SEVENTH YEAR OF SERVICE

RADIO ENGINEERING

Vol. VII JUNE 1927 Number 6

R. M. A. Show Number

See pages 758 and 759 for complete list of Exhibitors

Harmonic Distortion

An explanation of its origin and how it can be eliminated in inter-stage couplings

The Purchasing Department

Some interesting slants on the art of purchasing and the importance to a manufacturer of a Purchasing Agent

Manufacturing Resistance Units

How necessity has, in the instance of resistors, brought about new developments

Vacuum Tube Characteristic Chart

Complete data on the special duty tubes now marketed

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The first of a series of articles on Servicing by a man who makes it his business

NEXT MONTH

Eliminating the loop characteristic in the output of an A. F. amplifier

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The Technical Magazine of the Radio Industry

Let's be SENSIBLE about this SOCKET POWER question!

WE'LL all save money - dealers, jobbers, and manufacturers - when we stop expecting the impossible.

Let's get down to the facts on this socket-power question. Let's not rush into pitfalls that a little sound thinking will avoid.

Based purely on research and experience, MAR-CO has come to the conclusion that...

—there is no such thing as a "good, cheap eliminator"...

either "A" or "BC". Dealers, as well as manufacturers, have already spent plenty of money to find that out.

But MAR-CO also knows that there is a good, *profitable* market for socket-power equipment...*properly* made...and properly *sold.*

In line with this viewpoint MAR-CO is announcing three A.C. power devices:

—a socket "A" power, using Raytheon cartridges, at $60, list.

—a socket "BC" power, giving *all* the needed *exact* voltages, at $55, list.

—a DRY storage battery charger and power control, at $12.50, list, with *renewable* cartridge rectifier.

All of these power units serve a definite need. They do not conflict - rather they give the careful radio dealer his *sensible* answer to the socket-power questions of his customers.

And as the maker of both eliminators and chargers, MAR-CO's advice on their proper use is entirely unbiased...

To the set owner who wants *complete* freedom from batteries, *permanent* unvarying power - MAR-CO offers "A" and "BC" socket powers.

These two devices may be used separately or together. They do away with batteries entirely. They are splendidly made - purposely designed to give the *exact* output desired under varying conditions. Handsome and rugged in appearance, they have the reserve strength to merit your wholehearted confidence. With each one, MAR-CO gives an unqualified year's guarantee.

MAR·CO

OF COURSE, the man who wants such dependable quality in socket-powers must be prepared to *pay* what *good* equipment *costs*.

But the point is this . . .

Without charging a *quality* price, MAR-CO knows no way of building a socket-power that can carry a MAR-CO guarantee . . . or that dealers can *safely* recommend.

To compromise ▪ to expect good results *without* paying for good equipment ▪ leads only to grief.

And to the set owner who does not want to spend the price of *good* "eliminators", MAR-CO's advice is this . . .

Don't buy ANY eliminator. Instead, rely upon heavy-duty dry cells for "*BC*" supply, and upon a storage battery and well-designed charger for "*A*" supply.

With the right charger, this combination is a thoroughly satisfactory source of enjoyable reception, at low cost.

And MAR-CO also offers the *right* charger. Small and compact, it is entirely free from liquids of any sort, tubes, or noise. It also provides complete automatic "*A, B* and *C*" power control. The rectifying element is a simple cartridge, guaranteed for 2000 hours, and then replaceable at slight cost.

This, then, is MAR-CO's policy and position...

Either spend enough for *good* socket-power, or else rely on batteries and a MAR-CO *DRY* charger.

Such a policy can only receive commendation from engineering authorities. Such a course can only build lasting good will for the dealers who adopt it.

To all dealers who share this sensible view of the power situation, MAR-CO extends hearty cooperation. If you want to build *your* business on permanent customer satisfaction . . . if you want to sell equipment that makes good on your promises . . . if you want *profits* ▪ not grief . . . then build with MAR-CO. Get the complete details of this worthy socket-power line. Visit the MAR-CO booth at the Chicago trade show, or write today to Martin-Copeland Company, Providence, Rhode Island.

MAR·CO

HIGHLIGHTS

There is no such thing as a "good cheap eliminator".

As the maker of both socket-powers and chargers, MAR-CO's advice on their proper use is entirely unbiased.

Better for dealers not to sell ANY socket-powers than to sell *poor* ones.

For the set-owner who is prepared to *pay* what *good* equipment *costs* ▪ recommend MAR-CO Socket "*A*" power and Socket "*BC*" power.

For the set-owner who wants enjoyable reception at low cost ▪ recommend batteries and a MAR-CO *DRY* charger.

This is the *sensible* policy for careful dealers ▪ it leads to *profits* instead of grief.

MAR-CO

radio power supply units

SOCKET "*A*" POWER
SOCKET "*BC*" POWER
DRY CHARGER
with renewable cartridge rectifier

EDITORIAL

WITHIN the last year the radio industry has shown a natural desire to remove itself from cut-throat merchandising schemes and settle down to legitimate business procedure. Which may be rather a hard way of saying that, since experience has lent foresight to manufacturers and their minions they, as a group, have come to realize that altruistic tendencies may, after all, serve them best in the long run.

We applaud the statement that the radio industry is now an industry indeed. Healthy competition, the backbone of every industry, heralded its own coming into the radio field and manufacturers are helping to toot the other fellow's horn for everyone's benefit. This move brings with it new and stronger hope for more than moderate prosperity.

Though every industry has been through a somewhat similar dilemma there is no reason or room for mortification because the radio industry couldn't evade corruption and instability. Groups, as well as individuals, must learn by experience and it is characteristic of the young in particular that they are incapable of learning anything from the experience of others. This is not so odd for, after all, each and every being is governed by a different set of circumstances.

It is refreshing to know that the radio industry has been and is such an entirely different proposition from any of our other industries that no set rules governing these could be directly applied to advantage. No other industry, with the possible exception of the motion picture and automobile industries, has suffered such severe growing pains in so short a time. In no other industry has the old had to give way to the new so rapidly. What is accomplished is almost immediately undone by new developments. It is a hard and fast pace, very much handicapped by the psychological and set upon by seasons. The very nature of radio makes of the industry one by itself. Everything from engineering practice to sales methods are necessarily foreign to general industrial practice.

Yet, for all of this "the complexion of the child clears" and we know healthier blood flows. Today, there is the closest cooperation between rival manufacturers. We find them grouped together to straighten out the standardization tangle which has been a thorn in the side of every manufacturer. The R. M. A. and the N. E. M. A. are doing remarkable work considering the obstacles they are up against.

So it is that ideals and attitudes have changed all along the line. The un-ethical and non-ethical have either been forced out of the industry or remained to thrive only because they have reformed. There is no longer room for individuals who work only to attain their own ends. Let it be said that no one has needed to move a finger against them: they have not been able to survive under the dominating force of legitimate industrial practice. It has always been so, just as it is true that every new industry must live under a shadow until it has grown sufficiently large to have power and sufficiently old to have gained wisdom from individual experience.

The radio industry is well on its way on the last lap. It has reached its present size because of constant readjustment in business procedure. Standardization remains to be dealt with in a more strenuous manner. It is true that a vast amount of work has been done. It is equally true that there is a great deal more to accomplish. Progress defeats standardization at every turn, but it is only through standardization that progress is made. One is closely related to the other. There is no necessity, however, for stressing the importance of standardization; it has been of so much benefit to the radio industry that no sane person could question its present value or suggest that the work has gone far enough.

It might be said that from all indications the radio industry has turned over a new leaf and one is not assuming affectation in declaring that the coming radio year is going to be the biggest and best.—M. L. MUHLEMAN, *Editor*.

RADIO ENGINEERING

The Technical Magazine of the Radio Industry

Edited by M. L. MUHLEMAN

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Seventh Year of Publication

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Departments

RADIO ENGINEERING

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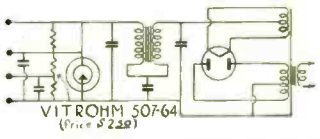
VITROHM RESISTORS
—in power supply units

SILVER-MARSHALL
652 RESERVOIR B SUPPLY

Uses Vitrohm Resistor 507-64



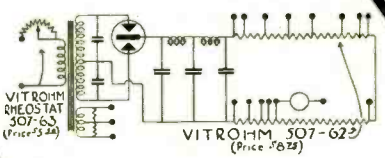
35 years of research and experience in the manufacture of resistors is incorporated in Vitrohms for radio.

There are available Vitrohms to give you noiseless, dependable service wherever resistance is indicated in a current or power supply circuit.

Vitrohms do not age or change in resistance value after use. Ten, twenty or thirty years of constant use under all conditions are every-day records of Vitrohms.

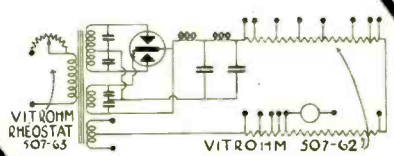
RAYTHEON A-B-C
350 m.a. CURRENT SUPPLY UNIT

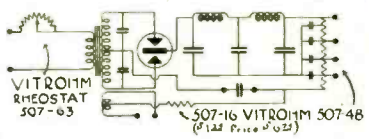
Uses Vitrohm Resistor 507-62 and Vitrohm Rheostat 507-63



QRS A-B-C
400 m.a. CURRENT SUPPLY UNIT

Uses Vitrohm Resistor 507-62 and Vitrohm Rheostat 507-63





QRS and RAYTHEON
85 m.a. CURRENT SUPPLY UNIT

Uses Vitrohm Resistors 507-16 and 507-48

Vitrohms are "pre-aged" wire wound on porcelain tubes and protected by fused-on vitreous enamel for the permanent protection of resistance wire and terminals.

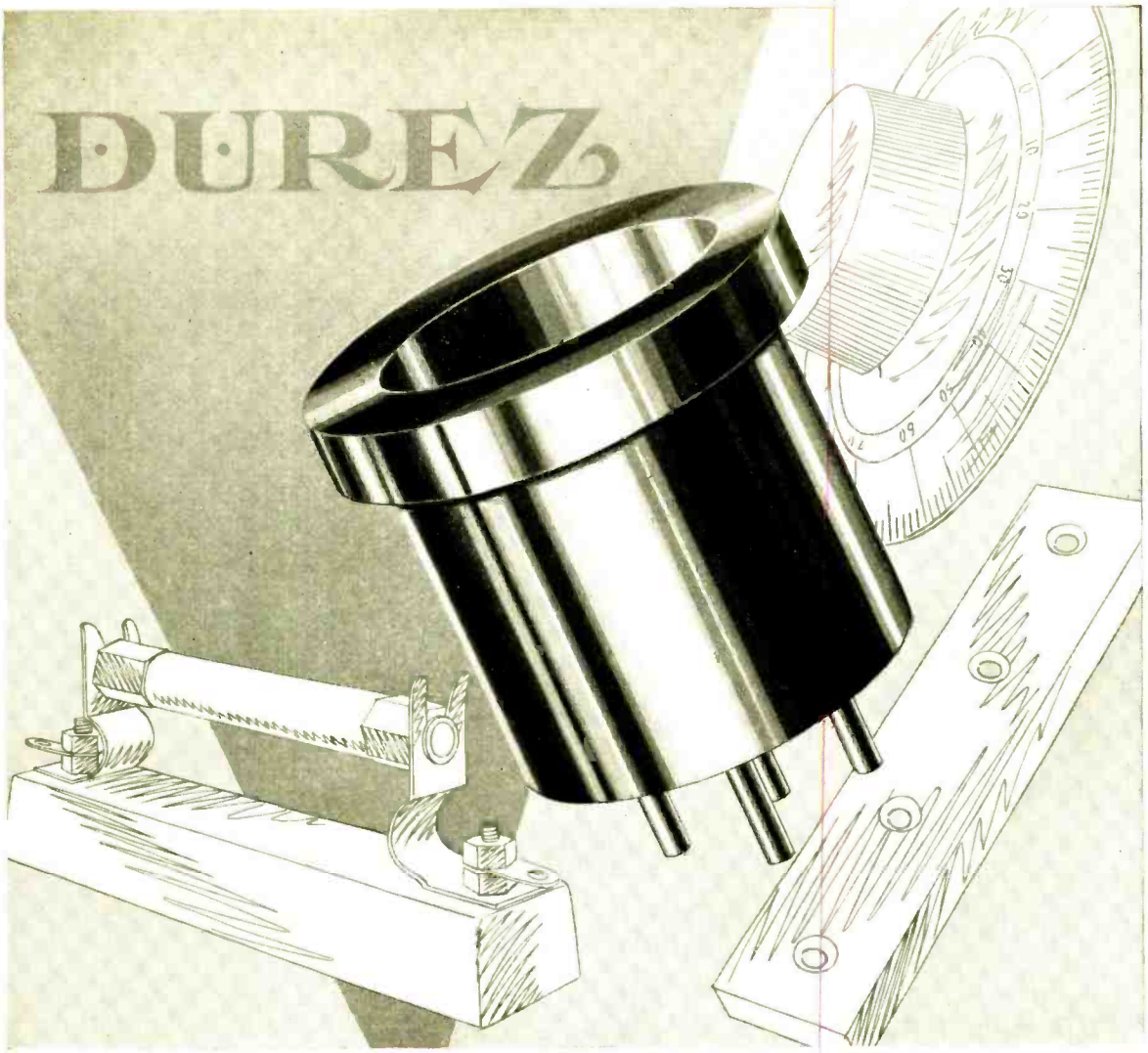
Per square inch of surface, Vitrohms have greater watt dissipation than any other resistor.

Send 15c for "How To Use Resistance in Radio." It contains many circuits of interest to all experimenters. Bulletin 507 describing Vitrohms for radio is sent without charge upon request.

* Approved by the Raytheon and QRS Laboratories.

Ward Leonard Electric Company

37-41 South Street Mount Vernon, N. Y.



DUREZ—molded parts with high dielectric strength and permanent luster—DUREZ

DUREZ molded parts have a rapidly increasing range of application in the radio, automotive and electric appliance industries wherever a combination of high dielectric strength and excellent appearance are essential. Durez is electrically non-conductive, non-inflammable and is resistant to heat. It has a permanent high luster after molding, and neither wear, age nor deteriorating agencies affect its attractiveness. The surface will not crack, check or scar.

Durez molds with perfect accuracy. It duplicates exactly the smallest detail of intricate design. Complex parts can be made rapidly in a single operation, and the high mechanical strength of Durez makes thin section molding entirely practical.

Radio panels of Durez molded with ornamental inscriptions and embossments present a handsome appearance. The strength of Durez permits the extensive use of holes, slots and metal inserts in molding panels and sub-panels. Dials, variometers, instrument cases and tube bases are made quickly, durably and beautifully of Durez.

Durez is speeding the production and improving the products of many industries. Use the facilities of the Durez laboratory to determine its place in your process. Counsel and investigation without obligation.

Molded samples of brown, black, red, green, mahogany or walnut Durez sent on request.

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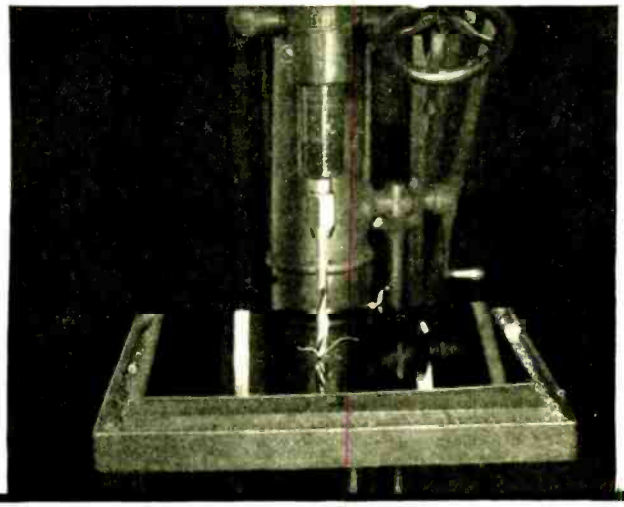
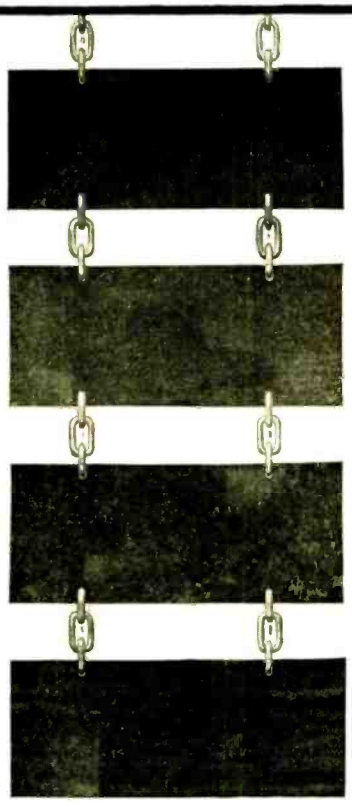


Four Finishes

Ebony is a lustrous black finish. Walnut Burl, Walnut Grain and Mahogany finishes very closely resemble a polished panel of the natural wood.



Cuts *without* Chipping

AS the drill sinks into the Micarta panel, it throws up a smooth curl and bores a clean hole without a sign of a chipped edge.

All machining is easy when Micarta is the panel material used. Micarta is smooth, tough, and hard—but not brittle. Sawing, drilling, planing, engraving, or even punching makes a clean cut without shattering the satin-like surface of the Micarta panel.

Workmanship put into Micarta is permanent. Micarta is unaffected by oil, water, or temperature changes. It is not inflammable. It will not shrink, warp, "cold flow" nor crack. Micarta is the permanent panel material.

Westinghouse Electric & Manufacturing Company
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Sales Offices in All Principal Cities of the United States and Foreign Countries

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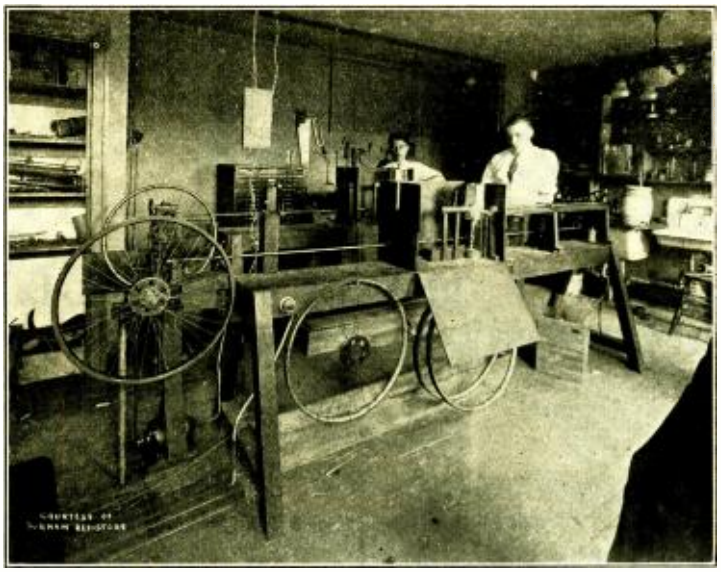
MICARTA The Permanent Panel Material



A partial view of apparatus for manufacturing metallized resistance filament

In order to overcome certain of these disadvantages, some years ago a unit was devised which consisted of two metal electrodes dipped in ink. The resistance was controlled by the distance between the two electrodes and the concentration of the ink. This unit was in many ways very imperfect. It was not compact; it was not portable; it was not permanent; and the resistance could not be adjusted within ten per cent. of the desired value.

Shortly after this, the very familiar unit consisting of a piece of paper dipped in India ink and clamped between two copper contacts was developed. There was scarcely any virtue outside of cheapness and compactness which was possessed by this type of resistor. It could not be made within 20% of the desired value; it changed from day to day; was entirely unable to carry currents even of the order of a few milliamperes without breaking down.

An improvement upon the forementioned type was made by inclosing the carbon paper and contacts in a small glass tube. Even with this protection these units were erratic in behavior.

It was at this point in the development of high resistance units that engineers began experimenting with a view to the development of a strictly scientific product. After many months of patient research, a method was found by coating the inside of glass tubes with a thin layer of metal. The glass tube was provided with brass caps and the caps were in metallic contact with the metal coating through the medium of low melting point alloy. While this type of resistor was an improvement over previous units, the film of metal was necessarily so thin in order to obtain the desired high resistance that it was impossible to make a perfect contact with the alloy in the brass caps. Further the heat due to carrying the largest currents required for coupling units, made permanent changes in the resistance of these microscopically thin metallic films. This type of resistor frequently showed excellent characteristics immediately after manufacture. However, after several months of use these units deteriorated rapidly due to crystalization of the conducting film. Almost every conceivable type of substance was deposited on the inside of these glass tubes. Every known kind of glass and countless alloys for sealing it were tried. Each new specimen was subjected to the most rigorous scientific tests. Literally thousands of specimens were constructed.

The "Metallized" Resistor

Out of all this experimentation there was finally evolved the present type of "metallized" resistor with the "glass core" which fulfills the most exacting requirements which could be placed upon a high resistance unit. The glass tube, internally coated with a thin film, was abandoned. In its place a fine glass filament is used. This filament is spun in a very ingenious and efficient machine in lengths of five hundred feet and is entirely uniform in diameter. The glass fibre is then passed through a conducting solution, and then into a high temperature furnace through which a steady flow of gas is maintained. This process results in the production of a perfectly homogenious conducting surface, thoroughly hardened upon one of the finest insulators known. The coated filament has many advantages over the internally coated tube. First, due to the much smaller area of the filament it is possible to have quite a thick coating of conducting material and at the same time produce a very high resistance. Second, it is comparatively easier to put a protecting layer over the conducting filament. Third, it is easier to make measurements of the conductivity of the coated fibre as it is fed out of the coating machine. The ease of measurement obtained in the case of the fibre insures a uniform product.

