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RADIO NEWS

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BROADCAST WRNY STATION

Edited by HUGO GERNSBACK

Remote Radio Control Without Wires

See Page 892

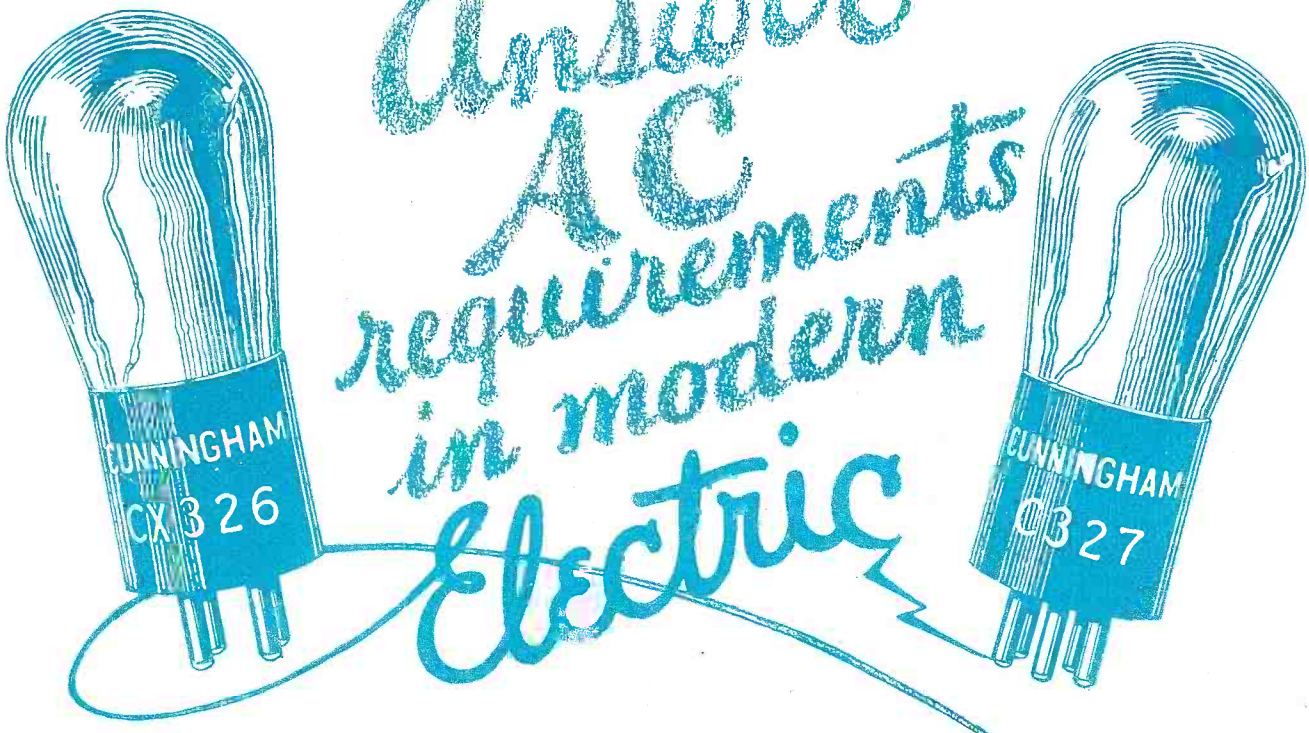
W. E. REINICKE

In this Issue:

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
SCIENCE & INVENTION - RADIO LISTENERS' GUIDE - SPARE-TIME MONEY MAKING - FRENCH HUMOR - AMAZING STORIES

Cunningham RADIO TUBES

CX326 — C327

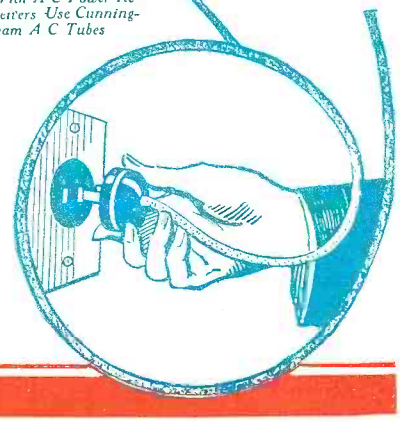


Answer A C requirements in modern Electric Radio Reception

THE popular demand for the latest and most improved A C power receivers calls for the latest development in A C tube construction.

Cunningham A C tubes CX-326 and C-327 are outstanding in their performance and will bring your A C power receiver up to its highest efficiency.

See that these two tubes are doing their duty along with other Cunningham tubes in your A C receiver.



With A C Power Receivers Use Cunningham A C Tubes

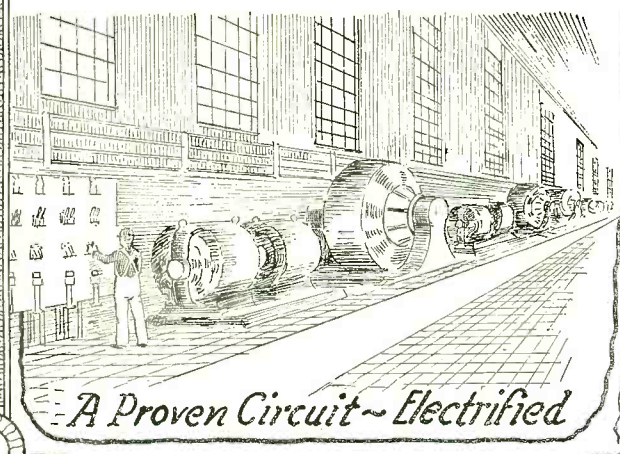
E. T. CUNNINGHAM, INC.

NEW YORK CHICAGO SAN FRANCISCO

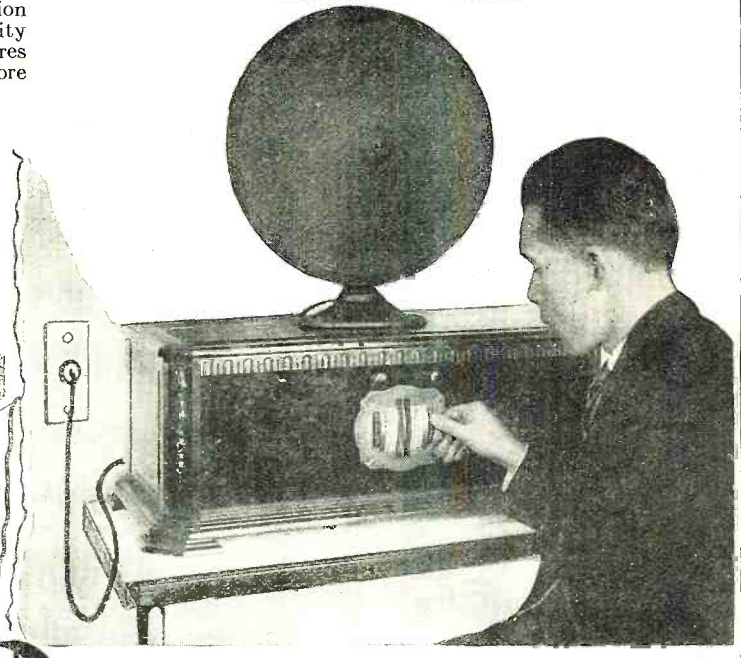
Announcing A New Standard In Electrified Set Building

NEW! ALL WAVE *R.E.L.9*

R. E. L. 9 is at last something new in design and construction in the long-looked-for electrified circuit. Its unusual simplicity makes it entirely different, and its many exclusive features create a marked improvement over anything heretofore offered in perfect socket power operation.



A Proven Circuit ~ Electrified



SPECIFIED PARTS for the "ALL WAVE" R.E.L.9

1 Panel, drilled, 8″ x 24″	Cortlandt Panel Eng. Co.
1 Binding Post Strip	Cortlandt Panel Eng. Co.
1 Strip for Pup Jack Mounting	Cortlandt Panel Eng. Co.
2 Aluminum Shields	Aluminum Co. of America
1 Double Drum Dial	Tyrman Electric Co.
3 ML-23 Condensers	Hammarlund Mfg. Co.
2 Extension Shafts	Hammarlund Mfg. Co.
8 Spring Sockets	Benjamin Elec. Mfg. Co.
1 Audio Transformer	Sangamo Electric Co.
1 MF. Fixed Consenser, .001	Sangamo Electric Col
1 MF. Fixed Condenser, .002	Sangamo Electric Co.
1 Autoformer	Thordarson Elec. Mfg. Co.
4 Plug-in Units, Type F	Radio Elec. Laboratories
2 Plug-in Units, Type B1	Radio Elec. Laboratories
1 Plug-in Unit, Type B2	Radio Elec. Laboratories
5 Matched Fixed Condensers	Radio Elec. Laboratories
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2 Pup Plugs	Yaxley Mfg. Co.
50 ft. Colorubber Wire	Belden Mfg. Co.
12 ft. Bus Bar	Belden Mfg. Co.
1 AC Heating Transformer	Transformer Corp. of America
8 AC Tubes	Sovereign Elec. & Mfg. Co.
1 Baseboard, 12″ x 25¼″	
1 Cabinet for Panel, 8″ x 24″ x 12″.	
1 ft. Spaghetti, screws, spacers, etc.	

SPECIFIED PARTS for the POWER UNIT

1 Transformer, T.2098	Thordarson Elec. Mfg. Co.
1 Choke, T.2099	Thordarson Elec. Mfg. Co.
1 Push-Pull Transformer, T.2408	Thordarson Elec. Mfg. Co.
1 Output Choke, T.2420	Thordarson Elec. Mfg. Co.
3 Parvolt 2MF. ser.C 1000-v. cond.	Acme Wire Co.
4 Parvolt 1MF.ser. ABy-passcond.	Acme Wire Co.
4 Spring Sockets	Benjamin Elec. Mfg. Co.
1 Truvolt Resistor, C.40	Electrad, Inc.
1 Truvolt Resistor, B-7.5	Electrad, Inc.
2 Truvolt Var. Resistors, T.100	Electrad, Inc.
2 Truvolt Var. Resistors, T.5	Electrad, Inc.
1 Rheostat, 60 ohms	Yaxley Mfg. Co.
1 Panel, drilled, 7″ x 12″ 3/16″	Cortlandt Panel Eng. Co.
12 Ensign Binding Posts	H. H. Eby Mfg. Co.
20 ft. Bus Bar	Belden Mfg. Co.
1 Baseboard, 12″ x 15″	
5 ft. of spaghetti insulation. Screws, etc.	

AFTER a long series of experiments, Mr. R.E. Lacault who designed this receiver, is pleased to announce that R.E.L.9 embodies all the latest improvements known to the art of quality set building, and the improvements include such performance as to be truly amazing even in this day of rapid advances, to say nothing of its marked simplicity of construction.

The "All Wave" R.E.L.9 is easy to build, as you may see by reading the detailed description, and you too can obtain the same wonderful results that Mr. Lacault has with the laboratory model by using the very same parts that he used.

The parts listed are the best adapted for the R.E.L.9. They were selected only after careful laboratory tests had been made. These standard parts have produced a set that has amazed and delighted engineers who are in a position to judge, by knowledge and comparison.

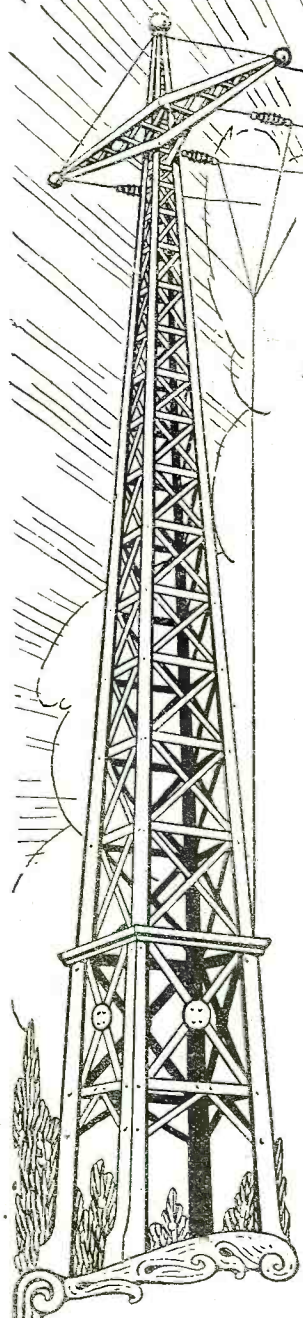
SOME OF THE R.E.L.9 OUTSTANDING FEATURES

1. The modulation system (patent issued and pending), originated by R. E. Lacault and recognized as the most sensitive method of signal reception.
2. Selectivity, permitting the reception of stations 10 kilocycles apart without interference and without distortion. The full width of the side bands is preserved, due to the circuit design.
3. The sensitiveness is such that distant station reception is a matter of course rather than an occasional occurrence.
4. Complete electric operation on AC without hum. This insures constant and even power, and consequently even results.
5. Highest quality audio amplifier, incorporating the best element available for perfect reproduction.
6. Push pull amplifier, reproducing music and speech with absolutely perfect fidelity, and with any amount of volume you want.

Other features are: Plug-in Coils, permitting the reception of short waves without any changes in the set. Shielding of the Radio frequency units, vernier drum dials, ease of tuning, permanent calibration, and, last but not least, simplicity of construction, making it easy for any one to build this wonderful set with the assurance that it will give perfect results.

FREE The "All Wave" R.E.L.9 is fully described in a folder which we will be pleased to mail you on request. **FOLDER**

R.E.L. LABORATORIES
1931 Broadway Suite 406 New York City



RADIO NEWS

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VOLUME 9 **FEBRUARY, 1928** NUMBER 8

Contents of This Issue:

In Forthcoming Issues:

HOW "B" SOCKET-POWER DEVICES WORK

By John B. Brennan, Jr.

A simple explanation of the whys and wherefores of this important and widely-used instrument.

AN AUTOMATIC CONTROL FOR BROADCAST RECEIVERS

By Harold A. Wheeler

A novel circuit trick for keeping the volume of received signals at a constant amplitude.

MORE DATA ON THE SHIELDED-GRID TUBE

Further applications of this new and interesting tube, which has an amplification factor of 40.

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The Crosley A C Bandbox is the leading radio of today—*because*

AT LAST! The radio tube that needs no batteries! Here it is functioning quietly, smoothly, powerfully in this new Crosley 6 tube receiver—the A C Bandbox.

Now, the Crosley A C Bandbox needs no more attention than you pay the electric lamp that lights your home.

This is what the world has anticipated and many have imitated. Crosley offers it to you at the WORLD'S LOWEST PRICE—$110 without tubes.

Combined with the Crosley facilities for economical manufacture is the patent situation of which Crosley has full advantage. Licensed to manufacture under the patents controlled by the electrical and radio industries, the Crosley Bandbox is a NEW receiver incorporating latest radio developments, the most advanced ideas of radio reception as well as sound reproduction. This outstanding engineering job is best understood when you consider its features are such as are found in radio twice and more its price.

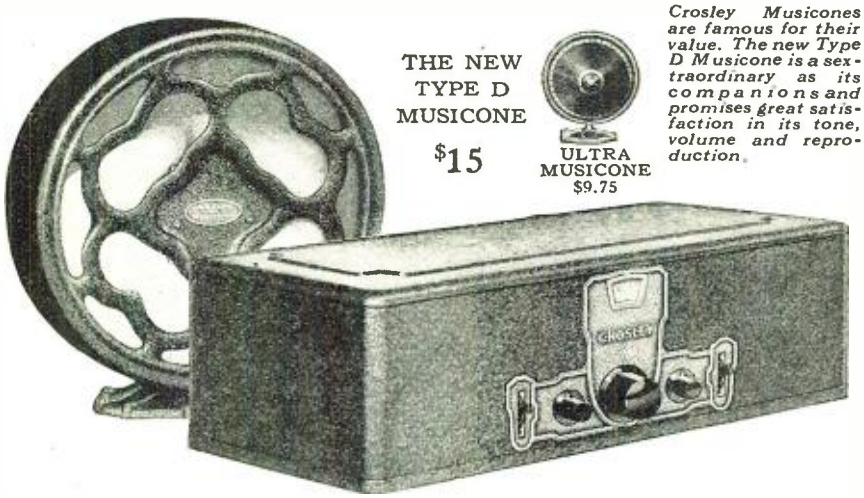
1. Complete shielding of all elements.
2. Absolute balance (genuine Neutrodyne).
3. Volume Control.
4. Acuminators for sharpest tuning.
5. Single cable connections.
6. Single station selector.
7. Illuminated dial.
8. Adaptability to ANY type installation.

The set is solidly mounted on a stout steel chassis. As all controls are assembled together in the front, cabinet panels are easily cut to allow their protrusion. The metal escutcheon is screwed on over the shafts and the installation has all the appearance of being built to order.

Two large furniture manufacturers have designed console cabinets in which the Bandbox can be superbly installed (Showers Bros. Co., of Bloomington, Ind., and the Wolf Mfg. Industries of Kokomo, Ind.). Powel Crosley, Jr., has approved them mechanically and acoustically and has seen to it that the famous Crosley Musicones are built in them so that the best type of loud speaker reproduction may be insured.

The Bandbox is housed in a brown frosted crystalline finished metal case which is easily removed for console installation.

See the new Crosley A C Bandbox at your dealer's NOW! Hear first hand its delightful performance! Enjoy the best in radio at the least cost! Write Dept. 22 if you can't locate a dealer!



THE NEW TYPE D MUSICONE $15

ULTRA MUSICONE $9.75

Crosley Musicones are famous for their value. The new Type D Musicone is a sextraordinary as its companions and promises great satisfaction in its tone, volume and reproduction.

SUPER MUSICONE $12.75

CROSLEY RADIO

Crosley is licensed only for Radio Amateur, Experimental and Broadcast Reception.

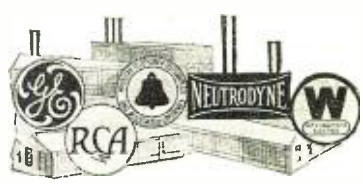
THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr.
President
Cincinnati, Ohio

Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher.

of these wonderful tubes

The amazing new RCA alternating current tubes—the UX 226 and UY 227—utilize for their filaments and their heating regular house-lighting current. Current is stepped down through transformers. Rectifiers are *not* used.

the radio patents of these industries

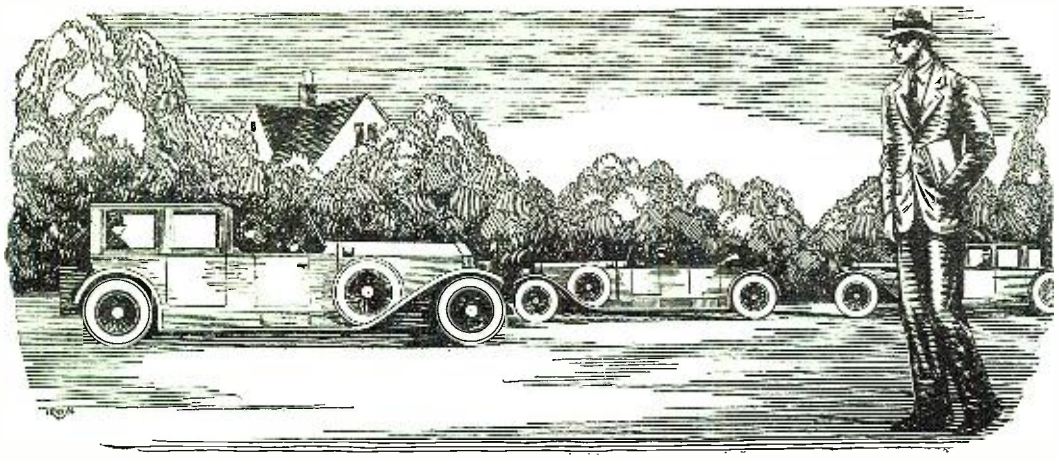


The research and development work of these great industries—The Radio Corporation of America, The General Electric Co, The Westinghouse Co., The American Telephone & Telegraph Co., and The Hazeltine and Latour Corporations—are available to Crosley engineers in the constant advancement of radio design.

and the amazing capacity of this MERSHON *Electrolytic* CONDENSER

This is one of Crosley's great features. It is an exclusive Crosley device. It is self-healing—will last indefinitely—never needs attention and eliminates the danger of blown out paper condensers which are causing so much trouble in electrically operated sets.

INDEX TO ADVERTISERS



Many times in the old days, while I trudged home after work to save carfare, I used to gaze curiously at the shining cars gliding by me, the prosperous men and women within. Little did I think that inside of a year, I, too, should have my own car, a decent bank account, the good things of life that make it worth living.

I Thought Success Was For Others

Believe It Or Not, Just Twelve Months Ago I Was Next Thing To "Down-and-Out"

TODAY I'm sole owner of the fastest-growing Radio store in town. And I'm on good terms with my banker, too—not like the old days only a year ago, when often I didn't have one dollar to knock against another in my pocket. My wife and I live in the snuggest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlady when she came to collect the rent for the little bedroom I called "home!"

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the "end of a blind alley." I thought I never had had a good chance in my life, and I thought I never would have one. But it was waking up that I needed, and here's the story of how I got it.

I WAS a clerk, working at the usual miserable salary such jobs pay. Somehow I'd never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—all the really well-paid vacancies I ever heard of seemed to be out of my line, to call for some kind of knowledge I didn't have.

And I wanted to get married. A fine situation, wasn't it? Mary would have agreed to try it—but it wouldn't have been fair to her.

Mary had told me, "You can't get ahead where you are. Why don't you get into another line of work, somewhere that you can advance?"

"That's fine, Mary," I replied, "but *what* line? I've always got my eyes open for a better job, but I never seem to hear of a really good job that I can handle." Mary didn't seem to be satisfied with the answer but I didn't know what else to tell her.

It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about myself. A few burning words that were the cause of the turning point in my life!

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors — the people who knew me best—really thought of me!

"Bargain counter sheik—look how that suit fits," one fellow had said in a low voice. "Bet he hasn't got a dollar in those pockets." "Oh it's just 'Useless Anderson," said another. "He's got a wish-bone where his back-bone ought to be."

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so dissatisfied with my answer that "I hadn't had a chance?" *Did Mary secretly think that too?* And after all, wasn't it *true* that I had a "wish-bone" where my back-bone ought to be? Wasn't that why I never had a "chance" to get ahead? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed the pages of a magazine on the table, searching for an advertisement that I'd seen many times but passed up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the radio field and how a man can prepare quickly and easily at home to take avdantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

WHAT'S happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, *I've had a Radio business of my own!* At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

NOW I'm making real money. I drive a good-looking car of my own. Mary and I don't own the house in full yet, but I've made a substantial down payment, and I'm not straining myself any to meet the installments.

Here's a real tip. You may not be as bad off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be *doing* something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well-paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. 2S, Washington, D. C.

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Dear Mr. Smith:
Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesmen will call on me.

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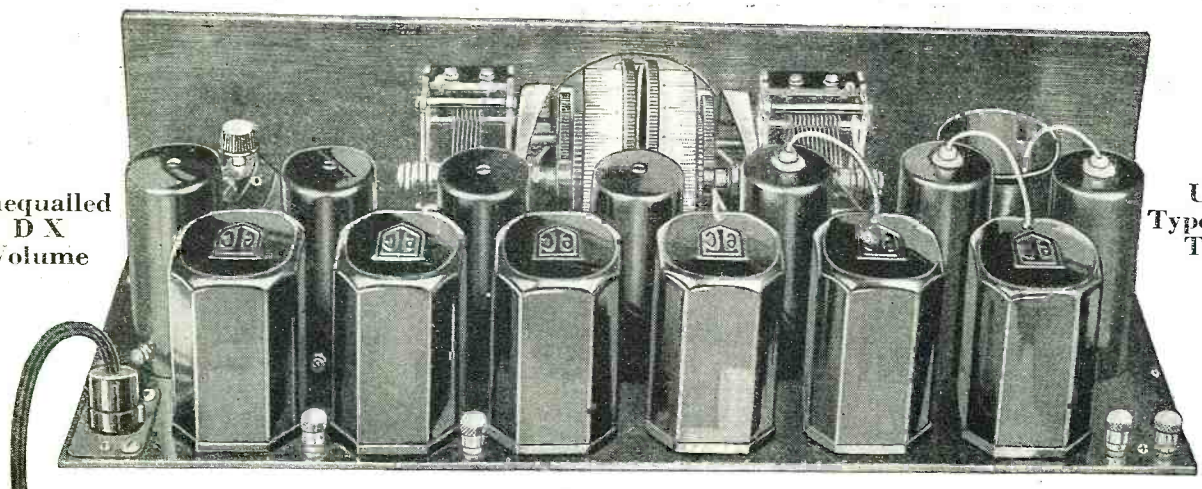
Tyrman "70"

Shielded Grid Amplimax

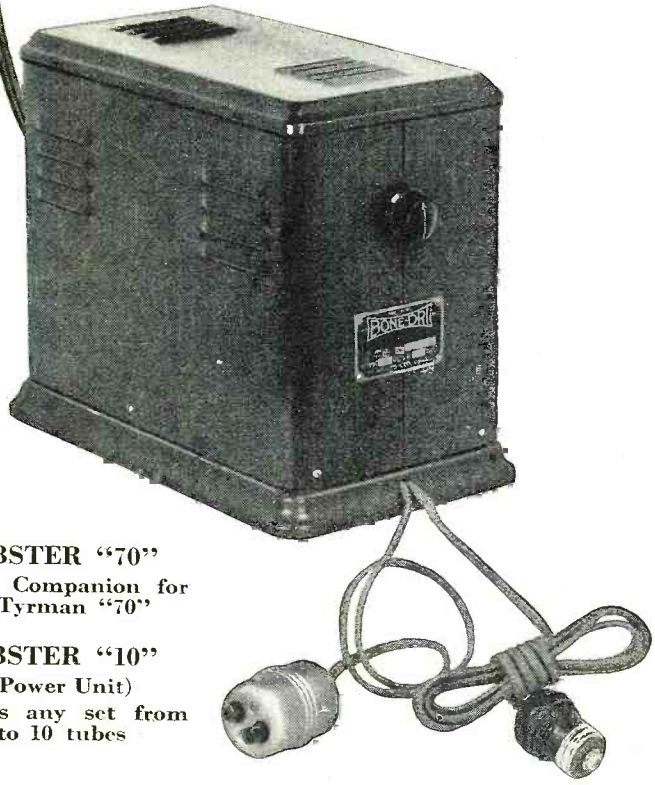
FOR EXCLUSIVE

A C or Battery Operation

Unequalled D X Volume



Using Type SP 122 Tubes



WEBSTER "70"
A Real Companion for the Tyrman "70"

WEBSTER "10"
(A Power Unit)
Operates any set from 4 to 10 tubes

3000 Miles on a SIX FOOT antenna without Distortion or Oscillation

The Tyrman "70" is guaranteed to outperform any other present-day receiver when built according to specifications.

Until now all claims for distance, selectivity, volume and tone quality have been based upon number of tubes employed.

Now greater results are obtained through Tyrman Laboratories by the development of the Tyrman "70."

Build this new receiver and be the first to benefit by this revolutionary improvement.

TYRMAN ELECTRIC CORPORTION

143 W. AUSTIN AVE. CHICAGO, ILL.

TYRMAN ELECTRIC CORPORATION
Dept. RN—143 W. Austin Ave.
Chicago, Illinois

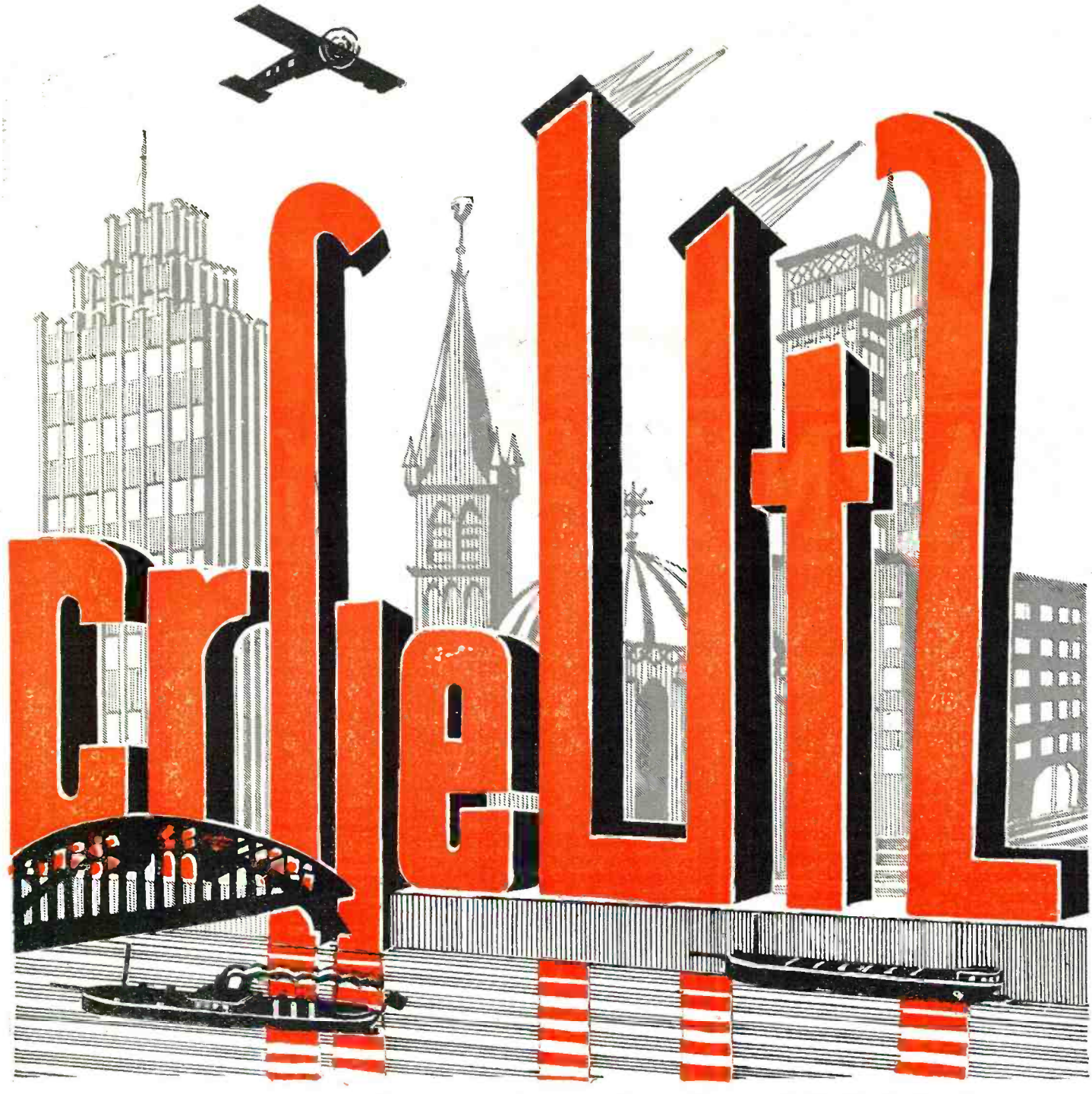
Gentlemen:

Kindly send me, gratis, special literature describing Tyrman "70" Shielded Grid Amplimax in detail.

Name .....

Address .....

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



FOR the past six years and now more than ever, Leutz Custom Built Radio Receivers are giving complete satisfaction and superior performance in every civilized country in the world.

Every Leutz receiver is made to special order, delivery requiring two to four weeks average. The output is limited to the capacity of the skilled craftsmen and engineers. Leutz receivers have a laboratory test minimum range of 2000 miles and the calibrations given with the receiver. A Leutz receiver when shipped is perfect due to the individual attention given, furthermore it is guaranteed to be free from any electrical or mechanical defects for one year.

New literature on the latest Leutz products is now available for distribution. Write for your copy today.

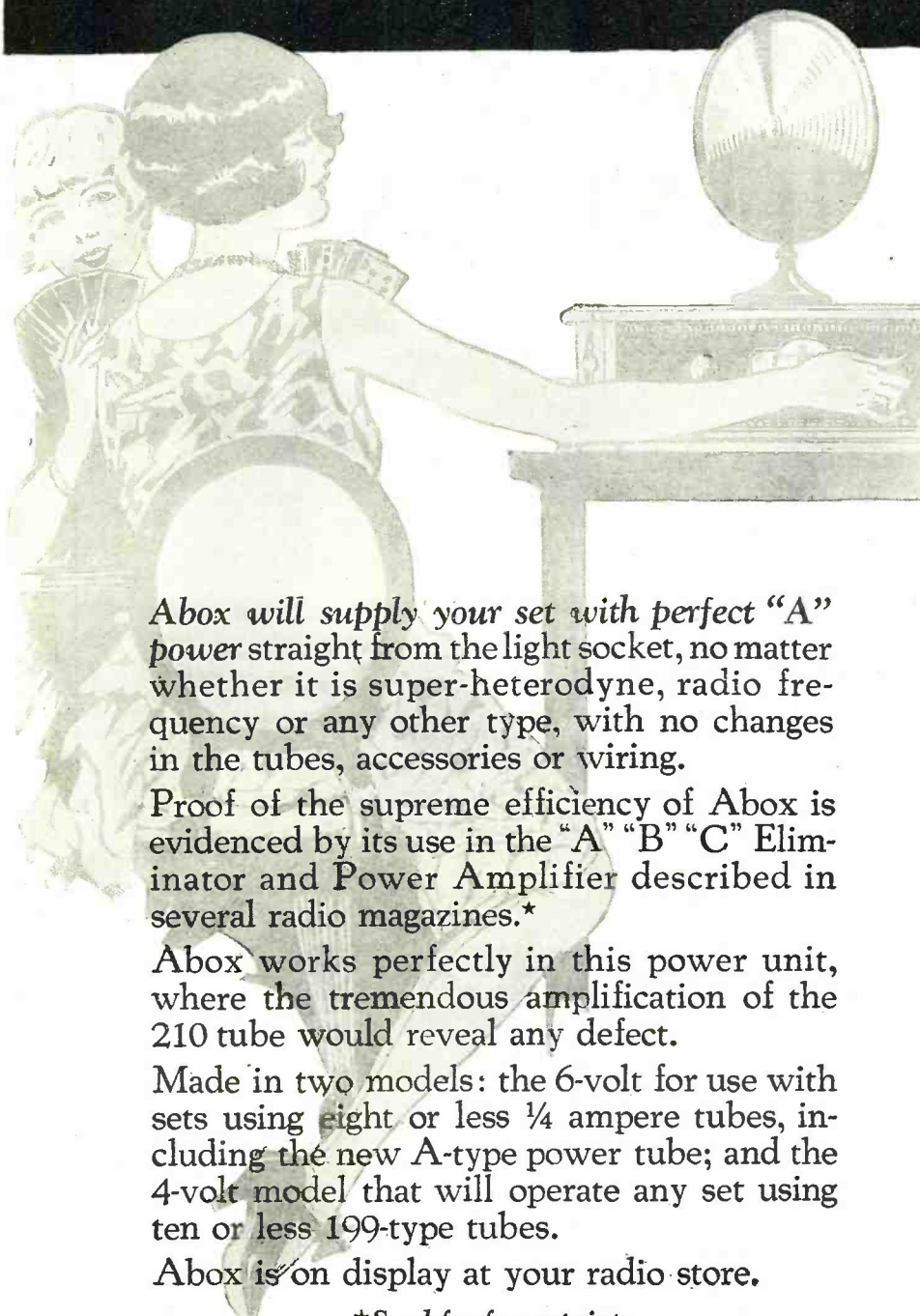
THE 1928 EDITION OF "MODERN RADIO RECEPTION" WILL BE READY FOR DELIVERY JANUARY 8th. Completely rewritten and right up to date this book contains 384 pages and over 250 illustrations of modern radio receivers. PRICE $3.00, money back if not satisfied.

C. R. LEUTZ, INC.

Sixth and Washington Avenues **Long Island City, N. Y.**

Abox

"A" BATTERY ELIMINATOR



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$32.50

Input—110 volts, 50-60 cycles A. C.
Output—6-volt direct current, 2 amperes.
Shipping weight, 25 lbs.

Abox will supply your set with perfect "A" power straight from the light socket, no matter whether it is super-heterodyne, radio frequency or any other type, with no changes in the tubes, accessories or wiring.

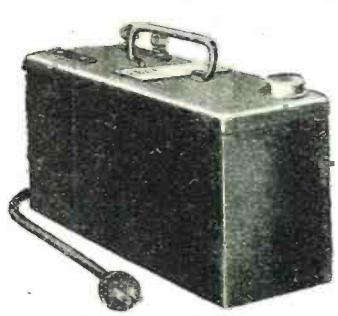
Proof of the supreme efficiency of Abox is evidenced by its use in the "A" "B" "C" Eliminator and Power Amplifier described in several radio magazines.*

Abox works perfectly in this power unit, where the tremendous amplification of the 210 tube would reveal any defect.

Made in two models: the 6-volt for use with sets using eight or less ¼ ampere tubes, including the new A-type power tube; and the 4-volt model that will operate any set using ten or less 199-type tubes.

Abox is on display at your radio store.

**Send for free reprints*



Four-volt model for sets using 4-volt tubes. Fits Radiola battery compartment. Size, 8¾ inches long, 4 inches wide, 6⅞ inches high. Output—.6 amperes, 4 volts D.C. Price **$27.50**

All prices slightly higher on West Coast

The Abox Company

215 North Michigan Avenue — Chicago, Illinois

Radio News

Hugo Gernsback Editor & Publisher

Editorial and General Offices, 230 Fifth Avenue, New York

Vol. 9 FEBRUARY, 1928 No. 8

What's What in Radio

By Hugo Gernsback

THE present radio season is quite an unusual one. As so often has happened in radio, the entire art right now seems to be undergoing a sort of silent revolution. About a year ago, it was unusual to hear the term, "An Electric Radio" or "A Socket-Operated" or "An Electric-Current-Operated Radio." Today, the public is asking all sorts of questions about these improvements; and these few remarks are addressed to those whose interest in radio is only from an entertainment viewpoint, and who do not as a rule care about radio technicalities. The questions are those which are most often asked by laymen today.

What is an electric radio receiver?

An electric radio receiving set, today, is understood to be a receiver which can be connected to a light socket, the tubes in the set being of the so-called alternating-current type. Such a set contains no batteries of any kind. It contains no liquids. It uses a "B" power-unit, which furnishes plate current by converting the house current into suitable form.

What is an electrified set?

By an electrified set is meant a light-socket-operated set wherein no changes have been made from the model operated by batteries. It uses the standard battery-type vacuum tubes; but, instead of a storage battery, an "A" socket-power unit is employed; and for the "B" current, a "B" power-unit is provided. These devices replace entirely the "A" and "B" batteries, and therefore require no recharging and infrequent renewal of tubes. It is possible, also, to use a storage battery which has attached to it a charging device. The charging is done automatically, and the battery then need not be removed from its place to be charged.

Can an electrified or an electric set be operated from any light socket?

No. It is necessary to find out, first, what sort of current you have. About 90 per cent of all current supplied in the cities of the United States is alternating, 110-volt, 60-cycle. Most of the appliances for electrified sets, and most electric sets, are designed to work on current of this kind. But there are sections in the United States, particularly in our large cities, where 110-volt direct current is still used. Wherever there is direct current or alternating current of unusual voltage or frequency, you cannot use an ordinary electrified or electric set. If there are any doubts in your mind as to what current you have in your home, call up the electric company to whom you pay your lighting bills, and they will give you the information as to what current they supply. In large apartment houses, the superintendent of the building will be glad to give the information.

There are also sections of the country where, though alternating current is used, it is not of 60-cycle frequency, but some other, such as 25. As a rule, neither electrifying accessories nor electric sets can be used with such current; although some manufacturers are making special appliances to meet such conditions. Be sure you post yourself on this point. In the country, particularly on farms, there are a great many 32-volt private lighting plants. Neither the electric set nor the standard electrified set can be worked from this 32-volt current.

Which is better, a battery-operated set, an electrified, or an electric set?

These types work about alike. As a rule, the electrified and electric sets can deliver more power. On the other hand, a battery-operated set is apt to be somewhat quieter, in the present stage of the art. To the average user, the trifling line noises that occur in electrified or electric sets are of no consequence; particularly when the volume control is turned on full, such slight noises as occur when nearby lights are switched on are as a rule never heard. The battery-operated set, though admittedly somewhat quieter, requires constant care in the charging of the "A" battery and renewal of the "B" batteries. The need for attention disappears almost entirely with the other two forms of sets.

How much does it cost to operate an electrified or an electric set?

That depends upon the number of tubes and the system used in the particular set referred to. No exact answer can be given without knowing exactly what set is to be used, because all sets vary more or less. In any case, no current is used when the set is not in operation, except where a storage battery with an automatic charger is used. But in any case, on an average, the cost of running an electrified set is seldom more than five cents an evening, if the set is run for three hours. This may vary to as little as two cents, and as high as ten cents; the lower cost being for a smaller set and the higher cost for a larger set, say of the ten-tube variety.

How long should a modern radio set last?

Again this depends upon the type of set. You do not expect a $400 car to last as long as one costing $15,000; the same should be true with a radio set. The low-priced sets are not equipped with high-grade parts; whereas the sets of the better make are made with the purpose of permanent satisfaction uppermost. Temperature changes, wearing of the condenser shafts, dust, corrosion, particularly if the set is used near the seashore or in a moist climate, all have their effects upon the materials. The *average* life of a radio set is about three years; although we have seen many in use that are much older than this. It also depends upon how much a set is used. Usually most of the wear comes in on the tuning adjustments; but it is a mighty poor set that can wear out its condenser bearings in less than three years. The *useful* life of the average radio set is about that of the average automobile, and that is about three years.

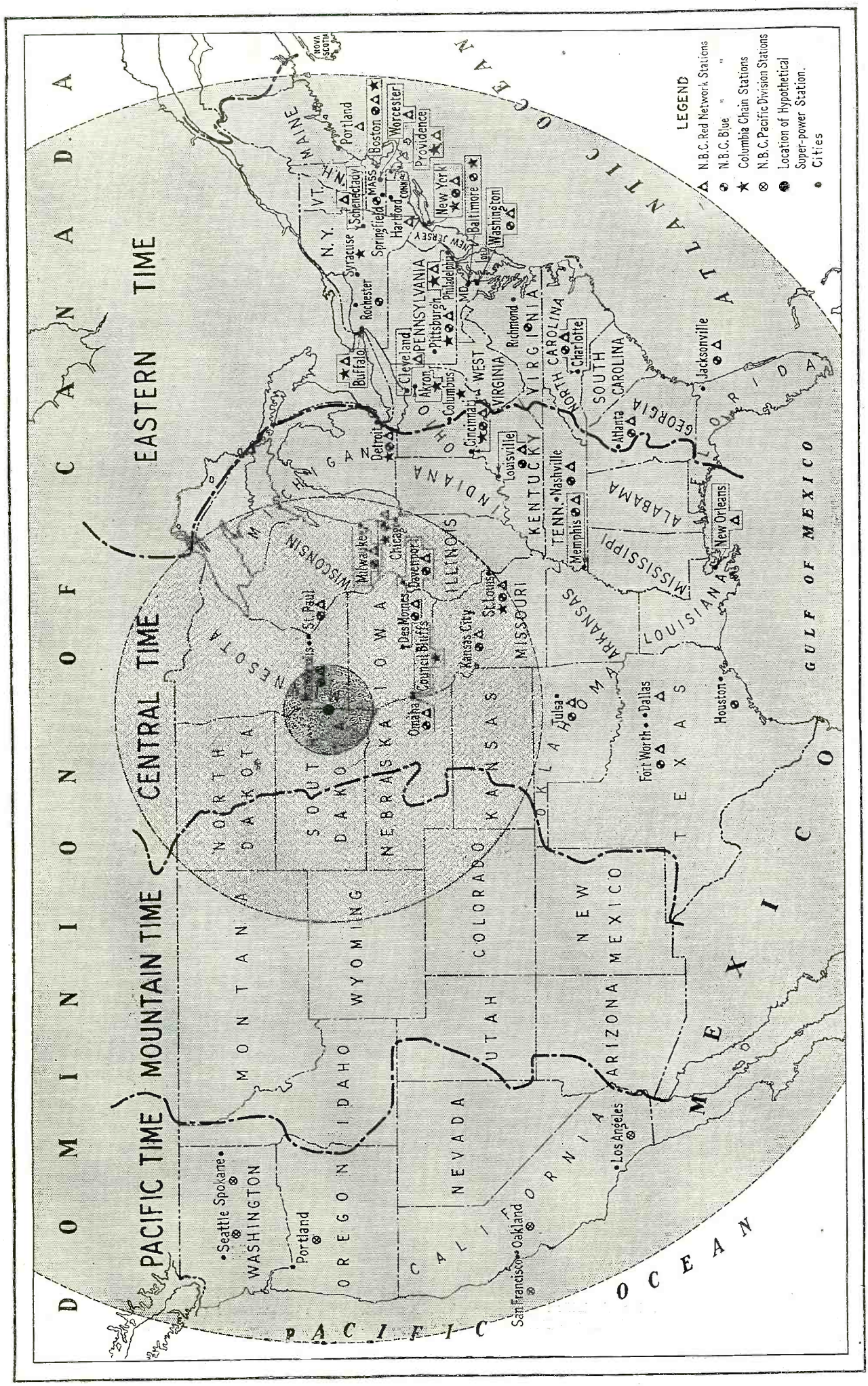
Are battery sets obsolete?

No. Battery sets will be in use for many years to come. Wherever there is an unsuitable supply of electricity, such as direct current, or 110-volt, 25-cycle current, or 32-volt farm-light current, battery sets will be used. Indeed there may be, in time, a grand come-back of the battery-operated sets, due to the development of different tubes. We already have the double-grid tube, which uses only a fraction of the current that other tubes take; but its possibilities are yet more or less in the future.

Which is better, the cone or the horn speaker?

Both have their merits. It may be said that the cone speaker reproduces the lower notes more faithfully, whereas the horn-type speaker usually reproduces the higher notes more faithfully. This is true of the general run of speakers, though there are a number of cones on the market which reproduce the low and high notes equally well. The best combination, however, comprises a horn and a cone connected to the set, either in parallel or in series, and placed in different parts of the room. This gives the greatest fidelity in reproduction available today. There are, of course, such exceptions as the large exponential horn, which gives very excellent reproduction on both the low and high notes. This speaker, however, takes up a great deal of room.

Mr. Hugo Gernsback speaks every Tuesday night at 9.30 P. M. (E.S.T.) from station WRNY on various radio and scientific subjects.



THIS map shows the distribution of the various broadcast stations comprising the radio "chains" or networks, and also the location of a hypothetical super-power station which might be constructed to cover the entire United States with a radio signal of unfailingly acceptable strength. Estimated on the basis of the 100-mile service area for which 50-kilowatt stations are rated (small shaded area), such a station would require about 11,000 kilowatts of power (on the "inverse square" rule) to cover the 1,500-mile radius indicated by the outside circle. With about 1,250 kilowatts it would cover a circle of 500 miles' radius, as indicated by the center circle. This is the order of power which supposedly would drown out all atmospheric interference; but engineers are sceptical whether any transmitter, however powerful, can be guaranteed to do this.

The super-power station would be located approximately on the border line between the states of South Dakota and Minnesota, near the northwestern corner of Iowa.

Note that the Mountain Time zone of the country does not contain a single chain station. For the call letters of the stations in the four national networks see the end of this article, page 944. The small dots, not the symbols, indicate the cities where studios are located, though the transmitters are often some distance away.

What About the Future of Chain Broadcasting?

Will the Radio Networks Survive? Some Factors of the Problem Considered from the Listeners' Standpoint

By Charles Magee Adams

CHANGE is, of course, as inevitable a consequence of existence as that proverbial team, death and taxes; a fact nowhere more obvious than in the field of radio. So swiftly has development followed development, that one technical practice or set of conditions has hardly become established before it has been superseded by something newer and better. But, in spite of our being accustomed to this process of constant evolution, as radio enthusiasts necessarily must be, it comes as considerable of a shock to discover that competent observers are now noting along the radio horizon signs that portend the supplanting of chain broadcasting by something newer and better.

Unlike so many other developments which have had their moment of the spotlight, and then passed off the stage, chain broadcasting has endured for four years—a longevity which has given it the rank of a near-permanent institution, as things in radio go. Moreover, it is at the present time just developing to the proportions which were promised from the beginning. Yet authorities, whose judgments are too keen to be dismissed lightly, recognize in recent developments along two diverse lines—those of higher-powered transmitters, and those in the field of the phonograph—potentialities which, if realized, may well relegate chain broadcasting to a place on the radio shelf.

So it seems worth while to analyze the situation, not so much from the standpoint of the technician as from that of the listener—the ultimate consumer of broadcasting, and therefore the individual whose interests must be accorded first place.

THE MERITS OF THE SYSTEM

What are the advantages of chain broadcasting to the listener? The answer to this is, of course, obvious.

First, the network system has enabled the presentation of much superior programs; not only through distributing the cost of engaging better artists among many stations, instead of saddling it on only one, but also through making available to much of the country broadcasts of events of wide public interest. Second, it has made possible the enjoyment of these programs under conditions of local reception, as against DX.

Anyone who remembers the caliber of programs which were outstanding four or five years ago need not be told that the first result alone represents a genuine advance in broadcasting. But, it seems to me, the second is even more important from the listener's standpoint. The freedom from interference of all kinds which reception from a local station offers is generally recognized; and contact with listeners discloses the astonishing extent to which set owners, who once ranged far and wide in quest of entertainment, now limit the bulk of their listening to local stations, chiefly outlets of the various chains, for this very reason of more satisfactory reception.

AND ITS DEMERITS

Next, what are the disadvantages of chain broadcasting? The first, and the most serious from the listener's standpoint, is occasioned by the difference in time between the various zones into which the country is divided.

To eastern listeners this appears a detail of small importance. But for those living elsewhere it constitutes a real problem, since practically all network programs originate in New York and are scheduled according to New York time.

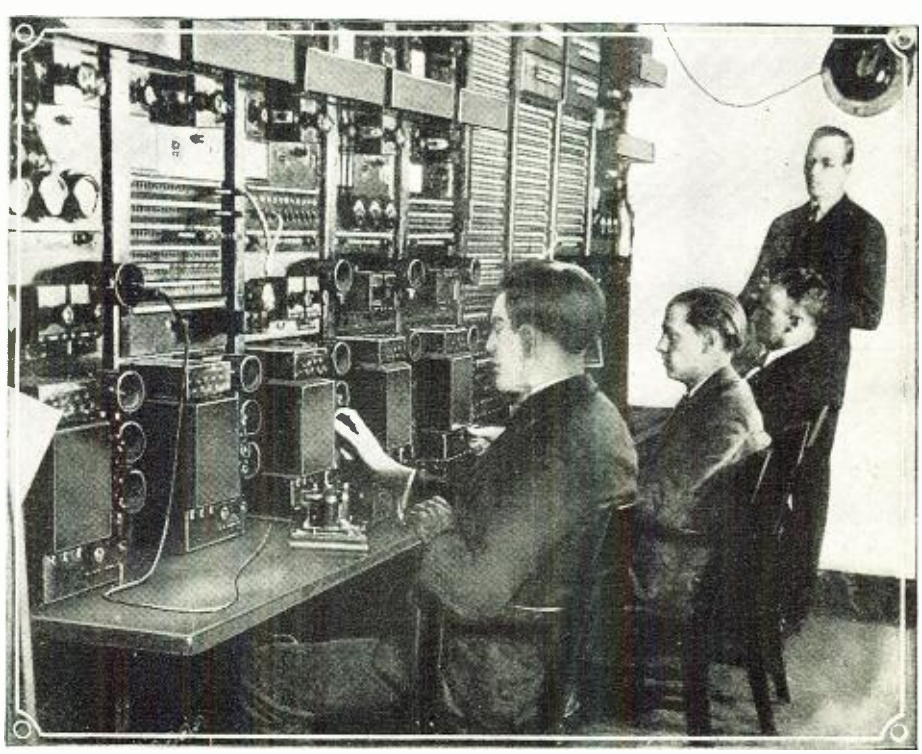
A difference of only one hour means an annoying conflict with the habits of listeners. For example, a chain program put on the air at 7:30 p. m. eastern time falls at 6:30 p. m. central time, when many listeners in the latter zone are not free to enjoy what is offered. A difference of two hours, as between eastern and mountain time, or eastern and central when the former is using daylight saving, entails a heavy loss in the western audience, unless the program is one of compelling interest; and the difference of three hours between the eastern and Pacific zones is such a prohibitive obstacle that the National Broadcasting Company has found it necessary to make its Orange network a separate unit, except for the airing of national events or daylight programs.

It is true, of course, that it has been possible to change the habits of listeners to some extent, by educating them to listen in at times to which they were not accustomed; and also to set programs at a compromise time acceptable to listeners in zones between which there is only an hour's difference. But a difference of two hours or more presents such complications that chain broadcasting cannot overcome the handicap, save in the few exceptions just noted, at least with key stations in New York; and the suggested solution of establishing a key station for each of the various zones would entail a sacrifice of the economy in artists' fees which the network system effects.

SECTIONAL OR NATIONAL PROGRAMS

The reference to event broadcasts leads naturally to a second disadvantage of the network method from the listener's standpoint—namely, its unwieldiness as regards programs with sectional interest.

Because they are designed first of all to serve the sponsors of commercial programs whose support makes them possible, the chains are organized on a scale as nearly national as practicable. From the standpoint of financing this is, of course, sound; and on the score of service to the listener it is also an advantage, particularly as far as broadcasts of national events are concerned. But, for material with only sectional interest, the network method discloses a serious weakness.



The WEAF control board, located at 195 Broadway, New York City, through which all the chain broadcasts over the "Red" network are distributed.

Land lines connecting the member stations are planned for service from a single key station, generally located in New York. No provision is made for breaking up the chain into regional units, served from lesser key stations, for the good reason that, under the conditions of national operation which usually prevail, this would be uneconomical. Such an arrangement makes the airing of programs with a sectional appeal practically prohibitive; a disadvantage which has become more and more apparent to listeners of late.

SMALLER TIE-UPS DESIRABLE

Football games are an apt example. With few exceptions, notably the Army-Navy contest, they are of interest chiefly to listeners living in the states or sections represented by the teams taking part. It is true that most of them are put on the air by single stations. But these, it will be noted, are rarely of sufficient power to serve properly the entire area in which listeners are interested, especially under the handicap of daylight transmission. If a few stations, selected to cover the territory, could be tied together for such a broadcast, the resultant service would be keenly appreciated by listeners. But existing chain facilities are, for the sound reasons just cited, not adapted to this purpose; and the leasing of lines for such a single event is, as a rule, too costly.

Many other events of interest to listeners in a section, larger than can be served by a single station of average power, could be mentioned—conventions, industrial gatherings, meetings of various kinds; and it is also true that many entertainment programs could be developed to a point of greater interest if aimed at simply a sectional audience. But, as chains are now constituted, what is put on the air must have a national appeal.

The question of whether chain broadcasting will survive accordingly resolves itself, from the listener's standpoint, to this: do recent developments in higher-powered transmitters or phonograph technique offer possibilities that would eliminate the disadvantages of the network method, at the same time retaining its advantages?

SUPER-POWER TRANSMITTERS

First, as to higher-powered transmitters. There is no question that a station with 50 or 100 kilowatts output, such as WJZ, WEAF, or the new WGY, can command an audience which, for part of the time, compares favorably with that of a sizable chain system. Therefore, a station of this power as a substitute for a chain would make feasible the presentation of superior programs by high-class artists, the first advantage of the network method.

Further, it is equally clear that a few such stations properly placed could eliminate the difference in time handicap under which the networks now labor (assuming, of course, that each operated independently); and also that they would lend themselves well to the airing of material with special interest to listeners in their respective sections.

So, as a substitute for chain broadcasting, the higher-powered transmitter scores on three of four points. But on the fourth, that of service compared with local reception from a chain outlet, it falls short.

This is said with full respect for the fine results secured by those transmitters using 50 kilowatts or more. It is true that such stations have materially increased their service range by employing increased power. But it is also true that, as compared with that supplied by locals, the dependability of their service at any real distance has been considerably over-estimated in many quarters.

EFFECT OF DISTANCE

For example, the writer lives some 600 miles from WJZ and there are nights when this big station "comes in like a local," to use the stock phrase; but there are also nights when it does not come in at all, because of static or other atmospheric obstacles. KDKA is about 200 miles away from my location, and at times this pioneer comes in better than local; but again there are times when it too does not come in at all.

The still more serious error in popular discussion of recent super-power developments, particularly with respect to WGY's 100-kilowatt set, is the assumption that doubling the power doubles the effective range. At the time WJZ's present equipment was installed, engineers explained that, because of the "square-root rule" which applies in such a case, it is necessary to increase the power four times in order to double the signal strength, which means 200, and not 100 kilowatts, is the next step in power increases, but one not expected in the near future.

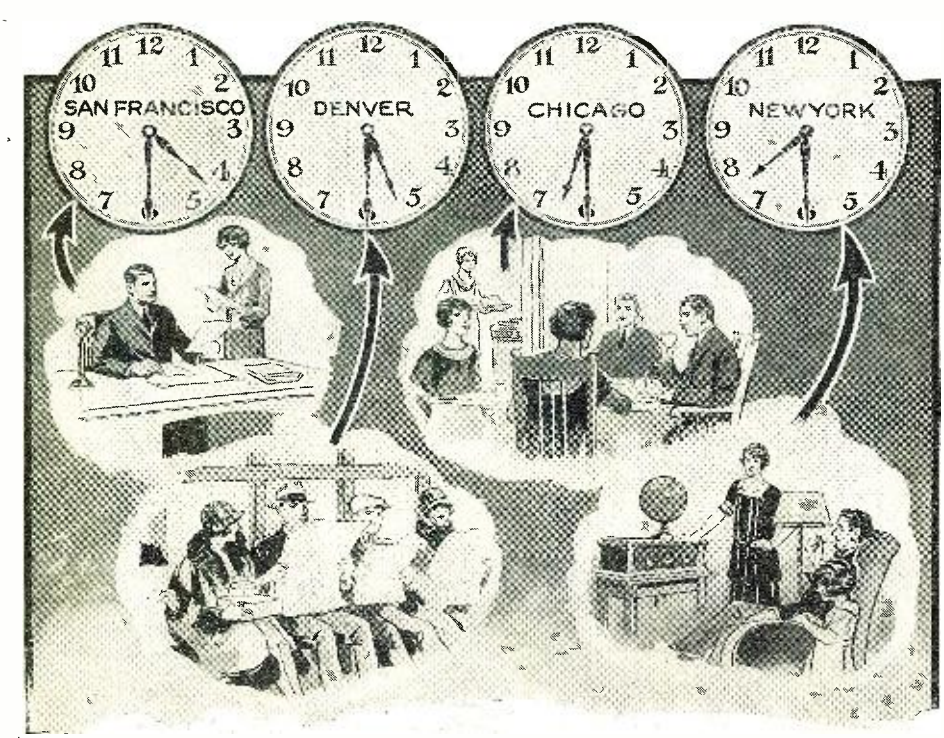
In the light of all this it should be clear that, gratifying as the results have been, recent developments in higher-powered transmitters do not offer any present or near-future substitute for chain broadcasting in the vital matter of dependable service over a territory even approximating that served by present networks; and further, that anything approaching a dependable nation-wide service from a single station is still only a hope; since a power of at least 1000 kilowatts and possibly as high as 10,000 would seemingly be required for this.

PERFECTION OF THE PHONOGRAPH

Next, as to the phonograph. It is pretty generally agreed that recent advances in the technique of recording and reproduction have reduced the loss in musical fidelity represented by this method, as against direct presentation, to an almost negligible quantity. In fact, the chief obstacle to the widespread adoption of the phonograph as a source of broadcast entertainment at the present time seems to be the prejudice of listeners, carried over from the days when the shortcomings of the phonograph were manifold, and broadcasting emphasized rather than minimized them. This can obviously be overcome by proper education, plus some further technical refinements.

If, accordingly, chain programs were recorded and broadcast from records, instead of being carried over telephone lines from key stations (which has been suggested by competent authorities) it is clear that such a substitute arrangement would retain both the advantages of the network method—superior programs by superior artists, and dependable reception from local stations—at a cost that might be even less than that of the present method. In addition, such a system would eliminate one disadvantage of chain broadcasting, that of the difference in time, by making possible the airing of programs at an hour best adapted to the audience being served; and further, it would go far toward eliminating the second disadvantage, by enabling the presentation of programs with sectional interest.

But the phonograph falls short in the matter of national-event broadcasts, which have come to have such an important place in radio programs. It is inconceivable that listeners would relish an "embalmed" version of affairs like the reception to Colonel Lindbergh, championship fights, or political conventions. The interest of such events lies in their news value, and no recording could hope to equal their direct airing over network systems.



The man in New York has finished dinner and is settled down for his evening's radio entertainment before his fellow listeners further west are quite ready for a chain program; thus the latter must miss many good eastern programs.

CHAIN METHOD STILL BEST

So neither the higher-powered transmitter nor the modern phonograph proves to be a completely satisfactory substitute for chain broadcasting just now.

It may well be, of course, that a combination of the two will, in the not too distant future, supplant networks to a large extent. Instead of being broadcast through a few score of stations linked by telephone lines, programs of the ordinary type may be recorded and transmitted by many locals, supplemented by a dozen or two truly super-power stations so placed as to supply regional service; and with chain facilities making possible the connecting of all for the airing of outstanding events. Such a compromise arrangement would afford maximum service to the listener and, accordingly, is a possibility which can be anticipated with interest as developments take shape.

But, in the meantime, chain broadcasting as at present constituted seems certain not only to remain, but to continue its expansion, notwithstanding these promising substitutes.

The Advantages of the Broadcast Networks

By Dr. Alfred N. Goldsmith

NETWORK operation has been subject to much commendation and to some criticism. Its more enthusiastic supporters have seen in it the only effective means of serving the country as a whole with programs of the highest quality. Others, however, have expressed the fear that network broadcasting would tend to needlessly standardize operation of unified groups of powerful stations; and have doubted whether such a plan was socially desirable.

It would not be appropriate to consider here matters involving political controversy. It is assumed that if the radio listener is pleased by the excellent service which he gets from broadcast stations, the problems of governmental regulation of broadcasting will be greatly simplified and, in large part, automatically solved. After all, the fundamental aim of broadcasting is that the listener shall be pleased and instructed. Translated into more specific terms, this means that programs, of both the entertainment and educational varieties, must be radiated in such a way that practically every person in the United States can get clear, reliable reception with a certain reasonable amount of program choice.

ECONOMIC CONSIDERATIONS

Considering first the commercial aspects of sponsored programs (containing indirect advertising), it should be remembered that this is an age of nationally-distributed products. The great industries of the United States sell their products on a nation-wide scale and are interested in reaching the entire population as prospective purchasers.

The tendency towards the national distribution of products has extended even into the fields of art and literature. It has been found that musical and literary talent naturally gravitates to the larger cities; and that those so fortunate as to possess it in a high degree require correspondingly large financial returns for their efforts. Hence the best entertainment cannot be used to satisfy small groups of people having limited purchasing power.

Radio broadcasting employs artistic and other talent of which there is but a limited supply and that found only in relatively few parts of the country in readily available form. The purchasing power of the audience of an individual station is sometimes insufficient to justify the commercial sponsors of a program in using the best available talent.

Fortunately, network broadcasting by groups of fairly high-power stations enables the obtaining of an audience of high purchasing power, such as will economically justify the finest possible programs utilizing the most capable (and generally expensive) performers. There is in addition a large class of non-commercial features which can reach the public nationally through network broadcasting or not at all.

On occasion it has been pointed out that commercial broadcasting is justified if the additional profits due to broadcasting, obtained by the sponsor organizations through the sale of their products to the audience of the broadcasting stations, are considerably larger than the cost of providing the programs given to such audiences. This important general principle at once leads to the conclusion that nationally-advertised products require national distribution of the finest possible programs, if an economic set-up is hoped for.

TECHNICAL CONSIDERATIONS

From time to time the suggestion has been made that, perhaps, the United States could be adequately covered by a very few extremely high-power broadcast stations. Without denying the ultimate possibility of such an achievement, it is nevertheless a fact that *it is not* possible indefinitely *to increase the reliably-reached audience of a broadcast station, by merely increasing the transmitting power, using any technical methods now available.*

In the present state of our engineering knowledge, we do not know how to overcome marked fading or irregular fluctuation and distortion of signals, which effect begins to detract from the quality of the received program at distances between approximately 75 and 150 miles from the transmitting station.

If, accordingly, we aim at a 150-mile range as the greatest feasible service range now technically available, and use stations of 50 kilowatts or more to secure such a range (perhaps even going to powers as high as 1,000 kilowatts in certain special districts), we shall accomplish about all that can be expected of a single broadcast station, using present-day methods of transmission and serving listeners using existing methods of reception. In some cases the audience of such a station is not large enough to justify economically the best possible programs.

(*Continued on page* 942)

Dr. Alfred N. Goldsmith, Chairman of the Board of Consulting Engineers, National Broadcasting Co., and one of the world's leading broadcast authorities.

Who Will Applaud a Dollar's Worth?

Editor, Radio News:

Evidently the article on Page 478 of your November number entitled "What Every Station Wants—Applause" was written by a person interested in the operation of a broadcast station. (*He is a newspaperman*—Editor). Assuming that to be the fact, he is endeavoring to establish the value of his station, as an advertising medium, based on its popularity with listeners, as evidenced by the number and character of communications received. This idea or plan would parallel the value of a newspaper, as an advertising medium, based on its circulation. However, there is a distinctive, everyday value in the newspaper, amounting to a necessity or demand by the public that does not yet exist for the radio. News vs. amusement would typify the difference.

"You can lead a horse to water but you can't make him drink;" the same principle applies to the listener, if any serious effort is made by broadcast stations to make an advertising billboard of the air. Any attempt to accomplish that purpose, coupled with the distracting confusion caused by the multitude of stations, large and small, emitting mediocre programs, plus static and fading will disgust listeners and after awhile the ash man will discover a new type of cast-off debris in the can.

There are delightful, presumably paid-for, programs broadcast with a touch of inoffensive advertising included; and certainly a number of fine stations operated by manufacturers and dealers in radio products—all of which are undoubtedly highly appreciated by the great majority of listeners.

