Tenth Year of Service

RADIO ENGINEERING

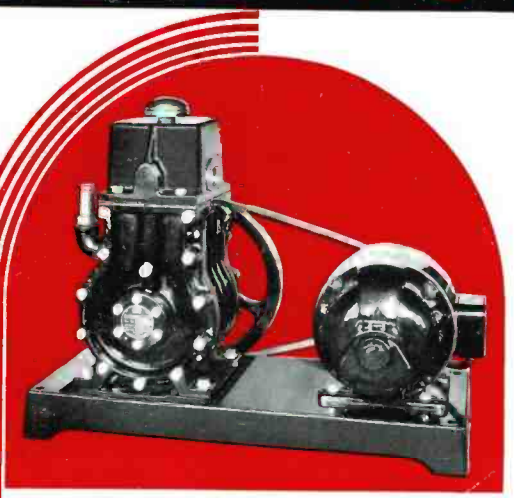
Vol. X SEPTEMBER, 1930 No. 9

IN THIS ISSUE

Sold only by subscription
$2.00 per year

The Journal of the Radio Industry

ANNOUNCING



The new CENCO HYPERVAC PUMP, with grooved pulley attached, measures 17" x 13" x 12". It weighs 83 pounds. The pulley diameter is 10¼".

CENCO-HYPERVAC PUMP

The new CENCO HYPERVAC PUMP represents the greatest advance yet made in the perfection of oil-sealed Rotary Pumps. It brings to production—

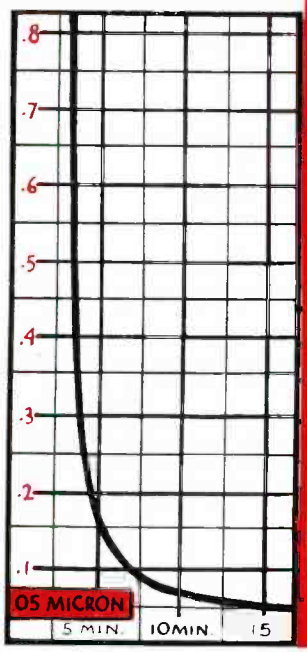
Larger Single Pump Capacity

Quicker Recovery

New Low Limit of Pressure Reduction

Lower Pressures Faster Work

Note the speed at which new low working pressures are attained. Laboratory tests show that the CENCO HYPERVAC PUMP reduces a 22 litre volume from atmospheric pressure to 0.8 micron in approximately 3 minutes . . . to 0.1 micron in approximately 7 minutes.



The CENCO HYPERVAC PUMP is very small relative to its large capacity. It exhausts so low that a guarantee of 0.05 microns can be given—*20 times better than any previously guaranteed vacuum* . . . the first pump of its kind to combine large volume displacement with the ability to reach exceedingly low pressures. This combination speeds up the production of high vacuum in a system (see chart at left). Power requirements low. For further information address us at 460 East Ohio Street, Chicago.

CENTRAL SCIENTIFIC COMPANY

New Resources for Better Service

FOR a year construction work has been in progress at the FORMICA factory and this complete new plant is now ready for production.

It is the largest unit in its industry—occupied by an organization which has specialized on the production of laminated phenolic material, and has made nothing else for 17 years.

There is available an exceptional amount and variety of equipment not only for producing the fundamental material but for machining it in every way in which the material can be worked.

Exceptional facilities and exceptional experience make possible high quality and uniformity in the product.

Send your blue prints for estimates

THE FORMICA INSULATION CO.
4638 Spring Grove Ave., Cincinnati, O.

FORMICA

RADIO ENGINEERING

Reg. U. S. Patent Office

Member, Audit Bureau of Circulations

Western Editor
ULMER G. TURNER

Editor
DONALD MCNICOL

Associate Editor
AUSTIN C. LESCARBOURA

Vol. X | September, 1930 | Number 9

Contents

Departments

The Break Had to Come

AT the I. R. E. Convention in Toronto, in late August, it was good to observe the Canadian manufacture of radio receivers going full blast.

In the United States, September 1, was the time set by a number of large factories for resumption of production on a paying scale.

F. A. D. Andrea, of Fada, states that his company expects to produce more sets in 1930 than in 1929. The manufacturers of the Sparton and of the Lyric receivers got under way during the summer and according to a survey their products are moving encouragingly.

There is evidence that Philco's attractive line is moving out to the retail shops in good volume, and H. A. Brennan, of Gross-Brennan, reports 51 per cent sales increase in Stromberg-Carlson receivers for the first six months of 1930.

General Electric and Westinghouse, as well as General Motors, have in motion merchandising campaigns that are sure to stir purchasing activity.

As an index of general conditions, the F. W. Dodge Corporation's review of building and engineering activity in 37 states east of the Rocky Mountains amounted to $600.-573,400.00 in June, 1930, the largest monthly total since July, 1929. The increase was 35 per cent over May, 1930, and 15 per cent over June, 1929.

The first thing we know we shall be wondering when the depression was on.

Published Monthly by

Bryan Davis Publishing Co., Inc.

52 Vanderbilt Ave.

New York City

Publishing
AVIATION ENGINEERING
RADIO ENGINEERING
PROJECTION ENGINEERING

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

Bryan S. Davis, *President*
James A. Walker, *Secretary*
E. M. Bacon, *Advertising Manager*

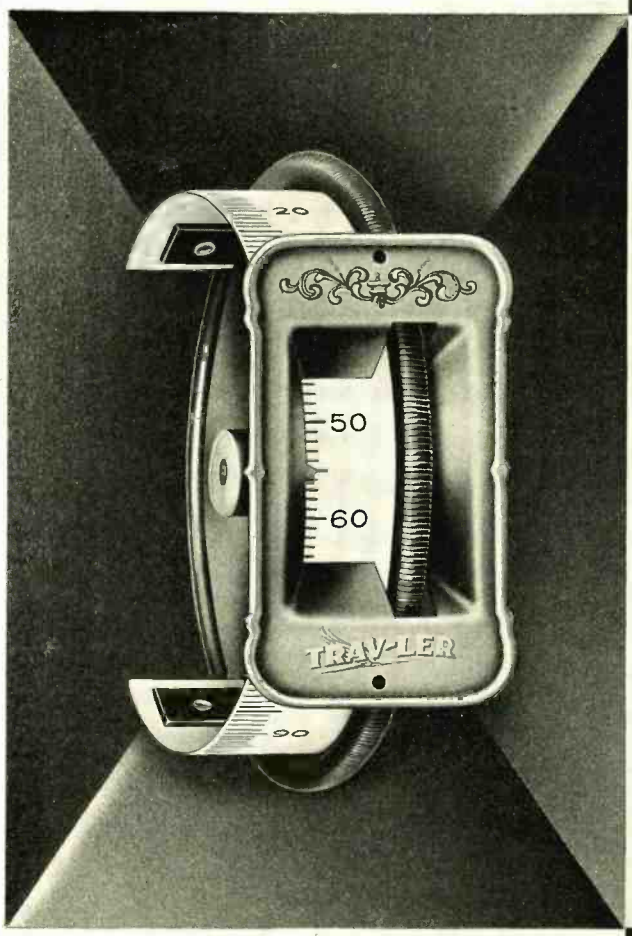
Entered as second class matter at the post office at Albany, N. Y., January 9, 1925, under the act of March 3, 1879.

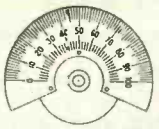
Yearly subscription rate $2.00 in U. S. and Canada; $3.00 in foreign countries.

CROWE

TUNING UNITS & PARTS

FOR MIDGET SETS

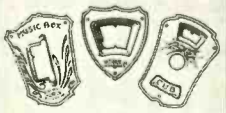




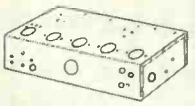
AN INEXPENSIVE DIRECT-DRIVE DIAL WITH PYRALIN SCALE FOR SETS WITH PILOT LIGHT. ACCURATE TUNING.

SCALES MAY BE FURNISHED IN ETCHED OR LITHOGRAPHED METAL, OR PYRALIN. ALL COLORS AVAILABLE. MAY BE READ IN ANY DIRECTION.

A GOOD DIRECT-DRIVE DIAL WHERE GREAT ACCURACY IS NOT NEEDED. SCALE IS ETCHED OR LITHOGRAPHED ON METAL TO SUIT NEEDS.



ETCHED OR EMBOSSED ESCUTCHEONS IN WIDE RANGE OF DESIGNS ARE AVAILABLE TO FIT ALL CROWE TUNING DEVICES. SPECIAL PATTERNS AT SMALL EXTRA DIE COST.



CROWE WELDED SUB-BASES ARE SOLID AND VIBRATION PROOF. ALUMINUM, COPPER, BRONZE, NICKEL AND OTHER FINISHES. PRICES ARE REASONABLE.

SEND FOR BULLETINS 32, 36, 36A

DESIGNED to *sell* sets and engineered to *keep* them sold, Crowe tuning units and parts are built with a painstaking regard for quality and workmanship—at a price within the reach of all. . . . . In anticipation of new developments in the Midget Radio field, several new tuning devices will be announced shortly by Crowe.

●

CROWE NAME PLATE & MANUFACTURING CO.
1739 Grace Street ... Chicago, Illinois

Editorial

September, 1930

IT IS WISE TO THINK OF THE FUTURE

AMONG some of the large aggregations of manufacturing interests there has ever been a tendency toward elimination of the smaller companies making required parts, and companies dealing in raw products required by the large manufacturers. On the other hand (and this is particularly the case in the radio business) there are large manufacturing interests that have in fairness, as well as to their own advantage, encouraged the parts and accessory companies by purchasing regularly from them.

Business depression for a few months or a year may suggest to the larger concerns that manufacturing savings are possible if they extend and enlarge their own manufacturing lines to include everything required in the assembly of their main product.

Most people will agree that it would be a mistake on the part of those who enjoy the market for the finished product to aim to control the manufacture of every element in its makeup. The mistake would not in all instances be in the economies of manufacture, but in the loss of good will, destruction of purchasing wherewithal, and in permitting to grow up those conditions of monopoly which proceed just so far before there is disturbing reaction.

▲

RADIOS MUST BE MOVED

THE periodical readjustment of values which has been going on during the past six months has encountered most of the vicissitudes which other and former like periods encountered and overcame.

In 1896, 1907 and 1920 industry halted for a spell while the people of the country took occasion to gather up the slack, so to speak.

It seems that as a people we are somewhat given to rushing ahead pell-mell for from eleven to thirteen years. During this time many things get out of joint; so-called vicious circles get into dizzy motion, and the ties which bind the origin and foundation of the nation to a desirable destiny become slack from lack of attention.

Those who can recall, or who have studied the unusual things done during previous periods of business depression to restore the thought of the people to money earning and money spending, will be interested in the present action of the Radio Corporation of Kansas, distributors of radio receivers. Without waiting for the healing process of readjustment to come about "in the course of human events" this company decided to perform a major operation—to hurdle all mesne agencies of exchange; reverting all the way back to a simple and plain system of commodity barter.

In this undertaking, resort is not had even to wampum or to "beaver" money: radios are to be traded for wheat.

In full page newspaper advertisements this well-known distributor states "the price of wheat is ridiculous and it is up to the merchants who consider the farmers among their best friends and customers to do what the Farm Relief Board can't."

According to W. E. Titus, president of the corporation, this offer is a "live and let live" policy with no strings attached. "The present market does not pay production cost on a commodity that every person in every walk of life requires for his daily sustenance," he says. "Realizing that the farmers in the vast wheat farming region planted their acreage in good faith and have every right to expect a decent price for their labor and investment, we are willing to do our share to correct an injustice."

Dealers in outlying towns have been authorized to accept wheat at ninety cents a bushel for any radios in their stocks. It is said the offer is attracting widespread attention in central Kansas and building good will and business for the concern responsible for it.

Obviously, there are wheat collection, consolidation and disposition problems in the plan, but the scheme is interesting nevertheless as an index of the impatience of industry with periods of frozen credits.

Donald McNicol

Editor.

IT PAYS TO PICK SCREWS CAREFULLY

Now..

PHILCO simply drives these unique Screws into drilled holes with an air hammer. They save considerable time and labor and the assembly is absolutely secure!

Fastening devices play an especially important part in the production of radio equipment. Numerous assemblies are necessary, and upon the way they are made depends production speed and economy. The Philco Speaker assembly illustrated provides a typical example of the advantages that can be obtained by using *the right fastening device for the job.*

Philco once used hex head machine screws to fasten the speaker shell to the malleable iron pot. Holes had to be tapped and then the screws run in with a socket wrench. It was a slow and costly job compared with the present method.

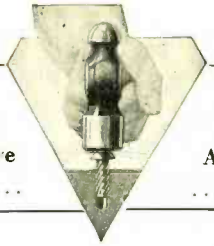
Once..

THIS assembly was made with hex head machine screws. Holes had to be tapped, and the screws turned in with a wrench. Obviously a slower, costlier method.

Now, only one easy operation is necessary. Hardened Metallic Drive Screws are simply driven into the drilled holes with an air hammer. Tapping is eliminated, since these unique Screws cut their own thread in the metal as they are hammered in. And tests prove that the fastenings are absolutely secure—essential to this assembly since even slight looseness would distort the reproduction.

Perhaps some of your own assemblies can be made better, easier and cheaper with Hardened Metallic Drive Screws. Try them and see for yourself what they will accomplish. The coupon brings free samples—use it now.

PARKER-KALON
TRADE MARK
HARDENED METALLIC
REG. U. S. PAT. OFF.
Drive Screws
PAT. JAN. 29. 1924-No. 1482151-OTHERS PENDING



PARKER-KALON CORPORATION,
Dept. L, 190-198 Varick St., New York, N. Y.
Send me samples of Hardened Metallic Drive Screws. I want to try them for:.....

.....
Name .....
Address .....
.....

NOW in thousands of Midget Sets

The ROLA Midget "K" Units

THIS little brother of the famous "K" Series—known throughout the industry for the realization of tone control—is establishing its own record for popularity. K-5's and K-6's are standard units with the majority of midget set producers today.

Just like the larger "K" Units, except in size, these tested and perfected Midget speakers offer the manufacturer an unparalleled opportunity to distinguish his sets on the dealer's floor.

As the most economical solution to the speaker problem, these compact units warrant your immediate investigation. Manufacturers who have sought a dependable speaker source, timed to their production schedules and in line with unit costs, marvel at the low cost of ROLA Units.

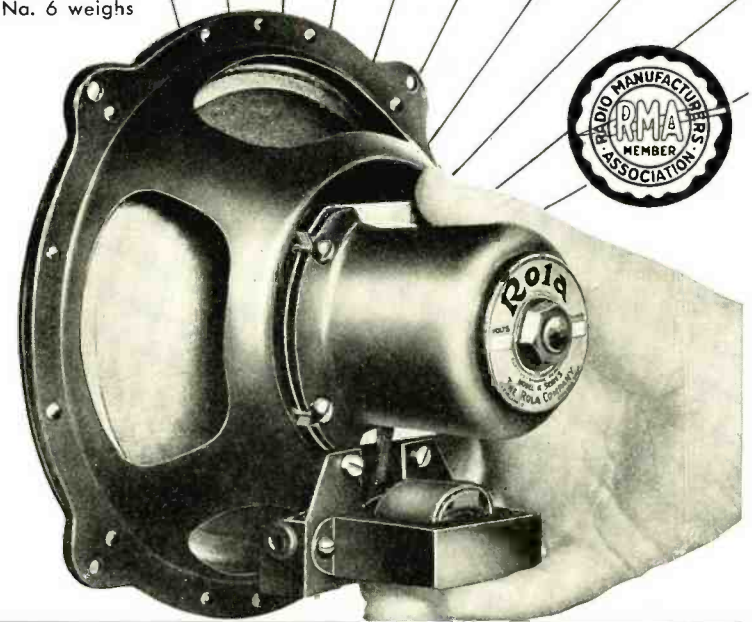
Hear your set with a ROLA. Give it this dominating sales feature and watch the response from your dealers.

The dimensions are given opposite. No. 6 weighs 6 pounds and No. 5 weighs 5 pounds. Each unit is backed by the organization whose name is respected by the entire industry for aggressive engineering and quality production. Immediate shipment from either our Western or Eastern plants. A demonstration will convince you and enthuse your dealers. Send us your specifications and complete information will be forwarded to you.

FOR MANTEL, AUTOMOBILE AND SMALL CONSOLE SETS

MODEL K-6
Height 8½ inches, Depth 5¾ inches

MODEL K-5
Height 8½ inches, Depth 5½ inches



RADIO MANUFACTURERS' ASSOCIATION RMA MEMBER

The ROLA COMPANY

CLEVELAND OHIO

OAKLAND CALIF.

Greatest Advancement in 1930 Sound Recreation

NOW ANOTHER FAMOUS RADIO DEALER SELECTS NATIONAL Union Tubes

Davega-Atlas, operating 38 stores in Greater New York, and 68 stores in the East and Middle West, choose this quality tube for its *selectivity* and *superior tone.* Other important dealers everywhere are following suit.

DR. R. E. MYERS

DAVEGA makes its decision! Once again one of America's biggest tube outlets has made competitive tests . . . and once again the superiority of National Union tubes has been proven. And not only the chains! Progressive dealers everywhere have been quick to realize the opportunities offered them by National Union Tubes. Almost overnight National Union has leaped to an enviable position in the tube industry.

This has not surprised us. Last March, when Dr. Ralph Myers and his staff of 15 Westinghouse engineers joined us, we knew we were on the right road. Dr. Myers had made 1,000,000,000 Radiotrons and Cunningham tubes. He stood at the top of his profession.

Today the quality of National Union tubes is unquestioned! National Union sales policies are firm and fair to all. National Union banking sponsorship assures stability and strength. It is a connection that thousands of dealers are justly proud to have made.

INVESTIGATE THIS TUBE. If you have never given National Union tubes a trial in your own sets do so at once. You will be amazed and delighted at the new clarity of tone. Ask your jobber about our 6-fact profit plan. Ask him also about the store display plan that furnishes you, *free,* attractive window posters of all the radio stars.

National Union jobbers will gladly explain both of these dealer-help plans. If you do not anticipate a call from your jobber in the next day or two, write or wire to the main offices in New York.

AT THE LEFT you see the seven-column newspaper advertisement that Davega-Atlas ran in the July 25th issue of the New York Times. Read the important paragraph in the big black circle. It is the message they gave to the public in explaining their choice of National Union radio tubes.

NATIONAL UNION RADIO CORPORATION
400 MADISON AVENUE · NEW YORK CITY

GILBY FILAMENT WIRE

CUTS SHRINKAGE!

THE use of Gilby Filament Wire is almost an economic necessity. Leading tube manufacturers have adopted this wire as standard and have seen their production shrinkage drop to a minimum.

One prominent manufacturer reports shrinkage of less than 3% after standardizing on Gilby Filament exclusively.

Find out for yourself the precision, uniformity and efficiency of this product. We will be glad to cooperate with your engineers or to submit samples. Write us.

GILBY PRODUCTS

Filament Wire—Gilby Selvege Mesh (Pat. applied for)—Plain Nickel Mesh—Support Wire—Nickel Ribbon—Plain and Carbonized—Seamless Tubing—Grid Wire—Carbonized Nickel Ribbon

GILBY WIRE COMPANY

WILBUR B. DRIVER, *President*

NEWARK NEW JERSEY

A NEW Radio Frequency Primary

that simplifies balancing

The new Dudlo layerwound Radio Frequency Transformer Primary eliminates costly materials heretofore considered indispensable.

It's easier to "balance" screen grid circuits with this new Dudlo Radio Frequency Primary. And because the circuit characteristics of the coil are sealed in, they remain constant throughout the life of the set.

These and many other desirable features have won the approval of the industry for this contribution to radio. Aware of the general need for more economical production, General Cable Engineers have developed a better method and product.

The Dudlo Radio Frequency Primary coil has already been incorporated in many of the country's finest sets, and together with its companion Radio Frequency choke coil, is now available to your own specifications.

GENERAL CABLE CORPORATION

EXECUTIVE OFFICES: 420 LEXINGTON AVENUE, NEW YORK • OFFICES IN PRINCIPAL CITIES

The SOURCE of SUPPLY *for*

high quality metals and alloys, refined especially for vacuum tube parts

Molybdenum (99.95% pure)

An exceptionally high grade product, refined by exclusive Fansteel process which assures unusual purity and uniformity.

Moly "B"
Moly "X"

Two carefully compounded hardened Molybdenum Alloys, excellent for heaters, springs, hooks and support members, each possessed of special characteristics that make it best for certain purposes.

Tantalum (99.9% pure)

A superior metal of extremely low vapor pressure, great gas absorbing properties and ability to withstand high temperatures. Ideal for plates and grids.

"TAW" Metal

A new Tantalum Alloy of exceptional characteristics.

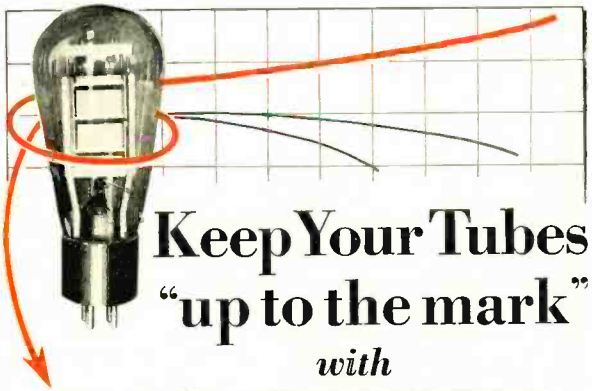
Caesium
Rubidium

Pure metals and salts for photo-cells.

All Fansteel metals are made in the Fansteel plant, under strict laboratory control. Supplied in all standard commercial forms.

Write for full information and prices.

Fansteel wire doesn't get "mixed" in stock. Carton and Bakelite spool both plainly labeled



Keep Your Tubes "up to the mark" *with* FANSTEEL WIRE AND METALS

Fansteel, in its field, is the best source of supply for tube makers. There are Fansteel metals or alloys for filaments, plates, grids, cathodes and support members, also special metals for special tubes.

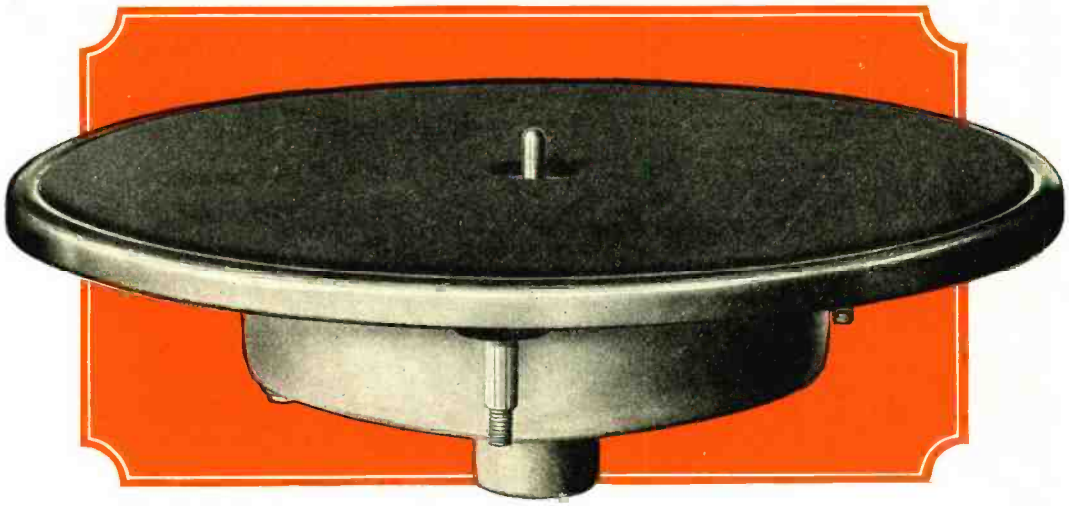
Fansteel metals and alloys are refined *by Fansteel* direct from the ore, especially for use in tubes, finished to accurate dimensions, chemical analysis and grain structure always kept uniform by strict laboratory control.

Fansteel metals are available in any desired size or state of anneal, and are ready for use. They require none of the elaborate treatment necessary with some metals. In this way, they save operations and lower manufacturing costs.

Manufacturers are invited to write for samples of Fansteel metals—better still, call in a Fansteel engineer.

FANSTEEL PRODUCTS COMPANY, INC.
North Chicago, Illinois

THE HAMMOND PERFECT PITCH ELECTRIC PHONOGRAPH MOTOR



A New Electric Phonograph Motor That Is Winning Approval

A new phonograph motor that allows a new kind of accurate reproduction. One that does not change the pitch on account of bent records, change in load, voltage fluctuations or other irregularities. A motor that runs smoothly, without noise... requires no oiling. These are the facts that sell Hammond motored phonograph combinations—and appeal to your merchandising department.

The absence of a mechanical governor—the far simpler and more rugged construction of this new motor is of interest to your engineers. Ease of mounting and the small cabinet space required are also important.

We shall be glad to send our bulletin "F" that tells the complete story. Or, let us send a sample motor and testing instructions to your laboratory where you may determine for yourself that this is the ideal motor you have sought. Address your inquiry to the Hammond Clock Company, 2911 N. Western Ave., Chicago, Illinois.

HAMMOND

Hammond Phonograph Motors are manufactured exclusively by The Hammond Clock Company under Hammond patents and applications. For sale only to manufacturers of phonographs and radio-phonograph combinations.

IMPRESSIONS and EXPRESSIONS

By AUSTIN C. LESCARBOURA

Superheterodyne Possibilities

NOW that the superheterodyne circuit is made available to many radio manufacturers, it becomes perfectly good taste to speak about the merchandising possibilities of this circuit.

Two thoughts occur to us with regard to putting this circuit to work in creating more radio sales: First, we believe the frequency converter accessory, whereby short-wave signals may be converted to broadcast frequencies for reception by the usual broadcast receiver, is a genuine sales possibility; and secondly, we believe that the combination broadcast and short-wave receiver, is feasible with the superheterodyne circuit, while somewhat far-fetched with the tuned r-f. circuit.

Recently, in the technical radio press, there have been several descriptions of frequency converter devices which serve to tune in short-wave signals and to convert the high frequencies down to the moderate frequencies handled by the usual broadcast receivers. The idea is to have the broadcast receiver serve as an intermediate-frequency amplifier. Thus a simple accessory with one or two tubes, placed ahead of the broadcast receiver or between it and the antenna circuit, serves as a means of tuning in short-wave signals with excellent results. At $50.00 or less, the frequency converter would go over big. It is far more attractive than the short-wave adaptors of the past, which made use of the broadcast receiver only as an audio amplifier.

Then there is the combination broadcast and short-wave receiver. Due to the ease with which the minimum of coils may be changed, this combination is feasible. Indeed, in Canada the combination set has long been available. It would go big here in the States.