After the conducting coating has left the furnace it is next coated with a durable protective film of insulating varnish which is then thoroughly dried by the application of heat. This impenetrable coating completely protects the conducting filament against atmospheric changes.

A close-up showing one of the labelling benches where the units are labelled and boxed preparatory to shipment

Continuous Testing

As the coated glass filament passes through the various stages of manufacture, its resistance per unit length is *continuously* tested. Literally, there is no inch of this fibre which has not been measured for resistance.

After the wire has passed through the measuring devices it is cut automatically in two foot lengths. It is then kept in sealed tubes until it is required for assembling the complete unit. Finally the wire is cut into lengths approximately 1¾" long and mounted in a glass tube with brass caps at two ends.

The alloy in which the filament is embedded in the caps, is the result of numerable experiments. Its properties are such that it makes perfect electrical contact with the filament. The cap grips the contacting filament so tightly that it is impossible to pull the filament out without shattering it. It is almost as if the cap, filament and alloy were made of one piece.

After the resistors are assembled they are again tested. The resistance units are normally made within a five per cent. variation. On special orders it is quite possible to make them within two and one-half per cent. variation.

All the meters used in the manufacture and assembly tests are constantly checked against laboratory standards. Production lots of samples are also tested periodically in a three-stage resistance coupled amplifier to make certain they are noiseless.

Tube Ballasts

Reason for their use, their characteristics and process of manufacture—By John De Giovanni*

IN the modern radio receivers much effort has been expended to simplify operation by cutting down, wherever possible, the number of moving parts and controls.

Along this line many ingenious devices have been developed with various amounts of success.

Tube ballasts, sometimes known as equalizers or automatic rheostats are probably the most efficient items which this trend has developed. A tube ballast is used in place of a rheostat to control the filament current of the radio tubes.

The perfect type of filament control would undoubtedly be one that would allow a rise of voltage to a definite point and maintain this point at all times. (Note curve No. 1 in the accompanying graph.) In the case of a 201-A tube, curve No. 1 illustrates the ideal type of control. However, curve No. 2 is the nearest possible approximation to the ideal type. Curve No. 2 is an exactly plotted curve of voltage control obtained when a tube ballast was employed in the filament circuit of a radio receiver. The benefits derived from this type control as compared to rheostat control (curve No. 3) are readily discernible.

Principle of Operation

The principle upon which a tube ballast operates is easily explained. It is a fact that metals have a positive temperature coefficient. By that we mean that as the temperature of the wire increases so does the resistance. Some metals possess this characteristic to a greater degree than others. Therefore, if the resistance of the ballast increases with a rise in the temperature of the wire the flow of current to the tubes is checked. This, simply, is the principle on which the operation of the tube ballast is based. The formula by which the resistance of the element may at all times be calculated is as follows:

$Rt = Ro\ (1 - XT)$

Rt = Resistance at temperature
Ro = Resistance of wire
X = Temperature coefficient
T = Temperature difference between Ro and Rt.

In choosing the resistance element of a tube ballast there are several metals which can be employed; copper has a temperature coefficient of .0039; tungsten, .0051; iron, .006; and nickel, .006.

It is readily seen from the foregoing that iron, tungsten, and nickel can be used most effectively. Of the three, iron and nickel are the more efficient. However, iron oxidizes very easily when subjected to heat or when exposed to air and must therefore be employed in an atmosphere of gases. This makes the manufacture of a tube ballast employing an iron element very difficult. Tungsten has this same characteristic to a greater extent.

By the process of elimination we are left with nickel. This unquestionably is the ideal material for the resistance element of a tube ballast, as it does not oxidize when exposed to the air and also because of its high temperature coefficient.

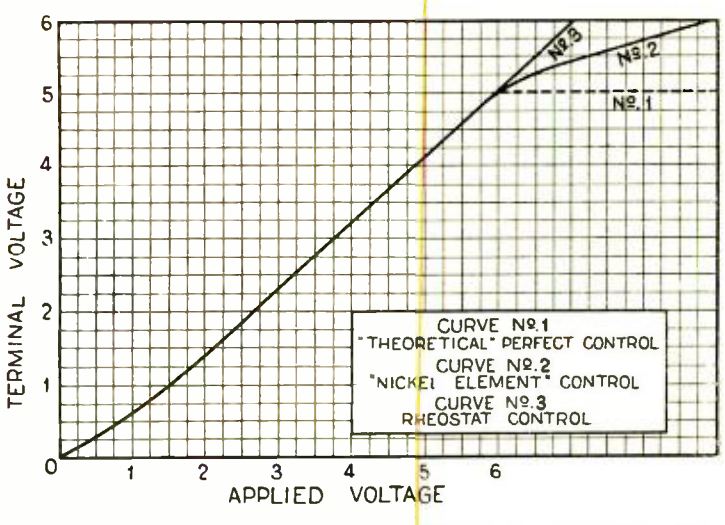
Difficulties in Manufacture

Having chosen nickel as the best material for the required element, many difficulties in actual manufacture present themselves. The nickel wire is only 1/1000 to 8/1000 of an inch in diameter. For this reason it is extremely difficult to handle and requires great skill in assembling and much intricate machinery. While a good unit will not heat to the melting point in ordinary operation, there may be times when it is accidentally short circuited and the element becomes red hot.

Therefore, ordinary soldering cannot be employed. At this point the benefit of nickel construction again becomes apparent, since due to its high melting point nickel will not melt nor oxidize, even when red hot. Iron or tungsten, on the other hand, would not only oxidize, but would burn out.

In laboratory tests a three-quarter ampere tube ballast employing a nickel element has withstood voltages as high as 110 without destroying the element.

The nickel elements composing a tube ballast must be suspended and absolutely free of the protective cover. The nearer self-suspension is obtained, the truer does it maintain its temperature coefficient. The cover is simply a protection against mechanical injuries.



Voltage curves of rheostat and ballast filament control and a theoretical perfect voltage control.

* *Engineering Dept., Polymet Mfg. Corp.*

R. M. A. Per

A. T. HAUGH
PRESIDENT, R. M. A.

Chicago Radio Trade Show Will Improve Relations

WE have all been so busy thinking about starting the radio season earlier that we have almost overlooked the many other aspects of value in the great Radio Trade Show.

© Frederick Pohle

A. T. HAUGH
President, R. M. A.

As spokesman for the radio manufacturers of this country I want to say that every radio manufacturer exhibiting at the Trade Show wants to hear from his jobbers and dealers there. To dealers and jobbers, let me say this:

If you are handling Mr. "A's" line of radio equipment and have some pronounced ideas about it, go up, introduce yourself and tell him or his sales-manager about it. He wants your ideas. He wants to know what your customers in your locality think about radio—and about HIS radio.

Manufacturers are not trying to sell you or your customers something they don't want. They are trying to make and give you just what your customers *do* want. You can help immensely by giving your frank views based on your day-by-day experience right out in the field, face-to-face with the final arbiter—the consumer whose dollar we all depend upon for our business.

I believe that many immensely valuable by-products of the Trade Show have been overlooked. One of these is the contact with other minds in the same line of business. We make goods, or if a dealer, we sell goods in one locality. We live there, stay there—and sometimes we are apt to get a bit hide-bound and acquire a restricted viewpoint. This Trade Show will give us all a national viewpoint, will show us the other fellows' problems and give us many of his ideas, with the result that we will all go home inspired, informed and with a much better understanding of the entire business.

MAJOR HERBERT H. FROST

"Through the collective efforts of men, most of the constructive work of this age is done."

IT is doubtful if any more fitting quotation than the foregoing could be found to epitomize the record of the Radio Manufacturers' Association in its fruitful history of three years.

Exactly where and at what moment the thought for a Radio Association was born may always remain a mystery, for the need of such had been felt by several manufacturers for some time, and frequent speculations had naturally followed and thoughts had been interchanged. Early in 1924 a small group of men were first called together and formed the nucleus of what is now the RMA.

The record shows that the original group comprising this informal council was as follows: *C. H. Belden, I. J. Carter, E. A. Conner, Herbert H. Frost, G. R. Haase, A. J. Howard, W. H. Huth, P. C. Lenz, Jr., A. Newcombe, E. N. Rautand, Frank Reichmann, Theodore Sheldon, W. H. Trimm, J. C. Tully, Fred W. Wellman, F. W. Will.*

© Harold Stein

L. S. BAKER
Executive Vice-President, R. M. A.

In the preliminary organization it became my lot to act as chairman, with Mr. A. J. Carter as secretary. Many regular round-table discussions of this group followed, the main theme of which was to find ways and means of bettering and stabilizing the manufacturing end of the radio industry. The idea of a national organization developed fast, and on May 12, 1924, the RMA was incorporated under the State Laws of Illinois.

© Harold Stein

MAJOR H. H. FROST
Member, Board of Directors, R. M. A.

Although the first two years were occupied largely in formative activities, the period was not without its outstanding accomplishments, which have continued to make it an organization known for action, and not useless waste of energy.

From the slender membership roll of 19, we went into the Atlantic City convention in May, 1926, with a membership of 146, which, as we celebrate our third anniversary, has been augmented to a roll of 258 responsible manufacturers of radio equipment.

Public Recognition

The RMA first gained public recognition when in its early history it fought the proposed Federal tax of 10% on all radio apparatus, accomplishing the defeat of that measure and thereby saving the American listening public millions of dollars. Similar successful efforts were prosecuted, both in Illinois and Michigan, to keep radio free from the attacks of class legislation.

The Future

While the future is always a speculation, a fair index of its promises may always be well taken from the

sonalities

past. Aside from such reflection, however, there are definite things to which we may look with full anticipation of realizing them. As our President, Mr. Arthur T. Haugh, stated a short time ago, "By reason of the various forces which are at work throughout the radio industry, we will one day find the broadcaster, the manufacturer, the jobber and the dealer, willing and able to act as one unit in matters affecting the business of this great industry. Technically, ethically and legally we will be able to stabilize the infant industry, making it a healthy business child and bringing it into its own with the public to which it is rightfully the greatest contribution of mankind of all times."

Since the RMA is entirely democratic in its structure, never having been dominated by any one group, but always gaining its strength to accomplish its purposes through the concerted efforts of all of its members, I am sure that as the future unfolds we will be found healthy and strong, in the vanguard of radio progress.

L. S. BAKER
EXECUTIVE VICE-PRESIDENT, R. M. A.

ALTHOUGH the R. M. A. long ago gained public recognition which can well stand unto itself, the continued growth of any industry is deeply rooted in the continued and expanding knowledge which the industry itself, and the public at large, has of that industry, expressed through its Association.

It is the purpose of the executive offices now located, not only in Chicago, but as well in Washington and New York, to expand their scope of effort as rapidly as possible, so that both within and without the Radio Industry it may be well known that the R. M. A. will be found prepared for any changes in the art, the determining factor always being proper protection of the public interest, which, of course, is the foundation of the entire industry.

P. C. LENZ, JR.
TREASURER, R. M. A.

I BELIEVE there are few trade associations in any industry which have, in so short a time, experienced as healthy a financial growth as has the R. M. A.

True, we have found ourselves in very close quarters at times, but by wise judgment on the part of the Board of Directors we have not only been able to relieve the immediate situation, but as a final result find ourselves more firmly entrenched in that very necessary matter for all such enterprises, that is a healthy treasury.

We now stand in splendid shape for the beginning of the new fiscal year.

© Bachrach

C. C. COLBY
Member, Board of Directors, R. M. A.

which follows closely upon the Chicago Trade Show, and within reason I believe we can attempt almost any one of the many further accomplishments which we hope to reach within the next year.

With 258 responsible radio manufacturers, we need have little fear of what the future will develop.

L. G. BALDWIN
SECRETARY, R. M. A.

IN considering the activities of the R. M. A., I am inclined to look more upon that feature of manufacturing which supplies the life blood from the manufacturing end, namely broadcasting, inasmuch as I have been charged with the work of the Broadcasting Committee for the past year.

As has been often stated before, there is indeed a unique relation between these two distinct industries, viz., broadcasting and the manufacture of radio sets, one being totally interdependent upon the other. I believe there is no analogy in industrial history to which it can be likened.

During the first few years of radio, manufacturers were so intent upon their own problems that for the most part they gave little attention to the broadcasting end of it, and consequently broadcasting has grown up as a financially independent industry unto itself.

However, when the legal situation developed in Washington last July, whereby no existing authority could control broadcasting, the R. M. A. was quick to join with the National Association of Broadcasters in formulating ways and means of not only controlling the situation as best we could until legislation could be effected, but, more than that, definite plans were laid which led to the formation of the well known National Radio Co-ordinating Committee, whose successful effort needs no review here.

As we enter our fourth year of the R. M. A., it is the conception, I believe, of the entire Board of Directors that we shall go forward, not only concerned in our immediate manufacturing problems, but constantly alert to those matters of broadcasting and the legal phases controlling the industry, which may affect the future of the art.

With the Hon. Frank D. Scott in charge of our Washington office, we are assured that the governmental aspects will not be overlooked, and it is the object of our Broadcasting Committee to interest manufacturers more and more as time goes on in making a definite contribution, both financially and otherwise, to the improvement of broadcasting throughout the entire country.

C. C. COLBY
MEMBER, BOARD OF DIRECTORS, R. M. A.

THE rapid rowth of the radio industry, almost without parallel in the history of trade and commerce, increased enormously the problems confronting the R. M. A. in its efforts toward the betterment and stabilization of the manufacturing end of the business and it is to the lasting credit of the 258 members of the association today that they have faithfully labored for the solution of those problems with the same spirit of co-operation that characterized the efforts of the early workers.

© Bachrach

H. B. RICHMOND
Chairm of Engineering Division, R. M. A.

The Radio Service Problem

Pointing out the advantages of scientific methods of servicing

*By J. Ray Blaich**

This is the first of a series of articles on Servicing by Mr. Blaich. Forthcoming articles will cover the institution of dealers' service departments, advanced testing equipment, servicing procedure, etc. These articles will be of equal interest to the Professional Set Builder and to the Radio Contractor-Dealer.—EDITOR.

WHEN a dealer is approached on the subject of radio service he generally throws up his hands in horror of the thing. The reason for his behavior is that his past experience has taught him that radio service is expensive and pregnant with trouble and annoyance. Never the less in the face of all this the writer maintains without fear of long sustained contradiction that radio service can be made a good paying branch of any live radio store. The difference between the store that is making money on radio service and the one that is not is generally in the methods used. The money making store has installed scientific methods for diagnosing radio troubles while the other store uses the "hunt and poke" system. Is it not logical to believe that since this is the age of science the scientific method is the only paying way? It most certainly is and without it radio service simply does not pay, in fact it is expensive. Let us look into this a bit.

Various dealers have various sales policies but the one most generally met with is a guarantee of three months free service on a complete radio installation. This seems a safe margin of time for the dealer since it covers well the life of tubes and batteries. Sales policies are somewhat outside of our line of thought but the subject was mentioned so as to get a starting point for our service proposition. Let us suppose then that a fan has purchased a radio receiver and the three months have passed with satisfactory service from the receiver. A short time later this fan drops into the store to report that the receiver has suddenly stopped working. If verbal corrections as given by the dealer prove effective everything is well but if not the dealer must either send his service man to the fan's home or the fan will bring the receiver to the store to be repaired and adjusted. Now is the stage where the dealer's repair cost enters into our picture. The big question now is, "What is wrong?" Right here is where the problem of scientific service manifests itself. How will the dealer go about finding the trouble? How long will it take him? How much should he charge the customer for the job? Of course, after the trouble has been located the charge for the repair will be commensurate to the time consumed but who is going to pay for finding the trouble? The dealer should set a rate for this work in due justice to the customer.

* *W. D. Andrews Co., Syracuse, N. Y.*

Setting of Fixed Rates

Now to look the situation squarely in the eye. How long should it take to find the trouble? That is rather difficult to answer since it will depend on the type of set at fault. Let us consider then, as a matter of convienence, some well known set such as a "neutrodyne." How long should it take the service man to determine that the second radio frequency stage is inoperative; or that one of the audio frequency transformers is "open?" One cannot say just how long since it all depends on the man doing the work. If he is well versed, the time for trouble shooting will be less than when the man has a meager knowledge gained perhaps through building one or two sets. Obviously the dealer cannot charge the customer with the variance between the two men. The fact that it took one longer than the other is no concern of the customer. The solution lies in the selection of men or methods that will locate the trouble in a certain length of time. This will permit the setting of fixed rates for the work thereby protecting the customer.

Now that we have narrowed the thing down to "men or methods" we shall decide in favor of "methods" because it has been found in the actual operation of a service department that advanced methods are real money savers. Why? Because it permits of using less expensive men, due to the supplementing of indicating instruments and a routine test for a certain amount of radio knowledge. This brings the operating cost down and every reduction along this line means a greater percentage of profit. With the method suggested above it should take at least a half less time and the writer has first hand information of a case where it took a twelfth of the time, approximately, to locate the trouble. Surely this is adding to the percentage of profit.

Scientific Servicing

At this time it may be well to explain just what we mean by the scientific and the unscientific method. The latter is the method which employs a pair of headphones in series with a battery and a set of search prongs. In order to employ this system the operator must be intimately acquainted with the receiver at hand first of all. Then he must go from one circuit to another in order until the point at fault is located. Should he skip a circuit on the way through it means that part of the proceedure, if not the whole of it, must be repeated, and the present day multi-tube sets have plenty of "trick" circuits. After the continuity has been checked the set is hooked up and "put on the air." If there is a broadcasting station operating within the range of the receiver everything is well but if not the operator must wait until it is possible to have some broadcast in order to test the receiver for actual operation. The scientific method is more in accord with the general practices of various manufacturers in determining the merit of their product before it is offered for sale. It employs certain indicating instruments whose deflections can be interpreted to mean continuity of circuit, short circuit, too high or too low resistance, point of balance, gain or loss in amplification and so forth. Of course a certain amount of common sense is needed to properly interpret the readings on the indicating instruments.

Value of Intelligent Servicing

Without question, it will require a greater initial financial expenditure to institute a scientific service department than one of the old type but the returns are greater. Let us consider a concrete example. A dealer had sold a combination radio and phonograph of popular make. The radio was of the type comprising two stages of neutralized tuned radio frequency, a regenerative detector and two stages of transformer coupled audio frequency amplification. The radio set operated from a storage battery with a trickle charger and a "B" eliminator. After two or three months of satisfactory service the radio suddenly took a turn for the worse. The general complaint was, lack of volume and distance, the range of the set being restricted to one broadcast station about twenty miles away. The dealer's man, who used the old method, made a call and blamed the combination power unit. This was removed and returned to the jobber for repairs. In three or four days the power unit was returned from the jobber plus a small charge for testing and handling. There was nothing wrong with the unit. The unit was reinstalled. The results were the same so a new set of tubes was tried. This seemed to improve things a little. Now two stations could be heard in-

stead of one. Several days passed and finally the customer, thoroughly out of patience by this time, told the dealer to either fix the set or take it back. The dealer's man made another try but was unsuccessful. Relations by this time were becoming quite strained between the dealer and his customer. The dealer finally got in touch with his jobber and arrangements were made for the jobber's man to inspect the set and check up the installation. Just fifty-four minutes passed from the time the jobber's man entered the customer's home until he departed with the set in good running order. The method of procedure was something along this line; first of all the proper indicating instruments were brought forth and the radio set and power plant put through a routine test. This test disclosed the fact that the power plant was delivering properly but that the second stage of radio frequency was not functioning correctly. The fault with the second radio frequency stage lay in a broken pigtail connection inside of the insulated covering, the connection running from the rotor plates of the tuning condenser to one side of the coil. The tube test disclosed a faulty tube. The aerial and ground test made evident a "leaky" lightning arrester. All of the above faults were quickly brought out by means of scientific methods while the dealer's man found none of them by the old method. It is probable that if he had managed to repair the receiver he would not have found the trouble in the lightning arrester.

With the above mentioned true experience the writer hopes to show that to pursue the old methods of radio repair the man doing the work must have a greater knowledge of radio technique than when indicating devices are used. He must therefore be a higher priced man despite the fact that the repair man using the scientific method will turn out more work in a given number of hours. The scientific method of repair makes for more successful work, for the repair man's knowledge of radio is combined with visible signs as shown on the indicating devices. That smoothness of operation and output from the service department are obtainable only with the scientific method.

It is hoped that dealers and repair men who have followed this article thus far have awakened to the fact that operating a service department without indicating instruments is a costly method. In other words then, the fault has been with the method of operation.

In the next article the process of scientific service will be explained together with diagrams and constructional data on the indicating instruments.

Matching Impedances

Regarding misconception of impedance requirements and loud speakers

*By Horatio W. Lamson**

WHEN two elements in an electrical system are connected together, the efficiency of the system depends to a large degree on the relations existing between the impedances of the units coupled together, and some form of "adjusting" transformer is required. Questions asked in recent correspondence would seem to indicate that there is some confusion as to the principle of such devices.

The design of the coupling device depends on whether it is desired to transfer the maximum of voltage, current, or power, to the receiving unit. In the conventional vacuum tube amplifier, the object is to obtain as high a voltage as possible in the grid of the succeeding tube. The load on the coupling device is practically an open circuit. In this case, the object is to obtain as high an input impedance in the coupling device as possible. As the transformer operates with its secondary practically open circuited, the primary impedance with secondary open circuited is a true indication of whether or not the device is suited for a given use.