All the good people need is a "Moses" to lead them to demonstrate their appreciation of good radio reception. They are all singing "Show Me the Way to Go." The great mass of them do not want "something for nothing." They go to the movies, theatres, concerts, etc., and would willingly pay for good radio entertainment.

I have some Irish blood in my veins and therefore could not qualify as a "Moses;" but I would suggest broadcasting a plan asking every radio listener to contribute $1.00 towards establishing a fund to cover the cost to stations and entertainers of one or more super-programs, of say not more than two hours' duration. If the stations did not wish to father the idea, it could be sponsored by your publication or by a committee of listeners.

A big hook-up could be arranged that would nullify any charge of favoritism between stations and, if I am anywhere near correct in my prognostications, the furtherance of this plan would lead to a permanent high-class form of reception which millions of listeners would be glad to pay for.

There is a vitally essential factor to consider concerning the future of radio. The Radio Commission at Washington is supposed to be the "Moses" that is to lead us out of the wilderness of confusion of the ether. "Watchful Waiting" may be the proper and polite motto; but I think the clearing of the air might be supplemented and expedited by having expert, technically-qualified persons determine the number of stations that can be operated in a practical and satisfactory manner and then, after a number is fixed, have stations that can reach all portions of the country ask listeners to select that number of stations by name of location and letters and send in the list as their vote (to some designated address) for the retention of such stations as the majority favor.

A check of these votes would materially assist the commission in bringing order out of chaos.

The problem of forcing the effusions of approximately seven hundred broadcasting stations into eighty-nine wavelengths is parallel to the attempt to make individually distinct the audible efforts of seven hundred members of the gentler sex, all trying to broadcast at once their opinions and foibles over eighty hundred and ninety wavelengths. I am willing to allow the ladies—God Bless 'Em!!—a much greater spread and still assert that both problems are impossible.

Here's my dollar and, if there is an idea herein contained worth a million dollars, as per your Editor's statement, kindly forward draft for a hundred thousand dollars, on receipt of this brief letter, as an evidence of good faith.

Geo. W. Pangborn,
1203 *Fletcher Trust Bldg.,*
Indianapolis, Ind.

(*This is a business man's letter, direct and to the point. We fear, however, that the voluntary response from fans would not be large; although in other countries from* $3.00 *to* $20.00 *a year license fee is paid by set owners for a choice of programs which cannot be compared to that available to most listeners in this country. Many in this country would undoubtedly be willing to contribute liberally, if they knew that the hat would be passed systematically; but radio in this country has developed out of that stage. What is needed is a method of proving to the sponsors of any particular radio program that it is bringing them business; and the cost of the best features which can be put on the air will speedily be forthcoming.*—Editor.)

Daylight DX Records

Editor, Radio News:

One radio subject that seems important to me, at least, has had very little discussion—or if it has, I have missed it. That subject is daylight reception in the broadcast range. I have heard announcers at high noon, in Chicago, dedicate a selection to "Mrs. Blank, who is listening in at Kansas City," when I am sure there was not a ghost of a chance that the lady heard even the carrier wave. With a superheterodyne, by using aerial and ground, I can get WOC, Davenport, Iowa, 160 miles west of Chicago, with fair consistency in daylight; occasionally I have heard Cincinnati and St. Louis, 250 miles distant, when the sun was shining. That is the best I have ever done.

In your opinion, will greater sensitivity—as, for instance, by the use of the shielded-grid tube—help daylight reception, or is

(*Continued on page* 946)

Melba Meking

A featured artist on the programs of station WOR. She makes a specialty of Spanish songs, and accompanies herself on the guitar.

Vaughn de Leath

The real "Original Radio Girl"—She has been broadcasting since 1921, and is now a National Broadcasting Company staff artist.

Reinald Werrenrath

Noted concert baritone who has developed a large radio following through his recitals before the WEAF microphone.

The "Capitol Family" Passes Its Fifth Radio Birthday

By Julia Shawell

FOR five years, the world's largest "family" has never missed a single Sunday evening without getting together in groups of untold thousands to hear the voice of its "daddy" and to enjoy the entertainment provided by its talented members.

Every Sunday night, Montana meets its New York cousins, while Major Edward Bowes' "Capitol Family" joins around a continent of loud speakers for its weekly family gathering. For five whole years this enormous unit, bound by a common tie, has been growing in leaps and bounds; until now the weekly session of the great clan means that a million ears heed the same voice at 7.20 o'clock, Eastern Standard Time. For two hours these radio brothers, sisters, cousins, and some of their great-grandmothers, span thousands of miles and drop off for the family conclave on Broadway.

Five whole years on the ether have solidified the "Capitol Family" into a permanently-adopted group that has brought into the fold every interest, every type, every color and every creed. Recently the "Capitol Family" observed its fifth anniversary of broadcasting, and the deluge of congratulatory messages that came in from all over the world was testimony enough to its multitudinous growth from a tiny circle of less than a dozen members, who timidly sent out their first greetings over WEAF's wave in November of 1922. Now fifteen of the country's biggest stations help to carry the Sunday message of good cheer to every man and woman who belongs to this circle.

The magical growth of Jack's famous beanstalk was the limited idea of some stilted imagination compared to the wonders of the multiplying of the "Capitol Family." With the size of this family grown beyond the computation of statisticians, the National Broadcasting Company now and then adds another station to the chain and another hundred thousand drop into the fold.

Imagine a million children sitting, quietly waiting for the word of their father, and heeding it with satisfaction and enjoyment, without any duty or obligation for their time and attention. Well, this is exactly what happened last Sunday night, what will occur next Sunday night, and what has been the regular occurrence every Sunday for five years.

"Good evening, Family," Major Edward Bowes greets the listening hordes, and the family circle is joined once more with every program bringing in new converted cousins to the clan.

A MODEST BEGINNING

Any event typifying the spirit of broadcasting, any mention of radio entertainment, would be incomplete without considering this enormous "family" and its artist members. When radio was a crawling infant, just feeling its way into the pioneer homes where newly-built receiving sets testified to enthusiastic conquests made by this latest of the world's sciences, the daddy of the "Capitol Family" was introducing his wondering children to the newcomer and helping to guide its way into a path of permanent development and worthwhile purposes.

The first symphonic music ever broadcast from a theatre was sent out to the "Capitol Family," and also marked the premiere radio program from the Capitol Theatre. That was on November 19, 1922, when Major Edward Bowes, as managing direc-

Top of page: The Capitol Theatre, 51st Street and Broadway, New York City. At the bottom of the page: left, Sylvia Miller, soprano; right, Dr. William Axt. Top center: Eugene Ormandy, violinist. Bottom center: Westell Gordon, cellist.

tor, and S. L. Rothafel, the popular "Roxy," as director of presentations, arranged with WEAF to broadcast the first number by the Capitol Orchestra, which Erno Rapee then directed.

That was in the way of an experiment, with Roxy's voice introducing itself to a continent, which was later to receive him as one of the most popular personalities who ever took to the ethereal waves. Montana and Nebraska responded to the first effort and the following Sunday, in addition to the orchestral music, Betsy Ayres and William Robyn sang to their unseen and newly-organized "family" in a special presentation, "Where the Volga Flows."

Names and voices have come and gone in these Sunday night programs since that occasion, and a few of the charter members have remained. But every new entertainer has had his or her followers; while some of them have risen to fame on the strength of their popularity with their Capitol listeners in every state in the Union.

That first Christmas Eve on the air! Thousands of the original "Capitol Family" members recall it, with Roxy's beautiful message of Yuletide cheer, and its special greeting for the convalescent soldiers in service hospitals. Evelyn Herbert, now a popular musical-comedy prima donna, was then a newcomer and sang "Agnus Dei," with Erik Bye. The voices of Betsy Ayres and Daddy Jim Coombs in a Christmas fantasy entered hundreds of happy homes and gave a little joy to not a few lonely hearts. That was the first "Merry Christmas" which followed Roxy's "Good night, God bless you."

Roxy has now become the leader of his own "Gang," and Major Bowes, who was then the silent parent in the early days of the young broadcasters, has taken his place at the microphones. It is his voice which each week leaves its kind thought with all the listeners and directs the artists.

One of the first members of the Capitol group, Frederick Jagel, is now a member of the Metropolitan Opera Company. Roxy has his own theater. Caroline Andrews, Marjorie Harcum, Yasha Bunchuk and others have added to their laurels on the concert stage through their radio associations.

ALL IN THE FAMILY

Probably the accomplishment to which the "Capitol Family" alludes with most pride is the list of hundreds of radio sets which members throughout the world sent to bedridden soldiers when the plea for help was broadcast.

Major Edward Bowes, head of the "Capitol Family."

Last Christmas alone, Major Bowes received more than 30,000 cards and letters from his young and old "boys" and "girls" in nearly every place where the "Capitol Family" has a member. More than 10,000 poems have been sent to him, during the past year, by listeners who have enjoyed the poetry he reads every Sunday night.

Often some unusually interesting episode

(*Continued on page* 924)

Top: Yascha Bunchuk, cellist. Center: Waldo Mayo, violinist. Left: Marjorie Harcum, contralto.

Above: Caroline Andrews, soprano. Lower center: Carlo Ferreti, baritone.

The Switch Engine of the Air

BY JOSEPH D. MOUNTAIN and C. STERLING GLEASON

THROUGH the inky black crypt of night, which yawned above the sheer Rockies, shot a comet, a tiny, droning comet of clear blue flame.

For all that Captain John Mettle, star pilot of the Neverlate Aerial Express Corporation, could see of the world, he might well have been on a comet hurtling through interstellar space. On either side of him played the tails of the comet, the streaking blue flames which poured from the twin exhaust pipes of the roaring motor. Beyond these, he could see merely blackness.

For hours Captain Mettle had been flying that tiny blue comet dead into the cryptic night; yet he was fully confident that he had deviated from his course not a ship's breadth. Nor was this confidence misplaced; for the equipment used by the Neverlate Aerial Express was the best that money could buy. Although still a venture for only the most intrepid men, flying the air-mail had been rendered as safe as night flying could be. And the paramount reason for this safety was the twin-beam radio beacon. When that device was operating, the mail ship was held as rigorously in its course as a railroad train.

The mechanism of the beacon was simple enough: two radio transmitters projecting parallel beams along the course, and a special receiver for the pilot. The transmitters operated at the same wavelength; but one was keyed to emit dots, the other dashes, of a predetermined length and speed. When the pilot flew exactly midway between the two beams, his set, receiving equal impulses from the two waves—which were keyed in a manner that caused the dots and dashes to overlap, producing a continuous sound—operated an ordinary relay, which kept a white light burning in the middle of the instrument-board. But when the plane drifted from its course, one beam was received with greater intensity; whereupon a special relay, tuned to the frequency of the dots or dashes, caused a green or red light to warn the pilot of his error.

Since the installation of the twin-beam radio beacon, not a single ship of the Neverlate Aerial Express had left its course. Only once had a ship arrived late at its destination; that was when a pilot had dropped his handkerchief and had landed to pick it up. For this infraction of the rules, he had been immediately suspended. Such prompt action had contributed largely to the enviable reputation of the Neverlate Aerial Express, which by sheer merit had won the coveted air-mail contract.

Intrepid flyer though he was, Captain Mettle was nevertheless glad to see a faint glow appear on the horizon. Directly ahead, through the circle of the propeller, it gleamed; and Captain Mettle nodded approvingly. Soon he would nose his ship downward and land in the glare of those great searchlights; men would hustle the bags of mail into the waiting truck and the Cheyenne ship; then he would be free to go home to his much-needed rest, and to his waiting family. Once more had the twin-beam radio beacon guided him straight as an arrow over the eight hundred miles of mountains and desert between Hollywood and Sweet Lake.

The glow resolved itself into two pillars of light; then, in the glare of the floodlights, he could see the field, with its pattern of smaller lights forming the letters "SL." Captain Mettle circled to read the wind direction from the large illuminated arrow; then he banked his ship into the wind for a landing. A whine of wires, punctuated by a series of short roars, as he opened the throttle to clean the raw gas out of the cylinders, and Captain Mettle brought his ship to rest exactly upon the line.

The waiting truck pulled up alongside; three men hauled the mail sacks from the compartment; and Captain Mettle, his fur collar thrown back on his shoulders and his goggles pushed up on his head, climbed down from the cockpit and turned—to look into the black muzzle of a villainous automatic!

"Hands up!"

* * * *

Bandy Field, the western terminus of the Neverlate Aerial Express, presented a scene of tense suspense. From Sweet Lake had come the staggering news that the midnight mail ship was almost ten minutes overdue. The reputation of the NAEC was at stake. What could have happened?

Captain Mettle had left Bandy Field on the very tick of the chronometer. The Wolfridge observation station, on the very topmost ridge of the high Sierra, reported that the ship had flown over that station at 8:08, two minutes ahead of the schedule, so close that he could read the number without the aid of the night glass. Since then, nothing had been heard. Captain Mettle had flown the eight hundred miles of the course one hundred and fifty-six times, without ever having been so much as a second late.

This tardiness of their star pilot was ominous. Whatever had happened must have happened suddenly; else, why had the pilot not started the automatic distress signal with which every NAEC ship was equipped? Was he down, somewhere in that tumbled maze of peaks and precipices, sand and sagebrush? Had his ship succumbed to the ever-present danger of motor failure? Or had the trusted pilot absconded with the cargo of registered air mail? Minutes passed, as minutes must; but they seemed like hours to the waiting men at Bandy and Sweet Lake Fields.

At 2:13 a glistening, high-powered motor car stopped in the pale light of the hangar

Then, in the eerie light, the perspiring president told a tale of terrible turmoil, while the radio operator searched the ether for news of the missing pilot.

to discharge its portly passenger. Puffing from the haste he had made during the past half-hour since he had been rudely awakened and told that the Midnight Mail had failed to arrive, rotund Alfred Neverre, president and principal stockholder of the Neverlate Aerial Express Corporation, bustled into the brightly-lighted office in a corner of the hangar.

"Has he arrived yet?" panted Neverre.

The radio operator shook his head. All this time the tardy pilot was getting more and more lost, if lost he were; or getting more and more dead, if dead he were.

"Then we must hold a conference," decided Neverre. "Call Major Moser and the Board of Directors."

From all parts of Hollywood, officials began to arrive. The secretary came in his town car; a motor bus rolled up and belched forth a load of vice-presidents; the treasurer arrived in his armored car; and President Neverre stopped tearing what little hair was left on his much-abused head, and marshalled the directors around a table improvised from a wing section and two boxes.

Then, in the eerie light of lanterns, the perspiring president told a tale of terrible turmoil—a tale of a dauntless pilot bravely battling against tremendous odds with the forces of Nature; or a tale of trial and temptation, of a soul-scathing struggle between conscience and desire. Briefly he outlined the advance of the NAEC to its present pinnacle, where it had won the confidence of the public by its record of 99.999 per cent of dependability. And now that long advance had culminated in a supreme climax. The best-beloved, the widest-known, the most benevolent, the kindliest, but, withal, the most exacting man in the world, had at last favored the NAEC with his patronage. None other than Harold Dare, famous motion-picture star and producer, had deceided to trust the distribution of the latest Dare super-special to the NAEC. The fact had been exploited to its utmost by nation-wide advertising. Every one of the many millions of film fans was breathlessly awaiting the arrival of this latest picture. The whole world was watching. Success meant the fortune and future of the NAEC; failure spelled disaster.

"And now," concluded the president, in his agitation pounding the wing section with a spark-plug wrench, "the NAEC has failed. Yes, we have dismally failed. We have at least delayed the precious films; perhaps we have lost them irretrievably.

"Already Captain Mettle is over two hours late—which, I remind you, means that he has landed, for his ship does not carry enough gas to fly two hours after landing time. I therefore believe I may say without fear of successful contradiction that something is wrong. And, gentlemen, since something is wrong, something must be done! You know your respective duties; do them!"

* * * *

The sun peeped through the morning ground-haze to see such an array of ships on the line as had never before been gathered at Sweet Lake Field. Major Moser, flight commander and general manager of the company, was on his way from Bandy Field, to direct them in the search for the missing flyer. He had been peering anxiously at the ground-haze below him; and now that the sun was beginning to disperse the mists, he spoke to the radio operator in the forward compartment of the huge transport. The operator clicked his key. At Sweet Lake Field a man waved his arms, a score of waiting pilots opened their throttles, and the long line of ships swept forward into the air. In a moment they were out of sight. A stillness as of death stole over Sweet Lake Field.

As hours of search dragged on, it became evident that the lost ship would not be found. President Neverre, pacing the office at Bandy Field, grew frantic. He dreaded confessing the failure of his organization. Even if Harold Dare, who was noted for his magnanimity, should find it in his great heart to forgive, the reputation of the NAEC would be blasted. In the unreasoning public mind, one failure would outweigh hundreds of successful flights. Eagerly as he hoped for news, he dreaded it still more. Probably Harold Dare would not trust his precious films again to the air mail; for what happened once might happen again. Unless the missing plane was found, the NAEC faced ruin.

With a shudder of apprehension he heard the radio operator's typewriter click out a message. Over the man's shoulder he watched the words form themselves on the paper:

(*Continued on page* 938)

It was indeed a droll thing to see the hardened rogue of a thousand films outdo the most artless ingénue in soulful weeping. As if catching the spirit and regretting their leader's past, the henchmen also began to cry.

Broadcastatics

HE WAS ENTIRELY OUT OF THE EGG-CASTING RANGE

First Comedian: "Didn't it make you nervous, to be telling your jokes the first time to a radio audience?"

Second Comedian: "Nervous? Man, I never felt safer in my life!"
—*Gleason Pease.*

DOWN ON THE FARM

Farm Hand: "Could you use a good man who can plow, milk, drive a team, shear sheep and make good cider?"

Modern Farmer: "Know anything about a six-tube Globo-Superodyne?"

A PESSIMIST IS A FELLOW WHO HAS TO LIVE WITH AN OPTIMIST

Home Set Builder (to neighbor): "See that receiver over there? I built every bit of that with my own hands, and I'm telling you a thousand wouldn't buy it!"

Neighbor (possibly jealous): "Well, I don't doubt your word at all. I'm one of the thousand!"—*Carl Sandstrom.*

EXPOSED WIRING IS SOMETIMES SHOCKING

Bartlett: "Why don't you electrify your set?"

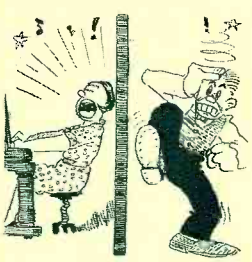
Smartlett: "Oh, heavens, I did! But my wife says that if I ever tell another story like that one we won't be invited again."
—*Gleason Pease.*

UNUSUAL MODESTY OF A MICROPHONE ARTIST

Voice of Announcer (from loud speaker): "This is Station W-I-L-L, broadcasting."

Small Boy (who is quick at spelling): "Hey, pa, why don't that fellow give his full name?"—*Burt Steeg.*

"THAT WASN'T ANY MUSIC: THAT WAS A SOPRANO!"



Mr. Jones (of Apartment No. 1): "Say, can't you keep that radio of yours a little more quiet?"

Mr. Smith (of Apartment No. 2): "We haven't any radio; that was my wife you heard singing."—*T. C. Brown.*

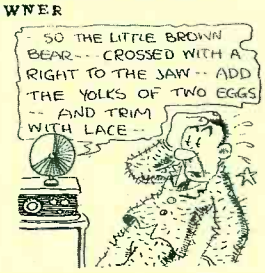
JUST LIKE A MAN!

DX Fan (tuning in a Spanish address on new receiver): "Hurrah! That's CZE, Mexico City, right off the bat!"

Radio Widow: "Huh! Why in thunder didn't you get a set that could talk English?"—*W. E. Casey.*

PRAYER OF AN UNSELECTIVE SET'S OWNER

My radio gets most anything
From near and distant climes,
I only wish that everything
Would come at diff'rent times.
—*Constance R. Dowd.*



EVERY B.C.L. SHOULD KEEP A LITTLE IN THE HOUSE

Drug Clerk: "No, sir, we haven't any Radio Powder in stock. I can't say I ever heard of it. What do you want to use it for, anyway?"

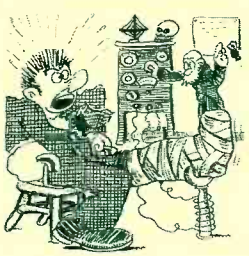
Radio Novice: "For radio bugs. A friend of mine who is an expert says there's a lot of them in my set."—*William Lemkin.*

AFTER A BAD NIGHT FOR STATIC

Doctor: "Feeling kind of shaky this morning, eh?"

Malaria Patient: "Oh Heavens, yes! I feel like a mere radio-photograph of my former self."

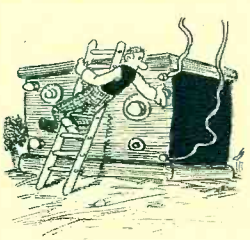
HE WANTED PLAIN T.R.F. TREATMENT



Doctor Sawbones: "Yes, I know a broken leg is mighty painful; but I'll give you some sort of an anodyne."

Patient (a radio fan): "Oh, I can't afford anything so expensive. Better give it just an ordinary set."
—*Gleason Pease.*

HE WAS WISE TO THE RADIO GAME



Radio Beginner: "I'd like to buy a radio set with a real large circuit."

Set Builder: "For the love of Pete, why?"

Radio Beginner: "Because I read in the Radio Information book that a short circuit is often the reason why your set doesn't work."—*David Pommiss.*

RADIO RHYMES ..... No. 4

A Britisher Chats on Radio

By E. Blake, A.M.I.E.E.

WHEN I say Britisher, I would not have you think that I am indigenous to Sierra Leone or North Borneo; and this, not because I do not admire the denizens of those places, who are, I suppose, my fellow-brits, but because I come from the County of Kent, England, which is about as big as a Minnesota wheatfield and has a great name for apples, hops and pretty women (*and the long tails of its inhabitants* —Editor), besides containing Canterbury Cathedral and Dickens' house at Gadshill.

The village where I was born was a village before the Battle of Hastings was fought in A.D. 1066. The cornfields which still enclose its one street were the property of Leofwine, brother of King Harold. When Harold was killed at Senlac my village, etcetera, were given to Bishop Odo; but now they belong to the Rochester Urban District Council, and the village has a coal-gas lamp and a policeman who is a postman in the morning and a market-gardener in the afternoon. Three things have survived Bishop Odo's influence; the speech of the men of Kent, the yellow hair and blue eyes of them, and the little Saxon Church which has weathered its thousand years and is still a going concern. So I have Old England in the bones of me, for in this tiny, unchanging spot the dust of my ancestors must lie thickly indeed; and I am worse than a Britisher—I am English; I have not the saving grace of being Scotch, Irish or Welsh.

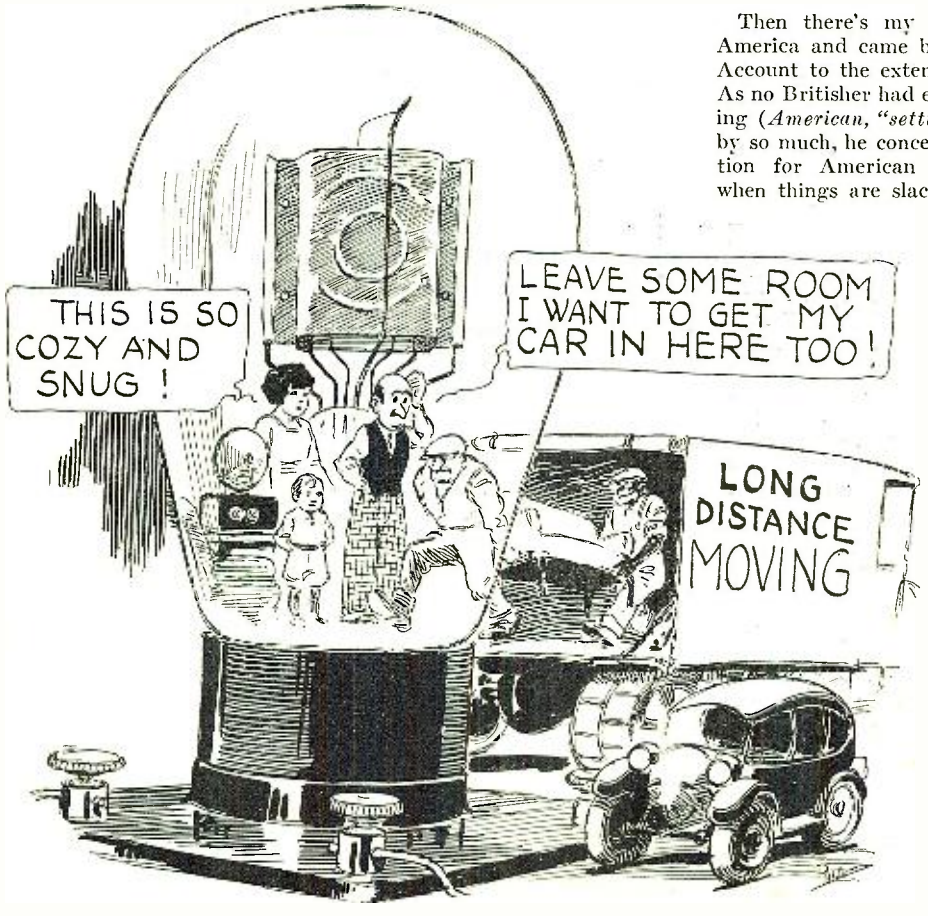
Having palmed off this disgraceful piece of pro-British propaganda upon the helpless American nation, in the disguise of an introduction, I would like to say at once that I shall not be so foolhardy as to attempt to tell you anything about radio. More probably I shall reveal what we don't know about it. When I talk radio over here I realize how much I owe to Mark Twain, and I lay it on with a trowel, in humble imitation of that mighty tale-teller. But compete with his countrymen? No! I am not cast in the heroic mould.

SLANG OF TWO NATIONS

It's a queer thing—but the truth—that for us, America holds a sort of ideal or standard in many matters. If a "fan"—or is it "ham?"—wants to boost, and of course he does, he tells you he gets 2LUCK or 3WUMP on his loud speaker loudly enough to rattle the crockery. I receive dozens of letters from young men who, having picked up Miami Beach on a one-tube receiver, apparently see no more to hope for in life and propose to collect butterflies or study for the law.

MR. BLAKE, who was for many years Editor of The Wireless World, *of London, is one of those radio enthusiasts who can see and appreciate a big subject from two sides—port and starboard, as it were. We have not as yet made up our minds whether he is really spoofing us,* doncherknow, *or whether we are supposed to spoof him. At any rate, you will observe some bally good ideas in this article, which has really all to do with radio—beg pardon,* wireless, *hi say, old chap.*

—Editor.



More and more things are being built into our vacuum tubes; is this the next step the industry will make? Our British cousin fears as much.

Miami was a terrible craze last winter and bade fair to sap the vitals of our young manhood. Now, I hear, the wind has veered to 2XAF. If you can't receive 2XAF on a crystal, in your sleep, you are likely to be hounded out of society. Not high or good society; radio society.

There is not as yet any decided tendency here to call a radio valve a "tube," but that will come in good time. We must not hustle the imagination of stolid materialists who cannot recognize in a pear-shaped bulb any special likeness to a tubular object. When you say "tube" to a Britisher he thinks of a sewer-pipe or the glass tube of the chemical laboratory, or the subway, which used to be called the "twopenny tube" because the fare was twopence—20 cents—any distance. (*Mr. Blake's overestimate of twopence is probably unintentional. It is* 4.0625 *cents by the morning papers.*—Editor.) He calls a valve a valve because somebody called a valve a valve; and he has always called a valve a valve because it is a valve.

As for those "A" and "B" batteries, the youth of Britain does not love Algebra, but likes the sound of "high tension" and "low tension." Not so snappy, certainly, but descriptive and calculated to impress the family. And the girl.

PRODUCTION PROBLEMS

Then there's my boss. He once visited America and came back wrong in his Cash Account to the extent of twenty-five cents! As no Britisher had ever succeeded in standing (*American, "setting"*—Editor) him back by so much, he conceived a genuine admiration for American business methods and when things are slack he calls me unto the holy carpet and says, "We must find out what they are doing in America." To this I invariably reply, that they are using double the number of tubes, getting all the distance geographers can provide, at quarter the price and in half the time, with four times the signal strength, one-third the distortion, a sixth of the input, and an eighth of the running costs.

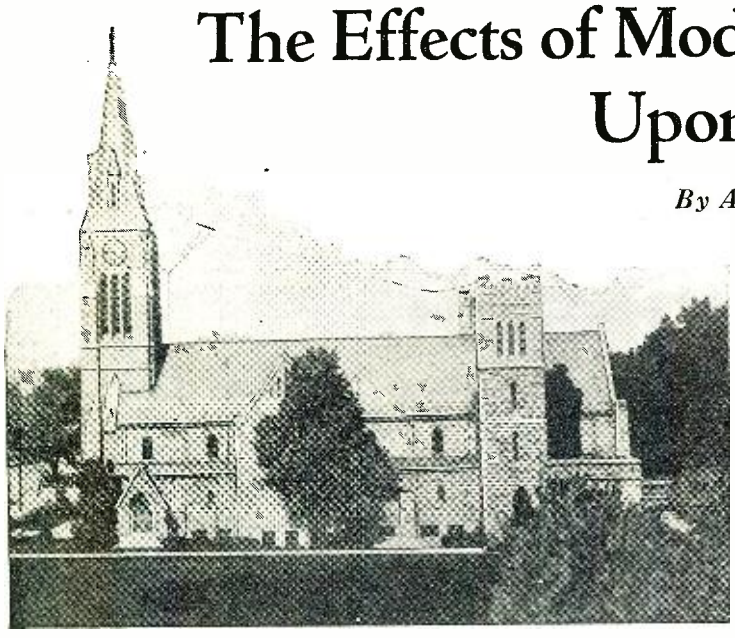
"Well, why can't *we* do it?" he queries, lighting his American business man's cigar and trying to roll it from port to starboard, just like Noah Beery.

"M-mass production," I stammer. "Are you game to lay down plant and tools for three million receivers per annum? Because if you are I want a rise (*American, "raise"*) before I start calculating our losses."

(*Continued on page* 934)

The Effects of Modern Radio Broadcasting Upon Religion

By Arthur T. Brown



This building, 7,500 feet above the sea, houses KFBU, the only broadcast station in the more than 80,000 square miles of this thinly-settled state. Its programs are solely religious and educational. The 500-watt transmitter was given by Mrs. E. H. Harriman to Bishop Thomas for work in this missionary diocese.

St. Matthew's Cathedral (Episcopal) at Laramie, Wyoming

AT the beginning of Lent, last spring, an announcement was made, once only, at a religious service broadcast in New York City at 8:15 on a Monday morning. The announcement was that, to all persons requesting it, would be sent a list of the preachers who were to broadcast during the Lenten season under the auspices of the New York Federation of Churches. Within a few days the Federation received over five thousand requests for the list. Now, five thousand is not a large number in New York for anything, whether skyscrapers or ideas. But this small incident shows that several times five thousand people were listening to that religious service at 8:15 on a Monday morning. They were not all shut-ins, either, since some of the requests were from persons who walked into the Federation office to make them.

People do listen to religious broadcasts—indeed, according to investigations made by some of the larger stations, these come next, after music, in popularity. That this is so need surprise no one. Religion, whether it be the Faith handed down through the Christian centuries—not to mention the Jewish, centuries before them—or some faith so new its official stationery has not yet come from the printer, is, next after bread and butter on the one hand, and love on the other, the most engrossing of human interests. It is so because we all live by faith, even though our faith be only the minimum of the agnostic, *viz.*, that human intelligence is entirely inadequate to receive ultimate truth.

It is obvious that it is important to discover, if we may, what broadcasting is doing to religion. Such an inquiry should include, as a background, a brief survey of what is being done before taking up the results of religious broadcasting.

It is, of course, obviously impossible, in this article to give a complete survey of what, religiously speaking, is being put on the air. To do that would necessitate an analysis of what each one of the six hundred stations is giving to the public in the way of religion. But some interesting facts are available, facts which seem, to me, at least, to indicate the drift of both policy and practice.

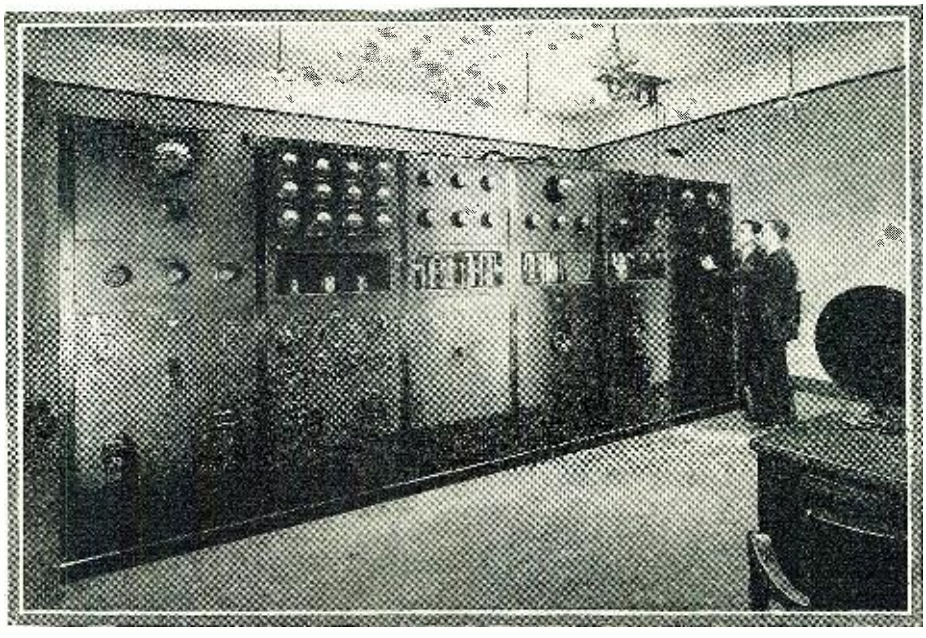
CHURCH-OWNED STATIONS

The first drift in practice is that, apparently, many of the multitude of churches which, two years ago, had their own broadcast stations, have given them up. At that time the largest single classification of stations was the religious. Now, the fall edition of the RADIO LISTENERS' GUIDE AND CALL BOOK shows only fifty-six whose owners are obviously interested primarily in broadcasting religion. The following table shows the number of stations and the total power radiated by each group, at the time of its compilation (in several cases increased power has since been granted.)

Classification	Number	Power—Watts
Baptists	10	2,515
Bible Schools	5	1,110
Congregationalists	3	610
Episcopalian	1	50
Independents	10	14,550
Lutheran	5	1,350
Methodists	7	1,240
Mormons	1	1,500
New Thought	2	500
Presbyterians	4	1,250
Roman Catholics	4	1,610
Seventh Day Adventists	2	260
Swedish Evangelicals	1	100
Universalists	1	100
	56	26,745

"Who are the Independents?" is the question one asks. They are religious groups which have not attained the status of denominations; such as Angelus Temple in Los Angeles, and the Dowie movement centering at Zion, Illinois. These relatively small groups were radiating more than half of the power used by the fifty-six stations. The People's Pulpit Association, for example, representing the movement more commonly known as "Russellism," has two powerful stations, WBBR (1000 watts), and WORD (5000 watts). The Zion station, WCBD, radiates 5000 watts. There are two other one-kilowatt stations in the list. All of these powerful stations, and the one large Baptist station (WSSH), represent what is loosely known as "fundamentalism;" though most of them would, and very properly, disclaim the term. Each, however, proclaims a definite gospel of the "evangelical" type; as do, also, the "Bible Schools," a type which is largely untouched by modern criticism. By means of these powerful stations this form of religious expression is to be heard in any part of the United States.

This statement, of course, does not mean that other kinds of teaching are not as universally heard, for practically every broadcaster carries religious services, including the chain stations. And, naturally,

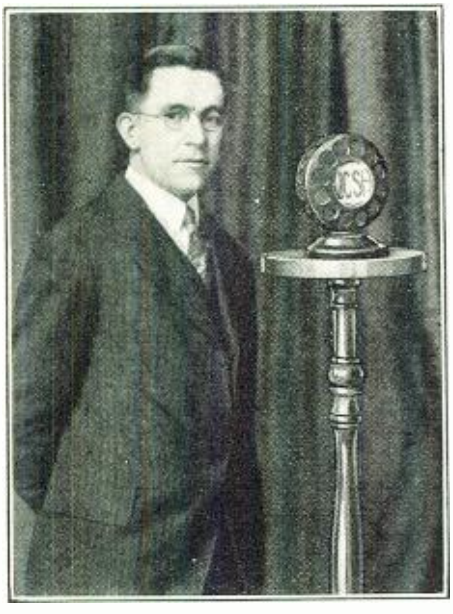


The 5,000-watt broadcast transmitter of station WLWL, at Secaucus, N. J., which is operated by the Paulist Fathers (Catholic); the studio is in New York.

most of them carry the most widely-accepted types of teaching, since they are both more easily available and more widely acceptable.

THE "RADIO PARISH"

Another kind of religious broadcasting that is proving very valuable in terms of human enrichment, has been inaugurated over station WCSH in Portland, Me., in the form of the "First Radio Parish," with Dr. Howard O. Hough as its minister. This is a non-sectarian work emphasizing the helpful and constructive aspects of a moderate



Dr. Howard O. Hough, minister of the "First Radio Parish" (undenominational), which operates through station WCSH, Portland, Maine.

(theologically-speaking) Protestant faith. It is proving of incalculable help to the thousands of isolated farmers, fishers, trappers, and so on, who are so abundant within the range of the station, as well as to the town dwellers. The pastor gives his whole time to the work, not only of broadcasting, but of visiting and helping his thousands of parishioners. This is, historically, the first instance in which the message and the method of its propagation have been adopted thoroughly to the medium (radio) used.

What seems to the writer an even more significant and growing practice, on the part of the more powerful non-religiously controlled stations, is the broadcasting of religious services which are arranged by and under the auspices of church federations. In several of our large centers of population these non-sectarian services, particularly in connection with Christmas and Easter, and the preceding periods, are given prominence.

CO-OPERATING ADVISERS

This tendency and practice is finding crystallization in the policy of the National Broadcasting Company in respect to religious broadcasting. This company, with highly commendable regard for the public good, has called into being an advisory council of men and women prominent in all walks of life to help it determine policies and standards for its programs. On this council, representing the religious interests of the nation, are a Protestant, a Catholic, and a Hebrew.

In addition to this council, the Protestant bodies have organized a National Religious Radio Committee, consisting of officials of the major denominations, strategically-located church federations and other general religious bodies, touching every phase of the common life of the Protestant churches. The Jewish religious interests have a similar advisory committee of national scope. And, of course, the Catholics have a unified policy also.

The Protestant committee, has approved two national services; that at which Dr. S. Parkes Cadman is the speaker, and the other, operated by the New York Federation of Churches on Sunday evenings, whose speaker is Dr. Harry Emerson Fosdick. The committee is providing, in co-operation with the department of music of the National Broadcasting Company, special religious services for Christmas week, Holy Week, and Easter, including the rendering of the great religious oratorios, whose beauty appeals to all mankind.

The policies worked out by these national committees, and recommended to the National Broadcasting Company, are significant; and so are here quoted from an address over the radio by the Rev. Charles S. Macfarland, chairman of religious activities of the N. B. C.

"First of all, the message (as given over the radio) should be constructive. The radio should be given over, not to the iconoclast for vituperative and defamatory tearing down, but to those whose message builds up personal and social life.

"It should be, not sectarian, for the purpose of mere denominational or organizational propaganda, but for the purpose of presenting those broad claims of religion which touch all human hearts.

"Search should be made throughout the nation for those prophets who can interpret religion at its highest and its best, that their message might be available for all the people.

"All radio stations are being encouraged to include this ministry in their programs."

The National Religious Radio Committee (the Protestant committee) takes the stand, in addition to the policies quoted above, that national religious services should not be broadcast during the time of the usual Sunday morning services of the churches, and that national agencies should not broadcast individual church services.

CONTROVERSY CONDEMNED

These policies point to two conclusions as to the effect of broadcasting religious services. One is that such services should have a unifying rather than a divisive effect. That this is, not merely a wish, but also a fact is shown by many things; among others, the opinions of many of the men in touch with nation-wide information as to what people want and do not want.

Father Cronin, director of the powerful Catholic station, WLWL, made the statement, in an interview published in the *New York Telegram* of Nov. 12, 1927; "The man who attempts to use radio broadcasting today for narrow, selfish propaganda purposes is misspending his money—wasting his own time and that of the usually-small audience which cannot tune him out."

Dr. W. B. Millar, president of the New York Federation of Churches, which has been broadcasting for more than four years, said to the writer, "People will not listen to sectarian controversy over the air: those who engage in it soon lose their public." And a certain small broadcast station, in the New York district, which persistently allowed such divisive sentiment to go out, has been disciplined by the Federal Radio Commission for doing so.

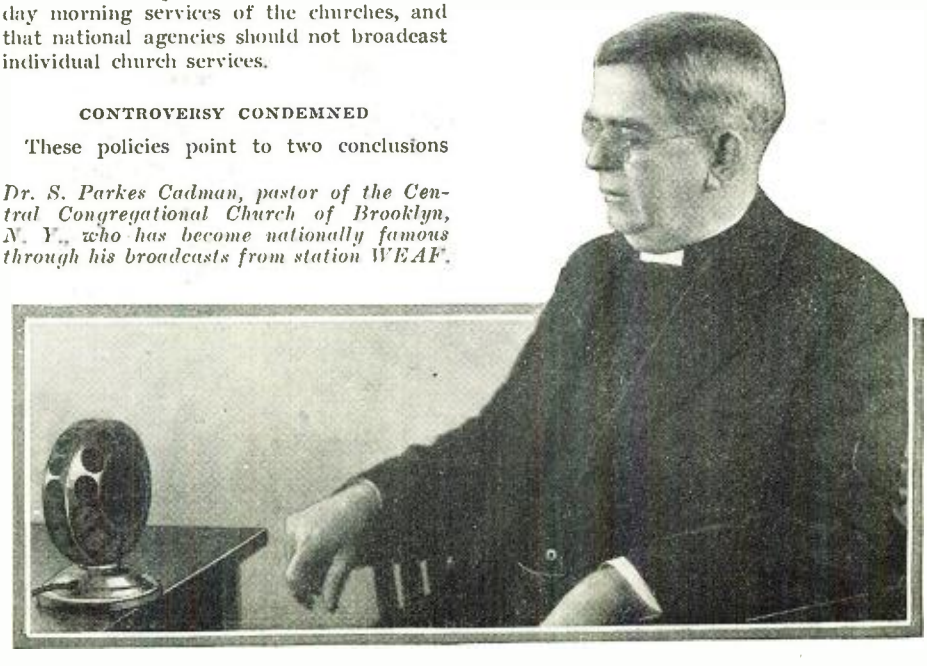
It is a well-known fact that the listeners to any religious broadcast, at least other than a purely local one, are from many faiths. Dr. Cadman and Dr. Fosdick are heard by Jews and Catholics, as well as by Protestants and by persons with no religious affiliation. "We are, therefore," to quote Dr. Fosdick (*New York Telegram*, Nov. 5, 1927), "getting better acquainted with each other, and multitudes of people are being surprised to learn what good sense, sound religion, solid devotion and highmindedness are to be discovered in people against whom once they held very hide-bound prejudices." That is the consensus of opinion of all of the persons best able to judge; that is, those who are daily in contact with the comments and criticisms that come in about every broadcast.

OUTSIDE THE CHURCHES

The second inference to be drawn from the policies of the national committees, mentioned above, is that broadcasting a service, if the preacher be nationally known, keeps

(*Continued on page* 942)

Dr. S. Parkes Cadman, pastor of the Central Congregational Church of Brooklyn, N. Y., who has become nationally famous through his broadcasts from station WEAF.



Radio Has Made "High-Brow" Music Popular

"Rich Man, Poor Man, Beggar Man, Thief"—and All Other Classes of Men and Women Have Been Brought by Radio to a Realization of the Beauties of Classical Music

By Mary Jordan

RADIO, more than any other instrument of civilization, has made art popular. It has taken it out of the caviare class and put it where everyone can have it for the taking.

As one of the highest forms of art, music has been carried out of stuffy concert halls where one in a million might hear; it has been picked up from the exclusive circles of the *intelligentsia,* where familiarity with Wagner and Brahms and Beethoven was a sign of an alleged culture; and it has been taken in its best and most nearly perfect expression, to the most remote quarters of the world.

Much as Europe and its centers of artistic learning have done to aid musical education and to develop artists, to advance the work of the student and to smooth the technique of the genius, the broadcast stations of America have done more, to further musical appreciation among the masses that number millions, than any other agency which has undertaken to spread art in any form over the universe.

And while the big stations of the country may have had some idea of enlisting new interest in music, that was a secondary motive; for the purpose of the ambitious programs which have gone out on the air for the past three or four years was not quite so altruistic. It was to hold attention which had already been gained and to create new interest among the unconverted hordes who, it was hoped, would become radio devotees.

Whatever the purpose, the result has been an amazing spread of musical knowledge among all types. The laborer in the street, shop or field now takes his evening recreation listening to an aria from "Il Trovatore" and, what's more, when the number is finished he knows just how to pronounce the foreign words.

Every set owner in America is a potential music-lover; for the fact is certain that a steady diet of jazz in any household will become monotonous, as will any one type of entertainment which the ether carries. And, because the American is innately a curious being, he may not know whether he would like to hear Gigli's voice or not; but, when he hears the magic of a great name, he will tune-in on the station which offers it and he will, with the general run, remain tuned in while the artist broadcasts. Even if his is only the germ of an appreciation, he will turn his dial again when an equally-famous name is announced and, after a few such concerts, he has gained some sense of the beauty of what is offered him.

OPERA FOR THE MILLIONS

Ten years ago, how many people in America had ever attended a concert where the talent was of the first rank? How many people in the whole nation had ever sat through an opera sung by the Metropolitan or the Chicago companies? Such a small minority as to make the statistics almost negligible. Even if music such as the Metropolitan offers were to be had in every big population center in the country, what percentage of the inhabitants would make an effort to attend, and how many could conveniently do so?

When the great Caruso drew 3,000 people to one of his concerts, that attendance was hailed as an indication of the tremendous popularity of the singer. If Geraldine Farrar in her best days was acclaimed in a music hall by a few thousand men and women, the event was pointed to as a display of the existence of the great "Farrar public." Famous artists of the past generation, who are now gone, live only by the reputation which the envied few created for

(*Continued on page* 932)

How can any human being ever be blasé about the wonders of broadcasting, when he realizes that even the "lumberjack" and his family, deep in the forests, may mellow their supper with some of the greatest of the world's music?

Keeping Broadcasts In Step on the Waveband Stops All "Squealing"

Clearing the Air of Heterodyne Effects Between Stations Using the Same Wavelength

By John H. Meredith

A PLAN for eliminating, or at least greatly reducing, one of radio's greatest maladies—heterodyning between stations assigned to the same wavelength—has been offered to the Federal Radio Commission by Franklin M. Doolittle, former instructor in radio communication of the electrical engineering department of Yale University.

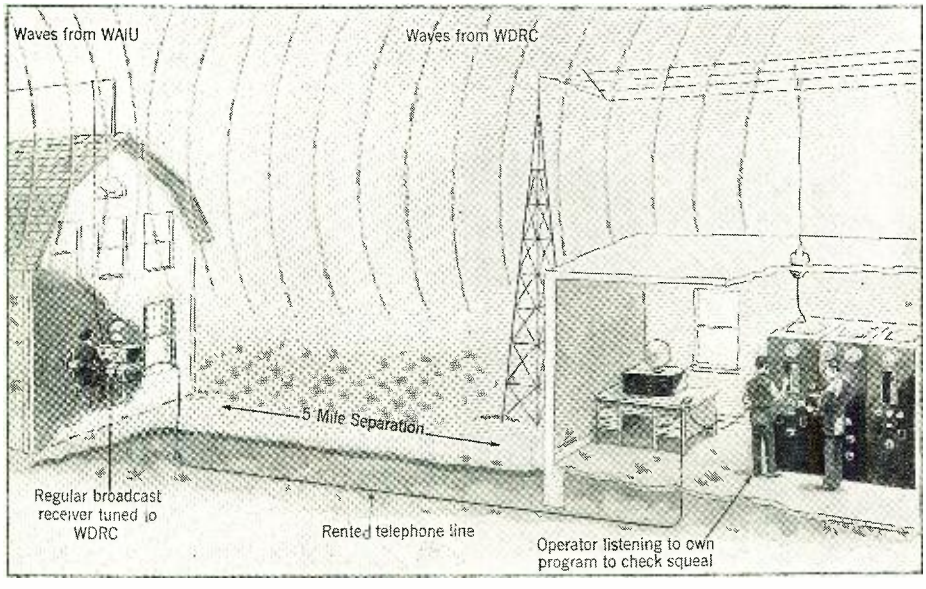
Mr. Doolittle, who is also the inventor of the "binaural" method of transmitting now used in most broadcast stations, became interested in the problem of eliminating heterodyne interference because his own station, WDRC, at New Haven, Conn., was experiencing a bad howl from WAIU at Columbus, Ohio, 500 miles away. In his own words, this is how he went about the problem:

"Before we adopted the present arrangements, the heterodyning was so bad that it ruined our programs for several nights.

REMOTE "MONITORING"

"I rented from the telephone company a circuit between my home and the transmitting plant, the two points being about five miles apart. The output of the receiving set is connected to the input of a two-stage amplifier which compensates for the line loss. As the circuit is entirely of cable, the quality is decidedly bass; the line could, of course, be 'equalized' to overcome this effect, but that is not necessary for the purpose. The set is tuned to WDRC's wave and left there.

"This arrangement allows the operator at the station to hear the program as it is being received, five miles away; and if a beat from Columbus is present, he then adjusts the wavelength of the transmitter until 'zero beat' is obtained. This arrangement does not necessitate passing radio frequencies over the circuit; but employs only the audio output of the receiver.



The operator at the broadcast station is thus enabled to determine if there is interference of his station's carrier with that of any other; and correct it accordingly.

"Our transmitter is of the master-oscillator type and we employ a crystal for checking its frequency; so that it is comparatively easy to make the adjustment with certainty and still not get away from our frequency. In this connection our crystal checks with Columbus within 100 cycles.

"I have particularly wanted to watch the results obtained with the system a number of nights before giving a report as to the results obtained. While the method does not completely eliminate interference, it greatly reduces this when Columbus is very loud, and for all practical purposes eliminates it when WAIU is coming in with moderate volume. In either case, it eliminates the howl and leaves only an unintelligible hissing sound in the background between breaks and soft passages of our program. This interference sounds like the hissing quality obtained when spark signals are received by the heterodyne method, and is not objectionable.

SIMULTANEOUS PROGRAM POSSIBILITIES

"We have had such satisfactory results with this method of reducing interference, that I am going to try an automatic control which will start to function as soon as the heterodyne appears. The general plan of the scheme is to control our transmitter with our crystal and to vary the frequency

(*Continued on page* 936)

Short-Wave Broadcasts from WRNY

SINCE WRNY's short-wave transmitter at Coytesville, N. J., went on the air recently, many listeners have inquired for information concerning the station's operating schedule and its exact transmitting wavelength. For the benefit of these correspondents and other radio fans possessing short-wave receivers, the following information has been prepared by the WRNY operating staff.

The programs of WRNY, originating in studios in the Hotel Roosevelt, New York, are broadcast on 30.9 meters (9700 kilocycles), at the same time that they are radiated on the station's regular broadcast wave, 326 meters (920 kilocycles). The short-wave transmitter has been assigned the call letters 2XAL. The full operating schedule is as follows: (all hours are Eastern Standard Time, five hours earlier than Greenwich Time.)

Tuesday, 7 p.m. until midnight
Wednesday, 7 to 9 p.m.
Friday, 7 to 11 p.m.
Saturday, 7 to 10 p.m.
Sunday, 4 to 6 p.m.

The signals of the WRNY short-wave transmitter have already been reported in all parts of the United States, many parts of Canada, in practically all the countries of Europe, and in Australia. Listeners hearing the station are requested to send report cards to the WRNY offices in the Hotel Roosevelt, New York City.

An excellent receiver with which to pick up the signals of WRNY and other short-wave stations was described in the October, 1927, number of RADIO NEWS. The three-turn coil described in that article should be used. The 30.9-meter signals should come in at about 85 on the tuning-condenser dial, if the parts specified are used.

What's New in Radio

"A" Power Unit Has Many New Innovations

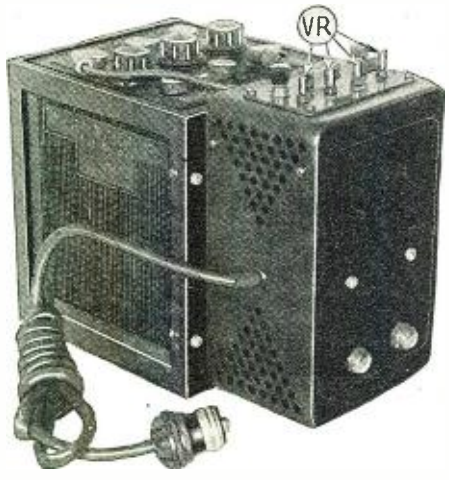
AN "A" power unit of improved design has just been introduced. It is of the usual trickle charger-storage battery type, but has several features which are not found in many other designs. The outfit is compact in design, entirely automatic, has two charging rates and employs a dry rectifier.

Pictures on this page clearly illustrate the construction of the unit. The external view shows the storage battery with the power unit in place, but with the battery cover removed. The second view shows the apparatus as it is placed in the power unit.

On the top of the power unit there are two binding posts, a fuse (F) and four metal posts (VR), two of which are connected together with a jumper. The binding posts are the output terminals of the power unit and are connected with the filament binding posts of the receiver. The fuse protects the unit from overload, and the four metal posts with the jumper are for changing the rate of charge. With the jumper in one position, the battery of the power unit is provided with a trickle charge which compensates for the current consumed under average conditions and keeps the battery fully charged. However, if the battery should become low as the result of overuse, the jumper may be connected with the other pair of posts and the battery is given a "booster" charge which quickly restores it to condition.

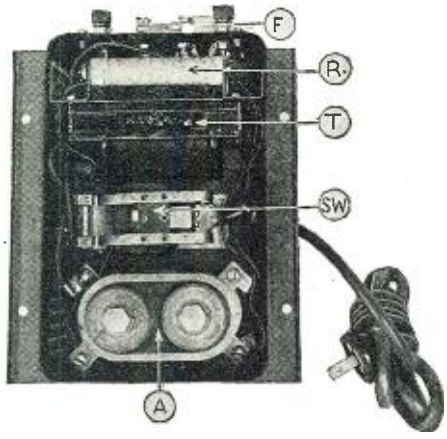
The inside of the power unit is shown in another view. The power transformer is shown as T; this instrument steps down the 110-volt house current to the potential required for charging the battery. The rectifier element (A) is of the dry electrolytic type and its purpose is to change the charging current from alternating to direct. The resistor R is connected in series with the charging current to reduce the rate of charge; this is short-circuited, when the battery is to be placed on a booster charge, by adjusting the voltage regulator (VR). Sw is an automatic-control relay switch which disconnects the power unit from the 110-volt current when the battery is in use, and reconnects the power when the battery is at rest. It is actuated by an electromagnet connected in the output circuit of the unit.

From the viewpoint of utility the power unit has other features. The weight is only 36 pounds, which is not excessive for a unit of this type. It is equipped with a hard-rubber cover for the battery, which serves to improve its appearance and protect the cabinet from acid. And lastly, it is small in size and will fit conveniently in a space of 7x10½ inches and 9 inches high.



External appearance of the "A" power unit: the four posts marked VR are for regulating the rate of charge which the battery receives.

Illustrations courtesy the Westinghouse Union Battery Co.



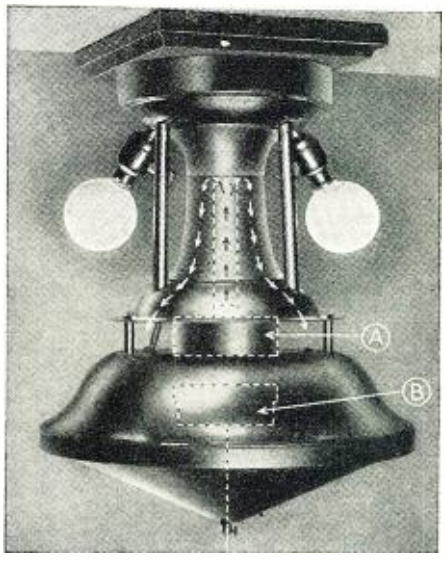
Arrangement of apparatus inside the power unit: A, rectifier unit; F, fuse; R, resistor; Sw, relay switch; T, transformer.

Speaker Is Combined with Lighting Fixture

A UNIQUE combination of radio loud speaker and electric-lighting fixture has recently been perfected and will soon be placed on the market. It was designed by C. A. Volf, Jr., an inventor of police and fire-alarm sirens; and embodies several new principles and adaptations. It is known as a "light speaker" and is so made that any speaker unit now generally available may be incorporated into the combination.

In the design of the speaker, provision has been made for uniform reproduction over a very large band of audio frequencies. Two loud-speaker units are used; the first operating a small horn speaker which emphasizes tones in the upper register, and the second actuating a cone which responds best to the lower notes. The wires from the loud-speaker units are drawn through the lighting fixture in such a way that they do not show.

The method of construction is clearly shown in the illustration on this page. The two loud-speaker units are shown at A and B. Speaker unit A operates the horn. It



In this phantom view the locations of the units are clearly shown: A is the horn unit and B that for the cone.

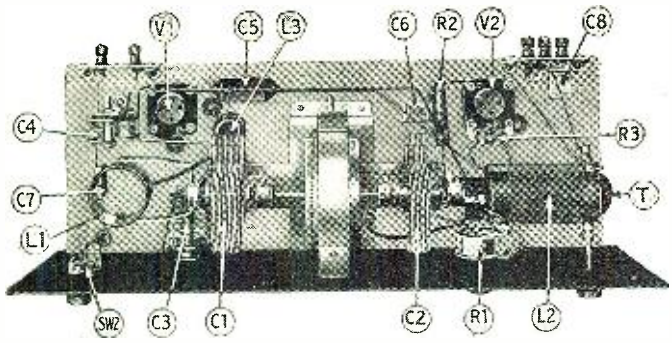
Illustration courtesy The Luren Radio Corporation

will be noticed that the dotted lines of the illustration indicate that a metal tube is connected to this speaker and the small arrows show the path of the sound vibrations in the horn. Speaker B is connected to a driving pin and operates the small free-edge cone at the base of the unit. Another interesting feature of the design is that the sound is radiated equally in all directions.

The size of the horn unit of the speaker varies in the different models, and the cones range from nine to sixteen inches in diameter. The fixtures are finished in bronze and have been designed to conform with many styles of furnishings used in apartments and hotels.

Electrified Kit Set Uses New A. C. Tubes

THERE has never been a question as to the efficiency of the Browning-Drake circuit, which has swept onward through the succeeding years with increasing rather than diminishing popularity since it was introduced in 1924; a rather uncommon occurrence in radio-kit circles. If there has been any criticism, it has been that, in keeping with the times, an increase in the simplicity of tuning and more modern physical construction would be a desirable addi-



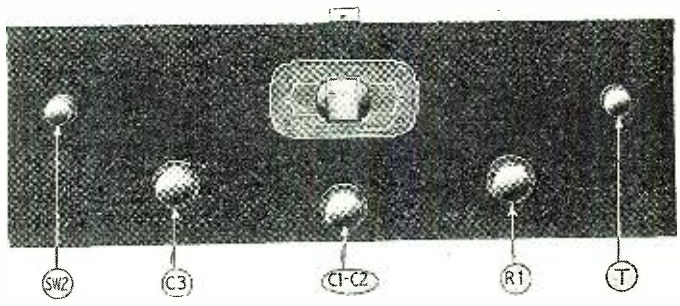
Left: Use of a new drum-dial assembly greatly facilitates the construction of this electric receiver. This illustration shows arrangement of parts on the sub-base panel.

tion to this effective design. Also, the audio reproduction of the set could be improved by the use of a new push-pull power amplifier.

This same fact being apparent to the inventors themselves, they have spent the past year in working out a brand-new mechanical design which would meet all modern requirements and still keep the high electrical efficiency characteristic of the thousands of sets that have been built in the past. One glance at the illustrations on this page will show that a radical departure in design has been achieved, and an examination of the details brings out the fact that the most modern mechanical and electrical requirements have been met.

There are many outstanding new features of the improved receiver; as the changes which have been made leave only the basic principles of the original radio-frequency circuit to bear resemblance to last year's set. A casual examination of the exterior immediately reveals an illuminated single control of the drum-indicator type. This increases the utility and also the appearance of the set. Inside the cabinet, the most modern metal-chassis construction is employed. Thirdly, the receiving unit proper consists of the radio-frequency and detector circuits, and this is used in connection with a two-stage power amplifier employing a push-pull circuit and using 210-type tubes in the last stage. The power amplifier includes a filament and plate-supply unit for its own tubes and also plate power for the receiver. Filament current for the set is obtained from a separate step-down transformer.

In the front-panel view the arrangement



Right: Front view of the new two-tube receiver. Sw, switch; C3, compensating condenser; C1, C2, tuning control; R1, volume control; T, regeneration control.

of controls is clearly shown. The knob in the middle of the panel controls the operation of the drum dial which is connected to C1 and C2, the two tuning condensers. The volume control (R1) is located to the right of this knob, and the "trimmer" condenser (C3) is on the left. In the upper right-hand corner of the panel the regeneration control (T) is located, and the switch (Sw2) for the dial light will be found in the corresponding position at the left of the panel. The set is turned on and off with a switch connected in the 110-volt A.C. line.

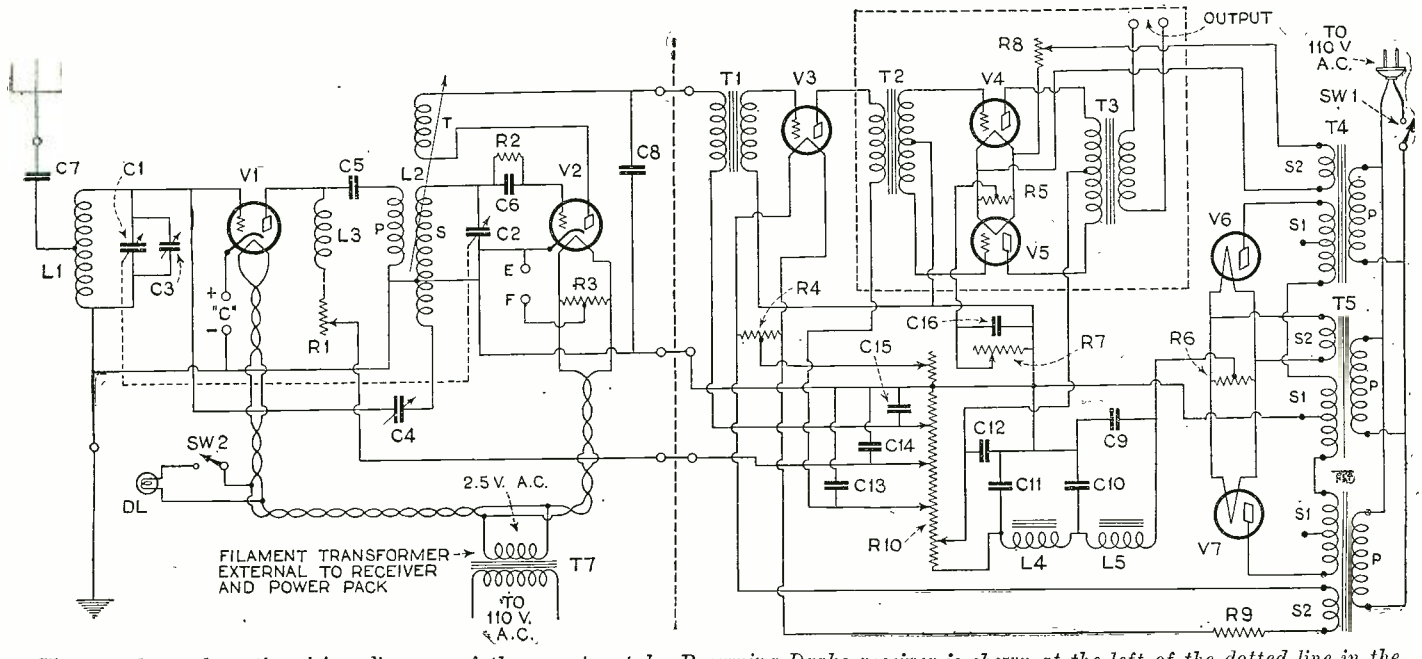
It is possible to appreciate more fully the simplicity of the design by examining the rear view of the receiver. The front panel of the set is made of an insulating material, and the sub-base panel is of aluminum. In the construction, the drum dial, the two variable condensers (C1 and C2) and the two R.F. transformers (L1 and L2) are mounted on an aluminum frame, which is fastened to the sub-base with four screws. The R.F. coils are mounted on the two extreme ends of the assembly at right angles to each other in order to reduce coupling. The few remaining parts of the set are mounted on the base; and as much of the wiring as possible has been located under the base.

ALTERATIONS FOR A. C. TUBES

In the schematic diagram on this page the portion of the wiring which is shown at the left of the dotted line is located in the receiver cabinet, and the wiring to the right of the dotted line is in the power unit. It will be noticed that the circuit diagram of the receiver is similar to that of the standard Browning-Drake circuit and the few changes which were made were necessary because of the use of A.C. tubes and single-dial operation.

Greatest possible efficiency is obtained by use of a directly-coupled antenna circuit, which consists of the coil L1 tuned by the condenser C1. The tap for the aerial is located in the approximate center of the coil and the aerial is connected to the coil through the fixed condenser C7, which has a capacity of .0001 mf. In order to compensate for different sizes of antennas a small "trimmer" condenser (C3) is connected in shunt with C1. The use of this condenser insures the success of the single wavelength-tuning control.