▲

Electrolytic Condensers

RATHER interesting, the sudden popularity of the electrolytic condenser. It seems only yesterday that the electrolytic condenser was suitable only for very low voltage work, such as A-eliminators for operating battery-type tubes on a-c. Now, suddenly, we are told that electrolytic condensers can handle up to 400 volts. Obviously, some important engineering developments have taken place in electrolytic condenser technique.

That there are some advantages in favor of the electrolytic condenser, goes without saying. In matters of high capacity, self-healing dielectric, compactness, low cost and so on, this new condenser has a real place in the radio picture. But on the other hand, there are disadvantages, too, which are perhaps not stressed so much. Most manufacturers have not told us, for instance, whether the filtering action of the electrolytic condenser is as great as that of a paper condenser of like capacity. We understand that electrolytic condenser capacity does not begin to be as effective as that of the paper condenser. Therefore, the high capacity, when translated into terms of effective filtering capacity, may not look so overwhelmingly favorable. Again, there are noises in certain electrolytic condensers which are troublesome. The heavy strain placed on the rectifier at the moment current is turned on and when the dielectric gas film must be formed, is considerable.

All in all, the electrolytic condenser may be a good thing. But let us not hasten to assume that the paper condenser is a thing of the past.

▲

Smaller Radios

THE trend in radio cabinet design swings once more towards smaller proportions. The most popular lines include low cabinets of compact dimensions, which, we are assured by jobbers, are going to sell best. Several lines include what might be termed arm-chair cabinets, or cabinets so low that their top comes flush with the arm of the usual arm chair. This is quite a contrast with the highboys of a year or two ago, and even the monster "period" cabinets which were certainly more furniture than radio.

And then, of course, there is the mantle-piece radio set, which is meeting with marked demand this coming season. Many leading manufacturers are including mantle-piece offerings in their line, aside from manufacturers specializing in such offerings.

Our guess is that radios are going to remain small. The idea today is that every home has or should have a radio set. It is a feature that is taken for granted. Consequently, we do not have to exploit our ownership of a radio set, as we did five years ago when radio was still a luxury enjoyed by a limited number of families. And so radio must assume the most modest proportions in the living room. The cabinet is not going to be the main consideration, as it has been in the recent past. More radio and less cabinet seems to be the order of the day.

▲

The October Rush

REAL production in the radio industry will get under way in October. Until that time, most manufacturers will have done little more than mark time, while studying the radio merchandising horizon with the most powerful spy-glass available.

The season is unusually late, this year. However, there are compensations. For one thing, the general business conditions will be more clarified by October than they have been during the spring and summer. It will be possible for the industry to make a better guess as to the available market than during past months.

But it is going to be a rush. We fear that many manufacturers are going to make all their products in two or three months' of heavy going. If so, it will be costly. Certainly it would be better if the industry stretched out its production schedule over as many months as possible, even if the plants were worked only a few days per week. As we read the many production schedules, we get the distinct idea that if our industry has been seasonable in the past, it may get even worse in the immediate future, where months, rather than seasons, will be the measure of the production term.

TYPE 504A . . .

the ideal high power tube for general use

DELIVERS 250 watts normal output as an oscillator or radio frequency amplifier. The standard "250-watter", de Forest Audion 504A, has a thoriated tungsten filament, making for low filament current. Where filament consumption is no object Audion 504 may be used with good results. Audion 504 has a robust tungsten filament and is preferred for heavy service. A radical departure from the usual plate construction is employed in these Audions, making for greater rigidity and greater heat dissipation. These Audions are recommended by well-posted engineers.

NET PRICE: $105.00

Characteristics of Type 504A and 504 de Forest Tubes

Fil. Voltage		11.0
Fil. Current	504A	3.85
Fil. Current	504	14.75
Plate Voltage	(Max.)	2000
Plate Current	(Max.)	250
Max. plate dissipation		250 watts
Amplification factor		25
Average plate resistance		5900
Average mutual conductance		5000

de Forest (AUDIONS)
RECEIVING AND TRANSMITTING TUBES

For further technical information, address our Engineering Department

DE FOREST RADIO COMPANY
PASSAIC, NEW JERSEY

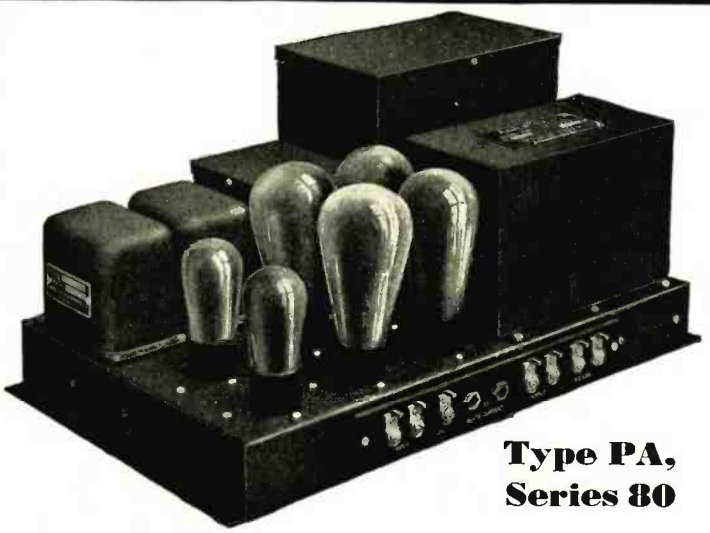
Boston	Denver	Chicago
St. Louis	Atlanta	Detroit
New York	Los Angeles	Dallas
Kansas City	Pittsburgh	Minneapolis
Philadelphia	Seattle	Cleveland

Export Department: 304 E. 45th Street, New York City, N. Y., U. S. A.

These are *net* prices on de Forest Transmitting Tubes

510	—15 Watt Oscillator	$ 9.00
503-A	—50 Watt Oscillator and R. F. Power Amplifier	30.0
511	—50 Watt Oscillator, A. F. Amplifier, Modulator or R. F. Power Amplifier	30.00
545	—50 Watt A. F. Amplifier and Modulator	33.75
552	—75 Watt Oscillator and R. F. Amplifier	24.25
504-A	—250 Watt Oscillator, Modulator or R. F. Power Amplifier	105.00
504	—A heavy duty 250 watt oscillator or R. F. Power Amplifier, tungsten filament	105.00
500	—500 Watt Special Oscillator	97.50
520-B	—5000 Watt Oscillator, R. F. Amplifier and modulator, water cooled	187.50
565	—7½ Watt Screen Grid R. F. Amplifier	16.50
569	—75 Watt Screen Grid R. F. Amplifier	37.50
561	—500 Watt Screen Grid R. F. Amplifier	292.50
566	—Half-wave hot cathode, mercury vapor rectifier	9.00
572	—Half-wave hot cathode, mercury vapor rectifier	22.50

AMERTRAN announces 2 NEW ADDITIONS to a famous line



Type PA, Series 80

AMERTRAN POWER AMPLIFIERS

An economical means of obtaining flawless reproduction of sound in large volume is available in a new series of Amertran Power Amplifiers, the result of months of laboratory experimentation and exhaustive field tests.

There are four sizes in the new Series 80, one to fill every requirement. The big Type PA-86, shown in the illustration will flood an auditorium with a full volume of music or speech without distortion. Smaller models are made for installations in restaurants, clubs, dance halls, schools and homes—wherever exceptional fidelity of reproduction at high volume is desired.

The mounting and construction is such that they are installed easily, with no bothersome wiring and connections, and are proof against tampering or damage. Simple controls and easy portability are added features that contribute to the popularity of Amertran Power Amplifiers whose record of performance has won the distinction of being considered the "Standard of Excellence" for Audio Reproduction.

Licensed under patents of R.C.A. and Associated Companies

AMERTRAN AUDIO TRANSFORMERS

In announcing the new and improved Amertran DeLuxe Audio Transformers, it is again shown that Amertran sets the "Standard of Excellence".

Redesigned for even greater protection from moisture—constructed to live a still longer, more useful and trouble-free life, with perfect fidelity of tone—Amertran DeLuxe Audio Transformers are always demanded when the best is required.

For perfect satisfaction—for long-lived economy—Amertran equipment is everywhere recognized as the wisest choice.

AMERICAN TRANSFORMER COMPANY
178 EMMET STREET
NEWARK, N. J.

AMER TRAN

For Complete Details Write for Following Bulletins:

No. 1000—The complete Amertran line—prices and specifications.

No. 1050—Amertran Audio Transformers. Describing 34 designs.

No. 1077—Amertran Concert Hall Amplifiers—Type 25-A.

No. 1079—Amertran Power Amplifiers—Type PA, Series 80.

No. 1088—Amertran Power Transformers and Blocks—Type 245.

No. 1060—Amertran Chokes-audio, filter and modulation chokes.

No. 1066—Amertran Rectifying Equipment for Radio Transmission.

R. E.-9-30

Please send following bulletins—check (✓) those you want.
Bulletin 1000 ( ); 1050 ( ); 1060 ( ); 1066 ( ); 1077 ( ); 1079 ( ); 1088 ( ).

Name.....

Street & No.....

Town..... State.....

RADIO ENGINEERING

Production, Administration, Engineering, Servicing

September, 1930

The Development of the Equipotential Indirectly Heated Cathode as Applied to Receiver Tubes†

*By V. O. Allen**

THE successful commercial application of the oxides of the alkali earth metals, as comparatively low temperature emitters on directly heated continuous filament, immediately made possible and practical the indirectly heated emitter and consequently the a-c. operated equipotential cathode. By 1926 there was an insistent demand on the part of set makers and the public for an a-c. operated set to do away with batteries, rectifying equipment for same and other apparatus that was troublesome to maintain, and the spring of 1927 witnessed a real effort by tube manufacturers to supply this demand. The result was the 427 type tube and later the 424.

The initial work in the laboratory was directed towards the production of a five volt tube with approximately the same characteristics as the 401-A and here (Fig. 1) is an illustration of one of the first 427 type tubes to be made up. It is a five volt tube and in order to get the necessary resistance in the filament at this voltage with the materials then available, it was necessary to use double heating elements.

† *Delivered before the Radio Club of America, May 14, 1930.*

* *DeForest Radio Company.*

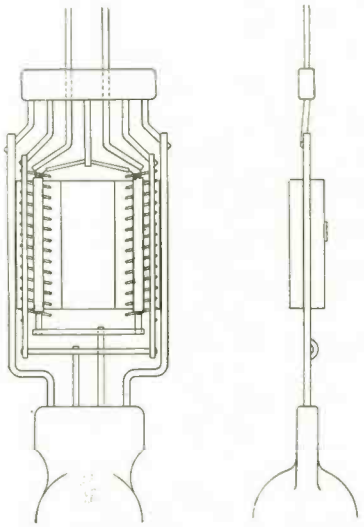


Fig. 1. Early 5-volt heater tube assembly.

The lower operating voltage of present tubes, of course, permits a heavier and short heater wire and here (Fig. 2) is one of the first types to be turned over for regular automatic production. We note the solid plate, short cathode sleeve, no spacers and the fragile heating element; needless to say much grief attended the first production schedule.

The first production gave poor performance. It was non-uniform, noisy, hummed, distorted signals and sometimes failed to detect at all. It was extremely critical during processing and the life was short. In all, the successful production of this type called for intensive research on materials, design and production methods.

One of the first construction changes made, however, considerably improved the functioning of the tubes. This was the use of the mesh plate. In forming the active oxides of barium and strontium on the cathode it is customary to use the carbonates and decompose to the oxide on exhaust. During this process some active material is sprayed over to the grid which emits as soon as it reaches 850 degrees K. A later study of reactions occurring at the cathode which will be discussed later resulted in the development of a coating that does not spray over in this manner.

In order then to overcome this grid emission it was necessary to keep the grid below 850 degrees K. The power radiated by a body is a function of temperature as indicated by these curves (Fig. 3) and varies with different material. We see from these curves (Fig. 4) that solid nickel surface does not radiate .65 watts per square centimeter until it reaches a temperature of 900 degrees K, which is the rate it must radiate in a 427 tube. Thus with the solid plate, the grid is running above 900 degrees K. where as with mesh it is running above 750 only, and even though it picks up some active material it does not emit.

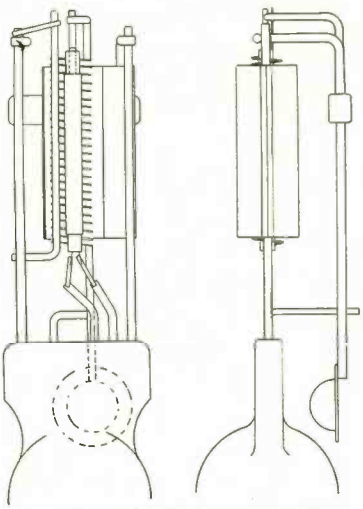


Fig. 2. Heater type tube assembly, for automatic manufacture.

The conventional type of a-c. cathode consists of a twin hole insulator threaded with tungsten or tungsten alloy heating element and the whole inserted or sweated into a metal tube coated with barium and strontium carbonate. Much work has centered about the twin hole insulator and without a doubt it is a vital factor in the life, manufacture and performance of the tube. The insulator must have a fusion point above 2270 degrees K. It must not warp, shrink, break, decompose or interact with the tungsten at this temperature. It must also, of course, be a good dielectric at this temperature with a uniform thermal conductivity and preferably an amorphous structure. The twin holes must be uniform and evenly spaced. It was to secure an insulator having these properties that tube makers searched.

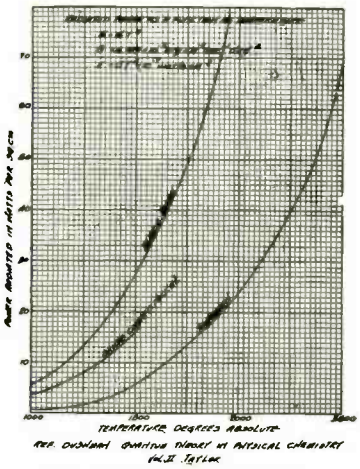


Fig. 3. Power radiation curve.

and it is only within the last six months that magnesia has been commercially available.

The Search for an Insulator

The ceramic industry had never been called upon to supply an insulator to stand up under such severe conditions, and there was surprisingly little data available. Many materials were investigated including silica, alumina, chromite, zircon, titania, thoria, and magnesia, and highly specialized technique had to be developed to extrude and fire these materials.

Production was commenced with ordinary twin hole porcelain, the laboratory life test with which indicared fair life. These life tests, however, were conducted with filament lighted continuously, and when tested intermittently to approximate operating conditions gave extremely poor life.

In order to decompose the carbonates on exhaust it was necessary to have a temperature of at least 1000 degrees K. at the sleeve, which meant that the tungsten had to burn at about 1870 degrees K. to secure the necessary temperature gradient. Now the fusing temperature of porcelain is about 1820 degrees K. so that it was practically impossible to secure good exhaust without tightly fusing the insulator around the tungsten, preventing it from moving freely. This resulted in broken and eroded filaments and the life could be estimated by the amount of fusion. This condition was controlled by the exhaust voltages as indicated by the filament current. The greater the fusion, the faster the conduction of heat from the filament and consequently the more current it would draw.

It was realized at this point that it was absolutely necessary to produce a satisfactory insulator with a much higher fusion point and in the meantime in order to supply the demand, several expedients were resorted to. The exhaust schedule was lengthened and the filament voltage kept as low as possible. The filament was coated with chromium; at first sprayed and later electro-plated. This improved the life considerably. Incidentally, considerable technique was built up in successfully plating tungsten continuously for this purpose.

The chromium acted as a getter for the water vapor in the porcelain, oxidized and thus formed a high fusion point oxide around the tungsten. This was by no means a solution, for exhaust voltages remained extremely critical and at best shrinkage was very high.

The chemical properties of alumina and magnesia immediately brought them under consideration as refractory insulating materials, but much difficulty was experienced in extruding, in finding a satisfactory binder, and in firing. A great improvement was made, however, by the production of a magnesia and magnesium silicate mixture, which had a fusion point above 1920 degrees K. With the use of this material which allowed much less critical exhaust filament voltages and of .25 per cent thoriated tungsten to give greater ductility, fair life was obtained. The problem was attacked also from another angle which resulted in opening up a very interesting field in the way of faster exhaust and better clean up.

It is well known that the addition of carbon to barium carbonate considerably lowers the decomposition temperature by approximately 400 degrees C. and this principle is used in the commercial production of barium oxide according to the following reactions:

$$BaCO3 + C \qquad BaO + 2CO$$

The author of this paper I think was the first to realize the possibilities of adding carbon to the coating to obtain this result and first studied the effects. The problem, however, was somewhat different in forming BaO when applied to filaments in vacuum as there is no oxidizing atmosphere in this case to take care of any excess carbon. Even when the carbon content was accurately calculated to interact according to this equation, erratic results were obtained. It was found that the carbon had to be added in the form of an organic salt of barium, which decomposes below 500 degrees C. with the formation of barium oxide. Evidently the carbon released below 500 degrees C. was very active and the barium oxide acted as a catalyzer in starting the reaction. This process is being used with much success to obtain high-speed exhaust. It completely eliminates trouble from gas. The carbon monoxide liberated instead of carbon dioxide makes an ideal cleaning agent to reduce possible oxidation of the elements, speeds up exhaust, the emission is increased and the carbon monoxide has a greater affinity for the getter. No doubt other improvements can be made by studying the reactions during exhaust. It is also interesting to note that no spraying of the active material occurs with the improved coating and no need arises to use mesh in preference to solid nickel. With this in mind, some manufacturers have investigated the possibility of improving over mesh, which has several objections. It is comparatively expensive; frays at the edges; it is not as rigid as strip metal; it is more difficult to process and clean up, whereas, perforated nickle which has been substituted by some manufacturers, overcomes these objections.

Tube Noise

While improvements were being made in processing and life, jigs speeded up mounting and insured accurate initial alignment, and mica spacers maintained this condition during shipment and life.

The noise factor was investigated and careful analysis made as to causes so that they could be gradually eliminated. The intermittent but persistent cackle that was characteristic with the first 427 was rather elusive, however, in checking. The intermittent nature of the noise led engineers to lay the cause elsewhere, but accurate measurements showed an intermittent discharge from the ends of the insulator.

Practically all manufacturers used a

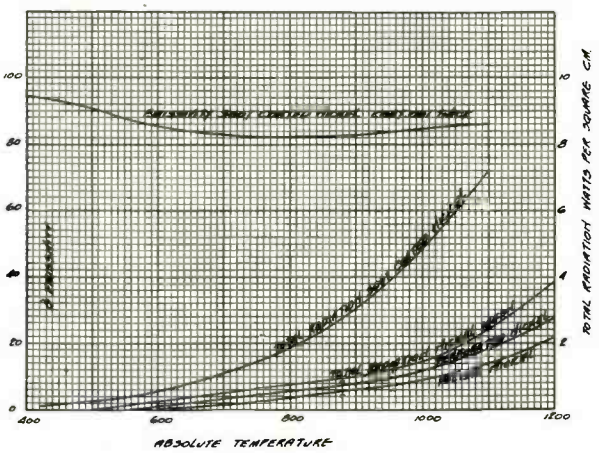


Fig. 4. Emission characteristics, various metal surfaces.

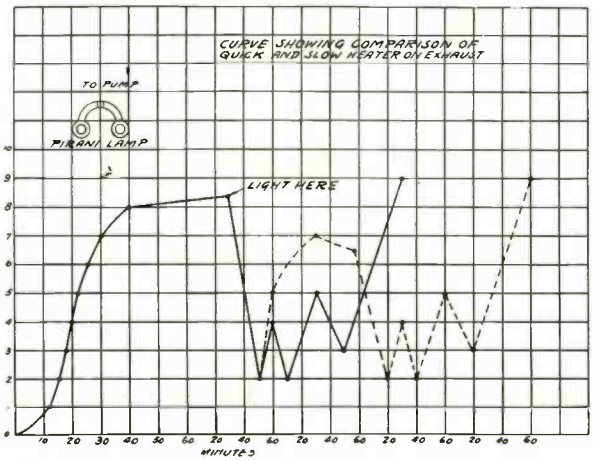


Fig. 5. Curve showing heating time.

short cathode sleeve, leaving the ends of the insulator unscreened, which were found to accumulate a charge, probably a piezzo electric effect. By completely screening the insulator with a long sleeve this cackle was entirely eliminated and the performance of the tube approached perfection.

The Alumina Insulator Not Satisfactory

About this time, research, after much effort, produced the alumina insulator. The extruding difficulties had been overcome and initial results were very encouraging. Owing to its high specific heat and fusion point, a filament was designed to burn at 1800–1900 degrees C. which condition permitted the use of a heavy, rugged tungsten hairpin. After a few hours operation, however, the tubes became distinctly noisy and investigation showed that the filament burning at 1800 degrees C. had actually interacted with the alumina reducing it to free aluminum and forming the yellow tungsten oxide. Now this oxide of tungsten gives a high vapor pressure and when formed in the tube reacts in the same way as a gas. It was found that this reaction took place above 1500 degrees C. and since at this temperature the tube would take entirely too long to heat up alumina was entirely eliminated as an insulator.

Magnesia Meets Requirements

Finally magnesia was produced and this was found to be the ideal material although tungsten will also reduce this at temperatures above 2000 degrees C. 1900 degrees C. then presents the highest temperature at which tungsten can be permitted to operate in combination with any insulator tested so far, to secure good life with good performance.

The availability of the magnesia insulator eliminated entirely the critical exhaust conditions and high shrinkages and we have now the perfected slow heater audion. We note the mica spacers, long sleeve, rigid close fitting insulator, heavy rugged filament tightly drawn, accurate spacing and clean cut construction.

The slow heating type usually takes from thirty to fifty seconds from the time of applying power to reach operating temperature, the lag depending on the thermal conductivity, specific heat, total mass of insulator, sleeve and coating and the temperature of the heating element. It is distinctly desirable and advantageous to obtain quick heating both from a standpoint of popular demand and economic production, as these curves show (Fig. 5). We see here that the time taken to heat the insulator is wasted on the pumps and pumping vacuum is costly.

The problems involved in overcoming this time lag center about the following:

1. Reduction of the mass of the insulator, either by cutting the cubical contents or decreasing the density of the insulating material or of the fired product.

2. Elimination of the insulating ceramic entirely except for two spacing plugs.

3. Development of a material with low specific heat and high thermal conductivity.

4. Securing as high a temperature gradient as possible between sleeve and heating element.

5. Reduction of mass of insulator by cutting or notching to permit direct radiation from heating element to cathode.

Several types of construction have been on the market that have been developed along these lines, but in most cases the perfection obtained in the slow heater has been sacrificed in obtaining quick heating. This is especially true when considering rigidity, and microphonic characteristics which make them wholly unsuitable for use in automobile sets or wherever the set is subject to jarring. For purposes of discussion, we can classify these types according to the method of transferring the heat from the filament to the sleeve as follows:

1. Conduction.
2. Radiation.
3. Radiation and conduction.

Under the first classification comes the tight fitting low density insulator, which is identical with the perfected slow heater except that the mass of the insulator is reduced by decreasing the density of the fired product. It is produced by mixing a bulky organic material with the regular mix to be extruded and the organic material burnt away during firing, to leave a light cellular structure. When the density is reduced to a minimum in this manner, heating time is cut to fifteen to twenty-seconds but the insulator is much weaker and harder to handle resulting in high shrinkage.

Under the second classification comes the spaced single coil, double wound spiral, spaced hairpin and it is at once apparent that this type cannot compare with the perfected type slow heater for rigidity and certainty under all conditions. The problem of preventing filament reaction is entirely eliminated and the tungsten may be operated around 2400 degrees C, thus

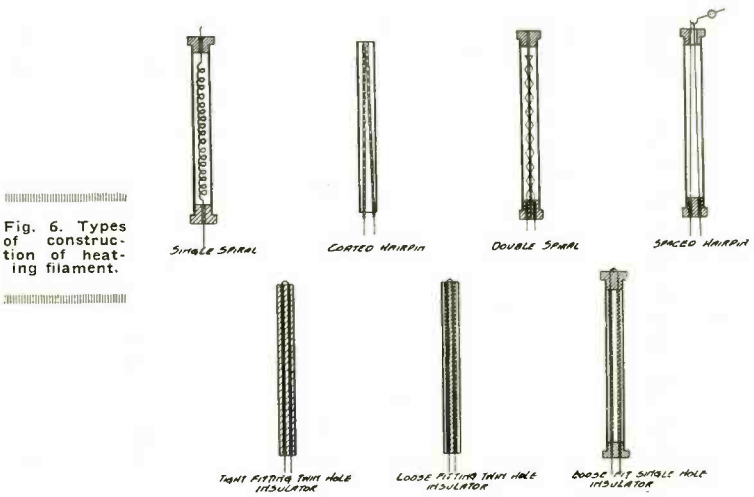


Fig. 6. Types of construction of heating filament.

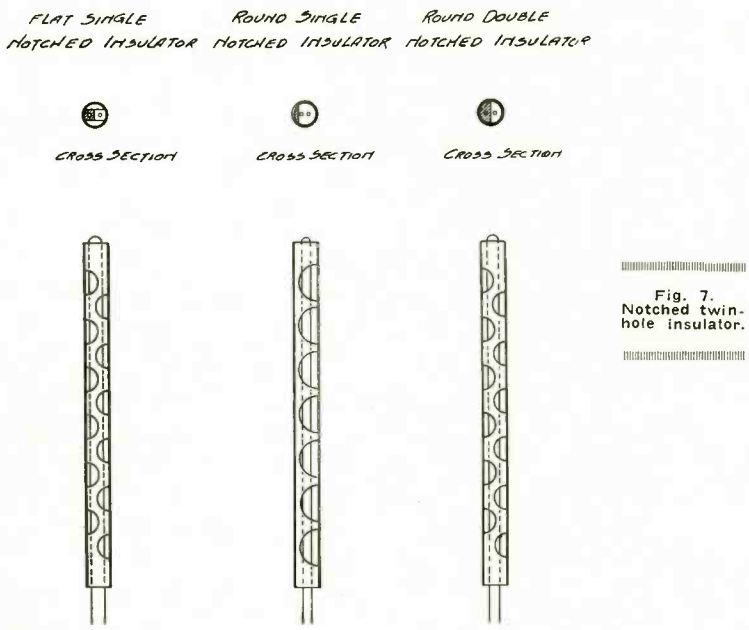


Fig. 7. Notched twin-hole insulator.

producing a very steep temperature gradient between the filament and sleeve and heating in 5 to 8 seconds. They are quite likely to be microphonic, however, and are not well adapted to production methods. This is not the only objection, however, in considering the single coil type. The concentrated coil creates a strong inductive field, which influences electronic flow, and further, necessitates an unscreened a-c. loop to complete the filament circuit. A theoretical consideration of these conditions at once suggests the possibility of hum, and actual tests show this to be the case. Many tests tend to prove that for noiseless operation, the a-c. heating circuit must be of the hairpin type or non-inductively wound spiral, and entirely screened.