There are many cases where it is required to get a maximum transfer of power occurs when the impedance of the receiving circuit equals that of the source. It is frequently necessary to use a transformer to obtain this optimum transfer in places where the source and load are of widely differing impedances. There seems to be a widespread misunderstanding of the function of transformer in this case. Frequently orders are received for a transformer to have "10,000 ohms primary impedance, 5,000 ohms secondary impedance." What is wanted is a transformer suitable for use between impedances of 10,000 and 5,000 ohms. A transformer having open circuit impedances as specified would be entirely unsuited to this use. The transformer is not "matched" to the load impedances, its function is to match the load impedances to each other. The object is not to get the maximum power into the transformer, but to get it into the load. For this purpose the impedance ratio, not the actual impedance is the important factor. The actual open circuit impedance is of importance, since it forms a load in parallel with the useful load. If a transformer with a 10,000 ohm primary were supplied for working out of a 10,000 ohm source, half of the available power would be lost in the transformer. The open circuit impedance must be several times the impedance of the loads being coupled together for an efficient transfer. A transformer, for example, for coupling a 10,000 ohm tube impedance to a reproducer should have 50,000 ohms or more, open circuit primary impedance.

What Speaker?

Frequently we are asked the question: "What speaker do you recommend for me to use?" or "Should I buy the ——— speaker?" This is one of those questions like: "Have you stopped beating your wife?" which cannot be answered directly without embarrassment. Leaving out of the question the fact that tastes differ to the extent that a speaker, which is shown by every test to be an accoustical atrocity, will have its enthusiastic admirers, while a high quality reproduction is condemned as "boxy" or "muffled," the answer is not simple, because the behavior of a speaker depends to a great extent on the amplifier with which it is used. It might be thought that the effect of the speaker and amplifier are directly additive, that a good speaker will sound better even on a poor amplifier than an inferior speaker. Such does not prove to be the case. Some speakers are, of course, so bad that they are terrible with any amplifier. Between a great many speakers, however, the amplifier will determine the choice. A perfect amplifier would, of course, sound best with a perfect speaker, and, as a rule, the better the amplifier, the better the speaker which will give best results. This can be very readily observed by means of an interesting experiment which does not require a great deal of apparatus. A simple filter is connected between the output of a high quality amplifier and a quick throw switch by means of which the speakers are to be compared. The inductance coil of the filter should be so constructed that it is possible to move the iron core in and out changing the cut-off frequency of the filter. With the filter removed, tune in a station having a high quality output and classify the speakers under test in order. If the amplifier and broadcast are of good quality, this test will probably give results indicative of the actual merit of the speakers per se. This is not always the case, as the type of music received also affects the result. As the iron in the filter is moved in and out, cutting out different parts of the frequency range, it will be found that first one and then another of the speakers will be selected as giving the most pleasing effect.

* *Engineering Dept., General Radio Co.*

Intelligent Purchasing

*The value of a Purchasing Agent to a Manufacturer—By John W. H. Beresford**

THE industrial progress made in this country within the last ten or twenty years has brought about a new set of conditions and we find today that the most important factor in manufacturing is mass production.

At one time a manufacturer could carry on a small business with comparatively low yearly sales and enjoy at least moderate profits. Today, competition is so strong that a legitimate manufacturing business cannot be continued at a profit unless a considerable financial outlay is provided for increasing manufacturing facilities for production on a quantity basis. The success of a manufacturer is dependent upon his ability to undersell his competitors. Which is to say that today the profits are in the pennies and a penny saved on the manufacturing price of an article may prove to be the sole reason for the success of the product and the business.

From the fact that pennies must be saved in production costs in order to sell the product it is evident that an experienced purchasing agent can be and usually is a company's best salesman and one of its greatest assets.

Value of Purchaser

There was a time when the value of a purchasing agent to a large organization was hard to realize because of the fact the money saved to the company through his efforts was not easily traced. Even today it is next to impossible to show, in cold figures, the yearly amount saved to a company by the purchasing department. The value of the department is realized only because the business executives of the organization have learned through experience that they cannot get along safely without one. The reasons are numerous. It is part and parcel of the purchasing profession to show good and quite often rare judgment in the buying of materials. Not that their fundamental judgment is any better than the average but the particular nature of the judgment they show is superior as it has come to them through long training in a specific field. As much can be said of any other profession. The purchasing agent has "a well developed nose for buying." It is an essential part of his business, to know not only specific markets, prices, sources of supply and demand and seasonal trends, but the general business outlook not only in his own field, but any other general conditions which effect every business to some degree. It puts the control and responsibility of all buying in the hands of one man and you can be assured of having the correct material at the right time and on the best possible terms. The purchasing agent, who is experienced, is clear-headed and not swayed by the glowing descriptions of salesmen nor the too optimistic or pessimistic ideas of his own organization. He is familiar with those different terms and specifications which are peculiar to different lines of business—is well versed on standardization, which enables him to keep his own specifications within accepted standard and keep down excessive costs arising from articles of special manufacture. He knows how and when to make contracts, and when to buy in the open market, when to go heavy on his requirements and when light.

The foregoing is not an attempted eulogy of purchasing agents but merely a means of pointing out that it is of considerable importance to place all buying responsibility in the hands of one man. If he has normal intelligence and is at all adaptable to new conditions he will find more ways for saving money in a week than the busy officials could think of in a season.

Eliminating red tape assists in the elimination of red figures.

Profits in Pennies

The radio industry is still in its infancy, yet it has already reached the point of industrial progress where mass production becomes a very important factor. Those radio manufacturers who are making a success of their business today and who have grown into large, stable organizations with sound financial background are the ones who, yesterday, had enough foresight or insight to realize that the success of their business rested in their ability to save the pennies. They know the advantage of buying materials in large quantities and they know the value to them of a purchasing agent who can analyze market conditions and cooperate with the sales department, production department and engineering department in working out the production program. A purchasing agent who, knowing the production figured upon and knowing the capabilities or limitations of the various departments and the attitude regarding prices and quality held by the company officials can go out and buy at the right time and buy well.

Radio Failures

Those manufacturers who may think they can get along sufficiently well without at least a purchasing man responsible for all buying might stop to look back on some of the notable radio failures and analyze the reasons for their downfall. In most cases this has been due to lack of organization, inaccurate figuring on the amount of production, "engineering blindness" and unintelligent buying. I have yet to find a case where failure was due directly to misfortune or lack of sufficient operating capital.

A radio manufacturing company, now very much out of business, "went into production" a few years ago on a very interesting type of radio receiver which, from the engineering standpoint, was considered excellent. The president of the company, which incidentally had been heavily financed, and had plenty of ready cash to cover the production program, handled all the buying of raw materials and special parts. In order to save money on a metal cast framework he bought a cheap grade of metal, which, unknown to him, was not suited for the purpose. He purchased large quantities of cheap fixed condensers that were far too inaccurate as to capacity value from the engineering point of view. In contracting for special shipping boxes he again allowed himself to be influenced by low prices. The result was disastrous. The supporting frames of the receivers did not stand up under shipment; neither did the shipping cases. The fixed condensers ruined what could have been an excellent receiver—and also ruined the career of an engineer.

The president of this company was a shrewd buyer but he didn't know how to save money by purchasing intelligently—he couldn't even save his own shirt. He merely lacked the aforementioned judgment of an experienced purchasing agent. Had he placed all the business of buying into the hands of a good purchasing agent there would probably be a different story to tell today.

Knowledge of Limitations Valuable

The sales engineer of one large organization near New York City handles all the purchasing. This man gets better prices on materials and parts because he not only saves money for his own organization but for the people from whom he buys. He saves money for other people because he knows what he wants and is acquainted with the limitations of materials and parts. His moulding specifications are reasonable and within the realms of possibility.

The sales engineer mentioned is probably worth more money than he receives. A man of this sort cannot be easily replaced but an intelligent purchasing agent can get the same results using his own experience plus the technical knowledge of the engineer, and leave the engineer with more time to devote to sales and research.

* *The United Lead Company.*

Harmonic Distortion

*An explanation of harmonic distortion and means for its elimination.—By E. E. Hiler**

This, the third of a series of articles by Mr. Hiler, is equally interesting as well as valuable for it covers in detail a much discussed and very enigmatic problem beside offering a practical solution.

Mr. Hiler shows how the loop characteristic in interstage couplings can be eliminated and he is going to illustrate, practically, how the loop characteristic can also be eliminated from the output circuit. This will be a new disclosure.—Editor.

IN the April and May issues we discussed the theory and application of Tuned Double Impedance Audio Amplification, where attention was directed mostly to the frequency characteristic obtainable with this system, for instance that of Fig. 1.

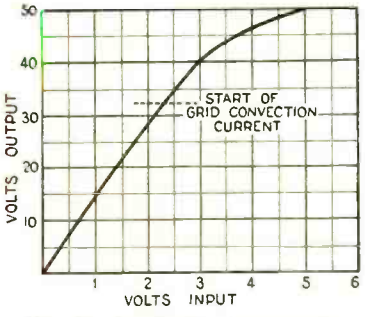


Fig. 2. Amplitude characteristic curve

A frequency characteristic curve is made with a constant amplitude or "volume," but it is also important to know what happens when the frequency is kept constant and the volume varied. This is called an "amplitude characteristic" and shows the amount of amplification obtained with different degrees of amplitude. As will be seen later this should be measured at a number of different frequencies. An example of one measurement is shown in Fig. 2.

Harmonics Important in Music

It is well known that the ability of the human ear to detect "tone-color," "timbre" or "quality" of sound produced by different musical instruments or voices, is dependent on the presence in the sonnds of overtones or harmonics. One instrument is distinguished from another unconsciously by the number and proportion of the harmonics and fundamental. The second harmonic is twice the frequency of the fundamental, or an octave above, the third harmonic is three times the fundamental and the fourth is four times or two octaves above the fundamental, etc. Three octaves above would be the eighth harmonic. The number of harmonics accompanying a fundamental varies from one or two to more than twenty; a good average is five. In order then to reproduce faithfully a musical tone, it is necessary to have straight line reproduction in the air at the receiver of the sounds in the air at the point of origin. Also, since the amplitude of the fundamentals and harmonics is not the same in any two instruments or any two tones on the same instrument and sometimes *even varies as the same tone is sustained*, it is very important that waves of different amplitudes of the various tones and overtones be amplified to the same degree in order to reproduce the relative amplitudes of these tones and overtones in their original relationship. Tone quality is therefore dependent on two variables, frequency and amplitude. Harmonic distortion in this article is limited to the effect on harmonics of varying the amplitude.

Examples of Harmonic Distortion

For instance, we are listening to a musical tone and we increase the volume until a point is reached where that quality which we had virtually "goes to pieces." The ability of a receiver or reproducer to produce an amount of volume without harmonic distortion is usually called its "undistorted power output." It is measured in a receiver by the square of the allowable maximum grid voltage swing.

An experience common to all is recalled when we have had a "rattle" in our loudspeaker and were unable to tell by the ear alone whether or not the rattle was in the speaker or in the set. A rattle in a set is by analogy an "electrical rattle" and its cause is similar to the cause of a rattle in a speaker. A rattle in a speaker is caused by something interfering with or limiting the motion of a moving part, while an electrical rattle is caused by some limiting factor in the amplifying circuit or tubes which limits the currents or voltages in their swings from maximum values to minimum values (see Fig. 8). A swing from maximum to minimum is the definition of amplitude, and the greatest swing from maximum to minimum is therefore the maximum amplitude.

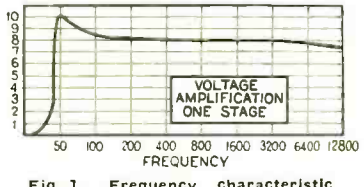


Fig. 1. Frequency characteristic curve of a single stage of tuned double impedance amplification

The Mathematics of a Maximum Value

Viewed from a mathematical standpoint the problem is one of determining maximum amplitudes of voltages and currents and their product maximum power as the case might be. We are all familiar with the statement that maximum power output is obtained in an external impedance when this impedance is numerically equal to the resistance of the tube out of which it works, the so-called "matching of impedances." Why this is so is shown on page 188 of *"Thermionic Vacuum Tubes" by H. J. Van Der Bijl.* The general method of finding out a principle of this kind is applicable to many of our problems. The curve showing how the watts power in the external impedance varies with the external impedance, other factors remaining constant, is shown in Fig. 3.

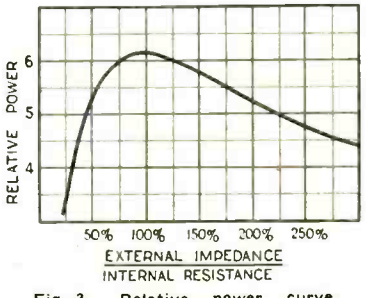


Fig. 3. Relative power curve, showing change with variation of impedance

This could have been predicted by analyzing the formula for power "P" in the external impedance "Z_o".

$$P = \frac{1}{\sqrt{2}}\mu^2 \frac{Z_o}{(r_p+Z_o)^2} \qquad (1)$$

In this μ="mu" of tube and r is the resistance between filament and plate internally. "Z_o" is assumed to have a phase angle of 45° in which case $r_o = x_o$, the resistance and reactance components of the impedance "Z_o". This phase angle is the reason for the factor $\frac{1}{\sqrt{2}}$ but does not affect the solution of the problem of maximum power at $Z_o = r_p$.

The first derivative of equation (1) by rule VII, page 35, *"Differential and Integral Calculus", by Granville,* is:

$$\frac{dP}{dZ_o} = \frac{1}{\sqrt{2}}\mu^2 \frac{r_p - Z_o}{(r_p+Z_o)^3} \qquad (2)$$

*Hiler Audio Corporation.

Charts for Determining Inductance and Capacity Values

Valuable reference graphs which indicate values of inductance and capacities for various wave lengths

*By V. T. Baird**

ASIDE from the nuisance of resorting to formulæ for calculating the required inductance value to cover a specific waveband with a variable condenser of given capacity there is also the chance of running into numerous difficulties if due consideration is not given to the physical characteristics of the coils.

No move has been made as yet to bring standardization into the field of inductances and it is very doubtful if anything will be done for some time to come because of the varied requirements of manufacturers. Yet, it is quite possible to draw near to standardization by supplying accurate working data on solenoid inductances with fixed physical characteristics which carry no stringent demands as to design detail.

Accompanying this article are a series of curves which have been worked out around inductances of the solenoid type of varying diameter. There are also two curve sheets which indicate the values of inductance required with variable condensers of different capacity values to cover specific wavelength bands.

The original calculations, worked into two and three decimal places, were transferred to the graph sheets and the resultant curves, correct to one decimal place, are accurate enough for all general purposes. There is no demand for perfect accuracy as inductance values calculated either by formulæ or worked out from these curves would show variation under practical conditions, when hooked into a receiving circuit.

It will be noted that curves are supplied for all standard capacity variable condensers, from 50–mf to 1000 m–mf in the chart of Fig. 1, and from 100 m–mf to 250 m–mf in the short wave chart of Fig. 2, and curves for coils ranging in diameter from one inch to four inches. In each of the coil charts (Figs. 3, 4, 5, 6 and 7) there are curves for coils ranging in length from one to three inches. The number of turns per

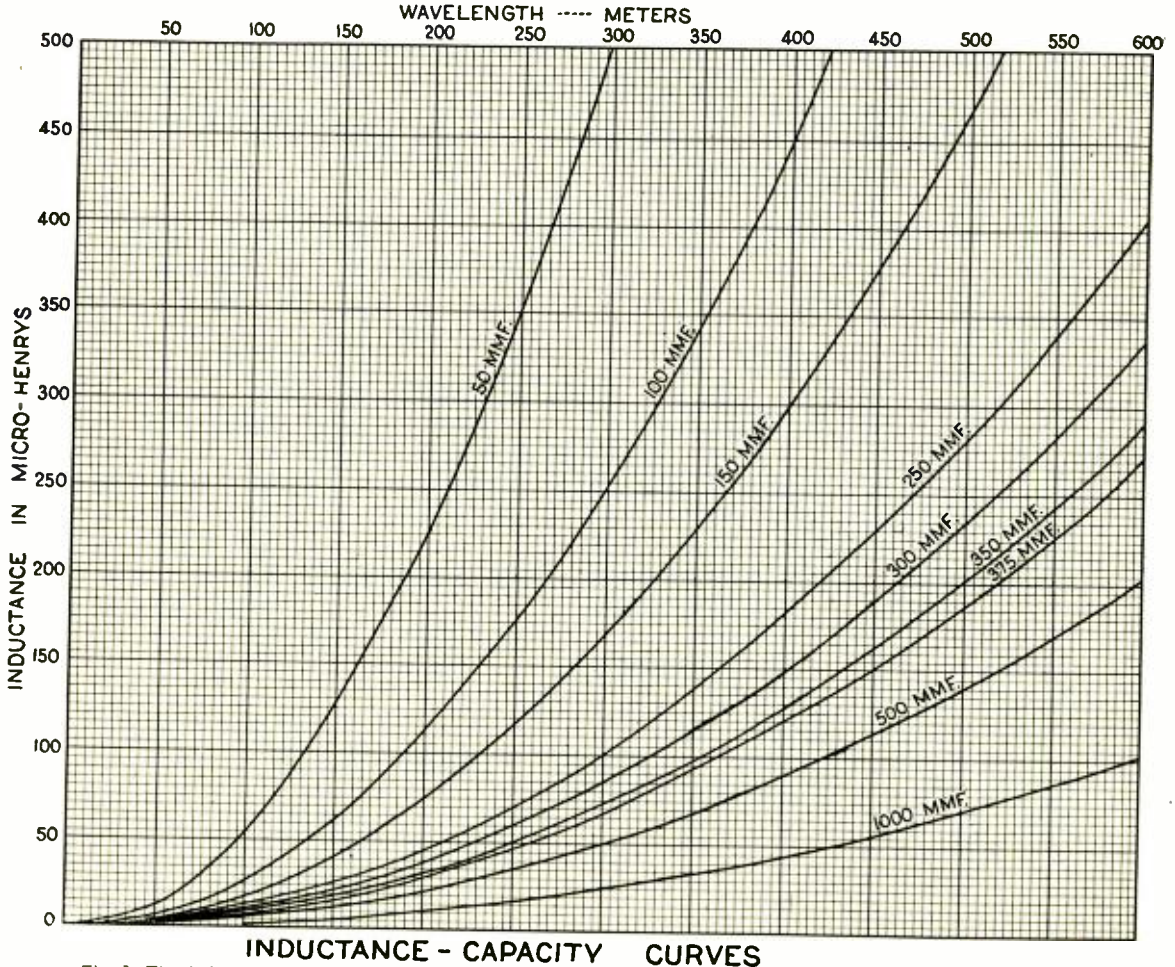
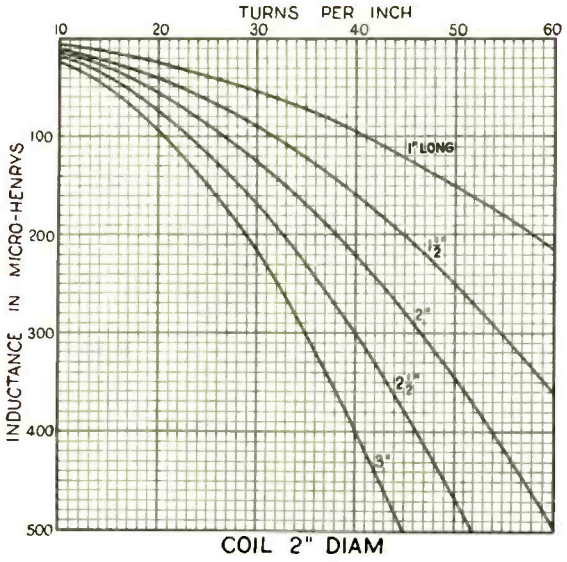


Fig. 1. The inductance in micro-henrys required for a given waveband in connection with any standard capacity variable condenser can be determined from this chart

* Engineering Department, Hammarlund Manufacturing Co.