An improved neutralizing system is another new feature of the circuit. In the past 199-type tubes were used; and when 227-type tubes were substituted the old circuit was found unsatisfactory. The new neutralizing circuit consists of an extra winding, which has been added to the secondary of the R.F. transformer, and an adjustable neutralizing condenser connected between this coil and the grid of V1. Changes will also be found in the plate circuit of the R.F. amplifier. It was found desirable to keep all R.F. currents out of the plate supply wires and consequently an



The complete schematic wiring diagram of the new two-tube Browning Drake receiver is shown at the left of the dotted line in the above illustration. The apparatus and wiring on the right of the dotted line is a power amplifier and plate-supply unit.

Illustrations courtesy Browning-Drake Corporation

0.5 mf. condenser was connected in the wire which runs to the primary (P) of L2, and a parallel feed incorporating a R.F. choke is employed to provide V1 with plate current. Volume is also controlled in this circuit by a variable resistance connected in the plate-supply wire.

POWER UNIT DETAILS

The power amplifier and plate-supply unit which has been designed for operation with this receiver, is of the most modern design. It employs two 281-type tubes (V6 and V7) in a full-wave rectifier circuit and it delivers an output voltage which is more than is required for the operation of the two 210-type tubes (V4 and V5) which are used in the push-pull power stage. Also the design of the amplifier is such that the percentage of distortion is negligible.

Three power transformers, with their 400-volt secondary windings (S1) connected in series and their primary windings (P) connected in parallel, provide the power for the rectifier circuit. The 7½-volt secondary windings (S2) of these transformers provide the filament current for the amplifier and rectifier tubes of the unit. After the plate current has been rectified it is filtered by a double choke coil (L4 and L5) and a bank of filter condensers. The drop in voltage across an adjustable resistor (R10) divides the voltage into the potentials required by the various tubes of the set and amplifier. Variable resistors are employed for securing the grid bias for the tubes of the amplifier, but small "C" batteries are used in the set for this purpose.

Construction of the power unit is simplified by the use of a new type of push-pull unit. This unit is available in completely-wired form, and contains two transformers, two tube sockets and two resistors. The parts in this unit are enclosed within dotted lines in the diagram.

PARTS REQUIRED

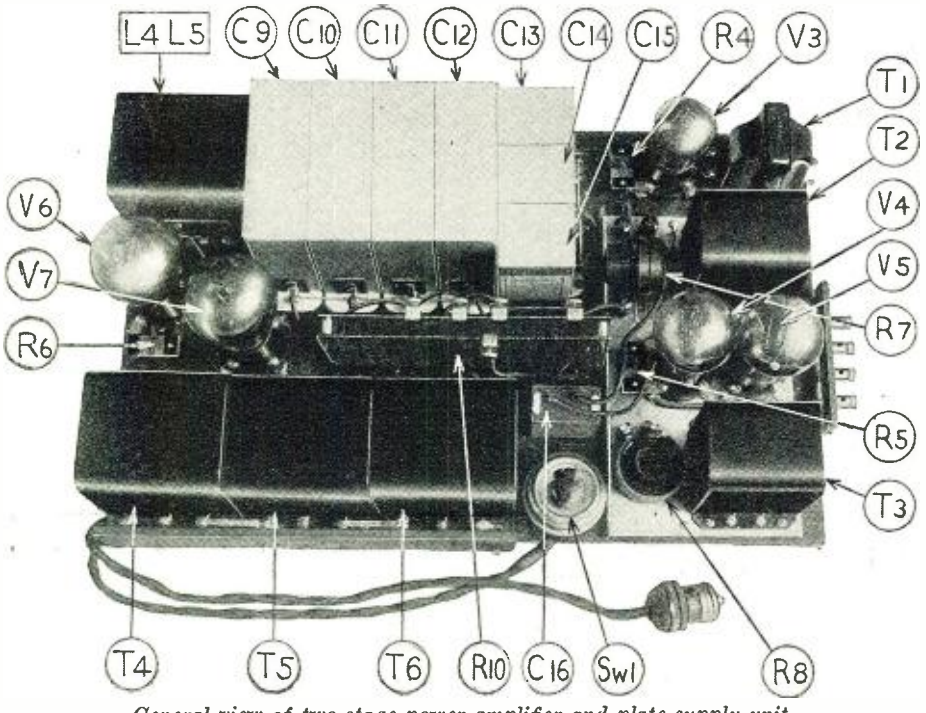
The parts incorporated in the power amplifier and plate supply unit are as follows:

Three General Radio (G.R.) transformers, type 365 (T4, T5 and T6); one G.R. audio choke, type 366 (L4 and L5); one G.R. push-pull amplifier unit, type 441 (apparatus shown within dotted lines in diagram); one G.R. resistance unit with five sliders (R10); one G.R. audio transformer, type 285D, (T1); three G.R. sockets, type 349; one G.R. resistor strip, 6-ohm (R9); two G.R. center-tapped resistors, 50-ohm (R4 and R6); one Tobe condenser, 2-mf., 2,000-volt (C9); three Tobe condensers, 4-mf., 1,000-volt (C10, C11 and C12); three Tobe condensers, 1-mf., 1,000-volt (C13, C14 and C15); one Tobe 1-mf. condenser, type 301 (C16); one Electrad 2,000-ohm variable resistance, "Royalty" type F, (R7); two rectifier tubes, 281-type (V6 and V7); two power-amplifier tubes, 210-type (V4 and V5); one A.C. tube, 226-type (V3); one baseboard 12 x 20 inches; one snap switch (Sw1).

The following is a list of the apparatus used in the receiver compartment:

One official Browning-Drake foundation unit and single-control drum-type kit consisting of L1, L2, C1, C2, drum dial, micarta front panel, aluminum sub-base panel, mounting hardware, etc.; one Browning-Drake midget condenser, 135-m mf. (C3); one Browning-Drake R.F. choke coil (L3); one Browning-Drake neutralizing condenser (C4); one Yaxley filament switch (Sw2); one Tobe molded condenser, .05-mf. (C5); one Tobe condenser, .00007-mf. (C6); one Tobe condenser, .0001-mf. (C7); one Tobe condenser, .001-mf. (C8); one Tobe Veritas grid leak, 6-megohms (R2); one Clarostat (R1); one General Radio center-tapped resistor, 50-ohm (R3); two Benjamin No. 5 contact sockets, type Y; five marked Eby binding posts ("Aer.," "Gnd.," "B+," "B—," "Output").

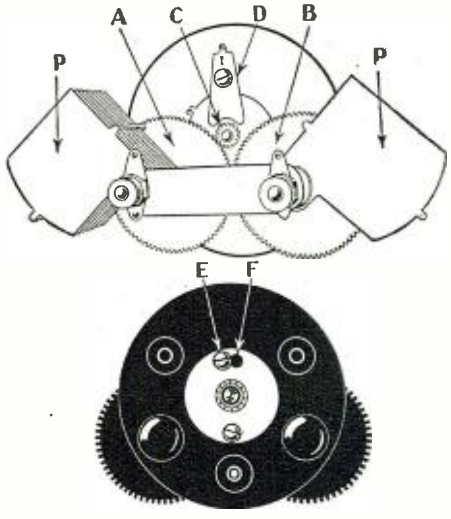
In addition to the parts mentioned, the following accessories are required for the operation of the receiver: one filament-heating transformer with a 2½-volt, 4-ampere secondary winding; two 4½-volt "C" batteries, and one loud speaker. One of the "C" batteries is connected to the two "C" terminals in the grid circuit of the R.F. tube. The second battery may improve results if connected between posts E and F in the detector circuit, but it is not necessary. If the battery is not used these two terminals should be connected together.



General view of two-stage power amplifier and plate-supply unit.
Illustration courtesy General Radio Co.

New Condenser Answers Modern Requirements

Drum dials have introduced a new problem for the radio constructor. When it is attempted to accomplish single-control operation in receivers using tuning controls of this type, it is usually desirable to locate the dial in the center of the panel and to mount the variable condensers on both sides. With this mechanical arrangement two types of condensers are required; namely, those which increase in capacity when the shaft is turned in a clockwise direction and those which increase when turned in the reverse direction.

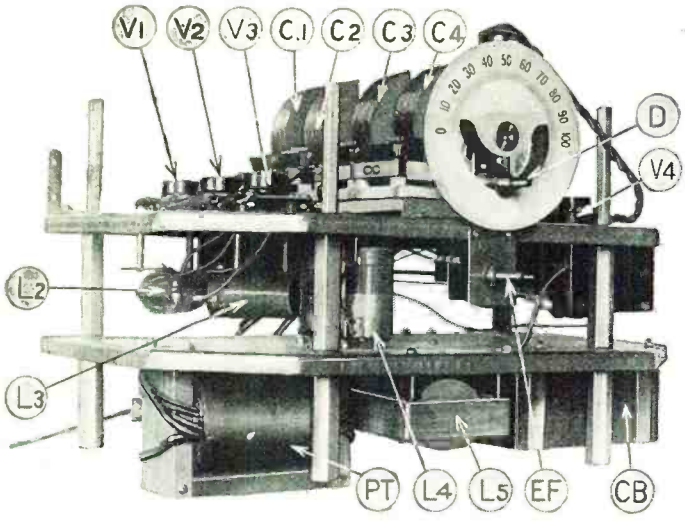


New twin rotor condenser, which may be adjusted for either a clockwise or a counter-clockwise reading.
Illustration courtesy Gray and Danielson Mfg. Co.

In order to overcome this difficulty, a manufacturer of "twin-rotor" condensers has developed a universal model. A simple operation, which may be accomplished in less than one minute with a screw driver, enables one to convert this new condenser from a clockwise instrument to one of the counter-clockwise type, and *vice versa*. The drawing on this page clearly illustrates the system which is employed. In construction this condenser comprises two large gears (A and B) which are in mesh with each other and which are directly connected with the two sets of rotor plates (P). These large gears are operated by a small gear (C) which is connected with the shaft. When the small gear is adjusted so that it is in mesh with gear A the condenser is operated in the reverse direction from that when the small gear is in mesh with gear B. In the condenser illustrated, gear C may be changed from A to B by removing the screw at E, shifting the bushing to the left and inserting the screw in F. C is attached to the frame at D.

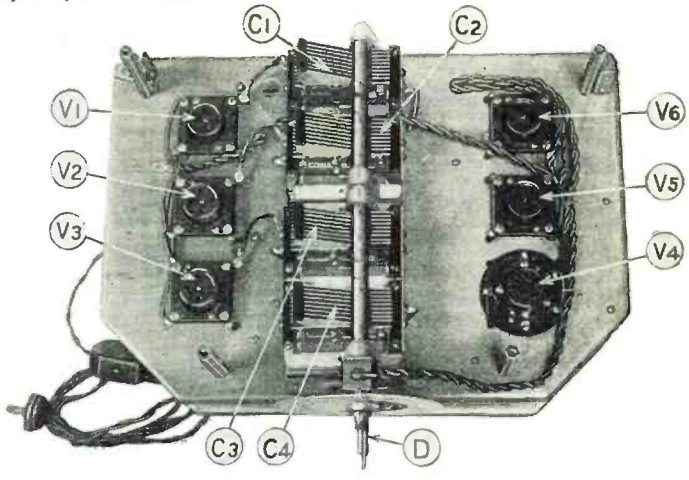
OTHER FEATURES

Aside from the feature described above, the twin-rotor design of variable condenser has other characteristics of interest to experimenters. Condensers of this type are unique, in that both sets of plates are en-



Modern two-deck construction is clearly illustrated in this general view of the receiver chassis removed from the cabinet.

Illustrations courtesy Splitdorf Electric Co.



The four-gang condenser unit and the six tube sockets are the only parts mounted above the chassis.

tirely insulated from the dial and dial shaft, and both sets of plates rotate. Provision has been made for grounding the dial shaft, with the result that body-capacity effects are entirely absent, and either set of plates may be connected to any part of the circuit, whether it be at high radio-frequency potential or not. The condensers are available in either the straight-line-wavelength or straight-line-frequency types, and in both designs the dial rotates through 360 degrees for a minimum-to-maximum change in capacity.

From the electrical viewpoint there are other points of interest in the design. The greatest care has been taken in the construction of the plates, in order to insure efficient operation. The plates are carefully aligned by hand and rigidly soldered in position at three points. Perfect electrical contact is insured by the flexible wires which are soldered to all moving parts.

New A.C. Set is Example of Modern Design

AN excellent example of modern radio construction methods, as they are employed in this season's commercial receivers, may be found in the set illustrated on this page. It provides a radio installation for the average home which may be described as a close approach to the "ideal;" and it leaves very little to be desired. Also, even though it gives results which should satisfy the most exacting individual, the cost of the set is within the reach of most radio fans and it is very economical to operate.

In a consideration of the outstanding features of the set, the compactness of the entire installation receives first attention. It is housed in an attractive cabinet which measures 18 inches wide, 14½ inches high and 13 inches deep; and all the apparatus used in the receiver and power-unit circuits is located in this small space. The loud speaker is the only instrument which is located outside the cabinet.

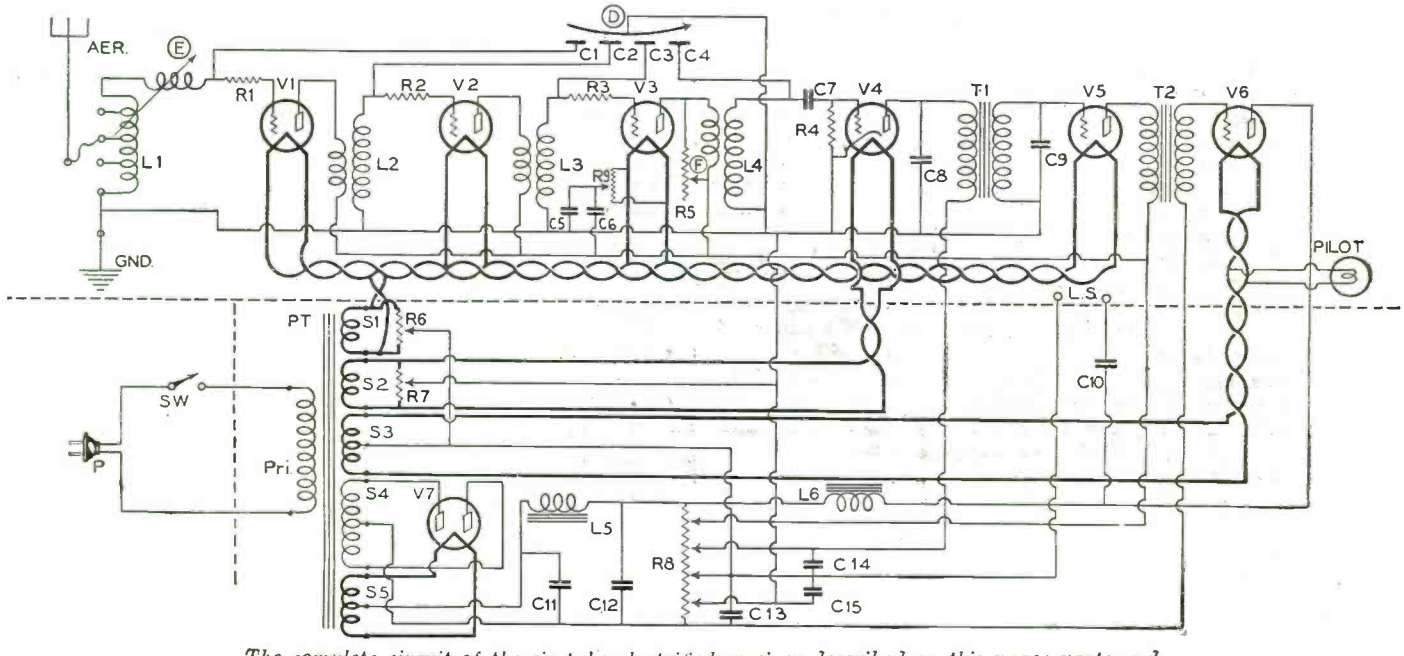
EASY ADJUSTMENTS

A second very important feature of the design is the simplicity of installing, adjusting and operating the receiver. To install the set in a new location it is necessary only to connect the loud speaker, aerial and ground to their respective binding posts, and insert seven vacuum tubes in the sockets provided for them, and a plug (P) in the light socket. There are no electrical adjustments to be made before placing the set in use, and the operation does not require skill. The switch, shown as Sw in the illustration, turns the set on, the centrally-located knob (D) controls the wavelength of all circuits with one adjustment; the volume is regulated by a second knob (F). When distant stations are being received, added sensitivity can sometimes be obtained by adjusting knob E.

Those who are interested in the circuit will find complete details in the schematic wiring diagram which appears on this page. Three stages of tuned radio-frequency amplification, a non-regenerative detector and two stages of audio amplification are used in the receiver. The plate-and-grid power-supply unit consists of a half-wave rectifier circuit. Tubes of the A.C. filament type are used throughout and the filament current is supplied by special windings on the plate transformer.

Direct coupling in the antenna circuit is employed in order to gain maximum sensitivity, and a small variometer is used to compensate for changes in the capacity of this circuit which are caused by the use of different aerials. L1, the antenna coil, is

(*Continued on page* 950)



The complete circuit of the six-tube electrified receiver described on this page; parts and wiring shown below the line are in the power-supply circuit.

Symbols—The Shorthand of Radio

An Explanation of What the Symbols Mean and How They Are Being Used in Circuit Diagrams

A SYMBOL (as used in the familiar schematic wiring diagrams) is a sign which in itself is simple and easily made, yet represents a radio part or device which may be complicated in its actual construction. The use of symbols greatly simplifies all kinds of radio diagrams, making it possible for radio fans and experimenters to trace the circuits easily. A glance at a schematic diagram shows in an instant the nature of any circuit, which would be difficult to trace from a pictorial representation, or the apparatus itself.

All of the standard and accepted symbols used in radio work are shown on the opposite page. They include everything in the standard list compiled by the Institute of Radio Engineers, and some things not covered by the latter. These symbols will be used as standard by RADIO NEWS in subsequent issues; and these pages may be profitably saved for reference. An explanation in detail of their meanings follows.

AERIAL: This symbol represents the ordinary type of outdoor antenna used with most receivers, although it covers also the indoor and underground types. The "loop" or "coil" antenna is shown below the extended type. Both the flat-spiral and square (box) loops are covered by the latter symbol.

GROUND: The standard symbol for an "earth" or ground connection is shown below the aerial symbols. This symbol is used wherever there is a connection of a circuit to the "ground;" which usually takes the form of a wire fastened to the water-pipe or steam-pipe system in the house. Under the ground will be seen the "counterpoise" symbol. The "counterpoise" is an insulated system of wires, placed a few feet above the ground under the antenna. It is used in place of the direct-to-ground connection, and usually only with radio transmitters. Its advantage is that it has a somewhat lower radio-frequency resistance than the ordinary ground; this is especially true when the soil is sandy or dry. The counterpoise acts as one plate of a large condenser, the other "plate" being the elevated aerial.

CONDENSERS: Several symbols for the variable condenser are shown. The first is the most generally used and will be found in almost every radio circuit diagram. The second is the same as the first except that the "rotor" (or set of movable plates) is indicated by a heavy dot. This is included when it is important that the plates should be connected in one certain manner.

Many circuits use "ganged" condensers for tuning, to decrease the number of tuning controls. Two symbols are shown for this type of instrument. The first indicates that a single large condenser, with a "common rotor" (all moving plates electrically connected) and a number of separate stator (fixed) sections, is employed. The other is used when a number of single condensers are coupled together on one shaft or by link-motions. In both of these symbols the number of sections or separate condensers indicated is obvious.

Two symbols for fixed condensers are shown: the first indicates a single instrument of any capacity, or size. The other has been adopted because of the extensive use of "A" and "B" power units in which a filter condenser, with a number of sections in one block, is required.

INDUCTORS: The standard symbol for inductors of any type is shown first. An example of the use of this symbol is for a radio-frequency choke, although it may also represent any air-core coil, untuned or condenser-tuned. Directly under this symbol is the standard air-core transformer symbol. This is used to represent any of the usual radio-frequency transformers, which are usually tuned by variable condensers. The next symbol is a special one, which designates the amplifying transformers used in the intermediate-frequency stages of a superheterodyne receiver. These transformers may be of either the air or iron-core type.

The next in order is the continuously-variable inductor, or, as it is generally termed, the "variometer." The first few symbols at the top of the second column show a number of iron-core coils. The first is a single iron-core coil, commonly used for A.F. and filter chokes. After this are two types of iron-core transformers; the first of these may represent either an amplifying transformer or a power transformer, such as used in "A" and "B" socket-power devices. The second has either a primary or secondary, or both, tapped at a center point, and is commonly used in "push-pull" amplifier circuits. Similar tapped windings are used also in power transformers, to obtain a mid-point of constant (zero) voltage, as compared with the two ends of the coil, at which positive and negative voltage alternately prevail.

FREQUENCY METER: This indicates a tuned circuit, whose frequency is inversely proportional to the square root of the inductance (L) and capacity (C) in the circuit. Either the inductance of the coil or the capacity of the circuit, in practice, may be adjusted to change the frequency of the apparatus. Such a tuned circuit may be used also as a wavetrap, or to introduce losses into a circuit with which it is not directly connected; as it "soaks up" energy of the frequency to which it is tuned. (A "frequency meter" is also a "wavemeter." For every frequency there is a corresponding wavelength, so that a calibration may be made either way. Frequency times wavelength equals 299,820.)

RESISTORS: A number of special types of resistor is shown next. The first is an ordinary fixed resistor, of any value of resistance. Below this is the variable resistor, of any range. The voltage divider, or potentiometer, is seen below. The last type shown is the symbol for the automatic filament ballast used widely in present-day sets to replace manually-controlled rheostats.

TUBES: The standard symbols of the ordinary three-element tube, the heated-cathode type of A.C. tube, and the new shielded-grid tube, respectively, with a number of rectifier tubes, are given. The heated-cathode tube is correctly called a *three-element* tube, since the filament is used merely for heating the electron-emitter (the "cathode") and does not enter into the actual vacuum-tube circuit; that is, it is not a true "element" or "electrode." The tip on the grid terminal of the shielded-grid tube symbol is used to show that this grid terminal is at the top of the tube, and to distinguish it from the other grid, the "screen grid," which connects to the "G" pin in the tube base. The other tubes are filament-type, half- and full-wave rectifiers; full-wave gaseous type, and two types of voltage-regulator tubes. These tubes are used, mostly, in "A" and "B" socket-power units.

CIRCUIT CONNECTIONS: The various methods of showing in a diagram how wires are connected are indicated in the last two columns of the chart. Four types of telephone jacks are indicated; the single-circuit open, single-circuit closed, double-circuit closed, and double-circuit open; these are the usual forms employed in modern receivers. The filament switch is indicated by an arrow with a circle at either end. This instrument usually takes the nature of a single-pole, single-throw switch. Below this are shown the lightning arrestor, indicating the gap which forms the path of aerial electricity to ground; and the electrolytic rectifier, in which the dark line indicates the negative plate (lead, often) and the open line the positive plate (aluminum, most commonly).

METERS: The standard symbol, for voltmeters and ammeters of all types and scale ranges, is a circle around a letter, either "V" or "A." If, for instance, a microvoltmeter or milliammeter is used, its scale reading is indicated alongside the symbol.

MISCELLANEOUS: The various familiar standard symbols for crystal detectors, telephone headsets, batteries, fuses and binding posts are shown. The phone-tip-jack symbol is new. The use of these tip jacks is becoming so widespread that it has been thought advisable to create a symbol for the devices.

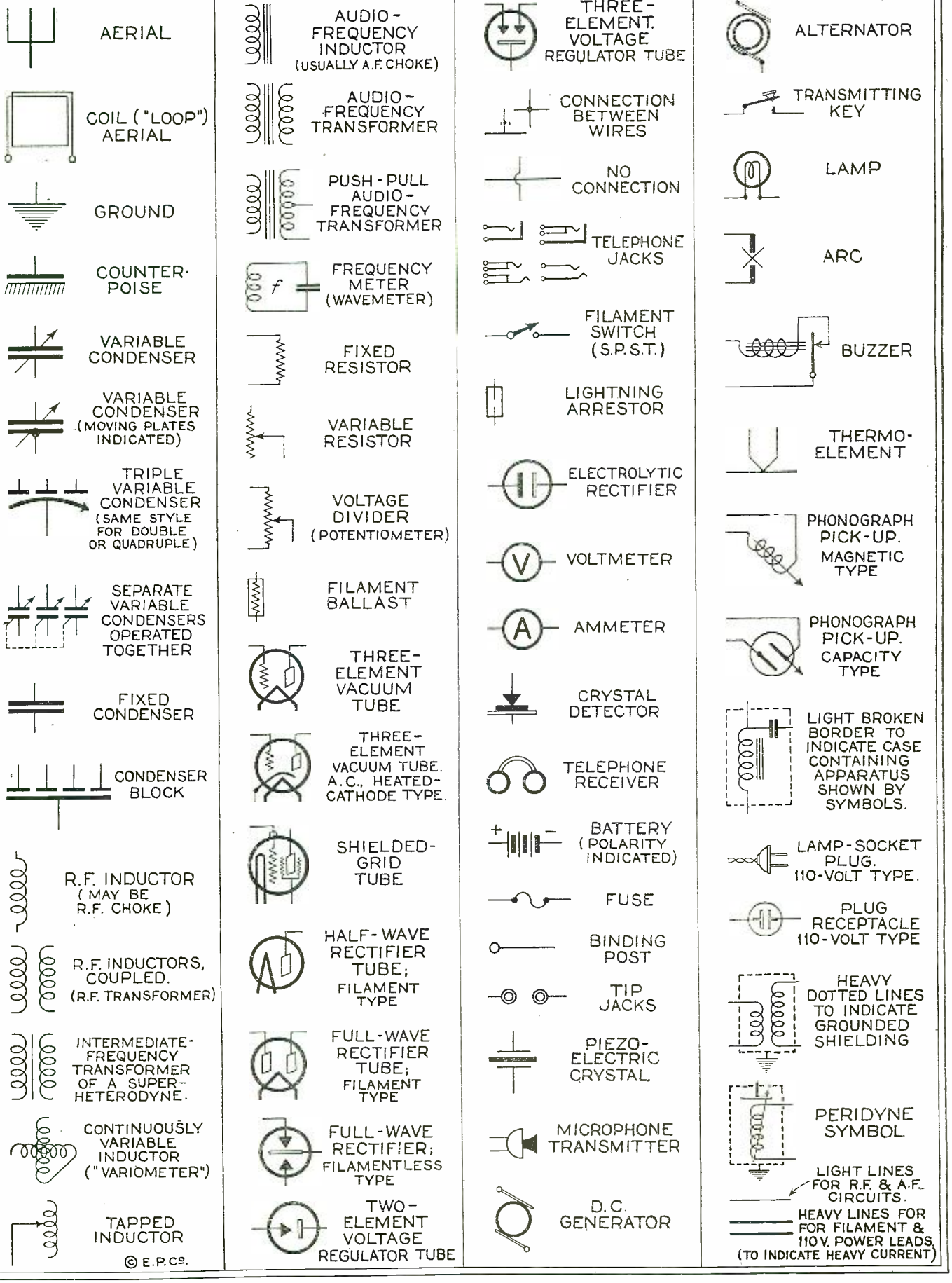
The piezo-electric crystal, used extensively in both broadcast and amateur short-wave transmitters to maintain a constant frequency, is shown by a heavy line with a lighter line on either side of it. Other symbols, used principally in connection with transmitting equipment, include those for the microphone, which may be of the ordinary telephone-transmitter type, or a more specialized device; the D.C. generator (dynamo or other source of direct current, other than a battery); the alternator or A.C. generator; the transmitting key, used in code work; the arc; and the buzzer. The common incandescent lamp, used generally as an indicator or pilot light, and otherwise as a ballast, in radio work, has an easily-recognizable symbol.

THERMO-ELEMENT: The contact of two different metals, when subjected to heat,

(*Continued on page* 930)

STANDARD RADIO SYMBOLS

ADOPTED BY "RADIO NEWS", FEBRUARY, 1928



A Remote Radio Control Without Wires

An Explanation of a Proposed Scheme for Tuning a Stationary Receiver from Anywhere About the House

BELIEVE it or not, the average radio listener is a lazy mortal. This may seem to many to be rather a harsh statement, but it is true nevertheless; else why should we find described daily new devices to eliminate some of the heroic labors that the listener must perform in order to operate his set? We have now trickle chargers that can be left connected to the storage battery, so that the owner will not have to carry the battery down to the cellar to charge it, or exert himself unnecessarily by lifting the telephone receiver from the hook and asking a service man to come around and get the battery.

The latest labor-saving device to appear is one that has great possibilities. No longer will it be necessary for Father to leave his comfortable arm-chair to tune in on a different station, because Mother doesn't like the color of the announcer's necktie at Station WXYZ; no, "them days is gone forever," if you have one of these "remote controls." All that need be done is to turn a knob on the front of a little box, which stands on your chair arm, and tune in the station that Mother wants to hear. No need to get out of that very comfortable position with your feet on the mantel-shelf to adjust the volume to its proper intensity; merely turn another knob on the same small box and the deed is done. Simplicity itself, isn't it?

A feature that will make its appeal to the female members of the family is that the only apparatus which need be in sight is the small control box and the loud speaker. No longer will these words be necessary in the family bosom of the experimenter: "When are you going to get a decent cabinet for that radio? I'm ashamed to have that old piece of junk sitting there on the living-room table." (No matter how splendidly the set may work, it is always known as "junk" to the females of the family.) For with a remote-control system that does not utilize any wires from the control apparatus to the set (which is the case in this method, invented by Bowden Washington and Wilson Aull, Jr., of New York City) the band amplifier and the fixed-frequency receiver may be stowed in a closet with all the batteries, chargers and what not.

The loops in the station selector (on the small table) are concealed within the box; the left-hand cabinet on the table contains the band amplifier; and the fixed-frequency receiver is on the right.

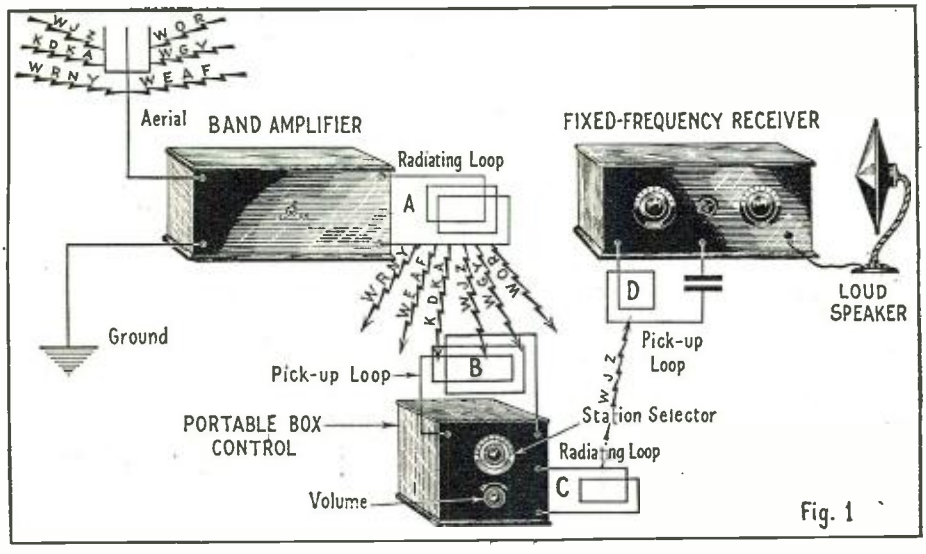


Fig. 1

Signals from all stations within the receiver's range are amplified in the band amplifier, and the one to which it is desired to listen is tuned in by the station selector and transmitted on a new wavelength to the fixed-frequency receiver.

THEORY AND OPERATION

The question now arises, how is this done? To tell the truth, the process is simplicity itself. Refer to Fig. 1, in which will be found diagramed a band amplifier, a portable control box and a fixed-frequency receiver, together with four loop antennas marked A, B C and D. On the control box are indicated two controls; a station selector and a volume adjustment. The band amplifier, to which is connected the regular aerial and ground, is a radio-frequency amplifier which builds up the signals of the waveband from 200 to 550 meters. It may use fixed R. F. transformers with overlapping tuning curves. The output of this amplifier is connected to a loop antenna, which, as is shown in Fig. 1, radiates all the signals picked up by the outside aerial.

The radiations from loop A are picked up by loop B, on the input side of the portable control box. Across this loop is connected a simple regenerative detector, the output of which modulates an oscillatory circuit, operating on a frequency that is either above or below the broadcast waveband. Let us assume that this frequency is about 540 kilocycles. Then from loop C we have a wave of 540 kc. frequency modulated by the detected signal from a certain station, let us say WJZ, which is selected by the regenerative detector. The modulated wave from loop C is picked up by loop D, across the input of the fixed-frequency receiver, this frequency being the same as that of the oscillating circuit in the control box, 540 kilocycles. Thus only the single frequency, 540 kc., will in any way affect the receiver, as it is tuned to that frequency alone.

CONTROL BOX IS SIMPLE

The small box that is placed on Father's chair arm is very simple of construction. It is entirely self-contained; *i.e.*, the loop antennas, the necessary batteries for the two tubes, the apparatus for tuning and the oscillating circuit are all within the confines of the small box. In order to facilitate construction, tubes of the 199 type are employed so that dry-cell batteries may be used and, consequently, two of the small type 22½-volt "B" batteries can be stowed away in a convenient corner. It is designed for sufficient sensitivity with non-adjustable automatic regeneration, so that only two controls are necessary—the grid tuning condenser for selection and a volume control, which may be a potentiometer controlling the modulations of the oscillator.

This control box may be as decorative as may be desired and the two controls, appearing on the outside of the box, can be made to correspond to the scheme of decoration, just as in some of the receivers appearing on the market at the present time.

The band amplifier and the receiving set can be made to operate from the same bat-

(Continued on page 932)

A Remote-Control Radio System DeLuxe

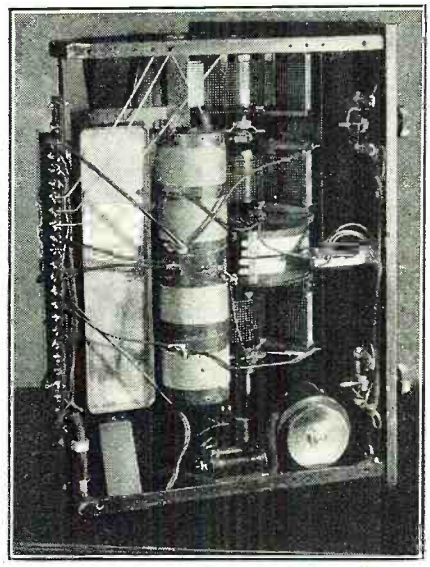
A Non-Technical Description of Installations Combining a Talking Machine and Radio Receiver and Capable of Being Controlled from Several Points

By G. C. B. Rowe

EVER since the inception of radio broadcasting as we know it today, engineers have been on the search for quality of reproduction that shall be equal to the original, and for a method of controlling the apparatus which will entail a minimum number of adjustments. For nearly a decade this search has been undertaken by men who have achieved many praiseworthy results; but the nearest approach to the goal of perfection in radio and talking-machine reproduction is embodied in the instruments pictured on this page.

The engineers who have designed this remarkable reproducer of music came early to the conclusion that it was impossible to use "any-old-kind" of a detector, audio-frequency amplifier and loud speaker, yet expect to get results in the neighborhood of even the average. Many commercial receivers were tested for selectivity, sensitivity, volume and fidelity of reproduction. The combination of these desired properties was found in a set which employed the superheterodyne circuit; but, even in this excellent receiver, it was found necessary to make some changes in the circuit to improve the quality. Then, too, the receiver to be finally adopted for use in these engineers' plans had to be simple of control; for it should be remembered that the chief purpose was to make this set capable of being controlled from a distant point.

The talking-machine end of the proposition proved to be a simpler matter, since the advent of the great improvements made



The rear view of the radio receiver, showing in the lower right corner the motor for driving the condensers.

in this field within the last eighteen months. It is possible to have the talking machine play twelve records, lasting through a period of approximately an hour and three-quarters, without any attention, the records being changed automatically. An electrical pick-up device is employed on the talking machine; so that the excellent audio-frequency amplifier used with the radio receiver can be employed to give the same faithful reproduction from records.

AN EXTENSIVE INSTALLATION

As may be seen from the accompanying illustrations, music-reproducing equipment of this nature occupies quite a good deal more space, and weighs more than the ordinary receiving set. In many cases it will be, therefore, found necessary to place it in some out-of-the-way corner, or in a closet. Some system of remote control is necessary, as a result, to facilitate tuning of the radio set, and to start and stop the talking-machine, from a point at some distance from the equipment.

This need for remote control resulted in the production of the small box shown in the lower right-hand illustration. This leather-covered box, which is about the size of the usual one containing cigars, has attached to it a plug having ten contacts. The house in which the instrument is installed is especially wired; so that the set can be tuned and controlled from as many

(*Continued on page* 960)

In the upper portion of the chassis is the radio receiver, beneath which is seen the automatic talking machine. In the case under the turn-table is the powerful amplifier.

The remote-control box, attached to which is the plug which fits into outlets located in different parts of the house. By means of this the receiver may be tuned to different wavelengths.

List of Broadcast Stations in the United States

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
KDKA	East Pittsburgh, Pa..**316 (Also 62 5, 42.95, and 27 meters and other short-wave transmissions on varying power.)		50000
KDLR	Devils Lake, N. D.....	231	15
KDYL	Salt Lake City, Utah..	234	500
KELW	Burbank, Calif.....	229	*500
KEX	Portland, Ore.....	240	2500
KFAB	Lincoln, Neb.....	319	5000
KFAD	Phoenix, Ariz.....	273	500
KFAU	Boise, Idaho.....	285	*2000
KFBB	Havre, Mont.....	275	100
KFBC	San Diego, Calif..... (Also 65.18 meters)	248	100
KFBK	Sacramento, Calif.....	535	100
KFBL	Everett, Wash.....	224	50
KFBU	Laramie, Wyo.....	484	500
KFCB	Phoenix, Ariz.....	*244	125
KFCR	Santa Barbara, Calif..	211	50
KFDM	Beaumont, Texas.....	484	500
KFDX	Shreveport, La.....	236	250
KFDY	Brookings, S. D.....	545	500
KFDZ	Minneapolis, Minn....	216	10
KFEC	Portland, Ore.....	214	50
KFEL	Denver, Colo.....	248	250
KFEQ	St. Joseph, Mo.....	231	1000
KFEY	Kellogg, Idaho.....	232	10
KFGQ	Boone, Iowa.....	210	10
KFH	Wichita, Kan.....	246	500
KFHA	Gunnison, Colo.....	254	50
KFHL	Oskaloosa, Iowa.....	213	10
KFI	Los Angeles, Calif.....	468	5000
KFIF	Portland, Ore.....	214	50
KFIO	Spokane, Wash.....	246	100
KFIU	Juneau, Alaska.....	225	10
KFIZ	Fond du Lac, Wis....**	268	100
KFJB	Marshalltown, Iowa...	248	*100
KFJF	Oklahoma City, Okla..	273	*750
KFJI	Astoria, Ore.....	250	15
KFJM	Grand Forks, N. D....	333	100
KFJR	Portland, Ore.....	283	100
KFJY	Fort Dodge, Iowa.....	232	100
KFJZ	Fort Worth, Texas....	250	50
KFKA	Greeley, Colo.....	545	200
KFKB	Milford, Kansas.....	242	*1500
KFKU	Lawrence, Kansas.....	254	500
KFKX	Chicago, Ill.....	526	2500
KFKZ	Kirksville, Missouri...	225	15
KFLV	Rockford, Ill.....	268	100
KFLX	Galveston, Texas.....	270	100
KFMR	Sioux City, Iowa.....	232	100
KFMX	Northfield, Minn.....	236	500
KFNF	Shenandoah,Iowa(day)	461	2000
KFOA	Seattle, Wash.....	447	1000
KFON	Long Beach, Calif.....	242	500
KFOR	Lincoln, Neb.....	217	100
KFOX	Omaha, Neb.....	258	100
KFPL	Dublin, Texas.....	275	15
KFPM	Greenville, Texas.....	231	15
KFPR	Los Angeles, Calif....	232	250
KFPW	Carterville, Mo.....	263	50
KFPY	Spokane, Wash..... (7XAB, 105.9 meters, 50 watts)	246	250
KFQA	St. Louis, Mo.....	248	50
KFQB	Fort Worth, Texas....	333	1000
KFQD	Anchorage, Alaska....	345	100
KFQU	Holy City, Calif..... (Also 31, 53, 63, 106 meters, 50 watts)	250	100
KFQW	Wenatchee, Wash.....	217	100
KFQZ	Hollywood, Calif..... (Also 108.2 meters, 50 watts)	232	100
KFRC	San Francisco, Calf...	454	1000
KFRU	Columbia, Missouri...	250	500
KFSD	San Diego, Calif.....	441	500
KFSG	Los Angeles, Calif..... (Has short-wave transmitter)	275	500
KFUL	Galveston, Texas.....	258	500
KFUM	Colorado Spgs., Colo...	283	1000
KFUO	†Clayton, Mo.....	515	*1000
KFUP	Denver, Colo.....	227	100
KFUR	†Ogden, Utah.....	225	500
KFUS	Oakland, Calif.....	256	50
KFUT	Salt Lake City, Utah..	250	50
KFVD	Venice, Calif..... (Also 105 meters, 50 watts)	208	250
KFVG	Independence, Kan....	225	50
KFVI	Houston, Texas.....	238	50
KFVS	Cape Girardeau, Mo.**2	24	50
KFWB	Los Angeles, Calif..... (Also 105 and 40 meters, 50 watts)	361	500
KFWC	Glendora, Calif.....	222	100
KFWF	St. Louis, Mo.....	214	250
KFWH	Eureka, Calif..... (Also 108.2 meters. 50 watts)	254	100
KFWI	San Francisco, Cal....	238	500
KFWM	Oakland, Calif.....	236	*500
KFWO	Avalon, Calif.....	300	250
KFXD	Jerome, Idaho.....	204	15
KFXF	Denver, Colo.....	283	250
KFXJ	†Edgewater,Colo.(near)	216	500
KFXR	Oklahoma City, Okla..	224	50
KFXY	Flagstaff, Ariz.....	205	25
KFYO	Breckenridge, Tex....	211	15
KFYR	Bismarck, No. Dak...	250	*250
KGA	Spokane, Wash.....	261	2000
KGAR	Tucson, Ariz.....	234	100
KGBU	Ketchikan, Alaska....	229	500
KGBX	St. Joseph, Mo.....	238	100
KGBY	Columbus, Obraska...	222	50
KGBZ	York, Nebraska.....	213	100
KGCA	Decorah, Iowa.....	248	10
KGCB	Oklahoma City, Okla..	216	50
KGCH	Wayne, Nebraska.....	294	250
KGCI	San Antonio, Texas...	220	15
KGCL	Seattle, Wash.....	231	50
KGCN	Concordia, Kansas....	208	50
KGCR	Brookings, So. Dak...	208	15
KGCU	Mandan, No. Dak....	240	100
KGCX	Vida, Montana.....	244	10
KGDA	Dell Rapids, So. Dak. (daytime).....	254	15
KGDE	Barrett, Minn.....	205	50
KGDM	Stockton, Calif.....	217	10
KGDP	Pueblo, Colo.....	224	10
KGDR	San Antonio, Texas...	207	15
KGDW	Humboldt, Neb.....	294	100
KGDX	Shreveport, La.....	213	250
KGDY	Oldham, So. Dak.....	207	15
KGEF	Los Angeles, Calif....	263	500
KGEH	Eugene, Ore.....	201	50
KGEK	Yuma, Colo.....	263	10
KGEN	El Centro, Calif.....	225	15
KGEO	Grand Island, Neb....	205	100
KGEQ	Minneapolis, Minn....	204	50
KGER	Long Beach, Calif.....	216	100
KGES	Central City, Neb.....	204	10
KGEU	Lower Lake, Calif.....	227	50
KGEW	Fort Morgan, Colo.....	219	*100
KGEY	†Denver, Colo.....	201	250
KGEZ	Kalispell, Montana....	294	100
KGFB	Iowa City, Iowa.....	224	10
KGFF	Alva, Oklahoma.....	205	25
KGFG	Oklahoma City, Okla.	216	50
KGFH	La Crescenta, Calif...	224	250
KGFI	San Angelo, Texas....	220	15
KGFJ	Los Angeles, Calif....	208	100
KGFK	Hallock, Minn.....	224	50
KGFL	Raton, N. M.....	222	50
KGFM	Yuba City, Calif.....	211	15
KGFN	Aneta, No. Dak.....	200	15
KGFO	Los Angeles, Cal.(port.)	204	100
KGFP	Mitchell, So. Dak....	213	10
KGFW	Ravenna, Neb.....	297	10
KGFX	Pierre, S. D. (day)...	254	200
KGGF	Pichér, Okla.....	207	100
KGGH	Cedar Grove, La.....	213	50
KGGM	Inglewood, Calif.(port.) (6XAL, 66.04 meters; 50 watts)	204	100
KGHB	Honolulu, Hawaii.....	227	250
KGHC	Slayton, Minn.....	210	15
KGHF	Pueblo, Colo.....	210	250
KGHP	Hardin, Mont.....	263	50
KGO	Oakland, Calif.....**384		5000
KGRC	San Antonio, Texas...	220	100
KGRS	Amarillo, Texas.....	244	*250
KGTT	San Francisco, Calif..	207	50
KGU	Honolulu, Hawaii.....	270	600
KGW	Portland, Oregon.....	492	1000
KGY	Lacey, Wash.....	244	50
KHAC	(airplane) San Francisco	204	50
KHJ	Los Angeles, Calif.... (Also 104.1 meters; 50 watts)	416	500
KHMC	Harlingen, Tex.....	236	100
KHQ	Spokane, Wash.....	370	1000
KICK	Red Oak, Iowa (day)..	322	100
KJBS	San Francisco, Calif... (6XAR, 33 meters; 50 watts)	220	50
KJR	Seattle, Wash..... (Also 105.2 meters; 5 to 250 watts)	349	2500
KKP	Seattle, Wash.....	265	15
KLCN	Blytheville, Ark. (day)	285	50
KLDS	Independence, Mo....	270	1500
KLIT	Portland, Ore.....	207	10
KLS	Oakland, Calif.....	246	250
KLX	Oakland, Calif.....	508	500
KLZ	†Dupont, Colo.....	297	*500
KMA	Shenandoah, Iowa....	395	1000
KMBC	see KLDS		
KMED	Medford, Oregon.....	250	50
KMIC	Inglewood, Calif.....	224	250
KMJ	Fresno, Calif.....	366	50
KMMJ	Clay Center, Neb.....	285	*250
KMO	Tacoma, Wash.....	254	250
KMOX	†St. Louis, Mo.....	300	5000
KMTR	Los Angeles, Calif.... (Also 108.2 meters; 250 watts)	526	500
KNRC	Santa Monica, Calif... (Also 108.2 meters; 100 watts)	375	500
KNX	Los Angeles, Calif..... (Also 107.1 meters; 100 watts)	337	500
KOA	Denver, Colo.....**326		*2500
KOAC	Corvallis, Oregon.....	270	500
KOB	State College,New Mex	395	*5000
KOCH	Omaha, Neb.....	258	250
KOCW	Chickasha, Okla.....	252	250
KOIL	Council Bluffs, Iowa.. (9XU, 61.05 meters, 500 watts)	319	5000
KOIN	†Portland, Oregon....	319	1000
KOMO	Seattle, Wash.....	306	1000
KOW	Denver, Colo.....	248	250
KPCB	Seattle, Wash.....	231	50
KPJM	Prescott, Ariz.....	214	15
KPLA	Los Angeles, Calif....	252	500
KPNP	Muscatine, Iowa.....	211	100
KPO	San Francisco, Calif...	422	1000
KPPC	Pasadena, Calif.....	229	50
KPRC	Houston, Texas.....	294	500
KPSN	Pasadena, Calif.....	316	1000
KQV	Pittsburgh, Pa.....	270	500
KQW	San Jose, Calif.....	297	500
KRAC	Shreveport, La.....	220	50
KRE	Berkeley, Calif.....	256	100
KRLD	Dallas, Texas.....	461	500
KRLO	Los Angeles, Calif.... (6XAN, 105.9 meters, 250 watts)	216	250
KRSC	Seattle, Wash.....	211	50
KSAC	Manhattan, Kansas...	333	500
KSBA	†Shreveport, La.....	268	1000
KSCJ	Sioux City, Iowa....	344	*500
KSD	St. Louis, Mo.....	545	500
KSEI	Pocatello, Idaho.....	333	250
KSL	Salt Lake City, Utah..	303	1000
KSMR	Santa Maria, Calif....	273	100
KSO	Clarinda, Iowa.....	227	500
KSOO	Sioux Falls, So. Dak..	210	250
KTAB	Oakland, Calif.....	280	500
KTAP	San Antonio, Texas...	229	20
KTBI	Los Angeles, Calif....	288	500
KTBR	Portland, Oregon.....	283	50
KTHS	Hot Springs, Ark....**	384	*1000
KTNT	Muscatine, Iowa.....	256	2000
KTSA	San Antonio, Texas...	265	2000
KTUE	Houston, Texas.....	213	5
KTW	Seattle, Wash.....	395	1000
KUJ	Seattle, Wash.....	200	10
KUOA	Fayetteville, Ark....	297	500
KUOM	Missoula, Mont.....	461	500
KUSD	Vermillion, So. Dak...	484	250
KUT	Austin, Texas.....	232	500
KVI	Tacoma, Wash.....	254	50
KVL	Seattle, Wash.....	203	100
KVOO	Bristow, Okla.....	349	1000
KVOS	Bellingham, Wash....	210	50
KWBS	Portland, Oregon.....	200	15
KWCR	Cedar Rapids, Iowa...	240	250
KWG	Stockton, Calif.....	345	50
KwJJ	Portland, Ore.....	229	50
KWK	St. Louis, Mo.....	234	*1000
KWKC	Kansas City, Mo.....	222	100
KWKH	Shreveport, La.....	395	1000
KWLC	Decorah, Iowa.....	248	50
KWSC	Pullman, Wash.....	395	500
KWTC	Santa Ana, Calif.....	222	100
KWUC	LeMars, Iowa (day)..**	244	1500
KWWG	Brownsville, Texas....	278	500
KXA	Seattle, Wash.....	349	500
KXL	Portland, Ore.....	220	50
KXRO	Aberdeen, Wash.....	227	50
KYA	San Francisco, Calif...	309	500
KYW	Chicago, Ill.....	526	*2500
KZM	Oakland, Calif.....	246	100
NAA	Arlington, Virginia...**	434	1000
WAAD	Cincinnati, O.....	268	25
WAAF	Chicago, Ill.....	389	500
WAAM	Newark, N. J..... (Also 65.18 meters, 50 watts)	268	500
WAAT	Jersey City, N. J.....	246	300
WAAW	Omaha, Neb. (daytime)	441	500
WABC	Richmond Hill, N. Y.. (Also 64.0 meters, 500 watts)	309	*2500
WABF	Pringleboro, Pa.....	205	250
WABO	See WHEC		
WABQ	Philadelphia, Pa.....	224	500
WABW	Wooster, Ohio.....	248	50
WABY	Philadelphia, Pa.....	248	50
WABZ	New Orleans, La.....	248	50
WADC	Akron, Ohio.....	238	1000
WAFD	Detroit, Mich.....	231	100
WAGM	Royal Oak, Mich.....	225	50
WAIT	Taunton, Mass.....	214	10
WAIU	†Columbus, Ohio.....	283	5000
WAIZ	Appleton, Wis.....	227	100
WALK	Willow Grove, Pa.....	201	50
WAMD	†Minneapolis, Minn...	222	1000
WAPI	Auburn, Ala.....	341	1000
WARS	†Brooklyn, N. Y.....	227	500
WASH	Grand Rapids, Mich..	256	250
WATT	Boston,Mass(portable)	201	100
WBAA	West Lafayette, Ind..**	273	500
WBAK	Harrisburg, Pa. (day).	300	500
WBAL	†Baltimore, Md.....**	285	5000
WBAO	Decatur, Ill.....	268	100
WBAP	Fort Worth, Texas....	500	5000
WBAW	Nashville, Tenn.....	240	500
WBAX	Wilkes Barre, Pa.....	250	100
WBBC	Brooklyn, N. Y.....	227	500
WBBL	Richmond, Va.....	234	100
WBBM	†Glenview, Ill.....**	389	5000
WBBP	Petoskey, Mich.....	240	100
WBBR	Rossville, N. Y.....	256	1000
WBBW	Norfolk, Va.....	236	100
WBBY	Charleston, So. Car...	250	75
WBBZ	Chicago, Ill. (portable)	204	100
WBCN	Chicago, Ill.....	288	250
WBES	Takoma Park, Md.....	265	100
WBET	Medford, Mass.....	288	500
WBIS	See WNAC		
WBKN	Brooklyn, N. Y.....	200	100
WBMH	Detroit, Mich.....	211	100
WBMS	Union City, N. J.....	200	100
WBNY	New York, N. Y.....	236	500
WBOQ	Richmond Hill, N. Y..	326	500
WBRC	Birmingham, Ala.....	242	250
WBRE	Wilkes Barre, Pa.....	250	100
WBRL	Tilton, N. H..... (1XY, 105, 109 meters, 250 watts)	232	500
WBRS	Brooklyn, N. Y.....	211	100
WBSO	Wellesley Hills, Mass.	384	100
WBT	Charlotte, No. Car...	258	*750
WBZ	†Springfield, Mass....* (Has short-wave transmitter)	333	15,000
WBZA	Boston, Mass.....	*333	500
WCAC	Mansfield, Conn.....	535	500
WCAD	Canton, N. Y.....	244	*500
WCAE	Pittsburgh, Pa.....	461	500
WCAH	Columbus, Ohio.....	234	250
WCAL	Lincoln, Neb. (day)..	380	500
WCAL	Northfield, Minn....	286	500
WCAM	Camden, N. J.....	224	500
WCAO	Baltimore, Md.....	244	250
WCAP	Asbury Park, N.J....	240	500
WCAT	Rapid City, So. Dak..	248	100
WCAU	Philadelphia, Pa.....	261	500
WCAX	Burlington, Vermont..	254	100
WCAZ	Carthage, Ill.....	250	50
WCBA	Allentown, Pa.....	222	100
WCBD	Zion, Ill.....	345	5000
WCBE	New Orleans, La.....	227	5
WCBM	Baltimore, Md.....	225	100
WCBR	Providence, R.I.(port.)	201	100
WCBS	Springfield, Ill.....	210	250
WCCO	†Minneapolis, Minn..**	405	*5000
WCDA	Cliffside, N. J.....	211	250
WCFL	Chicago, Ill.....	484	1500
WCGU	Brooklyn, N. Y..... Also 54 meters, 150 watts)	219	500
WCLO	Kenosha, Wisc.....	227	100
WCLS	Joliet, Ill.....	261	500
WCMA	Culver, Ind.....	261	500
WCOA	Pensacola, Fla.....	250	500
WCOC	Columbus, Miss.....	231	250
WCOT	†Olneyville, R. I.....	225	100
WCRW	Chicago, Ill.....	224	500
WCSH	Portland, Maine..... (Also 63.79 meters, 250 watts)	366	500
WCSO	Springfield, Ohio.....	256	500
WCWK	Fort Wayne, Ind.....	214	250
WCWS	Duxbury, Conn.....	265	100
WCX	See WJR		
WDAD	See WLAC		0
WDAE	Tampa, Fla.....	268	500
WDAF	Kansas City, Mo.....	370	1000
WDAG	Amarillo, Texas.....	263	250
WDAH	El Paso, Texas.....	234	100
WDAY	Fargo, No. Dakota...	545	*250
WDBJ	Roanoke, Va.....	231	250
WDBO	Orlando, Fla..... (4XE, variable, 250 watts)	288	*500
WDEL	Wilmington, Del.....	297	100
WDGY	Minneapolis, Minn...	286	500
WDOD	Chattanooga, Tenn...	244	500
WDRC	New Haven, Conn....	283	500
WDWF-WLSI,	New Bedford, Mass.....	261	250
WDZ	Tuscola, Ill. (daytime)	278	100
WEAF	†Bellmore, N. Y.....**	492	50,000
WEAM	North Plainfield, N. J.	263	250
WEAN	Providence, R. I.....	275	500
WEAO	Columbus, Ohio..... (Also 54.02 meters, 250 watts)	283	750
WEAR	Cleveland, Ohio.....**	400	1000
WEBC	Superior, Wis.....	242	*250
WEBE	Cambridge, Ohio.....	248	10
WEBH	Chicago, Ill.....	366	*500
WEBJ	New York, N. Y.....**	256	500
WEBQ	Harrisburg, Ill.....	224	15
WEBR	Buffalo, N. Y.....	242	200
WEBW	Beloit, Wis.....	258	500
WEDC	Chicago, Ill.....	242	500
WEEI	Boston, Mass..... (Has short-wave transmitter)	508	500
WEHS	Evanston, Ill.....	216	100
WEMC	Berrien Spgs., Mich...	484	1000
WENR	Chicago, Ill.....	288	500
WEPS	Gloucester, Mass.....	297	100
WEVD	Woodhaven, N. Y.....	246	500
WEW	St. Louis, Mo. (day)..	353	1000
WFAA	Dallas, Texas.....	545	500
WFAM	St. Cloud, Minn.....	252	10
WFAN	Philadelphia, Pa.....	224	500
WFBC	Knoxville, Tenn.....	234	50
WFBE	Cincinnati, Ohio.....	246	250
WFBG	Altoona, Pa.....	280	100
WFBJ	Collegeville, Minn....	273	100
WFBL	Syracuse, N. Y.....	258	750
WFBM	Indianapolis, Ind....	275	1000
WFBR	Baltimore, Md.....	244	100
WFBZ	Galesburg, Ill.....	248	50
WFCI	Pawtucket, R. I.....	242	100
WFDF	Flint, Mich.....	273	100
WFI	Philadelphia, Pa.....	405	500
WFIW	Hopkinsville, Ken....	260	750
WFJC	Akron, Ohio.....	227	500
WFKB	Chicago, Ill.....	224	500
WFKD	Philadelphia, Pa.....	248	50
WFLA	Clearwater, Fla.....	508	750
WGAL	Lancaster, Pa.....	252	15
WGBB	Freeport, N. Y.....	246	400
WGBC	Memphis, Tenn.....	278	15
WGBF	Evansville, Ind.....	236	250
WGBI	Scranton, Pa.....	231	250
WGBS	†New York, N. Y.....	349	500
WGCP	Newark, N. J.....	268	250
WGES	†Chicago, Ill.....	242	500
WGHP	†Mt. Clemens, Mich..	278	750
WGL	†Secaucus, N. J.....	294	*500
WGM	Jeannette, Pa.....	208	50
WGMS	Minneapolis, Minn...	246	500
WGMU	New York,N.Y.(port.) (Also 106 meters, 50 watts)	201	100
WGN-WLIB	Chicago and Elgin, Ill.....	416	15,000
WGOP	Flushing, N. Y.....	200	100
WGR	Buffalo, N. Y.....	303	750
WGST	Atlanta, Ga.....	270	500
WGWB	Milwaukee, Wis.....	219	500
WGY	Schenectady. N. Y...** (Also on 32.77, 21.96 and sometimes 5 meters)	380	50,000
WHA	Madison, Wisc.....	333	750
WHAD	Milwaukee, Wisc.....	270	500
WHAM	Rochester, N. Y.....** (Has short-wave transmitter)	278	5000
WHAP	†Carlstadt, N. J.....	236	1000
WHAS	Louisville, KY.....	322	500
WHAZ	Troy, N. Y. (Monday)	306	500
WHB	Kansas City, Mo.....	341	500
WHBA	Oil City, Pa.....	261	10
WHBC	Canton, Ohio.....	236	10
WHBD	Bellefontaine, O.....	222	100
WHBF	Rock Island, Ill.....	222	100
WHBL	Chicago, Ill. (portable)	204	100
WHBM	Chicago, Ill. (portable)	201	100
WHBN	Gainesville, Fla.....	297	10
WHBP	Johnstown, Pa.....	229	*250
WHBQ	Memphis, Tenn.....	232	100
WHBU	Anderson, Ind.....	220	15
WHBW	Philadelphia, Pa.....	220	100
WHBY	West De Pere, Wis...	250	50
WHDI	Minneapolis, Minn...	246	500
WHEC-WABO	Rochester, N. Y.	254	500
WHFC	Chicago, Ill.....	216	200
WHK	Cleveland, Ohio.....** (Also 66.04 meters, 500 watts)	265	*500
WHN	New York, N. Y.....	395	500
WHO	Des Moines, Iowa....	535	5000
WHPP	New York, N. Y.....	207	10
WHT	†Chicago, Ill.....	306	5000
WIAD	Philadelphia, Pa.....	288	100
WIAS	Ottumwa, Iowa (day)	322	100
WIBA	Madison, Wis.....	240	100
WIBG	Elkins Pk..Pa.(Sund'ys)	441	50
WIEJ	Chicago, Ill. (port.)...	201	100
WIBM	Chicago, Ill. (port.)...	201	100
WIBO	†Chicago, Ill.....	306	5000
WIBR	Steubenville, Ohio....	250	50
WIBS	Elizabeth, N. J.....	204	150
WIBU	Poynette, Wis.....	217	20
WIBW	Chicago, Ill. (port.)...	204	100
WIBX	Utica, N. Y.....	238	150
WIBZ	Montgomery, Ala.....	231	15
WICC	Easton, Conn.....	265	500
WIL	St. Louis, Mo.....	258	250
WIOD	Miami Beach, Fla....	248	1000
WIP	Philadelphia, Pa.....	349	500
WJAD	Waco, Tex.....	333	500
WJAG	Norfolk, Neb.....	285	*250
WJAK	Kokomo, Ind.....	234	50
WJAM	Cedar Rapids, Iowa...	240	250
WJAR	Providence, R. I.....	484	500
WJAS	Pittsburgh, Pa.....	270	500
WJAX	Jacksonville, Fla.....	341	1000
WJAY	Cleveland, Ohio.....	227	500
WJAZ.	†Mt Prospect, Ill....	263	5000
WJBA	Joliet, Ill.....	248	50
WJBB	Tampa, Fla.....	345	250
WJBC	LaSalle, Ill.....	227	100
WJBI	Red Bank, N. J.....	263	250
WJBK	Ypsilanti, Mich..	220	15
WJBL	Decatur, Ill.....	213	250
WJBO	New Orleans, La.....	263	100
WJBT	Chicago, Ill.....	389	500

THE list of broadcast stations here presented is in accordance with the temporary licenses issued by the Radio Commission; and subject to the possibility of minor adjustments being made by that authority, will remain in force for sixty days from December 1, 1927, at which time it went into effect.

And *w eohigher daylight power. *Standard or constant-frequency transmission. †Remote Cont rol.

(Continued on page 920)

The Somersalo Frequency-Filter System of Tuning

A New Method by Which the Processes of Selection and Amplification Are Kept Separate

By E. A. Livingstone

IN systems for the selective reception of radio waves, it has been common practice to connect several tuned circuits in cascade, by one of several coupling methods. In most of these there is an appreciable amount of reaction between adjacent circuits. The reaction between circuits destroys the selectivity of the tuned circuits and flattens out the resonance curve to such an extent that, in extreme cases, a double peak in the curve may result.

When direct coupling is employed, as in the filter circuits used by John Stone Stone in 1903, the coupling between circuits must be very loose, in order to prevent the reaction from destroying the selectivity. Too-loose coupling, however, prevents the efficient transfer of energy from one circuit to another.

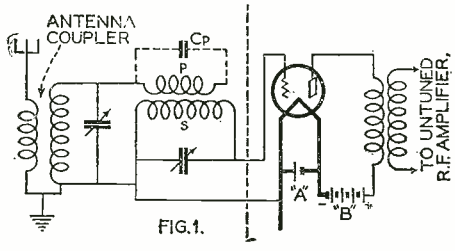
TUBE FEED-BACK TROUBLES

After the discovery of the three-element vacuum tube by Dr. Lee de Forest, in 1907, these tubes were used as coupling units because of their supposedly *unilateral* (one-way) coupling effect. However, it is common knowledge that a vacuum-tube relay is *not* unilateral in its coupling effect, but, because of the inherent capacity between the various electrodes, it will produce undesired reaction between the coupled circuits. If this reaction is not neutralized or suppressed, the circuits will oscillate at their natural frequency; thus causing interference in nearby receivers and distortion of the received signals.

Obviously, one way to overcome this difficulty is to design a system in which self-oscillations are unlikely to occur.

To the solution of this problem, Dr. George A. Somersalo, a well-known Finnish physicist and a former research engineer of the de Forest Radio Company, set himself several years ago; and, as a result of his research and experimentation, he has conceived and perfected a new system which has proven very satisfactory.

In his system, Dr. Somersalo has given up entirely the idea of coupling two tuned circuits by means of a vacuum tube, which is the method adopted by Alexanderson and others, and in which vacuum tubes with tuned input and tuned output circuits are used.



The fundamental tuning unit of the Somersalo system. The primary P is an open winding.

Vacuum tubes are, of course, used in Somersalo's system, but *not between tuned circuits;* as he has found that self-oscillation is not likely to occur if only the untuned circuits are coupled by vacuum tubes. Therefore, in the Somersalo system, *all the tuned circuits are placed ahead of the first tube,* thus forming a wave-filter. As a consequence, we have a multi-tuned antenna circuit, followed by an untuned R.F. amplifier.

To obtain both efficiency and selectivity with such an arrangement, Somersalo tried out every kind of filter, including the old filters devised by Stone. He found that in all these, when connected directly in the antenna circuit, either efficiency or selectivity was absent. In other words, these filters could not be made to produce both efficiency and selectivity at the same time.

After further research, Somersalo decided to use an *open* primary winding, as shown in Fig. 1.

In this arrangement the distributed capacity (Cp) of the winding causes a current to flow in the primary coil, P. This comparatively-small current induces a field around the secondary windings, and sets up a far greater current. It is generally necessary to minimize mutual capacity between the windings, since this capacity tends to reduce the efficiency of the transfer of energy. In this system, the loss of energy is comparatively small. The signal, after passing through the filter, is about as strong as it was in the antenna, provided the open coupling coils are large enough.

