stages are combined in a fourth compartment. Only one tuned screen-grid stage may be employed, or two, as desired.

Short-Wave Adaptors

In ordinary short-wave adaptors, a wide wavelength range is obtained with only a few coils and a comparatively large tuning condenser. As vacuum tubes are voltage-operated devices, they require in the tuned circuit a maximum of inductance and a relatively small tuning condenser. This is a disadvantage as far as manufacturing cost is concerned, but in the sectional unit type discussed, the most efficient arrangement has been carried out regardless of cost. This makes the receiver unsuited for ordinary broadcast wavelengths, but very materially increases the degree of efficiency for the short wavelengths. The various inductances and condensers are of the low-loss type. In addition to having complete shielding, the various circuits are all provided with an elaborate system of chokes and by-pass condensers, confining the r-f. currents to their proper paths.

It is interesting to note in the illustration of this sectional unit receiver that, in order to allow sufficient dial space for accurate calibration, the full dial circumference of the dials is employed. Mechanical action between dial and tuning condenser, in the form of a driving belt, provides a ratio of 1 to 2, permitting of vernier adjustment.

In the ordinary short-wave adaptor or receiver with only a few tubes, it is impossible to secure enough regenerative amplification in the detector circuit properly to operate a powerful audio amplifier. While the addition of one tuned r-f. stage in front of the detector helps to correct the situation and will produce fair loudspeaker signals, it is essential to have two tuned r-f. stages ahead of the detector in operating a powerful audio amplifier. The engineers of this sectional unit receiver have purposely omitted the push-pull audio amplifier design because of the extra input signal required to secure full output. A push-pull amplifier would require far more signal than can be obtained conveniently in a short-wave circuit. While such an amplifier would operate well with a powerful signal, it would cause the weaker signals, so prevalent in short-wave work, to be entirely lost.

Another question also comes up in connection with short-wave merchandising: Why not include the short-wave reception feature in the usual broadcast receiver? As a matter of fact, our Canadian friends across the border have been producing and merchandising superheterodynes provided with changeable coils so as to tune in the short-wave signals. Such sets have been highly popular. Obviously, the superheterodyne lends itself more readily to the inclusion of short-wave tuning than the usual tuned r-f. set.

Universal Receivers

It is our belief that eventually, as short-wave broadcasting becomes more commonplace, the broadcast receiver will include this feature. There are technical problems, to be sure, although today a separate short-wave tuner and detector might be included, with a switching arrangement to throw this feature on to the usual audio amplifier. In time, the engineers may work out a suitable circuit, perhaps with the turret arrangement of coils already referred to, whereby a broadcast receiver may tune in short, broadcast and even the long-wave signals employed in certain European broadcasting activities.

At any rate, the growing popularity of short-wave reception is something which should not be overlooked in engineering and merchandising plans. It provides a brand new deal for the industry and gives us one more opportunity to sell our old friends—the present broadcast listeners.

I.R.E. AND RMA TO HOLD JOINT MEETING IN TORONTO, CANADA, AUGUST 17–21, 1930

The first International Convention of the Institute of Radio Engineers, will be held in Toronto in August. Members of the RMA who attend the Convention will hold an RMA session. There will be plenty of entertainment and it is anticipated that the attendance will be large.

Herewith is a schedule of the events:

AUGUST 17

Registration at King Edward Hotel

AUGUST 18

Registration at King Edward Hotel.

Opening session — King Edward Hotel, ballroom.

Panoramic photograph of delegates.

Buffet luncheon—King Edward Hotel, ballroom.

Trip No. 1—Canadian National Carbon Company, Leaside transformer station and Canada Wire & Cable Company.

Trip No. 2—Shopping tour for ladies.

Popular lecture, Physics Bldg., University of Toronto.

AUGUST 19

Technical session—King Edward Hotel, yellow room.

Technical session — King Edward Hotel, ballroom.

Technical session — King Edward Hotel, ballroom.

Trip No. 3—Broadcasting station CKGW.

Trip No. 4—Sightseeing trip for ladies.

Trip No. 5—Can. Brandes Co. and sightseeing trip.

Sections Committee meeting—Engineers' Club.

Symposium—King Edward Hotel, ballroom.

AUGUST 20

Technical session—King Edward Hotel, ballroom.

Trip No. 6—Rogers Majestic Co. and DeForest Crosley Co.

Trip No. 7—Boat trip for ladies.

Golf tournament.

RMA committee meeting—King Edward Hotel, blue room.

Annual dinner and dance—King Edward Hotel, crystal ballroom.

AUGUST 21

Trip No. 8—Niagara Falls, Queenston Power Plant, Welland Canal.

RMA committee meeting—King Edward Hotel, blue room.

Radio Manufacturers' Association

The engineering division of the RMA has been invited to participate in the activities of the convention. Among the list of papers to be presented several are of particular interest to the manufacturer. These are to be presented during the session on Wednesday, August 20. In addition, a number of committee meetings of the engineering division are scheduled during the course of the convention.

The Radio Robot

A Useful Testing Laboratory in a Portable Case

By S. R. Winters

PERFORMING at least five important functions, a radio-servicing outfit invented by Ralph Stair of the Bureau of Standards is capable of testing and rejuvenating vacuum tubes, diagnosing the troubles of condensers, transformers, and other radio parts, testing complete receiving sets, and serving as a portable power unit from which any voltage (in steps of a volt or two) from zero to 200 volts alternating-current may be obtained. This invention, for which patents are pending, is the first trouble-shooter to combine so many services into one unit —testing both direct-current and alternating-current radio receivers, every type of vacuum tube, including rectifying tubes, and diagnosing crippled receiving sets as a whole.

Despite these manifold performances, the entire outfit weighs less than 30 pounds and it is completely self-contained. Of relatively small overall dimensions, the apparatus may be enclosed and clamped into a carrying case for carriage by a serviceman from one point to another with the facility with which one would handle a portable receiving set. The panel on which the testing devices are supported is rectangular in shape. Beneath the apparatus is a compartment for holding soldering irons, screw-drivers, and other tools ordinarily carried by a radio trouble shooter. This spare room renders it possible for the serviceman to concentrate the radio tools in a convenient location, instead of spreading them all over his automobile. This tool compartment may also accommodate a "C" or "A" dry-cell battery and afford room for the two insulated wires necessary to the functioning of the test kit.

The portable trouble shooter.

The 7x18-inch panel for testing and restoring the active period of life of radio receiving tubes contains two miniature automobile lamps. These act as trouble signals on the trouble shooting board. Like storm warnings sent out by radio or through visual means, these tiny lamps flash signals of troubled tubes. For instance, if one of the lamps lights this is an indication of a short circuit between the plate and filament of the tube under diagnosis; if, on the other hand, the other lamp radiates a glow there is proof of a short circuit between filament and grid of the tube. If the two lamps—either 6-volt automobile lamps or 6-volt flashlight bulbs—light at the same time this may be accepted as a warning of a short circuit between the grid and plate elements.

The section of this trouble shooting unit devoted to the testing of tubes is all-embracing, accommodating as it does every type of receiving and rectifying tube, including past and present models. There are three vacuum tube sockets on the test board and, with the use of a set of adapters, the following designs of tubes may be accommodated: Old and new 199-type base, the WD-11, old and new 1A-type base, and UY-227 or its equivalent (the new alternating-current detector tube.) Inasmuch as type WD-12, the alternating-current amplifier tubes, and most rectifier tubes have the new 1A-type base, all ordinary tubes of American manufacture may be tested. The conventional tube tester is not so comprehensive.

Furthermore, the tube testing section of this many sided trouble shooter can, by use of resistances in parallel, determine the filament emissions of tubes having a plate current as high as 2½ amperes. If the prongs of the three elements in a tube—grid, filament, and plate—are touching, this undesirable condition is disclosed by this test kit. With a plate voltage range from zero to 200 volts, the same test can be applied to rectifier tubes. The types of tubes whose active material may be restored by the rejuvenating process are all included in this rejuvenator. For instance, for type 201A a flash of 15 volts on the filament for 60 seconds and aging at 7½ volts for ten minutes are necessary. Types UX-120 and UV-199 are accommodated similarly—a flash of 10 volts for 30 seconds and an aging process of 4½ volts for ten minutes. Variable filament voltages, in predetermined steps, are available by merely turning a switch.