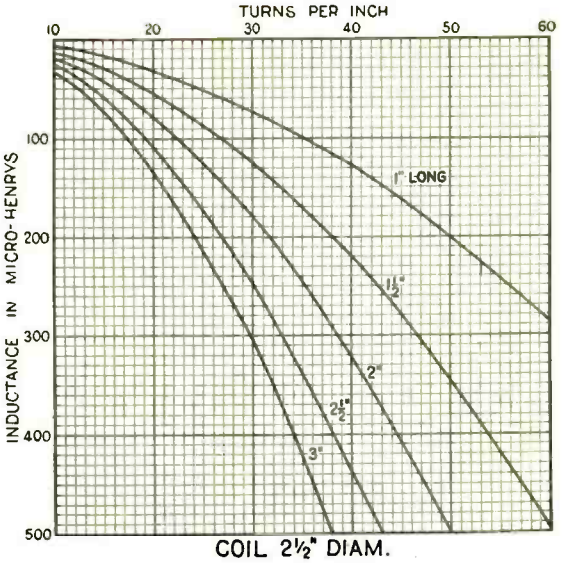
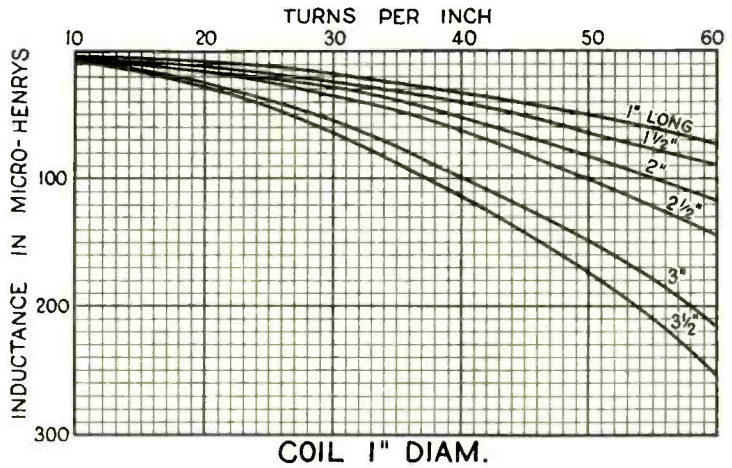
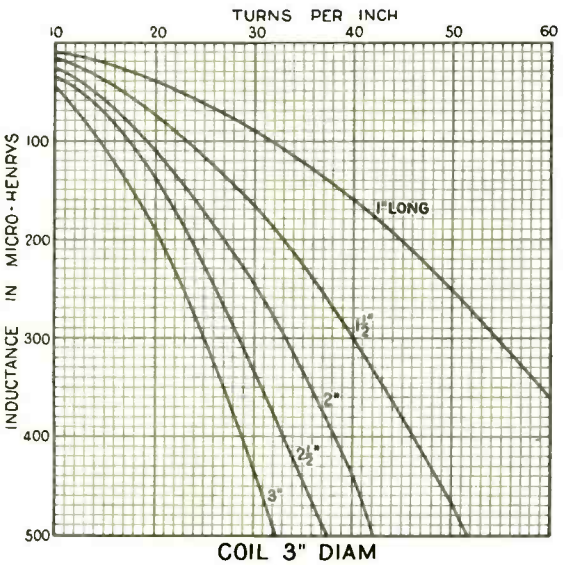
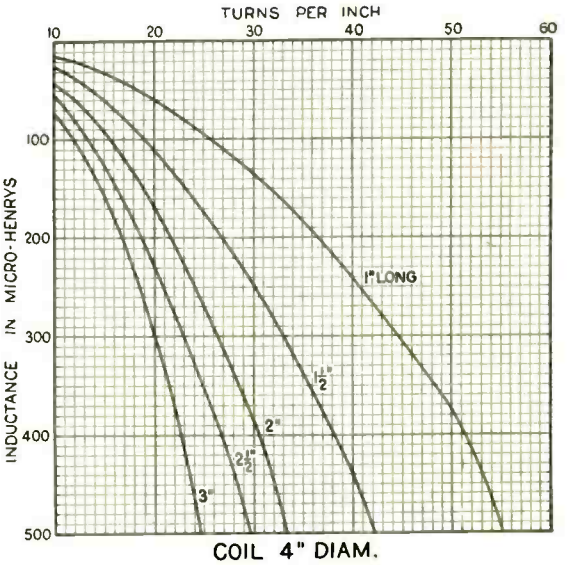


Fig. 3 to the right and Figs. 4 and 5 above show the number of turns per inch required for different coil lengths and specific coil diameters to cover inductance values normal for the broadcast wavelength band with standard capacity variable condensers



Figs. 6 and 7, below, serve the same purpose as the other curve charts on this page. These two are valuable for determining the characteristics of coils for short wave work as the curves are for coils 3 and 4 inches in diameter which are the usual dimensions. The inductance-capacity curves for the short waves are shown in Fig. 2





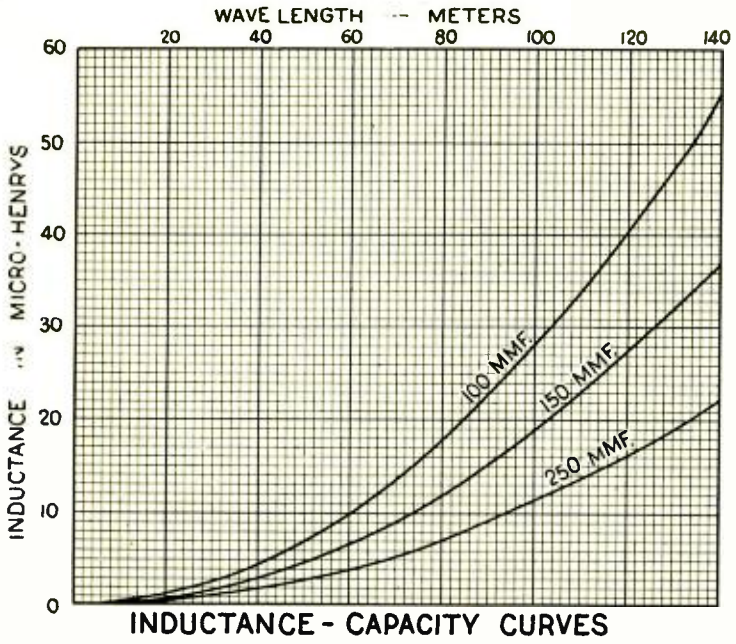


Fig. 2. Inductance or capacity values for short wave work can be determined from the above curves

inch of different guage wire can be obtained from the table of Fig. 8.

By cross reference it is simple to determine the capacity value of a variable condenser for a given coil or to determine the physical characteristics of the coil for a given capacity value. One is not limited to any coil length or coil diameter. Thus, the space in the receiver being designed can be taken into consideration first and a coil of suitable physical dimensions selected from the charts. The number of turns of wire required per inch of the coil can be determined immediately, the guage of wire found in the table of Fig. 8, and the most suitable capacity value for the variable condenser selected from the curves in either Fig. 1 or Fig. 2.

It is obvious that these curves practically standardize the design of the coils, or at least offer that opportunity, and if widely employed would save much confusion.

Examples of Use

It might be interesting to take a few examples and work them out so as to show the flexibility of the reference charts. Suppose the receiver being designed requires a coil no more than two inches in diameter and 2½ inches long. Using a variable condenser with a maximum capacity of 500 m-mf it is shown in the chart of Fig. 1 that the maximum inductance of the coil must be approximately 17° micro-henrys in order to reach the wavelength of 550 meters. Now, referring to the chart of Fig. 4 we see that a coil two inches in diameter and 2½ inches long must have around 38 turns to the inch in order to have a maximum inductance of 17° micro-henrys.

The above example is rather crude and round-about but goes to show that one can decide on the coil and determine the number of turns per inch for the most suitable condenser, or can decide on the condenser and determine the physical characteristics of the coil necessary to cover the desired wave-band most suitably.

Let us work through a more practical example. Suppose we wish to use a variable condenser having a maximum capacity of 350 m-mf. This is a good value as the curve for this capacity in the chart of Fig. 1 is not too abrupt in its upward bend. If 550 meters is the highest wavelength we wish to reach we find that the value of the inductance required is a shade under 245 micro-henrys. Now, by referring to the chart of Fig. 3, for a coil one inch in diameter, it will be found that it is just possible to reach an inductance value of 245 micro-henrys by using a coil 3½ inches long. However, a coil 2 inches in diameter, as shown by the curves in Fig. 4 is satisfactory providing it is at least 1½ inches long. If we increase the diameter of the proposed coil to 2½ inches it need be only one inch long to reach the required inductance value, as shown in the chart of Fig. 5 but the most satisfactory coil would probably be one with a diameter of 2 inches and a length of 2½ inches, as shown in Fig. 4. One of the reasons for this is that a coil of less length would require a small gauge wire in order to get the necessary number of turns in, per inch of coil.

Coils for Short Waves

For short wave work, it would probably be best to consider the 4 inch diameter coil only, the curves of which are shown in Fig. 7 as the electrical characteristics of this size coil are superior at the higher frequencies. The inductance-capacity curves for the short waves are given in the chart of Fig 2. The curves shown are for those capacity values usually employed in short wave receivers.

The accompanying charts also make it possible to design sets of coils, of the plug-in type, to cover narrow wave-bands, say one set to take in waves from 150 to 300 meters and another set for waves from 250 or 300 to 550 meters. Sets of plug-in coils are particularly valuable for short wave work and the chart of Fig. 2 has sufficient accuracy so that the inductance values and physical characteristics of the coils can be determined without the necessity of resorting to any cut-and-try methods. The accuracy of the curves in Fig 2 fall off as they go down in wavelength but even calculation by formulae is ineffective when dealing with high frequencies. The best one can hope to do when designing coils for very short waves is to approximate the inductance values.

Considerations

In designing coils it should be kept in mind that shielding reduces the inductance value and the closer the shield to the coil the greater the reduction. If shields are to be used and you wish to reach 550 meters maximum the coil or coils should have sufficient inductance value to reach 600 meters without the shielding.

For most efficiency coils 2 inches or smaller in diameter should be at least as long as the diameter, if not longer. Over 2 inches the coil may decrease in length as the diameter increases.

B. & S. Gauge	Turns per Linear Inch			
	Single cotton	Double cotton	Single silk	Double silk
12	11.5	10.9	.....	.....
14	14.3	13.5	.....	.....
16	17.9	16.7	18.9	18.3
18	22.2	20.4	23.6	22.7
20	27.0	24.4	29.4	28.0
22	33.9	30.0	36.6	34.4
24	41.5	35.6	45.3	41.8
26	50.2	41.8	55.9	50.8
28	60.2	48.6	68.5	61.0
30	71.4	55.6	83.3	72.5
32	83.4	62.9	101	84.8

Fig. 8. Table showing the number of turns per inch for different gauge wire

Coils having spacing between turns equal to from 7/10 the wire diameter to full wire diameter show least distributed capacity. Spacing less than 7/10 the diameter of the wire increases the distributed capacity of the coil considerably but on the other hand spacing equal to more than the full diameter of the wire shows a very small decrease in distributed capacity.

Wiring Houses for Radio*

New summer business for the radio contractor-dealer

RADIO is rapidly taking a more prominent part in the American home. It is no longer regarded as a novelty, but instead is made a chief source of entertainment and enlightenment. Just as the necessity of having the family grouped around a receiver to "listen in" by means of head-sets has been overcome, so has the era of confinement of radio entertainment to one room been ended. Many enterprising radio owners have enlisted the use of extension cords and portable jacks to enable them to operate a speaker on a porch or adjoining room. Progressive and far-sighted radio contractor-dealers and architects are now making practical, permanent installations in new homes, apartments, hotels, hospitals, and office structures, furnishing radio loud speaker service to all rooms or apartments in the building.

The home that is wired for radio service in its principal rooms should be very popular with every member of the family, but especially with the house-wife, since she spends a greater portion of her time in the house. It is now possible for her to hear her favorite programs regardless of what part of the house she may be in. This is accomplished by placing a receptacle jack in every room; connecting them to the output circuit of the radio receiver. The following paragraphs give detailed installation data of some of the more practical applications.

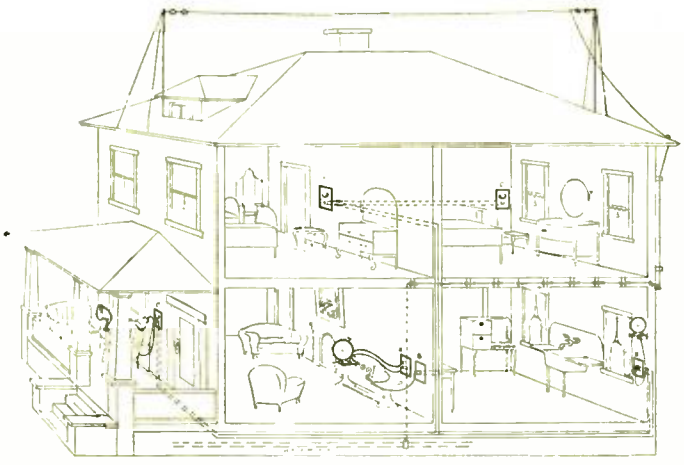


Fig. 1. Typical example of radio house wiring. A is an aerial and ground outlet jack; B, receptacle jack; and C, receptacle jack with volume control

Volume Controls

The receptacle jack in the bedroom may or may not be equipped with a volume control. If volume control is desired, the type of receptacle jack shown in Fig. 2 should be used. In case of sickness or confinement, a loud speaker or head-set may be used by the patient and the volume can be easily adjusted for his comfort.

Special jacks and a combination jack and volume control designed for use in buildings wired for radio

Any desired volume, from maximum down to a barely audible signal, may be obtained by turning the knob on the receptacle jack. This does not noticeably affect the volume of any other speaker which may be operating simultaneously in another part of the house.

The "radio-equipped" house in Fig. 1 also shows a volume control receptacle jack on the porch. In summer when the living-room is too warm for comfort, the loud-speaker may be carried to the porch and plugged into the jack. It is usually desirable to use a volume control receptable jack here so the volume may be reduced to avoid disturbing the neighbors.

Wiring Recommendations

Fig. 1 also shows the method of wiring the receptacle jacks to the various rooms. The wiring should preferably be done at the time the electricians are installing the lighting circuit. Any wiring contractor will be able to do this as only a few rules need be followed when making an installation of this kind. The receptacle jacks may be mounted on the wall or baseboard, either with or without a standard wall box. The wall box is not necessary but it is an effective protection against falling plaster and dirt. Fig. 3 illustrates both methods of mounting this equipment.

It is important that parallel wires be kept at least 2½" apart. The method of wiring shown in Fig. 4 allows approximately 18" of space be-

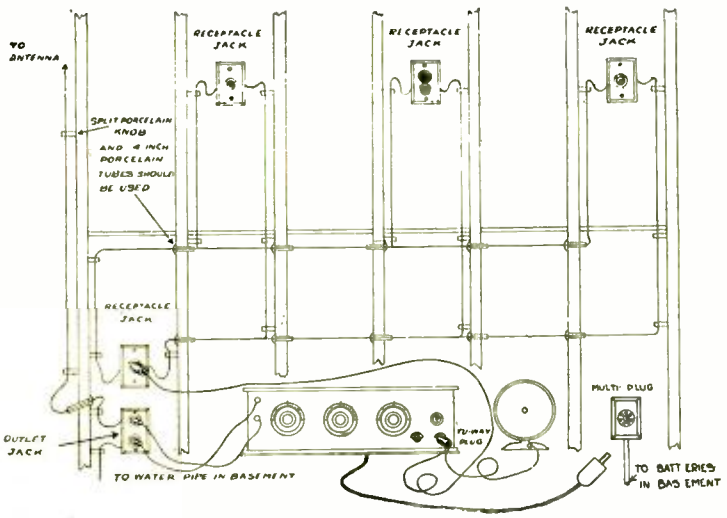


Fig. 4. Details of interior wiring job

* *Article prepared by Engineering Dept., Carter Radio Co.*

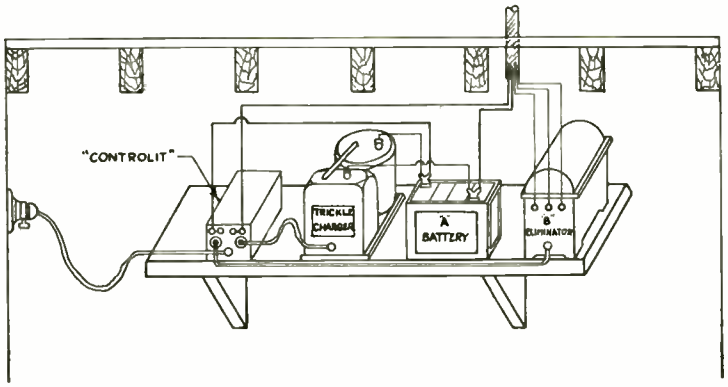


Fig. 7. Suggested layout for "A" and "B" units in cellar of house

tween wires,—keeping capacity between leads at a minimum. When running wires from one floor to another, they should be supported on split porcelain knobs as shown in the drawing. Leads running in horizontal directions should go through porcelain tubes inserted in holes drilled in the joist or studding of the building. Standard porcelain cleats may also be used—with this type of wiring the spacing between wires will be approximately 2½". (Radio Manufacturers' Association Standard.)

Open Circuit Wiring

The standard practice for open circuit wiring should be followed as much as possible. The wire should be No. 16 to No. 14 rubber and cotton covered. Wires should be allowed to hang loose enough to permit convenient connection to the receptable jacks. Fig. 4 is a detailed sketch to illustrate the method of running the wires. Fig. 2 clearly indicates the method of connecting the volume control type receptacle jack.

Metal Conduit Not Satisfactory

In cases where a building has fireproof construction, there is no space between the floors and walls to run open circuit wiring. It is impractical to run the wires in metal conduit, as is done with power wires, due to the choking effect of metal pipes and the capacity between conductors.

Some time ago, an installation of this nature was made in a large Chicago apartment building, but of course, the system would not operate. While an attempt to locate the trouble was being made, one of the wires connecting to the jack terminals broke off and the jack terminal accidently grounded on the circuit. To the surprise of all, it was possible to operate a loud speaker from this receptacle jack. The broken wire was taped, and the terminal permanently grounded on the conduit. This change was made in each room, thereby making the entire system operative.

The action of this circuit may be more readily understood when attention is called to the fact that the conduit acts as one plate of a fixed condenser in series with the loud speaker circuit. (See Fig. 5.) This method may be successfully used, but is not recommended since the open circuit wiring is less expensive and produces better results.

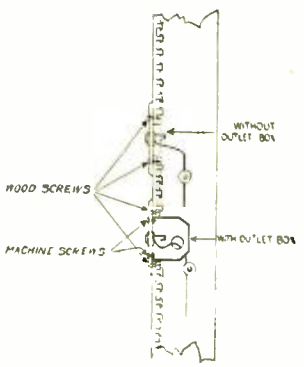


Fig. 3. Showing installation details of receptacle jacks

Fibre Conduit or Loom Recommended

There have been many installations where No. 14 rubber covered wire was encased in loom and buried in concrete floors and walls. When making an installation of this kind, it is necessary to maintain the spacing specified for open circuit wiring. The loom should be run between outlet boxes without a break. Several layers of tape wrapped on the end of the loom, inside of the box, will prevent its slipping out when the concrete is being poured.

Fibre conduit may be used instead of loom, affording better protection to the wires and permitting rigid construction similar to metal conduit. The conduit should be threaded at the ends and fastened to metal or fibre outlet boxes with metal nuts in the conventional manner. This material does not bend readily, so it will be necessary to use elbows or condulets when a turn is made. These may be made of either fibre or metal. It is rather unusual to run two separate lengths of conduit between two outlet boxes, but it is necessary in order to maintain the proper spacing between wires. Fig. 6 shows a simple and efficient way of doing this.

Batteries Concealed in Basement

A "radio-wired" house would not be complete without some method of concealing unsightly batteries. Of course if a console cabinet is used, the batteries may be kept in it. When this is not the case, however, the batteries may be kept in the basement and connected to the set by means of a multiplug. (See Fig. 4). This type plug will mount with a flush plate the same standard size as that used for the receptacle jack. The wires for the "A" battery circuit should be rather large (from No. 12 to No. 8 B & S gauge) to prevent excessive voltage drop. The size must be increased proportionately to the number of tubes in the set and the lengths of the wire.

When "A" battery charger and "B" eliminator equipment is located in the basement in this manner, some switching or control device is necessary. Fig. 7 illustrates such an arrangement using a relay switch, which is especially suited for this purpose. This consists of an extremely low resistance relay, which is connected in series with the filament circuit. When the battery switch in the radio set is turned on, the filament current passing through the relay causes it to operate, thereby automatically disconnecting the trickle charger and turning on the "B" eliminator.

Aerial and Ground Connections

An antenna and ground outlet jack is shown in Fig. 1, near the receiver to furnish a neat and convenient connection for concealed antenna and

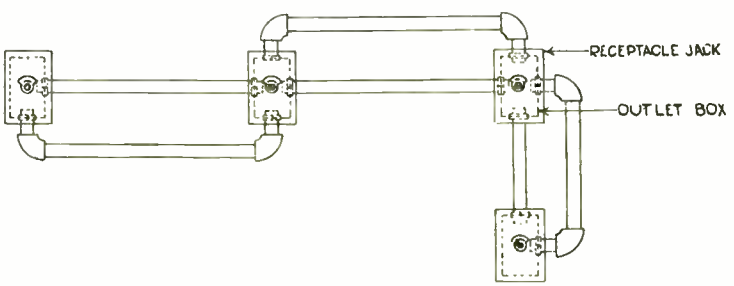


Fig. 6. Special conduit, and outlet boxes with receptacle jacks are recommended for fool-proof installation

ground wires. The outlet jack should be placed near the antenna lead-in, although reasonable distances will have no appreciable effect upon the operation of the receiver. The porcelain tube in the outside wall, through which the lead-in wire is brought, should slant down and the lead-in wire allowed to sag, as shown in Fig. 4, in order to prevent water from running down the wire through the tube and into the building. The aerial lead-in and ground wires may be run through porcelain tubes in the studding or joists.

The installation of lighting arrestors affords a factor of safety which should not be overlooked. The National Board of Fire Underwriters recommends that suitable arrestors be installed with all antenna equipment. These should be in accordance with the manufacturer's instructions.

Loud Speaker Service for Apartments

During the last few years, a great many apartments, hotels, and hospitals have been equipped with loud speaker service. This usually consists of one or more radio sets, operated by the private switchboard operator.