The third classification includes the thinly insulated heater loosely suspended in the sleeve, the low mass. loose-fitting twin hole insulator and the loose fitting single holed insulator, all of the hairpin shaped type. Several brands have appeared using the coated wire, but here again we have to make the criticism of microphonic action and leakage between the heater and sleeve. It is a very difficult to form an insulation on a wire especially tungsten without using a low fusing binder or such product. Tungsten is subject to oxidation and embritterment at medium temperatures, and also reacts and actually reduces aluminum oxide which is commonly employed. The several types of low mass loose-fitting insulators perform fairly well but are subject to microphonic distortion of insulator and sleeve, causing shorts. They are difficult to manufacture, fragile and do not attain very fast heating. After working many months on the cathode problem, we believe that the solution is to be found in the notched or cut-away twin hole insulator illustrated in Fig. 7. This design for quick heating retains all of the desirable characteristics of the slow heater. It is rigid, free from hum and noise, non-microphonic and long lived.

The insulator is made with large twin holes, the threading of which does not create an eye hazard to the assembler. The material has a high density giving strength and rigidity, and so adjusted as to permit the exposed portion of the heater to burn at the same temperature as the covered. The high specific heat and low thermal conductivity permits the initial heating energy to be radiated to the sleeve instead of being conducted to the insulator. Heating is thus secured in 5 or 10 seconds. The heavy filament is designed to burn at under 2000 degrees C. giving a steep gradient with ample life and freedom from interaction with the insulator. Fig. 8 shows a perfected quick heater audion.

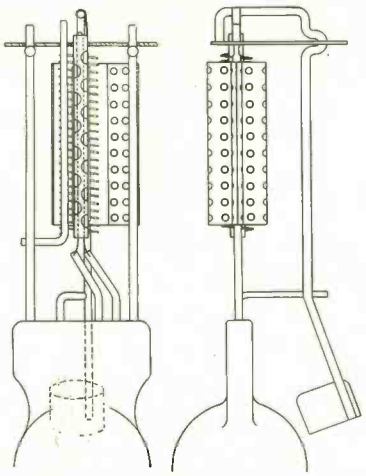


Fig. 8. Construction of perfected quick-heater audion.

It has indeed been a pleasure to trace the development of the equipotential indirectly heated cathode as applied to receiving tubes. To those who have had the opportunity to play a part in the development, the subject has been most fascinating. I sincerely hope that this visualized summary has been of interest.

▲

SHORT-WAVE TRANSMISSION NOW POSSIBLE WITH 35-KW. IN ANTENNA

MUSICAL thunder, accompanied by a vivid electrical display, has been encountered by radio engineers of the General Electric Company in their investigations near Schenectady, of high-powered, short-wave broadcasting.

In these miniature thunderstorms, which occur during any kind of weather, daylight or darkness, clear or overcast skies, the thunder is converted into music which corresponds to the input at the radio microphone.

WGY engineers have solved the problem of handling 200 kilowatts of power modulated, on long waves, but new difficulties are presented in the use of powers above 15 kilowatts on the short waves. In using powers up to 15 kilowatts in the antenna no unusual phenomenon has been observed, but when it was first attempted to increase the power to 35 kilowatts in the antenna vivid coronas flashed, wavering like ghostly spectres in mid-air. This corona demonstration didn't appear as long as the carrier alone was on, but as soon as the engineers attempted to modulate, the arc was struck in the surrounding air. This arc generally started about three or four feet from the antenna and shot upward four feet in the air. Since the power supplying the arc was modulated with music the arc alternately collapsed and built up in size corresponding to the modulation. This action set up air wave vibrations similar to thunder but instead of the roar and roll of thunder it was a musical sound similar to the music being broadcast. Men working 300 or 400 feet away thought they were hearing the output of a giant loudspeaker. If the arc were allowed to continue it moved out toward the end of the antenna, due to the movement of the hot gases, arced across the insulators cracking them open and finally the intense heat melted the copper and caused the antenna to drop.

The trouble was solved in two ways. Antenna wire of large diameter was adopted and a large corona plate or half sphere was placed at each end of the antenna. These measures reduced the voltage gradient at the wire surface due to the increased radius of curvature of conducting surface. It is now possible to get 35 kilowatts of power, modulated 100 per cent in the antenna without wasteful and destructive coronas.

The Vacuum — There's Something In It

Are we upon the threshold of the Electron Age?

*By John W. Hammond**

WHEN the front page of a San Francisco newspaper is read in New York State a few hours (elapsed time) after it is printed; when a popular lecturer makes a ray of light produce music and transmit his voice across the room; when Australia chats with America, and engineers talk of bringing waterpower from Pacific slopes to within reach of industrial markets in the northeast—even the sophisticated denizen of this ultra-modern world begins to inquire "Wherefor?" And the answer he gets has more than a touch of the mysterious, for they tell him, "It's the vacuum—it's all in the vacuum!"

But can there be anything whatever in a vacuum—defined as mere empty space, devoid even of air? Tremendously and emphatically, yes! Truth, in the twentieth century, is more than ever stranger than fiction, for this is truth; and the man who first uttered the paradoxical statement, "The vacuum — there's something in it"—Dr. Willis R. Whitney, director of the research laboratory of the General Electric Company conducts an institution which is engaged in nothing else than making truth stranger than fiction.

High Power (100 kw.) vacuum tubes, by General Electric Co.

Little unobtrusive glass tubes each enclosing one of these curious areas of "nothing-something" enabled a whole newspaper page to be reproduced within three hours clear across the continent and allowed Admiral Byrd in New Zealand to converse with his friends in this country, "face to face" nine thousand miles apart. Similar vacuum devices measure the heat and light of far distant stars; sort, grade and count quantities of small articles; safeguard premises from burglary and fire; turn on lights when darkness approaches; operate train signals, control electric motors, actuate compasses for ships and airplanes. Man has succeeded in utilizing the vacuum for transmitting entertainment programs great distances through space without connecting wires, for sending his messages to inaccessible or isolated spots, for aiding materially in alleviating his physical ailments. Every time he even switches on electric lights in his home he relies implicitly upon vacua, and millions of cubic feet of such light-giving "emptiness" are in nightly use throughout the world.

It has grown trite to allude to "scientific wizards." Yet the more trite it becomes, the more wizardry they perform. Getting something out of nothing—or practically nothing—is one of their concrete achievements today, for already they have obtained more wonders from the vacuum than a stage magician could extract from a silk hat.

The very nature of a vacuum gives it a tremendous aspect. Few persons outside the scientific world can readily conceive of a space entirely empty of matter, even of the gaseous substance termed the air. Hence, when the earliest scientific "magicians" began doing tricks with vacua they utterly astonished the laity. The classic experiment of Otto von Guericke with the two hemispheres was a long-remembered case in point.

The Air Pump

Von Guericke, burgomaster of Magdeburg, was a pioneer in electrical science. His accomplishments included the invention of an air-pump with which he obtained a partial vacuum—not a high vacuum, such as is common today, but still one in which the air content was pretty thin. One day in 1654 he called by appointment on Emperor Ferdinand III, accompanied by two teams of eight horses each, with their drivers and various queer paraphernalia. He showed the emperor two copper bowls which, when placed together, formed a hollow sphere. Between them von Guericke inserted a ring of leather soaked in wax and oil, making an air-tight joint, but there was no mechanical connection whatever. With his air-pump he drew off a great deal of the air from the sphere through a hole which was closed by a tap.

The teams of horses were then brought up, one being hitched to each of the copper bowls, or hemispheres. At the signal to go the sixteen horses pulled and strained, but their utmost exertions could not drag the hemispheres apart. The emperor, amazed, found it impossible to believe that the bowls were locked together merely by the difference in air pressure between the atmospheric density outside and the partial vacuum within.

This was the vacuum doing tricks. The vacuum universally at work did not come until two centuries later, and Edison was the scientific "magician" of this later affair. By that time men knew much more about electricity, and there is a close working relation between electricity and the vacuum. Edison hit on a relatively minor aspect of it when he placed a hair-like carbon filament within a vacuum and then con-

* *General Electric Company.*

nected the filament to an electrical circuit. The resistance of the filament to the passage of the electric current made it glow with incandescent light, while the vacuum prevented it from burning up — and, the incandescent electric lamp was born, essentially a vacuum device.

Had Sir Walter Scott seen this he might have paraphrased his own incredulous comment on the experiments of William Murdock, the pioneer of gas lighting. When he heard of Murdock's work he exclaimed: "There is a mad man who proposes to light London with—what do you think?—smoke!" If he had known of Edison's lamp he would probably have scoffed: "There is a mad man who expects to illuminate the world with—what do you suppose?—nothing! A vacuum!"

As it was, Edison's idea of an electric lamp was considerably ridiculed at the time. Among other criticisms, doubts were heard of the possibility of producing with facility such a high vacuum as was necessary. Sir William Crookes, the English scientist, who was then studying the subject, was asked if vacua as high as Edison required could be created in quantity. He replied, promptly and succinctly, "Why, such vacua can be produced by the ton!" And so they have been, ever since.

Edison, as fate would have it, did more than construct a practical and popular electric lamp depending on a vacuum. He was the first to observe a peculiar electric current originating with the hot filament inside the vacuum and known at the time as the Edison Effect. It was thirty years before scientists, working principally with Crookes' tubes, fully understood what this meant—that a hot filament in a vacuum gives off a stream of electrons (an electric current, but not usually a powerful one) capable of being manipulated in many remarkable ways and behaving variously in vacua of varying degrees.

The Modern Tube

In the successive brilliant discoveries that occurred in this great field, Richardson Millikan, J. J. Thompson, Fleming, DeForest, Langmuir—all of them laboratory experimenters of the great line—participated. This work culminated at length in the modern vacuum tube with its boundless possibilities, already numerous and by no means even approaching finality. Radio broadcasting, one of the most spectacular and best understood of modern feats with vacua, was one of the earliest, following that of radio telegraphy.

Great numbers of these modern tubes are now in world-wide use, each with its vacuum, and each vacuum more nearly perfect than ever before produced by man. So completely are these tubes and bulbs "exhausted" (that is, evacuated of air) that out of every seven hundred million molecules originally in each tube only one remains! Yet in every cubic inch of space in each tube there are still to be found, after the pumps have done their best, more molecules of air than there are people in the world! Thus it is far from utterly empty space, although a living creature in such an enclosure would instantly suffocate, if he did not literally explode before he had time to smother.

Growth of Tube Manufacture

This is quite sufficiently a condition of "empty" space, and innumerable such spaces are now in constant useful service in the every-day world. During the fall of 1929 General Electric manufactured its one hundred millionth vacuum tube. It is roughly estimated that about 250,000,000 tubes have been produced by all manufacturers since vacuum tubes first made their appearance around 1915. If all these tubes are still in service they represent in the aggregate a million and a quarter barrels of vacua. Could all this "empty space" be lumped together in one spot it would have a larger cubic area than the interior of the Lincoln Memorial at Washington and almost as great as the Senate chamber and the national hall of representatives combined. And this does not take into account the vacua in incandescent-lamp bulbs.

They comprise a diverse and extraordinary scientific family, these vacuum tubes. One, is the well-known pliotron of Langmuir, which lies at the heart of radio broadcasting. The most recent, the thyratron, just developed by Dr. A. W. Hull in the General Electric laboratory, is capable of greatly simplifying electric power transmission and solving some of America's economic problems of power supply. Thus out of the vacuum—out of practically empty space—the scientific wizards of today have already brought whole industries, wealth, prosperity, advancement, perhaps a new phase of civilization!

The Electron Age

Obviously, then, the present electric age, so-called, is unfolding in really astounding fashion. More and more the scientist is thinking of electricity—the invisible, inconceivably tiny electron—as the warp and woof of the physical universe. If this be so, the electrical age not only has come to stay but it may in time reveal its successive distinctive epochs, like the geological eras in the age of the earth. The world has already passed through the magnetic-electrical epoch; now it is entering upon the vacuum-electrical. Perhaps this will be followed by the atomic-electrical, and that in turn by the cosmic-electrical, in which tremendous undiscovered forces of outer space will become servants of dominant man. In that epoch a literal tour of the solar system may have been practically achieved, and the world will have gaily despatched its interplanetary Lindbergh—a good-will ambassador to the stars! Fantastic? Ah, but "truth is stranger than fiction"—and stranger than ever as the years pass!

THE BACKBONE OF RADIO

*By Charles E. Wilkinson**

MUCH has been done by the manufacturers to perfect each element of the modern radio receiver. Tubes, condensers, lock contacts, etc., have been given due attention. One line along which something remains to be done is that of perfecting the coils used. The wire itself and the insulation are of high grade, but in too many instances the mistake is made of skimping in the grade of paper tube used for windings.

The paper tube is the foundation upon which the coil is built. Much of the heating and much of distortion experienced is due to faulty paper coils.

Paper tubing for coil winding must be as free as possible from moisture. Tube material should be given, first, a dry bath and then a bath of lacquer or shellac.

Modern tube paper is boiled in a chemical solution which excludes all moisture. The paper is impregnated so as to resist moisture. This avoids mechanical distortion of the tube after winding. The chemical solution used has no deleterious effect upon the wire or the insulation.

Radio manufacturers in increasing numbers are realizing that it pays well not to overlook the importance of this last detail of set construction.

* *Vice-President, Philadelphia Paper Tube Corpn.*

▲

ALL SET FOR SEVENTH ANNUAL RADIO WORLD'S FAIR

WHEN the doors of Madison Square Garden swing open on the Seventh Annual Radio World's Fair, Monday, Sept. 22, the trade will see a more impressive exposition and a more beautiful one than they have ever seen before. The entire exhibition space within the Garden will be utilized again as in years past, for the reduction in the number of radio manufacturers is more than compensated by increases in individual space requirements, according to G. Clayton Irwin, Jr., general manager. That radio manufacturers are facing the future with every confidence is the only conclusion possible after the most casual inspection of the show.

The current Radio World's Fair, it is admitted, by the men on the firing line, has more than usual interest for the trade, and Trade Show hours, this year, noon to 2 P. M., every day except Monday, are expected to attract dealers and distributors as they have never been attracted before. It is predicted that there will be no hesitancy on the part of dealers and distributors in making commitments as soon as they have an opportunity of viewing the complete lines of all the various manufacturers, when they are able to inspect and compare, under one roof, their competition as well as the products of their present affiliations.

Practical Double-Grid Tube Circuits

By A. Binneweg, Jr.

Typical Circuits Which Can Be Used With Screen-Grid and Pentode Tubes

THE advent of the screen-grid tube and, later, the pentode has made it practical to experiment with combination circuits in which more than one grid is employed for control purposes. Although the screen-grid tube is designed primarily for use as a screened r-f. amplifier, it can be used in many of the two-control-grid circuits. The possible combinations with pentodes are numerous.

Typical double-grid tube circuits are discussed. They can be adapted for use with screen-grid or pentode tubes, for the many different purposes.

The Double-Grid Tube

Since the early days of the vacuum tube, various experimenters have proposed the use of electrodes in addition to the usual control grid and plate. Two-grid (four element) tubes have been used in foreign countries for many years. The screen-grid tube is a special type of the double-grid tube. The two-grid tube has many advantages over ordinary single-grid (three-element) tubes. Typical circuits showing the principles of operation will be considered.

Double-grid tubes are constructed in much the same way as three-element tubes of similar design. An extra terminal is necessary for the additional grid. In some foreign tubes this extra terminal is a thumb-screw at the side of the base, and in others an extra pin on the base is provided. The foreign tubes often employ a metal base. A typical foreign two-grid tube with extra grid terminal at the side is shown in Fig. 1. Fig. 2 shows a typical double-grid tube with its five base pins. The special socket required is also shown.

Fundamental Double-Grid Tube Circuits

A double-grid tube is represented diagrammatically in Fig. 3 like an ordinary three-element tube. Two grids are shown. The outer grid is shown nearest the plate.

A regenerative receiving circuit employing a double-grid tube is shown in Fig. 3. Connections are as usual, with the exception that the inner grid is connected to the positive of the plate battery, thereby reducing the space-charge effect and allowing the use of a smaller plate battery (as in the pentode). This circuit will operate with plate voltages from 4 to 10 volts. Other circuit values are as usual. A gridleak of about one megohm should be used.

The usual circuits may be employed with double-grid tubes. The necessary plate voltages are less, if the connections are similar to those in Fig. 3. For portable receivers, the double-grid tube has many advantages. In some respects the pentode may be said to have inherited its advantages from the two-grid tube.

There are two components in the plate circuit of a tube passing a modulated carrier; an audio-frequency and a radio-frequency component. The radio-frequency component can be fed back through a radio-frequency transformer and the audio-frequency component through an audio-frequency transformer, provided with a by-pass condenser through which the radio-frequency passes.

One tube may be used to amplify at audio and radio frequencies simultaneously. The various possible combinations with one or more double-grid tubes are numerous. In general, two tubes can be made to do the work of three or even four three-element tubes.

A portable arrangement using one of these tubes is shown in Fig. 4. If a separate antenna coupling coil is used, the selectivity is good. If properly operated this circuit acts as one stage of radio-frequency amplification, detector, and one stage of audio-frequency amplification. This circuit gives better results than the usual two-tube set, according to engineers. The r-f. amplification seems to be rather small.

A double-grid tube is capable of radio-frequency amplification, rectification and audio-frequency amplification simultaneously. Radio-frequency amplification with a single tube is possible without regeneration or oscillation. A non-radiating set having radio-frequency amplification, rectification and then audio-frequency amplification is possible as described later.

Fig. 1. Multi-grid tube.

In the circuit of Fig. 5, the tube acts as a rectifier. The outer grid is connected to positive B battery as is the case for the plate in the ordinary three-element tube; the outside grid here functions as a "plate." When the inside grid is positively charged, most of the electrons emitted by the filament pass through it toward the higher potential; some are attracted to the outside grid, constituting a "plate" current. The outermost electrode, or plate, is connected through the audio-frequency transformer to the negative filament terminal and is therefore negative, taking in no electrons. If the voltage induced in the secondary inductance is such as to place a positive charge on the plate, electrons will enter the plate, but if this voltage is such as to place a negative charge on the plate (outermost electrode), the electrons will be repelled. In other words, a rectified current will flow in the plate circuit. The tube therefore rectifies much as the old two-element tube. Under certain conditions this type of rectifica-

Fig. 2. Foreign double-grid tubes. Note base construction and special sockets.

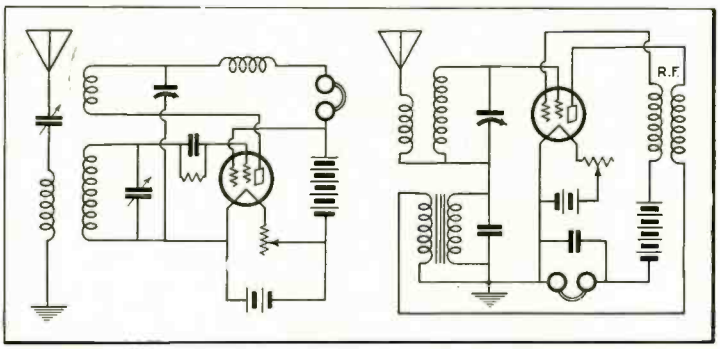


Fig. 3. Short-wave double-grid tube circuit.

Fig. 4. One-tube circuit having radio-frequency amplification, detector and audio amplification.

tion may give superior results to ordinary methods.

Amplification Before Rectification

The received oscillations may be subjected to amplification before rectification by connecting the tube as shown in Fig. 6. Here the received oscillation varies the inner-grid potential and thus varies the outside-grid (plate) current accordingly. This circuit includes an r-f. transformer. Thus if a positive voltage is impressed on the outside electrode, or plate, a plate current will flow, whereas a negative potential will repel the electrons. Rectification therefore takes place after amplification. The r-f. component is by-passed around the audio transformer and the rectified output is available at the secondary of the audio transformer.

The tube can perform these three functions simultaneously. A complete circuit is shown in Fig. 7. The rectified current in the plate circuit passes through an audio-frequency transformer the secondary of which is connected in the inside-grid circuit; the audio-frequency pulsations are thus amplified and flow in the outside-grid circuit where the output is available at the secondary of another audio amplifier. Two or three of these tubes are capable of furnishing a selective, very sensitive and non-radiating receiver.

A two-tube set which gives the volume of an ordinary three or four-tube set employing three-element tubes is shown in Fig. 8. The incoming pulsations are impressed on the outer grid, are amplified and pass into the regenerative detector. Here there is regenerative amplification. The audio-frequency component is stepped up by means of the audio transformer and impressed on the inside grid of the first tube, as shown. The audio-frequency is again amplified and is available at the speaker terminals. A "phasatrol" is used to shift the phase so that feedback energy cannot reinforce the original pulsations giving rise to oscillation in the r-f. tube. Other neutralization or balancing schemes may be used. The condensers shown are used to by-pass the r-f. around the impedances concerned.

A Good Portable

In Fig. 9 is shown a sort of a super-regenerator. It is not adapted for ordinary broadcast reception, but is an interesting arrangement for the experimenter or for portable use. By adjusting the filament voltage and the value of the grid resistance, the usual noises are greatly reduced. The arrangement is selective and quite sensitive. This circuit like some of the others, requires only from 4 to 15 volts on the plate.

Double-Grid Tube Oscillator

A typical double-grid tube oscillator circuit is shown in Fig. 10. This circuit is particularly useful for wavemeters and superheterodyne oscillators as it furnishes a practically constant frequency, which is quite independent of the operating conditions of the tube. Low voltage, as usual, can be used. From 5 to 10 volts gives quite strong oscillations. With the ordinary oscillator circuits employing three-element tubes, the oscillator does not usually operate well with all sizes of coils and condensers. With this circuit, using a four-element tube, one can employ almost any size of condenser and coil with comparatively little effect on the oscillator. The double-grid tube can be used in superheterodyne oscillator circuits. It is possible to have the same tube operate as both oscillator and first detector. The values of parts to be employed with the oscillator are not critical. One can use standard parts.

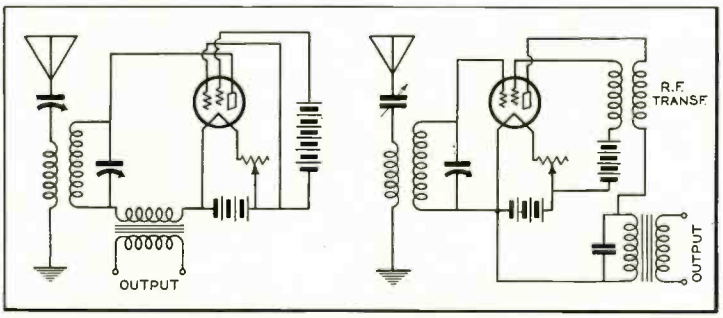


Fig. 5. This circuit shows the action of the tube as a rectifier. This circuit combined with that of Fig. 6, make the complete layout of Fig. 7.

Fig. 6. Illustrating r-f. amplification with a double-grid tube.

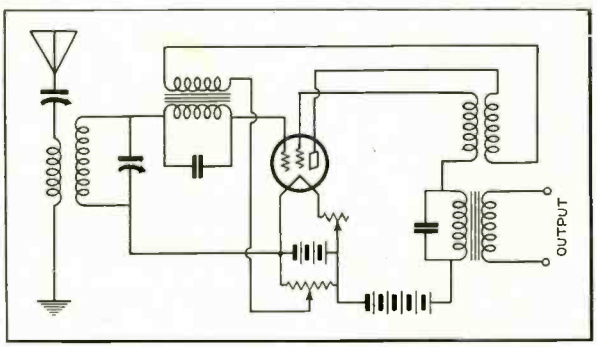


Fig. 7. Complete circuit capable of radio-frequency amplification, detection and audio amplification, with but one tube.

Characteristics of the Double-Grid Tube

The plate impedance of the double-grid tube, like that of the screen-grid tube, is rather high when both grids are connected together. In an American-made tube (Van Horne) the plate impedance with both grids at zero potential is about 100,000 ohms at a plate voltage of 150 volts. The characteristic curves are of interest for

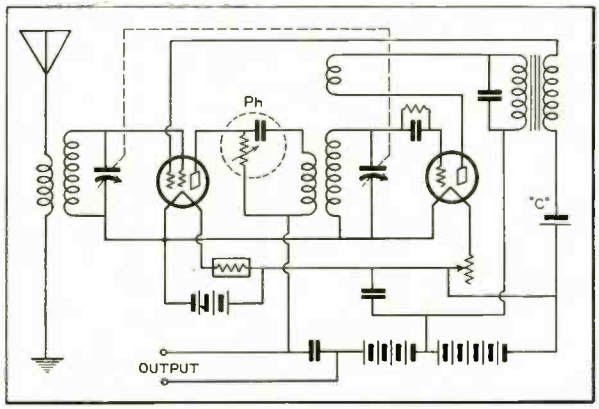


Fig. 8. Radio receiver using a double-grid tube and a regenerative detector — the equivalent of a three- or four-tube receiver.

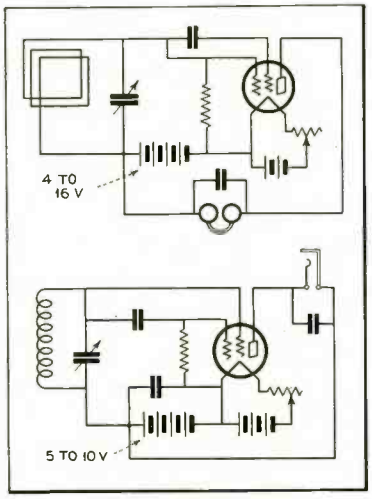


Fig. 9. A form of super-regenerative receiver.

Fig. 10. Typical double-grid tube oscillator circuit.

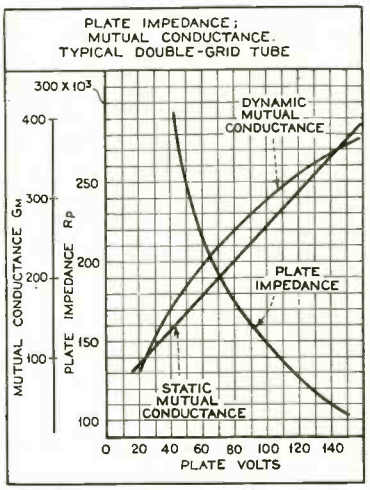


Fig. 11. Plate impedance and mutual conductance of typical double-grid tube.

comparison with screen-grid and pentode tube curves.

The Mutual Conductance (or Transconductance)

The ratio of the amplification constant to the plate impedance, gives much information about the operating characteristics. In Fig. 11 are shown curves of plate impedance versus plate voltage with both grids maintained at zero voltage. The dynamic and static mutual conductance are also shown.