A head telephone set, the necessary adjunct of other testing units, is not required with this trouble shooter. For example, when testing a condenser with this outfit by opening the circuit in the test kit and employing a pair of wires the examination for condenser leakage begins by impressing any voltage from zero to 200 volts direct current across it and then observing the milliammeter reading. Variable or fixed condensers may be tested. The exact procedure is as follows: Plug tester cord into house-lighting circuit and hook the test wires on two binding posts after inserting a vacuum tube in a socket. If it indicates filament emission, then open a double-pole-double-throw switch and bring the ends of the wires in contact with the rotor and stator plates of the condenser. A reading on the milliammeter indicates a short circuit; if there is no reading the condenser is not a fit subject for further trouble shooting. A source of alternating-current voltage is also provided for testing condensers; there be-

DR. C. B. JOLLIFFE.

NEW CHIEF ENGINEER OF THE FEDERAL RADIO COMMISSION

Dr. C. B. Jolliffe, former alternate chief of the radio laboratory of the United States Bureau of Standards, has been appointed chief engineer of the Federal Radio Commission. Dr. Jolliffe is a native of West Virginia and has been associated with the Bureau of Standards for about ten years, being a specialist in radio tube research and, more recently, he has assisted in the development of aircraft radio beacons.

ing high voltage and low voltage switches available for testing, as well as a shunt switch for the milliammeter when employing direct current as rectified by a vacuum tube.

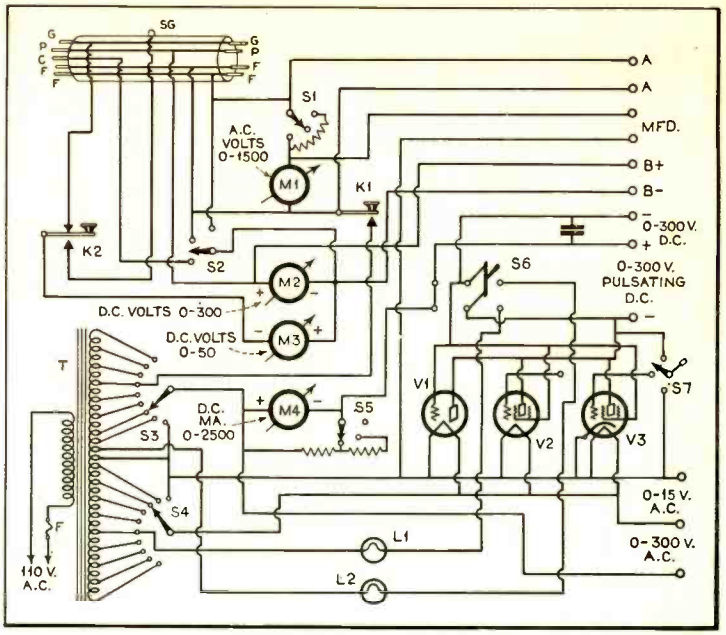
With shielded-grid vacuum tubes riding on a wave of popularity among broadcast listeners and experimenters, this all-embracing tube and set test-kit is capable of finding the trouble which may afflict this comparatively new type of tube. To make this special test, it is necessary to use an extra piece of wire and then the four-element tube may be tested by associating the two grids thus short circuiting them. Following this, there is a search for "shorts" in the other tube elements. For instance, after bringing the extra piece of wire in contact with the plate if the automobile lamp on the test board fails to light the shielded-grid tube is not short circuited.

There are three terminals for testing batteries. And, inasmuch as this trouble shooter affords two terminals connected to switches by means of which any voltage (in steps of a volt or two) from zero to 200 volts alternating current may be obtained the instrument assumes value for other purposes than those suggested. For instance, to operate a miniature electric train. Also low-amperage direct-current voltages from 0 to 200 volts may be obtained from two additional terminals. These may be employed in testing a radio receiver by supplying power for the filter system of the "B" supply.

This uncanny electrical and mechanical detective can locate trouble in a receiving set without unduly disarranging the completeness of the receiver. Two voltmeters and a milliammeter, operating separately, can be used to make known the voltages of A, B, and C batteries. A flexible five-wire lead and plug, with adapters to fit all receiving sets, is plugged successively into each socket of the receiver. By use of a direct-current voltmeter the conditions of "B" battery or B-eliminator unit and the primary windings and the loudspeaker are checked at one reading. The "A" battery, its lead wires, and the rheostat of one vacuum tube are examined and their conditions disclosed at one reading. The state of the grid biasing battery as well as the condition of the secondary winding of the preceding transformer may be checked by the milliammeter.

To summarize: all the tubes, the primary and secondary windings of transformers, the power packs, and the lead wires comprising a complete radio receiver may be subjected to a critical analysis by this almost human trouble shooter.

The transformer employed in this combination tube tester, rejuvenator and trouble shooter for radio parts and complete receivers is not on the market. It is a specially-wound product



Circuit arrangement of the trouble shooter.

and this as well as other novel features of the human-like trouble shooter are comprehended in the patent papers now pending. When testing and servicing receiving sets mark a definite trend in radio developments, this invention is designed to serve a purpose and meet a need not heretofore contemplated in the radio art.

Ralph Stair, in designing this outfit, was prompted by the demand for a thorough and yet comprehensive test kit. He had observed that human trouble shooters, for the most part, are inadequately equipped to locate many common troubles in receiving sets and if they are amply supplied with testing instruments the sum total is so bulky and numerous as to almost render their transportation prohibitive. At the present state of the art it is not sufficient merely to test a vacuum tube for filament emission or, with a pair of head-telephones, find a broken circuit in a transformer. Furthermore, a rectifier tube may light and yet fail to function properly, and many test kits require that a receiving set be taken apart for diagnosis.

This new and all-embracing test kit provides both direct-current and alternating-current voltmeters. The latter, with a range from zero to 6 volts, may be used for testing both a-c. and d-c. radio receivers. In testing the transformer of an a-c. receiver, for example, connections are made to the two posts of the alternating-current voltmeter and the condition of the secondary winding of the transformer noted. A test may be made to find out whether the voltage of the filament windings is correct for the type of tube used. The same wires and like setup may be employed in diagnosing the ailments of loudspeakers, telephones, choke coils, and other types of coils. For instance, a milliammeter reading will indicate whether the wire in the coil is broken.

This mechanical and electrical trouble shooter, in the light of a recent definition that a *robot* is a worker, has been given this appellation. Its multitude of well executed functions in diagnosing sick and crippled receiving sets defy enumeration or classification. Withal, this tube tester, rejuvenator, and trouble shooter—all in one unit—is without a duplicate, and it is significant in that it foreshadows radio servicing as an opportunity and obligation in future radio activities.

▲

MORE KEY STATIONS DE-LOCALIZE NETWORK PROGRAMS

Of significance as bearing on the future of broadcasting is the steady increase in key stations. Not so long ago, virtually all network programs originated in New York City. Today, Chicago, Washington, San Francisco and Los Angeles are functioning as regular key stations. There is promise of other key stations in the near future. After all, this is logical, for, as J. E. Smith, President of National Radio Institute, points out, a network can gather as well as distribute program material. By operating a number of key stations for the gathering of programs, the network becomes truly national in character, getting away from the strong local flavor which has hitherto been the main criticism of network features.

The Trend of Invention

By RICHARDS & GEIER

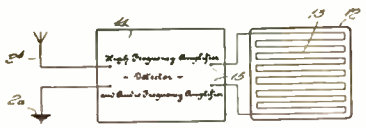
PATENT AND TRADE MARK ATTORNEYS 274 MADISON AVE NEW YORK CITY

SIGNALING SYSTEM

Chester L. Davis, of Washington, District of Columbia, Assignor to Wired Radio, Inc., of New York, N. Y., a Corporation of Delaware. U. S. Patent No. 1,756,086. (Issued April 29, 1930).

A television receiver comprising in combination means for receiving variable frequency energy, variable intensity apparatus comprising a coil having its inductance distributed in a plurality of sections disposed in horizontal planes parallel to each other and a glow discharge tube enveloping the different sections of said inductance.