One receptacle jack is usually multipled in each apartment or hotel room. When a tenant, guest, or patient, as the case may be, desires to hear a program, it is only necessary for him to plug into the jack. Of course, this does not allow individual selection but at times it may be possible to phone the operator and make a request for a definite program.

A modification of this system, which is somewhat more expensive to install and operate, but allows flexibility, was used in the Hudson View Gardens, a newly constructed group of large apartment buildings in New York. Each apartment is provided with four receptacle jacks, each one of which is connected to a different set in the operating room. Each tenant may then choose one of four different simultaneous programs by plugging into the various jacks.

It is no longer necessary, however, to use a separate selector switch jack for each station for this system. The new jack is equipped with one speaker jack and a multi-point switch. Different programs are selected by turning a switch knob on the wall plate. Selector switch jacks are available to furnish any number of programs up to nine.

When wiring an installation of this type, the "BT" lead is common to all circuits and connected to the sleeve (marked "t") of the jack. The plate leads of each amplifier are run to a corresponding terminal of each selector switch jack in the system.

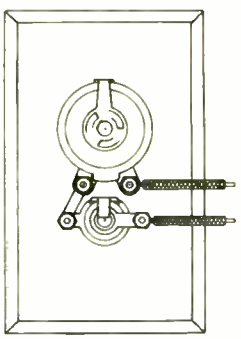


Fig. 2. Illustration of rear of combination receptacle jack and volume control

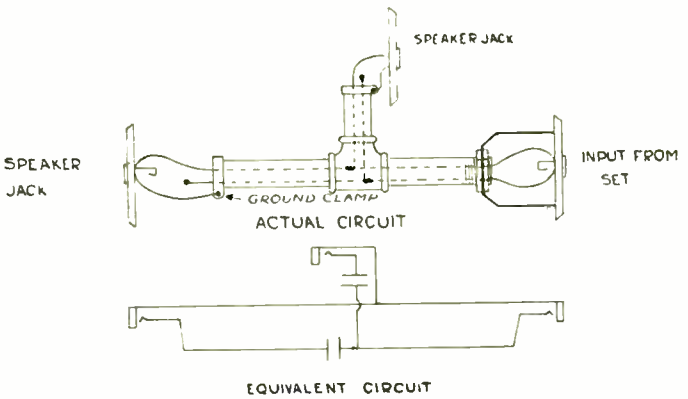


Fig. 5. A wiring installation and its equivalent electrical circuit

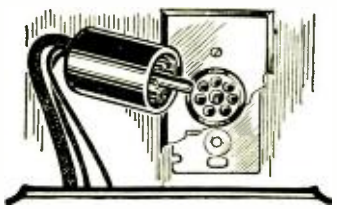


Illustration of a battery cable plug with wall plate

Radio Entertainment in Hospitals

There is also a great demand for radio service in hospitals. The same method of wiring as in apartment houses can be used, but receptacle jacks with volume controls should be furnished. A receptacle jack should be placed at the head of each bed enabling each patient to listen in with a head-set without disturbing those around him. The head-set may be equipped with soft rubber ear cushions to permit use for a long period without discomfiture. Here again, the receiver may be placed in the hands of the switchboard operator.

Receptacle Jacks for Completed Buildings

Thus far we have only considered the flush mounting type of receptacle jack, which is suitable for use in new buildings or old ones where the wires may be readily "fished" through the walls. Very often, however, there is occasion to install receptacle jacks in a completed building where it is not practical to cut mounting holes in the wall or to "fish" the wire through the partitions. The receptacle jack is intended for surface mounting and to be used with exposed wiring for homes, apartments, hospitals, etc., thereby making an ideal device for above mentioned condition. This is a single open circuit type of jack.

Wiring Recommendations

These jacks should be wired with standard "twisted pair" telephone wire when the total length of wire in the entire system does not exceed 500 feet (double). It is recommended that the use of annunciator wire or duplex cable, be avoided unless the total length of wire in the entire system is less than 200 feet. In large installations where the total length of wire in the system exceeds the lengths given above, it will be necessary to space the wire three or more inches,—in this case several hundred feet of twisted wire may be used in conjunction with the spaced wire. The twisted telephone wire to be used, of course, for the short runs from the main line to the jack.

The Power Amplifier

In conclusion, we will give a few suggestions regarding the receiving set to be used with such an elaborate system. It is obvious that the ordinary receiving tube would be badly overloaded if it furnished power to a great number of speakers. It is generally known that overloading the tubes will impair the tone quality of the entire system. A simple remedy is to use a power amplifying tube in the last audio stage. Another method is to use a separate power amplifier with a standard receiver. We recommend that the plate current of the power amplifier be kept out of the loud speaker system by means of an output transformer or a condenser-impedance coupling device. Many descriptions of power amplifiers have been published in radio periodicals, but for those who do not care to build such a device, complete power amplifier systems may be purchased from the Western Electric Company or the Radio Corporation of America, and many other radio manufacturing concerns.

Special Duty Vacuum

This chart does purpose or

Name	Type	Use	"A" voltage		Fil. current (Amps.)	Voltages (minimum)		Voltages (maximum)		Voltage "B" Det.	Grid return (Det.)	Plate current (milliamps)		Output resistance (Ohms)	Mutual conductance (Micromhos)	Voltage amplification factor	Remarks
						"B"	"C"	"B"	"C"			Min.	Max.				
Armstrong Electric Co. (Armor)	C. F. 112	Power Amplifier	6	5	0.5	90		157			F+			4500–8000	1200–1700	7.5–8.0	
	C. F. 571	Power Amplifier	6	5	0.5	90		180						2500	1200–1700	3.0–3.5	Use output device above 135 v. "B"
	C. F. 510	Power Amplifier	8	7.5	1.0	180		450						3000–5000	1100–2500	7.0–8.0	Use output device
	C. F. 516 B	Half Wave Rectifier	8	7.5	1.0												85 M. A. output
	A. C. 100	A. C. Tube	1.0	1.0	2.5	22		157						6000–12000	800–1400	7.5–8.0	Step-down trans. for fil. supply
C.E. Mfg. Co. (Cero)	G.	Hi-Mu	6	5	0.25	90	0.5	180	5.0	67–90	F+	0.8		25000–	800–	20	Det., Res. Impedance Amplifier
	H	Special Det.	6	5	0.25	67	3.0	90	4.5	67–90	F+	1.2	3.0	14000–15900	910–1030	14.4	Detector only
	J-71	Power Amplifier	6	5	0.5	90	16.0	180	45.0			9.0		2500–	1200–	3.0	Use output device above 135 v. "B"
	K	R. F. Amplifier	6	5	0.25	45	0.0	135	3.0	45–90	F+	3.0	4.8	11000–12800	975–1130	12.5	May be used as detector
Conewey Electric Laboratories (Magnatron)	D. C. 200A	Special Detector	6	5	0.25					20–45	F−						Detector only
	D. C. 240	Hi-Mu	6	5	0.25	90	0.1	180	1–3	90	F+						Det., Res. & Impedance Amplifier
	D. C. 112	Power Amplifier	6	5	0.5	90	6	180	12	45	F+			3500–8500	970–2000	8	
	D. C. 171	Power Amplifier	6	5	0.5	90	16.5	180	40.5					2000–2500	1250–1550	3	Use output device above 135 v. "B"
	D. C. 210	Power Amplifier	8	7.5	1.25	250	18	450	36					4800–5500	1350–1575	7.5	Use output device.
			6	6.0	1.1	90	4.5	180	12					6500–9500	785–1150		
	D. C. 213	Full Wave Rectifier	6	5	2.0												65 M. A. output
	D. C. 216B	Half Wave Rectifier	8	7.5	1.25												65 M. A. output
	Super-Rex	Half Wave Rectifier	6	5	0.5												50 M. A. output
	Rex	Half Wave Rectifier	6	5	1.0												36 M. A. output
E. T. Cunningham, Inc.	CX-112	Power Amplifier	6	5	0.5	90	4.5	157	10.5			4	8	4800–5000	1600–1670	8	
	CX-371	Power Amplifier	6	5	0.5	90	16.5	180	40.5			11	20	2000–2500	1200–1500	3	Use output device above 135 v. "B"
	CX-310	Power Amplifier	8	7.5	1.25	180	12	425	35			7	18.5	5000–7000	1100–1550	7.7	Use output device
	CX-340	Hi-Mu	6	5	0.25	135	1.0	180	4.5	135				150,000		30	Det., Res. & Impedance Amplifier
	CX-313	Full Wave Rectifier	6	5	2.0												65 M. A. ouptut
	CX-316B	Half Wave Rectifier	8	7.5	1.25												65 M. A. output
	CX-374	Voltage Regulator															Glow lamp
De Forest Radio Company (Audion)	D. L. 4	R. F. Amplifier	6	5	0.25	67		90					3.5	7800–	1150–	9	
	D. L. 15	Special Detector	6	5	0.25	22		45					0.5			15	Detector only
	D. L. 7	Power Amplifier	6	5	0.5	90	4.5	135	9				6	6500–	1100–	7	
	D. L. 14	Power Amplifier	6	5	0.5	90	16	180	40.5				15	2600–	1100–	3	Use output device above 135 v. "B"
	D. L. 9	Power Amplifier	8	7.5	1.6	350	30	500	51			25	35	6000	1083	6.5	Use output device
	D. R.	Half Wave Rectifier	8	7.5	2.0												35 M. A. output
Jaeger Research Labs.	J. X. 200A	Special Detector....	6	5	0.25	22		45						30,000	800	25	Detector only
	J. X. 171	Power Amplifier	6	5	0.5	90		180						2500	1350	3.4	Use output device above 135 v. "B"
	Special J. X. 201A	Special Detector	6	5	0.25	67		135						4200	1650	7.25	Det. and R. F. Amplifier
Ken-Rad Corporation	112	Power Amplifier	6	5	0.5	130	4.5	160	9					5000	1000	5	
	171	Power Amplifier	6	5	0.5			180	45					2500	1200	3	Use output device above 135 v. "B"
	200A	Special Detector	6	5	0.25	15		25									Detector only
	100A	Hi-Mu	6	5	0.25	135		180	45					40000	900	35	Det., Res. & Impedance Amplifier
A. J. Musselman, Inc.	5 P. D.	Special Detector	6	5		45							1.5				Detector only
	5 V. C.	Power Amplifier	6	5	0.5	90	6	180	12				8.5	5500	1450	8	
	6 P.	Power Amplifier	8	7.5	1.25	90	4.5	475	35			4	22	5000–9000	800–1600	7.5–8	Use output device above 180 v. "B"
			6	5	1.1												
	5 R.	Full Wave Rectifier	6	5	2.0												65 M. A. output
	7½ R	Half Wave Rectifier	8	7.5	1.5												65 M. A. output

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Tube Characteristic Chart

not include general dry cell tubes

Name	Type	Use	"A" voltage		Fil. current (Amps.)	Voltages (minimum) "B"	Voltages (minimum) "C"	Voltages (maximum) "B"	Voltages (maximum) "C"	Voltage "B" Det.	Grid return (Det.)	Plate current (milliamps) Min.	Plate current (milliamps) Max.	Output resistance (Ohms)	Mutual conductance (Micromhos)	Voltage amplification factor	Remarks
Perryman Electric Company	P. A. 112	Power Amplifier	6	5	0.5	90	4.5	157	10.5								
	P. A. 171	Power Amplifier	6	5	0.5	90	16	180	40								Use output device above 135 v. "B"
	P. A. 200A	Special Detector	6	5	0.25					45							Detector only
	P. A. 210	Power Amplifier	8	7.5	1.25			425	35								Use output device
	P. R. 213	Full Wave Rectifier	6	5	2.0												65 M. A. output
	P. R. 216A	Half Wave Rectifier	6	5	1.0												35 M. A. output
	P. R. 216B	Half Wave Rectifier	8	7.5	1.25												65 M. A. output
Radio Corporation of America (Radiotron)	U. X. 200A	Special Detector	6	5	0.25					45	F–		1.5				Detector only
	U. X. 112	Power Amplifier	6	5	0.5	90	6	157	10.5			2.5	8	4800–8800	890–1670	7.9–8	
	U. X. 171	Power Amplifier	6	5	0.5	90	16.5	180	40.5			10	20	2000–2500	1200–1500	3	Use output device above 135 v. "B"
	U. X. 210	Power Amplifier	8	7.5	1.25	250	18	425	35			12	22	5000–5600	1330–1550	7.5–7.7	Use output device
			6	6.0	1.1	90	4.5	157	10.5			3	6	7400–9700	775–1020	7.5	
	U. X. 226	A. C. Tube		1.5	1.05	90	6	180	13.5			3.7	7.5	7000–9400	875–1170	8.2	Step-down trans. for fil. supply
	U. Y. 227	A. C. Tube		2.5	1.75	90	6	180	13.5	90–180		3	6	9400–11300	725–870	8.2	Step-down trans. for fil. supply
	U. X. 280	Full Wave Rectifier	6	5	2.0												125 M. A. output
	U. X. 281	Half Wave Rectifier	8	7.5	1.25												110 M. A. output
	U. X. 213	Full Wave Rectifier	6	5	2.0												65 M. A. output
	U. X. 216B	Half Wave Rectifier	8	7.5	1.25												65 M. A. output
	U. X. 874	Voltage Regulator															Glow tube
	U. X. 240	Hi-Mu	6	5	0.25	135	1.0	180	4.5	135				150,000		30	Det., Res. & Impedance Amplifier
Raytheon Mfg. Co.	B	Full Wave Rectifier								(Gaseous conduction tube)							60 M. A. output
	B. H. 85	Full Wave Rectifier								(Gaseous conduction tube)							85 M. A. output
	B. A.	"A-B-C" Rectifier								(Gaseous conduction tube)							350 M. A. output
Schickerling Products Corporation	P. S. 12	Special Detector	6	5	0.25					37.5	F–						Detector only
	S. X. 100A	Special Detector	6	5	0.25					37.5	F–						Detector only
	P. S. 15	Power Amplifier	6	5	0.25	90	6	160	12			3	8	4800–9000	900–1700	8	
	S. X. 500	R. F. Amplifier	6	5	0.25	90	4.5	135	7	45	F+	2.5	4	11000–12000	680–730	8–10	May be used as detector
	S. X. 112	Power Amplifier	6	5	0.5	90	6	135	9			2.5	6	5500–8800	890–1435	7.9	
	S. X. 171	Power Amplifier	6	5	0.5	90	16.5	135	27			10	16	2200–2500	1200–1360	3	Use output device at 135 v."B"
	S. X. 210	Power Amplifier	8	7.5	1.25	250	18	350	27			12	18	5100–5600	1330–1509	7.5–7.6	Use output device
			6	6	1.1	90	4.5	135	9			3	4.5	9700–8000	775–940	7.5	
	High-Mu 20	Hi-Mu	6	5	0.25	90		135				3	4	16500	1210	20	Det., Res. & Impedance Amplifier
	Z. 80	Full Wave Rectifier								(Gaseous conduction tube)							100 M. A. output
United Radio & Electric Corp. (Ureco)	X. 112	Power Amplifier	6	5	0.5	90	4.5	160	9								
	X. 171	Power Amplifier	6	5	0.5	90	16	180	40								Use output device above 135 v. "B"
	X. 210	Power Amplifier	8	7.5	1.25			350	39								Use output device
			6	6	1.1												
	D. X. 200	Special Detector	6	5	0.25					45	F–						Detector only
	X. 240	Hi-Mu	6	5	0.25			135									Det., Res. & Impedance Amplifier
	X. 213	Full Wave Rectifier	6	5													
	X. 216	Half Wave Rectifier	8	7.5													
Zetka Laboratories, Inc.	Z. 200A	Special Detector	6	5	0.25	22		45									Detector only
	Z. 112	Power Amplifier	6	5	0.5	90	6	157	10.5								
	Z. 171	Power Amplifier	6	5	0.5	90	16.5	180	40.5								Use output device above 135 v. "B"
	Z. 210	Power Amplifier	8	7.5	1.25	250	18	425	35								Use output device
			6	6.0	1.1	90	4.5	157									
	Z. 216B.	Half Wave Rectifier	8	7.5	1.25												65 M. A. output

The Development of an A.F. Transformer

Its design and special process of manufacture

*By Albert Hall**

IN the summer of 1923, broadcasting was making rapid strides in England. As a consequence there had arisen a demand for loud speakers and amplifiers to work loud speakers. The musical reproduction obtained with the apparatus then available was certainly not good, but the novelty of obtaining such music was so great that despite this there was a very ready sale. Various opinions were given at the time as to the cause of this poor reproduction, which was usually thin and harsh. The commonest explanation was that the loud speaker was the culprit.

At this time there was little knowledge of the action of transformers when supplied with current of varying frequencies, but one felt convinced that the fault was largely in the type of transformer used in the amplifier.

It was soon realized that a transformer in conjunction with the tube, had to amplify all electrical vibrations throughout the musical scale equally, and apparatus was designed to actually measure this amplification at frequencies varying from 50 cycles to 8000 cycles per second. On testing all available audio frequency transformers in this apparatus, it was realized that they were extremely defective; that is, they would amplify a low note comparatively little, a note right in the middle of the musical scale, a great deal, and higher notes again, but little.

New Transformer Design

A new transformer was therefore designed and made. It was found that it was comparatively easy, by winding a sufficient number of turns in the primary to obtain a very good amplification of low notes, as well as of the middle notes, but the amplification fell off woefully in the case of the higher notes. It was then understood that this was due to the self capacity of the windings, especially of the secondary, which caused local circulating currents to flow in these windings. Finally a transformer was produced, which gave, with the tubes then available, a very uniform amplification from 50 cycles to 8000 cycles. This was available in the early Summer of 1924, but it is one thing to make a few laboratory transformers, where price and time of construction do not count; how could this laboratory model be converted into a commercial article—that was the problem. There were many difficulties. Coils had to be wound in a special way with fine wires to reduce the self capacity, but with existing winding machinery it was difficult to do this at any speed. The construction of the winding supports to obtain the low self capacity was also quite a problem, but finally, at the end of 1924, these difficulties were, in principle, overcome, and it remained to manufacture special winding machines, special tools for making coil supports and special tools and jigs for erection, etc.

Technical Details

The low self capacity of the coils is obtained by dividing them into sections. The low mutual capacity between the primary and secondary coils results from the use of air insulation between the coils. The coils are connected in such a manner that the effect of this small mutual capacity is further reduced. The leakage reactance is reduced by splitting the primary into two coils, one of which is inside and the other outside the secondary coil. This reduction in leakage reactance effectively eliminates the resonant peak, which occurs in many transformers at about 5000 cycles.

The primary inductance varies from 180 henries with no direct current in the primary to 80 henries with 3 milliamperes direct current in the primary coil. The transformer will carry 3½ milliamperes in the primary without appreciable saturation, occurring in the core. As the plate current of the tubes ordinarily used in the detector and 1st audio stages usually vary from ½ to 3 milliamperes direct current the transformer can be used without fear of decreased amplification due to saturation.

Special Testing Equipment

In the meantime the designer, having found that taking a dozen transformers of a well known make and testing each for its amplification at varying frequencies, while one or two would give the amplification expected from their known inductances and ratios of primary to secondary, on the other hand many would give results considerably less than the best, and he was able finally to prove that this was due to shorted turns in the windings, due to faults in the wire.

He therefore set himself to devise a very complete testing equipment. This he had to put in such a form that the amount of labor involved in testing the transformer was small, so as not to add to the cost.

A description of this testing apparatus will not be out of place here. We buy our enamel covered wire on a very rigid specification basis; much more rigid than the British Electrical Standards Requirements. Every reel of wire has 150 feet of its length tested in a mercury bath for pin holes in the enamel, and is rejected if more than twenty such pin holes exist in this length. Further, if more than ten per cent of a particular consignment of reels fails to pass, we reject the whole of the consignment. This has led to the suppliers taking special care that the wire we receive is good, since they cannot afford to have large consignments thrown back on their hands. The wire is tested in four automatic machines, in which the 150 feet is automatically passed through the mercury bath with a potential of eight volts between mercury and wire. Each fault is registered by the tiny flow of current taking place, working an automatic recorder, and for each reel the machine delivers a strip with a record of a total number of faults.

Winding and Assembling Coils

The reels, after testing, are delivered to the winding room, to which also goes all of the supporting reels, which have been produced by special machinery. The winding is carried out completely automatically, the operator only having to keep the machine supplied with reels and wire, and take care of broken ends.

From the winding room the completed coils go to the assembly room. Immediately on entering, each reel is passed over an iron core, in a special piece of apparatus designed to show any shorted turns. If such exist, the needle of the milliammeter moves to the left, varying in amount according to the extent of the short. If none exist, the needle moves slightly to the right. All reels which show any shorted turns are rejected.

The next stage is the building of the core into the reels. After this the terminal blocks, one of which, used for the primary, contains the by-pass condenser, are attached to the core and connected to the windings. The final stage of assembly is the enclosure of the transformer within its sheared cases.

Ten Final Tests for Each Transformer

The transformer is now completed from the manufacturing point of view. It still may possibly have defects, though the shorted turn test of the coils themselves would have largely eliminated this fault; the handling of the reels in the erection stage may have introduced other shorts. Also there is still the possibility of the automatic machines not being set perfectly

* *Chief Engineer, Ferranti Ltd.*

correctly, so the finished transformer is passed through a routine of another ten tests. These tests are carried out almost automatically in a special piece of apparatus by two operators whose duty it is to keep a supply of transformers in the apparatus, watch the instruments and remove such as prove to be defective, and finally to remove the transformers which have passed the tests. The apparatus is so automatic that these two operators can test 1000 transformers per day. Ten instruments fitted above the locations in which the transformer is passing in a particular test, indicate by the movement of the needle beyond a small defined limiting range, as to whether the transformer is defective or good.