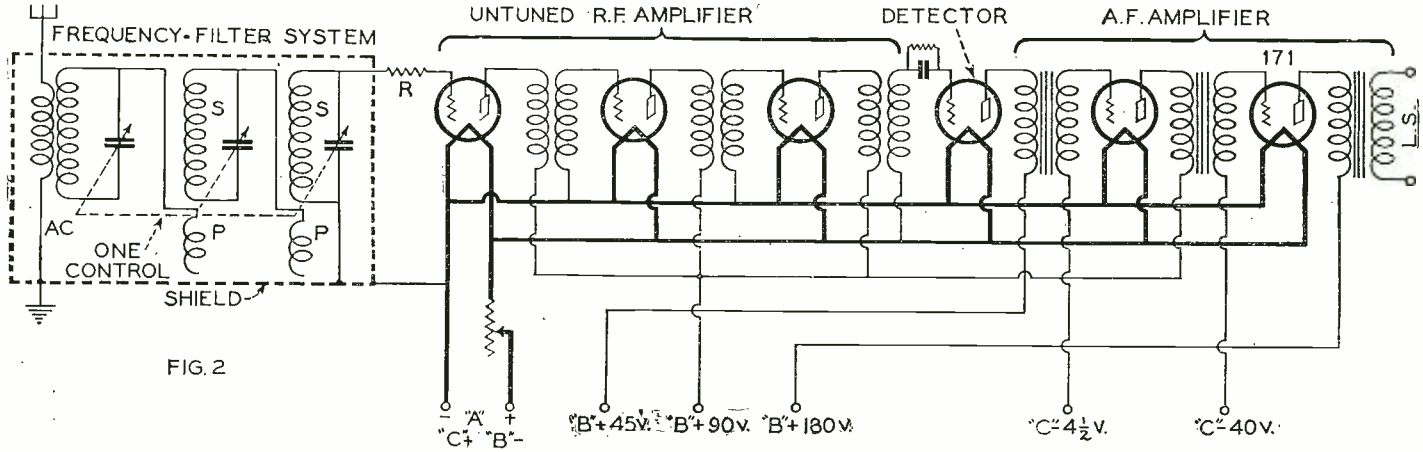
Dr. Somersalo attaches considerable importance to the size and design of these coils. If extreme care is not taken in this regard, the efficiency of the system is greatly impaired. Consequently, old coils, as used in ordinary T.R.F. amplifiers, cannot be used without modification.

WORKING OF THE SYSTEM

In the Somersalo circuit, the process of "selection" is concentrated in the filter and that of "magnification" in the amplifier. Thus these two processes have been separated, making selectivity and amplification quite independent of each other. If it is desired to increase the selectivity, one extra filter stage is added to the circuit. If greater efficiency be required, an R.F. amplifier stage is added. The inventor claims that this is not only more logical, but also more efficient than the tuned-radio-frequency system.

It has been demonstrated that squealing is conspicuous by its absence. The amplifier tubes do not require balancing or neutralizing. In the first tube, however, a peculiar effect may sometimes be experienced. If the feed-back, due to inherent grid-plate capacity, is too great the energy in the last filter stage is increased and made

(*Continued on page* 932)



Schematic diagram of a receiver employing a Somersalo triple tuning unit; and untuned R.F. amplification. The open primaries, P, are not grounded to the shield. Constants for the construction of this unit are not available at the present time.

How the Shielded-Grid Tube Obtains Its Sensitivity

Reduction of "Space Charge" and Internal Grid-to-Plate Capacity by "Screen Grid" Secret of Operation

By R. P. Clarkson

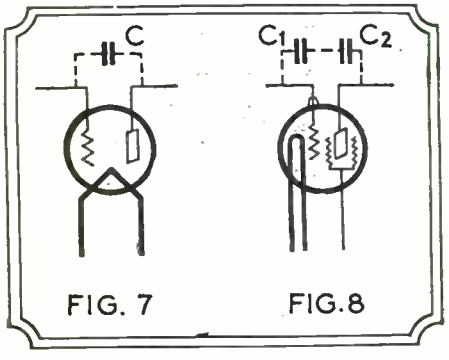
ONE of the questions most frequently asked is, why does not any positive potential on the plate of a three-element vacuum tube, whatever its amount, attract all the electrons that are emitted from the filament? The reason why it does not is because of the so-called "space charge."

The number of electrons emitted depends on the particular filament temperature, but electrons appear to be shot off at different velocities. Especially is this true of filaments not uniformly heated, and, generally speaking, all filaments are cooler near their supports than in their center.

THE "SPACE CHARGE"

Slower electrons just shoot off a little into space and come back to the filament. There is always a cloud of them around the filament, with the result that new ones emitted are repelled by those already in the space. Some of them, having a high velocity, shoot off through this negatively-charged cloud and are then repelled from behind by the cloud and drawn from in front by the positive charge on the plate; and so they join the stream passing from filament to plate.

This space charge (which is the negative charge of the hovering cloud around the filament) is much nearer the filament than is the plate. See Fig. 1. Increased plate voltage decreases the space-charge effect and hence increases plate current; which means that more electrons join the stream and fewer stay near. Not only is the space charge partly nullified but it is also actually



C in Fig. 7 is the internal-capacity effect of an ordinary tube. This is split into two components, in series, in a shielded-grid tube, Fig. 8.

decreased; so that the result becomes cumulative.

The grid is nearer the filament than the plate. Therefore, variation in the grid voltage has a greater effect, proportionally, on the space charge than a change in plate voltage. Hence, small grid-voltage variations make large plate-current variations and we have an amplifying effect, *whether the tube acts as a detector or as an amplifier.*

WHY "SHIELDED GRID?"

Just why the name "shielded grid" is being applied to the type of four-element tube which has just appeared on the market is a mystery. It is also puzzling to determine why this type of tube, well known years ago, has been presented to the public abroad and used so extensively among the European amateurs, yet has not been adopted here in America until now. The development is credited to a German experimenter, but almost any treatise on tubes discusses the functioning of these tubes and the advantages that would result from their use. However, since shielded-grid tubes are now available and are being designated as such, let us study them and learn to understand their fundamental action.

MR. CLARKSON, whose clear and easily-understood explanation of the shielded-grid tube will be appreciated by all RADIO NEWS *readers, is the author of the widely-read* Radio Data Sheets, *which have been appearing in the* New York Sun *and other American newspapers for more than five years. In the future he will be a frequent contributor to our pages.* —EDITOR.

First let us review the working of the three-element tube to refresh our memories. The incandescent filament sends out electrons. These are negative in polarity. The plate, being positively charged, attracts these electrons, forming a plate current or a plate-current path, as you wish (see Fig. 1). In this path is inserted a grid, which, by its variation of polarity or potential, controls the electron flow.

If the grid is negative it repels the electrons and overcomes a portion of the plate's attraction for them; thus cutting down the plate current (see Fig. 2). As it is much nearer the filament, a slight negative grid potential overcomes a considerable positive plate potential. The relative effects vary inversely as the cubes of the relative distances between the elements in the tube.

THE AMPLIFYING FACTOR (MU!)

We are used to thinking and saying that a slight grid-potential change causes a considerable plate-current change. This is the amplifying effect of the tube, the ratio of which, in theory, is 6 to 8 in the ordinary all-purpose amplifier tube. Let us recall that the usual plate voltage required for such a tube is 90.

But there is another controlling feature of the tube, mentioned previously; it is the "space charge," and is the effect of the mass of electrons which hover around the filament. This cloud is negative and repels the electrons attempting to fly out from the filament. Being closer to the filament than is the grid, it has a greater effect.

The existence of the space charge has many effects on the working of the tube, but for our present purposes we mention two. First, because the repelling effect of this charge is added to the repelling effect of the grid, *any slight change in the grid potential is only a partial change in the whole repelling potential.* In other words, the fact is that the grid effect would be many times what it is now, and (with nothing else happening) the amplification value of the tube would be raised from 6 or 8 up to 30 or 40. The effect of the space charge in ordinary three-element tubes is far greater than the effect of the grid, and this space-charge repulsion is a constant factor not affected by the incoming signal. It is a load on the tube and the cause of its low efficiency.

REDUCING THE PLATE VOLTAGE

The second thing is the effect of the space charge on the plate potential. As in the case of the grid, the effect of the space charge compared to the effect of the plate charge is inversely proportional to the cubes of their distances. The plate is far away. The space charge is almost at the filament surface. To overcome the constant repulsion of the cloud of electrons surrounding the filament, almost the entire plate voltage is utilized. With our usual tubes, over 85% of the plate potential goes into overcoming the space charge; 15% or less into establishing a plate current. If the space charge could be destroyed, therefore, the plate voltages required for tube operation would be only 15% of what they are now. In place of using 90 volts on the plate we would use 13½ volts or less.

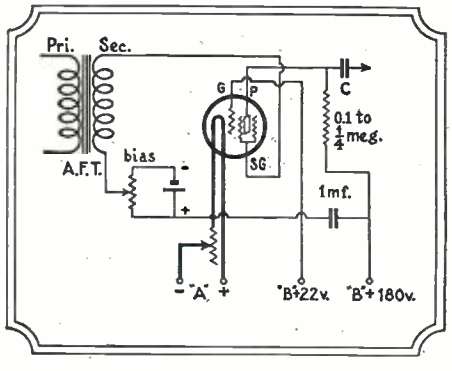
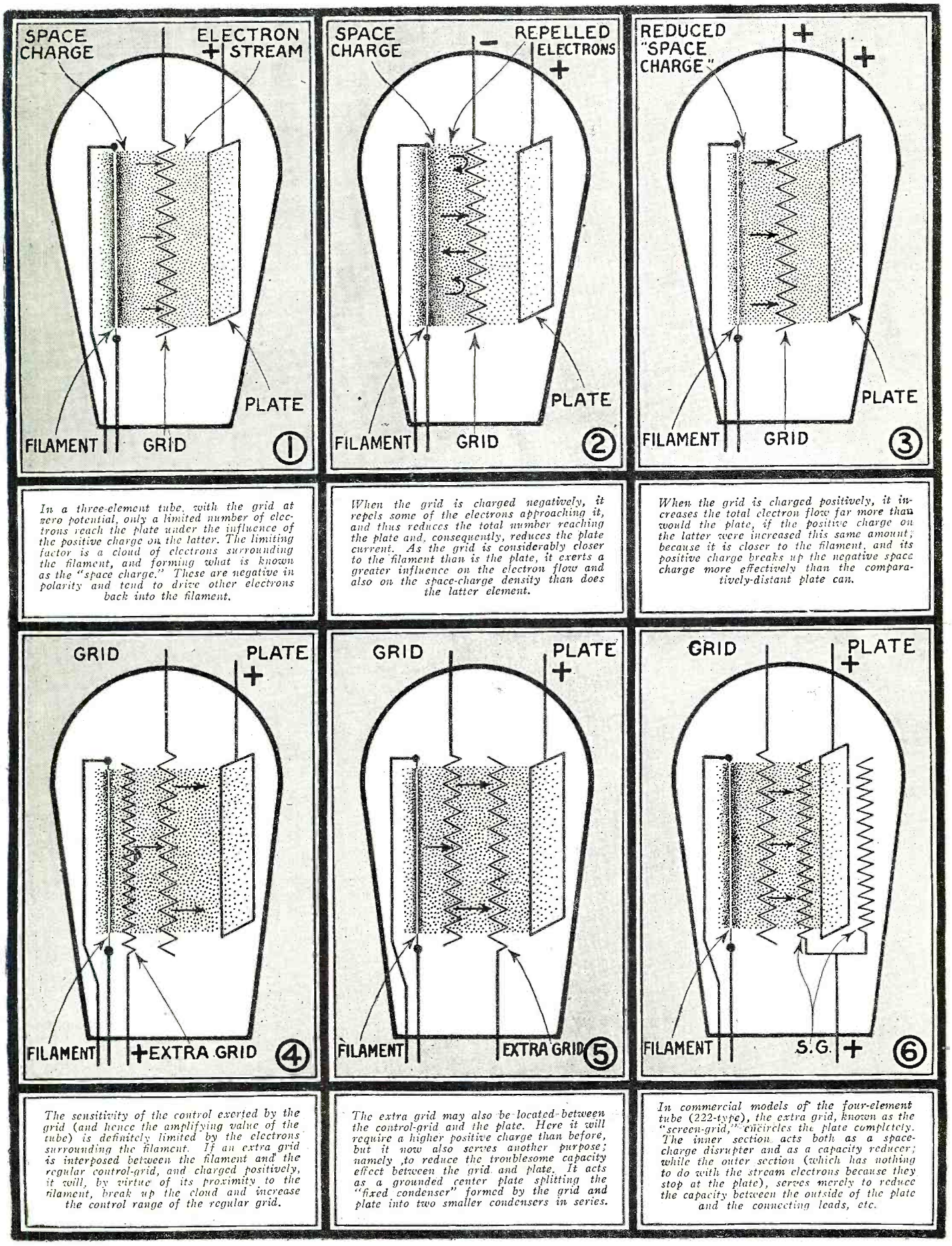


Fig. 9: In an A.F. circuit the normal control grid G is used as a space-charge element; the screen-grid (SG) now acting as the control-grid.

It is rather amusing, though irritating, to observe that, just as devices are being widely introduced to do away with the plate batteries, manufacturers should be getting ready to produce tubes, well known for years, in which the current required would be an entirely negligible quantity.

With the advantages of increasing the amplifying value of the tube and decreasing the plate voltage required, we should be content. That we can do it without increasing the plate-to-grid capacity is remarkable; for, of course, we can produce high-mu tubes by placing the elements close together, thus increasing plate to grid capacity enormously. Such tubes are on the market and have been for some time, but are usable only in A.F., not in R.F. circuits. That we can do all this and actually lower grid-to-plate capacity in this new tube makes us sit up and take notice.

(*Continued on page* 930)



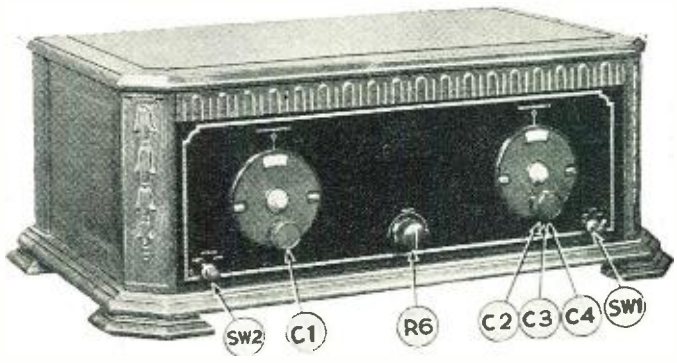
The Silver Shielded-Grid Six*

A Remarkable New Receiver Employing Three of the New Shielded-Grid R.F. Amplifier Tubes

By McMurdo Silver

THE six-tube, shielded-grid receiver to be described is, by comparison with most radio receivers that have gone before, a rather remarkable set; for it possesses a degree of sensitivity to distant stations and selectivity for cutting through local broadcast stations that can be equalled by few other receivers at the present time. So revolutionary (and the word "revolutionary" is used with a full knowledge of its meaning) is the performance of this radio receiver that the writer thinks it is safe to say that this set represents the turning point from the old era of receiver performance to the new. This set offers results which are most difficult, if not impossible, to equal with other designs at this writing. (December, 1927.)

In order to appreciate fully the performance of this set, without having heard and tuned it, a wide stretch of the imagination is needed. Imagine, for a moment a six-tube radio set, upon the front panel of which are the tuning dials and a non-critical volume control—a set that cannot be made to squeal or howl, no matter how it is operated. Imagine sitting down to tune this set in an average American home, with, say, a fifty-foot outdoor antenna and a good cone loud speaker. Imagine, if you can, starting at zero on the dials and slowly turning them up a degree at a time and hearing station after station for almost every dial degree—sometimes two stations in each degree. Imagine, in Chicago for instance, each one of the fifteen local stations spreading over not more than two to four dial divisions, and most of them tuning in or out in one to two dial divisions. Imagine selectivity so knife-like that, as the dials are tuned, stations do not tune in and out gradually, but literally "plop" in and out with an infinitesimal dial movement.

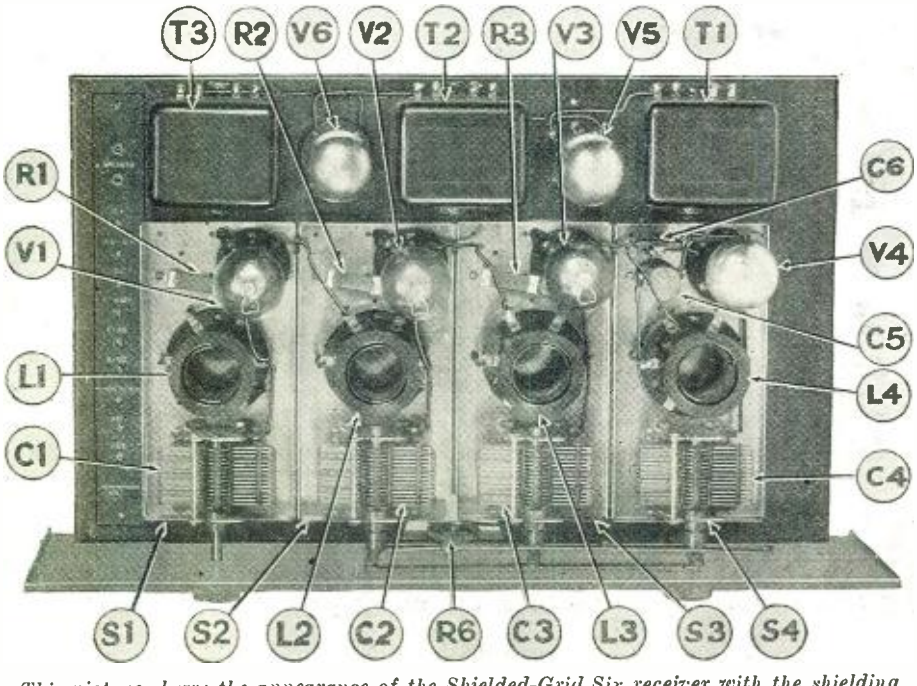


View of the new Silver Shielded-Grid Six receiver, installed in an attractive cabinet. The two vernier dials control the wavelength, the knob (R6) is the volume control, Sw1 is the battery switch, and Sw2 the antenna switch.

Picture the log of stations heard at the end of the evening, all with *too great* loudspeaker volume—so loud the set had to be tuned down—picture a log of fifty—even a hundred—stations, on the East Coast, on the West Coast, in Canada from Montreal to Vancouver, from Cuba to Texas and Mexico—all tuned in by moving just two dials, and never touching another knob, if you don't mind signals that literally roar in.

The above paragraphs are not a dream of the ideal radio set; they are just a simple explanation of the average performance of the Shielded-Grid Six receiver and all with tone quality the equal of that of any other standard receiver you might build or buy. And this is a set that you can house in any cabinet or console, and that won't be obsolete for years to come. Every one of the thousands of Shielded Sixes that have been built during the past several years can be converted to use the shielded-grid tubes, so thoroughly modern was the design of the original Shielded Six.

Very few changes in sets of the latter model are required to make this conversion. An additional shield for the components of the antenna-tuning stage and a few additional wires are about all the things that must be installed.



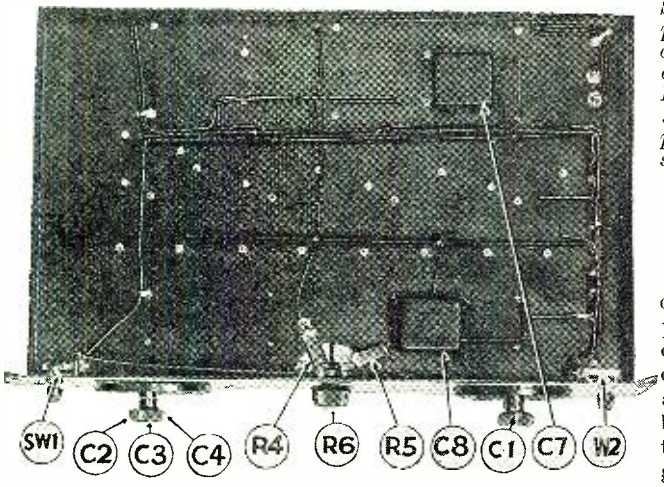
This picture shows the appearance of the Shielded-Grid Six receiver with the shielding cans removed. The three shielded-grid tubes are shown at V1, V2 and V3; and the special R.F. transformers which have been designed for these tubes are indicated at L1, L2, L3 and L4. The new tubes are used in the three R.F. circuits. V4 is the detector tube, and V5 and V6 are the two audio tubes, semi-power and power.

DESCRIPTION OF SET

The Shielded-Grid Six receiver, employing the new 222-type shielded-grid tube, is assembled from a six-tube radio receiver kit composed of the highest quality parts, and is similar in external appearance to the well-known Silver Shielded-Six.

The receiver consists of a heavy pressed-metal chassis, 12 inches deep and 19½ inches long, upon which all parts of the receiver, except the control dials, are mounted. Attached to this base is a handsome etched-bronze control panel, 7 inches high and 21 inches long. On this panel are mounted two vernier-control dials marked *"Station Selector I"* and *"Station Selector II."* All tuning is done with these two dials, the settings of which are varied to tune in stations. The dials "log" absolutely, in that a station once heard at any dial setting may be brought in again at the same dial setting; and the two dials "track" sometimes within a degree of each other. In the lower center of the control panel is a non-critical volume control, which does not affect oscillation, but serves merely to regulate the volume of received signals to a desired level. In the lower right-hand corner of the panel is an *"On-Off"* switch, completely turning on or off all power for the entire receiver by a simple flip of the fingers. In the lower left corner of the panel is a switch of similar appearance, allowing the choice of either selective or non-selective adjustments of

* Radio News *Blueprint Article No. 44.*



Several small parts and practically all the wiring are located under the chassis of the receiver. R4 and R5, filament resistors; C7 and C8, by-pass condensers; R6, rheostat; Sw1, battery switch; Sw2, antenna switch.

the antenna circuit, to accommodate varying lengths of antennas, such as will be encountered in different locations.

The receiver requires for its operation no less than 135 volts and preferably 180 volts of "B" power, at a total current consumption of 30 milliamperes (a total of 180 to 220 volts, which may be furnished by the reservoir "B" supply described on page 496 of November Radio News, is preferable.) In addition, "C" batteries, as dictated by the output power tube employed, are required, and a 6-volt storage battery or equivalent 6-volt "A" power unit. Using a standard "B" socket-power unit and "A" power unit, the receiver is completely light-socket-operated with the exception of dry "C" batteries, which are long in life and low in cost.

Three 222-type shielded-grid tubes are required for the R.F. amplifier. For the detector tube, a 200A-, 201A-, or 112A-type is recommended. For the first audio amplifier, a 112- or 112A-type is strongly recommended; though in both detector and first-audio positions 201A-type tubes may be used, but with inferior results due to overloading, so strong are the signals developed by the receiver. For the last audio output stage a 171- or 171A-type is recommended if a plate voltage of 180 to 220 is available. If not over 135 volts is available, a 112- or 112A-type output tube is recommended.

ELECTRICAL CIRCUITS

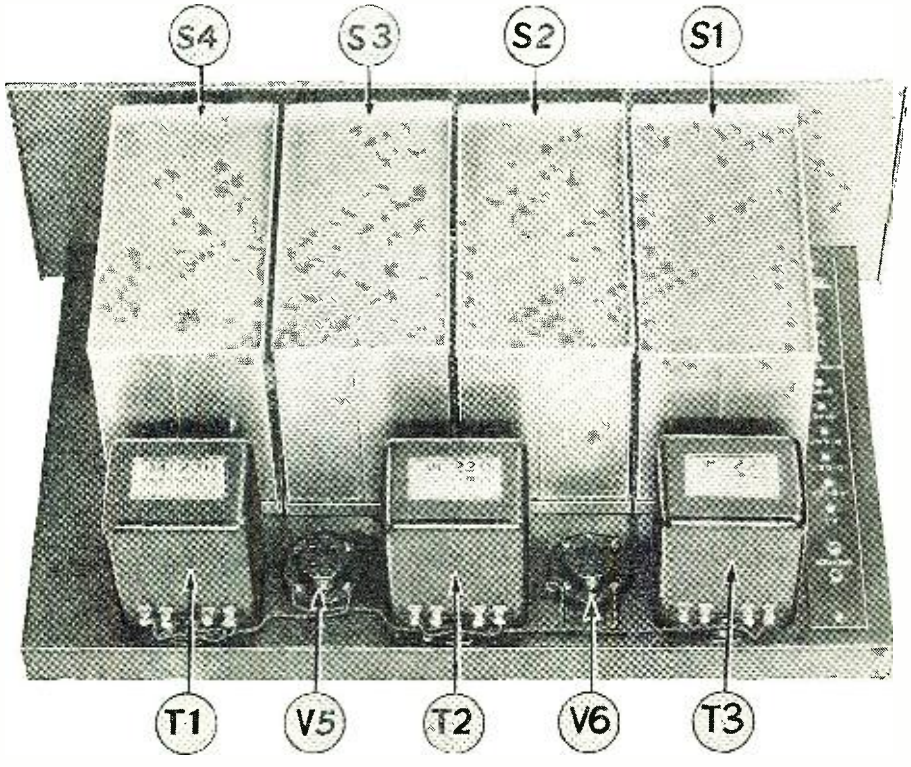
The receiver circuit consists of three stages of radio-frequency amplification sharply tuned, followed by the sharply-tuned detector circuit; which, in turn, works into a two-stage, audio-frequency amplifier. The radio-frequency amplifier circuits consist of low-loss variable condensers, providing substantially even spacing of stations over the control-dial scales, and low-loss, low-resistance, plug-in R.F. transformers. One condenser and one R.F. transformer are used in each of the four R.F. stage circuits, one circuit being housed in each of the four aluminum shielding cans. The antenna stage at the left employs a special antenna coupler provided with a tapped primary, allowing the use of a short or a long antenna at will by means of the switch in the lower left-hand corner of the panel. The three R.F. stages employ shielded-grid amplifier tubes, and the battery circuits of these stages are so arranged and so by-passed that, together with the effective shielding provided by the aluminum cans, no oscillation tendency or trouble is experienced in the receiver.

A very special feature of the radio-frequency amplifier circuit of the receiver is that it does not employ the tuned-impedance coupling, which has been believed necessary to the operation of shielded-grid tubes. This type of coupling is, inherently, extremely broad in tuning and is far from desirable; though circuits for tuned-impedance coupling are given with the data sheets accompanying shielded-grid tubes as a theoretical, but not necessarily a practical, means of operating these tubes. This type of coupling is highly undesirable in a radio receiver which is to be sufficiently selective on modern broadcast-receiver conditions, and it introduces circuit losses occasioned by the necessary grid-blocking condenser and grid leak which seriously impair the amplification possibilities of the shielded-grid tube; for, unlike the practice in previous radio-frequency amplifiers, regeneration is not employed in a shielded-grid amplifier and may not well be utilized to offset circuit losses.

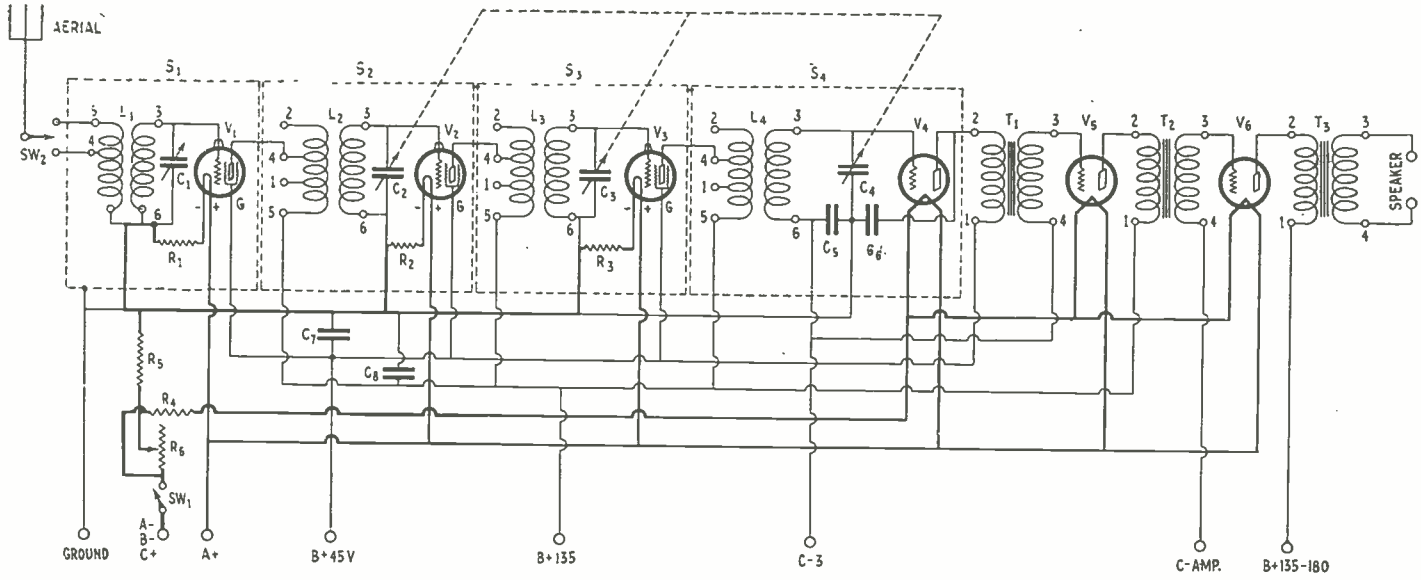
It is apparent to engineers that the amplification obtainable from a shielded-grid receiver is dependent upon the excellence of the tuning circuit (coil and condenser) making up the R.F. amplifier stage; and the selectivity upon the degree of coupling of one tube to the next through the tuned circuit. Because of this requirement, this receiver provides a tremendously high value of radio-frequency amplification, due to the unusually efficient design of the plug-in coils and condensers. In addition, the selectivity of the receiver has not been arbitrarily determined and put beyond the control of the user, but is made adjustable by means of extra taps upon the primaries of the R.F. transformers. Thus the receiver may be easily and simply adjusted to a point of highest efficiency by the merest novice, whether he be located in the middle of a desert far from broadcast stations or in the center of the most congested broadcast communities of the United States and Europe.

SHIELDING EFFICIENCY

Because of the impossibility of definitely pre-determining antenna characteristics, the antenna stage of the receiver is tuned by the *"Station Selector I,"* or left-hand dial control—the left-hand variable condenser (C1) in the schematic diagram, and contained in the left-hand shield compartment (S1) of the receiver. The three variable condensers (C2, C3 and C4) in the three right-hand shield compartments (S2, S3 and S4) tune substantially identical circuits consisting of laboratory-matched coils and condensers, and are connected together by means of a positive mechanical link with no back-lash; all three are tuned by the single right-hand *"Station Selector II"* dial. All radio-frequency circuits are completely shielded; the radio-frequency lead from one stage to the other passes the small crevice between the stage compartments through slots provided in the shields for that purpose, and is insufficiently exposed to cause signal pick-up. In fact, so thorough is the shielding of the receiver that it is practically impossible to pick up even a powerful local signal with the antenna removed; and with the two leads from the antenna-coil socket to the antenna switch removed entirely, the shielding becomes completely



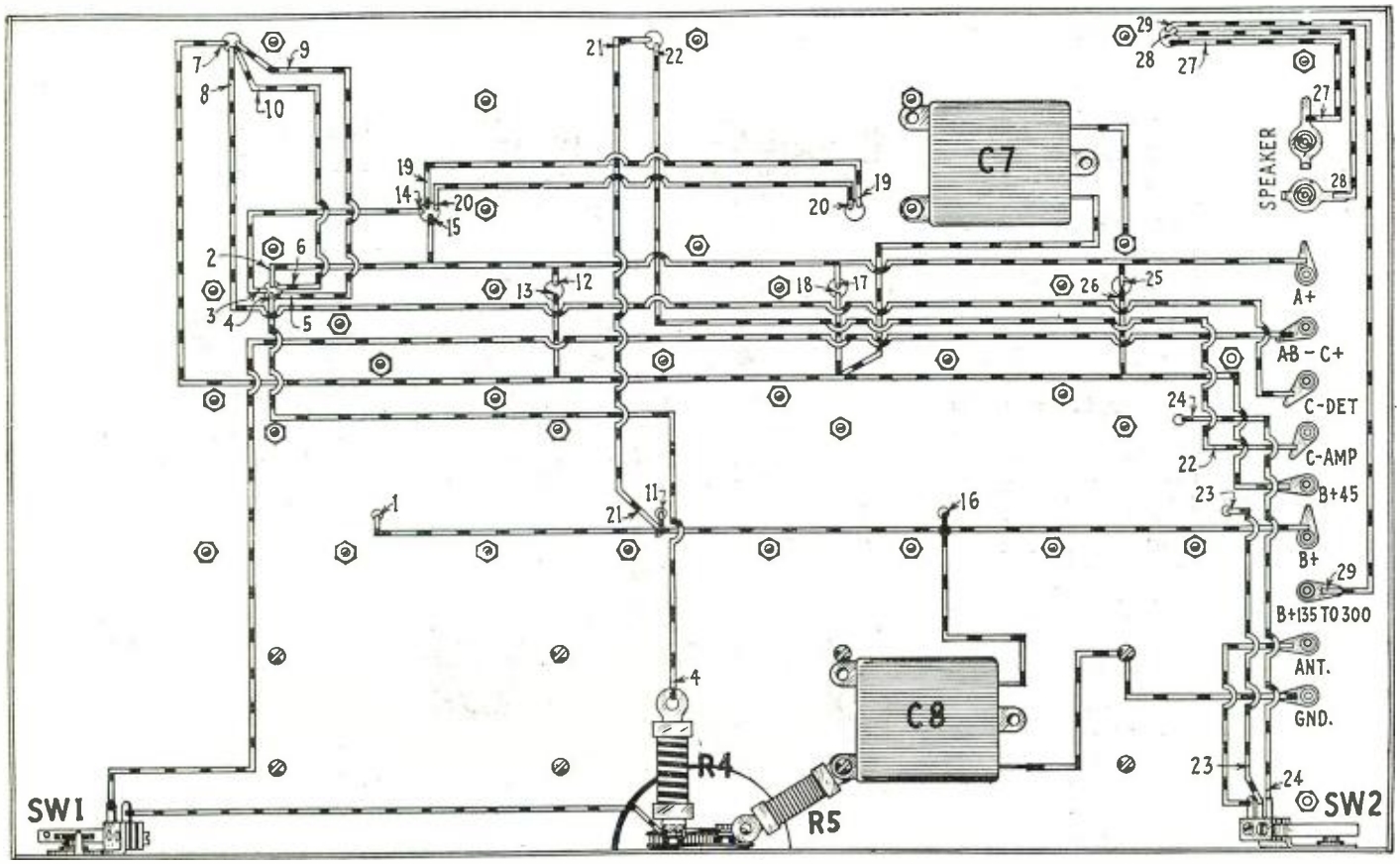
View of receiver with shielding compartments in place. S1, S2 and S3 are the first, second and third R.F. stages, respectively; S4, detector stage; T1 and T2, audio transformers; T3, output transformer; V5 and V6, audio-stage sockets.



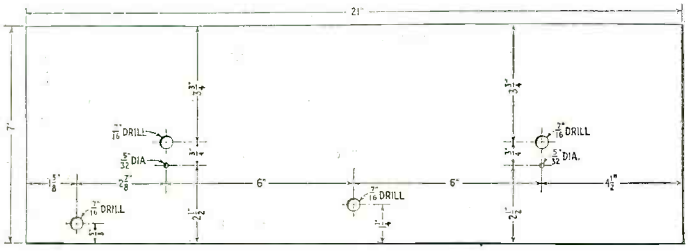
In this schematic wiring diagram of the Silver Shielded-Grid Six, dotted lines show the enclosure of parts and wiring within the stage shields, as well as the connection of the variable condensers by the link motion. In the detector circuit a biasing voltage is used on the grid to prevent overloading.

effective. So sensitive is the receiver, however, that simply placing one's finger upon the aerial binding post is sufficient to bring in stations, frequently over a radius of two hundred miles, with good loud-speaker volume — using only the body as an aerial. In fact, the use of a metal bedspring as an aerial will provide entirely satisfactory results.

The filament voltage for all tubes is regulated through the use of fixed resistors, which definitely establish the filament voltages within correct ranges and do not allow excessive potentials to be applied to the tubes. Three separate 10-ohm resistors (R1, R2 and R3) are used on the 222-type tubes and the voltage drop across each, about 1.32 volts, is utilized for grid bias. A 2-ohm resistor (R5), common to the filament circuits of all the 222-type tubes, prevents the filament voltage ever rising above 3.4 volts; while the volume rheostat (R6) of 20 ohms allows it to be turned down to a value so low as to reduce volume to practically zero. An 0.57-ohm resistor (R4), mounted upon one rheostat binding post, regulates filament voltage for the detector, and two audio-amplifier tubes. A "C" bias of 3 volts (which may be increased to 4½ under certain operating conditions), is used upon the detector tube and upon the first audio tube (V5). The use of this low bias is to improve low-note reproduction and handling capacity for strong signals. For a like reason, a plate voltage of 135 volts is employed upon the first audio stage with an optional plate voltage on the last audio stage of from 135 to 180, 200, or even 450 if a 210-type output tube is used.



In this pictorial wiring diagram the wires under the chassis are clearly shown. Where one passes through a hole in the chassis, it is marked with a number by which it may be identified in the diagram on the opposite page. The two fixed-resistor strips shown at R4 and R5 are mounted directly on the binding post of the rheostat R6.

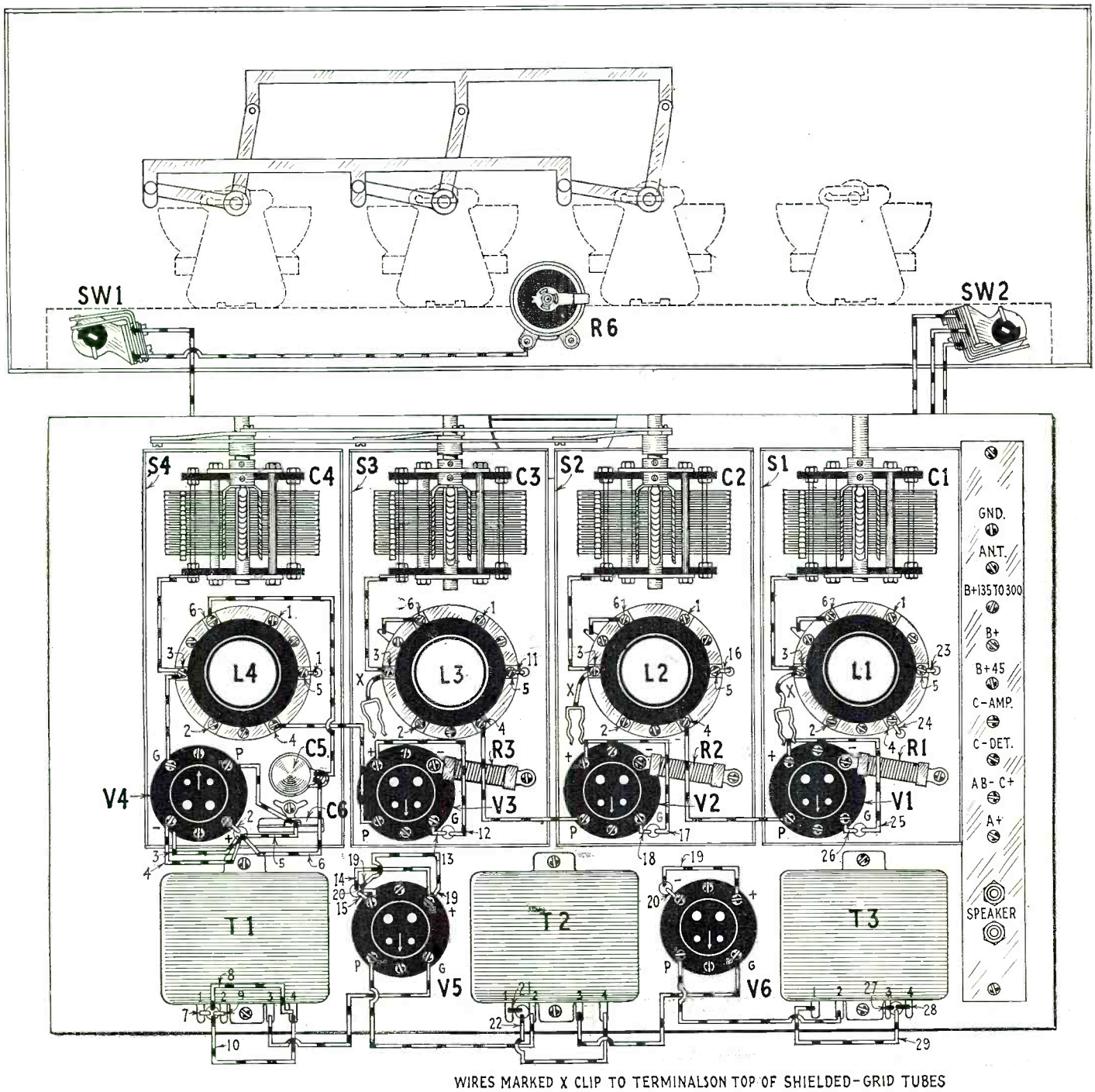


This drilling layout for the front panel of the Silver Shielded-Grid Six shows the position of the various holes required for mounting the tuning controls and securing the panel to the chassis.

ARRANGEMENT OF PARTS

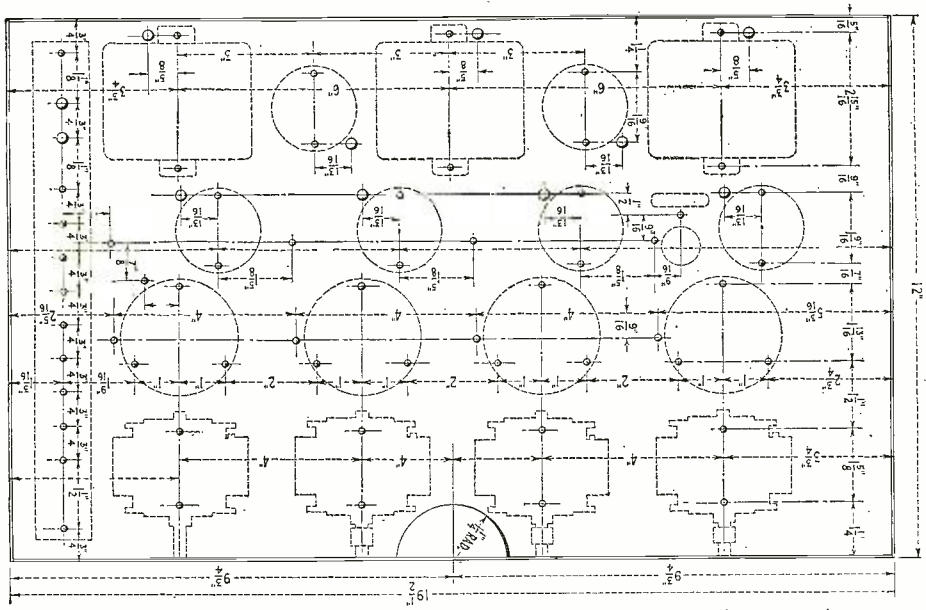
Looking down upon the chassis with the panel to the front, the stage compartments from left to right, S1, S2, S3 and S4 and the radio-frequency portions of the circuits, are physically located as in the schematic diagram. Behind these compartments is the audio amplifier, progressing from right to left, with the second audio tube (V6) the left rear-tube socket. The detector "C" bias and plate by-pass condensers (C5 and C6) are contained in the detector stage compartment (S4). The 10-ohm filament resistors for the R.F. amplifiers are contained in the S1, S2 and S3 compartments, and in each compartment are located, of course, a tube socket, a coil socket and coil, and a variable condenser. Beneath the chassis are fastened the 2-ohm and 0.57-ohm resistors (R5 and R4) and the two 1-mf. by-pass condensers (C7 and C8) connected between the metal chassis and the "B+45" and "B+135" leads. The metal chassis is grounded to the negative side of the R.F.-amplifier filament circuits. At its left end is a terminal strip carrying the loud-speaker tip jacks and connection screws, and connection terminals for all battery, aerial and ground wiring.

Through the use of interchangeable coils (L1, L2, L3 and L4) the wavelength range of the receiver is from 200 to 3,000 meters. Employing the standard "A" type coils, the wavelength range is from 200 to 550 meters, and a suitable coil set consists of one 116A antenna coil and three 119A R.F. transformers. For operation from 500 to 1,500 meters, one 116D antenna coil and three 115D transformers are employed; while, for operation from 1,400 to 3,000 meters, one 116E and three 115E R.F.



WIRES MARKED X CLIP TO TERMINALS ON TOP OF SHIELDED-GRID TUBES

All wiring above the chassis is indicated in this pictorial wiring diagram; it will be noticed that, for simplification, several instruments are connected directly to the metal of the chassis rather than to a ground lead. The three wires marked "X," which connect to posts "3" of the coil sockets, are clipped to the terminals mounted on top of the shielded-grid tubes.



All holes required for mounting apparatus on the metal chassis of the receiver are shown with the correct measurements, in the above drawing. All holes required for passing wires through the chassis are also shown, and the position of the various parts is indicated in dotted lines.

transformers are employed. "D" and "E" range transformers are not provided with selectivity-adjustment taps; since there is little congestion of stations in these higher-wavelength ranges.

INSPECTION

Before starting the actual assembly of the receiver, each part should be examined with the utmost care to make sure that it has suffered no damage in transit or handling before being received by the builder. The following points should be observed most carefully.

The rotor plates of the variable condensers should interleave centrally in the spaces between the stator plates, at all points throughout their arc of movement. There should be no play in the bearing, either side or lengthwise. Side play is automatically taken up by the spring bearings. End play may be taken up by locking the collars on the front of the shafts more tightly against the spring washers which are between them and the front end plates.

The antenna coil and R.F. transformers should be carefully examined to see that they have suffered no physical damage and that their contacts make satisfactory contact with the coil-socket springs.

The tube sockets should be tried with vacuum tubes to make sure that proper contact is effected between the socket springs and the tube pins.

The link-motion should be examined to see that the long bars are not bent. The tip jacks, battery switch and antenna switch should be examined to make sure that proper contact is made.

The balance of the parts need not be examined, except to see that they appear to be mechanically undamaged, as there is little chance of trouble arising with them.

PROCEDURE OF ASSEMBLY

The assembly of the receiver will be quite clear, upon careful inspection of the accompanying illustrations, which indicate the placement of all parts above and below the chassis. The two tip jacks should be fastened in the two large holes of the terminal strip; which should, in turn, be fastened at the left end of the chassis (as seen in the illustrations) by means of two machine screws and nuts. The 20-ohm rheostat (R6) should be mounted in the hole in the projecting lip, in the center of the front edge of the chassis, using the insulating washers provided to prevent any metallic contact between the chassis and the rheostat frame.

The antenna and battery switches (Sw1 and Sw2) should be mounted in the holes in the front edge of the chassis, the three-spring antenna switch at the left, and the two-spring battery switch at the right.

The illustrations should be carefully studied and the parts in the stage-shield compartment fastened down as indicated; care being taken to scrape bright the portion of the chassis falling beneath the stage-shield pans to provide good metallic contact between shield pans and chassis. The six tube sockets should be mounted with the arrows of all, except the detector socket, pointing to the rear; the detector socket arrow should point to the front. The 0.57-ohm resistor (R4) should have one mounting-foot bent at right angles and fastened to one terminal of the 20-ohm rheostat (R6). The .002- and 0.5-mf. condensers (C6 and C5) should be mounted in the detector-stage compartment in the holes provided, using machine screws and nuts. Thus, one connection of each condenser is automatically made to the chassis. The three 10-ohm resistors (R1, R2 and R3) should be mounted, one in each of the R.F.-amplifier stage compartments S1, S2 and S3. One end of each resistor should be fastened to the terminal screw of the tube sockets; and the other end, with a machine screw and nut, to the chassis as illustrated.

The audio and output transformers are to be mounted in the positions shown, as

(*Continued on page* 958)

SYMBOL	Quantity	NAME OF PART	REMARKS	MANUFACTURER★	
C1,C4	2	Variable condensers	.00035 mf. long shaft (special)	1	
C2,C3	2	Variable condensers	.00035 mf. short shaft (special)	1	
L1	1	Antenna coil	(Special)	1	
L2,L3,L4	3	R.F. transformers	(Special)	1	
	4	Coil sockets	(Special)	1	
S1,S2,S3,S4	4	Stage shields	(Special)	1	
T1,T2	2	Audio transformers		1	8,9,10,11,12,13,14,15,16,17
T3	1	Output transformer		1	10,11,15,16,17
R1,R2,R3	3	Fixed resistors	10 ohms	2	3,23,39
R4	1	Fixed resistor	.57 ohms	2	3,23,39
R5	1	Fixed resistor	2 ohms	2	3,23,39
R6	1	Rheostat	20 ohms (small size)	2	
C5	1	By-pass condenser	.5 mf.	2	4,18,19,20,21,22,23,24,25,26
C6	1	Fixed condenser	.002 mf.	21	2,18,19,23,24,25,27,28,29,30
C7,C8	2	By-pass condensers	1 mf.	4	2,18,19,20,31,22,23,24,25,26
V1,V2,V3	3	Shielded-grid tubes	226 type	5	31,32
V4	1	Receiving tube	200A type	5	31,32,33
V5	1	Receiving tube	112A type	5	31,32,33
V6	1	Power tube	171 type	5	31,32,33
Sw1	1	Battery switch	Single pole single throw type	3	2,39
Sw2	1	Antenna switch	Single pole double throw type	3	2,39
	6	Tube sockets	UX type	1	
	1	Link motion	For variable condensers (special)	1	
	2	Tip jacks		2	3,39
	2	Vernier dials		6	12,16,41,44,45,40
	1	Terminal strip	With 9 terminals (special)	1	
	1	Metal panel	Drilled, 7 x 21 inches (special)	1	
	1	Steel chassis	Steel 12 x 19½ x 1¾ inches (special)	1	
		Hook-up wire		7	13,29,42,43

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Silver-Marshall, Incorporated	2 Carter Radio Company	3 Yaxley Manufacturing Company
4 John E. Fast & Company	5 Radio Corporation of America	6 Martin Copeland Company (MARCO)
7 Kellogg Switchboard & Supply Co.	8 American Transformer Company	9 Thordarson Electric Mfg. Co.
10 Ferranti, Incorporated	11 Leslie F. Muter Company	12 Samson Electric Company
13 Acme Apparatus Company	14 Dongan Elec. Mfg. Company	15 General Radio Company
16 Pacent Electric Company	17 Tyrman Electric Company	18 Dubilier Condenser Corporation
19 Tobe Deutschmann Company	20 Acme Wire Company	21 Polymet Mfg. Company
22 Potter Manufacturing Company	23 Aerovox Wireless Corporation	24 Leslie F. Muter Company
25 Electrad, Incorporated	26 A. H. Flechtheim & Company	27 Sangamo Electric Company
28 Hart & Hegeman Manufacturing Co.	29 De Jur Products Company	30 Micamold Radio Corporation
31 E. T. Cunningham, Incorporated	32 Shield Plate Tube Corporation	33 C. E. Manufacturing Company(CeCo)
34 Benjamin Electric Manufacturing Co	35 H. H. Eby Manufacturing Company	36 Air Gap Products Company
37 Amsco Products Company	38 Alden Manufacturing Company	39 Herbert H. Frost, Incorporated
40 Kurz-Kasch Company	41 Electrical Research Labs. (ERLA)	42 Haltron Manufacturing Company
43 Cornish Wire Company	44 The National Company	45 Brooklyn Metal Stamping Company
46	47	48

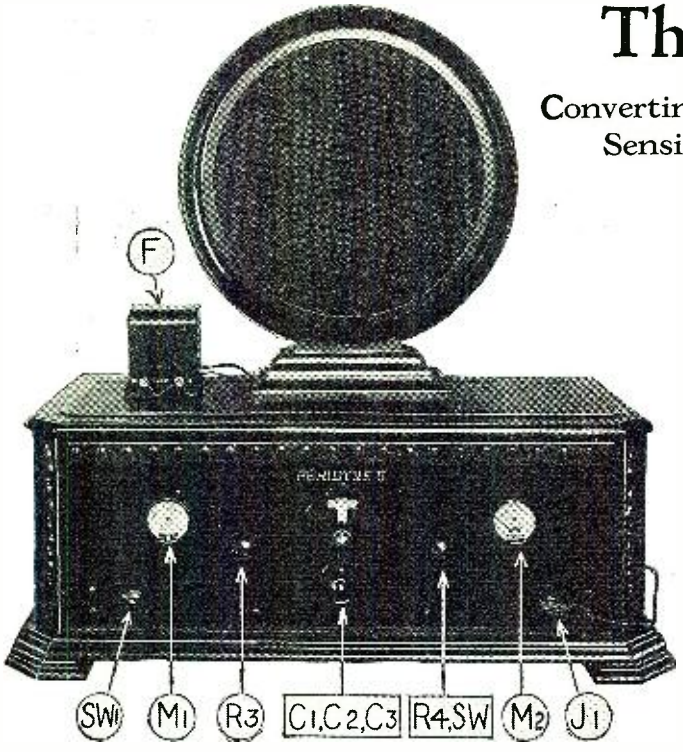
★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

The Electrified Peridyne*

Converting the Battery-Operated Model into a Highly-Sensitive Receiver, Using the New A. C. Tubes

By Hugo Gernsback



The front of the Electrified Peridyne receiver; C1, C2, C3, the control for the condensers; R3, volume control; R4-Sw, combination switch and filament control; M1, A.C. voltmeter; M2, D.C. voltmeter; J1, single-circuit jack, and F, output filter. The components used in this receiver are designated alike in the illustrations and in the list of parts (page 963) which gives their values.

AFTER the Peridyne Five appeared in the December issue, as well as the January issue of Radio News, and after an avalanche of letters was received for information and descriptions of an electric A.C.-operated receiver, the present article was written in reply. In designing the electrified Peridyne, the thought naturally was uppermost in my mind to make the conversion in such a manner that the original set will not have to be torn apart, or re-constructed, in order to convert it into an electric receiver. There are a number of alternating-current tubes available in the market now, all of which have their good qualities and their good points; but some of them have drawbacks when it comes to the electrification of a battery-operated set. For instance, the five-prong or Y-type tubes can, of course, be used; but this means ripping out at least one of the old sockets and putting in new ones, besides rewiring. Then there is another variety of alternating-current tubes, working on 3 volts, which also are satisfactory in their operation, but require an overhead "harness," which is run along the tops of the tubes.

I finally selected a four-prong heater-type tube, because experience showed that this type required the least constructional changes in the set and, after the experimental work had been concluded, it was found that a remarkably efficient electric set had been obtained. The power of the completed set is astonishing and, when using only 90 volts on the R.F. stages and full "B" power on the last audio stage, there is enough volume to operate a number of loud speakers and fill a large auditorium, from practically all nearby and local stations.

On comparing the wiring diagram of the electrified set with the wiring diagram of the battery set, it will be found that very few changes have been made. The only important one is the rewiring of the filament connections. A word of advice must be said here; and it is that, as those experimenters who have built alternating-current operating sets know by this time, the filament leads must be twisted, as indicated in the diagram and all the pictures. If the filament leads are not twisted, an objectionable hum will result.

REWIRING OPERATIONS

The particular alternating-current tube used in this set is a four-prong "heated-cathode" tube, operating on 15 volts; it consumes 0.35 ampere. This makes it possible to use a small toy transformer as an "A" power supply. It should also be noted that the filaments are no longer grounded. This means simply a little change, taking but a few minutes.

It is best, when rewiring the filament leads, to see to it that *two different colors are used,* never the same colors; because you are apt to get the wrong connection when both wires are of the same color. Please bear this in mind.

The other changes are all small: First, one of the voltmeters (M1) must be changed from 6-volt D.C. (which was the scale used in the D.C.-operated set) to a 25-volt A.C. instrument, for indicating the filament voltage.

Another minor change is the addition of a small fixed resistor of 60 ohms, indicated as R5 in the diagram, in series with the pilot light. This is necessary, otherwise DL (the 6-volt bulb usually supplied with a dial) will burn out.

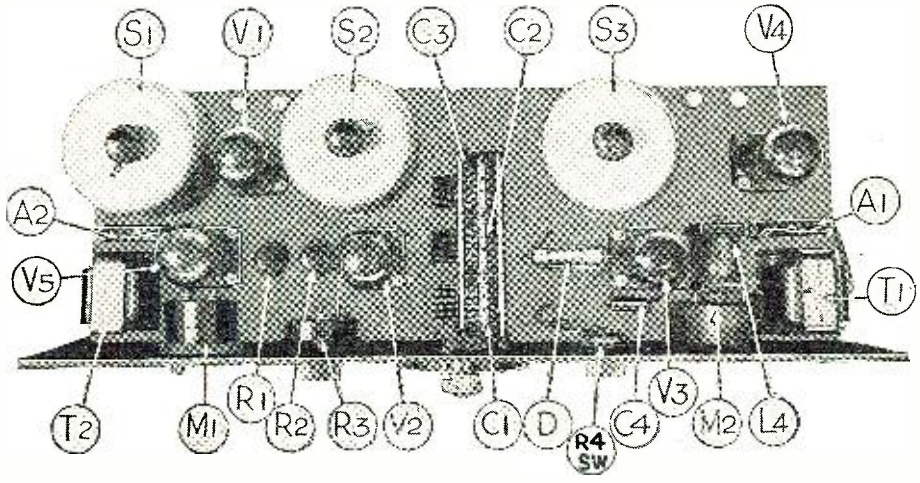
Another change is in the rheostat, R4, which now becomes a power switch. The new type listed in the specification sheet must be substituted. This is a 75-ohm rheostat with filament switch, and is structurally different from the one used in the battery set; as the latter cannot be used.

The only other change is condenser C4, which, in the battery set, was connected to the plate of the detector-coupled first audio-amplifier tube V3 and to "A—." It is now connected to the grid of that tube and to one of the filament leads, as shown.

TUBE CONNECTIONS

Right here, it becomes necessary to state that alternating-current tubes operate entirely different from direct-current tubes. If all the connections have been made, it may be found that there is a hum. This may be occasioned, particularly, by the filament leads being connected wrongly to the detector-coupled first audio amplifier. By reversing the leads, on this tube, the hum is usually done away with. On the rest of the tubes, always remember, that "B—" and "C+" leads must be connected to the *plus posts* of all tube sockets. The reason for this is that the cathode of the tube is connected to the plus post of the socket. This is the most important point and should not be overlooked, as no results will be obtained if these instructions are not followed.

In this set, the old cable (X) specified with the battery set is retained. In addition, we have two extra cables, each of two wires, termed "Y" cable and "Z" cable. Both of these cables are between six and



S1, S2, S3, Peridyne shields; V1-V4, A.C. tubes; V5, A.C. power amplifier; T1, T2, A.F. transformers; D, detector; L4, R.F. choke coil; R1, R2, filament rheostats; A1, A2, resistor mountings.

* Radio News *Blueprint Article No.* 45.

eight feet long and are used to connect the set to the power plant. The "X" cable shown in the illustration is the same one used in the battery set, but the fuses at H should be removed and the clips short-circuited.

THE POWER UNIT

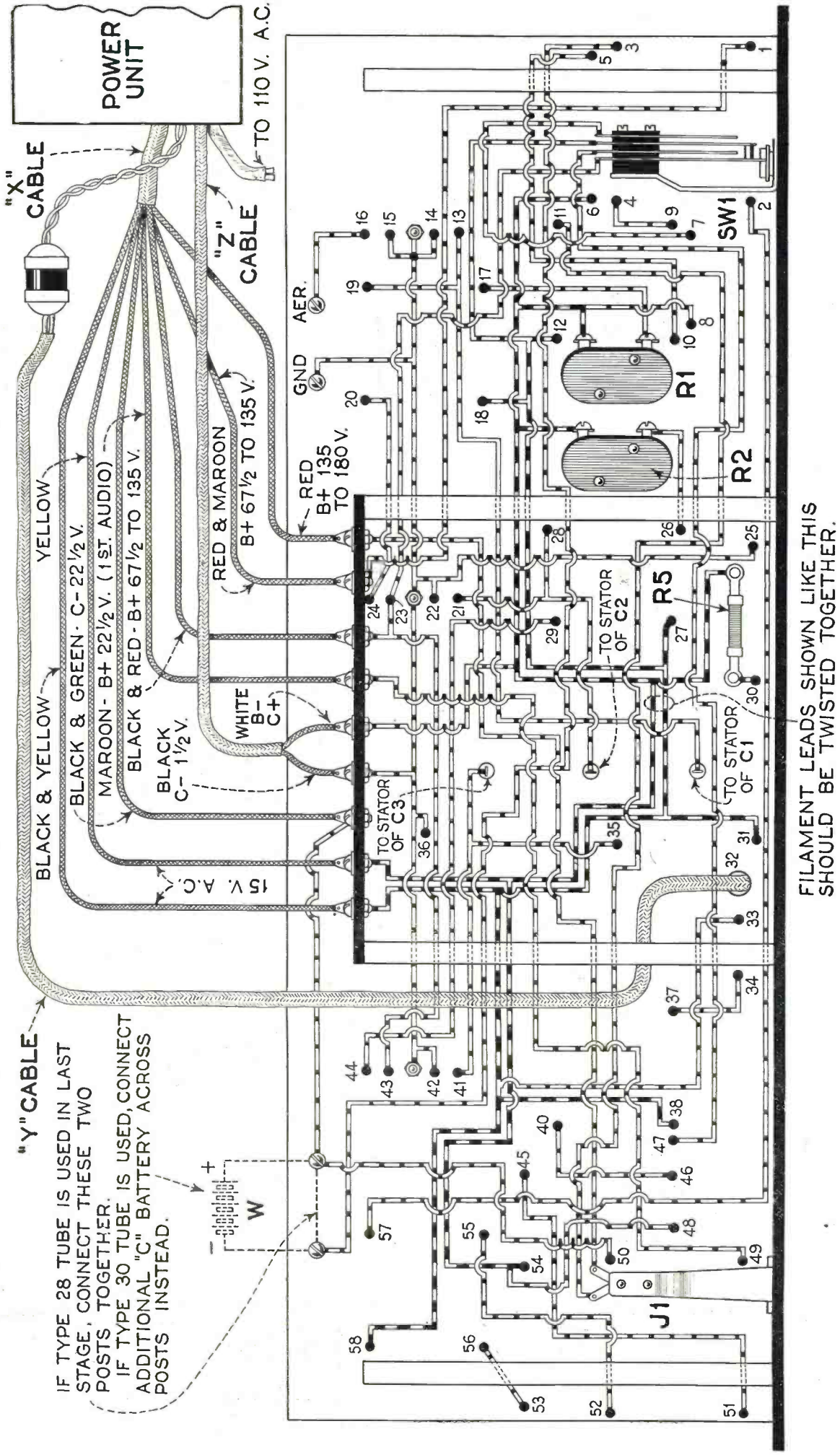
The power unit is remarkable for its simplicity and the small amount of space it takes up. It is one of the smallest power-supply devices, I believe, that has ever been described. It measures only 10½ inches long by 6 inches wide and 6 inches high; this is about the size of an ordinary storage battery. This unit is designed to be placed underneath the table, or in a cabinet console and should be at least four or five feet away from the set itself. The case may easily be constructed of ordinary sheet metal and painted to suit. Your tinsmith can make it for a small amount.

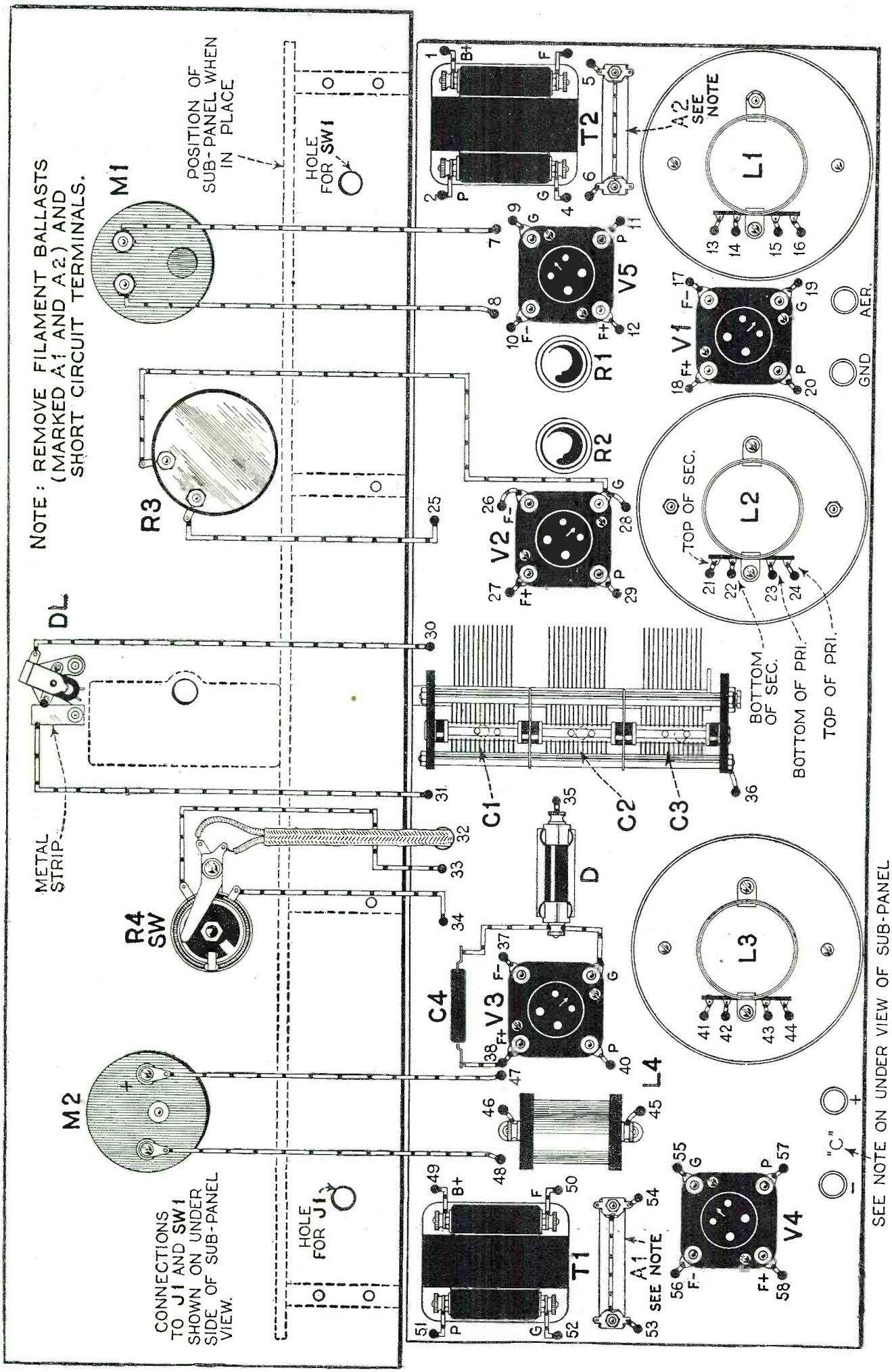
The switch Sw2, which controls the power, as well as rheostat D, are mounted on a small piece of bakelite, of the dimensions given in one of the illustrations.