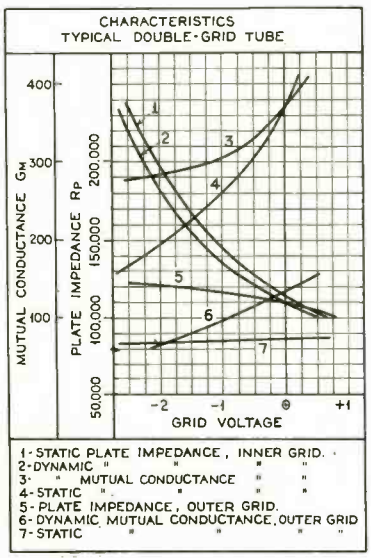


Fig. 12. Characteristics of double-grid tube.

Static values are obtained by using direct current, while the dynamic values; the values of most significance in actual tube operation, were taken using a frequency of 1000 cycles. The curves with each grid connected separately (the unused one being maintained at zero potential) are shown in Fig. 12. In these curves, in general, it is to be noted that there is considerable discrepancy between the static and dynamic determinations. This difference would be greater at high frequencies.

The double-grid tube, in which both grids are connected together, acts much like an ordinary "high mu," three-electrode tube; it is similar to the screen-grid tube in this respect. The slope of the curves is greater for the inner grid than for the outer, showing that the inner grid has the greater controlling action on the electron stream. The amplification-constant for the inner grid is very nearly 40, while for the outer grid it is 8, for this tube. The static values are somewhat different.

The change in characteristics with frequency is due to interelectrode capacitance which may become a serious factor at very high frequencies. The magnitude of the inter-element capacities is one of the chief differences between double-grid and screen-grid tubes. A "four-element" tube can be operated like a screen-grid tube in which the outer grid is employed as the "shield;" the screening, however,

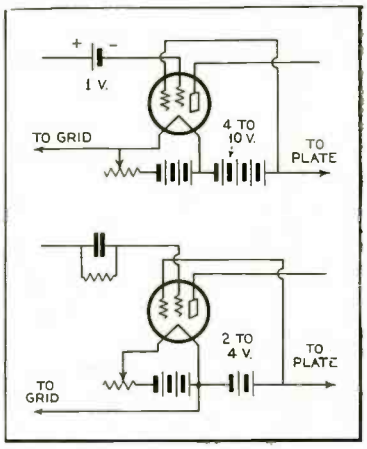


Fig. 13. Detector connections.

is comparatively poor. The two-grid tube will furnish more amplification per stage at radio frequencies than an ordinary three-element tube, however.

In Fig. 13 common connections for amplifier and detector arrangements are shown. In general, the inner grid is maintained at a positive potential. This voltage neutralizes to some extent the space charge, so lower plate voltages can be used; the inner grid can also be used for this purpose in a pentode.

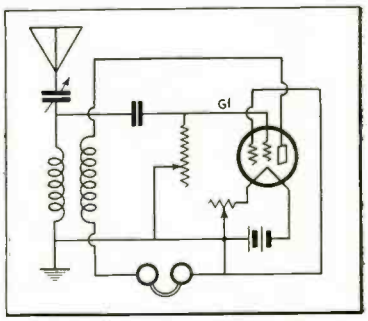


Fig. 14. A one-tube receiver which requires no "B" battery.

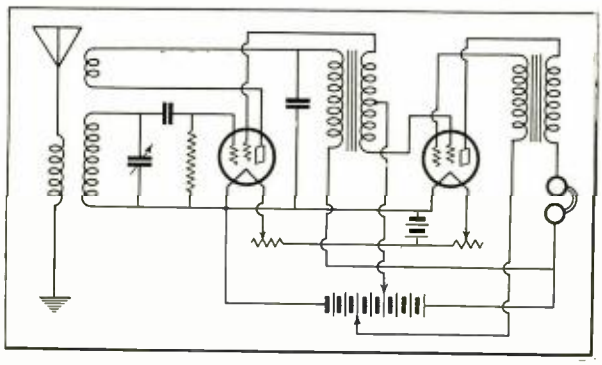


Fig. 15. Two-tube receiver the equivalent of three stages of audio amplification.

A four-element tube (tetrode)[1] will often give good signals with no plate battery. In portable receivers the plate battery takes space and adds weight, so the set is improved if no plate battery is necessary. A simple circuit for this purpose is shown in Fig. 14. A separate antenna coil will make it more selective.

There are many possible circuit combinations for double-grid tubes. In Fig. 15, is shown a two-tube arrangement which gives volume equivalent to three ordinary stages of audio.

[1] *Two-element or diode, three-element or triode, four-element or tetrode, five-element or pentode, etc.*

I. R. E. Convention Great Success

THE fifth annual and first international convention of the Institute of Radio Engineers was held in Toronto, Canada, August 18–21. At convention headquarters, the King Edward Hotel, 640 badges were issued to members and guests. The registration of members in attendance included 296 from the United States. 191 from Canada, one from England, one from Germany and one from Austria. Also, eighty-five ladies were present as guests.

Among those present were noted the following: Dr. Lee de Forest, Col. A. G. Lee, Melville Eastham, Dr. J. H. Dellinger, Lloyd Espenschied, R. A. Heising, Frederick K. Vreeland. Prof. H. W. Price, C. L. Richardson, R. A. Hackbusch, A. M. Patience, Martin Hodsoll, Donald McNicol, J. E. Smith, J. M. Leslie, Frank Dowsett, Henry McCardle, Harold P. Westman, Jack Binns, George Lewis, C. P. Edwards, J. P. Henderson, Bond Geddes, R. H. Marriott, S. C. Anderson. R. H. Manson, V. G. Smith, H. W. Northover. G. E. Pipe, W. C. C. Duncan, J. B. Byers, C. C. Meredith, Dugald Hepburn, Lieut. Col. Steel, H. P. Corwith, Hobart Mason, John W. Million, E. D. Cook, Maurice McCullough, Darrel B. Green, B. de F. Bayly, Jesse Marsten, Keith Henney, Arthur Lynch, G. W. Blessing, Austin Bailey, Harry F. Dart, C. B. Joliffe, A. W. Hull. Virgil M. Graham, Dr. A. Hoyt Taylor, E. D. Southworth, H. T. Friis, Norman E. Wunderlich, Keith Russell, G. W. Kendrick, Bruce W. David. Deane Kintner, A. Ringel, Harraden Pratt, A. B. Oxley and J. L. Hornung.

Technical Sessions

There were five technical sessions at which twenty-three papers were read and discussed. Each of the five sessions was largely attended by the visiting members of the Institute. A noteworthy feature of the technical sessions was that the discussions were participated in by an unusually large number of engineers interested in the various subjects presented.

Colonel Lee Presides

Dr. Lee de Forest, president of the Institute, was present during the first two days of the convention and conducted the various meetings. Dr. de Forest then had to leave for the west and the gavel was taken in hand by Col. A. G. Lee, vice-president of the Institute, who presided at all meetings during the remaining two days.

RMA Exhibitors

On the convention floor were arranged numerous exhibits of radio manufacturers. Among those represented were: The Canada Wire and Cable Company, The Utah-Carter Company, General Industries, Inc., RCA-Victor, RADIO ENGINEERING Magazine, Hammerlund Mfg. Co., International Resistance Co., Yaxley Mfg. Co., Amperite Corporation, Sprague Specialty Co., Kester Solder Co., Allegheny Steel Co., Scovill Mfg. Co., Electrad Company, Jewell Electrical Inst. Co., Rubicon Company, Supreme Instruments, Weston Electrical Inst. Corpn., "Radio Industries," McGraw-Hill Company, Easton Coil Co., Polymet Mfg. Co., Amrad Corporation, Continental Carbon Company, Arrow-Hart-Hegeman Electric Company, Igrad Condenser and Mfg. Co., Diamond State Fibre Co., C. H. Quackenbush Corporation, Canadian Marconi Company. De Forest Radio Company and Hickok Electrical Inst. Co.

Convention Trips

A bus trip was made to the works of the Canadian National Carbon Company and the Canada Wire and Cable Co., which was attended by 218 members. A bus trip to the works of the Rogers Majestic Company and the De Forest Crosley Company was attended by 257 members.

Daily sightseeing trips in buses and on a lake steamer were provided for the ladies present.

Institute Awards

At the banquet in the Grand Ball Room of the King Edward Hotel on the evening of August 20, attended by 260 members and guests, the two Institute awards were made. The annual award of the Institute gold medal went to P. O. Pedersen, of Denmark, the presentation address being made by Mr. H. T. Friis of the A. T. & T. Co., New York. The Morris Liebmann Memorial prize of five hundred dollars, awarded annually, went to Dr. A. W. Hull, of the General Electric Company, Schenectady, N. Y. The presentation address was made by Donald McNicol, editor of RADIO ENGINEERING, New York.

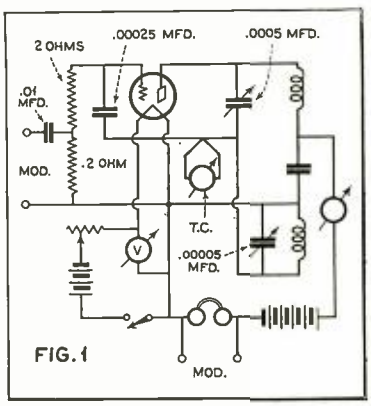
At the conclusion of the dinner an elaborate program of entertainment was put on and this was followed by dancing which continued until midnight.

The highly successful management of this convention by the Canadian members of the Institute of Radio Engineers is an index of the onward march of radio. The Toronto Section of the I. R. E. was organized but four years ago. That the unit has grown and prospered so that its members were able in 1930 to carry through to success the first international convention of this progressive society is a distinct credit to the officers of the Section and to the members of the various committees having the many details in charge.

Obtaining a Pre-Assigned Percentage Modulation In a Laboratory Oscillator

Here are Two Methods of Setting Up Laboratory Oscillators For Radio Receiver Tests Which Exclude Undesired R-F. Pickup

By C. H. W. Nason



Circuit of the type 384 oscillator.

IN determining the sensitivity of a broadcast receiver according to the standards as set down by the I. R. E. we employ a continuous wave modulated 30 per cent by an audio frequency of 400 cycles, and in obtaining the fidelity characteristics at some given frequency we employ a carrier modulated by a variable audio frequency at a constant modulation percentage of 30. Unless we are able to maintain this degree of modulation constant our curves are valueless and unless we can go back day after day to the identical condition, even more so.

In constructing laboratory oscillators for use in receiver investigation, the author has run into three major problems: first, that of maintaining a fixed and known percentage modulation; second, of constructing an attenuator capable of reliable division of voltages at the high frequencies involved; and last, of avoiding any possibilities of r-f. input to the receiver under test other than through the standard dummy antenna. This last practically excludes the employment of the variable mutual inductance type of attenuator.

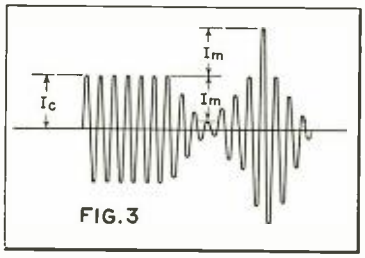
In this article the purpose is to give two methods of obtaining the required percentage modulation. One method is of extreme simplicity for use in hurried setups and the other is for employment where a fair degree of accuracy is required for a permanent piece of laboratory apparatus.

In the first case, there was available a General Radio type 384 oscillator, the circuit of which is shown in Fig. 1, with the necessary circuit changes indicated. These changes merely involved the insertion of a 2 mil. thermocouple in the grid circuit, together with a potentiometer arrangement for readily varying the plate voltage. A 1000-ohm resistance, across which the modulation voltage is to be applied, is inserted at the telephone terminals and normally used for a pair of telephone receivers. A curve is now plotted, as shown in Fig. 2, with Ep (d-c.) against I osc as read on the thermocouple meter.

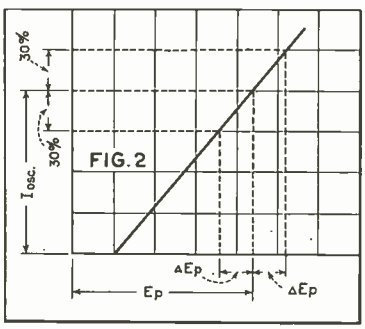
Having drawn the curve, we may refer to the sketch in Fig. 3, where the form of a modulated wave is shown, by definition K (% mod)=Im/Ic x 100. Supposing I osc for a given value of Ep (d-c.) to be 1 ma., then, if modulated to a degree of 30 per cent, the amplitude will vary from .7 to 1.3 ma. a-c. Drawing the horizontal lines from .7 and 1.3 ma. so as to cut the curve as shown in Fig. 2 and erecting the verticals we find the variation about the chosen value of Ep (d-c.) necessary to attain the required percentage modulation. This modulation voltage is obtained in "peak" volts which value will be approximately 1.4 that read on the tube voltmeter, which, it is assumed, will be calibrated in r.m.s. values.

As was stated, this method will be found extremely satisfactory in cases where a rapid setup with the material at hand is desired, its accuracy leaves a lot to be desired, and the method to follow is of a decidedly more precise nature.

Fig. 4 shows an r-f. oscillator modulator and amplifier, together with the



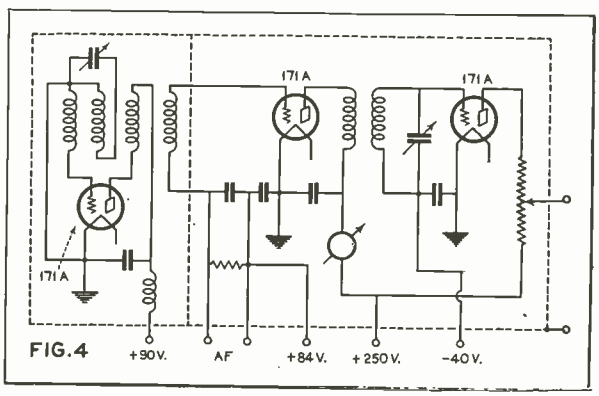
Form of modulated wave.

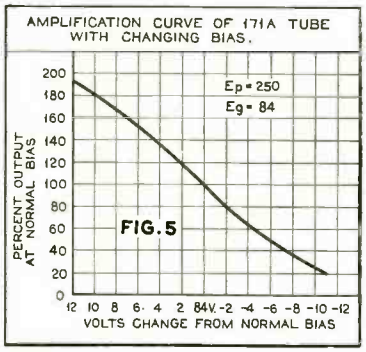


Modulation curve.

Right:

Radio - frequency oscillator, modulator and amplifier.





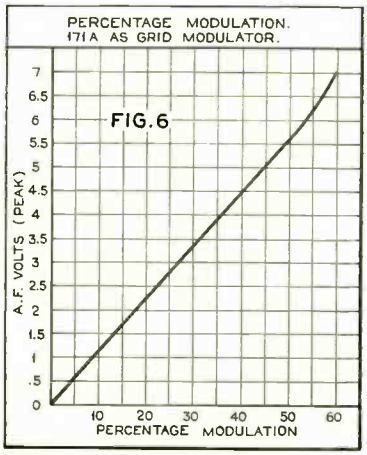
accessory apparatus. The condenser in the oscillator circuit may be accurately calibrated for the band to be covered. The transformer coupling, the modulation and amplifier stages should be designed so as to be broad enough to avoid cutting of side bands at high modulation frequencies. Any good interstage r-f. transformer will serve the purpose.

The oscillator circuit shown is of an extremely stable nature and amenable to precise calibration. The coils are wound on three bakelite tubes fitted one inside the other, and tuned by a 350 $\mu\mu f$ condenser. The winding data is as follows:

Grid coil—
40T No. 25 En. on 2 inch tube.
Plate coil—
40T No. 25 En. on 1½ inch tube.
Tuning coil—
80T No. 25 En. on 1¾ inch tube.

The pickup coil consists of a few turns wound over the outer coil and insulated with empire cloth.

The modulation system is based on the operation of the tube with such voltages that the change in effective gain with changing bias is linear. The curve in Fig. 5 is for a 171-A tube biased, as indicated, and is self-explanatory. Fig. 6 has been calculated



from the data in Fig. 5 and gives the peak values of a-c. to be applied across the resistance to obtain the desired modulation percentages.

Quality Check on Vacuum Tubes

By A. J. Fajen *

THE performance and quality of any properly designed radio receiver is dependent largely upon the tubes it uses. These tubes must be properly designed to have their characteristics similar to those around which the set was designed. These characteristics must be maintained within very close limits, and they must remain within those limits during the life of the tube. It is for this reason that are maintained complete engineering testing laboratories. All new types must be passed by this department before they are ready for production and release. This department is separate from the factory test and is a standard by which limits for the factory tests are determined.

Samples of all types of tubes are selected each day from production and given complete characteristic tests in addition to the tests they receive in the factory. They are tested on a specially designed test set. This set will test for filament current, emission (direct or indirect, according to type), gas content, by the method of reading reverse grid current or ionization current (according to the type), plate current, leakage, grid current, screen-grid current, amplification factor, plate resistance, mutual conductance (which is calculated from the two preceding readings), grid emission and heater cathode leakage. All of these tests are made on one set by a special arrangement of circuits and a control panel for the proper voltages. A set of this type uses laboratory meters. The meters are checked by standards or standard resistances three times each week. This complete characteristic test determines what changes are needed to bring the tubes in production closer to the bogy and characteristics, and determines characteristics for new types.

Standardized Tests

After the tubes receive the complete tests, they are labelled for life test, Test racks are provided for each type, on which they are operated at their maximum designed voltages. The filament types are burned continuously, but the cathode types, such as the -24 and -27, are burned intermittently. This is accomplished by a specially designed geared mercury switch that turns the tubes on for fifteen minutes, and off for five minutes. Radio tube engineers recognize this practice as an extremely severe test. However, with the new type insulator used in deForest cathode type audions, this intermittent test has no effect on the life of these tubes. It is not necessary to give the filament types this test, since the filament is free and not enclosed in an insulator as in the case of the heater of the cathode types. Readings are taken periodically to determine any change in original readings. These readings are recorded and any deviation from design characteristics is immediately checked and remedied.

Special force tests are made to determine how the tubes will stand up under adverse conditions as there are heavy line surges in various localities throughout the country that cause the tubes to be operated in excess of their proper voltages. It should be remembered that life of a tube should not be based on how long the filament remains lighted, but by the length of time that the tube maintains its characteristics within certain limits. The filament or cathode of a tube may light, but it can be inoperative in a radio receiver. New developments are constantly being tested in the deForest testing laboratories. Special tests are continually being made, such as bump tests, shipping tests, etc., to determine if the mechanical structure of the tubes will withstand severe shipping conditions. The spacing of the elements must remain the same during shipment or the tube will not function properly.

* *Engineering Department, DeForest Radio Company.*

Three-Electrode Thyratron Tube as a Rectifier

Over an experimental line engineers transmit high voltage direct-current

FROM a series of original investigations of electron discharges in gases which Dr. Irving Langmuir carried out in 1914 in the research laboratory of the General Electric Company has come the Thyratron tube, one of the most recent additions to the tube family. It has inherent advantages as a means of controlling electric power, and has begun to be used most effectively in this manner in such unique applications as the system of operating the stage lighting of the Chicago Civic Opera House from in front of the footlights, and the spectacular method of decorating with light the walls and ceilings of rooms, known as colorama.

But scientists believe that the possibilities of the Thyratron tube are not confined to the function of control. The men who have been responsible for its creation and development believe it may also become the means at some future time of accomplishing power transmission under more advanageous electrical conditions than those at present prevailing. This idea is based on the expectation that the Thyratron tube may make it possible to transmit electrical energy over relatively long distances by means of direct current instead of alternating current.

Seeking to develop this proposition, an experimental miniature transmission line has been set up in the General Electric research laboratory and equipped with Thyratron tubes. The artificial transmission line itself was represented by a copper bar about seven or eight feet in length. Electrical conditions were imposed, in the matter of ohmic resistance, which made this line equivalent to 400 miles of transmission conductor in a commercial system. As the longest commercial system now in existence is 250 miles in length, this experimental line, in its electrical characteristics, was more than 50 per cent beyond present practice.

At the sending end of the line was installed a bank of Thyratron tubes functioning as rectifiers, to convert alternating current into direct current for transmission purposes. At the receiving end of the line were installed other Thyratron tubes which functioned, in pairs, as inverters. They inverted, or changed back, the direct current into alternating current. The source of current-supply for the experimental system was the bank of transformers which furnished alternating current at 15,000 volts.

When this interesting experiment was tried, it was found that transmission of the power was accomplished without difficulty, and that the Thyratrons, operating at one end as

Dr. Irving Langmuir and Dr. A. W. Hull with Thyratron power tube.

rectifiers and at the other end as inverters, handled successfully the current at 15,000 volts. At the receiving end the tubes delivered the energy to transformers, which reduced the pressure to the voltage of the working circuits in the laboratory shop, and through these circuits it was put to work in motors, just as is done in every-day practice everywhere.

As a further demonstration, the experiment was later repeated with the addition of a double-conversion process at the receiving end of the experimental line. After having been inverted and sent through "step-down" transformers, the current was passed through a motor-generator set and reconverted again into direct current at working voltages. Thence it was supplied to shop circuits which required direct current, for regular work in direct-current motors.

The experiment was regarded as significant of what may be in store at some future period in electrical engineering developments. It is quite possible, from the present trend as revealed by this experiment, that within the next decade—precisely how soon laboratory men do not care to speculate—direct-current transmission on a scale comparable with or at least approaching, the present practice with alternating current will go into commercial usage.

Not since the earliest days of commercial application of electricity has direct-current transmission been considered practicable. In the electrical beginning of things, when arc lights first came into use, followed a few years later by Edison's incandescent lamp, almost all transmission in commercial systems was by direct current. That was 50 years ago, before the era of wide-spread electrical networks which serve a majority of the nation's population. The arc-lamp systems operated on the series circuit and started in 1879 and 1880 with pressures of 2,000 volts, although in more recent times they have gone as high as 8,000 volts. The incandescent system utilized the multiple circuit and transmission was at the low pressures of 110 or 220 volts. These represent two methods of transmitting economically by direct current, but their disadvantages would be so pronounced if employed under present-day conditions that the development of the transformer and the alternating-current systems that came in shortly before 1890 was little less than the salvation of electrical practice at that period. If transmission by direct current at high voltages can be accomplished, with the aid of the Thyratron tube, the benefits, both electrically and economically, will be decidedly noteworthy.

The Thyratron tube has been 15 years in reaching its present state of development as a perfected and effective control device, with latent possibilities in transmission mentioned above. After Dr. Langmuir had conceived the idea of making use of the character-

(*Continued on page* 46)

Radio Transmitting Tubes

By Dr. Paul G. Weiller

This article is a first-hand account of the elements of modern tube manufacture

THE transmitting tube is the big brother to the receiving tubes with which manufacturers and engineers are thoroughly familiar.

If the relation between the heat dissipated in the tube and its overall size, and that of its component parts were the same as in receiving tubes, there might be less of a tale to tell about transmitting tubes.

Considerations of space and greater ease of manipulation, the awkwardness of large glass containers plus the eternal weakness of humans in their desire to get a great deal out of very little has compelled us to cramp so much power into so small a space that every element in a power tube is strained to the utmost limit in operation—or during the manufacturing process itself.

The safety factor is very small. Consequently the manufacture of power or transmitting tubes is an art by itself.

There are two general types of air-cooled transmitting tubes. By far the most popular of the two has a Nonex glass envelope, practically all parts being made of tungsten, molybdenum or tantalum.

The filament of these tubes can be either plain tungsten, or where greater filament efficiency is required, thoriated tungsten. Coated filaments are not used as a rule.

The other type has envelopes of soft glass and parts of oxidized nickel. The filament is mostly platinum coated with barium and strontium oxides.

Hard Versus Soft Glass, and Nickel Versus Rare Metals

It may be well to begin a paper on transmitting tubes with the listing of pros and cons of both types of construction at a time when transmitting tubes bid fair to grow from a semi-laboratory product to the object of large scale production.

This transition is being caused partly by the requirements of the talkies and partly by the immense increase in the use of small transmitters for all sorts of uses for which radio as an inexpensive and convenient means of communication was not thought of only a few years ago.

Soft glass is cheaper than hard glass. Soft glass bulbs may be purchased at about two-thirds the price of hard glass bulbs. The price of soft glass tubing is, however, one-fifth that of hard glass tubing. The cost of glass for stems and exhaust tubing, including shrinkage, is an appreciable item in hard glass tubes.

Soft glass may be handled with customary gas fires. Hard glass requires oxygen for some operations, particularly for machine work, though small transmitting tubes can be made without the use of oxygen. There are few glassblowers who know how to handle hard glass properly.

Hard glass is much more resistant than soft glass to mechanical breakage, cracking, softening and sucking in when severely overheated during periods of overload, or during exhaust.

Because of lower resistance against heat and mechanical injury and because of absorption of a greater quantity of water vapor which is hard to entirely eliminate during exhaust, tube structures must be redesigned if soft glass is to be used as envelopes for types formerly made of hard glass. A simple substitution will result in a product of very inferior quality.

Soft Glass Tubes Are Made With Nickel Plates

Because the melting point of nickel is much lower than that of molybdenum greater heat dissipation must be provided by increased size of the plate itself and by covering it with a dark colored oxide.

Coated filaments are mostly used for this type of tube. It may be said without fear of contradiction that where overload carrying ability, long life and high voltages are important requirements the hard glass tube with rare metal plates is uniformly to be preferred; in fact no generally satisfactory soft glass, nickel plate tubes are available for much over 1000-volts plate potentials.

For amplifier service at 1000 volts or lower it is possible to make tubes with soft glass and nickel parts, somewhat cheaper than rare metal, hard glass tubes.

The Glass Work

The glass work connected with the manufacture of transmitting tubes is of a peculiar kind. Glassblowers must have considerable experience in tube work to be successful. Apparatus makers can seldom be trained to make satisfactory transmitting tubes. The equipment for glass working is relatively simple. The glassblower's table should stand in a corner where it is protected from draft and from too much light. The latter requirement may be surprising, but the reason is that the glassblower must always be able to see his flame so that he can hold the work in proper position in reference to different parts of the flame. In strong daylight the blast flame is barely visible.

Drafts will make the flame flicker. For good work a perfectly steady flame is essential.

A large amount of work can be done on a 10 or 16 burner cross fire similar to those on stem machines, and on two sizes of cannon fires, both of which are operated with gas at 8 inch water column and air at 5 pounds pressure.

For better production speed and for large pieces oxygen fires must be used. There are two types of oxygen cross fires. One is built somewhat like the fires on stem machines. Oxygen and gas are fed under pressure to a mixer where the mixture is regulated by a gas and an oxygen cock or valve.

These burners have a perfectly blue flame, emitting little light. They are not so easy to adjust and maintain adjusted as the type to be described. As gas and oxygen lines are connected through the mixer, some oxygen may get into the gas line and cause explosions. To prevent this a fire check is used.