Test No. 1.—Circuit continuity test of primary and secondary.

Test No. 2.—Test for shorted turns in complete transformer.

Test No. 3.—Flashing of primary to secondary by 1000 volts 50 cycles.

Test No. 4.—Same from both windings to core.

Test No. 5.—Watt loss test; really a test for the quality of the iron used in the core.

Test No. 6.—Insulation resistance from primary to secondary.

Test No. 7.—The insulation resistance from primary and secondary to core.

Note.—To pass the insulation tests Nos. 6 and 7, the insulation resistance in each case must exceed 500 megohms. Usually the figure is between 1000 and 3000 megohms, but on a very moist day some transformers may get as low as 500 megohms. If however, the same transformer was tested on a dry day it might rise to 1000 megohms.

Test No. 8.—Ratio test. The ratio of the transformer windings is measured with 50 cycle alternating current.

Test No. 9.—The amplification of the transformer with a standard tube is measured at 50 cycles per second.

Note.—Tests Nos. 8 and 9 between them, check as to whether the automatic machines are putting on the right number of turns.

Test No. 10.—The amplification of the transformer with the standard tube is measured at 8000 cycles. After leaving the testing machine the transformers are examined for any possible damage to the transfers on the casing, and then packed ready for delivery.

The percentage of rejects of completed transformers is not usually very great, and by a system of identification a reject can be traced back to a particular operator, so that steps can be taken to remedy as far as possible the faults introduced during assembly. The principal fault in all ordinary transformers, namely shorted turns, is practically eliminated by the careful testing of the reels before assembly, as above explained. Here, despite the care taken in testing the wire, the rejections of the reels occasionally rise to ten per cent, but again, a system of identification enables us to check the machine which did the winding of the rejected reel, and the maker of the wire, and if a particular batch of wire gives coils with too many shorted turns, the remainder of the batch is rejected. With this care the percentage of rejects can be kept within very reasonable limits.

The Miessner A.C. Tube

Data on a new tube with a low temperature, low voltage, oxide coated filament.

By B. F. Miessner*

ON September 15th, 1926, the writer delivered a paper before the Radio Club of America entitled, "A New System of Alternating Current Power Supply And Its Application to a Commercial Broadcast Receiver."

In this paper, the causes of the hum resulting from the heating of vacuum tube filaments by alternating current were set forth, and numerous curves based on actual measurements were included which indicate the amount of hum produced by the various types of standard tubes under varying operating conditions.

Two types of hum were discussed: one, caused by the variations in temperature of the filament cathodes; and the other caused by the Edison effect between the two ends of the filament. It was shown that if the operating conditions were carefully chosen the temperature effect hum and Edison or voltage effect hum could be made to neutralize one another so as to greatly reduce the hum output of the tube.

While the contents of this paper were devoted chiefly to studies of standard tubes, it pointed the way toward the development of a special tube in which the characteristics of standard tubes found most desirable for operation by alternating current, were accentuated.

The writer has experimented with tubes of this type during the past few years, and has recently developed them to a point of commercial practicability.

*Chief Engineer, The Garod Corporation.

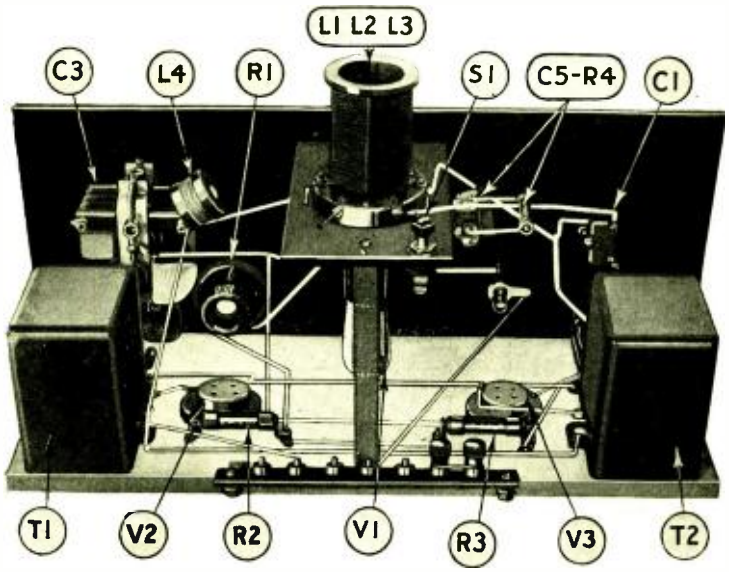
Details of Tube

The tube itself has standard 201-A grid and plate elements, but instead of the V type filament, it is provided with a straight filament of the oxide-coated type, of round section and operating at about 1 volt and 2.5 amperes. In the receiving set mentioned, this tube is used for detection as well as radio and audio frequency amplification, a 171 type power amplifier being used in the second audio stage. The amount of hum secured, using a very high quality audio frequency amplifier and loud speaker, is so low that it can hardly be heard with the ear close to the loud speaker, and is in fact considerably less than that obtained when a "B" eliminator of the best type is used with an ordinary receiver. The filaments are operated at a temperature which hardly makes them visible, and extended tests have indicated an unusually long life for this tube. Its amplification constant, plate impedance, mutual conductance and grid-plate capacity are very closely similar to those of the 201-A tube.

Unlike other AC tubes recently announced, this is not a four element tube with a separate heater for a separate cathode, but the cathode filament itself carries the raw alternating current, which heats it as does the direct current in tubes of ordinary type. It is, therefore a three element tube with only the four connecting prongs customary to other tubes, and requiring no extra connections, such as those required by the four element unipotential cathode tubes. Furthermore, this tube presents no more and if anything, less difficulty in its production than the standard three element tubes, and it can be produced with the use of the same grid and plate elements previously used in standard type tubes. It has none of the disadvantages of difficulty in evacuation presented by the four element tubes which have a large mass of heater wire, insulating material and cathode material, all of which contain a considerable amount of occluded gas.

Measurements of the new tube indicate them to be about twenty-five times as good, with respect to hum, as the 112 type tube which is the best of the standard tubes. That is to say, the hum is about 1/25 as much as that produced by the 112 tube. At the same time, the signal amplification is of the same order, while the plate current is only about 1/3 that of the 112 tube under their best operating conditions. Furthermore, the new tube can withstand a voltage variation of about 25% without perceptibly increasing the hum, or very noticeably affecting the signal amplification, whereas a voltage variation of 10% will considerably increase the hum for the 112 tube. It requires only about one second to become operative as contrasted to thirty to sixty seconds for heater type tubes.

Constructional Developments



A rear view of the completed 18 to 1500 meter receiver. The list of parts below provides the key to the symbols

An 18 to 1,500 Meter Receiver

Mr. L. W. Hatry describes a very unique form of all-wave receiver, which has a range from 18 to 1500 meters, in the July issue of *Radio News*. Plug-in coils are employed for covering the various wavelength ranges. To avoid multiplicity of coils and to provide an overlap of the tuning ranges, the author has chosen for these standard coil units a tuning condenser of .00014 mfd with a minimum in the order of .000015 mfd.

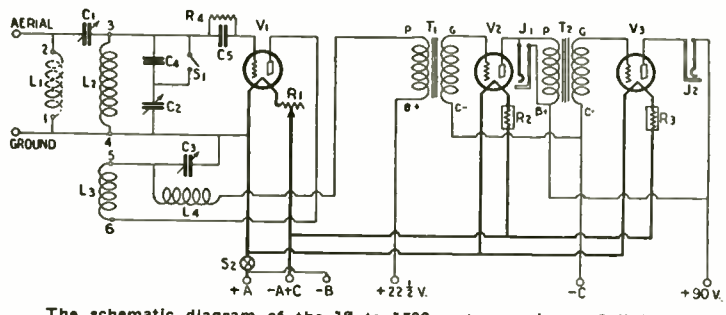
For wavelengths above 200 meters the coils are designed for use with .00035 mfd. as a maximum capacity but with practically the same minimum as mentioned before. To get these two capacity ranges, necessary to cover the waves from 18 to 1500 meters, a simple switch and series condenser arrangement is used in conjunction with a standard .00035 mfd variable condenser.

The circuit is of standard type employing both inductive and capacitative feedback. Regeneration is controlled by the capacity.

The parts required are:

L1, L2, L3—4 Plug-in coils (18—150 meters)
L1, L2, L3—1 Plug-in coil (150—350 meters)
L1, L2, L3—1 Plug-in coil (450—900 meters)
L4—1 R. F. Choke (1 M. H.)
C1—1 Midget variable condenser, .000025 mfd.
C2, C3—2 Variable condensers, .00035 mfd.
C4—1 Fixed condenser, .00025 mfd.
C5—1 Grid condenser, .00005 or .0001 mfd.
R1—1 Rheostat, 60 ohms.
R2, R3—2 Ballast resistors for 199 type tubes.
R4—1 Grid leak, 2 megohms.
T1, T2—2 A. F. Transformers.
S1, S2—2 Battery switches.
J1, J2—2 Open circuit jacks.
V1, V2, V3—3 199 type tubes.
3 UX tube sockets.
1 Vernier dial.
8 Binding posts.
1 Binding post strip 1" × 7" × ⅛".
1 Panel 7" × 18" × 3/16".
1 Baseboard 6½" × 17" × ½".
1 Coil shelf 6 × 3 ¾" × 3/16".

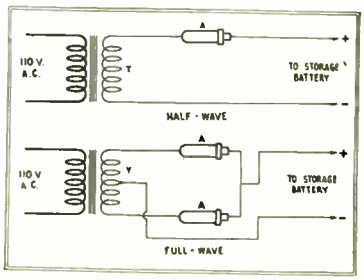
(The names of the parts manufacturers can be obtained from the article in Radio News.)



The schematic diagram of the 18 to 1500 meter receiver. Coil L_1 is not used for short wave work

Raytheon "A" Tube

The new Raytheon "A" tube, its characteristics and adaption, is described in an article by James Millen in the July issue of *Radio Broadcast*. Mr. Millen explains the theory of action of the various metallic and other elements which go to make up this compact rectifier unit and how these units are incorporated in charger devices for both half and full wave rectification.



Schematic diagrams of connections for half-wave and full-wave Raytheon "A" rectifier

Data is presented to aid the home constructor in building his own charger and a number of manufactured complete charger devices employing the new tube are illustrated.

The parts employed in a complete device are:

1 Step-down transformer.
1 Rectifier tube.
1 Fuse.
1 Set of clip leads or output terminals.

The remarkable efficiency of this new rectifier is due to an unique method of rectification, based on the little understood principle of securing rectification by the close association of two metallic conductors suitably arranged with a non-conducting agent, which combination serves to reduce the resistance to the flow of current in one direction to a very low order—in fact to a point closely approaching a continuous metallic conductor—while the resistance to the flow of current in the reverse direction is extremely high. The efficiency and economy obtained with the Raytheon "A," therefore, closely approach the results which would be theoretically obtained with the ideal rectifier.

The Raytheon "A" rectifier cartridge, which may be employed for storage battery charging or filament supply radio power unit

The R-71 A. C. Receiver

This receiver, described by Arthur H. Lynch in the *New York Telegram*, May 21st, is designed for use in connection with five of the new Armor tubes and one type 171 tube. The filaments of the first five tubes are supplied with raw alternating current from a special transformer. Each of these tubes draws approximately two amperes, and the voltage from the special transformer is approximately one volt. The filament of the power tube is supplied with current from a winding on the special B eliminator which, with the filament lighting transformer, is made up in a single unit, called the Mayolian A. C. driver. The circuit of the complete driver is shown in Fig. 2.

The power from the light socket is fed into the primaries of the two transformers, which are in parallel.

Fig. 3. Rear view of the R-71 A. C. receiver, and the driver unit

Parts List for the R-71

1 Driver unit.
1 Rectifier tube.
5 1 volt 2 ampere tubes.
C7, 8, 1 mfd. bypass condensers.
C9, 10, .5 mfd. bypass condensers.
R1, 2, 3. Plate resistors, type C.
R4, 5, 6, Metallized grid resistors, .5 meg.
R7, Heavy duty wire-wound resistor, 6,000 ohms.
R-8 Metallized resistor. .25 meg.
3 single Resistor mountings.
R9, Heavy duty wire-wound resistor, 2,250 ohms.
R10, Non-inductive grid suppressor resistor, 300 ohms.
R11. 12, 13, Non-inductive grid suppressors, with mounts, 1,000 ohms.

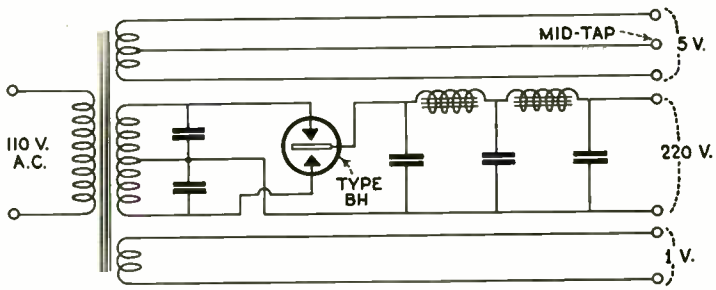


Fig. 2. Schematic diagram of the driver unit which supplies the "A" and "B" current for all tubes

1 Type 171 tube.
1 Tone filter.
T1, Antenna coupler.
T2, 3, R. F. transformers.
C11, .00035 variable condenser.
C12, 13, Dual .00035 mfd. variable condenser.
R. F. 1, R. F. 2, R. F. Chokes.
C1, 2, 3, .1 mfd. bypass condensers.
C4, 5, 6, .01 mfd. fixed condensers.
R14, Wire-wound potentiometer, 400 ohms.
3 Double mounts, for holding the resistors R1 to 6.
6 Sockets.
2 Dials.
2 Brackets.
1 Panel.
1 Sub-panel.

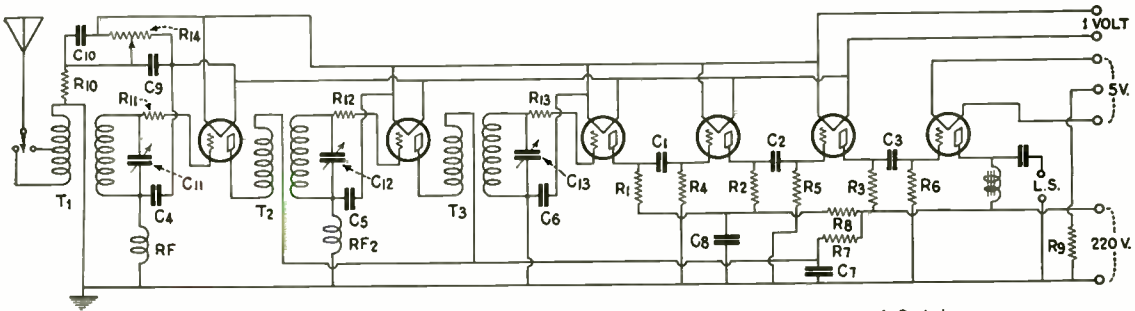


Fig. 1. Complete schematic diagram of the R-71 A. C. receiver, using the new A.C. tubes

International Radio Broadcast Tests

Editor, RADIO ENGINEERING:

It seems to me, and I feel sure that you will agree, that the editor of any radio publication has a double duty to perform. His first duty is of course to his readers, his second duty, it seems to me, is to the industry itself. Furthermore it seems to me that one is so much a part of the other that both interests are most identical.

Having this in mind, it seems to me that anything you can do for the industry, is actually doing something for your readers.

As you know, there were no International Radio Broadcast Tests held this year. During the three years they were held more than an ordinary amount of interest was shown on the part of the public and the manufacturers derived a great benefit by an increase in their business at a season when business would ordinarily drop down. Letters have reached me from quite a number of places in this country and abroad asking why these tests were not conducted this year, and whether or not there was any prospect of their being conducted next year. Most of the folks writing about these tests, have little knowledge of the amount of work necessary for bringing them about. If the tests are to be conducted next year, it will be necessary to begin work on their preparation immediately following the trade show in Chicago.

I believe that if the Radio Manufacturer's Association and the Radio Magazine Publisher's Association, The National Association of Broadcasters, The Radio Corporation of America, The American Telephone and Telegraph Co., The Commercial Cable Co., The Western Union Company and The Postal Telegraph Co., as well as the various press bureaus can be interested in another week of testing, it would be a particularly helpful proposition for the entire industry and certainly be of extreme interest to almost every listener in the country.

The individual or the organization which will undertake the promotion of these tests will certainly be picking a real job for itself or himself. Since I am no longer in the publishing field, I feel that this work is a little out of my province and for this reason, would very much rather assist somebody else in conducting it than attempt to do the work myself. I feel sure that if you, in co-operation with other editors of radio periodicals, will undertake this job, it will reflect credit upon you, will be of interest to the public and certainly of very great service to the industry as a whole.

Arthur H. Lynch, President.
Arthur H. Lynch, Inc.

Mr. Lynch's proposal will certainly stand consideration. It will be remembered that the last tests were disappointing to the radio fans because of excessive interference from radiating receivers. Surely conditions have altered greatly since the last test and the number of offending receivers in operation have decreased.

We would appreciate comments on Mr. Lynch's suggestion. In the meantime we are turning the matter over in our own minds.—Editor.

In Support of Quality

Editor, RADIO ENGINEERING:

One of the things which I should like to see discussed in your columns, both by your editors and readers, is the future trend of the radio industry as it affects the quality of the sets, parts and accessories offered for sale.

It seems to me that the radio industry is analogous in a great many ways to the automotive industry. They have both had the same rapid growth. Their problems of marketing are very similar and they both show the same tendency toward a high degree of manufacturing concentration. There are of course many other points of similarity between them and at least one interesting point of radical difference.

Since there is comparatively little utilitarian value to radio reception, it looks to me as though Ford merchandising in radio is doomed to failure in a much shorter length of time than its failure, if it can be called a failure, became apparent in the automotive industry. The day when listeners-in were impressed by hearing squeaks has passed and gone forever. People either want good reception or they don't want anything and consequently won't buy anything.

But when the American public makes up its much discussed mind that it does want something, there are plenty of statistics available to prove that it can and will pay for it—and pay well! But there is no reason to believe that the public does not include a large percentage of very shrewd buyers, the intelligentsia's contrary opinion notwithstanding.

Probably the first buying consideration in radio is performance, but no American buyer ever disregards the question of appearance in purchasing anything. On the contrary, he insists that anything he buys must look as though it cost him at least as much, if not more than he really paid for it, so that his friends will be sufficiently impressed.

For these reasons I, personally, believe that mediocre sets, parts and accessories, sold chiefly on the basis of price, are doomed to failure, and that the market for high quality and correspondingly high priced radio devices is steadily widening. I would be interested to know what some of your other readers think about it.

F. C. Trimble.
The H. H. Eby Manufacturing Co., Inc.

The Importance of Specializing

Editor, RADIO ENGINEERING:

There are two factors which tend to better our radio industry, namely, real engineering in place of haphazard experimentation, and the use of better radio parts. These two factors have served to produce far better radio sets, and I am sure they have been rewarded by a growing public confidence.

It is also encouraging to note that the jack-of-all trades is rapidly disappearing from radio. There are specialists now appearing for almost every major feature of radio manufacturing. There are specialists in condensers, specialists in vacuum tubes, specialists in dry batteries, specialists in storage batteries, specialists in "B" eliminators, and even specialists in resistors. By being specialists—knowing one thing well and doing it well—it has become possible for far-sighted manufacturers to do a truly good job. We have engineering technique even in small items and it is the sum total of the research and the engineering of all these specialists that has made for our present remarkable attainments in radio.

Charles Golenpaul, Sales Manager.
American Mechanical Laboratories, Inc.

NEWS OF THE INDUSTRY

Atwater Kent Institute Service Course for Dealers

The Atwater Kent Mfg. Company have carried through an excellent idea in the line of service which other large manufacturing organizations might well follow. They are offering a free service course to dealers' representatives right in their own factory so that these men can get first hand knowledge of Atwater Kent receivers.

The course takes from two to three weeks and is very thorough, beginning with the making of minor repairs and then following through with the more important repairs, assemblies and tests.

As a whole when the dealer's representatives are through with taking the course they voice the opinion that they are very well able to take care of any repairs or installations which may confront them in the future.

The course is gladly given with no expense except, of course, the representatives salary, traveling expenses to and from the factory in Philadelphia, and hotel expenses while at the factory.

Fourth Radio World's Fair Opens September in New York

From the standpoint of everything pertaining to wireless communication, the fourth Radio World's Fair will set new standards of international interest, according to the elaborate program now being arranged by General Manager G. Clayton Irwin, Jr.

The exposition will be held in New Madison Square Garden, New York, September 19 to 24, inclusive.

First of all, it will be the greatest industrial display ever held under a single roof, with every leading manufacturer of radio apparatus exhibiting the latest products, all of them being of vital concern to the broadcast listeners of not only the United States but every country to which they are exported.

In the second place, the foremost scientists, engineers, professors, and other acknowledged experts, many of international fame, will deliver addresses on up to the minute developments in the radio art, and demonstrations of the new wonders in this field will be given for the first time in public.

Among the visitors will be foreign celebrities to whom invitations are now being sent.

Representatives of foreign concerns will come from long distances, and the diplomatic and consular officials of many countries will be special guests.