The "B" supply is a standard "B" power unit, including a Raytheon tube. The type specified is the one which is best suited for the operation of these particular tubes, and will not give rise to "motor-boating" and other feed-backs. Moreover, it was selected on account of its very small size and compactness. The filament-heating transformer is a toy transformer, with a tapped switch, set for the correct voltage; *i.e.*, set for its correct voltage, which will be found on the name plate of the transformer.

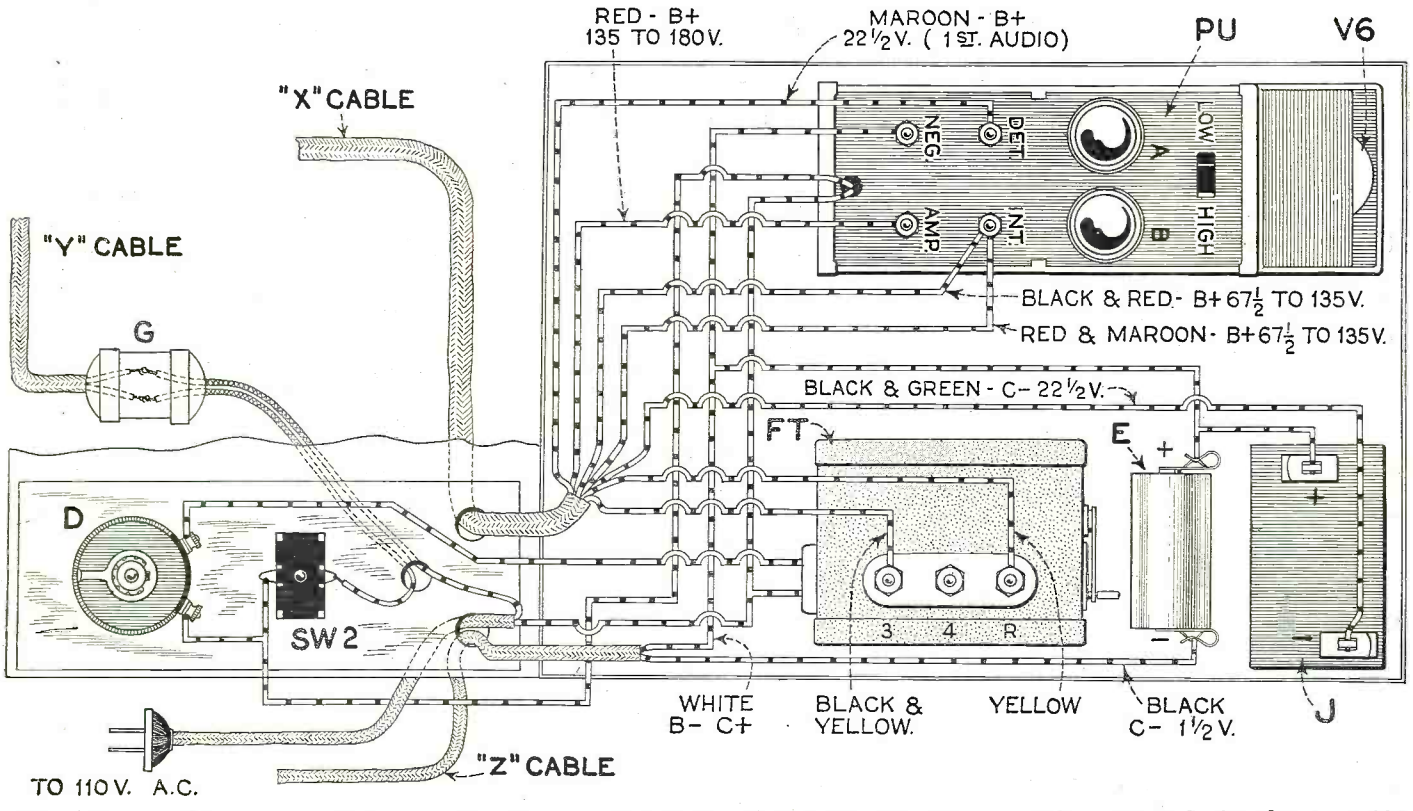
The entire assembly of the power plant is made as shown in one of the illustrations. There is just enough room left for the two "C" batteries, quite necessary for the successful operation of the set. Corrugated paper or asbestos can be used to house the two batteries, so that no short circuits can occur.

Once the "A" power unit has been assembled, it requires no further attention. The "C" batteries will last for many months.



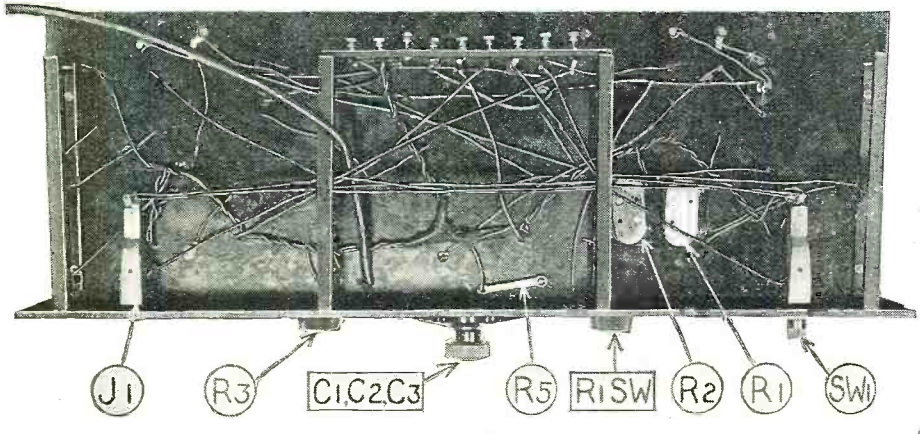


On the preceding page is shown the wiring beneath the sub-panel of the Electrified Peridyne 5. Above on this page are shown the connections from the components on the front panel and the top of the sub-panel. These parts bear the same symbols as those in the list of parts on page 963; and the holes for leads through the panel are numbered alike in top and bottom views.

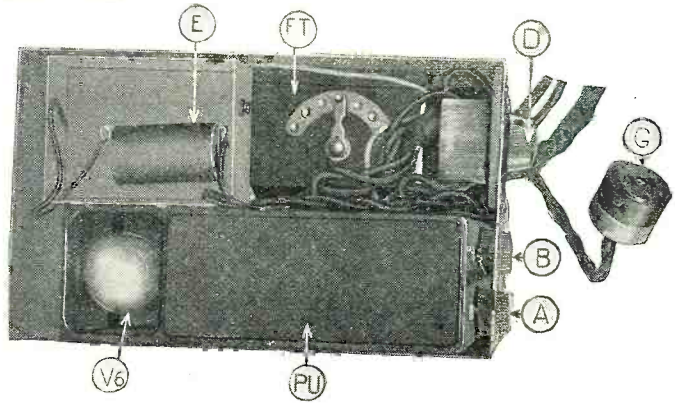


Wiring diagram of the power unit for operating the Electrified Peridyne. The schematic diagram of this unit will be found on page 962.

Extending from the power plant are the two knobs of the "B" power unit (A and B), used to adjust the "B" voltage; D is a filament control rheostat. It will be noted that there is used a connector G, in connection with the "Y" cable, which is necessary in case the power plant is to be disconnected from the set; while the leads of the cable can be soldered to the terminal board on the set. I would advise using binding posts of the spring-operated type; for the reason that, when the power plant is to be removed, the binding posts can be quickly disconnected, instead of unsoldering the connections—always a troublesome proceeding. It would be extremely difficult to transport the set and the power plant if they were connected together by means of all the cables, and it would then require two persons to carry the two units; whereas, if the cables are made with a connector, it becomes easy to disconnect. The leads to the 110-volt A.C. supply are connected to the usual plug, which goes to the socket.



The under side of the Electrified Peridyne is shown above. The various parts are numbered in correspondence with the diagrams on the preceding pages. On the right is the top view of the power unit. E, a 1½-volt "C" battery; FT, filament transformer; D, filament rheostat; PU, "B" power unit; G, stage connector; V6, full-wave-rectifier tube.

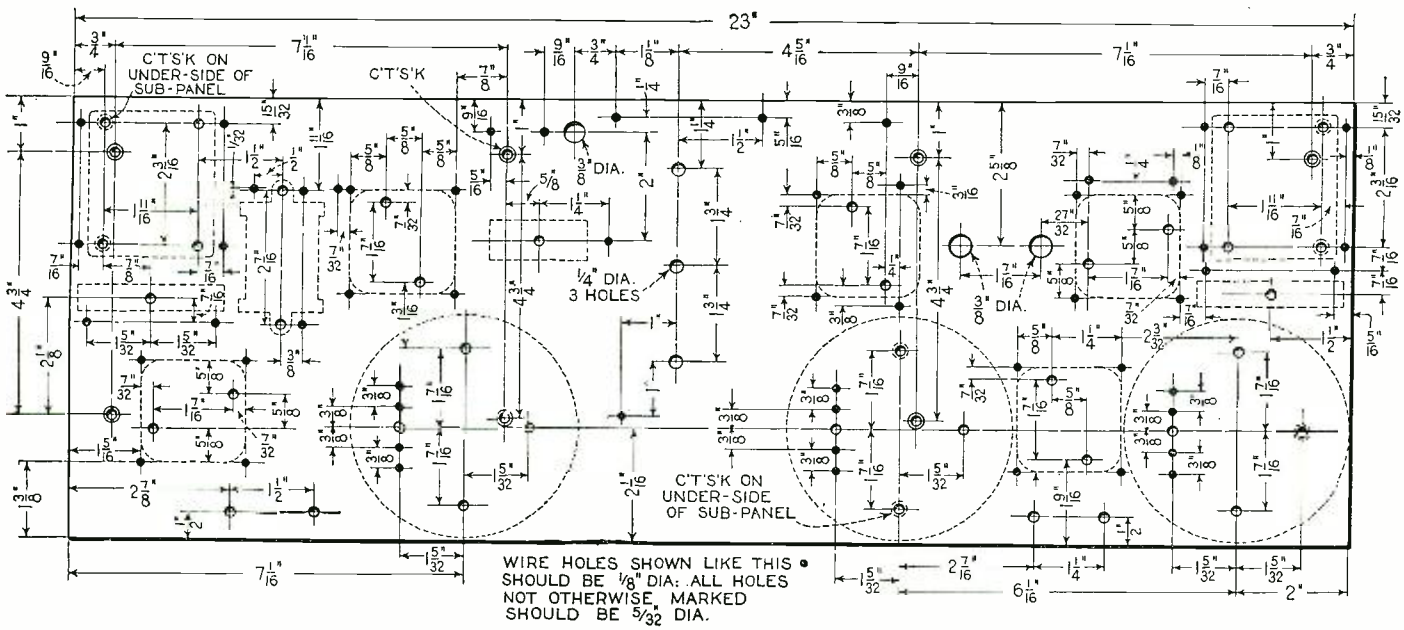


OPERATION

If all the connections have been made properly, and if the power plant has been built, we are now ready to operate the set. But before doing so, it should be remembered that the amperites in the filament circuit of the second and third audio amplifiers cannot be used with the 15-volt tubes; they are therefore removed and wire connections made across the two clips (A1 and A2). No filament resistor of any type is required with these two amplifier tubes.

We are now ready to test the set, and if all connections have been made, the current is turned on. Of course, before you do so, you will have made sure, that connections have been checked carefully. For safety's sake, only a single tube should be operated in a socket, to make sure that everything is in ship-shape order. If the one tube lights satisfactorily, all the others are put in.

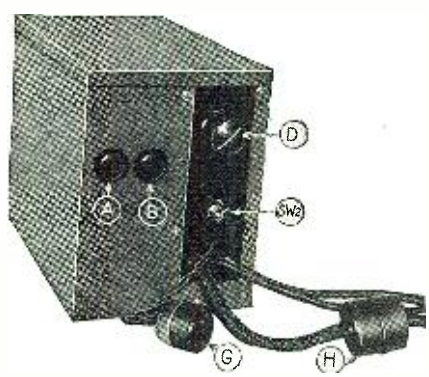
A peculiarity of these alternating current tubes is that it takes about thirty to forty seconds for the heater to heat up before the set begins to operate. A hum may be heard during that period, but it should not be loud. If everything is connected right and the "C" voltages are correct, the set will work with tremendous volume, and there should be no hum. If there is a hum, it should be so slight, that it is never noticeable when a station is tuned in.



Drilling layout for the sub-panel of the Electrified Peridyne. The parts are indicated by the dotted outlines. The layout for the power unit and its case will be found on page 962.

A most important point to remember with these A.C. tubes is that the "C" voltage is extremely critical. If any hum develops at all, it can usually be eliminated entirely by varying the "C" voltage. Usually, one and one-half volts (that of a single flashlight cell) is all that is necessary for the bias of the radio-frequency tubes; but on the second and third audio amplifiers, a "C" bias of from 4½ to 22½ volts is required.

As tubes vary, as well as the circuit and transformer characteristics, no exact rule can be laid down here. You will have to try which voltage gives the best results. This can be ascertained in a few minutes' time. You will find that, when the correct "C" voltage is ascertained, the set will give an exceedingly sweet and pure tone, and there must positively be no distortion. The tone will be full and round, and there must be no hum.

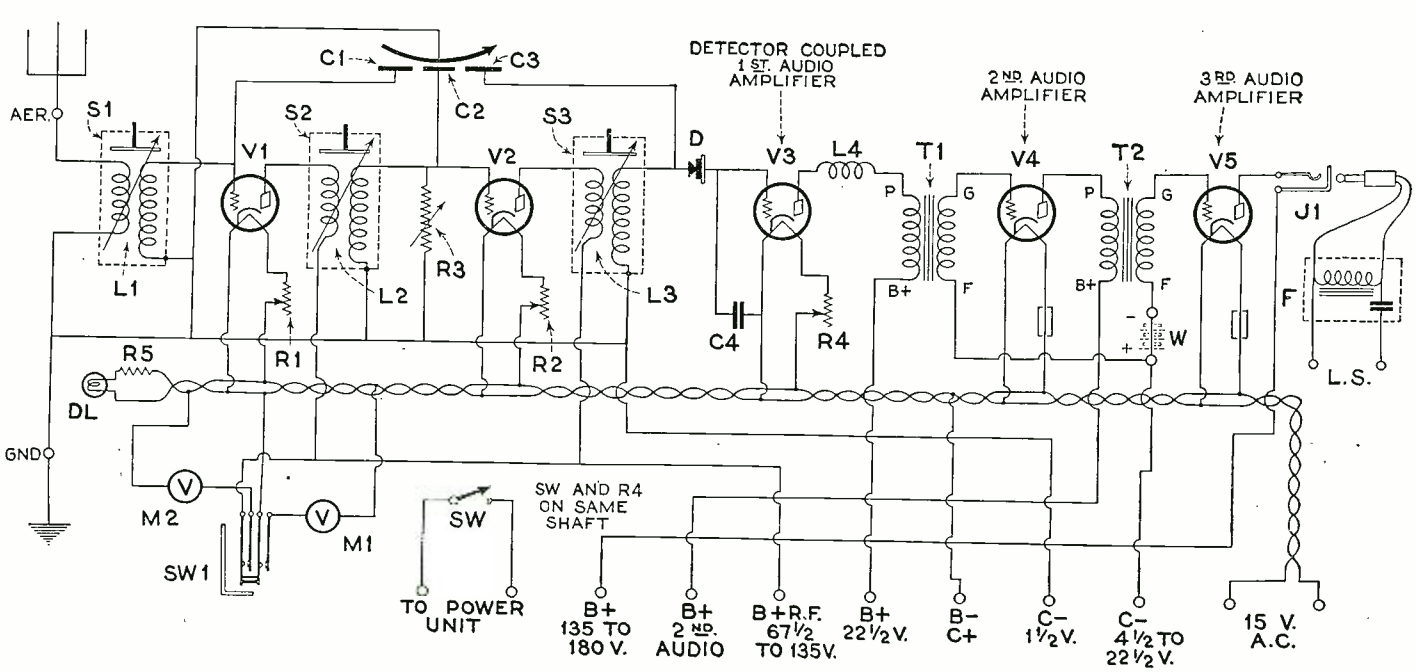


Front view of power unit: SW2, 110-volt snap switch; H, fuse-block housing; A and B, plate-voltage rheostats.

Remember also, what I have said before, that the filament leads of the detector-coupled first audio amplifier may have to be reversed if a hum persists. It may also be necessary to change the capacity of condenser C4. The capacity of that condenser is shown as .001-mf.; this capacity may be either too large or too small under some circumstances, and may have to be changed, but it is not at all critical.

If the set operates well, but howls, that is, oscillates, this can be overcome by carefully balancing rheostats R1 and R2. Careful adjustment is necessary. Rheostat R4 is set only once for best quality and left that way. It is never used in tuning. Resistor R3 is used to stop oscillation and to bring in a station clear, once a signal has

(*Continued on page 962*)



The schematic diagram of the Electrified Peridyne. The similar diagram of the power unit for use with this set will be found on page 962.

The "All-Wave Electric 9"*

An "Ultradyne" Receiver Using A. C. Tubes Together with a Power Amplifier and Power-Supply Unit

By R. E. Lacault

At the left is a view of the AC.-operated Ultradyne, mounted in an attractive walnut cabinet. The drum dial is the wavelength control, the knob at the left the volume control, and the other a sensitivity adjustment.

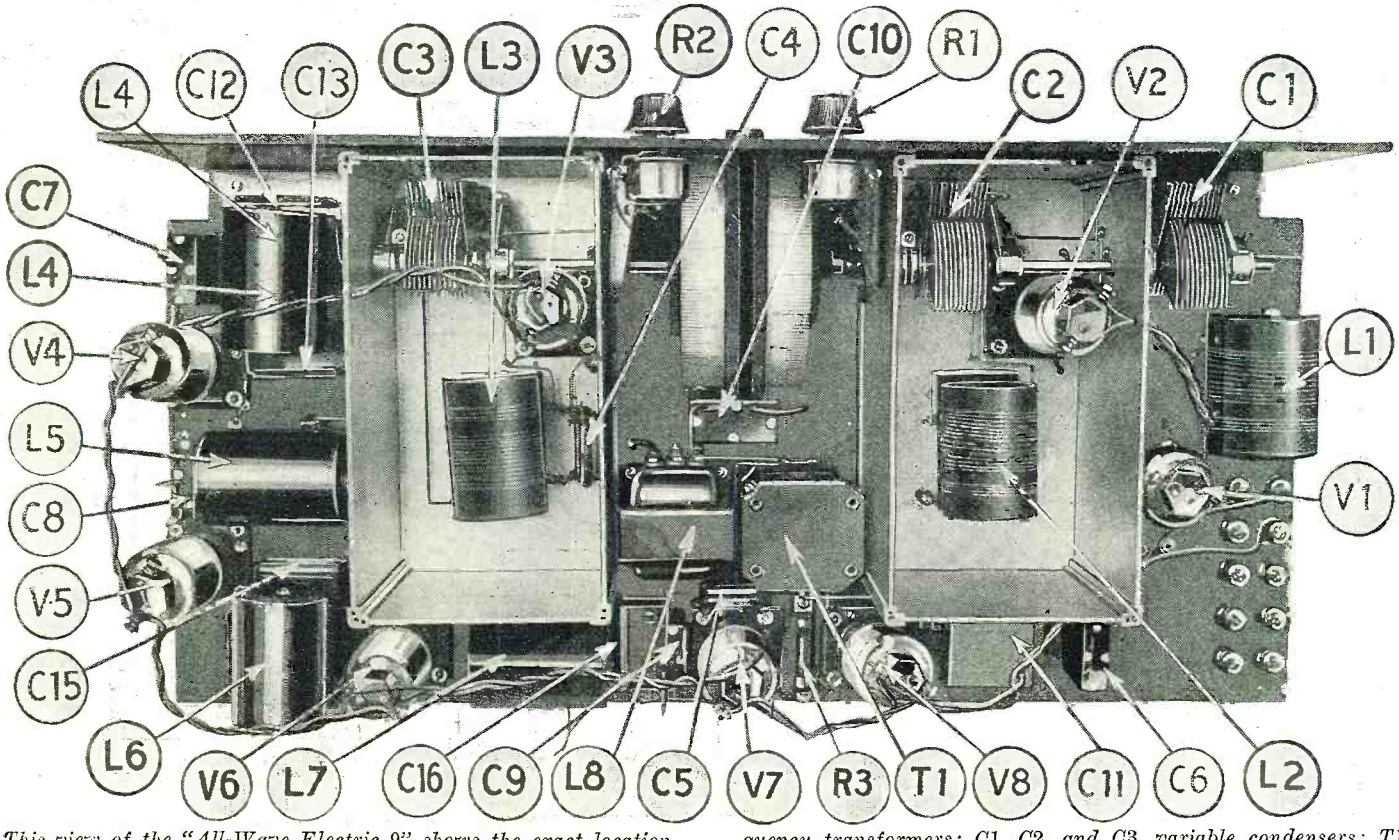
THE design of the "R.E.L. All-Wave Electric 9" is the result of an attempt to create a receiver that would incorporate every up-to-the-minute improvement known to the radio art. Every feature and every device that is known to be the best in radio has been used in the design of this circuit in order to make it efficient. This receiver is of the most advanced design and should be of interest to those who desire a set which is the last word from every standpoint.

The main features incorporated in the R.E.L. 9 receiver are, first: complete electrification without any hum, and without the use of complicated balancing arrangements in the circuit. Second: great sensitiveness, due to the use of the "modulation" system originated by the author and used in his previous designs. Third: selectivity sufficient to separate stations only 10 kilocycles apart without distortion. The set is capable, for instance, when operated in New York City, of receiving station WSM on 880 kilocycles at the same time that WLS on 870 kilocycles is operating, with WGBS, a local station, on 860 kilocycles going at the same time. Fourth: the sensitiveness is even all along the broadcast-frequency band. Fifth: plug-in coils are used in order to permit the reception of short-wave broadcast or amateur stations on the set proper, without any external adapting devices. The change of wavelength is accomplished by merely changing the coils. Sixth: a high-quality audio amplifier is incorporated into the receiver, producing marvelous quality.

AMPLIFIER-POWER UNIT

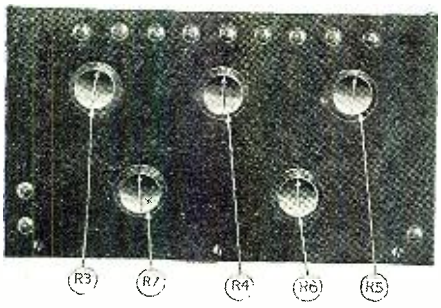
The quality and volume are enhanced by the use of a push-pull amplifier in the second audio stage. This permits the reception of a band or orchestra with full volume and with excellent quality. All those who have witnessed demonstrations of the R.E.L. 9, when using a good loud speaker, were amazed at the truthful reproduction possible with this amplifier arrangement. The power supply and push-pull amplifier are built as a separate unit and may be used with any other receiver; a feature which should be of interest to those owning more than one set. It is possible, by merely plugging the output of the receiver into the input of the power unit, to operate the loud speaker from any set and get the full volume and all the advantages of push-pull amplification, in addition to the necessary "B" and "C" voltages.

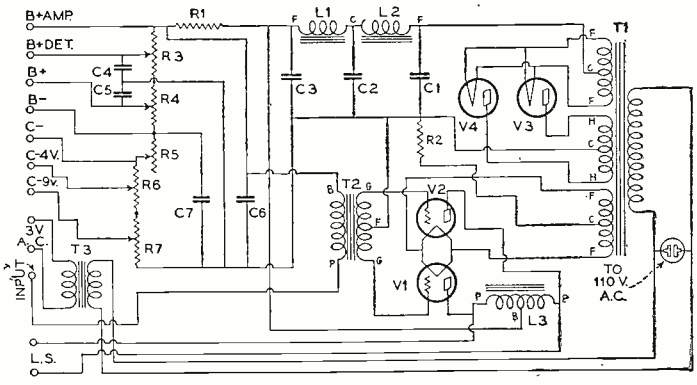
The radio-frequency part of the set is shielded, and drum dials are used for the control of the tuning condensers. The tuning is extremely simple, as only two small knobs are used, in addition to the main tuning dials. One of these is a volume control, and the other a sensitivity control regulating the action of the amplifier. Last, but not least, the set is extremely easy to build and the wiring very simple.



This view of the "All-Wave Electric 9" shows the exact location of all parts used in its construction. L1 and L2, R.F. transformers: L3, oscillator coupler; L4, L5, L6, and L7, intermediate-frequency transformers; C1, C2, and C3, variable condensers; T1, audio transformer; V1 to V8, A.C. vacuum tubes. The other parts may be identified by referring to the list on page 964.

* Radio News *Blueprint Article No.* 46.





Above: View of the control panel of the "A, B and C" power unit used in connection with this receiver. The five knobs control the adjustment of the five variable resistors shown in the diagram on the right, and the binding posts are connected to the similarly-marked posts in the receiver. The wiring diagram shows all connections of the power unit in schematic form.

THE MODULATION SYSTEM

In the ordinary type of superheterodyne, the first tube employed as a frequency changer is connected like a detector; with either a grid condenser and grid leak, or a "C" battery. This detector rectifies the incoming signal after it has been heterodyned, and the variation caused in the plate circuit is amplified through a long-wave radio-frequency amplifier.

In the system to be described a new principle is made use of; this, which has been called the modulation system, causes *the incoming signal to modulate the oscillations produced locally,* in the same way that the speech modulates the output of the oscillator tubes in a radio-telephone transmitter. This system, which is a departure from the conventional detector arrangement, is not only more simple, but produces a greater signal strength, which is more noticeable on weak signals.

The first tube, which is called the modulator, is connected across the oscillating circuit of the oscillator. Its plate-filament space is acting as a resistor, the value of which is varied by the incoming signal impressed upon the grid. In this arrangement no "B" battery is necessary; for the plate of the modulator tube is supplied by high-frequency current from the oscillating circuit. To receive continuous waves, this arrangement is very efficient; and it has been applied very successfully to the receiver described in this article. Greater sensitivity is obtained, due to the following difference between the two systems.

USUAL DETECTOR ACTION

In a detector circuit composed of a tuned circuit, a grid condenser with grid leak and a vacuum tube, the action is as follows: during each half-cycle the current flows up along the coil, through the condenser, and from the grid to the filament. When the grid is negative, however, it cannot pass through the space between the filament and the grid, and the amount of electricity which is stored between the condenser and the grid cannot escape.

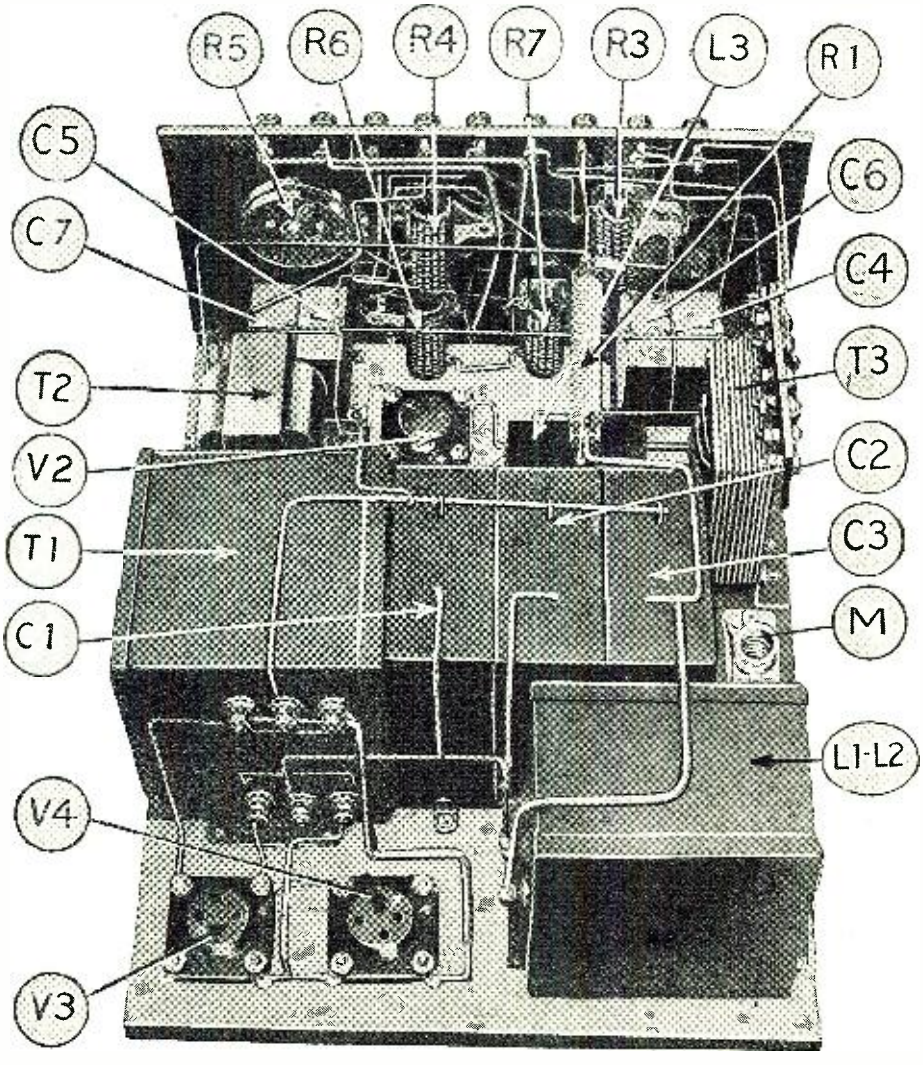
During the next half-cycle more current is added to what is stored, and so forth; each impulse making the charge on the condenser greater, and making the grid more and more negative.

Now the effect of making the grid of a tube negative is to decrease the flow of electrons between plate and filament and, thereby, the "B" battery current flowing through the tube. This is exactly what happens in this case, and after a while the grid may become so negative that the plate current is decreased by steps to zero and no more signals are heard; in other words, the tube "blocks." To avoid this, a high resistance or "grid leak" is used across the grid condenser, to provide a path for the grid charge; part of which leaks through it, and thereby cannot reach the value which cuts down the "B" battery current to zero.

In this system of detection, the response is about equal to the *square of the applied voltage;* which means that, the weaker the signal, the poorer the efficiency. For instance if a signal of value 1 is applied to the detector, the response will be equivalent to the square of 1, which is only 1. If the signal strength is 2, the response will be 4; and, if it is 4, the response will be 16. As one may easily see the sensitivity is not equal for all signals.

ADVANTAGES OF MODULATION

In the modulation system the response is even, for strong or weak signals, and this is what makes it better. Normally, when the set is in operation but no signals are received, the resistance of the modulator tube maintains its average value; but as soon as a signal is impressed upon the grid, the voltage on this grid varies and this, in turn, varies the internal resistance of the tube within wide limits, causing plate-current variations of a much greater order of magnitude than is the case with a regular detector. At the same time, no matter how small the impressed signal, a response in direct ratio to the impressed voltage is obtained.



General view of power unit showing arrangement of apparatus on the baseboard. The letters correspond to those in the circuit diagram above and the list on page 965.

Another advantage of this circuit is that the tube, operating with high frequency on the plate, produces better rectification; because the modulated plate current increases from zero to a given value during each of the positive half cycles instead of merely varying from an average value in accordance with the square of the applied voltage as explained above.

In practice it is found that a very weak signal, which is not heard at all or only faintly when a detector is used, is received with good volume with the modulation arrangement.

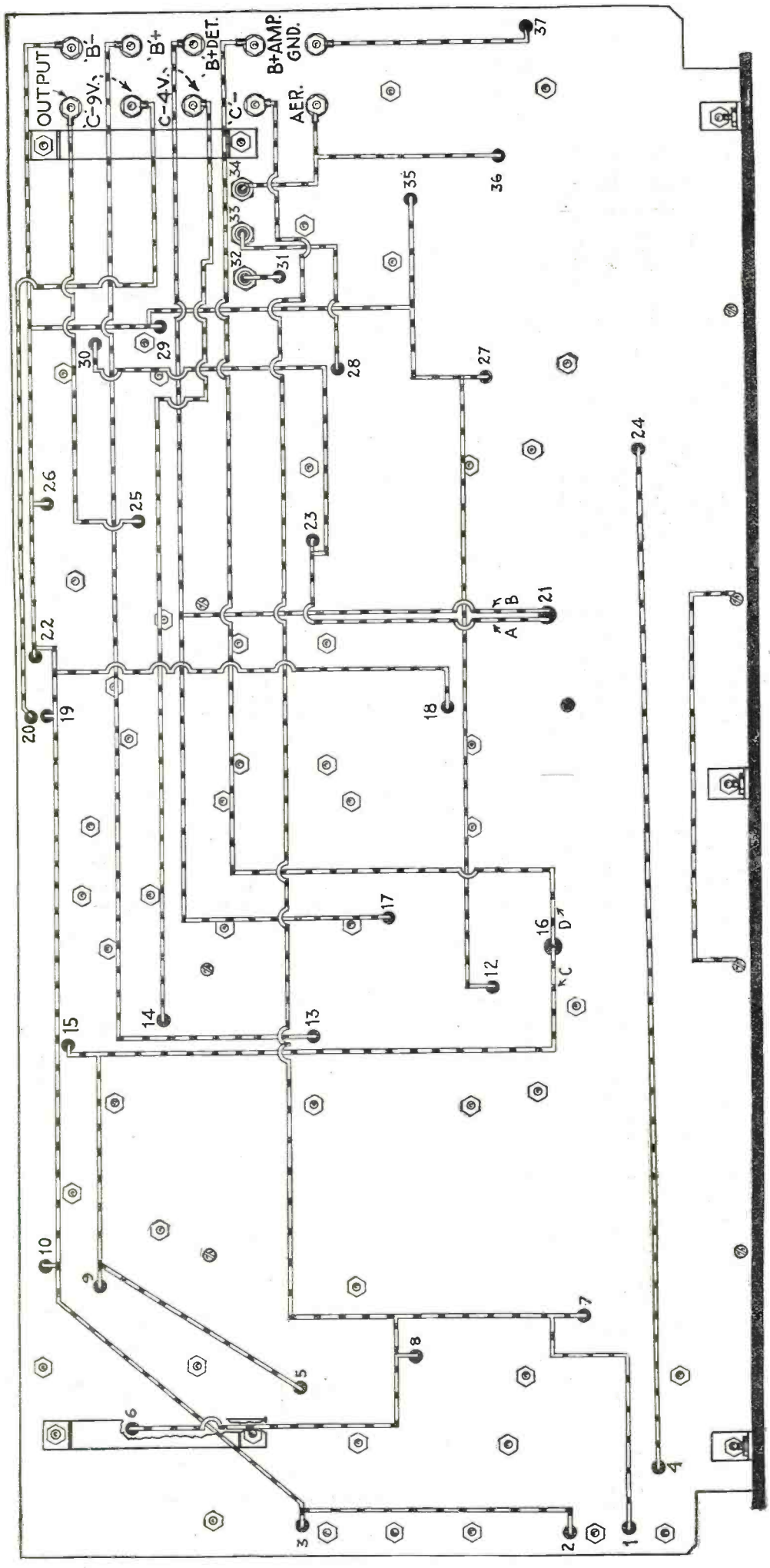
The R.E.L. 9 incorporates also ahead of the modulator, a stage of radio frequency, which, in addition to increasing the signal strength, sharpens the tuning and prevents stations from being heard at more than one setting on the dial when the dials are revolved simultaneously—as they should when tuning.

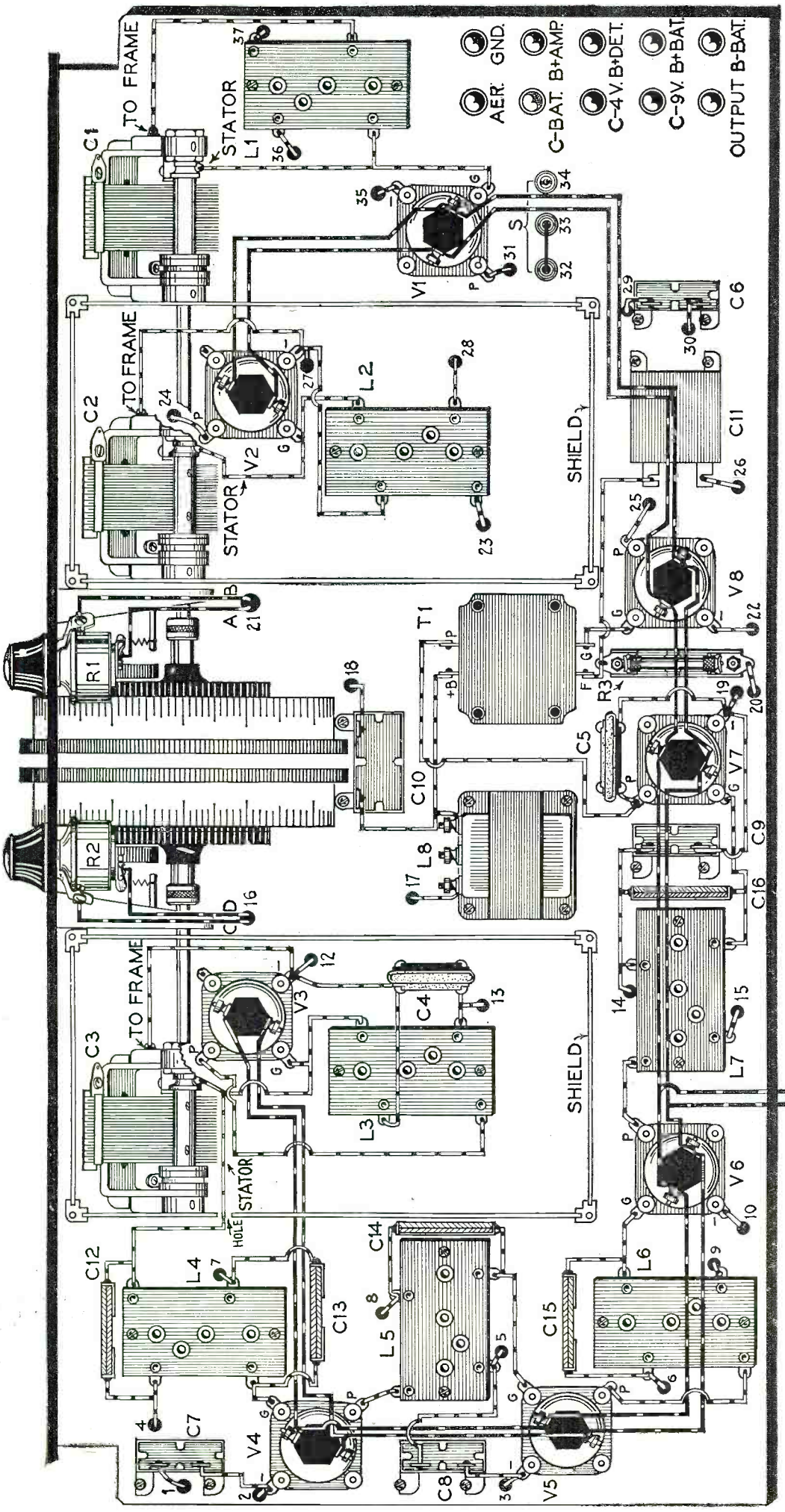
In addition the radio-frequency tube, which is controlled by the left upper knob on the panel, may be made to regenerate the signal—which results in tremendous sensitivity on weak signals. When receiving loud signals from local stations the R.F. tube may be controlled to act as a volume control, thereby permitting even and gradual amplification on all stations.

LAYING OUT THE RECEIVER

The first steps in assembling the R.E.L. 9 are to drill the sides of the aluminum shields, as shown in the drilling layout, to mount the variable condensers on the partitions and to pass the shaft through the sides of these shields. The position of the holes is important, and one should be careful, when tracing the side of the shield, to use an accurate ruler to measure the distances from the side and from the bottom of these aluminum partitions. The exact position of each hole should be marked with a center punch, and drilled to the size indicated in the diagram.

The next step is to drill the front panel; which is comparatively simple, since there are only two mounting holes at the top, three holes for the fastening screws, and one large opening for the drum dials. The latter, if no "fly cutter" is available, may be cut out around a circle which should be traced on the panel. The small spaces remaining between these may be cut out by means of a small saw; the large disk of bakelite will then come out easily, leaving the large opening required for the dial mounting. With a half-round file it is easy to even up the edge of the hole and make a smooth-looking job of the panel drilling. The next step is to lay out the drilling of the sub-base panel. The receiver described in this article uses a formica sub-base; all parts, including the binding posts and tip jacks, are mounted directly on this. However, if desired, a wooden base ½ inch thick may be used if three precautions are taken; namely, two small formica panels must be used for mounting the binding posts and tip jacks, and the base must be raised with rubber feet in order to make it possible to locate the wiring under the base. Drilling the sub-base may be facilitated by





tracing on a piece of paper a full-size template, which later can be applied on the panel. The ready-made full-size drawings, which are available to set builders, may also be used. Each of the holes should be marked accurately with a center punch and drilled. Many of the holes in the drilling layout are for the wires which run from the various parts to the binding post under the sub-base panel. The position of all the parts is shown exactly in the drawings.

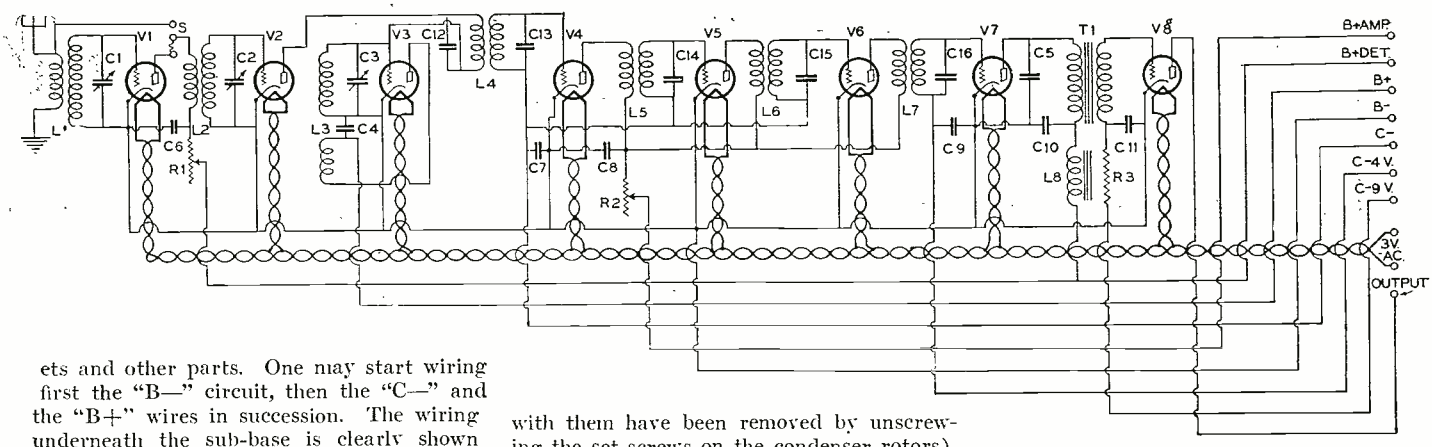
The bottom of each shield is held in place on the baseboard by means of a tube socket, which, when fastened with a screw through the shield, holds the shield in place on the sub-base. Be careful, when fastening the bottom of the shield, to have the front edge even with the edge of the baseboard to avoid gaps between the shield and the panel. It is important to mount these shields straight, in order that the long shaft of the condensers, which runs through them, shall be exactly parallel with the panel in order to have the drum dial turn true. Before fastening the bottom of a shield on the baseboard by means of the socket, the four corner braces should be mounted with four ½-inch 6/32 machine screws.

WIRING THE SET

When wiring this receiver the pictorial wiring diagrams which accompany this article will be found a great aid. The drawing at the left shows all of the connections which must be made above the sub-base panel, and the diagram on the opposite page shows the wiring which is located under the sub-base. Holes must be drilled in the base to allow the wires to pass through; and the exact position of every hole is indicated in the drawings. When tracing the wiring, it will be found that corresponding holes in both drawings are marked with the same number and that, where more than one wire passes through the same hole, distinctive letters are used for identifying each wire.

To wire the set flexible rubber-covered wire should be used. If a wooden baseboard is used with a separate binding-post strip, this may be more conveniently left unscrewed from the baseboard in order to make soldering to the lugs easier. The wires run directly from these binding posts through holes in the baseboard to various points where they connect to sock-

The diagram on the left shows all wiring above the sub-base panel and the drawing on the preceding page shows the wires under the sub-base panel.

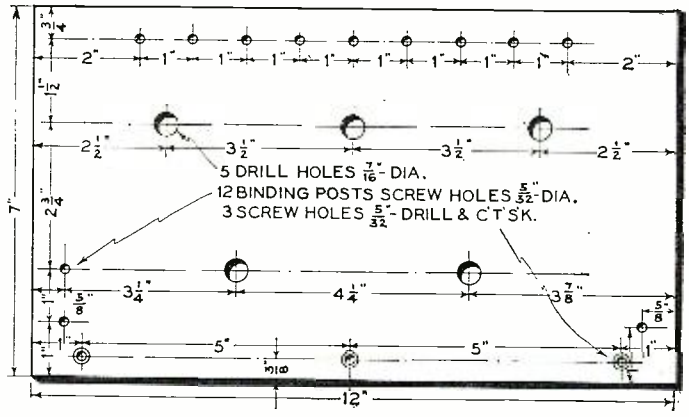


ets and other parts. One may start wiring first the "B—" circuit, then the "C—" and the "B+" wires in succession. The wiring underneath the sub-base is clearly shown and requires no further explanation. Needless to say, all the connections should be carefully soldered to make good contact and to avoid trouble in reception when the set is completed. This necessitates the use of a good soldering iron, some flux and good solder to make the proper connection. Rosin-core solder is recommended for this work.

The wiring above the baseboard is made quite plain in the pictorial drawings and should not require much explanation. Of course, here again soldering should be carefully done and the bus bar should be covered with spaghetti tubing, where it passes through the side of the shielding, in order to insulate it from the metal, which is connected to the "B—" circuit. Before the parts mounted inside of the shield are wired, the side partitions supporting the condensers should be placed in the slides of the corner braces, and the condensers connected with the sockets and the bases of the coils. To mount the dial, after the panel has been fastened to the sub-base panel, as shown in the drawing, the long extension shaft should be pushed through the condensers (the short shafts furnished with them have been removed by unscrewing the set-screws on the condenser rotors). After the long shaft has been pushed through the condensers, the set-screws should be reset, and the dial mounted as explained in the instructions furnished with it. The guide plates holding the vernier knobs should, of course, be mounted on the panel.

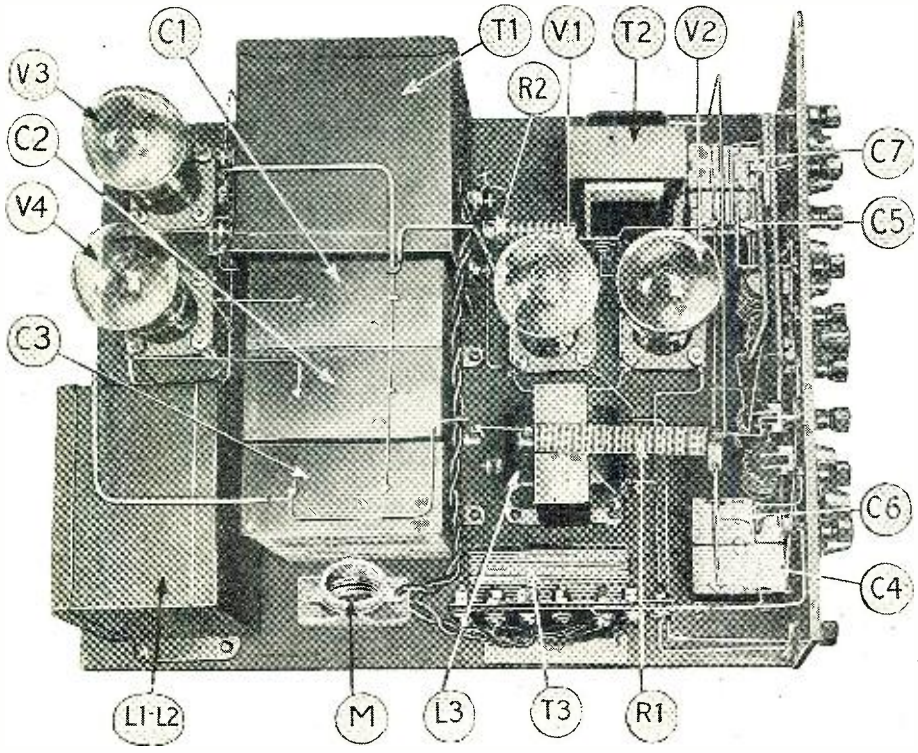
Above: Complete schematic wiring diagram of the "All-Wave Electric 9." The binding posts at the right are connected with the corresponding posts on the power (see diagram page 909) unit when the set is placed in operation. The three tip jacks marked "S" are for plugging in coils to change the wavelength range of the set.

Right: This panel layout shows the exact location of all required holes in the panel of the power unit.

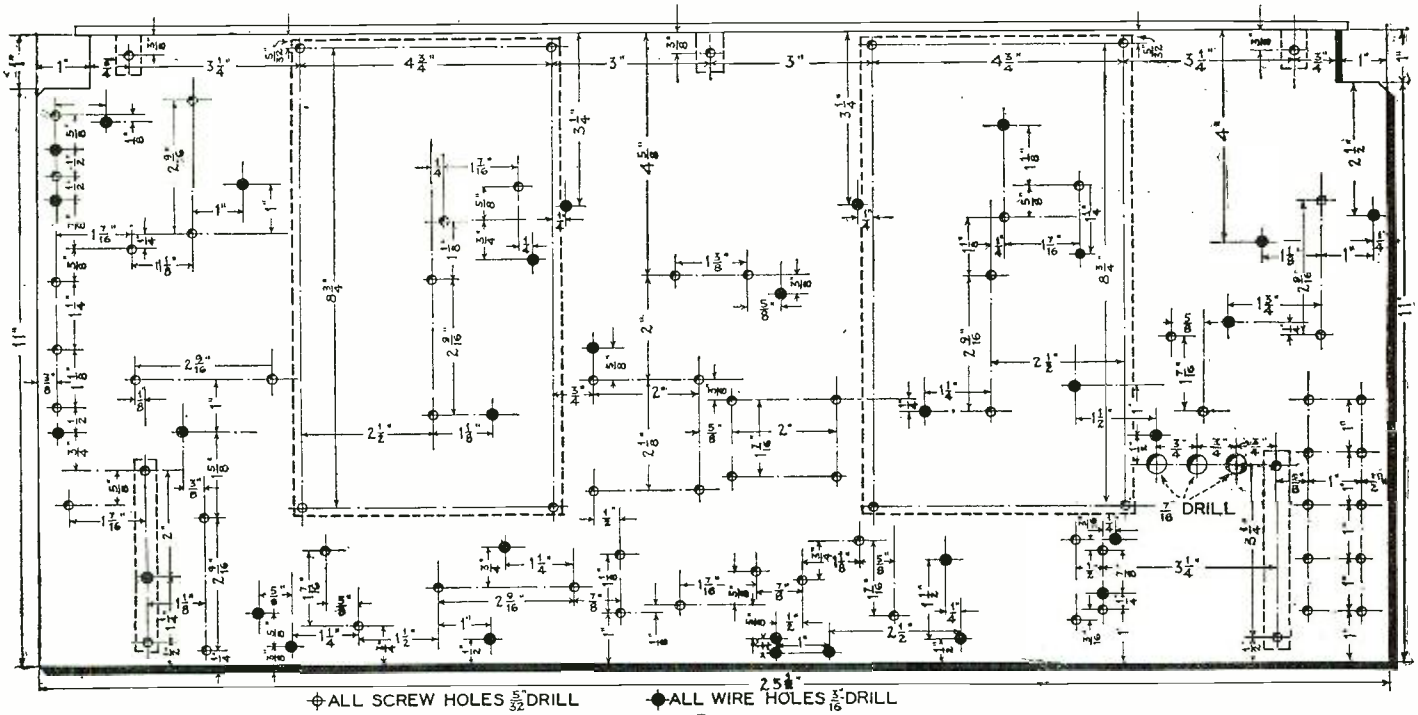


BUILDING THE POWER UNIT

The first step in building the power unit and push-pull amplifier is to drill the panel supporting the variable resistors and binding posts, as shown in the accompanying drawings. After it is drilled, the resistors and binding posts are mounted as shown. The whole panel may then be wired before it is mounted against the baseboard, as it is easier to reach the back of the panel and solder the connection to the resistors while the panel is not fastened. After these connections are made with bus bar, the panel should be fastened against the baseboard and the rest of the parts (such as the condensers, power transformers, chokes, sockets, etc.) should be fastened on the wooden baseboard and wired as shown. It is preferable to use bus bar to wire this part of the power unit, because the connections are stiff and remain in place; and, since a rather high voltage is carried by some of these wires, it is better to use this method of wiring. On all the high-voltage wires it is a good precaution to put some spaghetti tubing, to avoid the danger of shock if any of these wires are touched. The connections between the set proper and the power unit are very simple to make, since all the binding posts are similarly marked on the set and the power unit. The output of the set is connected, of course, with the input of the power unit, and the loud speaker is connected with the two binding posts marked "loud speaker" on the left of the panel. The heaters of the A.C. tubes are connected to the A.C. posts on the power unit.



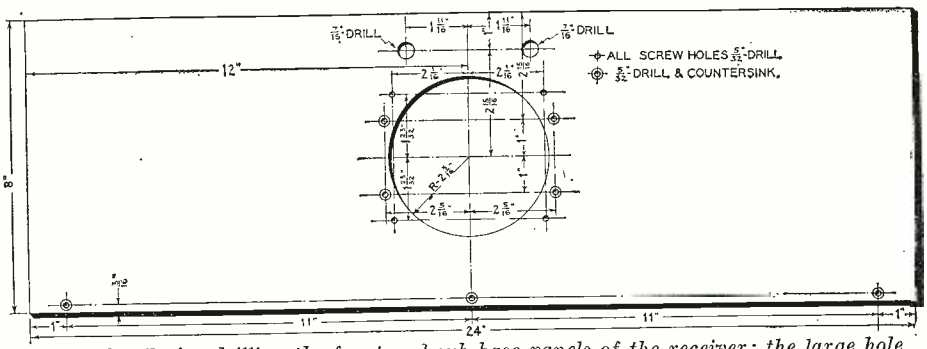
Another view of the power unit designed especially for the operation of the Electric Nine receiver. When operating the power unit the 110-volt receptacle (M) is connected by a cord to a lamp socket, at which the set is turned on and off.



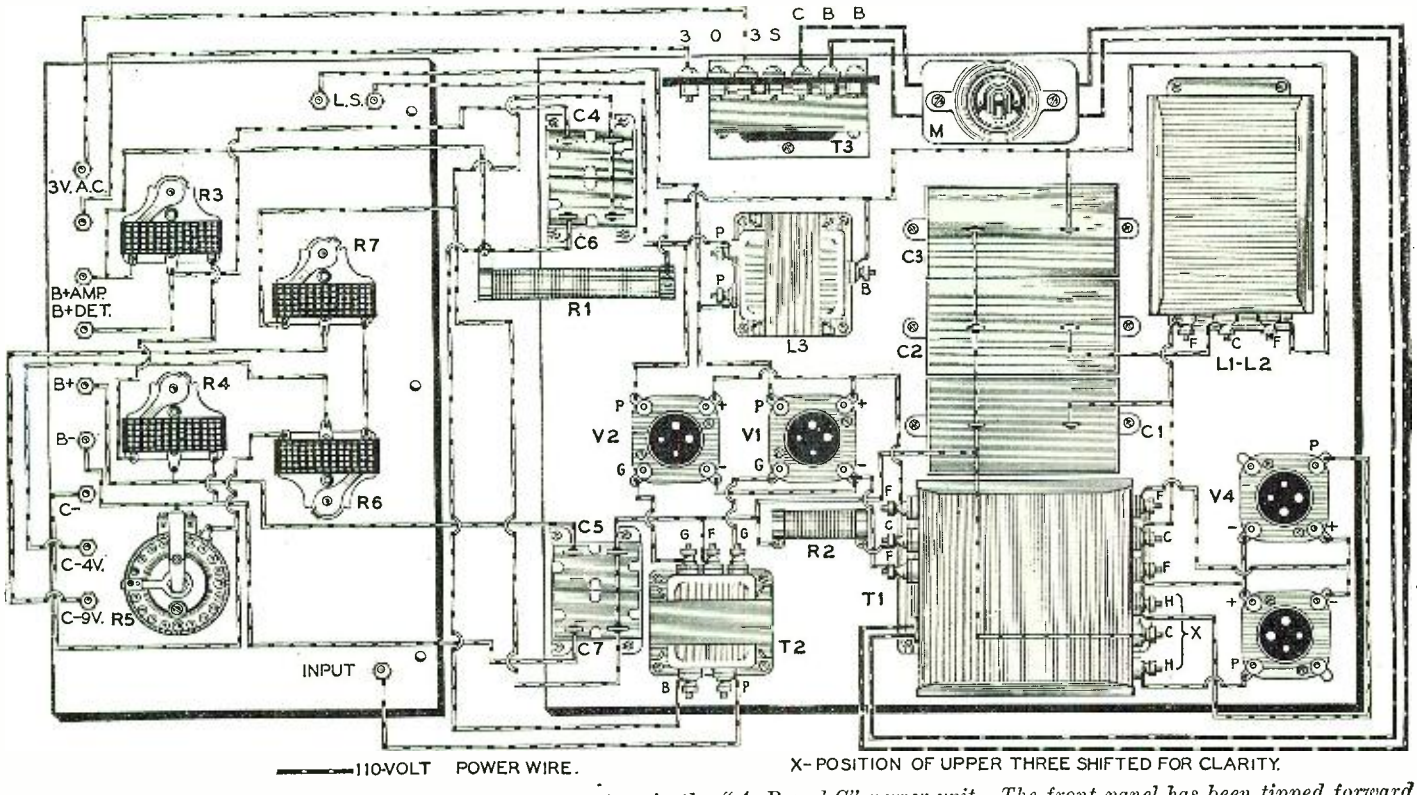
In order to tune in the broadcast wavelengths, the type B1 coils should be plugged in the left base on the sub-panel and inside of the left shield, and the type-B2 coil in the right shield; the four type-F coils are plugged into the bases which are mounted on the right and back of the right shield. The two "pup plugs" should be connected together with a short piece of wire and plugged into the two left "pup jacks" behind the extreme left variable condensers.

The A.C. tubes should be connected as shown in the diagram, with the supply leads taken in the center so that four tubes are connected on each side of the main leads

(*Continued on page* 964)



Above, details for drilling the front and sub-base panels of the receiver; the large hole for the drum dial may be cut by drilling around the circumference of the circle.



This diagram shows in pictorial form all necessary connections in the "A, B and C" power unit. The front panel has been tipped forward to show the connections to the resistors more clearly.

An "A, B and C" Socket-Power Unit and Power Amplifier*

This Easily-Constructed Unit Will "Electrify" Any Standard Receiver Using Battery-Model Tubes

By Lewis B. Hagerman

POWER!!! The keynote of radio! Great power and direct light-socket operation have always been desired in radio, and they have been radio's greatest problems.

The evolution of the powerization of radio from the old-style storage "A" battery and "B" battery to the present day "A" and "B" socket-power units has not been as spectacular as the progress made in other phases of the industry. Operating the radio receiver from the most convenient source of electric power, the light socket, has been the center of attention in radio engineering circles for the past two years.

First, we had the "B" power unit using a standard three-element tube as a rectifier. Then the electrolytic type, using a series of small rectifying cells. Following that the gaseous rectifier tube was developed. Now we are entering into a new era of radio powerization; the battery is fast becoming a thing of the past. We not only have "B" socket-power units and "C" power units, but also "A" power-units; the latter going away with one of the greatest sources of care that radio set owners have had to contend with.

QUALITY ACHIEVEMENTS

Another great improvement is power amplification. This has changed the radio set from a mechanical reproducer of sound to a true musical instrument. There is no comparison between the quality of reproduction or efficiency of a set equipped with full power amplification, and one without it. The effect of its use is "stereoscopic:" the instruments in an orchestral production stand out in bold relief; every type of music has life, reality and marvelous roundness and fullness of tone. This has been available only in very expensive and elaborate, high-priced receivers, all of which are equipped with this feature.

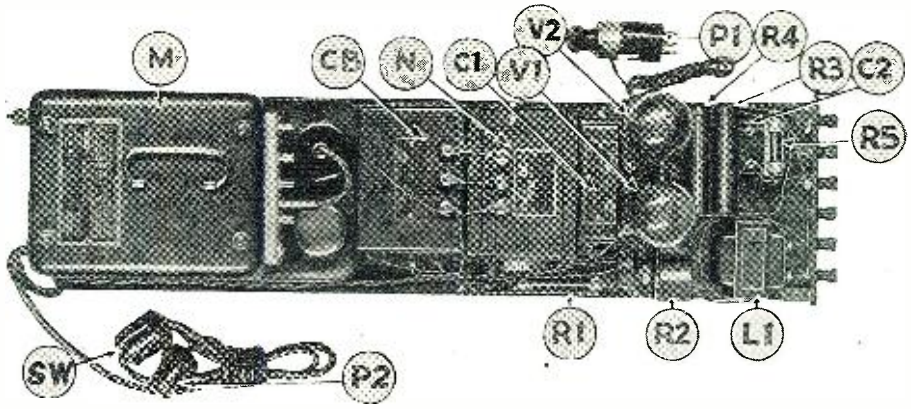
The development of new power tubes and the special equipment necessary to their operation has at last made it possible for anyone to equip his radio set so that it may have these greatly desired features of tremendous power and complete elimination of all batteries.

A properly-constructed power amplifier, used in connection with an "A, B and C" socket-power unit will make any radio set a true A.C. receiver, with no changes in the wiring or tubes, and will impart to it a tone quality, volume and efficiency far greater than could be obtained in any other way.

Distant stations that were formerly a whisper will come through loud and clear, and many that were never heard on a loud speaker before can be brought in with comparative ease.

It is not necessary to crowd the set to the point of oscillation or distortion in order to get sufficient volume on distant reception, and therefore, it is remarkably loud and clear and free from interfering noises.

Very fine power units can be purchased ready made to replace batteries and provide power amplification. The disadvantages are that the cost is rather high and it is sometimes a very complicated procedure to connect the various units to a receiver.



R1, 1,000-ohm resistor; R2, variable resistor; R3 and R4, 10,000-ohm resistors; R5, 100-ohm resistor; C2, 0.5-mf. by-pass condenser.

AN ECONOMICAL POWER SUPPLY

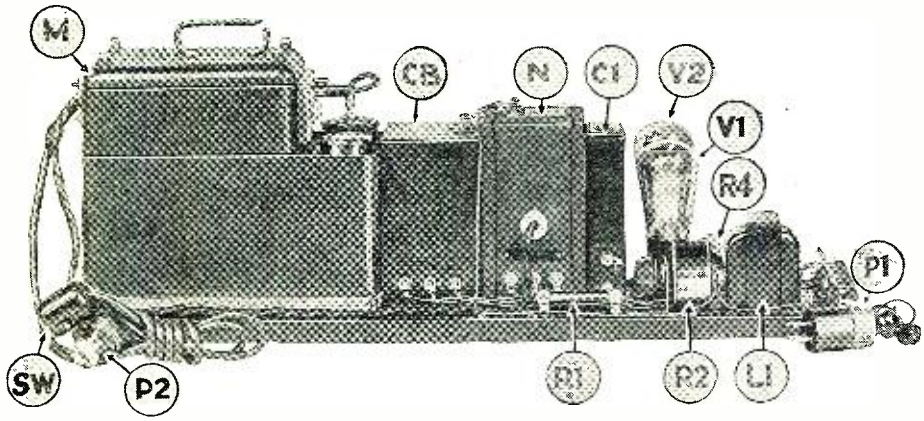
As an alternative, the "A, B and C" socket-power unit and power amplifier described in this article, which can be built by anyone at a moderate cost, is offered. It embodies a perfect "A" power-unit, a power amplifier using the new power tubes of the 210 type, and a "B" and "C" device supplying as high as 400 volts. It represents theoretically, mechanically and operatively, as satisfactory and complete a current-source power amplifier as could be desired for use in the home.

One of its salient features is its universal adaptability to any existing radio receiver of nine or fewer standard ¼-ampere tubes, without changes in the wiring or tubes of the set. It does not affect the operation or tuning of the set, except to operate it with great efficiency entirely from the alternating-current line.

It does not necessarily follow that because the radio set is given more power, it need be at all times unusually loud. You can tune your receiver to any volume that you desire, so that the utmost fidelity and beauty of reproduction may be had.

The selection of parts was made with a number of things in mind. The laboratory model has been in the process of development over a period of nearly a year and every part has been carefully tested to meet all requirements.

First, efficiency, reliability, adaptability for the circuit and simplicity. Second, ease of assembly, to simplify the construction of the complete unit; and third, compactness, so that the completed power-supply unit and amplifier might be placed in any battery table or console.



M, "A" power unit; CB, condenser block; N, power compact; C1, 2-mf. filter condenser; V1, power tube; V2, rectifier; L1, A.F. choke coil; Sw, 110-volt switch; P1 and P2, plugs.