This invention relates to signaling systems in general and more specifically to systems for the trans-



mission and reception of pictures by space radio or wired radio systems.

An object of the invention is to provide an improved system for the transmission of pictures.

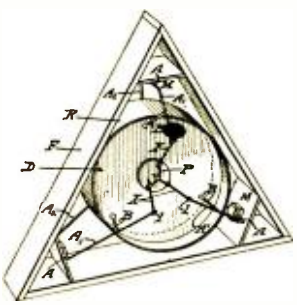
Another object of the invention is to provide an improved system for the reception of pictures.

▲

LOUDSPEAKER

John E. Kiernan, of Brooklyn, New York, U. S. Patent No. 1,756,201 (Issued April 29, 1930).

The invention relates to sound reproduction devices used in connection with radio receiving sets and known as loudspeakers, which are also applicable to



electrically operated phonographs and public amplifiers and in connection with talking motion pictures; and the object of the invention is to provide a strong, substantial device that will give a loud and natural reproduction of sound waves.

▲

RADIO TUBE

Howard M. Strobel, of Oak Park, Illinois. U. S. Patent No. 1,757,345. (Issued May 6, 1930).

This invention relates to tubes for use in wireless communication of the type commonly known as radio tubes, and it consists in the combinations, constructions, and arrangements herein described.

An object of the invention is to provide a tube which may be used in several different ways, such as

a detector, an amplifier, a static eliminator, etc., due to the fact that provision is made whereby the characteristics of the tube may be changed to effect the result desired.

Free books on patent and trade-mark law can be obtained by our readers upon request to Radio Engineering or direct to Richards & Geier. Copies of the patents described on this page may be obtained through the above mentioned firm of patent attorneys.

SOUND-REPRODUCING APPARATUS

LeRoy W. Staunton, of New York, N. Y., Assignor of one-half to Stephen Bourne, of New York, N. Y. U. S. Patent No. 1,746,838. (Issued April 29, 1930.)

This invention relates to sound-reproducing apparatuses and particularly to apparatuses which employ diaphragms adapted to be actuated in response to a sound-controlled electric current for setting up vibra-

tions in the free air. Such apparatus is adapted to be used, for example, as a loudspeaker in conjunction with radio receiving sets.

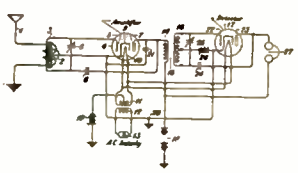
▲

TUNED RADIO-FREQUENCY AMPLIFIER

Russell S. Ohl, of New York, N. Y., Assignor to American Telephone and Telegraph Company, a Corporation of New York. U. S. Patent No. 1,755,266. (Issued April 22, 1930.)

This invention relates to radio-frequency amplifiers and particularly to means for preventing the setting up of oscillations in an amplifier of that type, which oscillations are of a frequency differing from that for which the amplifier is tuned.

The object of this invention is to provide means for preventing a feeding back from the output to the



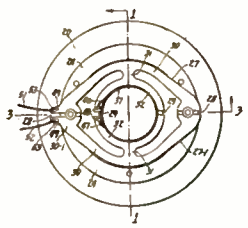
input circuit of a high-frequency amplifier of frequencies that are parasitic to the said high frequency, thereby suppressing any tendency on the part of the amplifier to oscillate at the parasitic frequency.

▲

DYNAMIC LOUDSPEAKER

Frederick Preator and Don R. Seely, of Salt Lake City, Utah, Assignors to The Utah Radio Products Company, of Salt Lake City, Utah, a Corporation of Illinois. U. S. Patent No. 1,757,386. (Issued May 6, 1930).

A vibratory system comprising a spider composed of semi-hubs spaced apart from each other and semi-rims spaced apart from each other and from said semi-hubs, a vibrating member supported in said semi-hubs, and a support for said semi-rims.



This invention relates to a dynamic loudspeaker, and its principal objects are:

First: To prevent the breaking of the moving coil leads.

Second: To make savings in the cost of constructing and assembling.

Third: To add materially to the life of the delicate working parts of the speaker mechanism.

Fourth: To preserve the structural integrity of the vibratory system, no matter what the climatic conditions may be.

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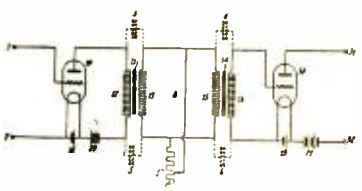
ARRANGEMENT FOR MULTISTAGE AUDIO AMPLIFICATION

Wilhelm Moser, of Berlin, Germany, Assignor to Gesellschaft fur Drahtlose Telegraphie M. B. H., of Berlin, Germany. U. S. Patent No. 1,757,466. (Issued May 6, 1930.)

This invention relates to radio apparatus and more particularly to systems known as audio amplifier systems. It has for its object to provide an audio amplifier system which will be free, to the lowest



possible degree, from noises and howling due to back-coupling between the various tubes.

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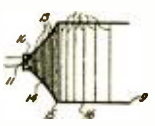
SOUND-TRANSLATING SYSTEM

Henry C. Harrison, of Port Washington, New York, Assignor to Western Electric Company, Incorporated, of New York, N. Y., a Corporation of New York. U. S. Patent No. 1,757,459. (Issued May 6, 1930.)

A sound translating member comprising a horn having a plurality of diaphragms of low elasticity spaced along a portion of the length of said horn and in contact with the inner surfaces of said horn.

This invention relates to sound translating systems such as tubular horns employed, for example, with phonographs and loud speaking telephone receivers.



An object of this invention is to provide a high efficiency coupling between a vibrating member of small area and a column of air of much larger area.

Another object of this invention is to reduce reflection losses in a loud speaking horn.

NEWS OF THE INDUSTRY

A SERVICE LABORATORY

The Westfield Radio Laboratories, 72 Cortlandt Street, New York, are now equipped to act as an authorized sales or servicing agency for manufacturers. The Laboratories also have a department for rendering prompt service on general repair problems for the trade, broadcast stations and reasearch laboratories.

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BETTER TUBES MEAN BETTER TUBE SALES

The RMA Trade Show at Atlantic City will be a milestone for the radio industry for more than one reason. One certain reaction will be a demand for the highest quality of tubes. Along this line, E. R. Fiske, General Sales Manager of Gold Seal Electrical Company, Inc., pointed out their recent development of radically new tubes, especially of the heater type, such as No. 227 and No. 224. This new development in constructing which they have achieved outstanding results, is bringing large orders from the United States Government and a number of set manufacturers. These new tubes are also now available for distribution to the trade.

▲

SOLA CORPORATION

J. G. Sola announces the formation of the Sola Corporation with laboratories at 3957 Lincoln Avenue, Chicago, Illinois.

The new corporation will manufacture special windings and a general line of small transformers for the radio industry, high tension transformers for neon signs and oil burning equipment.

▲

PREDICTS GROWING USE OF RESISTANCE COUPLING

If ever there was a see-saw contest in the radio art it is that between resistance-coupling and transformer-coupling. During the past two years, transformer-coupling has had the upper end, but now resistance-coupling, or so-called direct-coupling of screen-grid tube with power tube, returns with a fresh bid for favor.

According to the engineering staff of the International Resistance Company of Philadelphia, Pa., there is ample evidence that the latest types of resistance-coupled amplifiers are going to be widely employed this year. Several manufacturers are producing chassis for use in home-made or manufactured receivers. Until recently, this latest direct-coupled kind of resistance-coupled amplification employed but a single power tube, but radio technicians have now developed satisfactory push-pull amplifiers. The simplicity, compactness, light weight, high gain and remarkable tone quality of the several variations of direct-coupled amplification, are certain to count heavily in the extensive use of resistance-coupling this season.

▲

CORDONIC MANUFACTURING CORPORATION

Announcement has just been made of the completion of organization and corporation plans for the production of a new type condenser speaker which will be manufactured exclusively by the Cordonic Manufacturing Corporation, Holland, Michigan.

After many months of preparation the Cordonic speaker is now in production and ready for the market. Several manufacturers have already adopted the new Cordonic condenser speaker for their complete lines during the 1930 season.