The other type consists of a series of gas nozzles each one of which is blown by a separate oxygen nozzle fashioned by the glassblower himself from suitable glass tubing. As gas and oxygen remain entirely separated while they are within a pipe there is no danger from explosions. This type of fire can be very accurately regulated. Its biggest drawback is the intense white light at the base of each flame which is apt to affect the operator's eyes. The fires are best set up on a large table or bench covered with transite.

Glass blowing is still an art which requires great skill and can be acquired only by years of work under proper guidance. There is no short-cut to perfection.

The relatively small numbers in which transmitting tubes are made and the great variety of sizes and shapes preclude general applications of machine work, though stems and simple seals can be made by machine.

Stem Making

Nonex glass has the same coefficient of expansion as tungsten. Therefore, tungsten is used for all wires passing through the glass. To make good stems the tungsten must be perfectly sound, free from cracks and longitudinal pores. Because of the peculiar process by which tungsten rods and wire are manufactured the original rod sometimes is hollow through a considerable part of its length.

During the subsequent swaging and drawing these cavities to all appearances close, but the metal is never heated sufficiently to weld and a leakage path through the entire wire remains. The tungsten must be cleaned. New wire is best cleaned by passing it through a hydrogen furnace and subsequent tumbling with sand.

Wires recovered from defective stems or from old tubes can be cleaned with potassium nitrite (not nitrate). The wire is heated to bright red heat and a stick or lump of nitrite rubbed over it. The nitrite melts on the hot wire. The wire is then heated again until the nitrite flows over the entire part to be cleaned and quickly thrown in water. The water dissolves the salt and leaves the wire with a brilliant silver-like surface. One must be careful not to overheat the wire as tungsten will burn up in nitrite at high temperature.

It is very important that this cleaning operation be carried out with the greatest care as only perfectly clean tungsten will make a tight seal with glass. Because of the large size of the stem wires for power tubes stems cannot be made directly as it is done in receiving tube practice.

The large amount of metal carries the heat away faster than the glass at proper stem making temperature can supply it. Consequently when the glass is at proper temperature and consistency the part surrounding the wire will still be too cold to properly adhere to the metal. It is therefore necessary to surround the wire with glass before stem making. This operation is called beading. A piece of glass tubing of proper size is slipped over the tungsten wire and heated in a cross fire until the glass is melted and adheres to the wire.

As described here this operation seems simplicity itself. It is, however, one of the most ticklish. If the bead has not been sufficiently heated or if the tungsten was not sufficiently clean the wire will appear black under the glass. If it has been overheated bubbles will develop along the wire. In both cases a leaky stem will result. The perfect bead has a straw yellow tungsten surface perfectly free from bubbles.

Contrary to general belief no oxygen is necessary to make beads. The beading temperature is lower than that necessary to make good stems. Beading can be done quite well on a stem machine but the customary fires have to be replaced by larger ones. The same fires properly reset may be used for making hard glass stems. It is however preferable to use an oxygen fire on the pinching position.

Sealing

Sealing-in of transmitting tubes is an art. It would serve no immediate purpose to describe it here. Simple seals of moderate size as, for instance, the one on the 50-watt tube can be made on the machine if the production is large enough. To set fires on a sealing-in machine it is of course necessary to run through a considerable number of bulbs and stems until the machine performs the operation just right. This entails a loss of expensive material which is warranted only if several hundred tubes are run after fire setting.

The Plates

In the United States the plates of transmitting tubes are nearly always molybdenum. Tantalum has been tried sporadically but has never been adopted as standard.

Personnel and equipment are adapted to use molybdenum. The switch to tantalum would require changes in processes and equipment and retraining of personnel. The higher price of tantalum is also in the way of its general adoption. It is used extensively in Europe.

The important dimensions of the plates must be accurately maintained if the tube characteristics shall fall within specified limits.

A variation of plus-minus .0005 inch is the maximum that can be allowed. In some cases tolerances are even closer. Close tolerances also are necessary where parts have to fit. Molybdenum parts cannot be bent to fit or be forced into place without causing strains in the material which will cause distortion of the whole structure when the parts are submitted to severe heat treatment during baking or exhaust.

The design of transmitting tube parts and of the dies necessary to produce them must be done with great care. Molybdenum sheet has only a small elongation; it cannot be stretched or drawn to any great extent. Die work must therefore be limited to cutting and bending operations except for a few shallow ribs for reinforcing purposes. No deep drawn shapes are possible even if several operations are used. Somewhat better results may be obtained by spinning molybdenum.

Difficulties are experienced due to the fact, that molybdenum sheet is not uniform. Some parts of a sheet will show greater resiliency than others causing the stampings to take uneven shapes. Due to these peculiarities of the material, dies for molybdenum have to be designed differently from those for nickel sheet. Generally there will be a greater number of operations.

Assembling

Assembling must be done in rather elaborate clamping fixtures. After stamping and assembling, the parts are sandblasted to give the surface a rough finish which increases heat radiation considerably. Sandblasting breaks the hard surface skin formed on the metal by rolling and stamping. Some strains are released and occasionally considerable deformation takes place.

To bring the parts back to specified dimensions and to prevent further deformation during baking the plates must be placed on fixtures which maintain at least the most important dimensions absolutely correct.

Most of these fixtures are rather simple: A cylindrical mandrel for round plates, a few bolts with accurate spacers for some flat plates where holes for the bolts are available.

The plates are baked in hydrogen at 1200° Centigrade during 30 minutes. It is important to dry the hydrogen with caustic potash as even traces of water vapor will cause formation of some molybdenum oxide which may prove very disturbing to exhaust operations.

1200° Centigrade cannot be obtained with nichrome wire furnaces. At present most manufacturers of transmitting tubes use furnaces which are wound with molybdenum wire. The entire furnace is contained in a cast-iron box which can be made air-tight. The hydrogen is admitted to the box. The winding is therefore always in an atmosphere of hydrogen. Such furnaces may be operated at very high temperatures but they are rather awkward to handle. The life of the molybdenum winding is not long.

The resistance of molybdenum at 1200° Centigrade is many times the resistance at room temperature. Therefore power must be admitted very gradually, the voltage being increased gradually as the temperature of the

furnace increases, which requires rheostats or tapped transformers.

The refractory materials of which the furnace tubes are made also do not stand rapid heating or cooling.

If temperatures of not more than 1200° Centigrade are required a much more rugged furnace may be built with Globar and a tube of special nickel alloy. Such a tube will stand 1200° Centigrade without buckling or oxidizing unduly. The Globar will stand even higher temperatures. Furnaces of this type may be run on 110-volts directly without transformers. Full power can be switched on immediately.

Hydrogen is admitted only to the tube. The Globar heating element is surrounded by air. A furnace using about 7 kilowatts will heat about 20 inches of the tube to the required temperature. Such a furnace is simple and convenient and can be repaired in a few minutes should anything go wrong.

All parts going into a transmitting tube as grids, support wires, insulators, should be subjected to the same heat treatment. Vacuum treatment at 1400° Centigrade will also materially assist exhaust.

Structural Materials

Before going further it will be well to note some of the peculiarities of the materials of which power tubes are constructed, and also of some of those which have been tried and discarded. This may help in avoiding failures caused by improper materials.

Some side-lights on the choice of glass must be added here, to what was said in another paragraph.

As the degree of exhaust of the finished tube depends very much on the temperature to which the tube parts are heated during exhaust it is obvious that better tubes can be made in hard glass as the plates can be heated much higher without sucking in the bulb through overheating and consequent softening of the glass.

Another weakness which soft glass is more subject to than hard glass is electrolysis. Even hard glass becomes a conductor at temperatures below red heat. Any appreciable potential difference between two points of the heated portion of the glass will cause a current to flow which will rapidly cause further overheating and failure by sucking in.

Soft glass will begin to electrolyze at a much lower temperature than the hard glass now used.

The old types of glass are silicates of lime and either sodium or potassium. Such glasses are often called lime glasses. Lead added to glass will lower its softening point and also change its optical properties. Such glass- is called lead glass. A well-known patented glass is largely a melt of boric and silicic anhydride: the latter better known under the name of quartz, only very small proportions of lime being added. It is easier to work than quartz, but retains some of its desirable properties.

At first power tubes were made of Pyrex glass. Tungsten was used for stem wires because it has the same expansion coefficient as Pyrex. It was however found difficult to make Pyrex glass wet the tungsten. The result was leaky stems. By adding a little lead to hard glass, little of its refractory qualities were sacrificed, but it was made to wet the tungston.

Welding Molybdenum

We have already described some of the peculiarities of molybdenum. Its welding properties remain to be recorded. If one welds iron or nickel it may be observed that both metals weld at a temperature considerably below their melting point. The metals soften and can be made to coalesce by applying moderate pressure with the welding tool. Only a thin skin of oxide forms, which latter is quite a good conductor even when cold. Therefore, nickel and iron weld easily.

Molybdenum behaves in an entirely different manner. It does not become pasty at any temperature below its melting point. When the latter is reached the metal suddenly becomes liquid. Furthermore, the metal burns rapidly in air to an oxide which is a poor conductor hot or cold. Hence, welding molybdenum requires considerable skill. If one considers that a grid may have 50 or even more welds these peculiarities of molybdenum cause considerable difficulties in production.

A jet of hydrogen directed on the welder at the moment of welding helps matters some. Welding molybdenum to tantalum is better than molybdenum to molybdenum but parts containing tantalum cannot be hydrogen treated. It is rather suprising that arc welding is not resorted to more often.

Arc Welding

Arc welding of course requires fixtures to hold the parts in place. It also requires some changes in the structure, but is much more convenient than spot welding. The finished weld whether spot or arc welded is very brittle. If the structural elements which have been welded are out of line it is not as a rule possible to bend them into place without breaking the weld. It is necessary to make a perfect job when they are welded.

Spacers or insulators are best made of so called lava. This material has no connection with the well-known product of volcanic eruption. It is soapstone or steatite baked in hydrogen.

Ceramic materials, as several varieties of porcelain and similar materials containing magnesia have been tried frequently. While their mechanical and electrical properties are quite satisfactory it is not possible to manufacture them to sufficiently rigid measurement requirements.

The distance between holes in an insulator must in many cases be kept within less than two thousandths of an inch of the specified dimension. This is well-nigh impossible with ceramic materials because of the more or less erratic shrinkage of their clay base.

If several batches of such products are inspected it will be found that while the variation in dimensions between pieces of the same batch seem quite reasonable, the variations between batches exceed permissible limits.

Lava is machined before baking. The shrinkage during baking is only about one per cent and very regular. Its mechanical properties are not as desirable as those of porcelain, because it is more brittle.

▲

RADIO IN JAPAN

The Japan Wireless Company has installed a short-wave transmitting plant of the RCA type in the station in Aichi Prefecture, which carries on wireless traffic with Europe exclusively, while the receiving station at Yokkaichi, in Miye Prefecture has been equipped with beam appliances of the Marconi type.

▲

LARGEST RADIO STATION ON THE CANADIAN PACIFIC COAST

A RADIO station to be erected near Vancouver with a range of between 5,000 and 8,000 miles. is the outcome of a plan to consolidate several radio services at present being performed by the Department of Marine on the West Coast. Separate sets of equipment will be installed, each operating on a different frequency. Point to point communication with numerous outlying localities throughout British Columbia, which are not already served by wire connections, will thus be carried on simultaneously with ship to shore radiotelegraph and radiotelephone communications.

Vancouver now acts as a terminal station for approximately 36 private stations located at canneries, paper mills, etc., on the Pacific Coast and adjacent islands, but with the facilities which will be available at the new station, the radio organization will be so revised that most of these private stations will work direct with Vancouver, thus improving the circuits by reducing the existing long-wave relays.

The site of the station on Lulu Island will be well removed from the city, thus eliminating the possibility of interference with broadcast reception and also minimizing the degree of interference from various sources which at present affects the efficient working of the radio stations now being operated in the Vancouver area.

Coils For Radio Uses

and How They are Made

*By Harry L. Saums**

Paper-Section Coils

THE paper-section type of coil is the most widely used of any form of electrical winding, largely because it combines qualities of high insulation resistance and electrical reliability with the lowest possible cost.

These coils are wound on perfected semi-automatic machines, in "stick" form, several at a time. A supporting tube of paper, fiber or similar material is placed on the winding machine mandrel, which latter turns at a high speed while the wire is being guided in even layers to a pre-determined coil length. Paper insulation is inserted during the winding between each layer of wire, and the coil is thus built up of alternate layers of wire and paper until the desired number of turns is reached. The stick of coils is then removed from the machine, the individual coils are cut apart, supplied with leads and covers, and go on to the impregnating and finishing operations.

Due to the inside tube and layer form, the coils are self-supporting. Since several are made at a time, the quantity depending on coil length, the unit winding cost is a minimum. To keep winding costs low, coil lengths should be kept short.

Adjoining layers of wire are definitely separated with paper insulation, and the voltage drop between adjacent turns of wire is consequently relatively small, making for thorough and permanent freedom from shorted turns and eliminating likelihood of break-down in service. It is possible to design paper-section coils so that the insulation will meet the most severe commercial requirements.

The paper-section form of winding is very flexible, permitting completed coils which may be built up of several sections, either slipped over one another, assembled side by side, or in various combinations. Each section may be wound of a different size of wire, and with different turns, as required in transformer practice.

Plain enameled copper wire is commonly used in paper-section coils, in sizes 18 to 42 B. & S. gauge inclusive. Heavier wire may at times be employed for single layer sections, such as filament secondaries of power transformer coils, where fabric-covered wire is also useful.

Terminal wires, known as "leads," are anchored very strongly in these coils by the experienced coil maker. Final finish includes a wax or varnish treatment which excludes moisture and makes the winding mechanically rigid.

In many forms of electrical apparatus which require coils, production economies can be effected if original design work provides for the use of paper-section windings. This necessitates that more room be provided for the paper coil than would be necessary for other types, as paper-section windings obviously need somewhat more space for an equivalent number of turns, due to paper insulation and paper margins at the ends. Generous allowable dimensions for the coil usually permit lower costs. Close attention to this phase of the coil design is urged upon all designing engineers.

Form-Wound Coils

Coils of this construction, as the name implies, are wound in a form. This form may or may not become a part of the completed coil. If a temporary form is used in winding, the coil itself may be held together with tape tied or gummed at proper points. In the standard construction of dynamic speaker field coils, part of the form is left on the coil, adding desirable mechanical strength and protection.

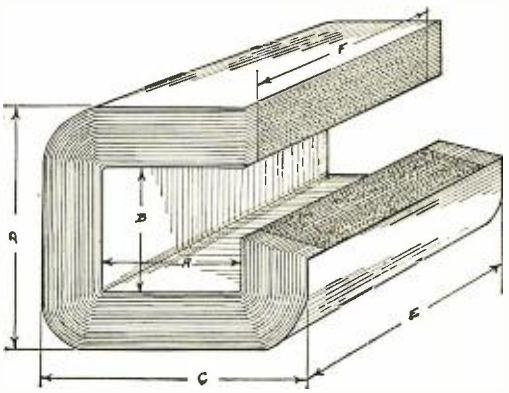
There is generally no insulation between the layers of wire, other than that on the wire itself. Enameled wire is most frequently used. Winding is usually of the "random" type so a greater number of shorted turns and lower insulation resistance are to be reasonably expected, than with paper-section coils.

The greatest advantage of form-wound coils is that the largest number of turns of a given wire can be put in in the space available, and this attribute is their principal recommendation.

Bobbin-Wound Coils

Coils wound on spools or bobbins are generally the most expensive type of construction. Large quantity runs sometimes permit multiple winding, but with average requirements, the winding process is a slow one, particularly if even layers are specified.

Bobbins of bakelite or similar molded material are the cheapest for very large quantities. Wooden spools, built-up fiber spools made from fiber washers and fiber tubing, or spools consist-



Cut-away choke coil, showing standard dimension symbols.

* *Chief Engineer, Coilton Division, Polymet Mfg. Corp'n.*

ing of an iron core (part of the magnetic circuit) with pressed-on fiber end flanges, are various types useful under certain conditions.

Neatly made bobbin-wound coils can be finished to give an excellent appearance, and are often preferred in exposed positions or where unusual mechanical protection is advisable.

Both fabric-covered and enameled wires are used extensively in bobbin-wound coils.

Cotton-Interwoven Coils

Cotton coils are made on special machines which wind the wire—usually plain enameled—in even layers, and continually interweave cotton strands between the wire and the wire layers. The winding process builds a heavier insulation of cotton at the end turns of each layer (where voltage differences are the greatest), and carries the cotton beyond the wire winding as a protecting margin. A center tube of fiber or paper, combined with the interwoven winding, makes a self-supporting coil of excellent appearance and good electrical characteristics. The cotton readily absorbs impregnating varnishes.

A slightly greater number of turns of wire may be built into a cotton coil than into a paper coil occupying the same space. The cotton coils, for average sizes, are more expensive than paper-section, but generally somewhat less than bobbin-wound coils of equivalent characteristics.

Explanation of a Few Terms Used in Coil Design Work

Build—The "build" of a coil, tube, or section of a coil, is the thickness of the part. This is generally measured on a plane which is at a right angle to the axis of winding. The *calculated* coil build is obtained by adding together the thickness of the tube, all the layers of wire, all the inter-layer paper and the cover. Briefly, in a paper-section coil, the *measured* build is the thickness of the coil over the end (i e., over the "flats"), measured from the inside of the tube to the outside of the cover by the shortest possible distance.

Space factor—The "space factor" is the relation between maximum space available and calculated theoretical coil build. It is expressed as a percentage, and equals

$$\frac{\text{Calculated coil build (in inches)}}{\text{Maximum space available (in inches)}}$$

The maximum space available is usually the height of the "window" opening in the lamination, or the distance which definitely limits the total thickness of the coil winding over the core, with necessary clearance allowance added in.

Obviously wire, paper and other parts cannot be wound with such intimate contact that a coil will occupy the exact dimensions given by calculation.

Properly chosen space factors are an essential to economical coil production. Any attempt to use space factors above the recommended limits will result in over-size windings or abnormally high costs.

Paper margin—The wire in the layers of a paper-section coil cannot be wound to the edge of the coil. There must be "paper-margin", for support, beyond the actual winding. The necessary length of this margin varies principally with the wire size being used. The distance from the edge of the coil to the start of the layer of wire, is commonly called "the paper-margin."

Specifications for Paper-Section Coils

It is preferred that customers sufficiently detail their requirements to facilitate manufacture and insure windings of proper construction.

A fully dimensioned drawing of coil, with lead locations marked, and accompanying descriptive data, constitutes the most desirable specification method.

For purposes of standardization, there have been adopted dimension symbols shown in Fig. 1. A and B indicate inside dimensions of square or rectangular coils. For round coils, A indicates inside diameter. C and D indicate width across "flats" over cover, for square or rectangular coils. For round coils, C indicates outside diameter. E indicates overall length of coil. F indicates length of winding.

For quotation or constructional purposes the following information is required.

1. Inside dimensions A and B.
2. Limiting outside dimensions C and D.
3. Length E.
4. Wire size.
5. Turns or resistance (if resistance, give temperature at which taken, and allowable tolerance).
6. Type, length and location of leads.
7. Impregnation or other treatment.
8. Any special tests coil must pass.

The above are minimum specification requirements. More complete information regarding use of coil and probable performance-demands often enables the manufacturer to make helpful recommendations.

For radio and similar exacting coil usage, specifications involving inductance determined under known conditions are carefully followed.

Choke Coil Design Suggestions

The requirements which filter choke coils must meet are tending to become more exacting as the radio art develops. The following data may help the radio engineer to decide if his design of a choke coil will go in the space provided for it and whether or not the coil is suitable for economical manufacture. Information given cannot serve as an absolute guide for all cases, as the shape of the coil, as well as the size of wire, number of turns and paper layers affect the space-factor which will be practical for the coil in question. The data given is intended to cover coils in which the core opening is substantially square and does not exceed 1¼ in. Coil design in which the core is decidedly rectangular should be allowed a more liberal space-factor.

(*Continued on page* 38)

WINDING TABLE FOR CHOKE COILS

Enameled Wire B. & S. Gauge	Minimum length of paper margin	Thickness of glassine layer paper	Necessary space-factor for economical production
40	1/16 in.	.0007 in.	75%
39	1/16 in.	.0007 in.	75%
38	5/64 in.	.0007 in.	76%
37	5/64 in.	.0007 in.	76%
36	3/32 in.	.0007 in.	77%
35	3/32 in.	.001 in.	77%
34	7/64 in.	.001 in.	78%
33	7/64 in.	.001 in.	79%
32	1/8 in.	.001 in.	79%
31	1/8 in.	.001 in.	80%
30	1/8 in.	.001 in.	80%
29	1/8 in.	.0012 in.	81%
28	1/8 in.	.0012 in.	81%
27	5/32 in.	.0012 in.	82%
26	3/16 in.	.0012 in.	82%
25	3/16 in.	.0012 in.	83%
24	3/16 in.	.0012 in.	84%
23	3/16 in.	.0012 in.	85%

DATA FOR CORE TUBE

Dimensions	Tube Construction
Up to ½ inch square	2 wraps .020 inch special paper board
½ inch to ⅝ inch square	6 × .005 inch Kraft
⅝ inch to ¾ inch square	7 × .005 inch Kraft
¾ inch to ⅞ inch square	8 × .005 inch Kraft
⅞ inch to 1 inch square	9 × .005 inch Kraft
1 inch to 1¼ inches square	10 × .005 inch Kraft
Rectangular	2 wraps .024 inch. special paper board

(*Continued from page* 36)

Let us assume that the electrical requirements will be met with a coil having 4000 turns of No. 33 enamel on a core having a cross section ¾ inch × ¾ inch. Dimensions A and B should then be specified to be 13/16 inch which allows 1/32 inch clearance for easy stacking of the laminations in the coil. This allowance should be made on any choke coil which falls within the dimensional limits of the data given. The length of the coil, dimension E, should be 1 inch for best manufacturing conditions, and may prove satisfactory from an electrical standpoint. The coil data, including use of preceding tables, can now be calculated in the following convenient form:

Turns=4000

Wire size=33 enameled

Wire diameter=.0077 inch over enamel.

Turns per inch=120.

Wire travel = ¾ inch. [Computed by subtracting from 1 inch (coil length) the sum of the two paper margins 7/64 inch + 7/64 inch and 1/32 inch additional for wax thickness; i. e., 1 inch—(7/64 + 7/64 + 1/32) = ¾ inch]

Turns per layer = 90. [As above given, wire travel per layer is ¾ inch, and turns per inch are 120, so .75 × 120 = 90.]

Layers = 45. [4000 turns divided by 90 (turns per layer) with result carried to an even layer.]

Layer paper = .001 inch glassine

Tube =7 × .005 inch Kraft

Cover = 1 × .005 inch Kraft

Build of tube = .035 inch (7 × .005 inch)

Build of paper = .045 inch (.001 inch × 45)

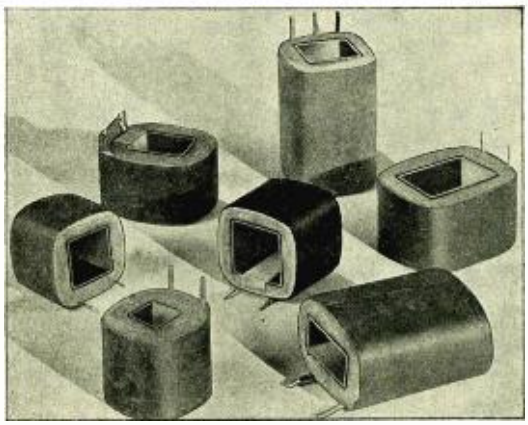


Fig. 2. Coils of various dimensions.

Build of wire = .347 inch (.0077 inch × 45)

Build of cover = .005 inch

Total build = .432 inch

The contemplated lamination we will assume has a window dimension in the direction of D of 5/8 inch or .5625 inch. The build being .432 inch the space factor for this coil equals $\frac{.432}{.5625}$ = 76.8 per cent. The space-factor given in the preceding table for this size of wire is 79 per cent. This coil will therefore be a good economical manufacturing design. If the calculated build is in excess of 79 per cent of the window dimensions then difficulty in the manufacture of the coil will be expected.

Choke coils are usually impregnated in a wax mixture and the ends are then sealed with the same material. In calculation allow 1/32 inch at each end for space occupied by wax.

Choke coils are tested before shipment for turns, opens and shorts. The turns are held to 3 per cent of the specified number unless a more rigid requirement is necessary; closer limits tend to increase costs. Narrow limits on both turns and resistance in the same coil cannot be met, as the finer wires must have a larger resistance tolerance. With turns held constant a resistance variation of ± 10 per cent is to be expected. If the resistance must be held closer than this, then a leeway of ± 10 per cent on turns should be allowed.

As the choke coil is one of the least complicated forms of winding, the calculation example here given may be considered as basic, and the same principles adapted to computations of other coil types.

R. H. LANGLEY TALKS ABOUT THE PETERSON SPEAKER

"IT isn't the speaker itself but the skill with which it is adapted to the radio set that makes the difference between intolerable squealing, rattles, squawkiness, etc.. and actual faithful, musical reproduction," according to Ralph H. Langley, director of engineering, the Crosley Radio Corporation. "Once again this long established truth has been demonstrated in the production of the new power speaker that is being used in the Crosley Companionship series for 1930-31.

"Six years ago, Charles W. Peterson developed an entirely new idea of loudspeaker motor. It was the result of many months of careful work in his own physics laboratory. When it was submitted to Crosley engineers they immediately recognized that the theory of the Peterson unit was entirely sound.

"So unique was the design of this speaker which proved capable of adaptation to the varied and ever increasing requirements of the radio industry that the mechanical arrangement has been improved, readapted, revised and changed to keep pace with the progress of the art and the advent of more powerful output tubes and more faithful amplifiers in radio sets.

"The latest problem in the engineering department was to adapt it to a single 245 output tube, resistance coupled to a screen-grid detector. Even the minutest detail of the construction of the speaker was carefully analyzed. Samples containing in graded steps different dimension for each of the improved parts were built and measured in two different sound pressure booths and they were also subjected to the most critical listening tests under a variety of room conditions.

"The result has been not only a remarkable adaptation of the speaker to the new set, but at the same time a decided improvement in its efficiency so that a greater volume of sound than ever before is realized from the output tubes. Hand in hand with this went a refinement of the parts and processes to eliminate minor difficulties that had been observed in the previous production and to thus increase the reliability and life of the completed speaker.

"Although the cone used on this new power speaker and the frame which supports it are both quite different from anything used in the past, casual examination of the motor itself might indicate that there has been no change. Actually, however. it is in the hidden, internal parts of this speaker, the armature, the spacing blocks, and in the exact number of turns of wire on each of the windings that the real changes have been made. These differences cannot be seen but they can be instantly appreciated the moment the music starts flowing from the new speaker."