In addition to the scientific deliberations, there will be daily meetings of the chief radio merchandisers of the country.

John J. Foy Joins Polymet

The Polymet Mfg. Corp. still maintaining its rapid strides in the radio industry, has established an advertising and publicity department with headquarters at the main offices, 599 Broadway, New York City. The advertising account is still held by Henry Decker Ltd.

John J. Foy, New Advertising Manager of the Polymet Mfg. Corp.

John J. Foy, formerly of the Dubilier Condenser Corp., is in charge of the new advertising department. Mr. Foy has had considerable experience in the radio parts field, having been connected in both advertising and sales work along these lines. It is his belief that with the very substantial appropriation and the proper follow up methods, a still greater season is in store for Polymet.

K. F. Reed Appointed Sales Manager of Federal Radio Corporation

The Federal Radio Corporation, manufacturers of Ortho-sonic receivers, announces the appointment of Kenneth E. Reed as Sales Manager. The selection of Mr. Reed for this important post marks one of the most rapid advances in a company which has been noteworthy for speedy progress since its marketing reorganization in 1925 under the leadership of L. E. Noble. Mr. Reed joined the Federal sales organization in August 1926, as territorial representative for metropolitan New York.

Farm Radios Increased 126 Per Cent Last Year

There are now 1,252,126 farms in the United States equipped with radio receiving sets, the Radio Service of the Department of Agriculture announced in the report of its past season's work.

This estimate was based on returns made by county agricultural agents throughout the country and showed a 126 per cent increase over the 553,008 sets estimated to be on farms July, 1925.

Iowa led the States with 99,990 farm radio sets, or an increase of 160 per cent since 1925. Indiana was second with 81,144, but this figure represented an increase of 377 per cent as compared with the 1925 figure.

Other leading States included Missouri with 77,510 sets; Nebraska with 69,784; Illinois with 65,832; Ohio with 63,448; Kansas with 62,055.

The large percentage of increase, however, was shown in Utah, where the number of sets was estimated at 6,061 as compared with 899 estimated in 1925.

Valley Electric Company

Following the March meeting of its Board of Directors, at which Herbert Elder was elected president of the company to succeed S. A. Whitten, the Valley Electric Company announced a policy of intensive development of the Radio Division.

Speaking of the company's policy for the future, Mr. Elder made the following statement at the company's local offices: "As one of the Pioneer Battery Charger concerns in the country, the Valley Electric Company was naturally interested in radio from the beginning, and has played an active part in its development. In addition to making the Valleytone Set, we are today manufacturing three distinct types of battery chargers, and two sizes of power units that employ the Raytheon Tube as a rectifying element. We believe in the future of radio, and we intend to share in its future development to an increasing extent.

"Jobbers and dealers in every section of the country are seeking standard lines backed by responsible manufacturers," declared Mr. Elder.

"The trend in radio indicates that the buying public will demand simplicity of operation in any set they may choose. We are convinced of that fact because of the unusual sales reception which has been accorded the advance announcement of our new single control seven-tube set.

"The sales situation," continued Mr. Elder, "is in sharp contrast to the conditions that prevailed in the industry five years ago, when February was the end of the heavy buying season.

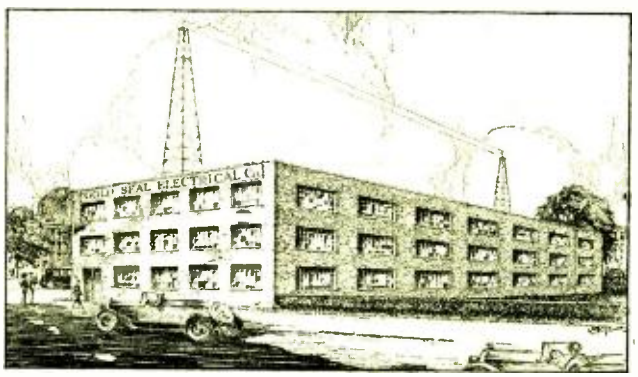
"Valley distributors and dealers have carefully regulated their stocks during the present season by cooperation with the Factory Sales Department so that not a single distributor is at present overstocked. This situation indicates a healthy condition and makes dumping of radio products unnecessary. The outlook is bright for the industry in 1927, and the coming year will be the greatest in the history of radio."

Gold Seal Electrical Co. Has New Factory

Gold Seal Electrical Co., Inc., manufacturers of Gold Seal Radio Tubes, are now getting settled in their new factory on 15th St. near Central Ave., Newark, N. J. The plant is laid out in accordance with the most approved methods of modern factory efficiency, providing for an uninterrupted flow of operations from the raw material to the completed and tested tube and to the packing and shipping departments. Capacity with present equipment is 25,000 tubes per day and there is ample room for expansion to accommodate the rapidly growing business of this Company. Its export business alone will take a large part of this increased output. The Executive offices of the Gold Seal Electrical Co. are at 250 Park Ave., N. Y.

Showers Brothers Lift Lid Off Radio Furniture

Recently Showers Brothers issued a statement through their advertising department that they were placing



The new home of the Gold Seal Electrical Co., Inc., in Newark, N. J.

Prest-O-Lite Company, Inc., Announces Sale of Its Storage Battery Business

The Prest-O-Lite Company, Inc., manufacturers of storage batteries, acetylene gas and gas tanks, announces the sale of its storage battery business to a new company, The Prest-O-Lite Storage Battery Corporation, an Indiana company.

The new company will continue to operate the mammoth battery plant at Speedway, Indiana, and because of concentration on batteries it is confidently expected that an increase in volume will result.

F. H. Landwehr, of Toledo, has been elected President of the new company, J. H. McDuffee, of Indianapolis, Vice-President, and J. B. Motley, also of Indianapolis, Secretary and Treasurer. These gentlemen, with F. M. Cobourn and F. A. Harrington, constitute the Board of Directors.

plant No. 4 at the disposal of the radio division. At this time there was also a statement made that the factories of Showers Brothers constituted 37 acres of floor space. Now, this was a very erroneous statement and Mr. W. Edw. Showers has asked that we immediately give credit where credit is due.

It is generally understood and known that Showers Brothers are the largest furniture manufacturers in the world. A recent survey of the three factories at Bloomington, Ind., Burlington, Ia., and Bloomfield, Ind., disclosed the fact that the entire floor space totals 125 acres. This only includes that under roof. The 37 acres referred to only included plant No. 4, which is some factory in itself.

Mr. H. T. Roberts, who maintains the entire radio division at 914 S. Michigan, Chicago, has made it clearly understood that Showers Brothers Radio Division will be thrown wide-open. In other words "the lid is off" and the radio dealers and jobbers will be able to obtain a service unsurpassed by any other manufacturer of radio furniture. There will be no limit set to the amount of pieces to be turned out.

Triangle Electrical Company in Big Expansion Program

The phenomenal growth in the business of the Triangle Electric Company, has made the present quarters of this active organization entirely inadequate.

A program of expansion is under way. The first step will be removal to greatly enlarged quarters in a fine five-story building located at the corner of Adams and Jefferson Streets. This location is unusually strategic for the business as it is right in the heart of the great new out-of-the-loop industrial section of Chicago, and also close to the new Union Station. The structure will be known as the Triangle Electric Building.

Buckingham One Profit Merchandising

Buckingham Radio Corporation, 25 East Austin Ave., Chicago, announces to the trade their new one profit plan of radio merchandising. This plan should be of interest to every distributor of radio as it makes available a progressive and thoroughly profitable method of merchandising. The basis of this plan is the new six tube, one dial control Buckingham Chassis, which can also be furnished under private trade names.

The basis of the one profit plan is that the set manufacturer has no license to exact a profit on cabinets, speakers and other material which he does not manufacture. The condition of the industry is such that there is no room for unnecessary handling charges and profits; consequently the Buckingham Corporation have formed a sales connection with several of the country's leading cabinet manufacturers whereby a complete and extensive line

The new Buckingham six tube, single control receiver

of cabinets are offered along with the new chassis. These cabinets are to be purchased direct from the cabinet manufacturer while the chassis comes from the Buckingham Corporation.

Of particular appeal is the point that the distributor, by this method, is able to set his own list prices, discounts, etc., to meet the conditions in his particular markets. This flexibility is certain to result in larger volume at better profits, for both distributor and dealer.

Crosley Enters License Agreement Under RCA Patents

Stabilization of the radio industry received marked impetus today when it became known that Powell Crosley, Jr., President of the Crosley Radio Corporation leader of the independent radio manufacturers, had entered into an agreement with the Radio Corporation of America whereby Crosley is licensed under many of the radio patents held by RCA, General Electric Co., Westinghouse Electric and Manufacturing Co., and the American Telephone and Telegraph Co.

The agreement entitles Crosley to the use of more than 100 basic patents except those covering the principle of the super-heterdyne and super-regeneration. All future laboratory developments of RCA and its associated companies in the field of tuned radio frequency receivers will be available to him.

Overtures were made to Crosley by RCA interests some months ago. Culmination of recent litigation clearing up the patent situation is said to have prompted Crosley, who also controls Amrad Radio Corporation of Boston, and who is interested in De Forest Limited of Canada, as a leader among hundreds of independent manufacturers to take this step to bring stability, heretofore lacking, in the industry.

The contracts are said to provide for a 7½ per cent royalty based on sales. More than half a million dollars already are said to have been paid to RCA by the Crosley corporation.

William Brand & Company

The William Brand & Company, makers of electrical insulating materials, have moved into new offices located at 268 Fourth avenue, New York City.

The new location provides the necessary extra space required by the expansion of the company. Increased facilities place them in a position to offer even better service than heretofore.

Recommendations for Electric and Radio Exhibitions

The National Electrical Manufacturers Association has prepared and adopted the following recommendations for electric and radio exhibitions, in order that such exhibitions may promote to the maximum the use of equipment, with a minimum of economic loss and internal friction. The Association's Committee on this subject believes that these recommendations will be of definite assistance in the arrangement and administration of electric shows and exhibitions and strongly urges their use as guiding principles.

1. For the fullest cooperation, exhibitors as a whole should have representation in the management of the show equal to that of the local management.

2. Class and nature of exhibits should be determined by the show management. Concessions for sale of novelties, candy, toys, etc., should be prohibited as they detract from the educational value of exhibits.

3. Souvenirs represent waste and extravagance of a character which the industry is trying to prevent. They are not beneficial in promoting the main educational object of shows. Their distribution at shows should therefore be prohibited.

4. Exhibitors should not be asked to give financial support through advertisements or in any other way to programs and catalogues. These, if issued, should not contain any individual or group names other than that of the exhibitors.

5. Passes should be issued to officers, official representatives and attendants of companies exhibiting, the number to be based equitably on the space occupied.

6. Exhibitors should have trade tickets at one-half the regular admission price, settlement to be made on the basis of the tickets actually turned in at the gate.

7. The show management should strive to make the character of the exhibit such as will reflect credit upon the electrical industry and at the same time keep the expense within reasonable limits. Any surplus after payment of legitimate expenses should be returned to exhibitors in proportion to the amount of space used.

8. The show management should have the right to discontinue and remove any exhibit which in its opinion is objectionable to exhibitors, the public or the industry.

9. Radio loud speaking devices of any description should not be used by exhibitors unless such devices are enclosed in suitable sound-proof booths or other enclosures approved by the show management, and which will entirely prevent objectionable noises and discord, annoying to other exhibitors.

10. In combination electrical and radio shows, electric motors, vacuum cleaners, washing machines, X-ray apparatus, spark coils and other devices which tend to create electrical and sound vibrations, should not be permitted to operate during the periods of broadcasting when radio exhibitors are anxious to demonstrate the receiving qualities of their apparatus.

11. The exhibitors should have the right to publish any speech, address or other matter that is broadcast direct from the show through the medium of any broadcasting station.

12. For the amount paid for space the show management should provide the following service to exhibitors:

Insurance against fire and theft.

Reasonable protection against fire and theft.

Watchman day and night.

Clean aisles and thoroughfares (not including exhibits).

Store boxes and other containers delivered in good order for return shipment.

13. Information concerning shows in which Member Companies are asked to exhibit should be sent to Nema headquarters.

New NEMA Committee

Gerard Swope, President of National Electrical Manufacturers Association has appointed a committee of seven executives from prominent electrical concerns to investigate the situation regarding patents in the electrical industry to determine whether some modification of the plan utilized by the National Automobile Chamber of Commerce may be made applicable to the electrical manufacturing industry.

The Committee appointed is: Leonard Kebler, President, Ward Leonard Electric Company, Chairman; A. G. Davis, Vice-President General Electric; A. Atwater Kent, President, Atwater Kent Mfg. Co.; M. C. Rypinski, Vice-President, Federal Brandes Co.; B. E. Salisbury, President, Pass & Seymour, Inc.; Harold Smith, General Solicitor, Westinghouse Electric and Manufacturing Company; Charles H. Strawbridge, President, Goodman Manufacturing Company; Alfred E. Waller, Managing Director, and Francis E. Neagle, Legal Counsel of the Association are ex-officio members.

At the Policies Division meeting held in March a resolution was passed authorizing the President to appoint the committee whose report will be presented to the Policies Division for action.

C. E. Mountford Moves

C. E. Mountford, manufacturer of the well known line of Kroblak Resistors, have moved into new quarters at 30-32 Sullivan Street, New York City, where they have tripled their floor space and equipped their plant with the most modern time-savings and cost reducing machinery.

Pearsall Co. Wholesaler for Sparton

The appointment of the Silas E. Pearsall Company, one of the best known wholesalers in the country, as distributor for the Sparton line of the Sparks-Withington Company, Jackson, Mich., has been announced by Harry G. Sparks, radio sales manager of the company, who has been in New York on business.

Before leaving for Michigan, Mr. Sparks gave a luncheon to the Sparton radio distributors in the Metropolitan area, at which a discussion of the merchandising situation was freely participated in by all those present.

Mr. Sparks led the discussion and aroused the enthusiasm of the party by touching briefly on the merchandising plans which the company has for the coming year. It was agreed that a big year confronted the Sparton line in the East.

NEW DEVELOPMENTS OF THE MONTH

Weston Radio Set Tester

The Weston Electrical Instrument Corporation, Newark, N. J., manufacturer of electrical measuring instruments has developed a Radio Set Tester (Model 519) for the especial use of the radio service man and for use by dealers in shooting trouble.

This testing set will measure the various voltages used in a radio set both at the battery terminals and at the tube sockets; for testing continuity and condition of circuits, and for testing the tubes under the same condition as exists when in their sockets. It will make all tests by using the regular batteries or battery eliminator used in the radio set, with no change in connections, so that no auxiliary batteries are required.

The instrument mounted in this set has three voltage ranges of 200, 80 and 8 volts and a current range of 20 milliamperes. The voltage ranges have a resistance of 1000 ohms per volt which means that full scale deflection is produced with a current of one milliampere. This high resistance makes the testing set suitable for testing radio sets operated either by batteries or battery eliminators.

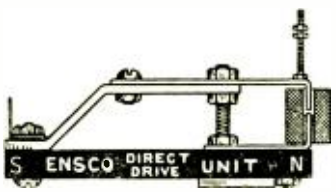
The Weston Radio Set Tester

Weighing only three pounds with adaptors and cables complete, this tester makes an ideal instrument for the service man and does away with the necessity of carrying batteries for making tests.

Ensco Direct-Drive Unit

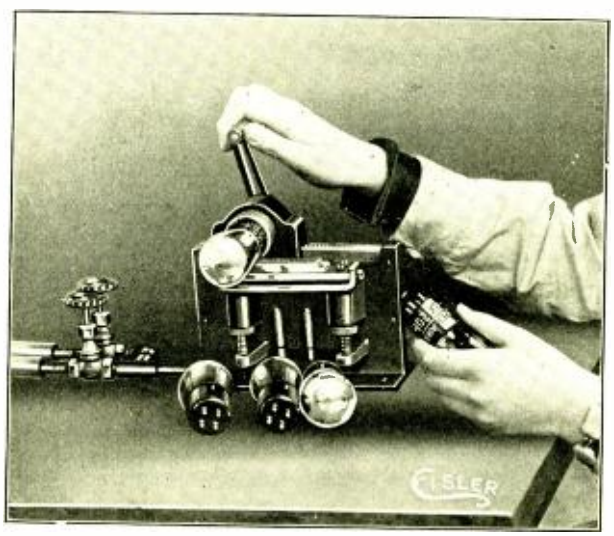
The cone speaker unit illustrated herewith will be found of interest to manufacturers and set builders in that it is of very simple and rugged construction and responds over a wide audio frequency range with excellent volume. Although primarily designed for driving a 3 foot cone, having made its first appearance on the market as part of a well known three-foot cone kit, it gives excellent results on cones ranging from 10 inches in diameter up. For the larger sizes a somewhat heavy paper gives best results such as Alhambra Fonotex, whereas a very thin light weight paper gives best results for the smaller cones.

The unit is of unique construction, having a straight bar magnet, N. S. instead of the conventional horseshoe type. The coil, shown in section, encircles the air gap, which may be adjusted by means of the two lock nuts. The armature is made of the proper dimensions to avoid the necessity of any reducing levers, hence the term "direct drive." This feature is of greater importance than one would think in that it insures almost perfect quality output, especially when a large cone is used.



The Ensco drive unit for disc and cone speakers. Note the simplicity of design

The unit is approximately 4¼" long. A mounting plate is provided on the back making it ideal for built-in speakers where a minimum of space and ease of assembly are required. Once assembled, with the cone clamped to the short, rugged drive pin with the two metal apexes furnished with the unit, it may be adjusted to suit the particular tube used and it need never be touched again. The coil is insulated to withstand plate voltages up to 200, so it can be used with a type 171 tube without an output transformer or filter. On higher voltages a protective device is recommended.



The Eisler automatic tube branding machine

Eisler Tube Marker

The Eisler Engineering Co., Inc. of 750 South 13th St., Newark, N. J., have announced a new automatic tube branding machine.

This machine is simple in construction, yet the most modern machine of its kind on the market today. The stencil block, which is made of chrome nickel steel and heated by two small burners, gives the base a clean cut distinct brand. The depth of the impression may be made as desired by means of two adjustment nuts, one at each end of the stencil block. The stencil blocks are made interchangeable.

The machine weighs ten pounds, and covers but twenty-five square inches of bench space. The amount of produc-

tion depends on the skill of the operator, but 3500 a day is an approximate output.

Shakeproof Lock Washer Co.

To meet the needs of radio manufacturers for a locking terminal with winged shanks, engineers of the Shakeproof Lock Washer Company, Chicago, have developed a new "anti-wiggling" lug that includes this feature. Now clamping, soldering and locking can be done quickly and easily—all in one assembly.

The new Shakeproof lock washer

This new product is constructed on the twisted tooth principle. A series of gnarled teeth, evenly distributed and set on an angle reduced by pressure, bite into the metal and hold permanently. Vibration only serves to tighten their grip. This eliminates one of the industry's most serious troubles —loose connections—as, after these lugs are clamped down by nuts, they cannot loosen by wiggling from side to side.

Complete information and free shop test samples can be obtained from the Shakeproof Lock Washer Company, 2501 North Keeler Avenue, Chicago.

Claravox Loud Speaker

Claravox Inc., of Canton, Ohio are now marketing a new model Claravox speaker which incorporates some distinctive features.

The Claravox modified cone speaker

The Claravox speaker is of the "modified cone" type and does not have the characteristic "barrel" sound common to many cone speakers.

The Claravox speaker has a self-contained filter system which improves tonal characteristics and permits the use of any of the power tubes that are now on the market, with a plate voltage up to 500.

Units can be supplied with or without the filter system.

Electrad Tonatrol

Electrad, Inc., makers of radio parts and accessories continue to bring out new products for their line.

The most recent of this company's new items goes under the name of "Tonatrol," a very efficient device for controlling tone and volume.

In laboratory tests this new instrument was found to permit an extremely delicate shading of volume, and to make possible soft, whisper-like music up to powerful volume with excellent clarity of tone.

The new Electrad "Tonatrol," a volume control combined with a filament switch

The manufacturers of this instrument have taken into account that it is a panel part. They have, therefore, made it very neat in appearance with the outside knob of genuine bakelite.

"Tonatrol" is made in two types; one called the standard type, and the other Type W. S. (with filament switch attached).

Durham "Powerohm" Resistors

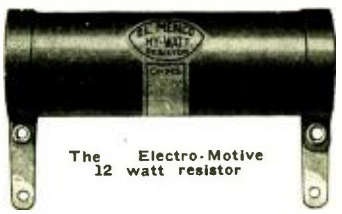
The Durham Metallized "Powerohm" Resistor is made in two sizes—a 2.5 watt type and a 5 watt type. The 5 watt units are of an overall length of three inches, whereas the 2.5 watt type are of the standard approved resistor length.

Durham "Powerohm" resistor unit. The units are made in two sizes; 2.5 watt and 5 watt

These Powerohms are made of the metallized filament that is incorporated in the Durham resistors, and the life tests of these units have indicated that they are capable of standing up under heavy loads for an indefinite length of time without deterioration or an appreciable change of resistance. The "Powerohm" is manufactured by the International Resistance Co., Philadelphia, Pa.

Electro-Motive "Hy-Watt" Resistors

The "Hy-Watt" resistor manufactured by the Electro-Motive Engineering Corp., 127 West 17th St., New York City is a permanent, durable resistor, as capable of withstanding high current loads with the same degree of security and freedom from change as the wire-wound resistor. It is also non-inductive.