For the first time in the history of radio, this company will offer condenser speakers to the entire industry.

An exclusive new policy of the Cordonic Manufacturing Corporation is their unique method of selling manufacturers Cordonic condenser speakers housed in beautiful, new, designed consoles. This model department was created to make extensive research of console construction which would permit a prospective manufacturer to obtain immediately a proper console for his line equipped with the new Cordonic condenser speaker. These designs are sold with the speaker.

Arthur A. Visscher, president of Cordonic, is an executive of many years standing and has had personal contact with many of the largest manufacturers, while manufacturing speaker and radio cabinets.

▲

EASTON COIL COMPANY

Nathan Dinion, president of the Easton Coil Company, Easton, Penna., announces the election of Arthur Freed as vice-president of the Easton Coil Co. Mr. Freed was formerly vice-president of the Freed-Eisemann Radio Corpn.

KESTER SOLDER OPENS EASTERN FACTORY

Due to the ever increasing demand for self-fluxing wire solder and the desire on the part of the Kester Solder Company to better service its eastern trade, they have put into operation a factory in Newark, New Jersey.

This plant is prepared to produce the principal items of Kester Solder and has the facilities to promptly service the industrial business, within a radius of 250 miles from Newark.

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CHUBB APPOINTED DIRECTOR, WESTINGHOUSE RESEARCH

L. W. Chubb, former manager of the radio engineering department of the Westinghouse Electric & Manufacturing Company, returned to the company June 10, as director of the Westinghouse research laboratories. The announcement of his return was made by R. S. Feicht, director of engineering. For some months past Mr. Chubb had been assistant to the vice-president of the Radio-Victor Company.

Mr. Chubb is a native of Fort Yates, N. D. He was graduated from the Ohio State University, class of 1905. His alma mater conferred upon him the degrees of mechanical engineer and electrical engineer. The year of his graduation he entered the apprenticeship course of the Westinghouse Company. Upon completion of his training in that special course he

L. W. CHUBB

was given a position in the Company's engineering department where he was assigned to the laboratory of standards.

In 1907 he joined the research division and carried on a large number of scientific investigations. His delvings into research work in connection with the preparation and properties of magnetic steel are especially noteworthy. On two occasions he represented America in International electro-technical conventions held in Europe.

Mr. Chubb is filling the position left vacant by the promotion of S. M. Kintner to assistant vice-president.

▲

NEW CALLITE HANDBOOK

The Callite Products Company, 540–39th Street, Union City, N. J., announce their new catalog and handbook on tungsten, molybdenum and special alloy products.

This handbook contains useful information on the application of their extensive line of metallurgical products for the radio tube, incandescent lamp and electrical industries.

Copies may be procured by radio engineers and executives writing direct to the Callite Products Company.

R. S. M. A. BULLETIN

The first successful year of the Radio Service Managers Association was brought to a close on the evening of May 26th at the Engineering Societies Building, 33 West 39th Street, New York City, when John S. Dunham the retiring president, presented the gavel to Henry C. Struckmann the newly elected president for the 1930–31 term.

The election of C. P. Baldwin, vice-president; Arthur Z. Goldman, 2nd vice-president; Howard A. Shannon, W. F. Bankauf, F. E. Sage and J. F. B. Meacham as directors, followed.

John S. Dunham, as provided in the By-Laws, as the past president assumes the chairmanship of the board of directors.

Grover C. Kirchhof the present secretary-treasurer will continue in that capacity for another year.

▲

STAHL JOINS ARCTURUS

A recent addition to the staff of the Arcturus Radio Tube Company, Newark, New Jersey, is C. E. Stahl.

Mr. Stahl was elected to the board of directors and appointed general manager. He comes to the Arcturus Company with a wide experience of the radio business gained since the early days of the industry.

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SOLVING THE QUICK-HEATING TUBE PROBLEM

That a 10 or even a 5 second tube is more desirable than one taking 30 seconds to a minute to heat up, goes without saying. However, if quick-heating is gained at a marked sacrifice in tube life and reliability, then it is best to stand by a slower heating time. And that is precisely what the tube industry has done until recent developments in insulating materials have shown a way to gain quick heating without sacrificing life and reliability.

For several years past, or ever since the heater type tube was first developed in the laboratory, Henry L. Crowley has been keenly interested in this problem. He experienced the trying days of the first a-c. heater tubes, when the life was lamentably short, and he contributed materially to increasing the span of life to a full thousand hours or more by developing suitable insulating materials. However, he has steadily sought to reduce the heating time of tubes, without sacrificing life and reliability. The latest crolite formulas possess the desired characteristics for long life and reliability, together with excellent heat conductivity. However, it has been necessary to reduce the bulk of the insulator tubing, so as to secure quicker heating. To this end, Mr. Crowley and his engineers have worked on many ingenious designs of heater tubes, wherein the bulk has been consistently reduced without weakening the insulator mechanically or electrically. Today, several new designs are finding their way into heater tubes, and are reducing the heating time materially—and safely.

▲

NATIONAL UNION NAMES HALSEY

The Halsey Supply Corporation, located at 228-230 Halsey Street, Newark, N. J., has just been appointed as the wholesale distributor of National Union Radio tubes. The Halsey Company is a large jobbing outlet, covering all of the state of New Jersey, five counties in New York State, and is about to open a branch at Wilkes-Barre, Pa., and another at Sunbury, Pa., to cover a portion of the state of Pennsylvania. They are also jobbers of the Sparton radio set.

▲

FLEWELLING JOINS VAN HORNE

E. T. Flewelling, whose connection with radio goes back to the days "before the War," has joined forces with the Van Horne Tube Company, of Franklin, Ohio, working with Dr. John S. Van Horne, whose reputation for vacuum tube research and development is international. Flewelling resigned as president and chief engineer of Radio Products Company to perfect a complete new line of radio service instruments and short-wave adapters for the Van Horne Tube Company, according to J. L. Leban, vice-president.

Working in the Van Horne laboratories, Flewelling developed a new circuit for tube checking, embodying the famous straight-line consecutive order construction that brought him the first prize at the Radio World's Fair in New York early in the history of the industry, and which is still recognized as the outstanding unit of its kind.

NEW DEVELOPMENTS OF THE MONTH

AMRAD ELECTROLYTIC CONDENSERS

The single anode, inverted type, Mershon electrolytic filter condenser contains one anode, as its name suggests, and is so mounted on the power converter base board that its anode terminal is at the bottom.

It is designed to project through the chassis base (upon which it is mounted) so that connection to the anode terminal can be made to the under-base wiring of the equipment. This facilitates wiring to it, and for this reason it has proven popular with many radio receiver manufacturers.

The copper container is 4⅛ inches high (plus additional terminal height, ¼ inch). The diameter of the 8 mf. capacity unit is 1⅜ inches and the 18 mf., unit 1¾ inches.

The single anode, upright type, Mershon condenser is of the same height as the inverted type unit. It is constructed, however, only in one diameter, 1¾ inches, the same sized container being used for the 8 mf. and the 18 mf. capacities.

A mounting bracket, similar to that designed for the inverted unit is supplied for this purpose, as well as a decorative cover for the top.

In the case of the upright type condenser, the expansion vent is on the cover with the anode terminal, and the bottom is flat.

The multiple anode Mershon condenser is available in double, triple, and quadruple anode units. The highest capacity manufactured is the Quadruple-18 size (containing four 18 mf. anodes), with a total capacity of 72 mf. This is a special size, and is designed only for use as a single anode unit.

▲

NEW COIL TESTER

The Rubicon Company, 29 North 6th Street, Philadelphia, announces an entirely new instrument for detecting short-circuited turns and defective insulation in coils and windings. This instrument will detect the presence of a single shorted turn in a coil of wire, regardless of the total number of turns; it will also detect defective insulation between layers and terminals.

The operation of the coil tester is exceedingly simple. The coil to be tested is placed inside a bakelite cup in the front part of the instrument. No electrical connections are required. If the coil is perfect, nothing happens; but if the coil contains one or more short-circuited turns, or if the insulation is impaired, the spot of light seen on a ground glass window will be displaced, and the magnitude of this displacement is a measure of the seriousness of the fault.