The following members of the Crosley engineering department worked with Mr. Peterson in the development of the new speaker: R. H. Langley, A. F. Parkhurst, Roy Bird, Andrew Kidd, Edward Austin and T. A. Hunter.

CONTROL *Counts Most!*

BABE RUTH recently wrote that "Control makes a pitcher and lack of it breaks him." Simple . . . easily understood.

In radio it's also a case of CONTROL. That's where CENTRALAB comes to bat with a Volume Control that is as smooth as Dazzy Vance's pitching —yet as powerful as Babe Ruth's slugging.

CENTRALAB volume controls in millions of radio receivers are making this a nation of red hot radio fans.

Announcement!

New theatre Faders and Mixer-T Type Volume Controls are in production. Of a different design than any other, these controls offer Constant Impedance to both Input and Output circuits.

There is a special Engineering Bulletin ready for Projection Engineers.

WRITE FOR IT
Dept. 212B

Centralab

CENTRAL RADIO LABORATORIES
Dept. 212 B, 16 Keefe Ave. Milwaukee, Wis.

Radio Becomes a Musical Instrument

Tone, Fitted to Individual Ear, Acoustics and Program, Becomes Paramount Feature of Forthcoming Season's Superlatives

By Austin C. Lescarboura

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

RADIO has been sold to the American public on the basis of long-distance reception, sharpness of tuning, use of particular tubes, a change in speakers, the beauty of the cabinets, attractive price and various other considerations, all of which have served the industry well in causing people to buy and buy and buy.

And now, having just about exhausted appeals, the radio industry has decided to exploit radio receivers for their true value, namely, as musical instruments. Not to the imaginations of men seeking the thrill of tuning in far-off stations, nor again to the eye that desires the sight of a fine piece of furniture, but to the *ear* of the nation, is the industry addressing itself. This 1930 realization of the true place of radio receivers in our lives, is a thing to which we may point with pride. Too much selling of products is done on irrelevancies. It is good to find an industry stressing the essentials of that which it sells—stressing them not only in their advertising and selling activities, but also in their design and production.

Improved Broadcast Receivers

The science of broadcasting having been virtually perfected, and receivers having been designed which lack the hum and squeal and squawk which characterized earlier models, the radio receiver has arrived at the point where it may justly say, "I reproduce music." In the first place, the novelty of long-distance radio having somewhat worn off, the public is satisfied with a few local stations in place of many distant ones. No longer do set owners go after records of distance and numbers, except when indulging in the latest thrills of short-wave radio.

Chain broadcasting is another thing. More, perhaps, than anything else, have the networks, by making possible the reception of the finest programs through many local stations throughout the country, brought about a true realization of the significance of a radio receiver. "First Things, First" has become the motto of the radio industry. The purpose of receivers is to reproduce broadcast programs. All right then, we shall perfect reproduction of these programs and stress fidelity of reproduction in design, manufacture and sales. And that is just what is being done. *Tone quality* is the keynote of radio receivers, vintage of 1930.

Tone Control Important

The RMA Trade Show discloses the trend toward perfection of tone. One manufacturer is featuring the tone control as the main talking point for the line. Instead of placing the tone control at the rear of the set, or somewhere on the chassis so that only the serviceman can find it and make necessary adjustment, this manufacturer places the tone control on the front panel, embellished with a sliding indicator passing over a full visibility scale marked "Bass" at one end and "Treble" at the other. In this manner the set operator can immediately note how the set is acoustically adjusted, as well as make any desired change in tone quality. This is one of the best merchandising points of the year, for an otherwise standard line of radio sets has been given a fresh appeal which is certain to count heavily in a highly competitive market.

Actually, from the engineering standpoint, there is nothing new in this idea. One well-known manufacturer of variable resistors has been preaching adjustable tone control for years, without securing a single interested manufacturer. The present merchandising scoop is nothing more than a variable high resistance in series with a small fixed condenser, shunted across the plates of the two power tubes arranged in push-pull. Less resistance in the shunt circuit causes more of the higher frequencies, responsible for the crisp, harsh, treble effect, to be by-passed before reaching the loudspeaker.

There is a real reason for tone control—just as much reason and even perhaps more than for the conventional volume control. In the first place all musical tastes are not alike. The fact that piano manufacturers have been producing so-called bass, treble and medium toned pianos for years past, is indicative of varying musical tastes. All radio merchandisers know how one excellent set will not sell to a given buyer, while a poorer set will, purely on the basis of varying musical tastes. Furthermore, programs differ. Some programs with harsh, sharp, sparkling dance music, may sound infinitely better with a lower cut-off of the high frequencies. On the other hand, a soft, mellow orchestration may become muffled, tubby and altogether impossible if the cut-off is definitely set around 4000 cycles, which is frequently the case especially in sharply tuned r-f. sets. Lastly, room acoustics play a large part in the tone quality obtained from a given set. If the room is well furnished, with good rugs, ample draperies, and heavily stuffed furniture, a set with plenty of high frequencies is necessary for pleasing rendition. But if, on the other hand, the room is sparsely furnished, with bare floors, no stuffed furniture, and an absence of draperies, then the set must have a low cut-off, for otherwise it will prove disagreeably shrill.

For years past, dealers have been confronted with the fundamental tone problem in selling radio sets. Time and again sales have been lost, due to fixed tone quality. More than an economically feasible stock of receivers has had to be carried, so as to make due allowance for different musical tastes.

And now, at last, radio manufacturers are beginning to see the light. Adjustable tone quality takes its place alongside other important refinements in recent years.

Compensating for Transmission Irregularities

Another manufacturer who has pioneered in adjustable tone control in his line of receivers, has a so-called tritoned receiver this season. This manufacturer seeks to compensate for the distortion due to the over-abundance of land wires employed in network broadcasting. He states that music will be heard through his receivers just as it is played at the key studio, and not as it goes out from a distant transmitter, with distorted tone caused by the many miles of wire lines through which it has traveled. Musical deficiencies will be made up, throatiness of speech will be eliminated, and, if we are to believe our ears, what so frequently appears to be the carnival calliope will henceforth be heard under its true colors of the philharmonic orchestra.

The importance of fresh tubes in radio sets is being stressed more than ever before by set manufacturers quite as well as by tube manufacturers. Unfortunately, there are no figures available on the difference in general efficiency between a given receiver with fresh tubes and the same receiver with exhausted tubes. That there is an enormous difference, is well known to engineers, but the public is woefully ignorant of the fact. It remains for

(*Continued on page 46*)

A Short-Wave Converter

By R. W. Tanner

FEW short-wave fans care to go to the expense of an additional multi-tube receiver for the reception of high-frequency broadcasts. Many types of converters are available on the market which may be plugged into the detector socket of a regular broadcast receiver. The audio amplifier only is then used, the r-f. stages remaining idle. Such converters are never entirely satisfactory due to their insensitivity and lack of selectivity. (Note: Selectivity should not be confused with critical tuning. There is a vast difference between the two.) Generally these consist of two tubes, a regenerative detector preceded by an untuned r-f. stage. As only one tuned circuit is employed the degree of selectivity is set by the principle of beat reception which is all right for code work but as soon as the detector is taken out of oscillation, the selectivity is wrecked. Signals as much as 50 to 100 kc. away can be heard and if some of these are code stations with bad key clicks, the din is terrific to say the least.

Seeing the need of a short-wave converter which would work with all broadcast receivers and give adequate selectivity and sensitivity with sufficient volume to operate a loudspeaker on even long distance signals, the writer started a series of experiments. The result was the super short-wave converter here described.

This converter makes use of the old familiar superheterodyne principle and is connected through a switch to the input of the regular broadcast r-f. amplifier which then functions as an intermediate frequency amplifier. In operation the broadcast dial is set at maximum, let us say, 540 kc. Then the detector in the converter is tuned to any desired short-wave station. By tuning the oscillator 540 kc. either above or below the detector, a beat note will be contained in the detector plate circuit. The intermediate frequency amplifier (broadcast amplifier) will then amplify this beat-note to a high degree. Due to the principle of beat reception, selectivity will be all that could be desired.

The schematic circuit of this type of converter is given in Fig. 1.

Two sets of plug-in coils are required to cover a range of 18 to 100 meters with .0001 mf. tuning condensers. The oscillator grid and plate coils L2 and L3 are wound side by side with L4 directly over L3.

It will be observed that a screen-grid detector is employed. This not only increases sensitivity but also eliminates interlocking of tuning controls, usual objections in short-wave superheterodyne design. The coupling coils L4 are connected directly in the detector screen-grid lead. Grid bias detector is employed in order to provide sharp tuning of L1-C1. The oscillator uses a series feed circuit which removes the greater portion of r-f. currents from the r-f. choke resulting in stable operation over the entire range. Both tuning condensers C1 are of the midget types and have a maximum capacity of .0001 mf.

The r-f. choke in the plate circuit of the detector should be one designed for 200 to 600 meter waves. The switching arrangement is clearly shown and employs a three-pole double-throw switch. The condenser C2 should not be greater than about .000025 mf. Larger than this would result in detuning of the first r-f. grid to too great an extent. Slight detuning is beneficial from the standpoint of tone quality since clipping of sidebands is reduced.

It sometimes happens that sensitivity is below normal with some makes of tubes. A variable resistor 0 to 500,000 ohms connected in the detector screen-grid lead (at the point marked X) will improve operation. Shielding is not necessary providing the oscillator and detector coils are separated at least 5 inches.

With this super short-wave converter stations can be tuned in which were impossible to find on other types of adapters. The user does not have to strain his ears, nor his imagination, to hear foreign broadcast stations since such stations are brought in like the proverbial "ton of bricks." If the broadcast receiver is a good one, interference from commercial or amateur code stations is seldom encountered.

A-C. hum even though the broadcast r-f. stages employ type 226 a-c. tubes, is at a minimum as only heater tubes are operated at the short-waves.

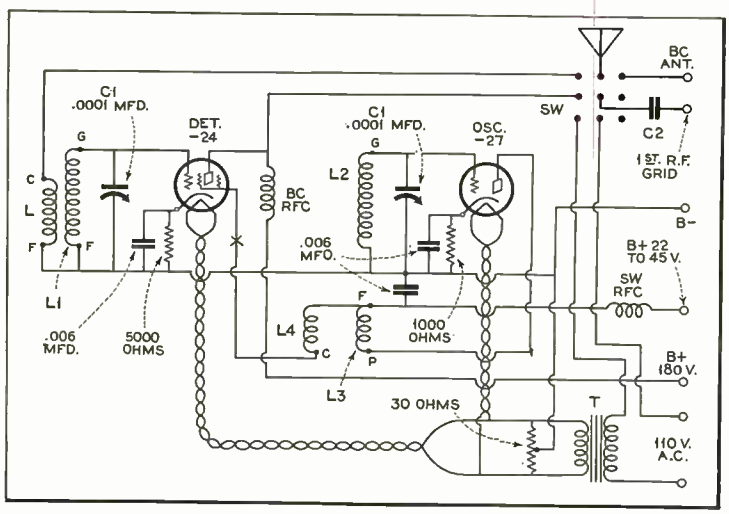


Fig. 1. Circuits of Tanner converter.

Don't let trick tubes black-ball your set

by George Lewis, Vice-President, Arcturus Radio Tube Company

THE moment of retail sale—the last hurdle between your factory and the ultimate listener—that's the pay-off time. Either your set meets the test, or your skillful engineering is largely wasted.

That's when slow-warming tubes can black-ball *your* set and turn the buyer to other makes. The 30-to-60-second delay embarrasses the dealer, irritates the customer, too often loses the sale.

But if your set is equipped with Arcturus Blue Tubes, the program snaps through in 7 *seconds*. The music is *clear,* true, *humless.* A strong first impression like this smashes sales resistance and sends your dealer's sales talk off to a running start. Quicker, surer sales are certain to follow.

And long after the sale, Arcturus' durability — proven by their world's record for *long life*—keeps on building good will for you.

Only Arcturus Tubes combine *clear* tone and *long* life with *quick* action. Don't take the chance of slowing-up your sales with trick tubes that give you some but not *all* of these necessary features. Specify Arcturus Tubes now, both for factory testing and standard set equipment.

ARCTURUS RADIO TUBE COMPANY
NEWARK, N. J.

ARCTURUS
Quick Acting
RADIO TUBES

Three Outstanding Service Instruments

Forty odd years of world wide instrument supremacy is reflected in the Weston Radio Test Equipment.

When selecting your servicing and test instruments bear in mind this fact that no other manufacturer has been able to successfully compete with Weston quality and dependability.

Model 547
A complete Test Set for all types of A.C. and D.C. Radio Receivers and Tubes. It is fast, convient and reliable in operation. Extensively used by radio service men. Also suitable as a handy portable test set for general factory and laboratory purposes.

Model 555
Counter Tube Checker. Widely used by better radio dealers to test tubes at time of sale. Checks all type tubes, A.C., D.C. and Rectifiers (both plates). Speed and ease of operation have made it very popular.

Model 564
A Volt-ohmmeter, compact and completely self-contained. Valuable aid in radio service and in laboratory work. For checking continuity of circuits, voltages. Ranges 10,000/100,000 ohms and 3/30/300/600 volts.

Write for descriptive literature.

Weston
PIONEERS SINCE 1888
INSTRUMENTS

WESTON ELECTRICAL INSTRUMENT CORPORATION
612 Frelinghuysen Avenue Newark, N. J.

Production Testing of Vacuum Tubes

By Abbott Feindel

IN AN effort to make production testing of vacumn tubes as foolproof as possible and to increase the efficiency of operators, the test equipment herein described was developed by engineers of the Arcturus Radio Tube Company.

The most common method of production testing in use today requires a test table with a voltmeter to indicate each voltage used and either rheostats or potentiometers to adjust these voltages. Obviously, the efficiency of an operator is greatly reduced when it is necessary to watch the voltmeters and make adjustments whenever the voltages deviate from the correct values.

Where a large number of test tables are used the checking of meters becomes quite involved. For a -45 type tube, for instance, each position would require eight meters to properly read all characteristics.

This method of testing also allows for considerable error. There is a possibility that operators may read voltmeters incorrectly. Also operators may fail to observe the voltmeters as often as necessary, with the result that many tubes are tested with incorrect voltages at the test socket.

With these disadvantages in mind, test equipment was designed to eliminate voltmeters, potentiometers and rheostats on the test tables. This was accomplished through the use of motor-generator sets located at a central point, the terminal voltage of each generator being equal to the voltage required at the test socket.

These machines consist of flat compounded d-c. generators driven by synchronous motors. With this combination the generator voltages will not change appreciably with load or with fluctuations in the voltage of the line from which the motors are driven.

Fig. 1, shows the layout of the control panel which is located midway in the line of tests tables. At the top of the panel is an indicating lamp to notify operators to proceed with testing. The voltmeters are connected across the terminals of the generators.

Above the voltmeters, in the diagram, are relays and fuses. These relays are connected across the line on the load side of the fuses. In case any voltage drops to zero, the corresponding relay will operate, closing an alarm circuit which informs the operators that some voltage is off and that testing is to be suspended until the trouble is located.

As it is impossible to allow any appreciable resistance in the lines from the generators to the test tables, circuit breakers could not be used as a protective device. It was, therefore, necessary to use fuses to protect the generators from short circuits. These have been found to operate satisfactorily.

On the panel board field rheostats control the terminal voltages of the generators. This is the only means used to adjust test voltages and need be regulated only occasionally.

The motor starting switches and the alarm bell are at the bottom of the board. The synchronous motors, being small, are started directly from the line.

Careful consideration was given the feeders from the generators to the test tables. Their size was calculated to give a negligible voltage drop, and all joints were sweated solidly.

The simplicity of the test tables is shown in Fig. 2. The instruments shown are, ranging from left to right, filament current, plate current, and emission. A microammeter for measuring grid current is located on the table top. The keys to the left of the microammeter are for measuring plate current and emission. With the keys in the foward position, all meters are protected from short circuit.

A schematic diagram of the wiring from the generators to the test tables is shown in Fig. 1. Relays R operate in case fuses C blow, closing the bell circuit B. P is the pilot lamp, and does not light unless switch is closed.

Ammeter A4 measures filament current and is in the circuit at all times. Short circuited filaments are so rare that it was not deemed necessary to protect it.

With key H in position 6, and keys L and E open, microammeter A1 and plate milliammeter A3 are protected. In case of a grid filament short, microammeter A1 will register a few microamperes; relay K will operate, due to the high plate current, short circuiting milliammeter A3, and removing the short circuit from lamp N which will light. Short circuits of other types will be taken care of in a like manner.

If no short circuit is indicated, true plate current may be read by closing key L. This key is necessary because the resistance of relay K is so high that a slight voltage drop is caused with it in the plate circuit.

Emission is next read by throwing

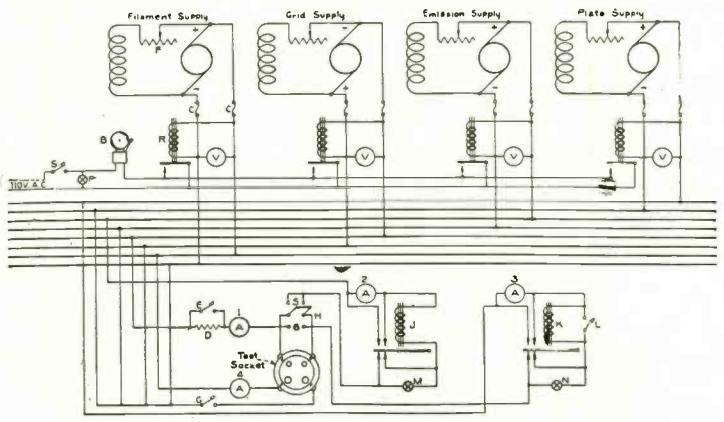
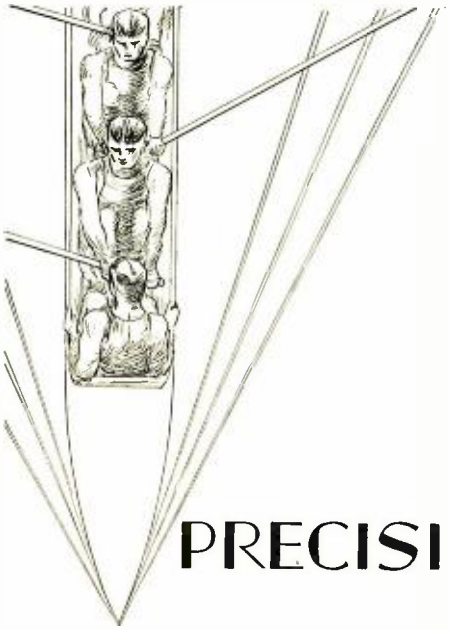
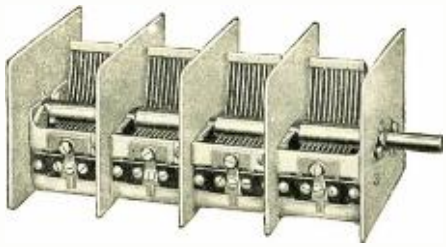


Fig. 1. Wiring layout of test panel for production testing of tubes.



PRECISION



ROWS of powerful arms, pulling with uncanny synchrony, an awe-inspiring spectacle of perfect mental and physical coordination, real PRECISION, if ever at all.

The new Hammarlund "Battleship" Multiple Condenser, presents an even more fascinating picture. With its perfectly aligned, rugged plate setting and frame, it is a model of PRECISION.

The utmost in exactness, mechanically, as well as electrically, it is the receiver component, perfect. *It will pay you to investigate.* Address Dept. RE9.

HAMMARLUND
Manufacturing Co.
424-438 W. 33rd St.
New York

For Better Radio
Hammarlund
PRECISION
PRODUCTS

FROST-RADIO

FROST-RADIO

Tandem Units that "check and double check"

Because they are built right in every detail Frost-Radio Tandem Units "check and double check" when you build them into a receiver. These dual controls are built in two styles: Two wire wound units or one wire wound and one carbon element unit. Each unit completely insulated from the other. Protected windings. Single hole mountings. All terminals are brought out at one side for cable wiring. Maximum resistance of each unit up to 4,500 ohms. Dissipation, each unit, 4 watts. Supplied in any combination of curves.

May We Send You Our Complete Volume Control Treatise?

A book every radio engineer should have because it was prepared by engineers to answer the kind of questions radio engineers ask. It explains why Frost-Radio wire-wound volume controls are everlastingly silent, smooth-working and efficient. May we forward your copy?

HERBERT H. FROST, *Inc.*
Main Offices and Factory
ELKHART, IND.

HERBERT H. FROST, Inc. RE 9-30
ELKHART, INDIANA

Please send me your complete treatise on the subject of noiseless wire-wound volume controls.

Name_____

Firm Name_____

City_____ State_____

key H to position 5. If a short circuit develops at this time, relay J will operate, short circuiting A2 and lighting lamp M. True grid current is indicated on A1 with key E closed. This key should not be closed if the microammeter needle reads beyond a red line drawn on the face of the meter.

With this equipment in use, it becomes necessary only for an operator to insert a tube in the test socket, observe the short indicators, throw a key to read plate current, another to read emission, and a third to read grid current. No thought need be given to the voltages supplied to the test socket.

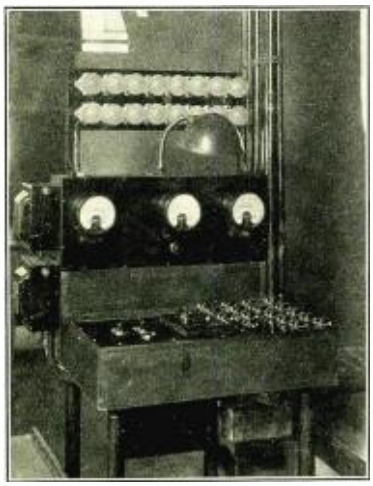


Fig. 2. Layout of equipment

The time required to instruct an operator to use one of these test sets is considerably less than for one of the older type, there being fewer operations to learn and no voltage values to remember.

With this setup it is possible to obtain a production of 300 tubes per hour from each position. The cost of this equipment was approximately the same as for the same number of test tables of the older type.

▲

THREE-ELECTRODE THYRATRON TUBE AS A RECTIFIER

(*Concluded from page* 31)

istics displayed by electron discharges in gases for controlling an electric arc by means of a grid, Toulon, in France, experimented in 1922 with Langmuir's process and devised an improvement on his method. Later Langmuir and his assistants made other improvements. About 1926 Langmuir envisioned the broad practical possibilities of the principle, and thereafter Dr. A. W. Hull, in the same laboratory, developed the tube to its present status, making its commercial use in controlling power supply a reality. The tube, of the three-electrode type, differs from the familiar Pliotron tube in being an arc rectifier in which a power arc is controlled electrostatically by the grid. In its control function it will economically handle relatively large amounts of electric power.

▲

NATIONAL RADIO WEEK

National Radio Week, September 22–28, is occupying the center of activities for the National Federation of Radio Associations and the Radio Wholesalers Association at this time. Numerous letters have been mailed to interested parties and such splendid response received that it is an assured fact that National Radio Week this year will be greater, better and further reaching than ever before.

Members of the Radio Wholesalers Association are ordering quantities of streamers, posters and seals for all of their retail outlets to display in a proper manner and local radio trade associations are re-creating the week as National Radio Demonstration Week, particularly in New York City in cooperation with the Radio World's Fair. Every retail outlet in the New York and Metropolitan area is receiving streamers and posters to be used in calling the public's attention to National Radio Demonstration Week.

On the far west coast, the Pacific Radio Trade Association in San Francisco, is carrying on a huge campaign to bring radio to the attention of the public for this week. There is no public radio show in San Francisco this year, instead, all of the retailers are holding "open house" for the radio public. wholesalers are cooperating in the purchase of streamers and posters, special display sections are being run in local newspapers together with special broadcasts over the air. Radio sales will be given an added impetus in that locality through the observance of the event.

RADIO BECOMES A MUSICAL INSTRUMENT

(*Continued from page* 40)

tube manufacturers to conduct such tests and, in simple form, to make the facts known to the radio public at large. It is certain that after tubes have served for more than five hundred hours, the tone quality of the set, let alone volume, sensitivity and even selectivity, is to some degree affected.

Certain refinements in loudspeaker design are also responsible for the stressing of improved tone quality in the new season's offerings. There have been highly important developments in loudspeaker diaphragms, particularly the fabric type, making for greater flexibility so as to produce the exceptionally deep notes now passed by the audio amplifier.

All in all, it's TONE this coming season. Tone quality is what will make for repeat sales. Tone quality will sell radio to persons who have withstood all previous sales arguments—persons who are true music lovers, who only now become interested in radio when radio is truly a musical instrument.

▲

DR. A. W. HULL RECEIVES THE LIEBMANN MEMORIAL PRIZE

AT the 1930 Toronto convention of the Institute of Radio Engineers the Morris Liebmann Memorial Prize was awarded to A. W. Hull, of the General Electric laboratories, Schenectady, N. Y. This prize is awarded annually by the Institute for meritorious achievement in radio science.

The prize, consisting of five hundred dollars in cash, was presented to Dr. Hull at the closing banquet of the convention by Col. A. G. Lee, vice-president of the Institute. At the request of Vice-President Lee, Donald McNicol, past president of the Institute, delivered a short address appropriate to the occasion. Mr. McNicol said: "It is a pleasure for the officers of the Institute to award this prize to Dr. Hull. In the onward march of radio and in the literature of the art Dr. Hull's name has been a household word for years past. In the year 1906, when Dr. Lee de Forest delivered his memorable paper at a meeting of the A.I.E.E., describing the invention of and operation of the Audion, Professor M. I. Pupin, who was present, expressed his view that new, hybrid names should not be coined for attachment to electrical devices.

"In 1906, and for about a decade following that, the Audion continued to be of nearly uniform size—about the same as that of present-day radio receiving tubes. The employment of the tube as a generator of useful oscillations opened the way for larger dimensions in order to produce greater powers, with the result that today tubes are in use so large and bulky that two strong men have a task in carrying one of them safely.

"With these two features of the tube—its name and its size—Dr. Hull and his laboratory associates have had much to do in the years that have passed. Today, there are audions, radiotrons, magnetrons, dynatrons, plio-dynatrons, thyratrons, and there seems no end to the uses and the names which may be given to new applications of these electron devices.

"With the outstanding advances in the tube art no man has had more to do than this year's recipient of the Liebmann prize — D. A. W. Hull, of Schenectady."

NEWS OF THE INDUSTRY

STAAKE NEW ADVERTISING MANAGER FOR NATIONAL UNION

National Union Radio Corp., 400 Madison Ave., New York City, continues its program of expansion and development, begun last August with the acquisition of four extensive tube-manufacturing plants in Chicago and the east.

The latest step was the signing on of Paul C. Staake ("Stocky" of Middle West varsity football fame) as National Union's new advertising manager. Staake is one of the bright lights in radio advertising. He was acquired from DeForest Radio Co., Passaic, N. J., where he has been serving as director of advertising and publicity, in charge of sales promotion, broadcasting, and advertising in newspapers, trade publications, national magazines and outdoor posters.