* Radio News *Blueprint Article No. 47*

The most critical instrument is the "A" supply and the unit (M) selected is a true storage-battery substitute, suppressing the alternating-current component to such a degree that it is inaudible even with the tremendous amplification of the power amplifier.

THE FILAMENT-SUPPLY FILTER

The efficiency of the "A" power unit is due mainly to the tremendous capacity of the electrolytic condensers used in the filter circuit which is embodied in the unit. These have a capacity of *several hundred thousand microfarads*, obtained by virtue of the usual arrangement of nickel and steel plates immersed in a non-acid caustic solution which constitutes the condenser. *The plates form one side of the condenser, and the solution the other.* When an electric current is passed through the unit, films of hydrogen and oxygen form over the entire surface of the plates. This film is infinitesimally thin and forms the dielectric of the condensers.

Because a condenser increases in capacity as the thickness of the dielectric decreases, this extremely thin film is entirely responsible for the tremendous capacity obtained. The power unit is comparatively simple. It consists of a transformer to step down the alternating current to the required low voltage, a rectifier to change the current from alternating to pulsating direct current and a two-stage filter, using a choke coil and the two large condensers, which smooth and filter the pulsating direct current, changing it to pure, hum-free direct current necessary for "A" power.

The alternating component of the pulsating direct current is reduced to less than one three-thousandth of its original value. This is far below the point of audibility and cannot be detected with headphones, even when the output is passed through a 210-type power amplifier.

THE PLATE SUPPLY

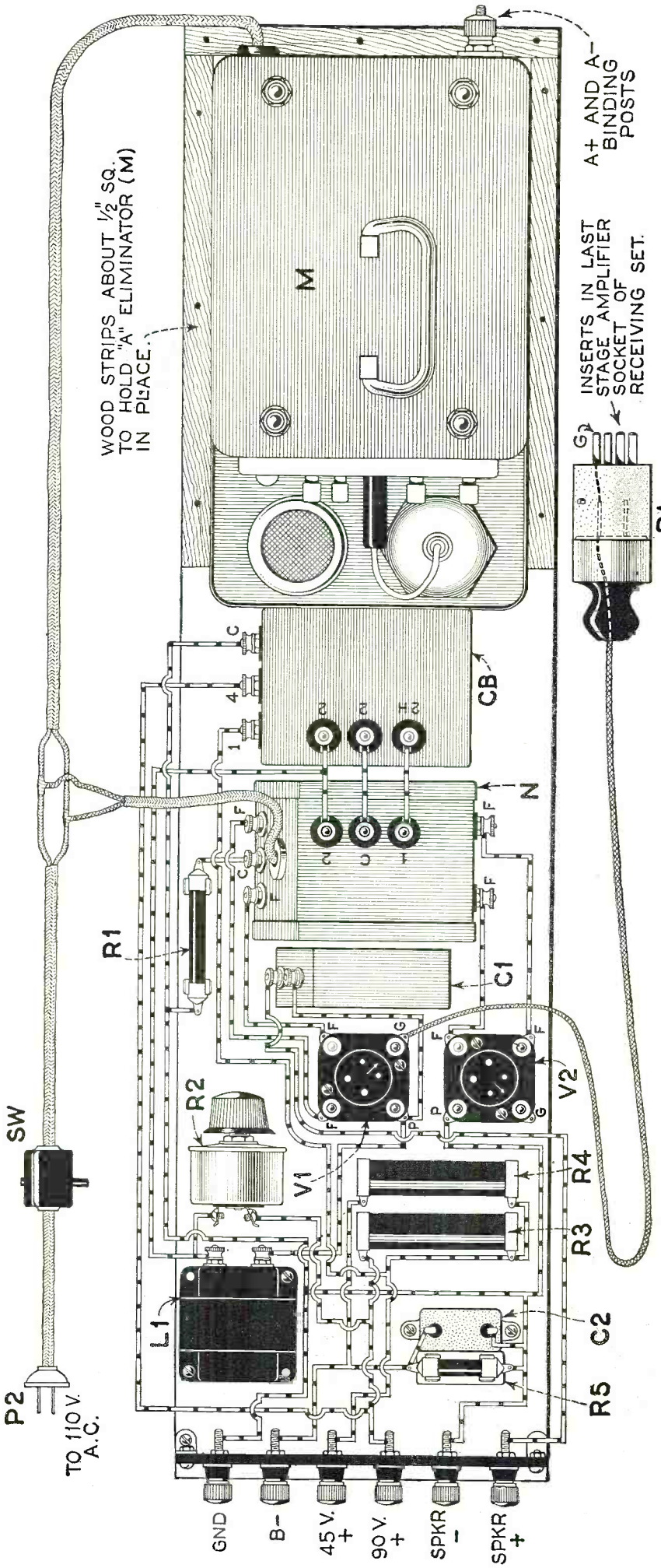
The power unit (N) is a very efficient source of high voltage, a filament supply for the 281 and 210 tubes and an efficient filter. It contains a transformer with one high-voltage winding, two filament windings and the two necessary 30-henry choke coils for the construction of a three-stage filter circuit. It makes an efficient "B" supply for the 210-type tube and the radio set, and designed in such a way that it can be incorporated in a power-amplifier assembly with a minimum of space and wiring.

The choke coil in the speaker circuit is a small, heavily-constructed unit and is built in such a way that the case will not vibrate to the electromagnetic pull of the iron core when the output of the amplifier is passing through it.

In conjunction with the power unit (N) a special condenser block (CB) is used. The terminals on the condenser block match those on the power unit and thus probably two-thirds of the wiring that would otherwise be necessary is eliminated. This makes a compact and efficient unit without a conglomeration of small parts and wiring. In this condenser block are contained all the necessary filter and by-pass condensers required for the entire amplifier unit, and "B" supply.

The additional condensers used include: one 2-mf. 600-volt unit and one ½-mf. 160-volt unit. Special care must be taken

(*Continued on page 954*)



The wiring diagram of the "A, B and C" power unit and power amplifier. The schematic diagram, location diagram and list of parts will be found on pages 954 and 955.

A Five-Lead Cable Plug Readily Made

THE recently-developed battery-cable plugs have provided radio listeners and experimenters with a new convenience of great value. Receivers which have been equipped with these connecting units may be attached to the batteries and disconnected again, as many times during an evening as necessary, and with practically no

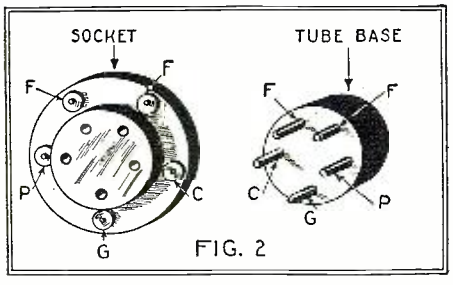
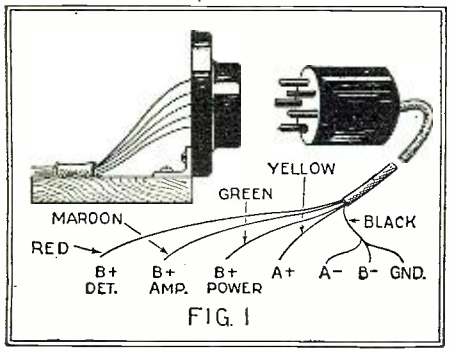


Diagram shows arrangement of terminals on a standard UY socket and tube base of the type used for a battery-cable plug.

effort on the part of the experimenter. Also, there is the great advantage of being always sure that the set is correctly connected; for, if the battery cable plug is installed properly, it is impossible to connect the batteries in the wrong manner.

Most of the battery-cable plugs on the market have provision for seven wires. This is very convenient when the "C" batteries are connected externally; however, in many cases these cells are placed in the receiver cabinet. Therefore, a five-wire battery cable plug would answer the requirements of a large number of fans and, in some cases, four wires are sufficient.

Experimenters who enjoy building parts for their radio receiver will find that the five-wire battery-cable plug described in this article is very easy to build and at the same time very practical. The parts needed are; a vacuum-tube socket of the UY type (five-contact), an old base of a UY-227-type tube, a five-wire battery cable composed of different colored wires, a mounting bracket and sealing wax. In constructing the unit, the first step is to mount the socket on the rear edge of the sub-base panel in a vertical position. Next, the five wires at one end of the battery cable are soldered to the five terminals inside the tube base. The system which should be followed for these two operations is illustrated in Fig. 1.



The method of mounting and wiring a home-made battery cable plug is clearly shown above.

Before connecting the cable to the batteries, and the socket terminals to the battery leads of the set, it is necessary to decide upon the plan which will be followed. In most cases the five wires which will be connected with the cable are; "B+ Power," B+ Amplifier," B+ Detector," "A+," and A—B—ground." These should be connected with the red, maroon, green, yellow and black terminals of the cable, respectively. Next, make note of the terminal inside the tube base with which each wire is connected, and connect the socket terminals with the leads of the receiver in exactly the same way. To complete the plug the tube base may be filled with sealing wax. The arrangement of terminals on the tube base and socket is shown in Fig. 2.

If a four-wire battery cable plug answers the requirements of the receiver, a tube base and socket of the UX type may be used.

Contributed by Jack R. Behms.

Making a Phonograph Pick-up Device

THE mechanically-inclined experimenter can easily make an electrical phonograph pick-up attachment from the old phonograph reproducer, with the aid of a spare headphone or a speaker unit—a small adjustable unit giving best results.

The phonograph unit should be disassembled, taking out the diaphragm, which will be replaced by the metal diaphragm of the phone piece, to the center of which must be soldered the end of the chuck which holds the needle.

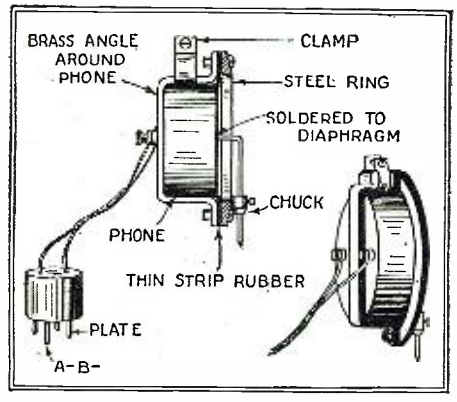
The hard rubber cap should be taken from the phone and the phone fitted into the metal ring of the phonograph unit to which the chuck is attached; a small strip of rubber or cork is inserted around the edge to insure quiet action.

A clamp or brass angle around the unit will hold it together tightly and it may be secured by a smaller clamp to the tone arm, which, however, serves no other purpose than to support the unit.

The electric current set up in the unit by the vibration of the diaphragm, through the needle which moves in accordance with the grooves in the record, is led to the detector socket of the set by two wires, which may be soldered into an old tube base, so that one connects with the plate terminal, and the other with the "A—B—." Two of the prongs are unused.

The incoming signal is amplified and when a good cone speaker is used the results are worth the little work put into it.

Contributed by Miles E. Cason.



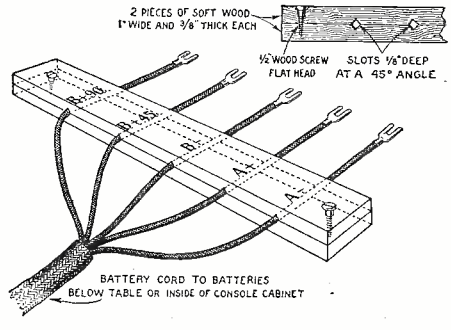
An electric phonograph pick-up unit may be made of an old sound box and a loud-speaker unit as shown.

Battery Leads Separator and Marker

BATTERY cables, like all other improvements and accessories to a radio receiver, have advantages and disadvantages. In most cases the efficiency of a set is increased by use of the cable; because the proper size of wire is used in every case and better connections to the binding posts of the set and batteries are made by the special connecting lugs. Also, for both electrical and mechanical reasons, it is desirable to have all battery wires in cable form.

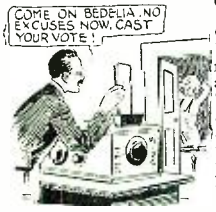
On the other hand oftentimes, when the battery cord is disconnected from the binding posts of the receiver, the corresponding color code employed at the battery end of the cable is forgotten; it then becomes necessary to look inside the cabinet, or below the radio table, to see just how the batteries are connected. This difficulty may be avoided by using the wooden separators illustrated on this page. They may be made

(*Continued on page 969*)



Complete details for building an inexpensive battery-cable separator are given in the above drawing.

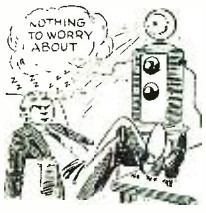
FOR THE WILY POLITICIAN



Item smacking of the election booth, in the *New York Herald-Tribune* of Oct. 23: "—and with 112.5 VOTES on the shield the maximum reverse current is about 1.90 milliamperes." This machine should prove a boon to the vote-getters; as their followers apparently will now be enabled to vote at home without bothering to go to the polls.

Contributed by Harold C. Dow.

HAVE YOU INSOMNIA?



Help for the sleepless, related in the *Rochester Democrat and Chronicle* of Oct. 21: "Five-tube sleeper new 100 amp. 6-volt A. B. and C battery, $65 complete." Now, gents, not only will this set aid you in dropping into the arms of Morpheus, but you will never have to lose sleep about the battery. One couldn't worry about one like that!

Contributed by Robert W. Louvain.

LET'S GIVE UP!

Advertisement (?) from the *Johnstown (Pa.) Daily Tribune* of Oct. 18: "New SELF-BUILT radio 5-tube set, 2 dry cells 45 volts. One WIDTH cell 6 volts. Sonoratrone AIR PIT. All complete for $97. Also WOOD SOCKET POWER $138." If you have any idea in the world what's on sale, you're a better man than we are, Gunga Din.

Contributed by Kenneth A. Vaughan.

IS THIS A NEW TREATY?

International news in the *New York Telegram* of Oct. 22: "PARIS for a real 210 power pack, complete with tubes, $29.95." That looks like a pretty fair swap to us. From all we know of Paris we have a strong hunch that it would be well worth the thirty bucks. By the way, can we sell you the automobile rights to Fifth Avenue?

Contributed by Warren Cox.

AND WASN'T THAT A DAINTY DISH—?

From *Walthal's Weekly Bulletin* (New York) we have this appetizing advertisement: "Pacent SUPER Audioformer, $3.39." Now, Willy, you take the market basket and run down to the radio shop and get three pounds of audioformer, two pecks of grid leaks and a quart of battery juice. Hurry back; there's company coming for supper.

Contributed by G. Carson.

ALL AT ONCE, TOO

Exposure of a greedy radio fan in the *Dayton (O.) Herald* of Nov. 1: "Using the same six-tube set he HOGGED ninety-four stations in one evening from 7:30 until midnight." We should think that this gent would have a hard time keeping all these stations in one place; but then radio is a wonderful thing, you know.

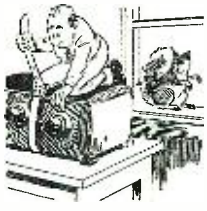
Contributed by Wm. R. Gilman.

THIS IS SERVICE PLUS

Rotarian gesture from the *Waukesha (Wis.) Daily Freeman* of Oct. 27: "Radio Service, All makes FIRED, installed or repaired, . . . All work guaranteed." Of course there may be a certain amount of truth in that advertisement, but we should think that it would lose just a little of its drawing power with the insurance man.

Contributed by John P. Schock.

IT MIGHT BE LAZY



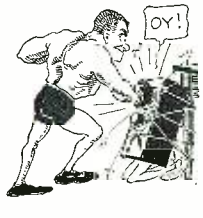
Memories of the recent holidays expressed in the *Los Angeles Daily News* of Oct. 26: "Radio—Want OVERSTUFFED SET, saxophone, violin or anything." Now that's what we would call a real sporting offer. But we hereby inquire of the wide world, what is the radio set overstuffed with and why? If food, is it turkey—or currents?

Contributed by James Conway.

IF you happen to see any humorous misprints in the press we shall be glad to have you clip them out and send to us. No RADIOTIC will be accepted unless the printed original giving the name of the newspaper or magazine is submitted, with date and page on which it appeared. We will pay $1.00 for each RADIOTIC accepted and printed here. A few humorous lines from each correspondent should accompany each RADIOTIC. The most humorous ones will be printed. Address all RADIOTICS to

Editor, RADIOTIC DEPARTMENT, c/o Radio News.

IS ITS NAME GENE OR JACK?



Hefty wallop contained in the advertising columns of RADIO NEWS' December issue: "List price with cord, switch and PUG, $40." We suppose that when this socket-power unit gets too obstreperous and motorboatery you tie it up with the cord and then get the boxing gentleman to administer punishment with the switch. Yes?

Contributed by C. D. Hilyard.

WOTTA SET! ! !

Following the craze for more compact sets, comes the advertisement in the *New York Herald-Tribune* of Oct. 30: "Socket, without tubes $600. door. Operated from light speaker. Loop contained in F 45-60 six tubes. Built-in." If anyone should step out of a hearse and ask you, a loop in six tubes is going some *plus.*

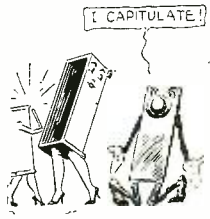
Contributed by Edgar C. Taylor.

OH, THEM LIQUID NOTES!

Under the advertisement of a Canadian G. E. Co. loud speaker in the *Vancouver Sun* of Oct. 22 we find this line: "This advertisement is not published or displayed by the Liquor Control Board or by the Government of British Columbia." The music must have a kick in it and may be intoxicating, if a line such as this is necessary.

Contributed by Charles L. Foster.

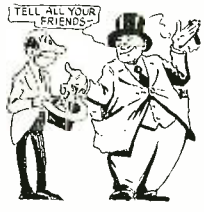
YOU JUST CAN'T RESIST THEM



Vampish method of obtaining panels, mentioned in an advertisement in the *Kansas City (Mo.) Post* of Nov. 4: "Another table model with cabinet of selected mahogany with panels GAINED ENTICINGLY." The idea is (you see) the cabinets are let loose among the panels and then vamp the susceptible ones till their resistance is all gone.

Contributed by Wm. A. Pewitt, Jr.

A BOON TO POLITICIANS



A plan for making things easier for the poor, overworked political leaders is related in *Liberty Magazine* for Nov. 5—"FREE ELECTION flow"—this in speaking about a vacuum tube. Whether the flow is from the cup that cheers or from the well-lined pockets of these gentlemen of the polls, is not told; but we can make our own guess.

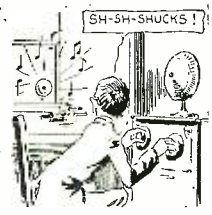
Contributed by A. E. Friedman.

THIS MUST BE MIKE'S BROTHER

In the *Rowan Battery Supply Company's* catalog appears an advertisement of a R.F. choke coil which "limits radio-frequency currents to certain PATS—" When Mike of the Investigation Dept. heard about this gadget he hot-footed it right out to the plant, and wanted to know why they showed such discrimination between Hibernians.

Contributed by Wayne C. Roy.

TREAT 'EM GENTLY, BROTHER



Hints on tuning from the *Verdun (Quebec) Citizen* of Nov. 17: "The trick is to DANDLE the condenser with one hand and the tickler with the other, in such a manner that the sound in the phones caused by the movement of the tickler is always a soft HUSH." Will some of our blooping neighbors please read this *hush* advice again.

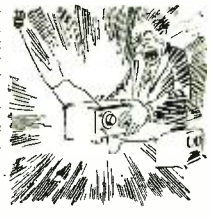
Contributed by S. A. Madrick.

SHOCKED THEM TO DEATH?

This from a circular of the *American Radio Company*: "Yankee Meters Carefully INSECTED." Well, at last we have found the habitat of the Bugus Radiotious! Mike of the Investigation Dept. tracked it down to these meters and, for his valuable work, he is to be awarded the platinum medal of the S.P.C.R.P. (Society for the Prevention of Cruelty to Radio Parts.)

Contributed by J. M. Sisterman.

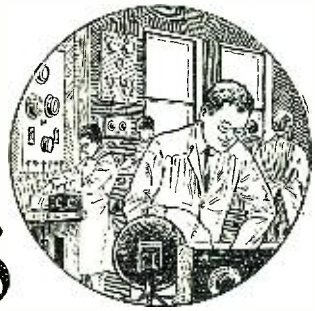
A TREATMENT FOR BLOOPERS



Solution of a great problem in the *Kansas City Post* of Oct. 29: "A three-tube regenerative set is mfd. placed across the 110-volt line to the storage battery re-charger will usually eliminate the troublesome hum heard in the nearby receiving set." And believe you me, that ain't all it will eliminate! We think the operator should be shunted across, too.

Contributed by Richard E. Wiles.

Radio News Laboratories



RADIO manufacturers are invited to send to RADIO NEWS LABORATORIES samples of their products for test. It does not matter whether or not they advertise in RADIO NEWS, the RADIO NEWS LABORATORIES being an independent organization, with the improvement of radio apparatus as its aim. If, after being tested, the instruments submitted prove to be built according to modern radio engineering practice, they will each be awarded a certificate of merit; and a "write-up," such as those given below, will appear in this department of RADIO NEWS. If the apparatus does not pass the Laboratory tests, it will be returned to the manufacturer with suggestions for improvements. No "write-ups" sent by manufacturers are published in these pages, and only apparatus which has been tested in the Laboratories and found of good mechanical and electrical construction is described. As the service of the RADIO NEWS LABORATORIES is free to all manufacturers, whether they are advertisers or not, it is necessary that all goods to be tested be forwarded prepaid, otherwise they cannot be accepted. Apparatus ready for, or already on, the market will be tested for manufacturers free of charge. Apparatus in process of development will be tested at a charge of $2.00 per hour required to do the work. Address all communications and all parcels to RADIO NEWS LABORATORIES, 230 Fifth Avenue, New York City.

HEAVY-DUTY BATTERY

The "B" battery (No. 36) shown, submitted by the Bright Star Battery Company, Hoboken, N. J., is of the dry-cell, heavy-duty type, and is especially designed to be used in radio receivers having power tubes and requiring a relatively-large amount of plate current. This battery is 7¼ inches high, 8¼ inches long, and 4½ inches wide; its weight is approximately 14 pounds. It contains 30 cells which, when connected in series, keep the terminals at a potential difference of 45 volts; a middle tap for 22½ volts is provided. The cells are well insulated, so that the life of the battery on open circuit is very long.

The ampere-hour capacity of the battery varies with the method of discharge (continuous or intermittent) and also with the current drain, but is very satisfactory.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2187.

TUBE SOCKET

The sub-panel socket (type 482-S) shown, submitted by the Alden Manufacturing Company Springfield, Mass., is of the shock-absorbing type, and is intended for direct sub-panel mounting. The tube-

supporting element is of moulded bakelite. The contact springs, which function at the same time as suspension-elements, are of phosphor bronze and insure perfect contact with the prongs of the tube.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2221.

FLAT PLUG

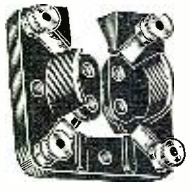
The flat plug (No. 2 shown) submitted by the Carter Radio Company, 300 South Racine Avenue, Chicago, Ill., differs from the conventional type of radio plugs in the respect that its molded-bakelite handle fits close to the panel. The cord tips are held by screws, and

provision is made for attaching a stay cord. This plug is of good construction and very neat in appearance.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2222.

TUBE SOCKET

The tube socket shown, submitted by the Airgap Products Company, 9-13 Campbell Street, Newark, N. J., is of excellent construction. The base is of molded bakelite and the springs are of nickel-plated phosphor bronze, having double side-wiping contacts. The unusual feature of this socket is that its bakelite base is designed with a gap between the corresponding springs of the plate and the grid, thus increasing considerably the resistance between those elements.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2223.

RADIO-FREQUENCY TRANSFORMER

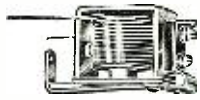
The radio-frequency transformer shown, submitted by the General Manufacturing Company, 6637 Cottage Grove Avenue, Chicago, Illinois, is of the interchangeable, plug-in type. The primary and secondary are of enamcled wire and are wound on a bakelite tube,

2⅜ inches long and 1¼ inches in diameter. This form is provided at its base with a four-prong plug which fits in any standard UX socket. The ends of the windings are soldered to the prongs of the base plug. This transformer is made in different inductance values, thus allowing extension of the range of the receiver in which it is used.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2224.

AUTOMATIC RELAY SWITCH

The relay switch shown, submitted by the same company, disconnects automatically the trickle charger from the house-lighting line when the receiver is turned on. The winding of this relay is in series with the filament circuit of



the receiver, and takes approximately 0.8-ampere to operate, and therefore, it can be used successfully with any receiver using four or more 201-A-type tubes. The resistance of the winding is low (approximately 0.142-ohms) so that the voltage drop across it is practically insignificant. This relay is sturdy, compact and reliable in operation. Pure silver is used as contact metal.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2225.

RHEOSTAT

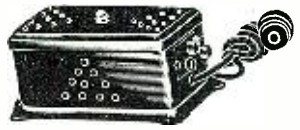
The rheostat shown submitted by W. Wohleber & Company, Wien VII, Zieglergasse 11, Austria, is designed for baseboard mounting, and may be mounted even on the tube socket. The resistance wire, of approximately 38 ohms, is wound on a threaded hard-rubber cylinder

approximately 1⅝ inches long and ½ inch in diameter. One end of the wire is attached to a small binding post, while the other is free. A short brass rod, which is held by two brass plates attached to both ends of the cylinder, guides the double wiping-contact element. A very fine adjustment of the resistance can be obtained.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2226.

TRICKLE CHARGER

The automatic "A" power unit shown, submitted by Swan-Haverstick, Inc., Trenton, New Jersey, is a trickle charger operating from a 60-cycle, 110-volt A.C. house-lighting line. It uses a special full-wave rectifying cartridge, and has a charging rate of approximately 1.2 amperes. This charger embodies an automatic switch, which



connects the line to either the trickle charger or the "B" power supply. The switch is operated from the filament switch of the receiver, and takes approximately 0.63 amperes; it will function properly in connection with any receiver having three or more 201A-type tubes. The voltage drop across the winding of the relay is very low, as the resistance is only 0.205 ohms. The entire apparatus is enclosed in sheet-iron housing, having a black crystalline finish.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2227.

AUDIO-FREQUENCY TRANSFORMER

The audio-frequency transformer (type 112 shown) submitted by the Victoreen Mfg. Company, Cleveland, Ohio, embodies in one cast-aluminum shell two transformers for the first and second audio stages of a radio receiver. These

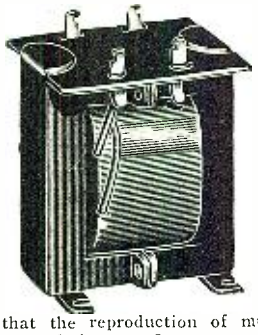
transformers have exceptionally heavy iron cores, and are so designed that the best results with regard to quality and volume are obtained when they are operated in connection with two UX-112 tubes, using from 200 to 400 volts on the plates with a corresponding negative grid bias from 10 to 30 volts. The output, which is of the finest quality, may be regulated to a volume so high that only a few loud speakers of the best makes are able to reproduce it without rattling and distortion.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2228.

A.F. TRANSFORMER

The audio-frequency transformer (type S-M 240) shown, submitted by Silver-Marshall, Inc., 846 West Jackson Boulevard, Chicago, Illi-

nois, has a ratio of 3:1. This transformer is mechanically and electrically, a very well-built instrument. The amplification characteristics of this transformer within the range of the practically used audio frequencies are very good;

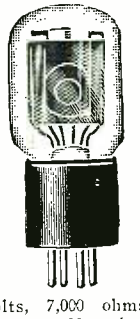


so that the reproduction of music and speech is very fine.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2229.

VACUUM TUBE

The vacuum tube (type AC1 shown) submitted by the Daven Radio Corporation, 160 Summit Street, Newark, N. J., has its filament heated from 60-cycle house-lighting current, stepped down to 1.5 volts. The rated operating current is 1.05 amperes. The dynamic characteristics of this tube taken from a set of six are: amplification constant, 7.9; plate impedance



at 90 volts, 7,000 ohms; mutual conductance at 90 volts 1135 micromhos (measured value). This tube has a standard UX base and operates very satisfactory as an amplifier, either in radio or audio stages.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2230.

VACUUM TUBE

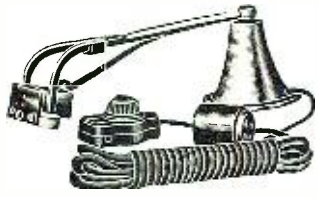
The "Archatron" vacuum tube shown, submitted by the Ken-Rad Corporation, Owensboro, Kentucky, is of the UX-201A type, and is equipped with a large UX socket. The average value of the dynamic characteristics of this tube (as taken from a set of six) has been found to be: Amplification constant, 8.9; plate impedance at 90 volts, 8,000 ohms; mutual conductance at 90 volts (measured value)

1130 micromhos. The operation of this tube as detector or amplifier, either in radio or audio stages, is very satisfactory.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2231.

PHONOGRAPH PICK-UP AND AMPLIFIER

The "Revelaphone" shown, submitted by the Amplion Corporation of America, 280 Madison Avenue, New York City, is an electromagnetic device which makes it possible to reproduce music and voice from a phonograph record by the use of any radio receiver having two or more audio-frequency stages. This apparatus consists of an electric pick-up unit held by a hinged arm which is pivoted in a conical support attached to the "motor board," a special plug attached to a 20-foot cord and an auxiliary plug, as explained below, and a volume-control unit. The magnetic pick-up element contains a strong magnet with pole pieces



molded in the bakelite housing, a coil and a soft-iron armature with an aluminum attachment to carry a phonograph needle. This attachment is held in its position by two small soft rubber plates. The soft-iron armature moves freely, without touching the center of the coil; its lower end extends into the air gap between the two pole-pieces.

To operate this device, after the base with the hinged arm and the pick-up unit has been mounted in the proper position, the cord is connected to the output volume-control unit, and the attached plug is inserted in the socket of the detector. If the radio receiver has only two stages of audio frequency, the regular detector tube is used as an amplifier by placing it in the socket on top of the plug. In case it has three audio-frequency stages, this tube is replaced by the auxiliary plug. This apparatus works very satisfactorily.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2232.

FILAMENT-CURRENT TRANSFORMER

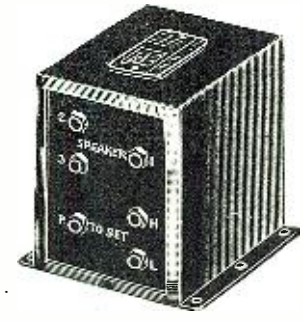
The "A" power transformer shown, submitted by the Bremer-Tully Mfg. Company, 532 S. Canal Street, Chicago, Illinois, is a 25-watt step-down transformer and

supplies the necessary low voltages for heating the filaments of all the tubes in radio receivers using raw A.C. It operates from the 110-volt 60-cycle house lighting line, and supplies 1½ volts, 2½ volts and 5 volts, the latter for power tubes of the UX-171 type. This transformer is enclosed in a black japanned sheet-iron shell, and is mechanically and electrically very well designed. It is provided with two cords, one 8 feet long with a plug to fit into the receptacle of the house line, and another 3 feet long with an attached toggle switch to control the input filament (the toggle is designed for mounting on the receiver panel). An extra receptacle, built into the transformer, permits connection of the 110-volt line current to the "B" supply unit.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2233.

OUTPUT TRANSFORMER

The speaker coupler shown, submitted by the same company, is an output transformer which connects the last tube of a radio receiver to the loud speaker. It is intended to allow only the A.C. component of the plate current to pass through the loud-speaker windings. The fine windings of the speaker coils are thus protected against burning out, and no continuous pull due to the direct plate current is exercised on the armature of the loud speaker. Three phone tip-jacks in the input and three in the output permit various combinations, and allow selection of the best-matching impedance between the loud speaker and the last tube. This instrument is very well built and of neat appearance. It may be installed either inside the radio receiver or on a table near the loud speaker, without the use of tools.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2234.

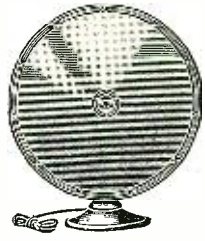
LOUD SPEAKER

The loud speaker shown, submitted by the Radio Cabinet Company, 2123 Iney Street, Indianapolis, Ind., is of the free-edge-cone type. The paper diaphragm is 12 inches in diameter; the unit is of a conventional type using laminated pole pieces, and a special flat armature to which is attached the rod carrying the cone. A condenser, approximately .0065-mf., shunts the windings of the unit. This condenser is formed by 1500 turns of two insulated wires, wound on a small bakelite form. The unit and the cone are built into an attractive cabinet. The performance of this loud speaker is satisfactory with regard to quality and volume.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2235.

CONE SPEAKER

The loud speaker (type "B" shown) submitted by the Pacent Radio Corporation, 91 Seventh Avenue, New York City, is of the cone type and has a paper diaphragm 17 inches in diameter. The driving unit is of the floating-armature type and a very fine piece of electrical and mechanical



design. The coils are protected by molded bakelite shells. This loud speaker is capable of carrying the heavy output loads of modern receivers with power amplifying stages, and is sensitive to weak signals. The reproduction of music and speech is excellent, and the appearance is very neat.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2236.

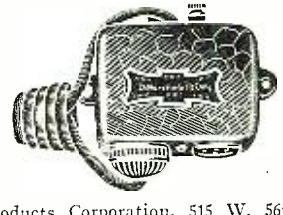
CONE SPEAKER

The "Pearl-O-Cone" reproducer (type LS shown) submitted by the Acme Electric & Manufacturing Company, 1444 Hamilton Avenue, Cleveland, Ohio, has a 17-inch free-edge cone of beautiful design, made of pearly pyralin. The unit is of the balanced-armature type; the driving rod is soldered to the center of the elastic attachment carrying the pyralin cone. This loud speaker has very good tonal characteristics and affords satisfactory results with regards to both quality and volume.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2237.

RELAY SWITCH

The automatic relay switch shown, submitted by the LaMore



Products Corporation, 515 W. 56th Street, New York City, controls automatically, from the receiver switch, the operation of the trickle charger and the "B" power supply unit. By inserting the plugs of the trickle charger and the "B" power supply unit in the corresponding receptacles of the switch, one side of the house-lighting line is permanently connected to both these devices, while the other is attached to the armature of the relay, which connects it to either one or the other. This switch can be used on any radio receiver having four or more tubes of the 201A type, as it takes to operate it approximately 0.85 amperes. The voltage drop in the winding of the magnet is negligible, as the resistance of the wire is small. The relay is small and compact.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2238.

(*Continued on page 973*)

Letters from Home Radio Set Constructors

UNDERGROUND RECEPTION

Editor, RADIO NEWS:

I wish to state my experience with buried aerials. To begin with, about five years ago I buried 100 feet of No. 12 *bare copper* wire eight or ten inches deep for use as a counterpoise. Two years later, with another set, I used it as an aerial and brought in Chicago and other distant stations. The reception was clearer than on the overhead aerial, but with less volume; I decided I was sacrificing volume for clarity. This set, a Bremer-Tully Nameless, was not shielded.

Last summer I could bring in Chicago stations almost any night, and I had KOA at 10:55 E. S. T. last night on this aerial, after tuning it in on the overhead aerial first. I am now using a B.-T. Counterphase 8-12.

I have tried an insulated lead-covered aerial buried about three inches under the ground, but found it not so good; due, perhaps, to its not being deep enough, and also to the ground's not being packed above it.

Another experience I might mention is the case of a friend to whom I recommended the bare copper aerial. This was buried four inches under ground and brought in WTIC, WBZ, WGY, WJZ, and several others with good volume, on a Grebe "Binocular," unshielded. A lead-covered wire was bought and installed, pancake style, in a hole five feet deep. This did not give as good results; but my friend informs me it is improving—which is perhaps due to the earth packing.

WILLIAM RASCHE,
46 Hunting Hill Ave., Middletown, Conn.

(While no device is certain to extend reception, the buried aerials have given good results in pick-up of signals without atmospherics. Our correspondent's letter indicates that it is well to give them a thorough test; and that, if one goes to the trouble of installing one, it is well to bury it deep enough, and wet down and pack the earth thoroughly about it.—EDITOR.)

LETTERS for this page should be as short as possible, for so many are received that all cannot be printed. Unless a set is made from a published description, a schematic sketch should be sent; photos can be used only to illustrate a novelty, and then only if large and very clear. Inquiries for information not given here should be sent to the constructor direct; but he should NOT be asked to furnish data already published, here or elsewhere.

This department is for free discussion to the extent that space permits; but RADIO NEWS accepts no responsibility for the opinions of readers as to the relative merits of apparatus and circuits.

TRANSPACIFIC RECEPTION

Editor, RADIO NEWS:

You will find enclosed acknowledgment of reception from 2GB, Sydney, Australia, and 2YA, Wellington, New Zealand. The latter speaks of 3YA, Christchurch, New Zealand, from which I have since had very good reception. I mailed them a card, but it takes about three months to hear from them. All told, I have been able to hear eight stations in Australia, one in Tasmania, three in New

(Continued on page 973)

List of Broadcast Stations in the United States

(Continued from page 894)

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
WJBU	Lewisburg, Pa.	214	100
WJBW	New Orleans, La.	238	30
WJBY	Gadsden, Ala.	234	50
WJBZ	Chicago Heights, Ill.	208	100
WJJD	Mooseheart, Ill.	**366	1000
WJKS	Gary, Ind.	232	500
WJPW	Ashtabula, Ohio.	208	30
WJR-WCX	†Pontiac, Mich.	441	5000
	(Also 32 meters, 75 watts)		
WJZ	†New York, N. Y.	**454	30,000
	(3XL, 59.96 meters. 30 k.w.)		
WKAQ	San Juan, Porto Rico	322	500
WKAR	East Lansing, Mich.	285	*500
WKAV	Laconia, N. H.	224	59
WKBB	Joliet, Ill.	216	150
WKBC	Birmingham, Ala.	219	10
WKBE	Webster, Mass.	229	100
WKBF	Indianapolis, Ind.	252	250
WKBG	Chicago, Ill. (portable)	201	100
WKBH	La Crosse, Wis.	220	500
WKBI	Chicago, Ill.	216	50
WKBL	Monroe, Mich.	205	15
WKBN	Youngstown, Ohio.	214	50
WKBO	Jersey City, N. J.	219	500
WKBP	Battle Creek, Mich.	213	50
WKBQ	New York, N. Y.	219	500
WKBS	Galesburg, Ill.	217	100
WKBT	New Orleans, La.	252	50
WKBV	Brookville, Ind.	217	100
WKBW	Amherst, N. Y.	217	5000
WKBZ	Ludington, Mich.	200	15
WKDR	†Kenosha, Wis.	248	15
WKEN	Kenmore, N. Y.	204	250
WKJC	Lancaster, Pa.	252	50
WKRC	Cincinnati, Ohio.	246	500
WKY	Oklahoma City, Okla.	288	150
WLAC-WDAD	Nashville, Tenn.	225	1000
WLAP	Louisville, Ky.	268	*30
WLB	Minneapolis, Minn.	246	500
WLBC	Muncie, Ind.	210	50
WLBF	Kansas City, Mo.	210	50
WLBG	Petersburg, Va.	214	100
WLBH	Farmingdale, N. Y.	232	30
WLBI	East Wenona, Ill.	238	250
WLBL	†Stevens Point, Wisc.	333	*1000
WLBM	Cambridge, Mass.	231	50
WLBN	Chicago, Ill. (portable)	204	50
WLBO	Galesburg, Ill.	217	100
WLBQ	Atwood, Ill.	218	25
WLBR	Rockford, Ill.	248	15
WLBT	Crown Point, Ind.	248	50
WLBV	Mansfield, Ohio.	207	50
WLBW	Oil City, Pa.	294	500
WLBX	Long Island City, N. Y.	204	250
WLBY	Iron Mountain, Mich.	210	50
WLBZ	Dover-Foxcroft, Me.	208	250
WLCI	Ithaca, N. Y.	248	50
WLEX	Lexington, Mass.	216	50
WLIB	See WGN		
WLIT	Philadelphia, Pa.	405	500
WLOE	Chelsea, Mass.	211	100
WLS	†Chicago, Ill.	**345	5000
WLSI	See WDWF		
WLTH	Brooklyn, N. Y.	256	250
WLTS	Chicago, Ill.	484	100
WLW	†Cincinnati, Ohio.	428	5000
	(Also 52.02 meters, 250 watts)		
WLWL	†Kearney, N. J.	370	2000
WMAC	Cazenovia, N. Y.	225	500
WMAF	So. Dartmouth, Mass.	416	500
WMAK	Tonawanda, N. Y.	545	750
WMAL	Washington, D. C.	242	500
WMAN	Columbus, Ohio.	234	50
WMAQ	Chicago, Ill.	**447	1000
WMAY	St. Louis, Mo.	248	100
WMAZ	Macon, Ga.	270	500
WMBA	Newport, R. I. (port.)	204	100
WMBB	†Chicago, Ill.	252	5000
WMBC	Detroit, Mich.	244	100
WMBD	Peoria Heights, Ill.	205	250
WMBE	St. Paul, Minn.	208	10
WMBF	Miami Beach, Fla.	384	500
WMBG	Richmond, Va.	212	50
WMBH	Joplin, Mo.	204	100
WMBI	†Addison, Ill.	**263	5000
WMBJ	Monessen, Penna.	232	50
WMBL	Lakeland, Fla.	229	100
WMBM	Memphis, Tenn.	240	10
WMBO	Auburn, N. Y.	220	100
WMBQ	Brooklyn, N. Y.	204	100
WMBR	Tampa, Fla.	252	100
WMBS	Lemoyne, Pa.	234	250
WMBW	Youngstown, Ohio.	214	50
WMC	Memphis, Tenn.	517	500
WMCA	†New York, N. Y.	370	500
WMCO	Saginaw, Mich.	219	250
WMES	Boston, Mass.	211	50
WMPC	Lapeer, Mich.	234	30
WMRJ	Jamaica, N. Y.	207	10
WNAC-WBIS	Boston, Mass.	461	500
WNAD	Norman, Okla.	240	500
WNAL	Omaha, Neb.	258	250
	(Also 105 meters, 50 watts)		
WNAT	Philadelphia, Pa.	288	100
WNAX	Yankton, S. D. (day).	278	250
WNBA	Forest Park, Ill.	208	200
WNBF	Endicott, N. Y.	207	50
WNBH	New Bedford, Mass.	248	250
WNBJ	Knoxville, Tenn.	207	50
WNBL	Bloomington, Ill.	200	15
WNBO	Washington, Pa.	211	15
WNBQ	Rochester, N. Y.	207	15
WNBR	Memphis, Tenn.	229	100
WNBT	Elgin, Ill. (time sigs.)	35.5	500
WNBW	Carbondale, Pa.	200	5
WNBX	Springfield, Vt.	242	10
WNBZ	Saranac Lake, N. Y.	232.	10
WNJ	Newark, N. J.	268	250
	(Has short-wave transmitter)		
WNOX	Knoxville, Tenn.	265	1000
WNRC	Greensboro, N. C.	224	500
WNYC	New York, N. Y.	526	500
WOAI	San Antonio, Tex.	500	5000
WOAN	Lawrenceburg, Tenn.	285	250
WOAX	Trenton, N. J.	240	500
WOBQ	New York, N. Y.	309	500
WOBR	Shelby, Ohio (portable)	204	10
WOBT	Union City, Tenn.	205	15
WOBU	Charleston, W. Va.	268	50
WOC	Davenport, Iowa.	375	5000
WOCL	Jamestown, N. Y.	224	25
WODA	Paterson, N. J.	294	1000
WOI	Ames, Iowa.	265	*2500
WOK	†Chicago, Ill.	252	5000
WOKO	Peekskill, N. Y.	216	250
WOKT	Rochester, N. Y.	210	500
WOMT	Manitowoc, Wis.	222	100
WOO	Philadelphia, Pa.	349	500
WOOD	†Grand Rapids, Mich.	261	500
WOQ	Kansas City, Mo.	341	*250
WOR	†Kearney, N. J.	422	5000
	(Also 65.4 meters, 50 watts)		
WORD	†Batavia, Ill.	252	5000
WOS	Jefferson City, Mo.	361	500
WOW	Omaha, Nebr.	508	1000
WOWO	Fort Wayne, Ind.	229	*2500
	(Also 22.8 meters, 1000 watts)		
WPAP	see WWAO		
WPCC	Chicago, Ill.	224	500
WPCH	†New York, N. Y.	326	500
WPEP	Waukegan, Ill.	216	250
WPG	Atlantic City, N. J.	273	5000
WPRC	Harrisburg, Pa.	210	100
WPSC	State College, Pa. (day)	300	500
WPSW	Philadelphia, Pa.	207	50
WPTF	Raleigh, N. C.	545	500
WPUB	New York, N. Y.	236	500
WQAA	Parkesburg, Pa.	216	500
WQAE	Springfield, Vt.	250	50
WQAM	Miami, Fla.	384	750
WQAN	Scranton, Pa.	231	250
WQAO-WPAP	†Cliffside, N. J.	395	500
WQBA	Tampa, Fla.	238	250
WQBC	Utica, Miss (day).	216	100
WQBJ	Clarksburg, W. Va.	240	65
WQJ	Chicago, Ill.	447	500
WRAF	Laporte, Ind.	208	100
WRAH	Providence, R. I.	200	250
	(Has short-wave transmitter)		
WRAK	Escanaba, Mich.	283	50
WRAM	Galesburg, Ill.	248	50
WRAW	Reading, Pa.	238	100
WRAX	Philadelphia, Pa.	213	250
WRBC	Valparaiso, Ind.	238	250
WRC	Washington, D. C.	**468	500
WRCO	Raleigh, N. C.	217	250
WRCV	Norfolk, Va.	210	100
WREC	†Memphis, Tenn.	254	50
WREN	Lawrence, Kan.	254	750
WRES	Quincy, Mass.	217	50
WRHF	Washington, D.C. (day)	322	150
WRHM	†Minneapolis, Minn.	261	1000
WRK	Hamilton, Ont.	205	100
WRM	Urbana, Ill.	273	*500
WRMU	New York, N. Y. (port)	201	100
	(2XAO, ship, 105.9 meters, 100 watts)		
WRNY	†New York, N. Y.	326	500
	(Also 30.91 meters, 500 watts)		
WRPI	Terre Haute, Ind.	208	100
WRR	Dallas, Tex.	461	500
WRRS	Racine, Wis.	248	50
WRST	Bay Shore, N. Y.	211	250
WRVA	Richmond, Va.	254	1000
WSAI	†Cincinnati, Ohio.	361	5000
WSAJ	Grove City, Pa.	224	250
WSAN	Allentown, Pa.	222	100
WSAR	Fall River, Mass.	213	250
WSAX	Chicago, Ill. (port)	204	100
WSAZ	Huntington, W. Va.	242	100
WSB	Atlanta, Ga.	476	1000
WSBC	Chicago, Ill.	232	500
WSBF	St. Louis, Mo.	258	250
WSBT	South Bend, Ind.	400	500
WSDA	see WARS.		
WSEA	Virginia Beach, Va.	263	250
WSIX	Springfield, Tenn.	213	150
WSKC	Bay City, Mich.	273	250
WSM	Nashville, Tenn.	337	5000
WSMB	New Orleans, La.	297	500
WSMK	Dayton, Ohio.	297	200
WSOE	Milwaukee, Wis.	270	250
WSRO	Middletown, Ohio.	236	100
WSSH	Boston, Mass.	288	100
WSUF	see WTAR.		
WSUI	Iowa City, Ia. (day)	476	500
WSUN	St. Petersburg, Fla.	508	750
WSVS	Buffalo, N. Y.	204	50
WSYR	Syracuse, N. Y.	225	500
WTAD	Quincy, Ill.	236	*250
WTAG	Worcester, Mass.	517	500
WTAL	Toledo, Ohio.	240	250
WTAM	Cleveland, Ohio.	**400	*3500
WTAQ	Eau Claire, Wis.	254	500
WTAR-WSUF	Norfolk, Va.	236	500
WTAS	†Batavia, Ill.	275	500
WTAW	College Station, Tex.	484	500
WTAX	Streator, Ill.	248	50
WTAZ	Richmond, Va.	220	15
WTFF	Mt. Vernon Hills, Va.	203	10,000
WTFI	Toccoa, Ga.	210	250
WTHS	Atlanta, Ga.	270	200
WTIC	Hartford, Conn.	535	500
WTMJ	Milwaukee, Wis.	294	1000
WTRL	Midland Park, N. J.	207	15
WWAE	Chicago, Ill.	227	500
WWJ	Detroit, Mich.	353	1000
WWL	New Orleans, La.	246	1000
WWNC	Asheville, N. C.	297	1000
WWRL	†Woodside, N. Y.	200	100
WWVA	Wheeling, W. Va.	517	250

*Allowed higher daylight power. **Standard or constant-frequency transmission. †Remote Control.

LIST OF CANADIAN BROADCAST CALLS

CFAC	Calgary, Alta.	435	500
CFCA	Toronto, Ont.	357	500
CFCF	Montreal, Que.	411	1650
CFCH	Iroquois Falls, Ont.	500	250
CFCN	Calgary, Alta.	435	1800
CFCQ	Vancouver, B. C.	411	10
CFCT	Victoria, B. C.	476	250
CFCY	Charlottetown, P.E.I.	312	100
CFGC	Brantford, Ont.	297	50
CFJC	Kamloops, B. C.	268	15
CFLC	Prescott, Ont.	297	50
CFMC	Kingston, Ont.	268	20
CFNB	Fredericton, N. B.	248	25
CFQC	Saskatoon, Sask.	330	500
CFRB	Toronto, Ont.	291	1000
CFRC	Kingston, Ont.	268	500
CFYC	Burnaby, B. C.	411	500
CHCS	Hamilton, Ont.	341	10
CHCY	Edmonton, Alta.	517	250
CHGS	Summerside, P. E. I.	268	25
CHIC	Toronto, Ont.	357	500
CHMA	Edmonton, Alta.	517	250
CHML	Mt. Hamilton, Ont.	341	50
CHNC	Toronto, Ont.	357	500
CHNS	Halifax, N. S.	322	100
CHPC	Vancouver, B. C.	411	1000
CHRC	Quebec, Que.	341	5
CHSC	Unity, Sask.	268	50
CHUC	Saskatoon, Sask.	330	500
CHWC	Regina, Sask.	312	15
CHWK	Chilliwack, B. C.	248	5
CHYC	Montreal, Que.	411	750
CJBC	Toronto, Ont.	291-357	500
CJBR	Regina, Sask.	312	500
CJCA	Edmonton, Alta.	517	500
CJCJ	Calgary, Alta.	435	250
CJGC	London, Ont.	330	500
CJGX	Yorkton, Sask.	476	500
CJOR	Sea Island, B. C.	291	50
CJRM	Moose Jaw, Sask.	297	500
CJSC	Toronto, Ont.	357	500
CJWC	Saskatoon, Sask.	330	250
CJYC	Scarboro, Ont.	291	500
CKAC	Montreal, Que.	411	1200
CKCD	Vancouver, B. C.	411	1000
CKCI	Quebec, Que.	341	23
CKCK	Regina, Sask.	312	500
CKCL	Toronto, Ont.	357	500
CKCO	Ottawa, Ont.	435	100
CKCR	St. George, Ont.	258	25
CKCV	Quebec Que.	341	50
CKCW	Bowmanville, Ont.	312	5000
CKCX	Toronto, Ont.	291	500
CKFC	Vancouver, B. C.	411	50
CKLC	Red Deer, Alta.	357	1000
CKMC	Cobalt, Ont.	248	5
CKNC	Toronto, Ont.	357	500
CKOC	Hamilton, Ont.	341	100
CKPC	Preston, Ont.	248	8
CKPR	Midland, Ont.	268	50
CKSH	St. Hyacinthe, Que.	312	50
CKSM	Toronto, Ont.	291	1000
CKUA	Edmonton, Alta.	517	500
CKWX	Vancouver, B. C.	411	50
CKY	Winnipeg, Man.	384	500
CNRA	Moncton, N. B.	322	500
CNRC	Calgary, Alta.	435	500
CNRE	Edmonton, Alta.	517	500
CNRM	Montreal, Que.	411	1650
CNRO	Ottawa, Ont.	435	500
CNRQ	Quebec, Que.	341	50
CNRR	Regina, Sask.	312	500
CNRS	Saskatoon, Sask.	330	500
CNRT	Toronto, Ont.	357	500
CNRV	Vancouver, B. C.	291	500
CNRW	Winnipeg, Man.	384	500

Conducted by C. W. Palmer

THIS Department is conducted for the benefit of our Radio Experimenters. We shall be glad to answer here questions for the benefit of all, but we can publish only such matter as is of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent. Please make these questions brief; if the inquiry is concerning a circuit other than a standard, published one, delay will be prevented by enclosing a diagram and other necessary information.
2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.
3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.
4. Our Editors will be glad to answer any letter, at the rate of 25c. for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

Vacuum-Tube Voltmeter

(Q. 2265). Mr. A. J. Stewart, Richmond, Va. asks:

"Can you explain the use and construction of a vacuum-tube voltmeter. I have noticed quite a number of references to this instrument in recent magazines and technical books. I also believe that it is possible to use a milliammeter with a resistance in series to make a direct-current voltmeter. Can you explain how this is done, if possible?"

A. 1. The vacuum-tube voltmeter is a very useful instrument, and finds wide use in an electrical laboratory. The simpler type is not at all difficult to make up, and with it some interesting measurements can be made. For best results, it should be calibrated; but even without calibration it is still possible to make a number of measurements with it that will give a general indication of the comparative merits of various coils, amplifiers and other units.

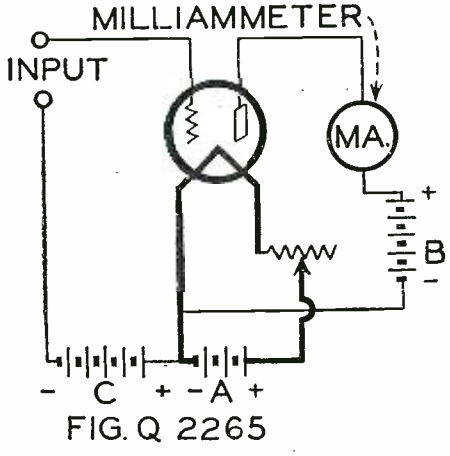


FIG. Q 2265

The circuit of a simple vacuum-tube voltmeter is shown. The milliammeter used should have a scale reading from 0 to 1½ milliamperes.

The circuit diagram of a vacuum-tube voltmeter is shown above. See Fig. Q. 2265. The "B" battery voltage need not be more than 22½ volts and the indicating instrument in the plate circuit should be a D.C. milliammeter with a maximum-scale reading of not more than 1½ milliamperes. The "C" battery voltage should be adjusted until the meter reads about one-tenth of a milliampere when the terminals at the input are short-circuited. The tube is now operating on the lower bend of its characteristic curve, a condition similar to that under which a detector operates with the use of a "C" battery. Now if any voltage, whether direct or alternating, is impressed across the input terminals, the plate current will change. If a calibration is to be carried out, it is accomplished by impressing various known values of voltage across the input terminals, and reading the corresponding deflections of the milliammeter. Then, if the input terminals are connected across any unknown voltage, it is possible to determine the value of this voltage by noting the deflection of the plate milliammeter. The actual voltage is determined from the previously-made calibration curve. As mentioned above, even though instruments are not available with which a calibration can be made, it is possible to make comparative tests. For instance, by placing the same input current on several amplifiers under test and then connecting the vacuum-tube voltmeter across the outputs, comparative readings can be obtained. Obviously, the amplifier which produces the greatest deflection has the greatest amplification. When testing receivers for the amplification obtained, the "slide-back" method can be used. In this case, a potentiometer is connected across the "C" battery and the center terminal of the potentiometer is connected to the input terminal. In this way, if a head set is connected in the plate circuit, the potentiometer can be adjusted until the signal just fades out, and a comparison made as to the point on the potentiometer scale at which this occurs.

A Voltmeter from a Milliammeter

It is possible to make up a very useful and fairly accurate voltmeter, using a milliammeter and a good fixed resistor. Actually a voltmeter consists of a sensitive milliammeter in series with a high resistance. In calibrating, the meter, with the resistance in series, is placed across known voltage sources, and its scale marked off in volts instead of milliamperes. Suppose we have a meter with a full-scale reading of 2 milliamperes, and we want to use it as a voltmeter for use on power-supply devices which supply voltages up to 220. To determine the value of the resistance, necessary in series with the meter, we divide 200 by .002, and the quotient, 100,000, is the required resistance in ohms. If we place the milliammeter in series with a 100,000-ohm resistor across an unknown voltage, the needle will deflect over an angle proportional to the voltage. We have made a voltmeter in which the meter reads 2 milliamperes when the voltage is 200. Then, if the meter reads 1½ milliamperes, the voltage is 150; and, if the meter reads 1 milliampere, the voltage is 100. This calculation may be carried on throughout the complete scale.

It is not always possible to obtain accurate resistance units; so that it is in general, wise to calibrate the voltmeter to allow for errors in the fixed resistor. The calibration is accomplished by placing the fixed resistor and meter across the different known voltages, and plotting a curve showing the deflection of the meter for different voltage values. If no voltmeter is available so that comparative readings may be made, a new "B" battery can be used, since the voltage of a new battery is fairly accurate. Readings should be taken at 22½, 45, etc. It will not be necessary to calibrate the full scale of the meter, since the calibration curve will be a straight line. The graph should be made on ordinary square graph paper, with the milliampere readings across the bottom in units of one, and the voltage readings on the vertical side in units of 100.

The simple calculations above disregard the slight resistance of the milliammeter but, unless extreme accuracy is necessary, the results obtained will be sufficiently close.

A 350-Milliampere Power Unit

(Q. 2266). Mr. S. C. Jones, Urbana, Ill. writes: "I would like to construct an "A, B and C" power unit using the 350-milliampere gaseous rectifying tube. If possible, I would like to construct the transformer and choke coils. I am enclosing a copy of the diagram of my receiver, and would like to know also what changes are necessary to adapt this receiver for use with the power unit. Five 201-A-type tubes are used, with a 112-type in the last stage."

A. 1. You will find a circuit for such a power unit on this page; see Fig. Q. 2266A. As you may see, the rectifier tube is connected to the secondary windings of the transformer in the usual manner with an 0.1 mf. buffer condenser across each secondary section, to absorb any stray radio-frequency currents present in the rectifier tube or transformer. The output of

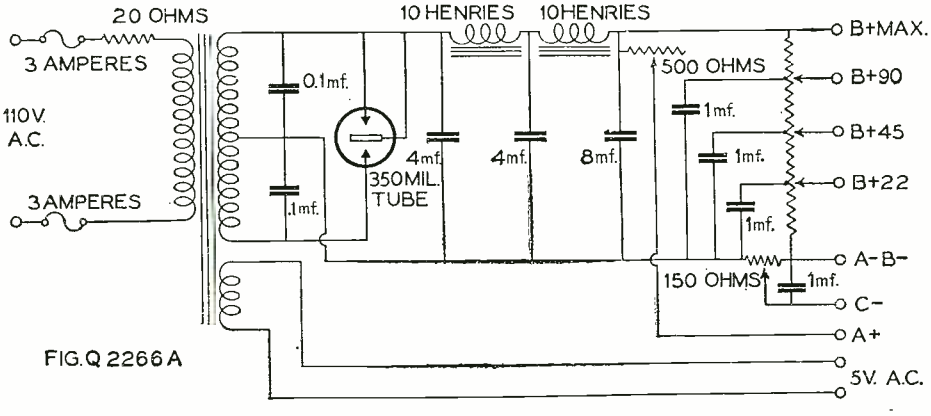


FIG. Q 2266A

The circuit of an "A, B and C" power unit using a 350-milliampere tube is indicated here. The 500-ohm resistor between the "B" positive and "A" positive should be able to dissipate at least 250 milliamperes.

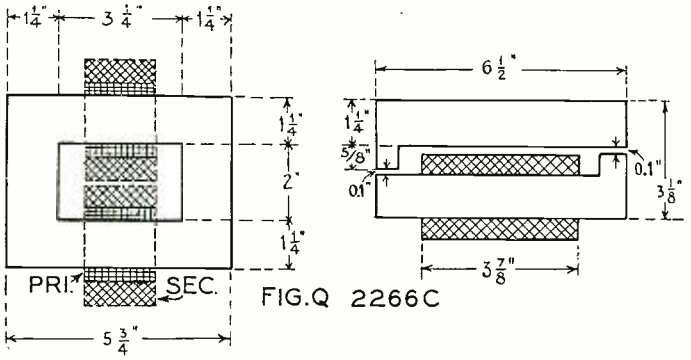


FIG. Q 2266C

The specifications of the cores for the transformer and choke coils are shown here. It will be noticed that two air-gaps of 0.1 inch are left in the opposite sides of the choke coil, in order to reduce eddy currents, which would reduce the inductance, and consequently the efficiency of the choking action.

the tube is passed through a filter system consisting of a bank of condensers, totalling 16 mf., and two 10-henry chokes wound with wire of a much larger size than is ordinarily used. Under average conditions, the unit will supply about 300 milliamperes at 200 volts, at the output of the filter.

The receiving set to be used with this eliminator must have its filaments wired *in series*. You will find the diagram of your 6-tube tuned-radio-frequency set, with the filament circuit changed to suit this power unit, in Fig. Q. 2266B. You will notice that the five 201A tubes are placed in series, while the 112 tube is operated from a separate winding on the power transformer. The five tubes in series will require 25 volts at 250 milliamperes, since each tube draws that current at five volts. As the output of the filter system is at, roughly, 200 volts, the remaining 175 volts must be absorbed by resistors in series with the tube filaments. Added to the 500 ohms, indicated for this purpose, is the 150-ohm resistance of the "C" biasing resistor. This resistor is placed in series with the negative terminal of the filter output; so that a total of 650 ohms can be used in series with the tube filaments to limit the current to 250 milliamperes.

The "C" biasing resistor is provided so that "C" voltage drop for the power tube can be obtained. The "A" current, in passing through the 150-ohm resistor, undergoes a drop in voltage; which can be used as "C" bias by connecting the grid return of the power tube to the negative side of the resistor. To regulate the various "B" voltages, a 7500-ohm wire-wound resistor unit is connected between the positive and negative terminals of the filter. By setting the slider taps at various positions, any "B" voltage up to the maximum of the filter output can be obtained for the plates of the tubes. When the "B" voltage taps are disconnected, the 7500-ohm resistor draws a steady current of about 25 milliamperes from the filter circuit. As soon as the sliders are connected, however, the plate circuits of the tubes in your receiver split the current flow into several paths, and very little current is carried by the resistance wire itself.

The Power Transformer

The construction of a power-transformer core is shown in Fig. Q. 2266C. Silicon-steel laminations, No. 28 gauge, are used for this purpose. On account of the extremely high current capacity, it is necessary to include some regulating device in the transformer circuit, to limit the surge of current when the transformer is first connected to the line. This may be accomplished by placing a 20-ohm resistor in series with the transformer primary, thus limiting the value of the starting surge current; or by designing the transformer with a high "leakage reactance," so the secondary voltage will be reduced from 320 volts at 350 milliamperes, to below 150 volts if the load is temporarily increased, as would be caused by a sudden surge on the input side. For a home-made transformer, the resistance method, while less economical of power, is the safest to use, and the transformer has been developed with this consideration in mind.

Using a resistor of 20 ohms in the primary, and a current of about 1½ amperes, approximately 30 volts will be lost by drop in the resistance; so that the transformer must be designed for an 80-volt primary instead of 110. For the core, sufficient laminations must be used to make a pile 1¾ inches high. Using the core dimensions given, the transformer coils are wound in two identical sections, one section being mounted on each leg of the coil. The primary winding is wound first over a piece of empire cloth and consists of 113 turns of No. 16 D.C.C. wire on each coil. After a layer of empire cloth has been wound over the primary, the high-voltage section is added; it consists of 932 turns of No. 25 D.C.C. wire. Over this secondary, with suitable insulating cloth between, is wound the filament-lighting secondary, for the receiving set's power tube; this contains 8 turns of No. 22 D.C.C. wire.

The coils are assembled on the core so that the beginnings of the two windings can be tied together, which places the two primary coils and the two secondary coils in series. In the case of the secondaries, the junction of the two secondary coils is used as the center tap, thus assuring an accurate electrical mid-point. The assembled transformer should be securely clamped at each end, insulating the clamps from the core with fibre or heavy cardboard strips. Do not connect the transformer directly to the 110-volt line without the resistor in series; since it will become quite hot if this is done. It may be more satisfactory to purchase this transformer; as difficulty may be encountered in obtaining the silicon steel, and ordinary sheet iron is not suitable for this purpose.

The Choke Coils

They are identical in construction, each coil containing 6,000 turns of No. 26 enameled copper wire, wound on a core whose dimensions are given in Fig. Q. 2266C. An air-gap of 0.1 inch is provided on each side of the core (at opposite ends as shown) to prevent saturation of the core and consequent lowering of the inductance. The D.C. resistance of each choke is about 160 ohms. This produces a total voltage drop of about 50 volts, with 275 milliamperes flowing through the windings. The choke coils and transformers should preferably be enclosed in grounded iron cases to prevent magnetic interaction. The filter condensers should be of a type capable of withstanding 300 volts D.C., and the two 0.1-mf. buffer condensers should have a 350-volt A.C. rating. The power unit should be thoroughly protected against overload by properly fusing the input leads. The normal power consumption of the unit is 1½ amperes, or roughly 150 watts. Two 3-ampere screw-type fuses should be connected in the primary leads. Do not use larger fuses than this size, since adequate protection will not be obtained.

If desired, the wire-wound resistors of 150 and 500 ohms can be replaced with Mazda lamps. Two 40-watt lamps in series will make a 600-ohm resistor with a current-carrying capacity of 350 milliamperes. If the current is in excess of 250 milliamperes, when the circuit of your receiver is set up, additional lamps in series can be added until the current is reduced to the right value. A 60-watt lamp has a resistance of 200 ohms, and a 100-watt lamp a little over 100 ohms. Lamps of 10- or 25-watt capacity should not be used, since they are not designed to carry current up to 250 milliamperes. The "C" biasing resistor can be made by connecting two 100-watt lamps in parallel.