Being very sensitive, the coil tester is at the same time a very sturdy piece of apparatus, and may be used for inspection purposes in the production line. Because the operation requires no electrical connection, and because of the very short period of the indicating element, coils may be tested with great speed. As many as 2000 coils may be inspected in one hour by an unskilled operator.

The coil tester is operated from 110-volt, 60-cycle supply, requiring no batteries of any kind.

▲

NEW HOOKUP WIRE

The Cornish Wire Company, 30 Church Street, New York, has introduced a new hookup wire, with a high voltage breakdown. The wire is marketed under the trade name Paralac.

▲

NEW SHIELDED CONDENSER

The DeJur-Amsco Corp., Fairbanks Building, New York City, are introducing their new variable condenser for the coming season. It is completely shielded and has been developed especially for screen-grid receivers. Following are some of the features of this new DeJur-Amsco unit.

Aluminum cast frame. Aluminum cast shield plates. Ball bearings at both ends. Steel bushings and raceway. Three-eighths inch steel shaft, centerless ground and highly polished. Individual spring phosphor bronze wipe contacts to each rotor assuring perfect electrical contact. Lugs attached for individual returns. All metal parts except castings, rotor and stator plates heavily cadmium plated. Mounting studs cast into bottom of frame. Provision made for side mounting. Substantial compensating or trimming condensers. Available in 2, 3, 4 and 5 gang units.

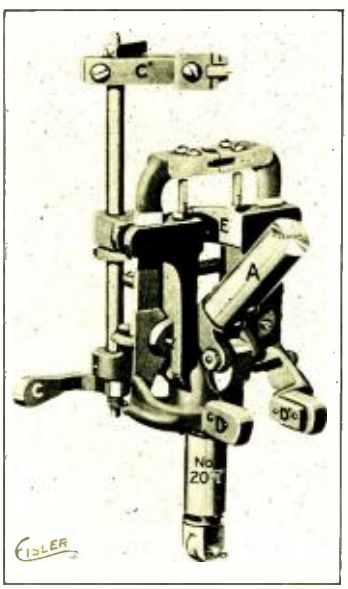
AMERTRAN

The American Transformer Company, 178 Emmett Street, Newark, N. J., is displaying types PA-51 and PA-70 concert hall amplifiers, for broadcast reception purposes. For a load of four speakers the output is 4.5 watts.

▲

NEW AUTOMATIC INDEXING TIPLESS STEM MACHINE

The Eisler Electric Corporation of 744–772 South 13th Street, Newark, N. J., offer to the market a new type tipless automatic stationary head stem machine, one unit of which is here illustrated. The new tilting die block operates in the following manner: by means of track arrangement, roller "B" is pushed upward tilting the die block "A" from its position "E." This permits the operator to readily feed the leadwire. As the machine indexes, tilting die block "A" returns to position "E," the operator feeds the



flare into the open jaws by pressing D, and D¹ then swings the tipless holder arrangement by pressing C and placing exhaust tubing in C¹ holder.

There are many additional novel features embodied in this machine such as automatic opening and closing of tipless arrangements; arranged for double press jaws; automatic blowout. Speed of indexing is increased so that head reaches the next position very rapidly. The machine occupies space 5 x 5 feet; employs ½ h.p. motor.

▲

TEST-O-LITE

Test-O-Lite, manufactured by the L. S. Brach Mfg. Corpn., 55 Dickerson Street, Newark, N. J., has been improved to take a range of voltage up to 550 volts. A new attachment enables it to test circuits as low as 10 volts. This makes Test-O-Lite an invaluable instrument for all radio men. It also has the remarkable feature of being able to test up to 50 megohms and replaces in many cases the use of a megger, and will enable one to detect faulty insulation. Test-O-Lite is the most convenient pocket testing instrument that has ever been invented. It not alone finds a broad field of usefulness in radio but is used by thousands of electricians for detecting polarity to direct current, blown out fuses, faulty spark plugs on automobiles; in fact, uses too numerous to mention.

A LEAD-IN AND GROUND WIRE WITH EASY STRIP INSULATION

A new rubber insulated lead-in and ground wire has been developed by the Belden Manufacturing Company, 4647 West Van Buren Street, Chicago, Ill., that eliminates the need for laboriously cleaning each wire of stranded cable.

Belden easy-strip lead-in wire, as it is called, strips clean and solders without further effort. This new wire is not only a big time saver, but results in a much more satisfactory soldering job, it is said.

▲

NEW HIGH VACUUM PUMP

A new commercial high vacuum pump for use in vacuum drying, impregnating and similar processes has recently been placed on the market by the F. J. Stokes Machine Co. of Philadelphia.

It is an oil-sealed, single-stage, rotary pump capable of maintaining a vacuum to within .05 millimeters of mercury on closed systems and on blank test shows a vacuum to within 10 microns of barometer, or better. It sells for considerably less than a two-stage pump, but will do the work for which the latter has been considered necessary.

Among the processes for which the pump is suited are the vacuum drying and impregnating of cables, radio condensers, field, armature and transformer coils; also wood and other materials with a heavy compound, stain or dielectric compound.

The pump has few moving parts consisting essentially of an oil-sealed rotor operating within a housing, both the rotor and the interior of the housing being machined to very close tolerances. There are few wearing parts and the bearings are extra large in size.

▲

NEW REVOLUTION COUNTER

A new and improved revolution counter is manufactured and marketed by the Meissner Manufacturing Company, 522 South Clinton Street, Chicago, Illinois, coil winders and designers of special coil winding machinery.

The new Meissner revolution counter counts from 0 to 10 000 or from 10 to 100,000 revolutions, covering for all practical purposes the complete range of coil winding.

It can be equipped with a solenoid and mercury switch mechanism to release a brake which stops the coil winding machine instantly. The counter can be set for any required number of turns and when the coil is wound to that number of turns, the revolution counter stops the coil winding machine.

▲

WESTON HAS CAPACITY MEASURING DEVICE

Weston Electrical Instrument Corp. has manufactured a microfaradmeter for capacity measurements where speed and accuracy are essential. The electrodynamometer type is made only for alternating current.

▲

BATTERY TESTER

The Roller-Smith Company, 233 Broadway, New York, N. Y., announces a new instrument, the Type BME No. 6 dry cell tester as described in detail in Supplement No. 2 to Bulletin No. 210.

With the type BME tester the current flow is limited to about 6 amperes on a new cell and the instrument indicates whether the condition of the battery is good, medium or bad.

▲

ZIERICK MOTOR-DRIVEN WIRE STRIPPER

The F. R. Zierick Mfg. Works, 68-72 E. 131st St., New York City are marketing a motor-driven wire stripper which performs the operations of stripping and twisting wires simultaneously.

The machine is portable, taking approximately 7 inches x 12 inches of bench space and is practically noiseless except for a slight hum from the motor.

This wire stripper has an adjustable stop for gauging the length of insulation to be removed and will take wires up to ½ inch in diameter.

The machine is operated by a foot pedal and is furnished with or without a-c. or d-c. motor.

Buyers Directory of Materials and Apparatus

Readers interested in products not listed in these columns are invited to tell us of their wants, and we will inform the proper manufacturers. Address Readers' Information Bureau.

Addresses of companies listed below, can be found in their advertisement—see index on page 62.

ALUMINUM:
Aluminum Co. of America
Fairmont Aluminum Co.

ALUMINUM, SHEET:
Fairmont Aluminum Co.

AMMETERS:
General Electric Co.
General Radio Co.
Weston Elec. Instrument Corp.

AMPLIFIERS, POWER:
General Radio Co.
Samson Elec. Co.

ANTENNAE, LAMP SOCKET:
Dubilier Condenser Corp.

ARRESTERS, LIGHTNING:
Cornish Wire Co.

BASES, SPEAKER:
American Felt Co.
Booth Felt Co.
Western Felt Company

BASES, VACUUM TUBE:
(See Tube Parts)

BENCHES, STEEL WORK:
Angle Steel Stool Co.

BINDING POSTS:
General Radio Co.

BOXES, STEEL:
Angle Steel Stool Co.