The Electro-Motive 12 watt resistor

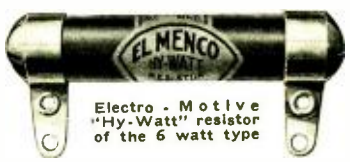
The resistor unit is formed of a compact homogenous mass of special resistance composition, baked at a high temperature on a rigid insulating base and with the surface of which it amalgamates.

The resistor unit can be supplied adjusted to an accuracy of better than 1% if required.

All the resistors are electroplated at the ends, eliminating variations of contact resistance at the terminals.

The "Hy-Watt" type resistor suffers a very small change of resistance with temperature. The change is 1% decrease of resistance for each 32°F rise of temperature. This compares very favorably with copper, for example: The variation in copper is seven times greater, namely—an increase of 1% for each 4½°F.

The resistor unit may be used without deterioration even at a dull red

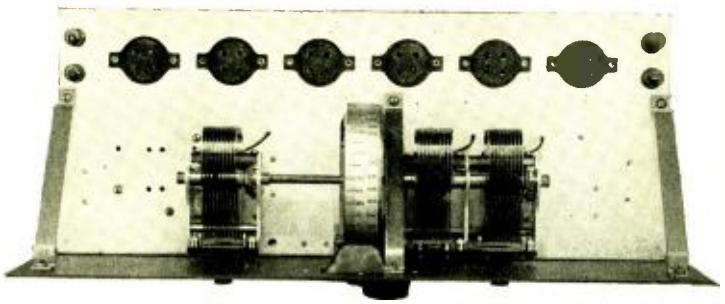


Electro-Motive "Hy-Watt" resistor of the 6 watt type

heat. Where the air circulation is good, a power dissipation of 25 watts per square inch may be considered a commercial maximum. For these high loads, the electroplated contact terminals insure arcing, which has been found to cause rapid deterioration in many types of high resistance units. The resistance coating on these units is a hard, durable film which is impervious to moisture and substantially unaffected by acids.

The small size resistors, having a 6 watt rating, are supplied in resistance values ranging from 50 to 200,000 ohms. Grid leaks have resistance value running up to 10 megohms.

The heavy duty resistors, with a 12 watt rating are supplied in resistance values ranging from 100 to 100,000 ohms.



The new V. S. L. Pierce Airo Receiver

U. S. L. Pierce Airo Receiver

The United Scientific Laboratories, Inc. of 80 Fourth Ave., New York City announce to the trade the new Model-B Pierce Airo Receiver chassis.

The Pierce Airo is a six tube tuned radio frequency receiver of latest design and has a single, illuminated drum type tuning control. It is of all aluminum construction and readily adaptable to electrification, though virtually a battery operated set. A power amplifier tube can be used in the last stage if desired.

Globe "Farapak" Condenser Blocks

The Globe Art Mfg. Co., 69 Winthrop St., Newark, N. J., are marketing a new type of block condenser known as the "Farapak." The block condenser is of the unit construction type, consisting of four or more 1 mfd. high

The Globe "Farapack" condenser block

voltage fixed condensers banked, and secured by polished steel clamping brackets. By use of this arrangement it is possible to obtain any desired capacity value in a compact form and one which can be mounted in any position.

Power Type Clarostat

The Power Clarostat, as with all Clarostats, is a one hole mounting job. It has a threaded nipple which slips through a 9/16 inch hole, and is provided with washer and lock nut, together with corrugated face to lock firmly in position.

Many uses will suggest themselves for a Power Clarostat. However, one of its intended applications is for the regulation of the filament current in the series-wired filaments operated on the BH and other 85 milliampere rectifier tubes of "A-B-C" radio power units.

The new 40 watt Power Clarostat

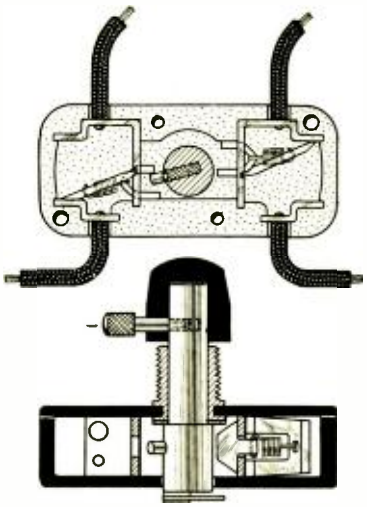
This device is also available as a fine voltage control on radio power units, requiring a larger device than the Heavy-Duty type.

The Power Clarostat may be substituted for wire wound resistances in the potentiometer bank of the largest radio power units, so as to obtain a variation of voltage yet with ample current carrying capacity to work side by side with wire-wound resistances.

The Power Clarostat is obtainable in several low ranges and in a Universal Range (200-100,000 ohms). It will carry 40 watts.

Saturn 3-way Switch

The Saturn Mfg. & Sales Co., Inc., of 48 Beekman St., New York City has introduced to the trade a distinctive type 3-way switch which contains two complete independent circuits and a "off" position. The novel mechnism of the switch is disclosed in the accom-



Details of Saturn 3-way switch

panying illustration. A small arm actuates two contacts under spring tension.

This 3-way switch can be put to any number of uses but is particularly valuable for controlling "A" and "B" circuits. Bakilite insulation is used throughout.

The Saturn Mfg. & Sales Co., Inc has also introduced a new automatic

The Saturn Automatic Relay Switch

relay switch designed to control the charging of the storage "A" battery. It is of very simple construction and when connected into the circuit will automatically connect the Charger to the "A" battery when the radio set is turned off. When the radio set is in operation the Charger is automatically disconnected.

Here! for permanency

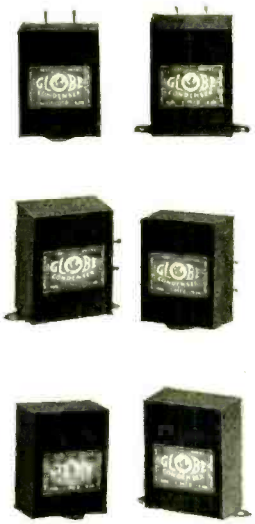
GLOBE CONDENSER

Manufacturers with the New FARAPAK

For Makers of Radio Receivers, B Eliminators, we are manufacturing all types Standard By-Pass, Filter and Hi-Voltage condensers. also special blocks when in quantities.

The "Farapak" block is suitable for most purposes, especially so. where a safety margin is desired. An example of the flexibility of our organization to meet the demands for special types may be seen in photograph below—a filter condenser of same type with mounting feet or terminals to fit your exact needs.

There is a Globe Condenser usually that will fit your product; if not. no matter how complicated your situation may be, let us assist you.



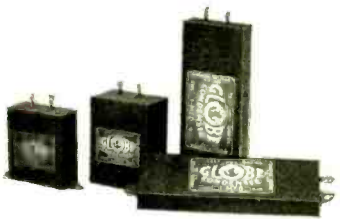
A safe type of condenser block for universal use, consisting of individual MFD. units made in any capacity desired from 4 MFD. up.

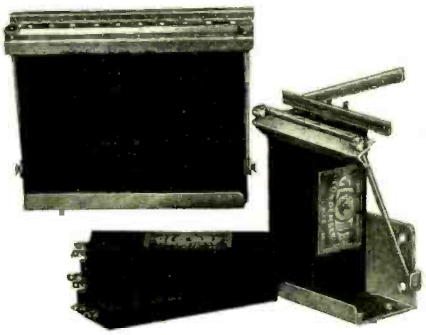
Each MFD. unit held firmly in place by a clamping bracket ready for mounting in any position.

As brackets are interchangeable, either Type BB 111 or Type BB 356 hi-voltage Globe Condensers can be used in assembling block, also the special designed terminal clips on block allow it to be broken up in MFD. measurements as required.

With all its advantages "FARAPAK" blocks will be priced no higher than other good blocks.

For manufacturers Blocks will be furnished assembled; for radio distributors. brackets and units packed separate to allow a wide range of types with a minimum of stock.



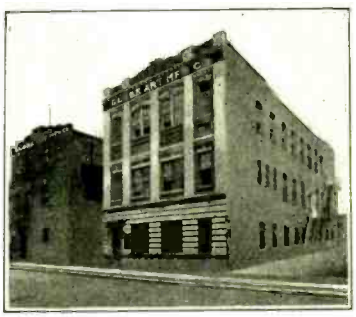


All Globe Condensers whether built for "FARAPAK" blocks or for individual purposes will not be found wanting in their capacity measurements —in fact the safety margins are so liberal in our tests that they can be counted on to carry a load of more than their required share.

Each condenser is labeled for its capacity with a guarantee that it will not deviate from its uniformity; they are also marked with A.C. and D.C. working voltages and tests they have passed.

Twenty years of the most exacting type of manufacturing is behind Globe Condensers — an experienced staff of condenser makers who pledge themselves to the creed of this factory: — "To build a product surpassed by none in quality of materials used and in workmanship."

For this reason every Globe Condenser is guaranteed to perform accurately at its given task.



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FARAPAK - GLOBE ART MFG. CO. INC.
69-77 WINTHROP ST. NEWARK, N.J.

SM UNIPAC for Power

Looking back a year to June of 1926, when Silver-Marshall cast a bomb-shell into the field of audio amplification with the now famous 220 and 221 audio transformers providing the rising low frequency amplifier characteristic only now copied, it does not seem surprising that S-M engineering should still lead in the field of A.F. amplification.

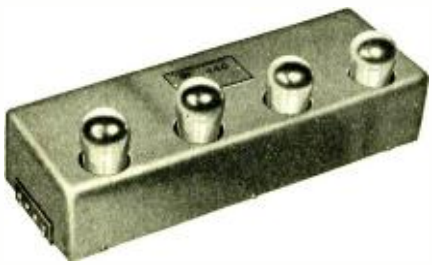
Now S-M offers the most powerful power pack yet devised, the amplifier stage of which develops over 50 per cent more undistorted power output than the average 210 power pack. And the Unipac amplifier has the same features of rising low frequency characteristic and 5,000 cycle cut-off that have made 220's and 221's the largest selling high-grade audio transformers on the market — two features to be found next season in the most advanced high-class equipment.

The power supply of the Unipac, unlike average power supplies, gives practically constant output, and is substantially the Reservoir B unit so highly endorsed by Keith Henney of Radio Broadcast laboratory. It furnished B voltage to any radio set and A, B, and C power to the push-pull amplifier stage — power constant, unfluctuating and free from "motor-boating" and "putting."

A Unipac added to your set provides it with the finest quality of reproduction, handling capacity to spare, and replaces all B batteries, operating as it does directly from the 105 to 120 volt, 60 cycle, house lighting socket. Even tho you may discard your set for a newer model, the Unipac will improve any set you ever buy or build — will remain the last word in distortionless power amplification and B supply for years to come.

The Unipac kit, with all parts including steel chassis and case, is available in two models. Type 660 contains the most powerful of all receiving amplifiers, a push-pull stage with 230 and 231 transformers, and is priced at $62.00. Type 660-B, with a slightly lower output level, includes a standard amplifier stage with 220 and 221 transformers, at $57.00.

The remarkable tone quality of the Unipac — its tremendous undistorted power output — is made possible only through the use of the S-M push-pull transformers — the new 230 input and 231 output models. They are priced at $10.00 each.



440 Jewelers' Time Receiver

The 440 Jewelers' Time Receiver consists of three R.F. amplifier stages and a detector, accurately tuned in the S-M laboratories to exactly 112 K.C., Arlington's wavelength, thus insuring reception of but one station at a time absolutely without interference. Enclosed in an attractive copper housing, it is priced at $35.00.

652 Reservoir B

The S-M 652 Reservoir B kit is essentially the power supply described by Howard E. Rhodes in the May "Radio Broadcast", supplied in kit form, with punched and pierced steel chassis and complete instructions.

The 652 will deliver up to 10 milliamperes at 45 volts, up to 45 milliamperes at 90 volts, and ample current for power tubes on the high voltage tap. It is free from "motor-boating," "hum," or other trouble. $34.50.

Silver-Marshall, Inc.

854 West Jackson Blvd., Chicago, U. S. A.

And then we will tell you about the Cage Antenna — *By Supertron.* What a surprise you're going to get — and a good *profit* too.

"to the whole world!"

This year SUPERTRON gains three years ahead of them all — by adding to its good quality a New Departure *by a chemical process* — It's a chemical application inside the tube — *It's an unseen virtue.* A decided improvement for clarity, volume, longer life — and good readings too —

Supertron cannot improve its construction — you will concede that *on sight* — so it improved the quality — *you'll* never know unless *you* try them.

No matter whose tubes you are selling — no matter whose tubes you expect to sell — even Supertron ***as was*** — no matter what you think of anybody's tubes, good, bad or indifferent, we say *Try Supertrons.*

For the sake of your family — for your own sake — for the sake of your business, your customers and your profits — by all means *Try* the New Departure Supertrons *by a chemical process.*

Come on ***all*** good jobbers and manufacturers — ask for as many samples as you like with a privilege to return the goods — Competitive tube makers are also welcome — *yes, the whole world.* Dealers should insist on a similar proof through their jobbers — *Do it now.*

A complete line of all types including the Supertheon Rectifier — an 85 mil. gas filled tube.

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Export Dept.—220 Broadway, N. Y. C.

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The NATIONAL COMPANY, INC., has moved to larger quarters four times since it was established in 1914. These moves may be likened to milestones in its progress. The new Malden plant marks the latest.

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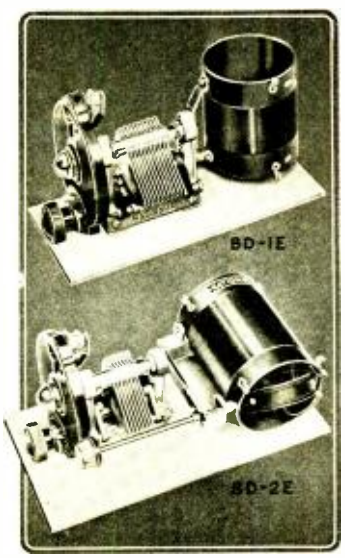
A new and unusually compact 2½ or 5 ampere battery charger, silent, long lived and so efficient that it automatically *tapers* the charge.

NATIONAL DUO-RANGE CHARGER

Price—$10.00 without tubes

Raytheon "A" Cartridges (two required) $4.50 each



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Buyers Directory of Equipment 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 advertisements—see index on page 806.

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Carter Radio Co.

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Westinghouse Elec. & Mfg. Co.

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Zierick Machine Wks.

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National Carbon Co.

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X-L Radio Labs.

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BRACKETS, SUBPANEL:
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BRASS:
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National Co.

CHOKES, RADIO FREQUENCY:
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Silver Marshall, Inc.

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COILS, IMPEDANCE:
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The wrong flux can quickly *break* him

After costly experiments scores of radio manufacturers have found there is but *one* safe flux for radio soldering—rosin.

Rosin, an organic mixture, is a *non-conductor* and *non-corrosive*. The glass-like surface of this material does not readily lend itself to the collection of dust (carbon particles) as will the sticky organic greases of paste. Nor will rosin attract moisture from the atmosphere; the chlorides of pastes and fluids will. *Moisture plus carbon particles defeat the best insulations produced. Moisture plus chlorides direct a slow but determined corrosive attack upon supporting metals.* Such slow corrosion in wiring causes a steadily increasing resistance to the flow of electrical energy.

Kester Rosin-Core Radio Solder scientifically combines radio's premier flux, rosin, with a solder alloy of unvarying quality. The use of Kester Radio Solder furnishes the user with a means of accomplishing *safer, faster and cleaner* set wiring.

Manufacturers using Kester Rosin-Core Solder are assured that no part of their production will ever be returned or fall into discard through the corrosive and conductive action of a chloride flux.

Our experimental and research laboratory has assisted many manufacturers in the solving of their soldering problems. A post card will bring you further information without obligation.

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Rosin-Core

CHICAGO SOLDER COMPANY
4224 Wrightwood Avenue, Chicago, U. S. A.

Originators and
World's Largest Manufacturers of Self-fluxing Solder

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Condenser Unit (Unmounted)

The Concourse Electric Co. specializes in special contract work on all types of fixed condensers for

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We are serving today 95 per cent of those manufacturers we served two, three and even four years ago. That speaks of *one* thing—*Satisfactory Service.*

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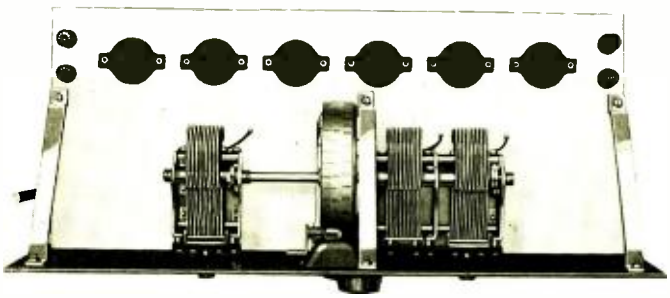
Concourse Electric Company
294 East 137th St. New York, N. Y.

Condenser Assembly for 350 to 400 Mil. Series Wired Power Sets

CONDENSERS

Announcing the New

PIERCE AIRO CHASSIS Model-B



HERE is a SIX TUBE — SINGLE DIAL — DRUM CONTROL — ILLUMINATED — ALL ALUMINUM Receiver which will appeal to the manufacturer and jobber. The new Model B, PIERCE-AIRO CHASSIS is a radical departure in set design. Selectivity, tonal quality and volume are the outstanding features of this remarkable chassis. Can be made entirely electric because it is readily adapted to "A" and "B" Eliminator operation. 201-A Tubes are used throughout with "C" Battery connection for Power Tube in last stage. Will fit any standard 7 x 18 console or cabinet.

JOBBERS and DEALERS: It will be to your advantage to investigate the PIERCE-AIRO proposition. Write or wire TODAY for further detail.

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QUALITY DONGAN PRODUCTS

What the New Sets Will Include

More, even, than in previous years Dongan Parts will be identified with the season's leading receivers and power units.

New designs in audio transformers and power unit parts are now available. Manufacturers who are designing sets to use the new Raytheon B A 350 m.a. tube can secure immediate delivery on Raytheon-approved transformers and chokes.

Individual Set Builders

No. 3591 Transformer and No. 3584 Double Choke are used with the new Raytheon B A 350 m.a. rectifier tube. A unit built up with these parts does away with all batteries and other power accessories. Better and much more satisfactory radio reception can be had now by plugging into a light socket for A and B power.

You can modernize your own set at slight cost and an eventual saving. The Raytheon B A 350 m.a. tube at $7.50 list, as well as the Dongan No. 3591 Transformer, $15 list and the No. 3584 Double Choke, $15 list, can be shipped at once by sending check or money order.

No. 3591 Transformer in handsome, durable case—available also in unmounted types

No. 3584 Double Choke

DONGAN ELECTRIC MANUFACTURING COMPANY
2995-3001 Franklin St.
DETROIT, MICHIGAN

TRANSFORMERS of MERIT for FIFTEEN YEARS

Four of a Kind!

A WORD of CAUTION! *Certain unscrupulous manufacturers are imitating the CLAROSTAT. Every genuine Clarostat has the name stamped on the case*

A Winning Hand

Manufacturers of Socket Power Units and Receivers, Engineers and Technicians, are invited to discuss their resistor problems with us.

All of them are Clarostats — But their Jobs are different, because—

The MIDGET

HERE is the baby member of the Clarostat family. It is tiny, compact, trim, yet ample for the purpose intended. The Midget is designed for receiving set applications requiring very low current-handling capacity, such as the plate control for r. f. and detector tubes, handling not more than two standard tubes in common; as a variable shunt resistance for regenerative control; and similar purposes. It is less than half the size of the Standard type Clarostat, and therefore fits in tight places. The Midget comes in a universal range suitable for receiver applications, and has a current-carrying capacity of 8 watts. Obviously, it cannot and will not do the work of its larger brothers.

The STANDARD

AS THE oldest member of the Clarostat family, the Standard type has become universally known as the greatest variable resistor. This type has countless applications, since it is obtainable in various resistance ranges including extra low for filament control, low for certain socket-power and re-charger applications, and the universal range running from 200 to over 5 megohms in five complete turns of its knob. The Standard type is a favorite in B-eliminators, as a variable voltage control. It is employed in receivers for all purposes from the extreme of a variable grid leak of several megohms to a volume control of a few thousand ohms. Its currant-carrying capacity is 20 watts.

The HEAVY-DUTY

IN GENERAL appearance — and quite aside from the Clarostat family resemblance—there is little difference between the Standard and the Heavy-Duty types. The latter, however, is a trifle deeper, so as to provide greater current-carrying capacity. It was mainly to provide a variable line voltage control that the Heavy-Duty type was introduced, although it has many applications in receivers and socket-power devices where heavy-duty conditions are met. It is available in various resistance ranges, from the lowest for filament control, to the low range for line-voltage control. The current-carrying capacity is 25 watts.

The POWER

THE big brother of the Clarostat family, for the present at least, is the Power type, fully capable of meeting present-day demands in electrified radio sets and socket power devices. It is a Clarostat in every sense — same design, same operation, same knob — but on a giant scale. In the low range, this type may be employed as a line voltage control, in which event it does a real job unaided by supplementary fixed resistances. It may be employed as a filament current control in the case of series-connected filaments supplied by a high-voltage rectifier. It has many applications in radio transmission and in broadcasting, where real work must be done, with a current-carrying capacity of 40 watts.

BOOTH 136-A AT THE R. M. A. SHOW

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