The Uses of Choke Coils

(Q. 2267). Mr. E. A. Johnson, Marlboro, Mass., asks:

"The manufacturers seem to be using choke coils in their receivers, at present, more frequently than was the custom a few years ago. Can you explain the reason for this, and also supply information as to where they should be connected?"

A. 1. There seems to be an increasing tendency, in radio design, to separate the radio-frequency component of the plate current, in vacuum-tube circuits, from the audio-frequency and direct-current components. In the plate circuit of the ordinary vacuum tube, we have two distinct components in the current flowing; because the normal direct current from the plate to the filament, due to the emission of electrons by the latter, is varied by the application of an alternating potential difference between the grid

(*Continued on page 928*)

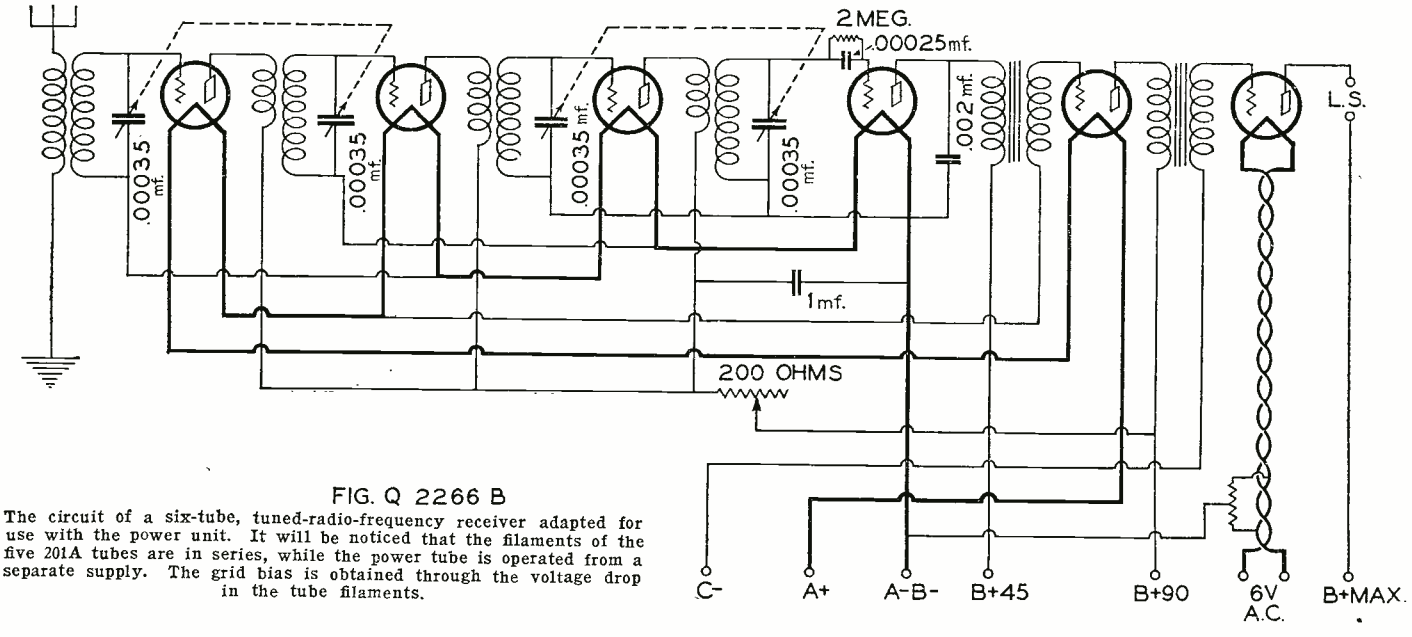
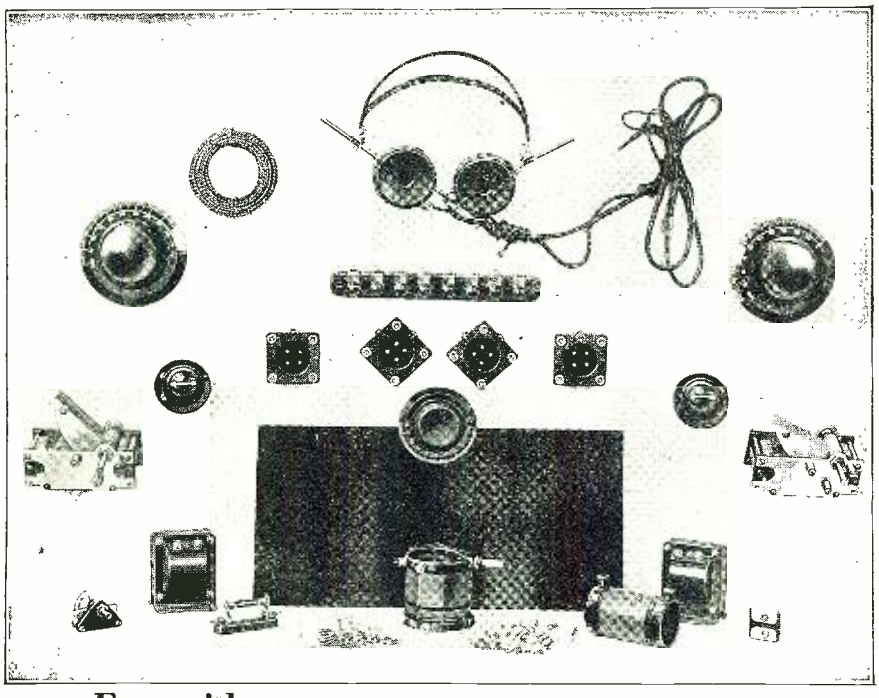


FIG. Q 2266 B

The circuit of a six-tube, tuned-radio-frequency receiver adapted for use with the power unit. It will be noticed that the filaments of the five 201A tubes are in series, while the power tube is operated from a separate supply. The grid bias is obtained through the voltage drop in the tube filaments.

LEARN RADIO and find



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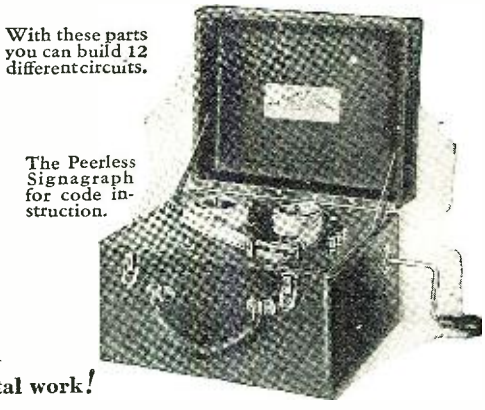

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Please send me your new catalog. I want to know more about your new radio course.

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"Capitol Family" Passes Fifth Birthday

(*Continued from page 877*)

—pathetic, happy or humorous—comes to the "Family's" headquarters in the theatre. Early in December of last year, Major Bowes read "A Little Journey"; eight verses, of which the last two were

"Why must there be hatred?
Greed and strife?
Do we need such shadows
Here in life?

"Tis a little journey
Soon gone by,
Let's be friends together
Ere we die."

At least a dozen estranged mothers and fathers wrote for copies of that poem.

One mother in a small Massachusetts town wrote the Major that she and her son had quarreled and that she wanted to send him that poem in the hope they would be reconciled for Christmas. The copy was forwarded to her and, at New Year's, one of the most treasured letters which the "Family" received was from this mother, who was happy once more. She penned her own gratitude, because her son had responded to the spirit of the poem and they had spent Christmas Eve together.

On another program, the "Family" heard "Around the Corner," carrying the idea that putting off calls until tomorrow and then tomorrow continues, until sad news comes and "around the corner there's a vanished friend."

The influence of broadcasting kind thoughts was emphasized by the number of those who wrote in to say that the program had made them realize their carelessness toward old friends and relatives, and that they had followed the admonition and had bridged the gaps which time had been allowed to make.

AGED AND FAR-OFF MEMBERS

So far as is known, the oldest listener to the Capitol programs is Mrs. Miriam Sparks Banister of St. Louis. On her most recent birthday, when she celebrated her 110th anniversary, the "Family" broadcast its best wishes to her. She is feeble and blind, but she is one of the "Family's" most enthusiastic members and never fails to tune in on Sunday nights.

Another Capitol "son" of ninety-seven years is John Brown of Gloucester, Mass., and because of his ardent adherence to the Capitol group he had a special number broadcast for him by Westell Gordon. He chose "The Bells of St. Mary's," and was quite proud when he heard his favorite sent out directly to him on the ethereal waves.

Those listeners comfortably seated in their own homes, near or far from the Capitol Theatre, never know under what circumstances and in what climate some other listener is made part of their group by the wonders of radio, which takes them all together to a little microphone in the Capitol studio at Broadway and Fifty-first Street, New York.

For instance, one December night, when the "Family" was thanking its stars for heat and comfort and hoping that its scattered members were also faring well, George S. Chuscher was joining the family for the first time, under considerable disadvantage. Here's how he writes of that initial reception of the Capitol programs:

ACROSS THE SEAS

"I have listened to your concerts, 3,000 miles away, and this may interest you. Picture an amateur wireless station situated among the hills of Scotland. The time is two a. m.; outside, a gale is roaring. Seated before a radio receiver an operator is anxiously turning dials and trying to pierce the barrage of static and ship-to-shore Morse traffic. After listening for thirty cold minutes, the operator stops to warm his benumbed hands and drink some hot coffee. It is bitter cold, there being no fire nor heat in the room, except that coming from an oil lamp. Back to dial turning again by the wavemeter; the receiver is tuned dead on to the wavelength of WEAF, when suddenly the static is cleared and behold over the ocean and hills comes the voice of one of the 'Family.' Muffled in a big overcoat, I listen during the 'Family' period. Sometimes lucky, often unlucky. Over here WEAF comes in fairly strong, modulation good, but night distortion and fading always take their toll. The 'Family's' voices were weak, but what a thrill they gave me and I want to thank you and to be one of your 'family' in this radio circle."

Besides WEAF, the stations which carry this Sunday night feature from 7.20 to 9.00, E.S.T., are WRC, Washington; WJAR, Providence; WWJ, Detroit; WCAE, Pittsburgh; WHO, Des Moines; WTAG, Worcester; KSD, St. Louis; WHAS, Louisville, Ky.; WSB, Atlanta; WSM, Nashville; WMC, Memphis; WGY, Schenectady; WOW, Omaha, and WBT, Charlotte, N. C.

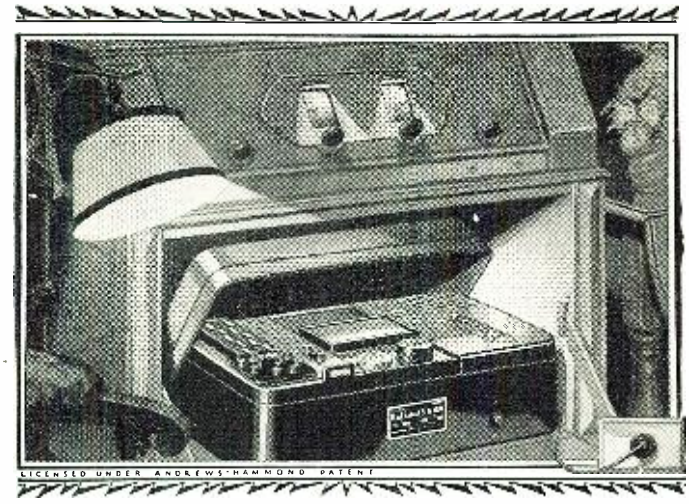
Now for a brief sketch of some of the best-known members of this huge "Family," which fills the air with talent and cheer every week.

THE HEAD OF THE FAMILY

To his multiple duties as managing director of the Capitol Theatre, the daddy of the "Family," Major Edward Bowes, adds the important one of serving as liaison between the theatre and the radio public. In 1918, in association with Messmore Kendall and others, he built the Capitol, then the world's largest theatre. The presentation of motion pictures is not the only phase of Major Bowes' activity in the industry. He was vice-president of the Goldwyn Pictures Corporation and, since its merger into the Metro-Goldwyn-Mayer Company, has served as vice-president of the consolidated company and a member of the executive committee. For his efforts as impressario for the "Family" radio programs, he was especially honored by the Sojourners at a dinner dance last June and presented with a jeweled sword by that organization.

ARTISTIC SONS AND DAUGHTERS

Every ear tuned in on these feature hours is familiar with the name of "Dr. Billy," otherwise known as William Axt. He began his studies in the National Conservatory of Music and went abroad, working with Dr. Paul Ertel in Berlin. Axt's operatic work began as assistant conductor under Oscar Hammerstein at the Philadelphia



Now AC Electric Radio

Licensed under Andrews-Hammond patent

To owners of a "B" eliminator:

Balkite "A" is like Balkite "AB" but for the "A" circuit only. It enables you to make an electric installation at very low cost. $35.

Balkite "B"

The accepted, tried and proved light socket "B" supply. One of the longest lived devices in radio. Three models, $22.50, $35, $42.50.

Balkite Chargers

Standard for "A" batteries. Noiseless. Can be used during reception. High rate or trickle. Three models, $17.50, $9.50, $7.50.

There are special models for 25-40 cycle current at slightly higher prices. Prices are higher West of the Rockies and in Canada.

Without the uncertainty of untried apparatus

And without any sacrifice in quality of reception

Of course you want an AC electric receiver. For its convenience. Now you can have it, without the uncertainty of untried apparatus and without sacrificing quality of reception.

Simply by adding Balkite *Electric* "AB" to your present radio set. Balkite *Electric* "AB" replaces both "A" and "B" batteries and supplies radio power from the light socket. It contains no battery in any form. It operates only during reception. It makes any receiver an electric set.

This method makes possible the use in electric reception of standard sets and standard type tubes. Both are tried and proved, and give by far the clearest and truest reproduction. With this method there is no waiting for tubes to warm up. No difficulty in controlling volume. No noise. No AC hum. No crackling or fading of power. Instead the same high standard of reception to which you are accustomed.

In this method there is nothing experimental, nothing untried. It consists of two of the most dependable products in radio—a standard set and Balkite. And if you should already own a radio set, the cost of equipping it with Balkite is only a fraction of the cost of a new receiver.

By all means go to AC reception. Its convenience is the greatest improvement in radio. But be as critical of an AC receiver as you would of any other. Let your AC receiver be a standard set equipped with Balkite *Electric* "AB." Then it will be as clear and faithful in reproduction as any receiver you can buy.

Two models, $64.50 and $74.50. *Ask your dealer.* Fansteel Products Co., Inc., North Chicago, Illinois.

Chicago Civic Opera

on the air Thursday Evenings, 10 o'clock Eastern time. Over stations WJZ, WBZA, WBZ, KDKA, KYW, WGN, WMAQ, WBAL, WHAM, WJR, WLW, WENR. 10:30 Eastern time: WEBH, KSD, WOC, WOW, WCCO, WHO, WDAF.

BALKITE HOUR

Balkite ELECTRIC AB

[contains no battery]

Opera House and continued until that impresario sold out to the Metropolitan. Victor Herbert then appointed him conductor for Emma Trentini in "Naughty Marietta;" and later he conducted for Alice Neilson, when that famous singer made her last attempt at light opera.

About this time, Morris Gest engaged him for the Century Theatre, where he conducted the big productions for three years. When the Capitol first opened he was chosen to assist in putting on the operatic numbers. He has been in charge of the training and coaching of the soloists and the preparation of the vocal numbers. He is rapidly gaining a reputation as a composer.

"Our David," as Major Bowes calls David Mendoza, is the youngest conductor of a large symphony orchestra. He began his studies at the age of seven, studying the violin with Franz Kneisel. During his career he was with the Russian Symphony for two years as a first violinist, and later with the New York Symphony in a like capacity.

Discarding the bow for the baton, he served his apprenticeship as a conductor in several motion-picture theatres on Broadway and, until Roxy organized his orchestra, had the distinction of conducting the largest theater orchestra in the world.

Prominent among the younger generation of musicians now attracting attention in New York is Eugene Ormandy, associate conductor of the Capitol Grand Orchestra. He has been affiliated with this group for the past four seasons. Born in Budapest and a pupil of Eugene Hubsy at the age of three and one-half years, Ormandy completed his studies ten years later, winning the prize medal of the Royal Hungarian Academy of Music. He gave his first concert when only nine years old, and at the age of nineteen received an invitation to play before the Royal Family in Vienna. Soon afterwards he was appointed court virtuoso by Archduke Josef. The World War limited his concert activities to Central Europe, where he gained much fame as the soloist of Berlin's popular Bluethner Orchestra. After the war, he came to America and has been a member of the Capitol "Family" ever since.

If a canvass of all the feminine artists on the air were made, it is doubtful if one would find a much more popular voice than that of Caroline Andrews, the "lark" of the group. She can boast of musical connections with such organizations as the De Koven Opera Company, the Philadelphia Opera, the St. Louis Municipal Opera and the "Student Prince" operetta. She began backstage at the age of five with the company in which her mother was singing. Her coloratura voice is really a delight, whether heard in an ambitious operatic aria or in a simple ballad or folk song.

Another young artist recently added to the "Capitol Family" is Sylvia Miller, youthful soprano. Although only sixteen years old, the natural beauty and unusual power of her voice have attracted much attention. She first came to public notice by winning the first gold medal in New York's music week. The award was made by a committee composed of Alma Gluck, Sophie Braslau and other stars.

Max Herzberg, pianist, began his studies with Rafael Josefy, Rudolph Ganz and, later in Germany, with Bussoni. He studied theory with Max Spicker and in 1905 toured as Schumann-Heink's accompanist. For two years from 1913 he was musical director for Victor Herbert, and he served in the navy during the war. From 1919 to 1922 he spent in Germany and in 1924 joined the Capitol staff as assistant musical director. The piano duets by "Dr. Billy" and Max are one of the popular features on these programs.

Marjorie Harcum is an attaractive contralto, who came to New York from Richmond, Va. By sheer hard work and perseverance she won a following for herself at the Capitol and has entrenched herself as one of the popular members of Major Bowes' artistic family.

When the Major announces that Westell Gordon, tenor, cellist and composer, is to be featured, he can always be assured of an attentive listening public. In the period of less than a year since he joined the Sunday night group, Gordon has proven himself a versatile and valuable addition to the circle. He is a son of the late James Westell, well-known London publisher, who was an intimate friend of Gladstone. He has toured the world in concert and his repertoire includes many ballads of his own composition.

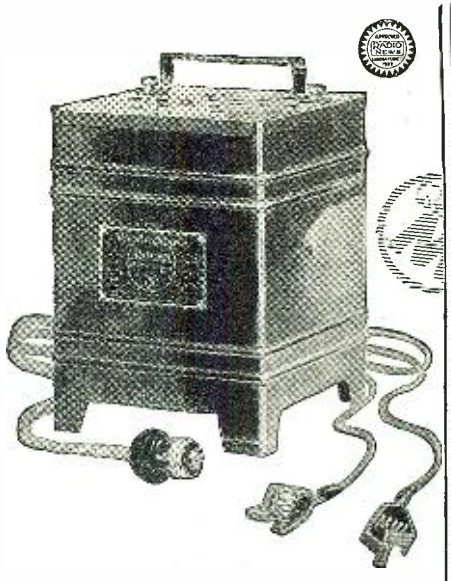
One of the "Family's" most remarkable artists is Yasha Bunchuk, Russian cellist. A pupil of the Petrograd Imperial Conservatory and a protege of Glazounoff, the famed Russian composer, he achieved an European reputation through appearance in England, France, Austria and Germany, prior to the war, in which he participated.

He arrived here two years ago and made his American debut in the Town Hall, New York. He instantly received recognition and is now a featured artist of the Victor Phonograph Company. His Guarnerius cello, which is 350 years old, and valued at $18,000 was presented to him by General Limoff, then commander of the Russian Army, when he completed his studies in the University of Petrograd.

These are just a few who have become familiar to America as artist-members of the "Capitol Family" and who have helped, by their talent, to swell the size of the Capitol circle to a gigantic clan of Sunday-night, stay-at-home music lovers.

Change one Rectigon lead—

for either trickle or high-rate charging



HERE'S a home charger that trickle charges, too! Rectigon has *two* charging rates. Under ordinary conditions, the low rate, "trickled in" during the hours that the radio is idle, will keep your "A" battery strong and efficient. Then, for occasions when prolonged use of the set drains more power than a trickle charger can replace, Rectigon's high rate charge will put your battery on its feet. Another change of terminals and you charge your wet "B". Also charges your automobile battery. *All with one charger*—Rectigon.

3 Ampere Rectigon
~~$18.00~~
now
$14.00

5 Ampere Rectigon
~~$28.00~~
now
$24.00

Remember — Rectigon is a Westinghouse product. It's safe. Has no moving parts to break or wear out—uses no acids or chemicals. Does no harm if you accidentally tune in or if the power company shuts off the current while you're charging. Rectigon is an economical charging outfit—to save you from continual charging station expense. At your dealer's.

Westinghouse Rectigon Battery Charger

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA.
Offices in All Principal Cities ✓ *Representatives Everywhere*
Tune in with KDKA—KYW—WBZ—WBZA

Rectox—for trickle charging only. Connect it permanently to your wet "A" battery. Every time you turn off the set, let Rectox put in new power for the next program. Trouble free—uses no acids or chemicals, has no moving parts. Adjustable to ½ and ¾-ampere rates.

Besides Rectigon and Rectox for better battery charging, Westinghouse also makes Micarta panels and tubing for better insulation, and radio testing instruments for better reception.

I Want To Know

(*Continued from page 922*)

and filament of the tube. It is often found that beneficial results are obtained if the two components are kept distinct in R.F., as well as in A.F. circuits, and there is therefore an increase in the endeavor to separate them.

The usual method adopted to achieve this result in radio-frequency circuits is to connect a radio-frequency choke coil and a condenser in the plate circuit; so that the R.F. component of the current will be forced to go through the condenser circuit. The choke is designed to offer *a very high impedance to any radio-frequency variation of current,* but a resistance to direct current so low that it does not affect the "B" supply appreciably.

On the other hand, the coupling condenser forms a complete barrier to the direct component of the plate current, but offers a comparatively low-impedance path to the varying currents caused by the radio-frequency signal.

A "choke coil" is simply an inductance coil, of a value suited to the particular conditions encountered. It is well known that an inductor offers no impedance whatever to a steady direct current (neglecting, of course, the small resistance of the wire); but, if the current varies in any way, then opposing voltages are built up in the field of the coil and tend to restrict the variations of the current. In other words, an inductance coil always tends to maintain the current at a steady value. The magnitude of the choking effect in any circuit depends both upon the inductance and upon the frequency. Consequently, in order to provide a suitably high impedance, at very high frequencies, such as those used for broadcasting, comparatively little inductance is required.

In some cases a choke can be used successfully, even though it is not tuned to the exact wave of the incoming signal, when the effect is at maximum. A particular case is that of a choke coil which has a natural wavelength of about 1500 meters. This coil exercises a considerable choking effect at ordinary broadcast wavelengths although, really, in such cases it is acting like a small capacity with a resistance in parallel. The direct "B" current, of course, flows entirely through the resistance; but the radio-frequency current finds the small capacity too great a barrier and seeks alternative paths. Of course, if the capacity were very large, say as much as .0001-mf., then the choking effect would vanish altogether; but, since the self-capacity of the coil windings is comparatively small, an appreciable impedance is offered to the radio-frequency currents.

This arrangement has the advantage that it can be used over a very wide band of frequencies. The usual method of connecting a radio-frequency choke in the plate circuit of a vacuum tube is shown in Fig. Q. 2267A.

Sizes of Chokes

The only important difference between R.F. and A.F. chokes is the frequency to which they are tuned. Radio-frequency choke coils are tuned to frequencies generally between 500,000 and 1,000,000 cycles; while audio-frequency chokes are tuned to frequencies between 100 to 5,000 cycles. An audio-frequency choke coil should offer an impedance very high at audio frequencies, but should be of a resistance sufficiently low so that direct current for the plate circuit is not unduly reduced. Since the inductive reactance of such chokes varies according to the frequency, it is a difficult matter to obtain sufficient reactance to act as a stop for the very low frequencies. As an example, a choke, to offer a certain reactance in ohms at twenty-five cycles, would require about eight times the inductance of a choke offering the same reactance at two hundred cycles. If the low frequencies are to be held back, a very large coil is required. Audio-frequency chokes always have an iron core. They are generally formed with layer windings of enameled wire, although cotton-covered wire is more satisfactory from the standpoint of low distributed capacity. The gauge of wire employed is determined by the maximum current used. Audio-frequency chokes are made with an inductance between twenty-five and five hundred henries; the inductance depending, of course, upon the circuit in which the choke is to act. The audio-frequency current will divide, in proportions inversely related to the impedance, between two or more possible paths, the greater part of the current flowing through the path of least impedance.

Audio-Choke Coupling

The method of coupling an audio-frequency amplifier, so that the audio-frequency current will be forced through the condenser, is shown in Fig. Q. 2267B. In this case, the output of a preceding stage is connected to a loud speaker, or to the grid of the next tube, through a condenser of suitable capacity. The choke coil is connected in the "B" battery lead to prevent the audio-frequency currents from leaking off to the ground through this battery. The choke coil must be large enough to keep the very low-frequency signals back, as well as the higher ones, or the quality of the reproduction will be seriously impaired.

Another very important use of the choke coil is in the filter circuits of power-supply units. In this case it is used to filter out the hum of the power line. These chokes always have iron cores and are built in sizes of from ten to over one hundred henries. The wire used must, naturally, be of a size capable of standing any current which is liable to be sent through it. To prevent saturating the core in cases where large amounts of current are used, one or more air gaps are often built into the cores. The total air gap must be wide enough to avoid magnetic saturation of the core, which would prevent normal or proper action. Yet the gap must not be

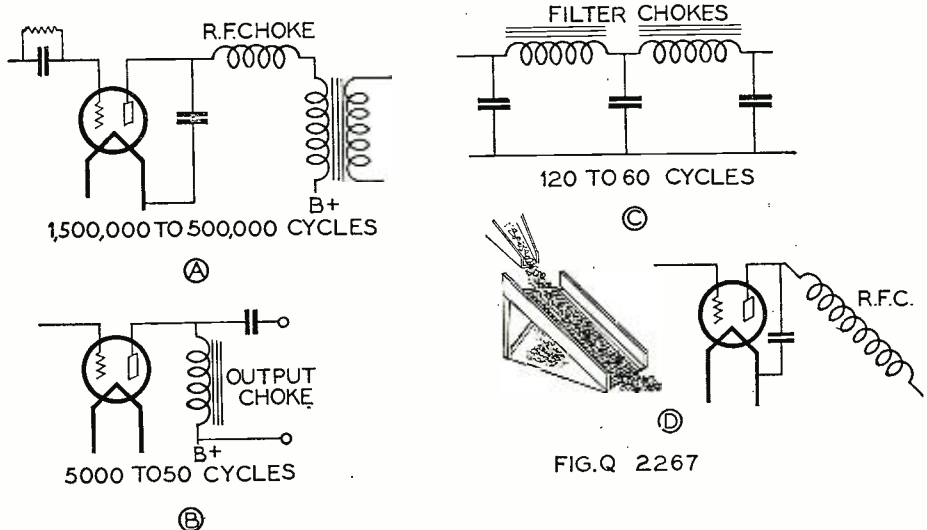


FIG. Q 2267

The purpose of a choke-coil-and-condenser system is to provide paths which offer different impedances to different frequencies, and therefore direct them almost entirely into different circuits. At A the choke is used to keep R.F. impulses from A.F. circuits, at B to separate the direct plate current from the A.F., at C to suppress the A.C. hum. In D a mechanical analogy to the electrical filter is shown.

The Favored Radio Authority in 314,000 of the Most Responsive Homes of Greater New York

THE EVENING WORLD was the first newspaper in New York to establish a Radio Department. When Radio was an experiment, when its present development was undreamed of, it was THE EVENING WORLD that *first* sensed its importance and gave it the recognition due a new force destined to revolutionize entertainment, instruction and the dissemination of news the world over.

This leadership THE EVENING WORLD has never relinquished.

Under the editorship of Captain Robert Scofield Wood, THE EVENING WORLD prints every Thursday a Mid-Week Radio Section second to none in America for its deep interest to the Radio fan.

It has *humanized* the Radio receiving set. It discusses the programs of the principal stations in a manner in which they have never before been handled. In this respect, it has increased the *value* of a Radio set by building up a new interest in it and a better understanding of its possibilities.

Of more importance to the Radio manufacturer, however, is the mass of merchandising information which has been assembled by the Research Division of the Advertising Department.

The Radio advertiser can hereafter approach the New York market—the largest market for sets and parts in America—equipped with the most complete information covering the city's sales possibilities.

Through a survey of Greater New York made by New York University, THE EVENING WORLD is prepared to lay before any Radio advertiser data governing distribution of population and buying ability never before available. Its merchandising maps simplify every step necessary to the successful invasion of this vast market, and inquiries are invited from manufacturers contemplating a New York campaign.

The Evening World

PARK ROW, NEW YORK

Radio Section Every Thursday

so wide as to reduce the inductance below the required minimum. See Fig. Q. 2267C.

The operation of a choke coil may be described by an analogy which, though not entirely exact, may be useful for this purpose. The ordinary screen sifter (Fig. Q. 2267D), used to separate crushed stone or gravel into sizes, may be compared in its action to a choke coil and condenser in the plate circuit of a vacuum tube. The short-wave, high-frequency impulses which pass the condenser are represented by the fine dust, sand, and water which drop through the holes in the metal screen. The large stones, which cannot fall through the openings in the sifter, may be compared to the direct current and very-low-frequency (long-wave) impulses, which are blocked by the condenser and pass through the coil from end to end.

Symbols—The Shorthand of Radio

(*Continued from page* 890)

generates a flow of electricity. This is used in scientific apparatus as a very delicate form of thermometer. In addition to this, such devices have been constructed to supply direct current to radio apparatus. While their use may not become general, the symbol is here indicated for the benefit of our readers.

PICK-UPS: The increasing popularity of phonograph attachments, which work through the radio-set amplifier, has brought about a demand for symbols indicating these various types of electrical "pick-ups." The two commonest types, the magnetic and the capacity, are shown here.

SHIELDING: When shielding is indicated in a circuit diagram, the question often arises, whether the enclosed apparatus is connected in any way to the shield. This will be indicated by a heavy dot at the point where the wire or apparatus leaves the shield; otherwise, the shield is insulated from the parts which it contains. The grounding of a shield, or metal case enclosing apparatus, is indicated by a ground symbol; though the connection may be made through other apparatus or the metal framework of a receiver.

PERIDYNE: While these symbols cover practically all needs in diagraming modern radio equipment, special cases arise from time to time. One of these is a recent one, the introduction of the Peridyne system of compensation. In this device the inductance of a coil is varied by the movement of a grounded plate, as shown.

LIGHT-SOCKETS: As the "electrification" of sets, by the use of house-lighting current, becomes more frequent, symbols indicating such connections will become more common. They are indicated; also, as RADIO NEWS has hitherto used heavier lines in circuit diagrams to indicate the filament circuits, with their heavier current, and to facilitate tracing these connections, heavy lines will be used also for *the power* leads in socket-power units and A.C.-operated receivers. In special cases, whenever the future progress of radio invention requires additional symbols, these will be explained in the article in connection with which they appear.

How the Shielded Grid Tube Obtains Its Sensitivity

(*Continued from page* 897)

PLATE OR GRID

The way in which the space-charge effect is overcome is the simple one of putting *a positive charge at the point where the negative charge accumulates,* or near that point. In other words, we introduce a fourth electrode into the tube, having no purpose in the radio circuit; it is simply devised to perform *a part of the work of the plate,* but to do this more efficiently because of its being nearer the troublesome cause.

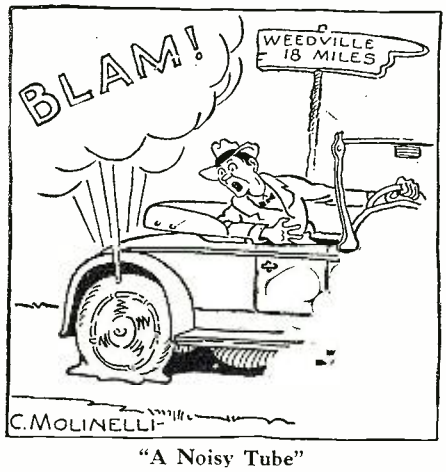
It is apparent that this new electrode must surround the filament, and that it must be open to permit electrons to fly through it. In other words, it may be another grid, an open winding or network.

It is further apparent that if, say, 77 volts of the plate potential is used in overcoming the space charge, the voltage required on the new electrode would, similarly, be 77 volts if it were as far away as the plate now is; about 10 volts if it were only half as far away, and only 3 volts if it were one-third the distance away.

All we need, then, is another grid placed a short distance from the filament and connected directly to a positive tap on the "B" battery. There is no other change in the circuit. We have not changed the grid and plate of the tube proper, and so have not affected the grid-to-plate capacity. We have not increased the tendency of the tube to oscillate and the tube is therefore just as good a radio-frequency amplifier as it ever was. We have increased the amplifying value and we have taken away the necessity for so much plate voltage.

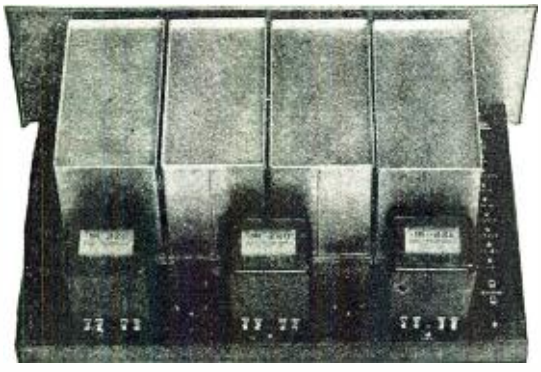
If, however, this new grid is put between the old grid and the plate and is kept at a constant positive potential, the effect is that of putting a grounded plate between the two plates of a condenser. We have split up the grid-to-plate capacity into two capacities *in series with each other;* giving a resultant grid-to-plate capacity of the tube far lower than it is now (see Figs. 7 and 8). That means, of course, that here is a detector or radio-frequency amplifier which is far more efficient and far more easily controlled than anything we have had heretofore.

Radio Term Illustrated



"A Noisy Tube"

SM



We Could Charge More—But a *Better* Transformer Can't Be Made

Imitated everywhere—never equalled—the S-M 220 audio transformer stands out today as the finest for audio amplification that money can buy, just as it did when introduced a year and a half ago. The 220 has been copied in one or more of its characteristics by every high-grade transformer put on the market since then—in the rising low note or in 5,000 cycle cut-off features first offered by S-M. That's proof that the principles the 220 introduced are right—that the market is still trying to catch up with the leader.

Don't be misled by exaggerated claims—for it takes plenty of core and wire to make a good transformer. The 220 has from 25 to 50 per cent more steel and copper in its construction than any other transformer on the market. That alone means the high primary impedance through which real bass note amplification is made possible.

That's why S-M 220's and 221's are specified in more popular receiver designs—why they have outsold every other transformer in their price field. That's why they're sold on an unconditional money-back guarantee to give better quality than other audio amplifying devices.

We could charge from 25 to 50 per cent more than we do, but at no price can you get a better transformer. The 220 audio is $8.00, and the 221 output is $7.50. They are priced low, but, you can't buy a better audio coupler for there are none finer.

We can't make the 220's cheaper, but if you desire a transformer somewhat lower in price, taking up a little less room, and with a little less core and wire, the new 240 audio and 241 output transformers are available—superior to most other transformers and far and away ahead of everything in their price field. They have the same general characteristics as the famous 220's and 221's, are the second largest A. F. transformers on the market and provide slightly less accentuation of frequencies below 80 cycles. They have the same 5,000 cycle cut-off for which 220's are famous, eliminating the objectionable whistles and heterodyne squeals of congested broadcasting. The 240 audio sells for $6.00, and the 241 output is $5.00. Hard to beat at any price, they are impossible to *equal* at these prices. And—you can bring your old set up to the minute using them—they're small enough to fit anywhere.

The Most Remarkable Receiver Ever Developed!

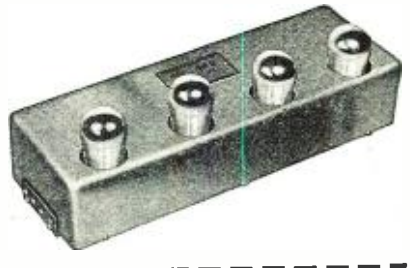
COMPARE a Shielded Grid Six with any receiver you ever heard of, tuned radio frequency set or super-heterodyne, irrespective of price. The Shielded Grid Six is better in all-around performance. Its distance reception possibilities are unparalleled. It is more selective; it has a finer tone—in fact it is so much better in every respect that there is no comparison at all. You can build either loop or antenna model in one evening, and if it will not out-perform any receiver you ever heard—*in every way,* to your satisfaction—return it and get your money back.

The 630-LSG is the generally preferred loop model. Operating in a steel apartment hotel in the heart of Chicago it will bring in either coast consistently—every night of the week and through the local barrage. The 630-SG (for short antenna operation), located at all favorably, will give a 2,000-mile consistent loud-speaker range on a twenty-foot antenna. The sensitivity of either model is so great that stations within 1,000 to 2,000 mile radius come in with loud-speaker volume. Your log with either model will look like a telephone directory—fifty or seventy-five stations in a single evening is just average results. The Sixes go right down to the noise level, do not repeat stations on the dials, and a new station will be found on almost every dial degree. Powerful locals never spread more than two or four dial degrees at the very most.

This is the kind of performance *you* can expect. The 630-SG for antenna use is $97.00, and the 630-LSG for loop operation is $91.50. Both are sold under the unqualified guarantee to out-perform anything you ever heard before. You can get either model custom built to your requirements if you so desire, laboratory assembled and tested.

The Famous 440 Time Amplifier

With a greater degree of selectivity, with a greater amplification factor—the 440 Jewelers' Time Signal Amplifier offers possibilities never before realized in long-wave amplifier construction. It is more accurate—with a finer degree of calibration—than any long-wave amplifier that may be built from standard parts today. It's so good that it simply can't be beaten—with any combination of individual parts or anything else. It is housed in a copper and brass catacomb which completely and individually shields the three radio frequency and detector stages. The 440 Time Signal Amplifier is tremendously popular already, for thousands have been sold this season, simply because it's the best long wave amplifier ever developed. It is tuned exactly to 112 K. C., the 2677 meter wavelength of the Naval Observatory station at Arlington (NAA). Price $35.00.



We can't tell you here all about th new S-M developments. If you will send us 10c we will give you more authentic information about Shielded Grid receivers, A. C. operation, real audio amplification, how to use a 210-tube in your set, and phonograph amplification, than you can hope to read in a week (blueprints and building instructions are 25c. per set).

SILVER-MARSHALL, INC.,
848 West Jackson Blvd., Chicago

Please send me all data on the new Shielded Grid Shielded Six, the 440 Time Amplifier, real audio amplifiers, and the new developments on A. C. operation, for which I enclose 10c. postage. Also: Blueprints and instructions for

630 Shielded Grid Sixes.....25c
Universal all-wave tuner.....25c

Name.....

Address.....

SILVER-MARSHALL, INC.

848 West Jackson Blvd. Chicago, Ill.

Radio Control Without Wires

(*Continued from page* 892)

teries or socket-power devices, which can be hidden in a closet along with the rest of the apparatus, except the portable control and the loud speaker. The latter can be arranged so that when it is plugged into a jack, it will turn on the filament current to the tubes, which will be cut off when the speaker plug is withdrawn. This may be easily done with a filament-control jack. Any number of these jacks may be distributed about the house, wired in parallel; so that, no matter in what room it is desired to have music, the loud speaker and the control box are all that it is necessary to carry there. There is little doubt that the radiations from the control box will be strong enough to operate the receiver from any point in an ordinary-size house. If the area to be covered is greater than that of the average eight-room house, then more powerful tubes can be used in the control box which, of course, then would have to be enlarged to accommodate the different batteries.

The band amplifier should have at least three stages, so that the entire waveband will be satisfactorily covered and amplified sufficiently. The transformer in the first stage can be made to cover the frequencies between 200 and 350 meters; that in the second, those between 325 and 450 meters, and the last stage, between 425 and 550. In this way, no matter where the signal lies in the broadcast band, it is amplified and retransmitted to the control box.

The single-frequency receiver, which we have assumed to be operating on 540 kilocycles, can be any standard broadcast receiver. Most of the sets that are being built at the present time tune slightly above and below the broadcast waveband. It is only necessary to tune the set once to the frequency at which the oscillator is working and allow the controls to rest in those positions. In reality, no matter how many controls the set has, they are reduced to one by employing the control box.

The Somersalo Frequency-Filter System of Tuning

(*Continued from page* 895)

far greater than in the preceding filter stages. This may impair the tuning in all except the last stage, but is easily remedied by the insertion of a resistor in the grid lead of the first tube to reduce the feedback.

DESIGN OF A RECEIVER

A practical amplification of the Somersalo system is shown in the complete circuit diagram, Fig. 2. Here we have a typical six-tube set, consisting of three stages of R.F. amplification, detector, and two stages of transformer-coupled A.F. amplification.

The method of tuning or "selection" is clearly shown in the shielded filter system on the left. After passing through the filter without any appreciable loss, the selected signal is amplified by the untuned R.F. stages, whence it passes to the loud speaker (L.S.) in the usual manner via the detector and the A.F. amplifier.

It will be seen from the foregoing brief description that Dr. Somersalo's frequency-filter system presents interesting possibilities, especially so since it is claimed that it does not infringe any existing patents.

The writer has operated a six-tube set built to Dr. Somersalo's specifications, and it proved a revelation in selectivity, sensitivity, volume and ease of handling.

(*At this writing,* Radio News *has no available data on the physical dimensions of the various R.F. transformers employed in the circuit shown on page* 895; *therefore, we must request that readers refrain from writing to us for this information. The coils in the frequency-filter system are quite similar to those employed in standard R.F. sets; we suggest that constructors who desire to work on this idea experiment with any coils they have on hand, adding and removing turns from the primary windings until satisfactory inductance values are obtained.*—Editor.)

Radio Has Made "High-Brow" Music Popular

(*Continued from page* 884)

them from the experience of listening. The overwhelming majority of the public had to take this talent for granted, to accept the decisions of critics and the approbation or condemnation of the choice ones who knew.

And then came radio!

Now when a million people say that Rosa Ponselle has a beautiful voice, they may not be expressing expert opinions, but they know they are expressing their own emotional reactions. They have felt the magic of her rich tones. How long would it take John McCormack in a concert season to reach a million of his admirers, directly, with his voice? A sufficient number of times to make a rest cure necessary from overwork at the end of a tour. A few years ago, on New Year's night, he stood before WEAF's microphone and the greatest audience of his whole career, the greatest audience which had ever listened to any one artist, heard every note of his concert. And that was the beginning of a popular and widespread musical appreciation in America.

Remember the furore which was made over the first efforts of broadcasters to put high-class music on the air? And the enthusiastic reception it received, beyond all expectations and emphasized by the ton of

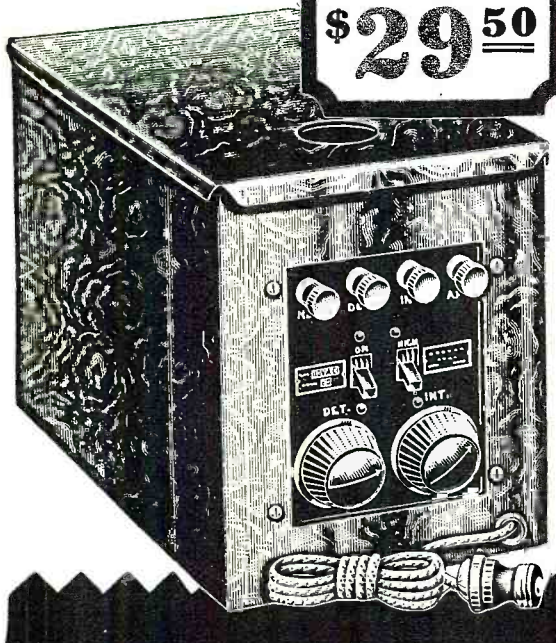
$1 DOWN Brings You Guaranteed "A" or "B" Eliminator

Electrifies Any Radio

Completely Replaces Batteries

No Battery
No Charger
No Bulbs
No Hum
Nothing to Wear Out
Or Replace
COMPLETE
$32.50

Completely Replaces "B" Batteries
Easy to Attach Plug Into Electric Light Socket
COMPLETE
$29.50



Super-Power "A" Eliminator

UNCERTAIN storage batteries with their changing power, chargers and other bothers and expenses are done away with. This eliminator is **not a battery charger combination** but **completely and permanently replaces "A" Batteries.** It consists of a large capacity rectifier which changes the alternating house lighting current into direct current. Then a highly efficient heavy duty filter system of extremely high capacity changes the pulsating direct current from the rectifier into smooth, even current for lighting the filament in the radio tubes. Smooth, constant, unvarying, humless current for your radio. Anyone can install this eliminator in a few minutes. Simply connect between electric light socket and the radio and your set is instantly supplied with current used only when it is in use. Works perfectly whether used daily or only at long intervals. No moving parts to wear out. Operates from light socket 110-120 volts, 50-60 cycle A. C., output 6 volts for all sets up to 10 tubes with or without power tubes. Fool-proof in operation. Now sold direct at astonishingly low price.

Super-Power "B" Eliminator

Used with any good "A" Eliminator, this "B" Eliminator completely electrifies any radio. Battery troubles are forever ended. You operate your radio as easily as you turn on a light.

Complete with Raytheon Tube — This Super-power **"B" Eliminator** can be used with any set up to 12 tubes. It comes complete with full wave rectifying 125mil. Raytheon tube, making possible the delivery of great current at a high voltage. This Raytheon tube has indefinite life as it has no filament to burn out. Delivers up to 180 volts.

The case is beautifully finished in olive green Duco with black panel etched in gold. Equipped with rubber-covered cord and socket plug. High voltage taps and variable adjustments enable the use of new power tubes. Operates from 110-120 A. C., 50-60 cycle current. Has tap for intermediate voltage on which 67½ to 90 volts may be obtained. The detector tap will supply 22½ to 67½ volts. Variable adjuster will deliver any desired detector voltage. On and off switch and high and low voltage switch are intregal parts of the eliminator. No additional switches or cords are necessary.

Only $1.00 Down—Then Test Before You Buy

Indicate on the coupon below which eliminator you wish. Pin a dollar bill to the coupon and mail it to us. We will send you the Eliminator you want to test. If you want both eliminators send two dollars and mark coupon accordingly. You test them for 30 days before you pay another cent. Balance on easy installments when you are satisfied.

New Low Prices

Our great buying power and direct sales method enables us to offer both eliminators at tremendous savings. The "A" Eliminator easily worth over $40.00 and more can be had here for $32.50---only $1.00 and balance on easy payments. The "B" Eliminator sells for the cash price of $37.50 and more but by buying direct on easy payments you can have if for only $29.50.

Elliott Radio Corporation

709 West Lake St. Dept. 399. Chicago, Illinois

Mail Coupon NOW!

Mail This Coupon NOW!

Elliott Radio Corporation, Dept. 399
709 West Lake Street, Chicago, Ill.

Attached find $1.00 for which you agree to send me ( ) "A" Eliminator at $32.50 ( ) "B" Eliminator at $29.50 (send $2.00 if both are desired) as described in your ad. Full particulars will be sent me by return mail and my money refunded if I do not accept your offer.

Name.....

Address.....

City..... State.....

mail that flooded station WEAF and the company which sponsored the programs.

Atwater Kent may have popularized his own radio receiver with the imposing weekly programs he has sponsored through the National Broadcasting Company; but he has been also one of the most important factors in advancing the cause of good music on the air.

EDUCATION FOR THE MASSES

How can any human being ever be blasé about the wonders of broadcasting when he realizes that the isolated lumberjack, sitting down to his crude meal of canned billy and hard bread, may mellow his supper with the greatest music the world has ever offered? How can any one accept as a matter-of-fact the radio programs sent out today, when he knows that men, women and children to whom finer music was an unknown thing now have the best of it in their daily lives?

And does the vast public really want the best in music, or is it satisfied with any second-rate entertainment which may be presented? The answer is plain. The response to the high type of musical program is not limited to those who have always had good music. They are the sort who, while they appreciate it and are sympathetic listeners, take the programs somewhat for granted. The great majority of writers who pen their thanks to the broadcasters after an important musical event on the air are the industrial workers in big cities, the farmers in the rural regions.

In spite of all generally-accepted theories to the contrary, the middle classes of America are being coated with culture and the germ of this culture, which is carried on the radio waves, is penetrating far deeper than the surface. They may be untutored in knowledge of the art of the brush and paint, they may be ignorant of the value of classic lines in clay, but when it comes to the notes of music, they know their operas and they know their artists.

All the loudly-spouted and vehement denunciations, of the commercially-obsessed nation that we are supposed to be, have been a boomerang to the denouncers. What the small cultured groups never could do, American commerce and industry have accomplished. A new coffee, a paint, a battery or a baking powder rides into a million American homes on ether-carried slogans and remain a household word. But how does it get there? On the wings of art! It is the program, commercially sponsored by the manufacturers, producers and distributors of utilities who have used music as a bait for attention and who have indirectly furthered their own interests while they have done more for the general advance of music than any of those who have sneered at them.

THE CONQUESTS OF RADIO

The artists of international reputation who have not appeared on broadcast programs are in a small minority. Four years ago, the Metropolitan Opera officials frowned on radio. The artists under their management were prohibited from broadcasting and, even though some of the more progressive ones were anxious to test their voices on the air, they were restrained from so doing. Then all restrictions were swept aside. Not only did the business management of musical art endorse the idea of radio concerts, but it went to great lengths to have some part in the lucrative field which suddenly opened to them.

Nowadays the listening public doesn't even get excited when a great symphony orchestra is announced for a two-hour broadcast. It merely accepts another feature as part of its radio entertainment. Mary Garden steps before the microphone and sings to forty-eight states at one time—and nothing unusual happens. Because, by this time, set-owners have become used to the superlative and they expect it. Mengelberg, Damrosch, Ponselle, Schumann-Heink, Hackett—they're all more than mere names now to many who had never known them before. Broadcasting has made them vivid personalities to the whole country and, with this familiarity, has come a strong appreciation of the kind of music they stand for. Who would ever have predicted it?

A Britisher Chats on Radio

(*Continued from page* 881)

"Can you purchase a six-valve set for $35 or can you not?" says he, like the Big Business Man in "Gold's Ghastly Grip."

"I can," I reply, "if you will let me make the cases of cardboard and the condensers of tinned iron, and the transformers of Woolworthite, besides putting cheap ether into the vacua (*American, "vacuums"*) of the valves."

Most times the telephone bell rings and saves me at this point and I go back to my room, cursing the evil genius that made Henry Ford write those interesting books.

I read the ads in the *Saturday Evening Post* and several other American periodicals, including Radio News, because I suffer from insomnia and my doctors advise me to read light fiction before retiring to lie awake and listen to the noise of the shunting (*American, "switching"*) in the local railroad goods (*American, "freight"*) yard. And I freely admit that we are ten years behind the romancers of the U. S. A. when it comes to the gentle art of advertising.

GLORIFYING THE AMERICAN RECEIVER

What I like about your ads is their charming irrelevancy. The British manufacturer of, shall we say, radio-frequency transformers, says bluntly, "Thompson Transformers are the best." All the world knows that he is either a liar, or a dreamer, or that he doesn't care a tinker's cuss one way or the other. He is bound to spend so much per annum on advertising, anyway, and what does he care what the advertising fellow says, as long as "Thompson" has a capital "T?"

Now, when I begin to observe an American advertisement of transformers, the first thing to catch my eye is a delightful halftone depicting a glorious bit of young womanhood exclaiming, "Wilbert, how *do* you get that authentic *timbre?*"

WHOLESALE PRICES

for Dealers, Community Set Builders, General Repairmen and Agents!

Be sure to get this great 128-page book with net prices to the radio trade.

Radio Specialty Company is radio's oldest radio parts mail order house in the country, and the new confidential prices on standard radio merchandise are the lowest of any radio house.

We are ready now to appoint additional agents in all parts of the country. If you are contemplating making big money in radio merchandise, be sure to get in touch with us at once.

WHEN WRITING TO US, USE YOUR LETTERHEAD

New 1928 ENLARGED EDITION NO. 18

New 75 HOOKUPS

500 ILLUSTRATIONS

THIS 128 PAGE RADIO CATALOGUE FREE

Buy from Radio's Oldest Mail Order House!

We are the oldest established, exclusive radio mail order house in the country. All orders are positively shipped within twenty-four hours; quick, prompt, courteous service. We carry a larger variety of radio parts, radio instruments, accessories and radio findings than any other radio house in the country.

"RASCO" has it

ANYTHING IN RADIO

You will find in Catalog No. 18 the largest assortment of radio merchandise in this country. Radio Specialty carries more radio parts and radio material than any other house in the country. You will find in this catalog positively the largest variety of radio merchandise.

If you are in need of certain small radio parts that other radio and mail order houses do not bother to carry, get the Rasco Catalog and you will find the small parts there, anything from a screw to copper ribbon, telephone diaphragms, as well as thousands of other small radio findings. Just to mention a few:

Lugs, nuts, jacks, plugs, all kinds of knobs, cords, panels, screws, sliders, washers, selenium, tinfoil, switches, crystals, cap nuts, Litz wire, cord tips, brass rods, resistances, binding posts, switch parts, carbon balls, switch points, lock washers, carbon grains, ground clamps, metal pointers, insulated tubing, low melting metal, antenna connectors, as well as thousands of other articles. *We carry the Largest Variety of Small Radio Parts in the World, BUT We also carry All Standard Radio Merchandise*

RASCO PRODUCTS

Radio Specialty Co

RASCO PRODUCTS

98 PARK PLACE NEW YORK

Wilbert appears in the background. He is one of those "discriminating" males who know whose collars and half-hose (*American, "sox"*) are "just right." A star of the first water! His prominent chin, Siouxian *coiffure,* straight nose and hygienic *ensemble* stamp the picture as the product of the most expensive "Sales and Service" studio in New York.

He answers, manfully, *"It's a Streyberger."*

By this time I have dreamed a whole romance, *a la* R. W. Chambers, and only when "Streyberger" butts in do I come to earth, yawn and go to bed. Clearly, Streyberger is a boot (*American, "shoe"*) or maybe a Voice Pastille. Anyhow, nothing so common, so prosaic, as a transformer is obtruded into the scene or the print.

I think I may fairly claim that you fellows lifted the idea of this kind of puzzle ad from us; because, long before the U. S. A. brought advertising to the status of an exact science, there was a domestic pot cleaner of saponaceous nature being sold here in huge quantities. It is still to the front, and for some forty years has been advertised by these words: "Monkey brand. Won't wash clothes." There's an idea for you! "Streyberger. Won't skin eels."

A TRIBUTE TO YANKEE INGENUITY

The fundamental difference between British and American amateurs (*American, "set builders"*) is that, whereas the Briton "makes," or if he is pompous, "constructs," his set, the American "builds" his. I observe that in your country the word "build" is applied to the art of assembling anything—except a building. I suppose you "construct" buildings. The idea of "building" a model steam-engine almost as large as a brick strikes us as an example of misapplied terminological grandiloquence, just like these very words—when I really mean to say "swank" (*American, "hot air"—"banana oil"*).

However, the American lad plays the part well, for in your magazines I often see photographs of him with his jacket off and his shirt sleeves rolled up, a spanner projecting from his hip-pocket and one paw holding down a blueprint large enough for a Board Room carpet. But he is only making a fixed condenser of capacity 0.0001-microfarad!

If I saw a British amateur in a similar predicament I should think he had given up radio and had taken to work, or that his wife had asked him to find out why the electric bell would not ring, which amounts to the same thing.

WHO STARTED THIS THING?

As I read history, there is no getting at the truth. In the days of my first set of (natural) teeth I was led to believe that Faraday practically invented electricity. Reading around, later, I found that Galvani did it, but was sued by Volta for infringement. Still later I discover that, after all, B. Franklin was the culprit. Arrived at man's estate, I judged that they were all mistaken and that Edison beat Tesla by a short head.

One day I was browsing amongst the classics and was pulled up smartly when I read that the stuff had been made by Aristifenit—or some such name—in large quantities, somewhere about 300 B. C. This was a severe blow to me and threw my perspectives out of gear. By this time I had become so cunning that I promptly made an exhaustive search of the Book of Genesis, hoping to find that Adam was in the game. But I drew a blank. This led me to doubt the existence of electricity.

A couple of hundred volts through the elbow—pure carelessness—revived my belief and I began to favor the theory that electricity had been discovered by Robert E. Lee, during the friction between the North and South. And then, heaven help me! I read that the Chinese knew of electricity 5,000 years ago. I'm done!

Since then I have noticed that the Chinese claim everything. If a man invents a collapsible president or a non-spillable bean, some ass writes to the "Times" newspaper, pointing out that these were known to the Chinks as far back as the Tso-tze-tzu-ling dynasty. As the matter stands at present, I vote for Geo. Washington. No one will assert that he couldn't have dug out the darned stuff if he had thought of it. This solution gives the "old country" a look in, too. (*Looks like more propaganda.*—EDITOR.)

In radio matters I find a similar cloudiness. Marconi plunged in with a complete outfit for radio. Several hundred yards' communication—if the coherer didn't blow up. Then Popoff was said to have been the "father of the coherer." Well—he's welcome! Next, Dunwoody, U. S. A. Army, clambers in with the carborundum crystal, which was for some years the hall-mark of a gentlemanly receiver, and gave me many a hectic hour in the days before the valve (or tube). Dr. Fleming then put two electrodes into an electric-lamp bulb and called the result a "valve." Not to be outdone by an effete Britisher, Dr. Lee de Forest promptly clapped in a third electrode and called the result a "tube."

HOW THAT TUBE'S GROWN!

Since then, other cheap imitators have shoved more and more electrodes into the tube, and now you can get a tube which contains the set, instead of *vice versa.* In a few years' time it will be necessary for the radio man, his wife and his family, to get inside the tube. Then I shall invent a tube to contain also—the dog and a cocktail outfit, with a spare room for the lodger, complete with loud speaker, toothpick stand and footwarmer, unbreakable windscreen, electron-sifter and cigar lighter; valet service optional. No gratuities (*American, "tips."*)

But I expect some Yank will be ahead of me, with an annex, folding, for squash rackets, fireworks displays; plunge bath and cinema screen.

Sometimes I wish I were back in my 1,000-year-old village in Kent, England.

Keeping Broadcasts In Step On The Waveband

(*Continued from page* 885)

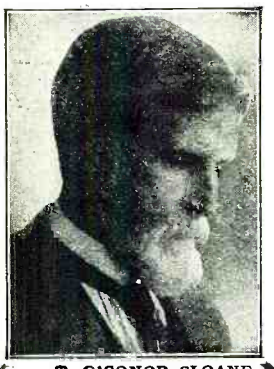
of the crystal by variations of its temperature, which is controlled from the receiving set at home.

"It would seem to me, that if such a system is practical, it might add to the practicability of chain broadcasting on the same frequency."

This same system has been used with success by a number of other Eastern broadcast stations, notably WODA, in Paterson, N. J. The general arrangement is illustrated herewith.

BURIED TREASURE can still be found in CHEMISTRY

Good Chemists Command High Salaries



T. O'CONOR SLOANE, A.B., A.M., LL.D., Ph.D.
Noted Instructor, Lecturer and Author. Formerly Treasurer American Chemical Society and a practical chemist with many well known achievements to his credit. Not only has Dr. Sloane taught chemistry for years but he was for many years engaged in commercial chemistry work.

You can make yourself independent for life by unearthing one of chemistry's yet undiscovered secrets.

Do you remember how the tales of pirate gold used to fire your imagination and make you want to sail the uncharted seas in search of treasure and adventure? And then you would regret that such things were no longer done. But that is a mistake. They *are* done—today and everyday—not on desert islands, but in the chemical laboratories throughout your own country. Quietly, systematically, the chemist works. His work is difficult, but more adventurous than the blood-curdling deeds of the Spanish Main. Instead of meeting an early and violent death on some forgotten shore, he gathers wealth and honor through his invaluable contributions to humanity. Alfred Nobel, the Swedish chemist who invented dynamite, made so many millions that the income alone from his bequests provides five $40,000 prizes every year for the advancement of science and peace. C. M. Hall, the chemist who discovered how to manufacture aluminum made millions through this discovery. F. G. Cottrell, who devised a valuable process for recovering the waste from flue gases, James Gayley, who showed how to save enormous losses in steel manufacture, L. H. Baekeland, who invented Bakelite—these are only a few of the men to whom fortunes have come through their chemical achievements.

What Some of Our Students Say of This Course:

I have not written since I received the big set. I can still say that it far exceeded my anticipations. Since I have been studying with your school I have been appointed chemist for the Scranton Coal Co. testing all the coal and ash by proximate analysis. The lessons are helping me wonderfully, and the interesting way in which they are written makes me wait patiently for each lesson.—MORLAIS COUZENS.

I wish to express my appreciation of your prompt reply to my letter and to the recommendation to the General Electric Co. I intend to start the student engineering course at the works. This is somewhat along electrical lines, but the fact that I had a recommendation from a reliable school no doubt had considerable influence in helping me to secure the job.—H. VAN BENTHUYSEN.

So far I've been more than pleased with your course and am still doing nicely. I hope to be your honor graduate this year.—J. M. NORKUS, JR.

I find your course excellent and your instruction, truthfully, the clearest and best assembled I have ever taken, and yours is the fifth one I've studied.—JAMES J. KELLY.

From the time I was having Chemistry it has never been thus explained to me as it is now. I am recommending you highly to my friends, and urging them to become members of such an organization.—CHARLES BENJAMIN.

I shall always recommend your school to my friends and let them know how simple your lessons are.—C. J. AMDAHL.

I am more than pleased. You dig right in from the start. I am going to get somewhere with this course. I am so glad that I found you.—A. A. CAMERON.

I use your lessons constantly as I find it more thorough than most text books I can secure.—WM. H. TIBBS.

Thanking you for your lessons, which I find not only clear and concise, but wonderfully interesting. I am—ROBT. H. TRAYLOR.

I received employment in the Consolidated Gas. Co. I appreciate very much the good service of the school when a recommendation was asked for.—JOS. DECKER.

Experimental Equipment Furnished to Every Student

We give to every student without additional charge this chemical equipment, including forty-nine pieces of laboratory apparatus and supplies, and forty different chemicals and reagents. These comprise the apparatus and chemicals used for the experimental work of the course. The fitted heavy wooden box serves not only as a case for the outfit but also as a useful laboratory accessory for performing countless experiments.

CHEMICAL INSTITUTE OF NEW YORK, Inc.
Home Extension Division 2
16-18-R E. 30th Street NEW YORK CITY

Now Is the Time to Study Chemistry

Not only are there boundless opportunities for amassing wealth in Chemistry, but the profession affords congenial employment at good salaries to hundreds of thousands who merely follow out its present applications. These applications are innumerable, touching intimately every business and every product in the world. The work of the chemist can hardly be called work at all. It is the keenest and most enjoyable kind of pleasure. The days in a chemical laboratory are filled with thrilling and delightful experimentation, with the alluring prospect of a discovery that may spell Fortune always at hand to spur your enthusiasm.

You Can Learn at Home

To qualify for this remarkable calling requires elaborate specialized training. Formerly it was necessary to attend a university for several years to acquire that training, but thanks to our highly perfected and thorough system of instruction, you can now stay at home, keep your position, and let us educate you in Chemistry during your spare time. Even with only common schooling you can take our course and equip yourself for immediate practical work in a chemical laboratory. Dr. Sloane gives every one of his students the same careful, personal supervision that made him celebrated throughout his long career as a college professor. Your instruction from the very beginning is made interesting and practical, and we supply you with apparatus and chemicals for performing the fascinating analyses and experimental work that plays such a large part in our method of teaching, and you are awarded the Institute's official diploma after you have satisfactorily completed the course.

Easy Monthly Payments

You don't have to have even the small price of the course to start. You can pay for it in small monthly amounts—so small that you won't feel them. The cost of our course is very low, and includes everything, even the chemistry outfit—there are no extras to buy with our course. Our plan of monthly payments places a chemical education within the reach of everyone. Write us and let us explain our plan in full—give us the opportunity of showing you how you can qualify for a highly trained technical position without even giving up your present employment.

Tuition Price Reduced

Besides furnishing the student with his Experimental Equipment, we have been able, through the big increase in our student body, to reduce the cost of the course. Write today for full information and free book, "Opportunities for Chemists." Send the coupon right now, while it is fresh in your mind. Or just write your name and address on a postal and mail it to us.

DON'T WAIT—MAIL COUPON NOW!

CHEMICAL INSTITUTE OF NEW YORK
Home Extension Division 2
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RN Feb. '28

The Switch Engine of the Air

(Continued from page 879)

"AT WOLFRIDGE STATION STOP NO SIGN OF LOST SHIP
(Sig) MOSER"

"Tell them to go back," despaired Neverre as he reached for the telephone. There was no alternative. Harold Dare must be informed.

Through the long line of stenographers, secretaries, and other studio underlings came the word to Harold Dare that he was wanted at the telephone. The name of Alfred Neverre assured the actor of the urgency of the call. He left the set at once.

Harold Dare's face grew grave as he heard the news. It would be impossible for him to come to the field himself, but he would delegate some of his subordinates to see what could be done.

"You need not feel so badly about the lost plane, Mr. Neverre," he reassured. "I realize the efficacy of the twin-beam radio beacon, and I know the high standard of your pilots and ships. I fear that there is something deeper than mere misfortune. You may not know it, Mr. Neverre, but there are those who would move heaven and earth to work me harm. They would realize at once that they could strike at me in no better way than by crippling my distribution.

"Further search in that wilderness of crags and peaks is useless, I am sure. If my belief is correct, namely, that some foul fiend is the cause of this disaster, then he will repeat his depredation in the near future. Give orders to your manager not to permit the Midnight Mail to leave until I arrive there.