BRACKETS, ANGLE:
Scovill Mfg. Co.

BRASS:
Scovill Mfg. Co.

BROADCAST STATION EQUIP'T:
Cardwell, Allen D., Mfg. Co.
General Radio Co.
Jenkins & Adair, Inc.

BUSSES, STEEL:
Angle Steel Stool Co.

BUTTS:
Scovill Mfg. Co.

CABINETS, METAL:
Aluminum Co. of America
Metal Specialty Co.

CABINETS, STEEL:
Angle Steel Stool Co.

CASTINGS:
Fairmont Aluminum Co.

CELLS, PHOTOELECTRIC:
National Carbon Co., Inc.

CEMENT, LOUD SPEAKER:
Maas & Waldstein Co.

CENTRALIZED RADIO SYSTEMS:
Samson Elec. Co.

CHAIRS, STEEL, FACTORY AND OFFICE:
Angle Steel Stool Co.

CHASSES:
Aluminum Co. of America
Metal Specialty Co.

CHOKES, AUDIO FREQUENCY:
American Transformer Co.
General Radio Co.
Meissner Mfg. Co.
Polymet Mfg. Co.
Thordarson Elec. Mfg. Co.
Transformer Co. of Amer.

CHOKES, RADIO FREQUENCY:
Cardwell, Allen D., Mfg. Co.
General Radio Co.
Hammarlund Mfg. Co., Inc.
Meissner Mfg. Co.

CHOKES, POWER:
American Transformer Co.
Concourse Electric Co., Inc.
Dongan Elec. Mfg. Co.
General Radio Co.
Meissner Mfg. Co.
Polymet Mfg. Corp.
Transformer Corp. of Amer.

CLAMPS, GROUND:
Fahnestock Electric Co.
Scovill Mfg. Co.

CLIPS, SPRING:
Electrad, Inc.
Scovill Mfg. Co.

CLOTH, WIRE:
(See Wire Cloth)

COIL FORMS:
General Radio Co.

COIL WINDING:
Acme Elec. & Mfg. Co.
Concourse Electric Co.
Dudlo Mfg. Co.
Easton Coil Company
Inca Mfg. Co
Meissner Mfg. Co.
Polymet Mfg. Corp.

COILS, CHOKE:
Acme Elec. & Mfg. Co.
Concourse Electric Co.
Dudlo Mfg. Co.
Easton Coil Company
Polymet Mfg. Corp.
Westinghouse Elec. & Mfg. Co

COILS, IMPEDANCE:
Dudlo Mfg. Co.
Easton Coil Company
Polymet Mfg. Corp.

COILS, INDUCTANCE:
Cardwell, Allen, D., Mfg. Co.
Easton Coil Company
General Radio Co.
Hammarlund Mfg. Co.
Inca Mfg. Co.
Meissner Mfg. Co.

COILS, MAGNET:
Acme Wire Co.
Dudlo Mfg. Co.
Easton Coil Company
Inca Mfg. Co.
Meissner Mfg. Co.
Polymet Mfg. Corp.

COILS, SHORT WAVE:
Easton Coil Company
General Radio Co.
Hammarlund Mfg. Co.

COILS, TRANSFORMER:
Acme Wire Co.
Dudlo Mfg. Co.
Easton Coil Company
Meissner Mfg. Co.
Polymet Mfg. Corp.

CONDENSER PARTS:
Aluminum Co. of America
Metal Specialty Co.
Scovill Mfg. Co.

CONDENSERS, BY-PASS:
Aerovox Wireless Corpn.
Amrad Co.
Condenser Corp. of America
Concourse Elec. Co., Inc.
Dongan Electric Mfg. Co.
Dubilier Condenser Mfg. Co
Igrad Condenser & Mfg. Co., Inc.
Polymet Mfg. Corp.
Potter Co., The
Sprague Specialties Co.

CONDENSERS, ELECTROLYTIC:
Aerovox Wireless Corp.
Amrad Corporation
Condenser Corp. of America
Polymet Mfg. Co.
Sprague Specialties Co.

CONDENSERS, FILTER:
Aerovox Wireless Corpn.
Amrad Co.
Concourse Electric Co.
Condenser Corp. of America
Dongan Electric Mfg. Co.
Dubilier Condenser Corp.
Igrad Condenser & Mfg. Co., Inc.
Kingston Products Corp.
Polymet Mfg. Corp.
Potter Co., The
Sprague Specialties Co.

CONDENSERS, FIXED:
Aerovox Wireless Corpn.
Amrad Corporation
Concourse Elec. Co., Inc.
Condenser Corp. of America
Dongan Electric Mfg. Co.
Dubilier Condenser Mfg. Co.
Polymet Mfg. Corp.
Potter Co., The
Sprague Specialties Co.

CONDENSERS, MIDGET:
Cardwell, Allen D. Mfg. Co.
General Radio Co.
Hammarlund Mfg. Co.
Polymet Mfg. Corp.
Scovill Mfg. Co.
Sprague Specialties Co.
United Scientific Laboratories

CONDENSERS, MULTIPLE:
Cardwell, Allen D. Mfg. Co.
Hammarlund Mfg. Co.
Scovill Mfg. Co.
United Scientific Laboratories

CONDENSERS, NEUTRALIZING:
Hammarlund Mfg. Co., Inc.
Polymet Mfg. Corp.

CONDENSERS, VARIABLE TRANSMITTING:
Cardwell, Allen D. Mfg. Co.
Concourse Electric Co.
DeJar-Amsco. Corp.
General Radio Co.
Hammarlund Mfg. Co.

CONDENSERS, VARIABLE:
Cardwell, Allen D Mfg. Co.
Concourse Elec. Co., Inc.
Frost, Herbert H., Inc.
General Radio Co.
Hammarlund Mfg. Co.
Scovill Mfg. Co.
United Scientific Laboratories

CONNECTORS:
Cornish Wire Co.
Scovill Mfg. Co.

CONTROLS, CURRENT:
Central Radio Laboratories
Polymet Mfg. Corp.
Shallcross Mfg. Co.

CONTROLS, VOLUME:
Central Radio Laboratories
Clarostat Co.
Ferranti, Inc.
Polymet Mfg. Corp.
Superior Resistor Co.

CONVERTERS:
Cardwell, Allen D., Co.
Electric Specialty Co.

CONVERTERS, ROTARY:
Electric Specialty Co.
Janette Mfg. Co.

COPPER:
Scovill Mfg. Co.

CORES, PAPER:
Paper Tube Company

CORDS, EXTENSION:
Anaconda Wire & Cable Co.
Cornish Wire Co.
Polymet Mfg. Co.

COUPLINGS, FLEXIBLE:
Chicago Gear Works
Hammarlund Mfg. Co., Inc.

CUSHIONS, SPEAKERS:
Western Felt Co.

DESKS, STEEL, OFFICE AND FACTORY:
Angle Steel Stool Co.

DIALS:
Crowe Nameplate & Mfg. Co.
General Etching & Mfg. Co.
Hammarlund Mfg. Co.
Scovill Mfg. Co.
United Scientific Laboratories

DIALS, DRUM:
Hammarlund Mfg. Co.
United Scientific Laboratories

DIE-CASTINGS:
Allied Die-Casting Corp.

DIES:
Willor Mfg. Corp.

DRAWERS, STEEL, BENCH:
Angle Steel Stool Co.

DRYER-IMPREGNATORS:
F. J. Stokes Machine Co.

DYNAMOTORS:
Electric Specialty Co.

ESCUTCHEONS:
Crowe Nameplate & Mfg. Co.
General Etching & Mfg. Co.
Scovill Mfg. Co.

EXPORT:
Ad. Auriema, Inc.

FELT, ACOUSTICAL:
American Felt Co.
Booth Felt Co.
Western Felt Co.

FELT, PACKING:
American Felt Co.
Booth Felt Co.
Western Felt Co.

FILAMENTS:
(See Tube Parts)

FILAMENT CONTROLS, AUTOMATIC:
Amperite Corp.
Polymet Mfg. Corp.

FLEXIBLE SHAFTING
S. S. White Dental Mfg. Co.