More recently, the company announced that Henry A. Hutchins, Jr., who had made a record as a large-volume radio sales manager, had been appointed director of sales. It was on Hutchins' recommendation that Staake was invited to join the organization.

▲

PILOT TO ESTABLISH GENERAL N. Y. OFFICE

The Pilot Radio & Tube Corporation, which recently moved its entire administrative and manufacturing organization to Lawrence, Massachusetts, will shortly establish a general office in New York City from which all sales work will be handled, according to an announcement issued by Charles Gilbert, vice-president in charge of merchandising. A warehouse will also be opened and from it shipments of Pilot merchandise will be made to dealers in the metropolitan area.

The New York branch of the company is expected to start functioning in September, with a force of about thirty men.

▲

DEJUR-AMSCO MOVE

DeJur-Amsco Corp., formerly located at Broome and Lafayette streets, have moved to their new quarters on Morton and Washington streets, New York.

▲

RESISTOR REPLACEMENT GUIDE

Under the title of "Resistor Replacement Guide," the service department of International Resistance Company, 2006 Chestnut St., Philadelphia, Pa., has prepared a most important piece of practical radio literature for the radio serviceman. In loose-leaf form so as to be kept constantly up to date by inserting new sheets issued by the organization from time to time, there is now available a vast fund of data dealing with resistance fundamentals, formulas, and requirements of standard radio sets for several years past. Standard radio sets are covered in handy tables which include indications of faulty resistors, the purpose of each resistor, resistor connections, color code of original, resistance value, and recommended resistor for replacement. A copy may be obtained by radio workers who send in 50 cents in stamps or coin, to defray actual cost of initial sheets, binder and subsequent sheets, to the company direct.

▲

THE RADIO AMATEUR

A new booklet entitled "How to Become a Radio Amateur," has been issued by the American Radio Relay League, Hartford, Conn. The book describes the design and construction of a short-wave receiver and transmitter. The price of the booklet is 10 cents.

▲

HIGH HEAT CONDUCTIVITY CERAMIC IMPORTANT IN RESISTOR DESIGN

How the modest metallized grid leak resistor with metallized filament enclosed in a glass tube, has become the sturdy power resistor of today with white insulator body containing approximately the same metallized filament, is a mystery to most workers. Yet the mystery is readily explained in terms of the extreme heat conductivity obtained with a new synthetic ceramic material known as crolite.

Realizing the need for an insulator of high heat-conducting properties, Henry L. Crowley & Company of West Orange, N. J., worked on various formulas in quest of the desired result. The problem was not alone one of developing a synthetic ceramic of high heat conductivity. It was also necessary to produce such material in tubular form, with an accurately maintained center hole into which the metallized filament would fit snugly, thereby providing good contact for the efficient radiation of the heat generated. Also, it was desirable to obtain a non-porous body, and one of good mechanical strength. The result of the development work is now presented in the Durham Powerohms, manufactured by the International Resistance Company of Philadelphia, Pa., with metallized filament and crolite tubing, with cast metal ends. Because of the higher heat conductivity, these resistors are made in capacities up to 2 watts, and, actually, will handle several times more wattage on overloads. These resistors are more stable and possess longer life, because of greater heat radiation and the non-porous nature of the protective tubing. They are strong mechanically, and will not break with ordinary handling.

▲

SMILEY TOURS EAST

R. E. Smiley, sales manager for The Ken-Rad Corporation, recently left for the East where he expects to spend several weeks in lining up several important distributors for the coming year.

Before leaving, Mr. Smiley said that from all indications this year promises to be one of the best enjoyed by the radio business.

▲

DEFOREST REPORTS BRISK DEMAND FOR TRANSMITTING AUDIONS

From the DeForest Radio Company's plant at Passaic, N. J., where a large department is devoted exclusively to the fabrication of the larger types of tubes, comes cheerful news of a steadily increasing business in transmitting audions. On certain types the production is from six weeks to three months behind orders. The DeForest line of transmitting audions is exceptionally complete, ranging from the 15-watt oscillator audion to the 5,000-watt water-cooled audion, and including thermionic rectifiers, mercury-vapor rectifiers and screen-grid amplifiers in various power ratings.

▲

WESTINGHOUSE PROMOTES T. R. LANGAN

C. E. Stephens, vice-president, Westinghouse Electric and Manufacturing Company, has announced the appointment of T. R. Langan as assistant northeastern district manager of the Westinghouse organization.

Mr. Langan has been with the Westinghouse Company for more than twenty years. Starting as an apprentice in the engineering department, he advanced through the construction, service and sales departments of the company to the office of manager of the transportation division of the Northeastern District, which office he held at the time of his promotion. He has been identified with the major high voltage a-c. railroad electrifications in the United States.

Mr. Langan will make his headquarters at New York.

▲

KEN-RAD APPOINTS EASTERN REPRESENTATIVE

Announcement has been made by R. E. (Dick) Smiley, sales manager for The Ken-Rad Corporation, of the appointment of Newton Norman for the states of eastern Pennsylvania, lower New Jersey, Delaware, Maryland and the District of Columbia.

▲

CECO SALES INCREASE

Edward T. Maharin, vice-president in charge of sales of the CeCo Manufacturing Company, stated recently that the July net sales of CeCo radio tubes were in excess of the combined sales for April, May and June. He also stated:

"Business already booked by us so far this year is ahead of that for the same period in 1929.

"The CeCo payroll is expanding daily." Mr. Maharin said. "New high-speed equipment is being installed in various departments. The CeCo plant is at present capable of turning out 55,000 radio tubes per day, on a regular schedule without overtime.

"The plant has been built with an eye to the future so that ample space is available for additional machinery when needed."

▲

DODGE BROTHERS PIONEERS IN AUTO RADIO WIRING FIELD

Dodge Brothers Corporation pioneered in a movement which now includes the leading motor-cars of the world,, when they announced more than ten months ago that wiring for the installation of Transitone automobile radios would be adopted as standard equipment on all closed body styles.

In addition to Dodge Brothers Sixes and Eights, all closed body styles of the various divisions of Chrysler Motors, including Chrysler, De Soto and Plymouth, are wired to Transitone specifications.

KURMAN ENGINEERING COMPANY

N. A. Kurman, managing director of the Herald Electric Company, has taken over the company and renamed it the Kurman Engineering Company. The headquarters are at 2214 40th Avenue, Long Island City, N. Y. The company manufactures coils and transformers, and test apparatus.

▲

PLASTIC PRODUCTS

The Karolith Corporation, 21-25 44 Road, Long Island City, N. Y., is about to add two stories to the corporation's factory for the manufacture of Casein plastics, synthetic resins in cast form, also rods, sheets and tubes.

▲

STROMBERG-CARLSON DECLARES EXTRA DIVIDEND

Directors of the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., declared the fourth consecutive extra dividend on the stock at their last meeting.

The Directors declared the regular quarterly dividend of $1,525 on the preferred and the regular quarterly dividend of 25 cents and an extra 12½ cents on the common, both dividends being payable on September 1 to stockholders of record at the close of business August 16. In 1927 and 1928 only one extra dividend was paid. In 1929 extra dividenos were paid on March 1 and December 1. So far this year there has been an extra of 12½ at each dividend rate, which means that the company's stock has been on a basis of $1.50 a year.

The payment of the extra 12½ cents for each of the last four quarters indicates that the $1.50 basis will continue.

Raymond N. Ball, president of the Lincoln-Alliance Bank and Trust Company of Rochester, was elected a member of the Board of Directors at the meeting.

▲

RESISTOR UNITS GANGED IN UNIQUE MANNER

For the sake of convenience in mounting and wiring, several prominent set manufacturers are ganging their metallized resistor units by arranging them side by side in a row and strapping them together at their center with one straight strip beneath and a corrugated strip on top, with screws through holes at the ends of the strips. This method is only possible with resistors having an insulated body rather than a conducting body. Connections are readily made to the ends of the resistors, which are fully exposed and free for the purpose.

The ganging of metallized resistors makes for a compact, simple, readily serviced receiver, since all resistors are concentrated in one place where they may be readily checked up and replaced if necessary.

▲

TRANSFORMERS

The organization of the Standard Transformer Corporation with offices and factory at 854 Blackhawk Street, Chicago, has been announced by Jerome J. Kahn. The officers of The Standard Transformer Corporation are Mr. Kahn and Mr. C. R. Bluzat, formerly sales manager and sales engineer respectively of The Transformer Corporation of America.

Mr. Bluzat has seen service in the French army as supervisor of radio communications. Upon coming to the United States he became affiliated with the engineering and testing department of Commonwealth Edison Company after which he accepted a position as chief engineer with the Stewart Battery Company of Chicago. When Transformer Corporation of America was organized, he became associated with that organization where he remained until T. C. A. went into the set manufacturing business. Mr. Kahn has been in the radio business since 1923. He was one of the incorporators of the United Air Cleaner Company and had, with Mr. Bluzat, been associated with T. C. A. since the early days of that company.

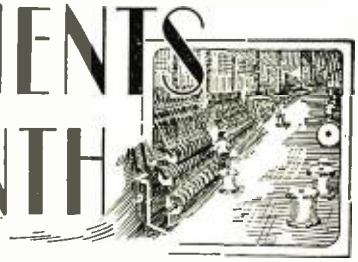
Samples and price lists are available to set manufacturers and engineers.

▲

VIKING TOOL MOVES

To provide for increased facilities in the manufacturing of their coil winding machines, The Viking Tool and Machine Company of Brooklyn, N. Y., are moving to their own plant at Mill and Main streets, Belleville, N. J., where they will occupy three large floors for their own use.

NEW DEVELOPMENTS OF THE MONTH



NEW SHORT-WAVE RECEIVER

The Dayton Scientific Corporation has recently been incorporated in the State of Ohio. Offices and plant will be located in Dayton. Manufacturing of radio and electrical devices and also research in these lines will be the functions of this company.

The officers are Oscar H. Hulberg, president; H. L. Burns, vice-president and treasurer, and George F. Holland, secretary.

One of the first products of this corporation will be a short-wave receiver suitable for the use of the non-technical trade and will be sold through distributors. Thirty-three distributors in the United States and South America have been appointed. About seventy will be appointed in this country according to present plans.

▲

EVEREADY RAYTHEON ER-230

The ER-230, new Eveready Raytheon tube is a general purpose tube suitable for use as detector, intermediate audio-frequency amplifier or radio-frequency amplifier. It is recommended particularly for the first two classes of service.

Rating

Electrical Characteristics:
- Filament voltage, 2.0 volts
- Filament current, 0.06 ampere
- Plate voltage—nominal and recommended, 90 volts (Max. 150 volts)
- Grid voltage—nominal -4.5 volts
- Plate current, 2.0 milliamperes
- Plate resistance, 12500 ohms
- Amplification factor, 8.8
- Mutual conductance, 700 micromhos

Approximate direct inter-electrode capacitances:
- Grid to plate, 6 mmf.
- Grid to filament, 3.5 mmf.
- Plate to filament, 2 mmf.

Dimensions:
- Maximum over-all length, 4-¼"
- Maximum diameter, 1-3/16"

Base
- Small "UX"

▲

TUBE TESTER

The Hickok Electrical Instruments Co., 10514 Dupont Avenue, Cleveland, Ohio, has brought out a new radio tube tester—Hickok AC-47. A descriptive booklet will be sent upon request.

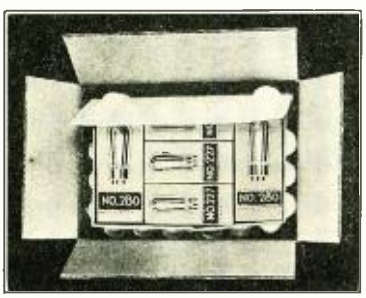
▲

NEW PACKING MATERIAL ALLOWS RADIO TUBE KITS TO BE SHIPPED SAFELY

Tube manufacturers, set manufacturers, mail order houses and jobbers have been searching for a non-excelsior packing material that will allow the shipment of small quantities of tubes or kits by either express, truck delivery, or Parcel Post, etc., without breakage and distortion.

A new packing material, now used by all the leading tube manufacturers, has met the problem squarely, and as a result, radio tubes in quantities of 5 to 50 are being shipped halfway around the world in perfect condition.

The moulded pulp packing pads made by Holed-Tite



Packing Corp., New York City, are the unique product. They are a newcomer to the tube packing field, but if you stop at the corner grocery store you will see a brother product, the Holed-Tite egg case packing, which carries our billion dollar annual egg crop to market undamaged.

GRID LEAKS

Grid leaks are high resistances (up to 10,000,000 ohms) employed in modern radio receiver circuits.

The earlier types of grid leaks consisted of a sheet of paper coated or impregnated with a small amount of conducting substance. Contact was established by metal eyelets which also served to hold the protecting paper label in place.

"Aquadag" was much used in this style of leak just as it is popular in the currently used hermetically sealed type.

A solid glass rod of small diameter is treated with Aquadag so as to bear a thin film. The dried rod is then sealed in a piece of glass tubing which protects the element from abrasion and changes in humidity.

In designing grid leaks employing Aquadag, it should be borne in mind that graphite possesses a negative temperature coefficient.

Aquadag is a product of the Acheson Oildag Company, Port Huron, Mich.

▲

NEW LINE ESCO DYNAMOTORS AND MOTOR GENERATORS

The Electric Specialty Co., Stamford, Conn., announces a new line of ESCO dynamotors and motor-generators, for operating alternating-current radio receivers, or other apparatus from direct current. They are equipped with standard attachment plugs—providing "plug-in" connection between alternating-current apparatus and direct current.

A new type filter is provided, which in addition to silencing the noises of the machines, smooths out

stray noises brought in by the direct-current lines. This gives quieter operation than from the alternating current lines.

All units have been made as trouble proof as possible. They are equipped with wool pack bearings, which are long lived, quiet in operation and require a minimum of attention. Semi-enclosing prevents damage from objects getting into the machine, yet permits ventilation, assuring cool operation. Dynamic balance eliminates vibration. (This is very important in the high-speed machines.)

Totally enclosed wiring improves appearances and safety. The new line of machines and filters are made in both high and low speed.

▲

NICKEL WIRE CLOTH FOR TUBES

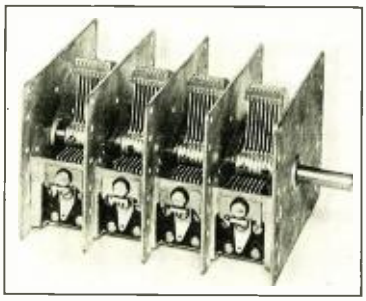
The Newark Wire Cloth Co., 351-365 Verona Ave., Newark, N. J., announce that they have perfected their "Sealedged" (Trade Mark Reg. U. S. Pat. Off.) on their new 85 x 70 mesh nickel wire cloth as used on the 227 tubes.

The principal difficulty with radio grid screens heretofore has been the unevenness of the edges of these plates and their tendency to unravel. As made by the Newark Wire Cloth Company unraveling is impossible. Their plates have a remarkably smooth and even finish all over. All wire ends are individually bent over, hence the name, "Sealedged."

The use of this material in tubes prevents wires dropping out from the cloth, thus overcoming a great many rejects of the finished tube due to short circuits.

The uniformity of the cloth is a great advantage to the screen plate manufacturer who saves considerable time in forming the plates as the accuracy in width, straightness, and all around perfection eliminates jamming in the guides.

The manufacturers are now making this wire cloth in a number of meshes and widths and are equipped to make it in any width desired.



NEW DE JUR CONDENSER

The De Jur-Amsco Corpn., 95 Morton St., New York, manufacture the condenser here illustrated, type 3604-A.

The frame is of cadmium plated steel. The overall length is 5⅞ inches. Double, triple and five-gang condensers of the same style are also stocked.

The rotors and stators are of aluminum. Perfect ball-bearings in case-hardened raceways are employed. The rotors are locked at the sides and bottom to eliminate the possibility of shift. The stators are likewise locked at one end for the same reason. The end plates of each rotor section are split in five sections.

Each condenser section is supplied with a combination wipe contact and soldering lug. Compensators may be attached to either side. The shaft may be extended from either end.

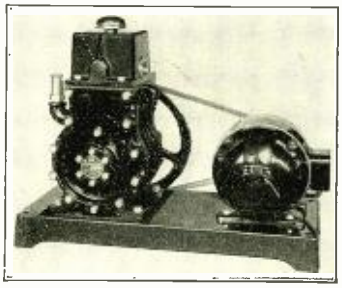
This line of condensers has been developed especially for mantle and automobile radio sets. Their limited space is the controlling feature.

▲

CENCO HYPERVAC PUMP

The Central Scientific Company of Chicago is about to announce a new type of oil-sealed, rotary, high vacuum pump, which will be known as the Cenco Hypervac pump. This pump is the result of extensive laboratory investigations to disclose all the factors desirable or undesirable in high vacuum pump design.

The Cenco Hypervac pump is not much larger than the Cenco Megavac pump in overall dimensions, but on account of its unique construction, it has nearly six times the free air capacity per revolution. The manufacturer guarantees the Cenco Hypervac pump to produce a vacuum of 0.00005mm of mercury pressure in a gas tight system. Such a guarantee has never before been made on an oil-sealed, rotary vacuum



pump. At a speed of 425 r.p.m. it reaches a pressure of one micron in one fifth of the time required by the Cenco Megavac pump.

Other design features of the Cenco Hypervac pump are slower speed of operation; provision for more rapid heat dissipation and therefore cooler operation; small oil requirement of only one pint; automatic vacuum treatment of all oil entering the finishing stage; and a small power requirement of only one third horse power.

The overall dimensions of the unmounted Cenco Hypervac pumps are approximately 15¼ inches high by 11 inches by 11 inches. A grooved pulley is provided for driving through a moulded rubber V-belt. The mounted pump with ⅓ horse power motor is illustrated above.

ALLOY METAL WIRE PRODUCTS meet all demands of high grade tube production

Our Wire, Strip and Filament Ribbon, used in the manufacture of radio tubes, are of a quality to meet all the pressure of modern production methods with minimum shrinkage.

Thus with non-corrosive nickel and nickel alloy products we are covering the industry's highly technical requirements with plenty of room to spare. Our own production methods facilitate delivery of any desired quantity made to your specifications.

ALLOY METAL WIRE COMPANY INC.

Manufacturers of

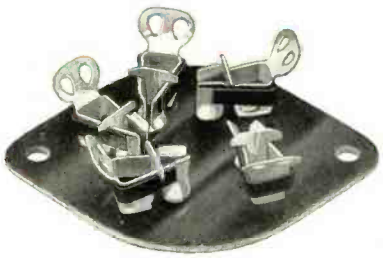
RESISTANCE WIRE;—NICKEL CHROME for Electric Heating Devices, Electric Furnaces, etc.
MONEL METAL, COPPER NICKEL WIRE for Rheostats, etc.

Branch Office
NEW YORK CITY
3637 Grand Central Terminal Bldg.

General Office and Works
Moore, Pennsylvania

Agents
SEATTLE, WASH.
Robinson Sales Co.
Polson Bldg.

CRC SOCKETS



CRC Sockets lend themselves to speedy production. The large size double hole solder terminals are easily reached with soldering iron and entire contact is heavily cadium plated.

CRC Sockets insure PERMANENT contact because of the tempered steel reinforcing springs.

CRC Sockets are highly efficient due to their minimum resistance in contacts — low capacity between contacts and their low absorption dielectric bakelite bases.

To manufacturers who have assembling facilities, CRC CLIPS are now available—either stock models or to your own specifications. Samples upon request!

RADIO MANUFACTURERS' ASSOCIATION RMA MEMBER

CENTRAL RADIO CORPORATION

BELOIT .. WISCONSIN

WEST COAST REPRESENTATIVES

Frank A. Emmet Sales Co.
Los Angeles, California

R. C. James & Co.
Seattle, Washington

SUPREME INSTRUMENTS

Supreme Instruments Corporation, Greenwood, Miss., have brought out a new Model 90 set analyzer and a new Model 19 tube checker. Circulars will be forwarded upon request.

DEFOREST HIGH-VOLTAGE RECTIFIER

A new high-voltage rectifier of extraordinarily high efficiency is announced by the DeForest Radio Company as still another addition to its line of transmitting audions.

The DeForest Audio 569 is a large sized mercury-vapor, hot-cathode rectifier rated at 20,000 maximum peak inverse volts, and 5 maximum peak amperes. It is ideally suited for high-voltage d-c. plate supply for transmitting and similar purposes. Standard 504A mountings are employed, and the tube operates in a vertical position. It is interchangeable with UX-869. The cathode is in the form of a heavy alloy ribbon arranged in helical form, and mounted about a heat deflector disc, while the anode is a carbon button directly above the cathode.

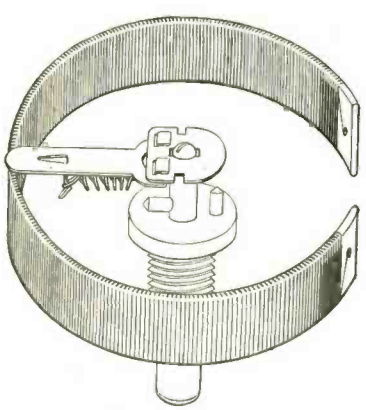
DUBILIER REPLACEMENT CONDENSER BLOCKS

Steadily adding to its list of replacement condenser blocks, the Dubilier Condenser Corporation, New York City, now includes 85 units for meeting the requirements of the principal receiving sets. B-eliminators and power packs produced during the past few years. These units are listed in a bulletin just issued by the company and available to jobbers, dealers and servicemen writing for same. The Dubilier replacement units are specifically designed to meet the requirements of the devices in which they are to be used, and are built to give satisfactory service over a long period of time, having ample safety factor.

NEW CUSTOM-BUILT A-C. SHORT-WAVE RECEIVER KIT

A short-wave set that is different now makes its debut under the sponsorship of the Insuline Corporation of America, 70-80 Cortland Street, New York City.

Extreme distance-getting ability, all-electric operation, wonderful tone quality, plenty of volume on far-away stations, screen-grid sensitivity—all these features are contained in the new I. C. A. Conqueror and would naturally be expected in a high-grade custom-built receiver.



VOLUME CONTROL

The H. H. Eby Mfg. Company, Inc., 22d street and Lehigh avenue, Philadelphia, Penn., manufacture the wire-wound control here illustrated. This is a heavy contact pressure with exceptionally light, uniform torque with spring contact arm. Rugged stop pins are mounted in shaft and bushing.

NEW CONDENSERS

Among the several new types of condensers introduced by A. M. Flechtheim & Co., Inc., of 136 Liberty St., N. Y. C., is type HS. This new condenser is remarkable for its small physical size and high working voltage, the condenser having a rating of 1000-v. d-c., or 660 r.m.s. rectified a-c.

Features of this new condenser are such that it fulfills a long felt need in aircraft receivers and transmitters and in portable radio outfits.

The Flechtheim Company also announces a new 5000-v. d-c., (3300 r.m.s. RAC) transmitting condenser which has proved its dependability in dozens of broadcast stations.

VIBRATION SHOCK ABSORBER

The Ialitz Mfg. Company, 570 Erie Building, Cleveland, Ohio, manufactures No-Vibe shock absorbers.

The vibration and shock absorber is a support or pad made of high-grade sponge rubber, with an integral outer coating or skin, to give a smooth appearance as hard rubber or finished wood.

In use, a cabinet of any kind, supported on a set of "No-Vibe" will absorb the vibration proceeding from the motor or other moving part of the cabinet itself, or will absorb the vibration and shocks of the floor or building and prevent the transmission thereof to the cabinet, which is particularly objectionable to radio apparatus.

NEW JANETTE 32-VOLT CONVERTERS

The Janette Manufacturing Company of Chicago announces a complete new line of 32-volt rotary converters for radio and talking machine use. The Janette rotary converter changes 32 volts direct current such as supplied by a number of farm lighting systems into 110-volt, 60-cycle, alternating current,

and is available in output capacities of 105, 210, and 315 watts.

The converters for radio use are equipped with a filter, a cord and plug connection for the d-c. circuit and a receptacle for plugging in the radio. If desired, they may also be obtained with a voltmeter and an a-c. voltage regulator.

AEROVOX INTERFERENCE FILTER

A new type interference filter which eliminates the unsightly features and inconvenience of the ordinary types of interference filters, has just been announced by the Aerovox Wireless Corporation, 70 Washington Street, Brooklyn, New York.

In this new interference filter, a plug receptacle is provided on one face of the unit and plug prongs are provided in the opposite face.

The prongs plug into any standard wall socket while the plug of the receiver or appliance can be plugged into the receptacle of the interference filter.

A novel feature in this unit is the mounting. In this mounting the location of the mounting holes have been designed to fit just over the mounting holes of the outlet wall plate so that the screw which fastens the wall plate to the outlet box can be used to fasten the interference filter and outlet plate to the outlet box, thus providing an efficient and convenient ground connection for the filter, instead of requiring the unsightly ground wire connection necessary with most interference filters.

TWO TIMELY INSTRUMENTS

The Weston Instrument Company, Newark, N. J., has on the market Model 489 volt-milliammeter for servicing automobile radio equipment. This is a ruggedly built meter carried in a strong leather case.

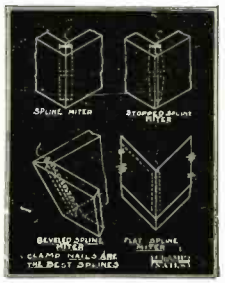
The Weston Company also has in stock Model 564 volt-ohmmeter, with a d-c. voltage range from 0 to 600, and a scale for resistance measurements up to 100,000 ohms.

HOOKUP WIRE

Paralac is the name of a new hookup, insulated wire being marketed by The Cornish Wire Company, 30 Church street, New York. The insulation is flame-proof and moisture-proof and slides back readily.

CLAMP NAILS

In an industry which is always seeking innovations, it is worthy of note that no method for making splined miter joints for radio cabinets has been found which will improve on Clamp nails. The advent of heavier chassis in radio sets has made obsolete the ordinary method of glueing joints and, as a result, the radio industry has turned to the manufacturers of fine furniture for a solution of this problem and found



that the Clamp nail method has been successfully used in the making of high-grade furniture for over a quarter of a century.

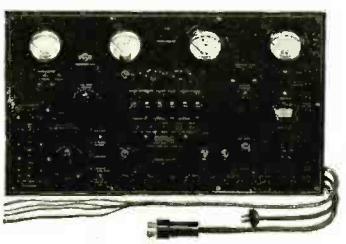
Clamp nails are steel splines that are used in making splined miter joints. They draw the joints up tight and hold them so under every condition of temperature or moisture. The manufacturers claim that these nails have 50 per cent more holding power than any other wood joint fastener and that they save more than three times their cost in assembling time. They do not split the wood, the flared equal flanges taking a full bite in the wood, thus drawing the joints up tight and strong.