FOIL:
Aluminum Co. of America

GALVANOMETERS:
General Electric Co.
General Radio Co.
Westinghouse Elec. & Mfg. Co.

GENERATORS:
Electric Specialty Co.
Janette Mfg. Co.

GETTER MATERIAL:
(See Tube Parts)

GRAPHITE
Acheson Olldag. Co.

GRID LEAKS:
(See Resistances, Fixed)

HEADPHONES:
Amplion Co. of Amer.

HINGES:
Fahnestock Elec. Co.
Scovill Mfg. Co.

HORNS:
Amplion Co. of Amer.

INDUCTANCES, TRANSMITTING:
General Radio Co.

INSTRUMENTS, ELECTRICAL:
General Electric Co.
Westinghouse Elec. & Mfg. Co.

INSULATION LAMINATED
Electrical Insulation Corp.
Formica Insulation Co.
General Electric Co.
National Vulcanized Fibre Co.
Synthane Corp.

INSULATION, MOULDED:
Bakelite Corp.
Formica Insulation Co.
General Electric Co.
General Plastics Co.
National Vulcanized Fibre Co.
Synthane Corp.
Westinghouse Elec. & Mfg. Co.

INSULATION, REFRACTORY:
The Stupakoff Labs.

JACKS:
General Radio Co.

KITS, TESTING:
(See Testing Kits)

LABORATORIES, TESTING:
Electrical Testing Labs.

LACQUER, WOOD:
Maas & Waldstein Co.

LACQUER, METAL:
Maas & Waldstein Co.

LACQUER, ENAMEL:
Maas & Waldstein Co.

LAMINATIONS:
Lamination Stamping Co.
Willor Mfg. Corp.

LAMPS, MINIATURE:
National Carbon Co., Inc.

LAMPS, PANEL:
National Carbon Co., Inc.

LEAD-INS:
Electrad, Inc.

LOCK WASHERS:
Shakeproof Lock Washer Co.
Thompson-Bremer & Co.

LUGS:
Fahnestock Electric Co.
Scovill Mfg. Co.
Shakeproof Lock Washer Co.
F. R. Zierick Mfg. Works

MACHINE TENDERS, STEEL, SHOP:
Angle Steel Stool Co.

MACHINERY, TUBE:
American Transformer Co.
Arrow Mfg. & Machine Co., Inc.
Central Scientific Labs.
Eisler Electric Co.
The Engineering Co.
Int'l Machinery Works, Inc.
Lepel High Frequency Labs.

MACHINES, SPECIAL
Willor Mfg. Corp.
F. J. Stokes Machine Co.

MAGNESIA, TUBES:
The Stupakoff Labs.

MAGNESIUM:
Aluminum Co. of America.

MAGNETS:
Thomas & Skinner Steel Products Co.

METALS, RARE:
Fansteel Products Co., Inc.
American Electro Metal Corp.

METERS:
General Electric Co.
Weston Elec. Instr. Co.

MICROPHONES:
Amplion Co. of America
Electro-Acoustic Prod. Co.
General Industries Corp.
Jenkins & Adair, Inc.
Universal Microphone Co.

MOLDING MATERIALS
(See Insulation, Moulded)

MOTORS:
Electric Specialty Co.

MOTOR-GENERATORS:
Electric Specialty Co.

MOUNTINGS, RESISTANCE:
Polymet Mfg. Corp.

NAMEPLATES:
Crowe Nameplate & Mfg. Co.
General Etching & Mfg. Co.
Scovill Mfg. Co.

NICKEL SILVER:
Gilby Wire Co.
Phosphor Bronze Smelting Co.
Riverside Metal Co., The

NUTS:
Shakeproof Lock Washer Co.

OHMMETERS:
General Radio Co.
Weston Elec. Instr. Co.

OSCILLOGRAPH:
General Radio Co.

PACKING PADS, CABINET:
American Felt Co.
Booth Felt Co.
Western Felt Co.

PACKING MATERIAL:
Holed-Tite Packing, Inc.

PANELS, COMPOSITION:
(See Insulation, Moulded)

PANELS, METAL:
Aluminum Co. of America
Metal Specialty Co.
Scovill Mfg. Co.

PANS, STEEL, LATHE CHIP:
Angle Steel Stool Co.

PAPER, CONDENSER:
Dexter, C. H. & Sons, Inc.

PHONOGRAPH MOTORS:
(See Motors)

PHOSPHOR BRONZE:
Baltimore Brass Co.
Phosphor Bronze Smelting Co.
Riverside Metal Co.

PHOTOELECTRIC CELLS:
(See Cells)

PICK-UPS, PHONOGRAPH:
Amplion Co. of Amer.
Electro-Acoustic Prod. Co.
Hardwick, Hindle, Inc.
Jensen Co.

PLATES, OUTLET:
Howard B. Jones

PLUGS, ATTACHMENT:
General Radio Co.
Howard B. Jones
Polymet Mfg. Corp.

PORCELAIN TUBING:
Isolantite Co.
The Stupakoff Labs.

POTENTIOMETERS:
Central Radio Laboratories
General Radio Co.
Polymet Mfg. Corp.
United Scientific Laboratories

POWER UNITS, A-:
Thordarson Electric Co.

POWER UNITS, B-:
Dongan Elec. Mfg. Co.
General Radio Co.
Thordarson Electric Mfg. Co.

POWER UNITS, A-B-C:
Dongan Elec. Mfg. Co.
General Radio Co.
Thordarson Electric Mfg. Co.

POWER UNITS, PARTS FOR:
American Transformer Co.
Dongan Elec. Mfg. Co.
General Radio Co.
Polymet Mfg. Corp.
Thordarson Electric Mfg. Co.
Transformer Co. of Amer.

PRESSED METAL PARTS:
The Metal Specialty Co.

PUBLIC ADDRESS SYSTEMS:
Amplion Corp. of America
Samson Elec. Co.

PUMPS, HIGH VACUUM:
Arrow Mfg. & Machine Co., Inc.
Central Scientific Co.
Eisler Elec. Corp.
Int'l Machine Works, Inc.

PUNCHINGS:
Aluminum Co. of America
The Metal Specialty Co.
Scovill Mfg. Co.

PUNCHINGS, BAKELITE:
Electrical Insulation Corp.

RECEPTACLES, WALL:
Scovill Mfg. Co.

REFRACTORY SPECIALTIES:
The Stupakoff Labs.

REGULATORS, VOLTAGE:
Amperite Corp.
Central Radio Laboratories
Clarostat Co.
DeJur-Amsco Co.
Polymet Mfg. Corp.
Ward Leonard Elec. Co.

RELAYS:
Cardwell, Allen D., Mfg. Co.

RESISTANCES, FIXED:
Aerovox Wireless Corp.
Central Radio Laboratories
Clarostat Mfg. Co.
The Daven Corp.
DeJur-Amsco
Frost, Herbert H.
General Electric Co.
Hardwick, Hindle Inc.
International Resistance Co.
Polymet Mfg. Corp.
Superior Resistor Corp.
The S. S. White Dental Mfg. Co.
Ward Leonard Elec. Co.

RESISTANCES, VARIABLE:
Central Radio Laboratories
Clarostat Mfg. Co.
DeJur-Amsco Corp.
Frost, Herbert H., Inc.
General Electric Co.
Hardwick, Hindle, Inc.
International Resistance Co.
Polymet Mfg. Corp.
Shallcross Mfg. Co.
Ward Leonard Elec. Co.

RESISTANCE WIRE:
(See Wire, Resistance)

RHEOSTATS:
Central Radio Laboratories
Frost, Herbert H.
General Radio Co.
Polymet Mfg. Corp.
United Scientific Laboratories
Westinghouse Elec. & Mfg. Co.

SCREW MACHINE PRODUCTS:
Aluminum Co. of America
National Vulcanized Fibre Co.
Scovill Mfg. Co.
Synthane Corp.

SCREWS, HARDENED SELF-TAPPING:
Parker-Kalon Corp.

SCREWS, DRIVE, HARDENED METALLIC:
Parker-Kalon Corp.

SEALING COMPOUNDS
Candy & Co.
Cochrane Chemical Company

SHIELDING METAL:
Aluminum Co. of America
Hammarlund Mfg. Co., Inc.
Radio Products Corp.