Clamp nails are manufactured by the Clamp Nail Company, 4550 Palmer Street, Chicago, Illinois, who will be glad to mail illustrated literature to manufacturers who are interested in this product.

A NEW RADIO TEST PANEL

The radio test panel, under the trade name of "DayRad" and manufactured by the Radio Products Company of Dayton, Ohio, is placed on the market for the purpose of providing shop tests. A test panel, to be efficient, must be engineered to check tubes separately from the receiving set and to analyze any household radio receiving set so that it will be possible to align, neutralize and tune the set. For the purpose of testing components of the set with condensers, resistances, etc., a separate test is provided for measuring the capacity condensers up to 10 microfarads and resistance readings are provided for on two scales, one of which is for relatively low and the other for relatively high resistances.

There are three main divisions in the test panel, first the tube checking division which takes care of tests on all tubes of current design, including the Raytheon, Kellogg, Cardon and other special types. In order that both plates of the 280 rectifiers may be tested, arrangement is made for this purpose. The middle section is the analyzer section and is particularly designed to quickly denote the position of the



various stages by means of replacing the tube in the chassis with the connecting cord which connects to the instrument and by placing the tube in the test panel. No adaptors are required on the panel which is also true of the tube checking device. Ample readings for current voltage on d-c. measurement as well as a full range for a-c. test is provided and the operations are completed by means of a series of cam key switches, all of which are very plainly marked. The third section has the grid dip meter, oscillator and output meter, the purpose of this section being to align the radio frequency circuit, neutralize neutrodyne receivers and to secure visual indications on the output meter when these adjustments are properly made. Special tests consist of condenser and resistance as well as artificial load on a power pack which is separated from the other tests so that this unit may be tested separately.

FOIL FOR CONDENSERS

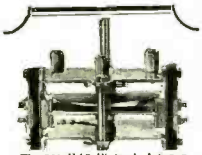
Reynolds Metals Company, Louisville, Ky., has taken over the Lehmaier, Schwartz Co., of New York and Richmond, Va. The company has four factories manufacturing various grades of foil.

WHAT! No Slump?

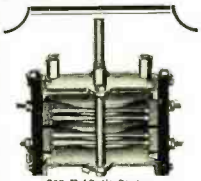
NEW adaptations of long known fundamentals continually reveal some necessity for condensers different in form from the usual standard types heretofore found adequate.

Are you keeping abreast of modern developments in the fascinating field of ultra-short wave radio communication? Up-to-date experimenters will at once see the advantages of a variable condenser with an adjustable stator allowing the maximum capacity to be set anywhere from 10 to 50 mmfds. and "spreading" the tuning correspondingly—such a condenser is our 201-E shown below.

With the ever-increasing traffic on the shortwave channels—selectivity and sensitivity become of paramount importance in the modern radio receiver. Many operators acclaim the merits of the push-pull system, using double section variable condensers in the tuning circuits. To meet this demand our 202-E has been developed giving a total capacity of .00075 mmfds. with 2 sections in series. With interchangeable coils a tuning range of 5 to 80 meters can be covered readily.



The 201-E (2 Plates). A taper plate condenser for short wave receivers. The stator plate is adjustable, affording maximum capacities of from 50 to 10 mmfd. Price $4.



202-E (Split Stator)
.000300 mmfds.
Sections in multiple
.000075 mmfds.
Sections in series
.000150 mmfds.
Per section

CARDWELL CONDENSERS

THE ALLEN D. CARDWELL MANUFACTURING CORPORATION

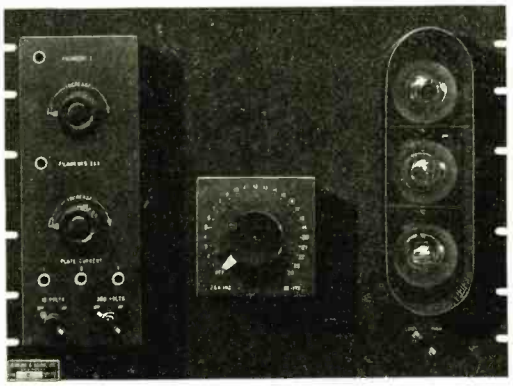
81 Prospect Street, Brooklyn, N. Y.

Since broadcasting began

"THE STANDARD OF COMPARISON"

JENKINS & ADAIR, INC.

STANDARD AMPLIFIER AND CONTROL PANELS



For six years Jenkins & Adair have been making precision amplifying and control equipment suitable for speech input and recording use. Our new "C" amplifier panel is shown above.

It is impedance and transformer coupled, with a maximum undistorted output of 10 DB and a total gain of 84 DB. The overall variation in frequency response of the average panel does not exceed ± .6 DB between 50 and 6000 cycles.

Send for Bulletin 15

JENKINS & ADAIR, INC.

ENGINEERS

CHICAGO, U. S. A.

PHONES, KEYSTONE 2130
3333 BELMONT AVENUE

CABLE ADDRESS
JENKADAIR

British Offices: 76 Old Hall St., Liverpool, England
40 Buckingham Gate, London, S. W. 1, England

French Office: 16 Rue de Chateaudun, Asnieres, France

PYROXYLIN LACQUERS

Regardless of what your finishing problem may be, the complete facilities of our Service Laboratory are constantly at your disposal without cost. Here scientific knowledge brings about the most practical and economical solution. "The Acknowledged Standard Since 1884."

WHEN you choose a lacquer today nothing should be taken for granted.

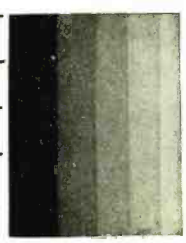
To develop in lacquer the highest degree of quality and uniformity requires the strictest adherence to scientific standards.

In our laboratories absolute control at all times over basic raw materials and chemical processes—continuous research—constant experimental testing and checking, have made Zapon Pyroxylin Lacquers superior for every use. This explains why it is decidedly more economical and satisfactory to insist on Zapon.

Upon the confidence of the buyer rests the reputation of Zapon steadily growing through nearly a half century to undisputed leadership.

THE ZAPON COMPANY

STAMFORD, CONN.



Buyers Directory of Materials and Apparatus

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

Addresses of companies listed below, can be found in their advertisement—see index on page 66.

ALUMINUM:
Aluminum Co. of America
Fairmont Aluminum Co.

ALUMINUM, SHEET:
Fairmont Aluminum Co.

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

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

ANTENNAE, LAMP SOCKET:
Dubilier Condenser Corp.

ARRESTERS, LIGHTNING:
Cornish Wire Co.

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

BASES, VACUUM TUBE:
(See Tube Parts)

BENCHES, STEEL WORK:
Angle Steel Stool Co.

BINDING POSTS:
General Radio Co.

BOXES, STEEL:
Angle Steel Stool Co.

BRACKETS, ANGLE:
Scovill Mfg. Co.

BRASS:
Scovill Mfg. Co.

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

BUSSES, STEEL:
Angle Steel Stool Co.

BUTTS:
Scovill Mfg. Co.

CABINETS, METAL:
Aluminum Co. of America

CABINETS, STEEL:
Angle Steel Stool Co.

CASTINGS:
Fairmont Aluminum Co.

CELLS, PHOTOELECTRIC:
National Carbon Co., Inc.

CEMENT, LOUD SPEAKER:
Maas & Waldstein Co.

CENTRALIZED RADIO SYSTEMS:
Samson Elec. Co.

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

CHASSES:
Aluminum Co. of America
Metal Specialty Co.

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

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

CHOKES, POWER:
American Transformer Co.
Dongan Elec. Mfg. Co.
General Radio Co.
Meissner Mfg. Co.
Polymet Mfg. Corp.

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

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

CLOTH, WIRE:
(See Wire Cloth)

COIL FORMS:
General Radio Co.

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

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

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

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

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

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

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

CONDENSER PARTS:
Aluminum Co. of America
Henry L. Crowley & Co.
Metal Specialty Co.
Scovill Mfg. Co.

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

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

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

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

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

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

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

CONDENSERS, VARIABLE TRANSMITTING:
Cardwell, Allen D. Mfg. Co.
Concourse Electric Co.
DeJur-Amsco. Corp.
General Radio Co.
Hammarlund Mfg. Co.
Jenkins & Adair, Inc.

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

CONNECTORS:
Cornish Wire Co.
Scovill Mfg. Co.

CONTAINERS, BATTERY BOX:
George F. Mitchell & Sons Co.

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

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

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

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

COPPER:
Scovill Mfg. Co.

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

COUPLINGS, FLEXIBLE:
Hammarlund Mfg. Co., Inc.

CUSHIONS, SPEAKERS:
Western Felt Co.

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

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

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

DIE-CASTINGS:
Allied Die-Casting Corp.

DIES:
Thomas & Skinner Steel Products Co.
Willor Mfg. Corp.

DRAWERS, STEEL, BENCH:
Angle Steel Stool Co.

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

DYNAMOTORS:
Electric Specialty Co.

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

EXPORT:
Ad. Auriema, Inc.

FADERS:
Clarostat Mfg. Co.

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

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

FILAMENTS:
(See Tube Parts)

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

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

FOIL:
Aluminum Co. of America

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

GENERATORS:
Electric Specialty Co.
Janette Mfg. Co.

GETTER MATERIAL:
(See Tube Parts)

GRAPHITE
Acheson Oildag. Co.

GRID LEAKS:
(See Resistances, Fixed)

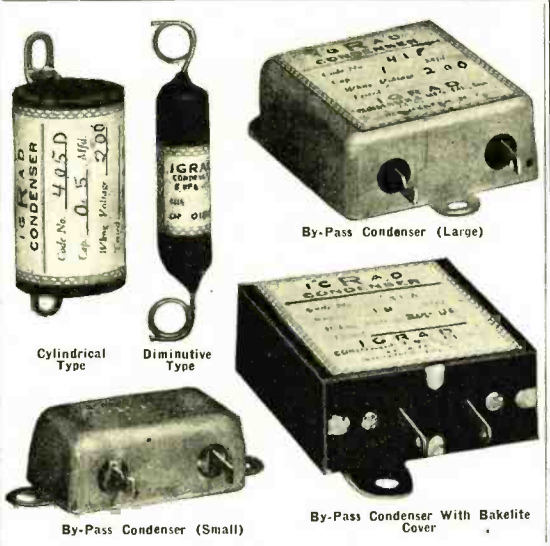
HANDLING EQUIPMENT:
Nat'l. Vulcanized Fibre Co.

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

HORNS:
Amplion Co. of Amer.

INDUCTANCES, TRANSMITTING:
General Radio Co
Jenkins & Adair, Inc.

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



We are Condenser Specialists

Send for new price list—just out

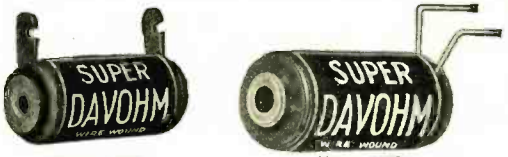
Igrad Condenser & Mfg. Co. *Home Office and Factory:* Rochester, N. Y.

Representatives:

Aaron Stedman & Co. Chicago, Ill.
The M. Simons & Son Co. (Export) New York, N. Y.
Dimond Sales Co. New York, N. Y.
Marshank Sales Co. Los Angeles, Calif.
Trade Contact Corp. Boston, Mass.
A. L. Gillies Toronto, Canada

SUPER-DAVOHM

Wire Wound Precision Resistors



Type BLT Type BWE

Super-Davohms are known and used in the entire world. Instrument manufacturers have adopted the Super-Davohm as an integral part of their assembled unit. Universities, electrical, physical, instrument and radio research laboratories are using Super-Davohms as laboratory standards because of their excellent characteristics.

Recommended for: Television Amplifiers, Telephone Equipment, Sound Picture Equipment, Fire Alarm Equipment, Voltmeter Multipliers, Resistance Amplifiers, Electrical Instruments, Laboratory Standard Resistors, Attenuators and Fading Controls.

Send Us Your Resistor Specifications
Samples on Request

THE DAVEN COMPANY
RESISTOR SPECIALISTS
General Office and Factory
158-160 Summit Street, Newark, New Jersey

SEND FOR OUR RADIO BARGAIN BULLETIN No. 65

Here are a few of the Values it contains:

THORDARSON Double Filter Choke. Model T-2458, contains two 18 Henry 250 Mill Chokes.....$4.75

THORDARSON 30 Henry 150 Mill Chokes. Type T-2030-A.....2.95

DUBILIER 11¼ Mfd. High Voltage Filter Condenser Block. D.C. Working Voltages 1,000, 600 and 100 .....2.75

FILTER Chokes, 30 Henries, 120 Mills 1.25

BRISTOPHONE Phonograph Pick-up with volume control:
Model "L" Automatic.....6.95
Model "M" Non-Automatic...4.95

THORDARSON High-Voltage Power Transformer, 250 Watts, for 2 UX-250's or 210's and 2 UX-281 Tubes 4.75

THORDARSON High-Voltage Power Transformer, 175 Watts, for 1 UX-250 or 210 and 2 UX-281 Tubes 3.50

RCA Power Transformer, Type 380, for UY-224 Screen Grid and UX-245 Power Tubes.....2.75

KOLSTER K-5 Electro-Dynamic Speaker, complete with 210 or 250 Power Amplifier and "B" Supply Unit in Cabinet. List $175.00 (less tubes) 15.00

GOULD Kathanode Unipower 6-Volt Automatic Radio "A" Power from light socket.....7.53

DUBILIER 4 Mfd. High Voltage Filter Condenser. D.C. Working Voltage 600 .....1.35

RCA Power Transformer No. 8335 for Radiolas 33, 18 and 17. Supplies Plate and Filament Voltages for four 226's, one 227, one 171-A and 280 Tubes.....3.25

RCA Two Stage Audio Transformer Pack Part No. 5667 for Radiolas 33, 18 and 17. Ratio of each Transformer 3-1 .....1.70

AEROVOX 7 Mfd. High Voltage Filter Condenser Block. D.C. Working Voltages 1,000, 800 and 400 .....2.50

JEFFERSON Step-down Transformer, 110 V. to 14 V. at 2½ Amps..95c

THORDARSON Sonora Power Transformer. Supplies plate and filament voltages to four 224's, one 227, two 245's and one 280 tubes. Used with B-31, 33 and 35 Sets 2.75

GRAYBAR Electric Motor and Phonograph Pick-up Chassis..19.50

IMPROVED Gordon Electric Phonograph Motor with automatic stop and speed governor.....8.95

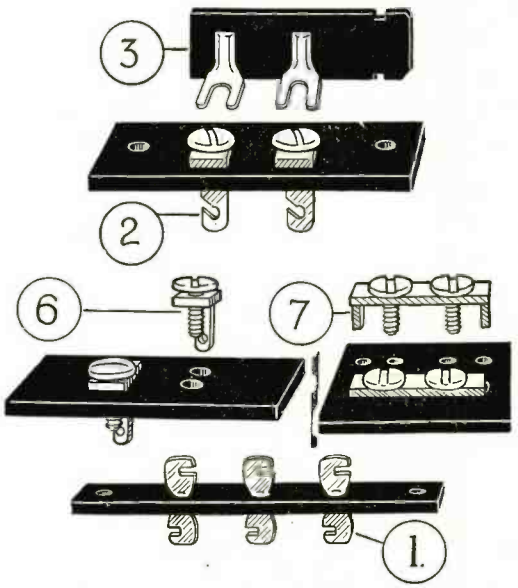
PACENT Phonograph Pick-up with tone arm, volume control and adaptors 4.50
without tone arm.....2.75

SAMSON "PAM" No. 16, Two Stage Power Amplifier (less tubes)..27.50

RCA Double Filter Chokes. Part No. 8336 for Radiolas 33, 18 and 17. Contains two 30 Henry 100 Mill Chokes.....95c

AMERICAN SALES CO., 19-21 Warren St., New York City

Howard B. Jones



Let us quote on your teminal Requirements

We have many other types in addition to those shown

HOWARD B. JONES
2300 WABANSIA AVE. CHICAGO, ILL.

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

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

INSULATION, REFRACTORY:
Henry L. Crowley & Co.
The Stupakoff Labs.

JACKS:
General Radio Co.

KITS, TESTING:
(See Testing Kits)

LABORATORIES, TESTING:
Electrical Testing Labs.

LACQUER, WOOD:
Maas & Waldstein Co.

LACQUER, METAL:
Maas & Waldstein Co.

LACQUER, ENAMEL:
Maas & Waldstein Co.

LAMINATIONS:
Lamination Stamping Co.
Thomas & Skinner Steel Products Co.
Willor Mfg. Corp.

LAMPS, MINIATURE:
National Carbon Co., Inc.

LAMPS, PANEL:
National Carbon Co., Inc.

LEAD-INS:
Clarostat Mfg. Co.
Electrad, Inc.

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

LUBRICANTS, RADIO:
Acheson Oildag Co.

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

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

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

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

MAGNESIA, TUBES:
Henry L. Crowley & Co.
The Stupakoff Labs.

MAGNESIUM:
Aluminum Co. of America

MAGNETS:
Thomas & Skinner Steel Products Co.

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

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

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

MOLDING MATERIALS
(See Insulation, Moulded)

MOTORS:
Electric Specialty Co.

MOTOR-GENERATORS:
Electric Specialty Co.

MOUNTINGS, RESISTANCE:
Polymet Mfg. Corp.

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

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

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

OSCILLOGRAPH:
General Radio Co.

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

PACKING MATERIAL:
Holed-Tite Packing, Inc.

PACKING AND SHIPPING:
Kimberly-Clark Corp.

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

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

PAPER, CONDENSER:
Peter J. Schweitzer, Inc.

PHONOGRAPH MOTORS:
The Hammond Clock Co.

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

PHOTOELECTRIC CELLS:
(See Cells)

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

PLATES, OUTLET:
Howard B. Jones

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

PORCELAIN TUBING:
Henry L. Crowley & Co.
Isolantite Co.
The Stupakoff Labs.

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

POWER UNITS, A-:
Thordarson Electric Co.

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

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

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

PRESSED METAL PARTS:

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

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

PUNCHINGS:
Aluminum Co. of America
George P. Mitchell & Sons Co.
Scovill Mfg. Co.
Soreng Manegold Co.

PUNCHINGS, BAKELITE:
Electrical Insulation Corp.

RECEPTACLES, WALL:
Scovill Mfg. Co.

REFRACTORY SPECIALTIES:
Henry L. Crowley & Co.
The Stupakoff Labs.

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

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

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

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

RESISTANCE WIRE:
(See Wire, Resistance)

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

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

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

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

SEALING COMPOUNDS
Candy & Co.
Cochrane Chemical Company

SHEET METAL PARTS:
George F. Mitchell & Sons Co.

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

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

SOCKETS, TUBE:
Central Radio Corp.
Henry L. Crowley & Co.
Electrical Insulation Corp.
Frost, Herbert H.
General Radio Co.
Howard B. Jones
Soreng Manegold Co.

SOLDER:
Kester Solder Co.

SPAGHETTI:
(See Wire, Spaghetti).

SPEAKER PARTS, METAL:
The Metal Specialty Co.

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

STAMPINGS, METAL:
Aluminum Co. of America
George F. Mitchell & Sons Co.
Radio Products Corp.
Scovill Mfg. Co.
Thomas & Skinner Steel Prod. Co.

STEPS, STEEL:
Angle Steel Stool Co.

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

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

SWITCHES:
Polymet Mfg. Co.
Soreng Manegold Co.

TABLES, STEEL WORK:
Angle Steel Stool Co.

TAPE, COIL:
Johnson and Johnson

TAPE, INDUSTRIAL:
Johnson and Johnson

TAPE, LOUD SPEAKER:
Johnson and Johnson

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

TERMINALS, SOLDER, SCREWS, SPADE;
Howard B. Jones
Thompson-Bremer & Co.

TESTERS, B-ELIMINATOR:
General Radio Co.

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

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

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

TESTING LABORATORIES:
Electrical Testing Labs.

TIN COATED METAL:
Baltimore Brass Co.

TOOLS:
Willor Mfg. Corp.

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

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

TRANSFORMERS, BROADCAST STATION:
Jenkins & Adair, Inc.
Samson Electric Co.

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

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

TRANSFORMERS, POWER:
Acme Elec. & Mfg. Co.
American Transformer Co.
Dongan Elec. Mfg. Co.
General Radio Co.
Kingston Products Corp.
Kurman Engineering Corp.
Polymet Mfg. Co.
Samson Elec. Co.
Thordarson Electric Mfg Co

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

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

TRUCK, STEEL:
Angle Steel Stool Co.

TUBE MACHINERY:
See (Machinery, Tube.)

TUBE, PACKING:
Holed-Tite Packing, Inc.

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

TUBE TESTERS:
(See Testers, Tube)

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

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

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

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

TUBING, COIL:
Paper Tube Co.

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

TUBING, PAPER — SPECIAL WRAPPED:
Paper Tube Co.

TUBING, PAPER & FIBRE:
Paper Tube Co.

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

TUBING, VARNISHED:
Alpha Wire Corp.

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

VARNISH:
Maas & Waldstein Co.

VOLTAGE REGULATORS:
(See Regulators)

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

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

WASHERS:
American Felt Co.
Aluminum Co. of America
Booth Felt Co.
Electrical Insulation Corp.
Scovill Mfg. Co.
Synthane Corp.
Thompson-Bremer & Co.
Western Felt Co.

WAXES, IMPREGNATING:
Candy and Co.
Cochrane Chemical Company

WAXES, INSULATING:
Candy and Co.
Cochrane Chemical Company

WAXES, SEALING:
Candy and Co.
Cochrane Chemical Co.

WIRE, ANTENNA:
Alpha Wire Corp.
Anaconda Wire & Cable Co.
Cornish Wire Co.
Dudlo Mfg. Corp.
National Vulcanized Fibre Co.
Roebling, J. A., Sons Co.

WIRE, BARE & TINNED COPPER:
Alpha Wire Corp.
Anaconda Wire & Cable Co.
Cornish Wire Co.
Dudlo Mfg. Corp.
Roebling, J. A., Sons, Co.
Spargo Wire Co.

WIRE CLOTH:
Buffalo Wire Works Co., Inc.
Cambridge Wire Cloth Co.
Cleveland Wire Cloth & Mfg. Co.
Gilby Wire Co.

WIRE, COTTON COVERED:
Anaconda Wire & Cable Co.
Alpha Wire Corp.
Dudlo Mfg. Corp.
Gilby Wire Co.
Polymet Mfg. Corp.
Roebling, J. A., Sons Co.

WIRE, ALL TYPES:
Alpha Wire Corp.
Anaconda Wire & Cable Co.
Cornish Wire Co.
Dudlo Mfg. Corp.
Polymet Mfg. Corp.
Roebling, J. A., Sons Co.

INDEX OF ADVERTISERS

Williams Press, Inc., New York—Albany

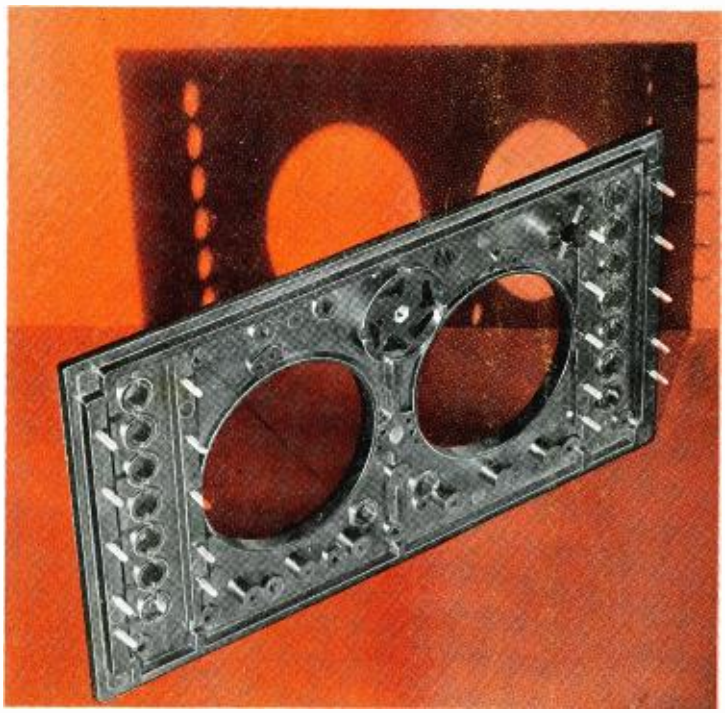
Dominating Radio

Children ten years ago — today enthusiastic young engineers in the making and already learned in Radio far beyond many men whose names have flashed to fame since 1922. From this new group will come the men who, unquestionably, will guide the future destinies of Radio. They will change the ways of today, always improving. Better, finer products will be demanded in the race for new achievements.

Dongan, ten years ago, determined to build just one product for Radio but to build that product superbly well. Transformers by Dongan will continue to represent the peak in design, construction and performance. When the boys of today become the engineers and buyers of tomorrow we intend to merit the preference of Transformers trademarked.

DONGAN

Dongan Electric Manufacturing Co.
2991-3001 Franklin St., Detroit



Bakelite Molded panel from the Jewell 199 Set Analyzer. Made by the Jewell Electricol Instrument Co., Chicago, Ill.

A SIMPLE PRESS OPERATION FORMS AN INTRICATE BAKELITE MOLDED PANEL

More than two score bosses, mounting posts, holes and recesses ... and twenty-one threaded metal inserts must be provided for this panel from the Jewell 199 Set Analyzer. However it is very simply accomplished with Bakelite Molded.

One operation of a molding press turns out the panel ready for use, complete with every necessary formation and detail. In the mold each hole and boss is accurately formed and located, the metal inserts are firmly embedded, and a smooth lustrous finish is acquired. Expensive assembling and subsequent finishing operations are thus avoided with a consequent production economy.

The Bakelite Molded panel is superior in other ways, too. It possesses high insulating value, is strong and hard and is not easily damaged. Being non-hygroscopic, it is unharmed by contact with moisture and atmospheric changes. It will not fade or discolor.

Bakelite Engineering Service—We manufacture a wide variety of Bakelite resinoid molding materials, varnishes, lacquers, cements, and other products. Twenty years experience in the development of these materials for radio and other uses, provides a valuable background for the cooperation offered by our engineers and laboratories. . . . . Write for Booklet 38M, "Bakelite Molded."

BAKELITE CORPORATION, 247 Park Avenue, New York. CHICAGO OFFICE, 635 West Twenty-second Street

BAKELITE CORPORATION OF CANADA, LIMITED, 163 Dufferin Street, Toronto, Ontario

BAKELITE

REGISTERED U. S. PAT. OFF.

"The registered Trade Mark and Symbol shown may be used only on products made from materials manufactured by Bakelite Corporation. Under the copyright "B" is the numerical sign for infinity, or unlimited quantity. It symbolizes the infinite number of present and future uses of Bakelite Corporation's products."

THE MATERIAL OF A THOUSAND USES