SHORT WAVE APPARATUS:
Cardwell, Allen D., Co.
De Forrest Radio Corp.
General Radio Co.
Hammarlund Mfg. Co., Inc.

SOCKETS, TUBE:
Central Radio Corp.
Electrical Insulation Corp.
Frost, Herbert H.
General Radio Co.
Howard B. Jones

SOLDER:
Kester Solder Co.

SPAGHETTI:
(See Wire, Spaghetti).

SPEAKER PARTS, METAL:
The Metal Specialty Co.

SPEAKERS:
Amplion Corp. of Amer.
Electro-Acoustic Prod. Co.
Jensen Radio Mfg. Co.
Potter Co., The
Rola Co., The
Transformer Co. of Amer.

STAMPINGS, METAL:
Aluminum Co. of America
Metal Specialty Co.
Radio Products Corp.
Scovill Mfg. Co.

STEPS, STEEL:
Angle Steel Stool Co.

STOOLS, STEEL, FACTORY AND SHOP:
Angle Steel Stool Co.

SUBPANELS:
Formica Ins. Co.
General Radio Co.
National Vulcanized Fibre Co.

SWITCHES:
Polymet Mfg. Co.

TABLES, STEEL WORK:
Angle Steel Stool Co.

TAPE, COIL:
Johnson and Johnson

TAPE, INDUSTRIAL:
Johnson and Johnson

TAPE, LOUD SPEAKER:
Johnson and Johnson

TELEVISION PARTS:
Clarostat Co., Inc.
Shallcross Mfg. Co.

TERMINALS, SOLDER, SCREWS, SPADE:
Howard B. Jones

TESTERS, B-ELIMINATOR:
General Radio Co.

TESTERS, TUBE:
General Radio Co.
The Hickok Elec. Inst. Co.
Radio Products Co.
Weston Elec. Inst. Co.

TESTING INSTRUMENTS:
General Electric Co.
General Radio Co.
Radio Products Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Corp.

TESTING KITS:
General Radio Co.
Weston Elec. Inst. Co.

TESTING LABORATORIES:
Electrical Testing Labs.

TIN COATED METAL:
Baltimore Brass Co.

TOOLS:
Willor Mfg. Corp.

TRANSFORMERS, AUDIO:
Acme Elec. & Mfg. Co.
American Transformer Co.
Concourse Electric Co., Inc.
Dongan Elec. Mfg. Co.
General Radio Co.
Samson Elec. Co.
Thordarson Electric Mfg. Co.
Transformer Corp. of America

TRANSFORMERS, B-POWER UNIT:
American Transformer Co.
Dongan Elec. Mfg. Co.
General Radio Co.
Kingston Products Corp.
Samson Elec. Co.
Thordarson Electric Mfg. Co.
Transformer Corp. of America

TRANSFORMERS, BROADCAST STATION:
Samson Electric Co.

TRANSFORMER CASES, METAL:
Metal Specialty Co.

TRANSFORMERS, FILAMENT HEATING:
Dongan Elec. Mfg. Co.
General Radio Co.
Thordarson Electric Mfg. Co.
Transformer Corp. of America

TRANSFORMERS, OUTPUT:
Dongan Elec. Mfg. Co.
General Radio Co.
Samson Elec. Co.
Thordarson Electric Mfg. Co.
Transformer Corp. of America

TRANSFORMERS, POWER:
Acme Elec. & Mfg. Co.
American Transformer Co.
Concourse Electric Co., Inc.
Dongan Elec. Mfg. Co.
General Radio Co.
Kingston Products Corp.
Polymet Mfg. Co.
Samson Elec. Co.
Thordarson Electric Mfg. Co.
Transformer Corp. of America

TRANSFORMERS, R. F., TUNED:
Cardwell, Allen D. Mfg. Co.
Hammarlund Mfg. Co., Inc.

TRANSFORMERS, STEP-DOWN:
Amplion Corp. of Amer.

TRUCK, STEEL:
Angle Steel Stool Co.

TUBE MACHINERY:
See (Machinery, Tube.)

TUBE, PACKING:
Holed-Tite Packing, Inc.

TUBE PARTS:
American Electro Metal Corp.
Buffalo Wire Works Co., Inc.
Callite Products Co., Inc.
Cambridge Wire Cloth Co.
Cleveland Wire Cloth & Mfg. Co.
The Engineering Co.
Fansteel Products Co., Inc.
General Plastics, Inc.
Gilby Wire Co.
Goat Radio Tube Parts Inc.
Newark Plate Labs.
Juno Fasteners, Inc.
Lepel High Freq. Labs.
Radio Products Corp.
The Stupakoff Labs.
Synthane Corp., Inc.
(See Parts, Tube.)

TUBE TESTERS:
(See Testers, Tube)

TUBES, A.C.:
Arcturus Radio Co.
Cable Radio Tube Co.
De Forest Radio Co.
National Carbon Co., Inc.
National Union Radio Corp.

TUBES, RECTIFIER:
Arcturus Radio Co.
Cable Radio Tube Co.
De Forest Radio Co.
National Carbon Co., Inc.
National Union Radio Corp.

TUBES, SCREEN GRID:
Arcturus Radio Co.
Cable Radio Tube Co.
De Forest Radio Co.
National Carbon Co., Inc.
National Union Radio Corp.

TUBES, TELEVISION
See *(Cells, Photoelectric.)*

TUBING, COIL:
Paper Tube Co.

TUBING, NICKEL:
Gilby Wire Company
National-Harris Wire Co.

TUBING, PAPER — SPECIAL WRAPPED:
Paper Tube Co.

TUBING, PAPER & FIBRE:
Paper Tube Co.

TUBING, REFRACTORY:
Henry L. Crowley & Co., Inc.
Isolantite Co.
Stupakoff Labs, Inc.

TUBING, VARNISHED:
Alpha Wire Corp.

UNITS, SPEAKER:
Amplion Corp.
Jensen Radio Mfg. Co.
Wright DeCoster, Inc.

UNIVERSAL JOINTS:
Chicago Gear Works

VARNISH:
Maas & Waldstein Co.

VOLTAGE REGULATORS:
(See Regulators)

VOLTMETERS, A. C.:
General Electric Co.
General Radio Co.
Weston Elec. Instrument Corp.

VOLTMETERS, D. C.:
General Electric Co.
General Radio Co.
Weston Elec. Instrument Corp.

WASHERS:
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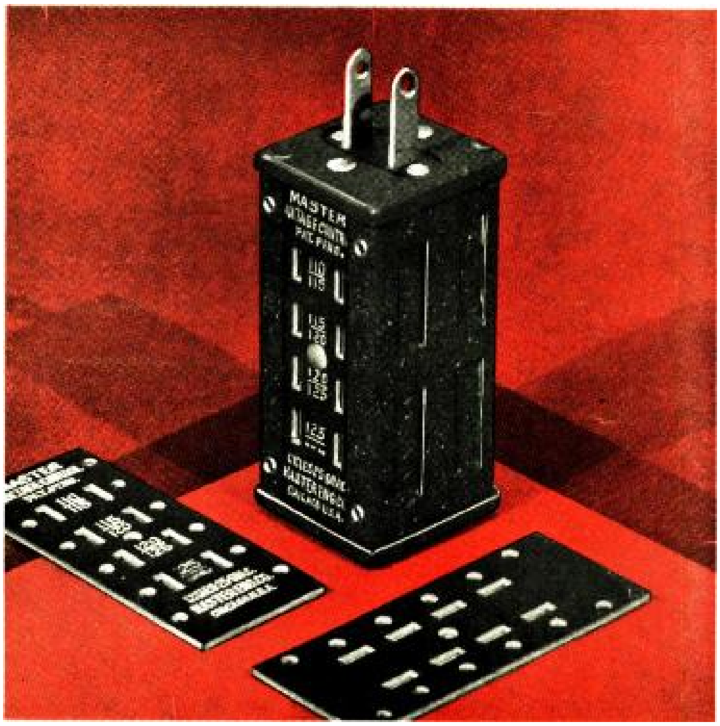

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