"No, Mr. Neverre, the negatives are stored in our underground film-storage vaults. Duplicate positives will be ready for this afternoon's ship. Please do not worry. I do not blame the NAEC in the slightest degree. Such coincidences as this do not merely happen. Your ships have flown that course every day for months and months without a single accident. Why should you have an accident today, of all days? The shipping of that film has been advertised far and wide. Even now theatres throughout this city are preparing to run news reels showing the loading of the film aboard the ship. Much as I regret to think evil of anyone, I know that there is one enemy of Flicker Films and of myself who would stop at nothing to prevent the realization of our desire to render our public better service. I shall proceed immediately on the assumption that foul play has been done."

Before Harold Dare returned to the set that morning, he filed three special rush orders: to his film-developing laboratories, to a manufacturer of mail-bags, and to a certain chemical supply house.

* * * *

Never before had the Neverlate Aerial Express been so signally honored by celebrity as that afternoon when the midnight mail took off from Bandy Field with the celebrated Harold Dare in the second cockpit. And never before, not even during the first suspense-fraught tests of the twin-beam radio beacon, had there been a flight so full of palpitating expectation. But as moments grew into hours and there was no sign of anything unusual, the tension relaxed. Wolfridge Station had been passed hours ago. Then, over the horizon, a glow grew. Could it be Sweet Lake Field?

Dare looked at his watch. 11:48. If so, Captain Craig evidently had not gauged his speed with proper accuracy.

The glow brightened into a glare of searchlights. The ship's nose dipped, then swung for a long spiral, and Dare saw over the side of the ship the letters "SL" outlined in light. The ship taxied up to the line beside the waiting truck. Craig cut the switches, and the engine died.

Craig turned with a smile. "So this is Sweet Lake!"

Harold Dare removed his goggles. "We are early, are we not?" he asked. But the smile had frozen on Craig's face. Dare whirled.

"No, Harold Dare, you are just in time!"

The malevolent face grinning behind the stubby automatic twisted into a sneer.

"As I thought!" gasped Dare. "Dandy Diavolo!"

"Aha! Fortune smiles on us today. A rich haul indeed. At last, proud hero, you are in my power! This time the tables are turned. In a thousand Flicker Films you have eluded my clutches, but in this episode of your career, triumph is mine! Never more shall simpering women and sentimental men applaud your meaningless mummery. This final scene belongs to me. Tremble, proud hero! You recked not on the efforts of Dandy Diavolo."

But dauntless Harold Dare moved not a muscle. "Diavolo, the end is not yet. In this episode, as in every other, right must triumph. You have overreached yourself."

Diavolo motioned to his henchmen, who had gathered around the two flyers.

"Show these gentlemen into the guest chamber," he commanded, with another sneer.

Prodded by the muzzles of the henchmen's automatics, Dare and Craig were conducted into a shack next the hangar, which, from the ground, was seen to be merely a temporary framework covered with a canopy. They were forced into chairs and roughly roped. Then the mail sacks were brought in and flung into a corner.

"Now," commanded Diavolo, "get gags and the time bomb, and we will prepare the reception for our guests."

Intrepid though he was, Captain Craig blanched under his coat of tan, but courageous Harold Dare was not to be outwitted.

"Ho, Dandy Diavolo," he taunted. "This time you have overreached yourself. Better look into the sacks and be sure the films are there before your triumph is complete!"

With an incredulous cry Diavolo swung upon a henchman.

"Get the bolt-cutter!" he snapped. "Open those sacks!"

Dare's eyes sparkled. He managed to thrust his hand into his pocket, and tossed a small key to Diavolo's feet.

"Here," he said, "don't go to all that trouble. See for yourself."

With trembling fingers Diavolo unlocked one of the bags.

"Pull the drawstring," advised Dare.

Diavolo plunged his hand into the bag and drew forth a sealed metal can containing a standard reel of film.

"He is sparring for time!" cried Diavolo, enraged. "Tie them tighter!"

But Dare leaned forward with a tantalizing smile.

"Are you sure, Dandy Diavolo," he said, "that all the bags contain film?"

"They are heavy enough," growled Diavolo, but without assurance. He opened another bag. It, too, held film. Then he turned the key in the lock of the third bag. He pulled the drawstring.

Unobtrusively, Harold Dare had thrust his face sidewise, pressing his nose tightly against his fur coat. He closed his eyes.

There was a tiny tinkle of glass and a slight hiss.

"What foolery is this?" shouted Dandy Diavolo. He drew from the bag a long, round metal can, shaped like a bottle from the neck of which protruded a few fragments of thin glass. The drawstring had apparently been looped about the glass tip of the bottle. Diavolo plunged his hand into the bag. The bottle had been held in place by a stiff wire framework. Below this were cans of film.

"The film is all here!" cried Diavolo, but his voice broke. Dare stole a sidelong glance at him. Two great tears had welled up in the rascal's eyes, and his face was working.

Dare could not restrain a chuckle.

"What is the matter, Dandy Diavolo?" he asked. "Have you at last repented your misdeeds and thought over your life of crime?" It was indeed a droll thing, to see the hardened rogue of a thousand films outdo the most artless ingénue in soulful weeping. He was sobbing as if his heart would break. As if catching the spirit and regretting their leader's past, the henchmen also began to cry. Even Craig, as if in sympathy, trickled tears.

Harold Dare shot sidelong glances at the henchman who sat by the door with a gun in his hand. Tears dropped upon the polished barrel. The man's shoulders heaved, the gun wavered; he nodded and drooped his head in utter dejection.

Dare waited no longer. Squeezing his eyes tightly, he hurled himself, chair and all, upon the man at the door. With a crash the two rolled outside. The chair splintered, and Dare's hands were free. Before the dazed henchman could move, Dare had him wrapped and tied. He tied his handkerchief about his own head, covering his nose and partly shielding his eyes. Then he dashed into the shack and dragged out Craig. He sprayed a tiny pocket atomizer in the flyer's face.

"Quickly," he urged. "Help me with the others."

In a few moments Diavolo and his henchmen sat on the ground, tied hand and foot. Generous Harold Dare would not apply the cruel gags which Diavolo had provided for his victims. A few drops from the atomizer restored the captives and they sat blinking at one another.

"We can hardly carry all four of these men at once, even if we fly both our plane and Diavolo's. Look in the other room of

the shack, where that radio antenna leads, and see if there is a transmitting set there," instructed Dare.

Craig disappeared into the shack. An exclamation was heard. In several moments, a man emerged, limping and stretching his arms. He wore the uniform of the Neverlate Aerial Express. Pieces of cord dangled from his wrists.

"Captain Mettle!" exclaimed Harold Dare. "At last we've found you!"

The flyer grinned. "Better late than never," he said. I heard the commotion in there and knew something had happened to Diavolo's plans. I had a little cry myself, before I recognized the smell of the tear gas and shut my eyes. Craig is calling Sweet Lake Field for help."

At these words Dandy Diavolo gnashed his teeth. "Perhaps you think you have foiled me, but remember, he who laughs last, Harold Dare, he who laughs last," he sneered; but his sneer had a half-hearted ring. He was beaten, and he knew it.

"Dandy Diavolo," replied Harold Dare, refusing to gloat over his fallen enemy, "you might have known better than to rob the U. S. Air Mail when my own reputation was directly involved. The thousand Flicker Films in which you have been checkmated, as well as the countless plots in real life against me which have come to naught, should have taught you that in the end, wickedness invariably is punished. You shall have to answer for this misdeed in Federal Court; you cannot placate the minions of the law as you have hoodwinked me heretofore by your fervent promises of reform. You are thoroughly foiled this time; and, while we are waiting for the planes from Sweet Lake, you might just as well tell us just how you managed to lure the mail ship to this false landing field, in spite of the twin-beam radio beacon."

"Be not too sure of yourself, Harold Dare," growled Diavolo. "The end is not yet. The law has many loopholes. However, the story will soon be in the papers, and in spite of my hate for you, I must admit that you have always given me my fair share of the publicity. I know I can depend upon you to give me credit where it is due.

"As you know, the twin-beam beacon gives a white light when the ship is in the true course, a red light when it is on the left side of the channel, and a green light on the other side. The ship thus runs on a veritable set of rails, just like a railroad train.

"My device operates just as a railroad switch. At a distance approximately the same from Bandy Field as Sweet Lake, I arranged this field, which, from the air at night, exactly resembles that at Sweet Lake. Here I set up a radio beacon, an exact duplicate of the NAEC Sweet Lake beacon, and tuned it to exact synchronism with that system. The antennas are arranged so that my beam crosses the NAEC beacon at a point a few miles from Sweet Lake. Here was my switch, but it had no frog. When the mail ship crossed this intersection, its indicator would flash first red and then green, but the switch would be crossed so quickly that the ship would be past before it had a chance to change its course. What was needed was an aerial switch-engine to transfer the ship to my beacon. Therefore I arranged a transmitter in a plane, tuned it to synchronism with *one beam only* of the Sweet Lake beacon, and sent it out to meet the midnight mail. By a bit of accurate calculation, we were able to fly quite close to the mail ship without being detected by the flame from our plane's exhaust, while we watched the mail plane through binoculars.

"You see, since the plane's transmitter emitted only a single, non-directional wave which was in step with one beam of the Sweet Lake beacon, it reinforced that beam and caused the mail's relay to give a red signal. When the pilot corrected this seeming error by steering his ship in the opposite direction, he was really deflecting his course into the beams of my beacon. After that, he simply followed the beacon right down into the false flying field, knowing nothing of his error until he had landed and was in my clutches."

"Indeed, a clever scheme," conceded Dare, "and one worthy of a better end. Little as your evil ways merit such a favor, you shall have your full share of the publicity. I realize that, like all professions, a life of villainy is not wholly a bed of roses. Much as I admire the cunning brain that devised such a scheme, in justice to the millions of film fans whose eagerly-awaited picture was nearly waylaid, I cannot countenance any miscarriage of justice."

Then down into the glare of the landing lights swooped three huge planes. On the side of the fuselage each bore the clock *rampant*, the insignia of the Neverlate Aerial Express. Two newsreel photographers sprang out and came hurrying over, dragging their cameras behind them.

"Come, Dandy Diavolo," said Harold Dare. And as the captives rose to their feet, Harold Dare turned to face the cameras, smiling his world-known and world-worshipped smile.

Improving Your Set With Controlled Resistance

RADIO reception makes use of three important electrical properties; inductance, capacity and resistance. The first two serve to tune or to adjust one circuit so that it will be in tune or in harmony with another, for maximum response to a given electrical frequency or wavelength. The third factor, resistance, serves other purposes, such as the control of volume, stabilizing of circuits, the balancing of a given circuit with another, the control of filament and plate currents, the control of line voltage in radio power devices, the control of sensitivity, and so on. However, while inductance and capacity are generally well taken care of in the usual receiver, the possibilities of controlled resistance are often overlooked.

The use of resistance in controlling the usual tube filaments is too well known to require review. The only critical filament jobs remaining are those in connection with the series-connected filaments and the new A.C. tubes. The former method, operating

with an "A-B-C" radio power unit employing a 350- or 400-milliampere tube, requires a high-resistance control of sufficient current-carrying capacity. The latter system, operating on a small step-down transformer, calls for a low-resistance control capable of handling considerable current, since the filament-type tube requires over an ampere, while the heater type requires almost two amperes.

ACCURATE HIGH RESISTORS

It is in the control of plate voltage that the variable resistor is most important; since with high voltages there is need of precise resistance adjustment over a wide range.

The most important resistance adjustment is that governing the plate voltages, especially in the radio-frequency stages, and altering the selectivity, sensitivity and stability of the receiver.

Most radio-frequency amplifiers are neutralized or stabilized by a fair margin, so that the R.F. tubes are actually operating considerably below the point of maximum sensitivity and selectivity which precedes that of oscillation. Obviously, the usual neutralizing methods should not be variable, for the adjustment is too fussy for a tuning operation. The same is true of the stabilizing methods, except the case of potentiometer-stabilization; and the main trouble with this method is that it stabilizes the receiver by means of losses. On the other hand, if it is possible to increase or decrease the plate voltage of the R.F. tubes, then it is feasible to increase or to decrease the sensitivity and selectivity of the R.F. amplifier until it is practically at the very peak of efficiency, without bursting into oscillation. This is a more efficient method than setting a limit arbitrarily on the efficiency of the receiver, in order to get along with any plate voltage that happens to be hooked up.

The method of improving the R.F. amplifier, therefore, is to apply to the R.F. tap a plate voltage higher than the usual 90; but to have a suitable variable resistor in series with this load. The variable resistor need not have a heavy current-carrying capacity, since we are dealing with but a few milliamperes.

In the case of the neutrodyne or capacity-neutralized circuit, the neutralizing condensers may sometimes be removed entirely and the set held just under the oscillating point at any wavelength by means of a variable resistor in the R.F. plate load—the one usually marked "B+90."

Of great importance, when using such variable-resistance controls is the matter of by-pass condensers; the latter serve to pass the R.F. energy via the shortest possible route in completing their circuit, with out lengthy troublesome detours through the high resistance of the variable resistor and the "B" power supply. It is good practice, in fact, to place a 1-mf. condenser between the "B+90" and the "B—," and again between the "B+Det" and the "B—" of the receiving set. The variable resistors should, preferably, be shunted by a 1-mf. by-pass condenser.

Efficiency Plus

COHEN: "Get someding else on dot radio, Issy."

ISSY: "But, Papa, it's a swell piano solo."

COHEN: "Eggsactly, but don't be wasteful, Issy. Toin dot von off and tune in on a full orchestra."—*A. MacGillicuddy.*

The Effects of Broadcasting on Religion

(*Continued from page* 883)

people from attending their own churches. That statement has, indeed, been made to the writer in so many words by a man in an excellent position to know.

Services by radio have had profound effects on the lives of many individuals. Not only have they brought incalculable comfort to many persons lonely or ill or despairing, but they have actually brought persons up from moral failure to moral success. Persons who had not been inside a church for a score of years have, by radio, been led to see the value not only, of worshipping, but of worshipping with their fellows. Many aged, ill, and infirm people attend worship by radio regularly.

Rabbi S. M. Cohen, of the Jewish committee, reports that congregations have been started in certain places because the consciences of Jews in them were quickened by the Jewish midweek broadcast. Those broadcasts, by the way, are heard by many non-Jews, some of whom regularly write in their comments.

Perhaps one of the most effective ways in which religious services via radio touch the heart is through their music. The thousands of letters that pour into the larger stations show clearly that well-known hymns mean a great deal to large numbers.

Many other details as to the effect of religious broadcasting might be given; but certain general conclusions should be drawn, leaving no room for those details.

The most important general conclusion is, undoubtedly, that the radio has brought, and will continue to bring, an enlarged understanding, by all of us, of what each thinks, feels, and hopes for in religion. Controversy, at least the ill-natured kind, cannot survive. *Radio is bringing about good manners* in religious discussion. Sensationalism, likewise, cannot stand the test of broadcasting. What people insist on is the essentials of the speaker's faith, and that what he says shall be, as nearly as possible, universally helpful.

And this well-marked preference by the public for what is universally helpful points the way, perhaps, to the gradual elimination in America of the multitudinous minor differences between sects, and parts of sects, which now divide the church and make it less effective than its leaders rightly feel it should be.

The Advantages of the Broadcast Networks

(*Continued from page* 871)

We are therefore forced to seek a method of increasing the reliably-reached audience, and the obvious solution is the linking together of a group of such stations separated by distances preferably not in excess of 200 or 300 miles (except in very sparsely-populated districts).

We may go so far as to say that probably the ideal broadcast system for any country, so far as we can now envisage it, comprises a plurality of nation-covering networks of high-power stations, these networks sending out suitably diversified programs.

THE INDIVIDUAL BROADCASTER

There can be no question that network operation has been a great advantage to the average broadcaster. It has brought him program features which would otherwise have been utterly unobtainable, either because of economic limitations or because of the location of his station in remote regions.

The local broadcast station, therefore, has assumed an institutional aspect, as the means whereby the surrounding community within its service area is brought into contact with the nation at large. It is a safe statement that, just as the local newspaper could hardly serve its community adequately except with the assistance of press associations and feature syndicates, so in even larger measure, the individual broadcast stations are assisted by network operation.

THE ARTISTS

Artists are admittedly a specialized group of human beings, entitled to unusual consideration because of the important creative nature of their work and, in many cases, requiring unusual encouragement to produce their best efforts. Network operation of broadcast stations has a curious double influence on artists. It really all depends on whether the artist is good or not; it is already clear that the rule of "the survival of the fittest" will hold strictly. To put it boldly, network broadcasting may make life harder for the mediocre artist, but it will certainly make it easier for the talented student or the great artist. Many a so-called musician may in the future be properly assigned to riveting or bookkeeping or some other appropriate occupation. Nevertheless, previously-discouraged students or artists of ability will find themselves given fresh opportunities of the most attractive sort.

Furthermore, by increasing tremendously the public interest in music and literature, national broadcasting encourages art and artists. It will permit the survival of otherwise threatened high-grade musical organizations previously catering to small audiences. And it will insure the permanence of still larger musical organizations and the provision of numerous opportunities for capable artists.

THE RADIO LISTENER

The radio listener on the side lines, will surely find all of the previous considerations most encouraging and pleasing from his point of view. He wants clear reception of excellent programs with program diversity, and this is just what multiple network operation of high-power stations can provide. It can bring to the homes in the small village or in the countryside the same carefully-planned and beautifully-executed pro-

grams that would otherwise be available only to residents in the larger cities.

Unduly-pessimistic prophets have predicted that network operation would somewhat curtail the program choice of the listener. Assuming a number of national networks in successful operation, every listener will be able to make his choice between their thoroughly worthwhile programs.

It is true that network broadcasting, by steadily raising the level of programs, will ultimately restrict the choice of the listener who, for some mysterious reason, wants a very poor program. But why should the listener worry about having his freedom to pick up an exceptionally bad program, arriving in mangled form from some distant station, somewhat restricted? It is better to concentrate our attention on providing freedom for the listener to select from among as many high-quality programs as possible from excellent nearby stations.

RECEIVING SET DESIGN

It is but natural that so powerful an agency as network broadcasting through high-power stations should have a marked influence on the design of receiving sets and that it should somewhat simplify the problem of the engineer and manufacturer. There was a time, not so long ago, when the ideal receiving set was supposedly designed to receive any station anywhere, no matter how many local stations were in operation on nearby frequencies (or wavelengths) and regardless of atmospheric conditions and local disturbances. Engineers were driven to the verge of mental breakdown in an attempt to meet such excessive requirements and manufacturers found it increasingly difficult to stabilize a radio market having such requirements.

In the past such extreme requirements may have been partly justified. As long as a man searching for the one good program which might be given on a particular evening (perhaps from a distant city) had to "fish" for distant stations, while powerful stations in his own vicinity interfered, receiving-set design was much hampered.

Network broadcasting, by making several good programs available as *local* programs,

simplifies receiver design in a manner which is perfectly clear to any competent engineer. The resulting economy of effort and expense is sure to be appreciated by the public and the manufacturers alike. The listeners will be able to purchase more simply-operated receivers, yielding finer tone quality than would otherwise be economically possible; and in consequence the manufacturers of radio receivers will be able to reach a larger potential market.

(From an address to the National Electrical Manufacturers' Association, at its midwinter meeting in Chicago.)

Network Broadcast Stations

Following is a list of the radio stations comprising the four national networks.

Red Network

Basic Red Network (National Broadcasting Company): WEAF, New York; WEEI, Boston; WTIC, Hartford; WJAR, Providence; WTAG, Worcester; WCSH, Portland, Me.; WLIT-WFI, Philadelphia; WRC, Washington; WGY, Schenectady; WGR, Buffalo; WCAE, Pittsburgh; WTAM-WEAR, Cleveland; WWJ, Detroit; WSAI, Cincinnati; WGN-WLIB, Chicago.

Supplementary Stations: KSD, St. Louis; WCCO-WRHM, Minneapolis-St. Paul; WTMJ, Milwaukee.

Midwestern Group: WOC, Davenport; WHO, Des Moines; WOW, Omaha; WDAF, Kansas City; KVOO, Tulsa; WFAA, Dallas; WBAP, Fort Worth.

Southern Group: WHAS, Louisville; WSM, Nashville; WMC, Memphis; WSB, Atlanta; WBT, Charlotte.

Special Network Additions: WJAX, Jacksonville.

Blue Network

Basic Blue Network (National Broadcasting Company): WJZ, New York; WBZA, Boston; WBZ, Springfield; WBAL, Baltimore; WHAM, Rochester; KDKA, Pittsburgh; WJR, Detroit; WLW, Cincinnati; KYW-WEBH, Chicago.

Supplementary Stations: KWK-KSD, St. Louis; WCCO-WRHM, Minneapolis-St. Paul; WTMJ, Milwaukee.

Midwestern Group: WOC, Davenport; WHO, Des Moines; WOW, Omaha; WDAF, Kansas City; KVOO, Tulsa; WBAP, Fort Worth.

Southern Group: WHAS, Louisville; WSM, Nashville; WMC, Memphis; WSB, Atlanta; WBT, Charlotte.

Special Network Additions: KPRC, Houston; WRVA, Richmond; WJAX, Jacksonville.

Pacific Network

The Pacific Coast Network (National Broadcasting Company), comprises: KPO-KGO, San Francisco; KFI, Los Angeles; KGW, Portland, Ore.; KFOA-KOMO, Seattle; KHQ, Spokane.

Columbia Chain

Columbia Broadcasting System: WOR, New York; WEAN, Providence, R. I.; WNAC, Boston, Mass., WKRC, Cincinnati, O.; WAIU, Columbus, O.; WADC, Akron, O.; KMOX, St. Louis, Mo.; WMAQ, Chicago, Ill.; WMAK, Buffalo, N. Y.; WGHP, Detroit, Mich.; KOIL, Council Bluffs, Iowa; WCAO, Baltimore, Md.; WFBL, Syracuse, N. Y.; WCAU, Philadelphia, Pa.; WJAS, Pittsburgh, Pa.

Why the A.C. Equamatic System Is Different

THE Karas A.C. Equamatic, which was described in last month's issue of RADIO NEWS, embodies five A.C.-operated tubes which function just under the point of oscillation; not at certain points on the wave-range, but at every wavelength setting from 200 to 600 meters. The tendency of the set to oscillate throughout the broadcast waveband has been eliminated by the method of neutralization employed.

This high tube efficiency at all wavelengths is obtained by the constant and equal transfer of energy between the primary and secondary of the three R.F. transformers.

The primary and secondary windings are entirely separated from each other. The primaries are mounted on the extended shafts of the variable tuning condensers, so that they turn automatically with the turning of the condenser dials. Each secondary coil is adjusted, both as to its distance from the primary coil and as to the angle it makes with the primary at any one setting. By reason of this design and of the numerous adjustments it allows, it is a simple matter to obtain an adjustment which will allow the same transfer of energy at 200 meters as at 600 meters. When the proper adjustment is made, and the dials are operated over the broadcast band, the result is a variable coupling between primary and secondary; varying automatically at a rate which maintains the tubes at their highest point of efficiency (just under oscillation) at every wavelength setting.

By reason of this design, the Equamatic System does away with the necessity for lesser methods, such as high variable resistors in the tuning circuits, potentiometers, and expedients which involve magnetic absorption.

Because of this flexibility of the coupling adjustment between primary and secondary coils, the A.C. Equamatic receiver tunes with a sharpness and selectivity that makes it valuable and effective in even the most congested broadcast areas.

A few hints on adjusting the neutralizing condensers will undoubtedly be appreciated by radio fans who built this excellent receiver.

With the adjusting thumb-screws of the neutralizing condensers turned entirely up, tune the receiver to some high-powered, low-wave station. Set the 0.2-ohm rheostat (R4) so that the receiver is just oscillating, with the control and volume dials turned entirely up; turn down the thumbscrews a little at a time until the signal clears up. Now turn up R4 and turn the dials back and forth across the point at which the station was tuned in. If the receiver still oscillates, make a slight adjustment on the

thumb-screws of the neutralizing condensers. A point will be found on these condensers at which the receiver will not oscillate when R4 is turned entirely up and the dials are turned over the entire broadcast range.

It is possible in adjusting these neutralizing condensers to go too far; in other words, *to have too large a capacity.* There is an intermediate point that will give exactly the right adjustment.

The only other adjustment that need be made is on the first primary coil; this should be varied, depending on the length of aerial used in connection with the receiver. It is sometimes necessary, with a short aerial, to provide maximum coupling on the first coil at the low wavelengths; this adjustment can be made only with a knowledge of the particular conditions under which the individual set is operating.

Criticism of a Radio Term

CLAIMING that the term "variable resistor," which is now so widely associated with current and voltage-control devices for radio, is inaccurate and misleading, Leonard Kebler, president of Ward Leonard Electric Co., in a recent letter to the Radio Manufacturers Association, asks that the use of the word *variable* as applied to resistors be abandoned by the radio trade.

In his letter of protest Mr. Kebler points out that *variable* carries with it several meanings which are inexact and which tend to create in the mind of the buying public faults and shortcomings which are not common to properly-constructed resistors of this type.

The term "adjustable resistor," according to Mr. Kebler, can be employed more exactly and effectively by the radio trade as a whole in merchandising this kind of resistances. The adjective *variable* carries with it the idea of possible fluctuation and undesirable change once the control resistor is set at a definite point. A comparative definition of "adjustable" and "variable" from Webster's New International Dictionary makes clear the distinction.

"*Variable*: liable to vary; too susceptible to change; unsteady; inconstant."

"*Adjustable*: made exact; free from discrepancies; brought into proper relation."

Interpreting the two terms in even a loose sense, Mr. Kebler concludes, one gathers that a variable resistor is one which is constantly changing in itself. An adjustable resistor is one in which the resistance value can be changed, but in which voltage and current characteristics remain constant for a given setting of resistance.

Yet the *variable* condenser has remained free of such imputations, and the "adjustable" condenser has failed to take. If we were to coin a word, "setable" might do.

What is a Battery?

THE Radio Manufacturers Association has recently been successful in its contention that a storage battery is not "an article of household use." This is not propaganda for socket-power units, however, but was called for by an official construction of a law requiring that a poison label or sticker be placed upon articles of household use containing caustics or corrosives. The Department of Agriculture, accordingly, has ruled that batteries need not be so labeled for interstate shipment; but that the electrolyte should be, if it is shipped in separate containers suitable for household use.

The Listener Speaks

(*Continued from page 872*)

the noise level too high for any kind of reception until we learn how to filter or by-pass the noise; or doesn't the carrier wave ever arrive at all at distant points under the sun?

Since distant reception is so far from an exact science, its rules being about as reliable as those of fishing, it would be interesting to collect testimony on daylight DX records, as so frequently done on night records. What some one else has done would at least give us a new mark to shoot at. Of course I am aware that the subject itself is old and the short-wave experimenters have a lot of data about it; but there are some possibilities, however limited, in the broadcast band—enough, I think, to make an interesting article.

PAUL H. WOODRUFF,
Managing Editor, "Manufacturers News,"
231 S. LaSalle St., Chicago, Ill.

(On the broadcast waveband, DX reception during daylight seems to be rather definitely limited by the influence of the sun. Increased sensitivity at the receiving end will overcome this effect to some extent; but, since natural and artificial static will be amplified in about the same ratio that the signals will, there is little to be gained.

You are quite correct in stating that distance reception is far from an exact science. There are so many variable factors involved that no one can sit down and establish rules or conditions for it.

In the short-wave field conditions are even more uncertain, the behavior of these waves being extremely erratic. On some wavelengths good DX can be accomplished over a certain distance only during the day and not during the night; on other waves the conditions are reversed. The principal factor is the change in the angle at which the waves are reflected from the "ionized layer" in the upper atmosphere, as shown in the articles on "Fading" in recent issues of this magazine.—EDITOR.)

How a Modern School Uses Radio

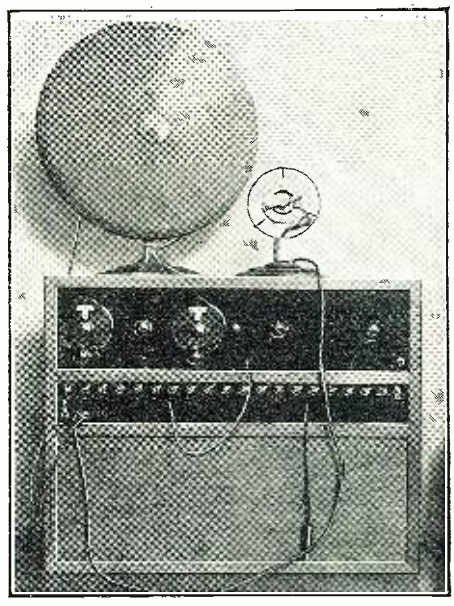
Editor, RADIO NEWS:

The article in the December issue of RADIO NEWS, "260,000 Good Customers Waiting for Radio," by Armstrong Perry, has attracted our lively interest. We happen to be one of the few schools in America that is equipped with a radio. Let us tell you about it.

On the principal's desk is the radio, equipped with amplifier, electric pickup, a public-address microphone and control panel. Each room in the building is supplied with a loud speaker, which is connected by wire with the radio in the office. Anything that comes over the air, if it is regarded by the principal as possessing educational merit, can be sent to any room or all rooms.

It has already been our privilege to listen to President Coolidge give his George Washington talk. We got returns on the national baseball series; and we listened to the Lindbergh receptions in Washington and New York. Every day we can catch splendid programs of various kinds from our local broadcast stations. We have invited leading citizens to talk to our pupils about various civic problems. Our pupils, as they sat in their rooms, caught "the spirit of Armistice Day" as it came to them through our set.

There are many uses to which the radio can be put in the school room. The great leaders of our public life will soon come to the future American citizens over the air. There can be no more effective method of teaching civics than is furnished by the radio.



Above is the apparatus located in Mr. Coombs' office, a radio receiver whose audio amplifier can be used with a phonograph or microphone, as preferred. Each room of the school has a loud speaker connected with its output.

By a very simple device, we connect our victrola to the radio and give pupils phonographic music in exactly the same manner as they receive radio programs. This combination furnishes programs for music appreciation, music for penmanship, music for folk dances, music for physical-education exercises, and music for various social functions of the school.

It has long been recognized that pupils in the penmanship classes do very much better work under the spell of good music. They write more smoothly, more evenly and more rapidly, and acquire habits that are more likely to stay with them in life. What is true of penmanship is true of other subjects of a manual nature, and manual training. We are certain that we have a combination that is going to be accepted in principle by schools throughout the country.

The public-address device places the principal in instant touch, by voice, with the entire school. It saves an immense amount of time for the principal and enables him to

give much more attention to the work of supervision.

It may be of interest to know that we are prepared to build this equipment for any school that desires to avail itself of our services.

D. R. Coombs,
Principal, Jordan Junior High School,
Salt Lake City, Utah.

Tribulations of a DX Hound in China

Editor, Radio News:

Should someone be bold enough to tell me that China is in lack of radio stations, I would run the risk of being sued for assault and battery by knocking his teeth out. Land stations and gunboats, whose number seems to have run into five figures, take delight in loading the ether with such a wild medley of dots and dashes from sunset to sunset that the poor BCL positively cannot get away interference-free for more than five seconds at a stretch. What is worse is the fact that about 99.99 per cent of these stations are spark producers, only the solitary .01 per cent being of the C.W. type. The result is, that the signals stubbornly refuse to abate in violence through the entire turn of the dial.

At present, there are four broadcast stations in this city, which regale the radio audience with regular "programs." All of them are super-powerful, namely, one one-quarter kilowatter, two one-twentieth-kilowatters and one one-two-hundredth kilowatter. The two intermediates have such a perfect system of high-tension supply and such delicate provisions for adjustment of wavelength that they give a beautiful mixture of nerve-racking noises and merrily overlap a score of meters on either side of their channel. While it may be an easy matter for an American BCL to tune out a wee local station of say ten to twenty kilowatts' power and bring in DX having a difference in wavelength of ten to fifteen meters, it is practically impossible for a Shanghai fan to get over these giants and pull in a DX station twenty or more meters above or below the scale.

Being one of those daring hounds who staunchly defy all difficulties and damages to get to their prey, I used to slight all these handicaps and to keep my headset in place obstinately for hours at a time. Indeed, sometimes I even actually welcomed the thundering clashes; as they would so deafen my blessed ears as to make them irresponsive to the mild outpourings from local broadcasts. Don't you agree, Sir, that this is one way of eliminating interference? For my part, I should say it is; for it was only after this deafening effect that I succeeded in pulling in twice 2BL, Sydney; once 4QG, Brisbane; and once 5CL, Adelaide, Australia.

However, I have now decided to give up this practice. What is the use of keeping on it if you steal out of bed when the wife is fast asleep and bring in a few European stations only to be drowned completely out by a sudden avalanche of dah-h-h-h to the *n*th h, just when the call letters and the locations of these unknown stations are being announced? You are left no wiser. Under the present conditions the real DX work one in Shanghai can score is not to

listen in at all. Will anybody take over my Silver Six, Universal Plio Six, and some five-tubers gratis, on condition that he constantly operates them in Shanghai for DX work exclusively, using a headset only?

L. WINGSAN KANN,

627 East Yuhang Road, Shanghai, China.

(Our correspondent's humorous picture of radio in the Orient may seem overdrawn—something like those of American broadcasting which were common last winter—but outside the United States there seem to be few sets of any selectivity. The complaint of most of RADIO NEWS' *foreign correspondents is that they are entirely too far from any broadcast stations. As to ship interference, we can only refer Mr. Kann to the International Radio Conference and the Shanghai Municipal Council.*—EDITOR.)

The Navy to the Rescue!

Editor, RADIO NEWS:

As I read from one end to the other of each issue I receive, I couldn't help but noticing that ungrateful letter in the November issue from some fellow out in Hague, South Dakota signing himself "A Reader." I will have to give him credit for not signing his name to a letter of that kind; it in my opinion is an outrage, considering he gets all that he is kicking so much about, for *nothing at all.* First of all, I would suggest this kind reader get up to date and invest a little in a receiver that can tune out a few dozen of the stations he is referring to. In my estimation he is all wrong; he is another one of this type, that wants everything to themself. It is a pity all of the broadcast stations don't shut down and his favorite station be the only one allowed on the air.

If he was down here in Cuba he would have just the opposite to kick about and that is, there wouldn't be enough stations to suit him. I am for more broadcast stations and more power to them; may radio broadcasting never cease. I have never listened to a station yet that I didn't enjoy to my heart's content. Let the stations be thick and close together, as it will kindle the desire to build and invent more selective receivers which will in time be able to tune them in and out to the tenth and fiftieth of a meter. His letter spells gratitude all the way through. Probably he had better go to the African jungles, instead of the tireless broadcaster; but mail also comes from there so we would probably have the perpetual kicker with us just the same.

A. C. LARSON,
Naval Radio Station,
Guantanamo Bay, Cuba.

An Announcer Frees His Mind

Editor, RADIO NEWS,

In the November issue Mr. Sowers asked a question which, to a radio listener, seems foolish, but to an announcer or studio manager, is the bane of his life. I speak from both sides of the question. As studio manager and announcer at K F W C—I nearly wrecked a perfectly good constitution and reputation, trying to get a response from the "Dear Pub" and they wouldn't even put in a kick. You hit it when you said the listener was getting something for nothing; if rotten, he could tune out, and if good, "why bother? He paid for his set. Now make him laugh."

Also, each one has a favorite station that they nearly have their dials set for, and very seldom switch from, and so they think they have done their duty by listening in. Very few realize the work there is to putting on a program, and a lot fewer care; but certain kinds of radio advertising do a plenty to queer a good program, and then is when the poor sufferin' set owner has a kick coming. Thank heaven he doesn't put it on paper.

While on the station I very seldom had a chance to listen in. After I got married, "the Missus" made me cut out radio work for a year; and I got a set, (never mind what kind but it was a dinger,) all dolled up so you could hear it a mile, or only across the room, get-all-I-want-in-DX-and-extra-fine-reception-for-fifteen-hundred-mile stuff guaranteed, and set up in my new home. Well, here goes; I got home; dug out the W. K. pipe and slippers, evening "pape" and tuned in. Fine orchestra playing and coming over wonderful, Friend Wiff comes a runnin' and starts raving over the music, when "This is Radio ——— Your friend in ???? broadcasting a program of orthophonic records by courtesy of the Blah Blah Music Co," etc., and so on for the next ten minutes. Then another record. I quit that and hunted another; he had tooth paste, fishing tackle and ocean excursions. Then came "Your friend from the 'Isle with a Smile'," a non-commercial station, putting out the greatest program of advertising ever, *BUT* good, and interesting.

The average *man* does not care to boost an advertised article by saying how good music they can select, while a *woman* will. This morning I have to indite an epistle to Chick Weldon, giving him the hand on his Ad Program of KMTR yesterday, simply because the side kick tuned in and then cleaned my pockets last night to buy up the junk he told about. His snappy "Don't go away, folks," got her, and she said it was quite a while before she realized what he was talking about and every bit of it got over.

Well, it simmers down to the fact that snappy and good stuff gets over, even if the people don't tell about it and pat us on the back; while a durn short period of tiresome stuff will put the sets off the station in a hurry. To resume, another kick from the listener; it seems as though every one ever born was a good radio announcer, (in his own opinion) and every station seems to think it doesn't matter who does the announcing. You would be surprised to know how few who have a "Radio Voice." Last night I was in on the N.B.C. program and on one of the big Pacific Coast stations, the whole program was spoiled by the local announcer. He seemed to have a cross between the stomach-ache, hay fever, and a first-class grouch with an English accent, (Mayor Thompson would have had him pinched in Chicago). The rule seems to be, let anyone handy do the announcing. As a result Charlie Mitchell, Chick Weldon, Graham McNamee, Phil and Lee Carline and a host of others are at the top; but there is lots of room up there yet, while the funny papers take a crack at the radio announcer. His job is no fun.

Well I started out to say something, and all I did was kick. But, believe me, I am going back in the game next month as announcer and manager, and I am going to

use just the line I have told you of, and see if it is not possible to get some results.

CHET G. WOOD,
San Bernardino, Calif.

An Old Subscriber Notes that Times Change

Editor, RADIO NEWS:

As an amateur and commercial operator I have read RADIO NEWS for quite a number of years, but, in my opinion, it has been degenerating for some time and is now what I consider to be—to use a popular phrase—the bunk. It appears to be now solely devoted to the interests of the B.C.L., and commercial operating is not recognized: except to be sworn at by the concert fiends.

Mr. Gernsback's editorials are good. Now and again Sylvan Harris or some other well-informed gentleman contributes an article which is worth reading; but the magazine seems to be getting more and more for the use of those who can't read good code. I am not altogether in favor of a "dryly scientific" magazine; therefore I think about half a page of jokes (and those scattered throughout the book) would be sufficient. The portrait section gives it the appearance of a motion-picture magazine and, although some of the ladies have a pleasant smile, RADIO NEWS is not the place for them.

It is getting to be easier and easier for people to break into print with letters not worth reading under the headings of "The Listener Speaks" and "Home Constructor:" and a lot of the "wrinkles" are old stuff. You have evidently dropped the "Book Review," which I thought was a good feature. It is time for the French "QST," at which you poked so much fun because of its mathematics, to retaliate by likening RADIO NEWS to a cross between "College Humor" and I know not what else.

The above are my views on the subject and my colleagues at the station agree with me; I have written frankly and hope you will not be offended as I quite appreciate the fact that it is impossible to please everybody and you are, no doubt, catering to the majority.

Respectfully yours,

J. E. KITCHIN,
Government Radio Station,
Alert Bay, B. C., Canada.

(RADIO NEWS *is now the largest radio magazine in the world because it caters to the greatest number of radio enthusiasts. This majority is composed of people who are interested only in the popular phases of radio reception, and who have little knowledge of the radio code and less of transmitting practices. You are quite correct in stating that* RADIO NEWS *is devoted to the interests of the broadcast listener; that is our aim, but not quite completely so, as we do publish enough technical articles to appeal to those more advanced radio fans who can appreciate them. The people who can read good code are comparatively few in number, and their special interests are covered by a magazine which has no other function; namely, QST.*

We beg to disagree with you on your remark about the worthiness of the letters we run. We try to pick letters that are of the greatest general interest and, if you do not believe that we are at least partially successful, just write to some of our correspondents and ask them what comments they

receive from other readers. One man who wrote us a short letter, which we printed, received over two thousand inquiries *from radio fans scattered all over the world.*

To an experienced radio man, like yourself, many "wrinkles" which we print seem like "old stuff"; but they are entirely new to the average home experimenter who is not a professional radio expert.

We have not entirely dropped the book-review section, as you will notice if you examine the back pages occasionally. We agree with you that it is a good feature, but what is a poor book reviewer to do when there are no new radio books to review?

Your last paragraph covers the situation admirably. We agree with you that it is impossible to please everybody at once, but at least we are appealing to the majority. —Editor.)

Truth Imitates Fiction

Editor, Radio News:

The attached news item may be of interest, especially after your story along the same lines ("The Voice of the People") published in the November issue of Radio News.

I. G. Utschig,
Fort Bragg, California.

(The best scientific fiction is prophetic. Some of the once seemingly-wild ideas of ingenious authors have been made the commonplaces of the present; and some of the oddities of the present will similarly be made the customary procedure of the future. Radio News, *in its selection of fiction for its readers, seeks always to choose that which is based upon recognized scientific principles, and consequently within the realms of possibility, so far as its electrical and mechanical details are concerned. The clipping sent by Mr. Utschig is reproduced below.* —Editor.)

WOMAN AROUSED FROM LONG COMA BY MUSIC OVER RADIO

Orpheus won over Morpheus in battle for the life of Mrs. Ethel Baldwin, 34, of Long Beach today, when the soft strains of radio and piano music were successful in arousing her from a dangerous coma in which she had lain many hours after being told of the death of her husband.

Friends noticed that when strains of music reached Mrs. Baldwin the little finger of her left hand moved slightly. For twenty-four hours music was then played. During periods when there was no broadcasting of music volunteers took turns of playing the piano.

This morning their efforts were rewarded. Mrs. Baldwin stirred, opened her eyes, looked about her, then murmured that she had to go to work. She was definitely aroused from her coma for the first time and, although she had momentary lapses, physicians held hopes for her recovery.

Mrs. Baldwin fainted when told of the death of her husband, Edward B. Baldwin, who succumbed after an operation for appendicitis. She became hysterical after regaining consciousness the following morning and then lapsed into the coma.—*San Francisco Chronicle,* Nov. 28, 1927.

What's New In Radio

(*Continued from page* 889)

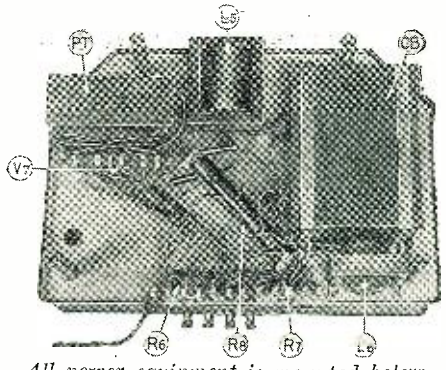
equipped with three aerial binding posts and the aerial is connected to the post which gives the best combination of selectivity and sensitivity.

SIMPLE CONTROLS

Single-control tuning is accomplished by use of a quadruple condenser unit (C1, C2, C3 and C4). This condenser is adjusted by the dial D and the four sections of the unit are connected in the grid circuits of the three radio-frequency stages and the detector; *i.e.,* it tunes the four coils L1, L2, L3 and L4. Oscillation in the three radio-frequency stages is prevented by the resistors R1, R2 and R3, which are connected in series with the grids of the tubes; these resistors have a resistance of 600 ohms each. Volume also is controlled in the radio-frequency circuits, and for this purpose a variable resistor (R5) is connected in shunt with the primary of the radio-frequency transformer L4. Distortion is reduced by locating the volume control in this position, thus preventing the detector tube from being overloaded by a powerful local broadcast station.

In the detector circuit the usual grid method of rectification is employed; *i.e.,* a grid condenser (C7) is used in the circuit. However, the grid leak (R4) is connected between the grid and the cathode of V4, rather than in shunt with the condenser above, and the power-handling capacity of the circuit is increased in this way. The grid condenser has a capacity of .00025 mf. and the grid leak a resistance of 2 megohms.

The audio-frequency amplifier of the receiver is transformer-coupled. In the first stage a small fixed condenser (C8) is connected across the secondary winding of the transformer (T1) to improve the frequency-response characteristics of the circuit. The fixed condenser (C8), connected in the primary circuit of the transformer, by-passes the radio-frequency currents. The transformer (T2) in the second audio stage is connected in the usual manner. In the output circuit of the last stage an output filter, consisting of an audio choke coil (L6) and 1-mf. fixed condenser (C10), is employed to protect the loud-speaker windings



All power equipment is mounted below the lower deck of the chassis; so that the receiver circuits are effectively shielded from the A.C. wires.

from the heavy plate current of the last amplifier tube.

Three different types of tubes are used in the receiver. V1, V2 and V3, the three radio-frequency amplifier tubes, are of the 226-type; V4, the detector tube, is of the heated-cathode or 227-type; V5, the first-stage audio tube, is also of the 226-type, and V6, the power audio tube, is of the 171-type. In the power circuit, V7 is a 213-type full-wave rectifier.

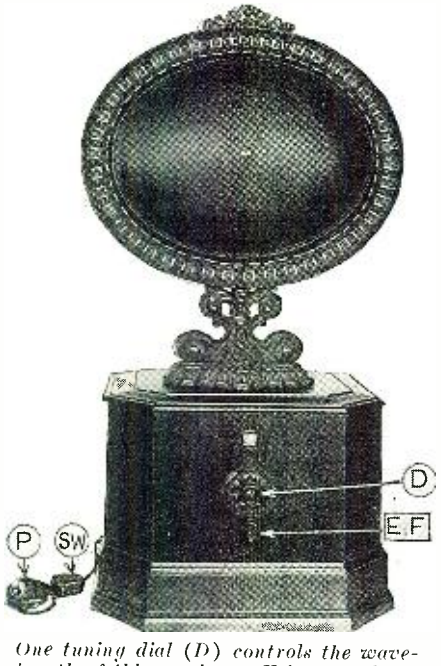
POWER CIRCUIT

It will be noticed that the wiring dia-

gram is divided into two parts by a dotted line. Wiring above this line is located in the receiver circuit and wiring below the line is in the power circuit. Power for the operation of the set is obtained from the 110-volt house-lighting circuit and is transformed to the proper potentials by the power transformer PT. Winding S1 of this transformer supplies a potential of 1.5 volts for the 226-type tubes; S2 provides 2.5 volts for the 227-type detector; S3 delivers 5 volts for the dial light and the 171-type tube; S4 delivers plate power to the 213-type rectifier (V7) and S5 heats its filament.

The filter circuit of the power unit consists of a single choke coil (L5) and two condensers, C11 with a capacity of 4 mf. and C12 with a capacity of 6 mf. The voltage-divider (R8) is a wire-wound fixed resistor having a total resistance of 13,200 ohms and taps at 650 ohms, 800 ohms, 5,300 ohms and 10,700 ohms. Connected as shown, it provides the following positive potentials for the plate circuits: 180 volts, 110 volts, 45 volts; as well as negative potentials of 6 volts for the 226-type tubes and 40 volts for the 171-type tube.

In addition to the parts already mentioned five by-pass condensers are used in the plate supply circuit. They are shown in the diagram at C5, C6, C13, C14 and C15, and have

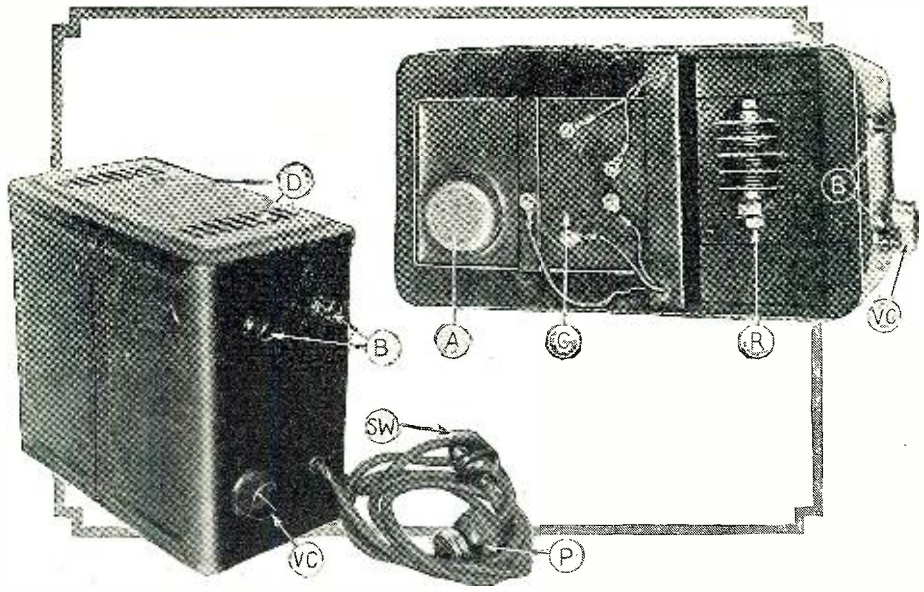


One tuning dial (D) controls the wavelength of this receiver. F is the volume control and E is an additional sensitivity control, Sw turns the set on and off.
Illustration courtesy Splitdorf Electric Co.

a capacity of approximately 1 mf. each. In the filament-supply circuits two low-resistance potentiometers (R6 and R7) and one center-tapped fixed resistor (R9) are used. These are employed for obtaining a point of zero potential and greatly reduce the effect of the A.C. hum.

New Power Unit Gives Three Amperes of D.C.

THIS year more radio receivers are being "electrified" than ever before. Many types of power-supply units which operate from house-lighting circuits have been developed and have proved entirely satisfactory for use in both the plate ("B") and filament ("A") circuits. Plate-power units are available in many sizes which answer



Two views of a new power unit which delivers 3 amperes at a potential of 6 volts. This device uses a dry electrolytic rectifier R, and an electrolytic condenser (C), and a heavy-duty choke as a filter.

Illustration courtesy Valley Electric Company

the requirements of all types of receivers. On the other hand, most filament-power units have a limited output, as a large number of those which are now available deliver only 6 volts at 2 amperes. This is ample for the operation of sets using seven or eight tubes; but sets which use a greater number of tubes, or include power tubes which require a greater amount of current, often need more than 2 amperes for their operation. The new design of filament-power unit which is illustrated on this page may be used for these large sets.

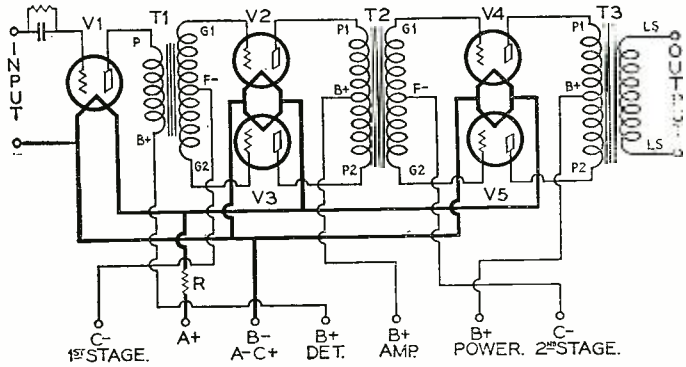
This filament power unit has a power output of 6 volts at 3 amperes, which is ample current for the operation of all types of receivers using 6-volt tubes. It consists of a power transformer connected with a dry rectifier unit. The filter circuit employs a heavy-duty choke coil and an electrolytic condenser connected in the usual manner. Also, it is provided with a voltage-control resistor which makes it possible to adjust the voltage to the correct value, regardless of the number of tubes used in the receiver.

The illustrations show the external appearance of the unit and also the arrangement of parts under the metal cover. The two binding posts marked B are the output posts of the unit. Sw is a switch in series with the 110-volt circuit, which may be used to turn it off and on; and P is the plug which is inserted in the light socket. The output voltage is controlled at VC. Holes have been cut in the metal cover at D for ventilating purposes. With the cover removed the electrolytic condenser (C) and the dry electrolytic rectifier unit (R) may be seen. A is the filler hole for adding distilled water to the electrolytic cell of the condenser. The transformer and heavy-duty choke coil are mounted under R, but cannot be seen in the picture.

Because of the fact that distilled water is added to the condenser, this type of power unit should not be confused with the storage battery-trickle charger type. On the contrary, the power unit delivers full voltage instantly when connected with the house current and *it does not require charging*. In other words, the power unit operates only when the set is in use. Another advantage of the power unit is that it may be connected to any receiver without making any changes in wiring. It is necessary only to connect it in place of the storage battery and to insert the plug in the light socket.

An Interstage Push-Pull Transformer Developed

FOR the past several years it has been the aim of practically all radio engineers to improve radio reproduction in every way possible. In their experiments they have found that overloading the tubes of the audio amplifier has been the chief cause of poor rendition in the past; and as a result they have devised many methods for overcoming this difficulty. Power tubes have



The unit illustrated on the left is a new-type push-pull transformer with center-tapped primary and secondary windings. It makes possible the use of the amplifier circuit shown.

Illustrations courtesy Samson Electric Company

been developed and recommended for use in the last stage of amplification. Propaganda advocating the use of a suitable grid-bias potential on all amplifier tubes has been circulated. The use of higher plate voltages on all audio amplifier tubes has been pointed to as a necessity, and push-pull has been described as the ultimate refinement for those who desire the best music possible.

Push-pull amplification is generally admitted to possess many advantages which cannot be gained by other methods. In circuits of this type two tubes are used to do the work of one; but, due to certain characteristics of the circuit, the output of the two tubes is more than two and one-half times the output of either tube when used alone. Secondly, push-pull amplifiers are not affected by slight voltage variations, such as frequently take place in the output of plate power-supply units. Thirdly, another cause of frequent distortion (namely, saturation of the cores of audio transformers) is eliminated in push-pull transformers because of the fact that the plate current flows in opposite directions in the primary winding. And fourthly, the use of the circuit causes a stabilizing effect, similar to that of a voltage-regulator tube, and as a result improves the operation of the detector and radio-frequency amplifier tubes.

FOR THE EXPERIMENTERS

Until recently push-pull amplification has been used only in the last audio-frequency stage, and the transformers which have been designed for the purpose have had a center-tapped secondary winding, in the case of the input unit, and a center-tapped primary winding in that of the output unit. However, because of the fact that standard transformers with center-tapped primary and secondary windings were not available, it has been impossible for the amateur to experiment with this type of amplification in the intermediate audio stages.

The illustration which accompanies this article shows a new type of push-pull amplifier which may be used for interstage coupling purposes. This makes it possible for the experimenter to build a two-stage push-pull amplifier with both stages transformer-coupled. The circuit which may be used will be found on page 952.

In the diagram V1 is the detector tube and T1 a push-pull transformer of the input type with a center-tapped secondary winding. V2 and V3 are the first-stage amplifier tubes connected in a push-pull circuit, and T2 is the new interstage type of push-pull transformer with center-tapped primary and secondary windings. V4 and V5 are the power tubes of the second audio stage, and T3 is a standard output-type push-pull transformer.

In the operation of the amplifier, the detector tube used may be either a 201A or a 200A type; the first-stage amplifier tubes may be of the 201A or 112 types, and the second-stage amplifier tubes should be power tubes of the 171 or 210 types. With this arrangement there is ample power for all requirements and distortion is reduced to a minimum.

TUNING IN

MADGE: "Dolly is always changing her barber."

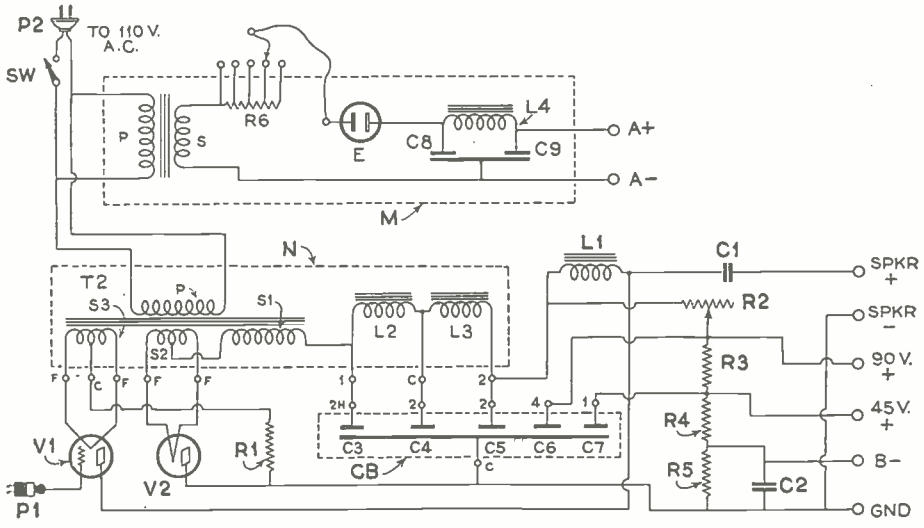
MARJORIE: "She says she can never get the right wavelength."—*J. J. O'Connell.*

The "A, B and C" Socket-Power Unit and Amplifier

(*Continued from page 915*)

that the large condenser shall be of at least a 600-volt working voltage. The output of the amplifier at times is tremendous, and ordinary condensers of a lower voltage rating will not stand up. This cannot be stressed too greatly, as substitution in this value positively must not be made.

The fixed resistors must have a large current-carrying capacity. Those used in this unit in every case have a capacity in excess of that specified in ordinary amplifier circuits. This has been found advisable in order to prevent heating of the units and possible burn-outs. The difference in cost is so small that it is always advisable in radio power-unit construction to have a large margin of safety in the value of the current-carrying devices.



The circuit diagram of the socket-power unit and power amplifier, the components of which are named in the list of parts below.

SYMBOL	Quantity	NAME OF PART	REMARKS	MANUFACTURER ★	
M	1	"A" power unit	6-volt, 2-ampere output	1	10,11
N	1	Power compact	Power transformer and 2 choke coils	2	
CB	1	Condenser block	2-2-2-4-1 mf. (special 210 type)	3	12
C1	1	Filter condenser	2 mf., 600 volts	3	12,13,14,15,16,17,18,19,20,21
C2	1	By-pass condenser	1/2 mf.	3	12,13,14,15,16,17,18,19,20,21
L1	1	Audio choke coil	Plate circuit type	2	21,22,23,24,25,26,27,28,29
R1	1	Fixed resistor	1,000 ohms, 5 watts, wire-wound	4	15,16,17,18,21,30,31,32,33
R2	1	Variable resistor	Heavy duty universal range	5	
R3,R4	2	Fixed resistors	10,000 ohms, 10 watts, wire-wound	4	15,16,17,18,21,30,31,32,33
R5	1	Fixed resistor	100 ohms, 5 watts, wire-wound	4	15,16,17,18,21,30,31,32,33,34
	2	Tube sockets	UX type	6	4,8,32,35,36,37,38,39,40
	2	Resistor mountings	For R1 and R5	4	
	1	Terminal strip	With six posts and mounting brackets	8	4,41
V1	1	Power tube	210 type	7	31,42,43
V2	1	Rectifier tube	216-B type	7	31,42,43
	1	Baseboard	Wood panel 6½ x 25½ x 1 inches		
P1	1	Base of tube	UX type		
Sw	1	Off and on switch	110 volt type		
		Hook-up wire	Insulated	9	14,32,44,45
	8 ft.	Flexible wire			

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 The Abox Company	2 Thordarson Electric Mfg. Co.	3 John E. Fast & Company
4 Amsco Products, Incorporated	5 American Mech. Labs. (Clarostat)	6 Benjamin Electric Mfg. Company
7 F.T. Cunningham, Incorporated	8 H.H. Eby Manufacturing Company	9 Cornish Wire Company
10 Fansteel Products Company, Inc.	11 Valley Electric Company	12 Tobe Deutschmann Company
13 Dubilier Condenser Corporation	14 Acme Wire Company	15 Aerovox Wireless Corporation
16 Electrad, Incorporated	17 Polymet Manufacturing Company	18 Carter Radio Company
19 Potter Manufacturing Company	20 IGRad Condenser & Mfg. Company	21 Leslie F. Muter Company
22 Pacent Electric Company	23 Samson Electric Company	24 Jefferson Electric Mfg. Co.
25 American Transformer Company	26 The National Company	27 Acme Apparatus Company
28 Ferranti, Incorporated	29 Dongan Electric Mfg. Company	30 Arthur H. Lynch, Incorporated
31 Daven Radio Corporation	32 De Jur Products Company	33 Electro Motive Eng. Corp. (MY-WATT)
34 International Resis. Co. (Durham)	35 Air Gap Products Company	36 Alden Manufacturing Company
37 General Radio Company	38 Silver-Marshall, Incorporated	39 Herbert H. Frost, Incorporated
40 Electrical Research Labs. (ERLA)	41 K-L Radio Laboratories	42 Radio Corporation of America
43 C.E. Manufacturing Co. (CeCo)	44 Belden Manufacturing Company	45 Kellogg Switchboard & Supply Co.
46	47	48

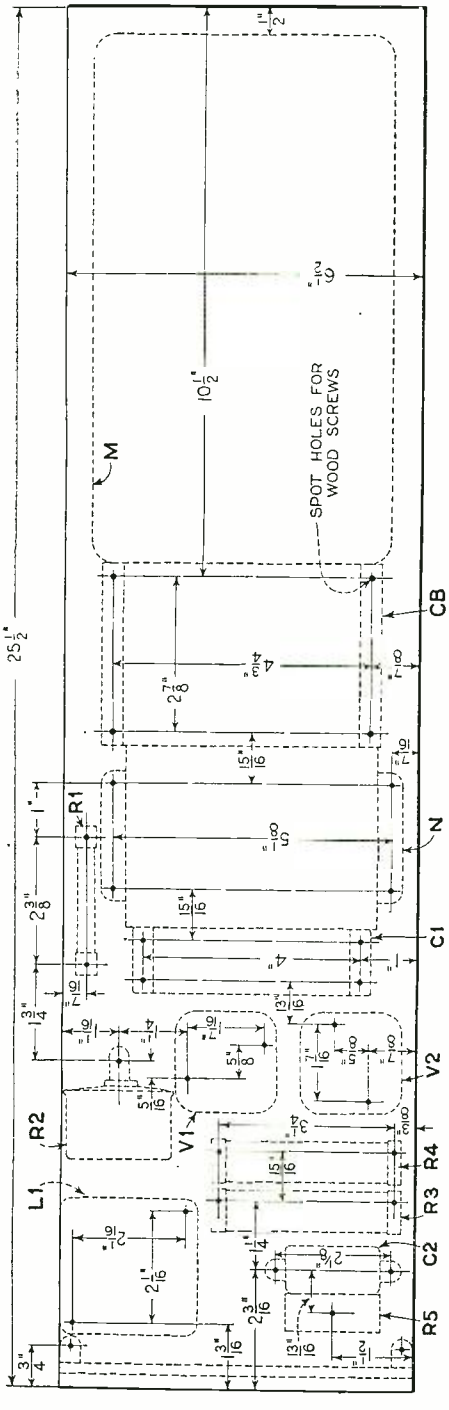
★ THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

OTHER DETAILS

A heavy-duty variable resistor of the carbon-compression type is used as the "B" voltage control. Its large current-carrying capacity and fine-adjustment feature makes it ideal for this purpose. A base-mounting bracket is used and this enables it to be very easily attached and mounted on the sub-base. It may be necessary to place a small washer between the bracket and the unit, to tighten the mounting nut securely, A circle of bus-bar wire will serve admirably.

Cushioned base-mounting sockets have proven very satisfactory in this unit. They are small, compact and easily wired and, although cushioning the sockets for these tubes is not absolutely necessary, they protect the tubes to a certain degree against



How the apparatus is located on the baseboard with drilling instructions given for a sub-panel if one is used.

injury caused by a chance jar or jolt. Both tubes are very delicate mechanically and have long filaments. Every precaution should be taken so that they will not be subjected to unnecessary handling.

The tubes may be of any standard make of the 216B- or the new 281-type rectifier and 210-type power-amplifier tubes. With these you are assured of having a maximum of efficiency and power.

For hooking up the set, rubber-covered, stranded, tinned hook-up wire is used. By all means, do not use cheap, poorly insulated wire or bare bus bar. The voltages handled are upwards of 600, and a chance short would prove disastrous.

The additional parts are binding posts and strip, baseboard and an "on-and-off" switch for the A.C. line. The selection of these is optional.

ELECTRICAL DESCRIPTION

Before entering into a description of the construction of this power unit, the schematic wiring diagram (Fig. 1) will be considered. A casual examination will show that it may be divided into two distinct parts; *viz.*, the "A" power circuit which is enclosed within the dotted lines marked "M," and the "B" and "C" power circuits which include the remaining apparatus and wiring.

The "A" power circuit does not present any constructional problems for the builder, as the unit is available in a completely-wired form. However, the technical features will be explained. First in the circuit is a step-down transformer, the primary (P) of which is connected directly to the 110-volt house current, and the secondary (S) to the rectifier and filter units. R6, the tapped resistor in series with the secondary winding, is for the purpose for controlling the output voltage of the power circuit. There are five taps and, by connecting a flexible lead to the proper post it is possible to obtain the exact voltage for the receiver, regardless of the number of tubes used. The maximum output is 6 volts at 2 amperes.

The rectifier unit is shown at E. It is an electrolytic cell and uses the same electrolyte as the electrolytic condenser. L4, C8 and C9 compose the entire filter circuit. C8 and C9 are a condenser bank of the electrolytic type, and L4 is a heavy-duty choke coil. The two output binding posts of the power unit are connected directly to the filament binding posts of the receiver.

SIMPLICITY OF CONNECTIONS

The principal part of the "B" power circuit is the "power compact" (N). This unit contains T2, the power transformer, and L2 and L3, the choke coils. The primary winding (P) is connected in shunt with the primary P above. The secondary winding S1 provides the high "B" voltage, S2 the filament voltage for the rectifier tube V2, and S3 the filament voltage for the power amplifier tube V1. The arrangement of wiring inside the unit N is such that only eight binding posts are required to connect it with the rest of the circuit. Two of these wires connect with the filament of V1, two connect with the filament of V2, three connect with the condenser block (CB), and one connects with R1, the resistor which provides the voltage drop for biasing the grid of the power amplifier tube. Condensers C3, C4, C5, C6, and C7 compose the condenser block (CB). C3,

C4 and C5 are used in the filter circuit, and each has a capacity of 2 mf. with a voltage rating of 600 volts. C6 is a 4-mf. condenser with the same voltage rating, and acts in the capacity of a by-pass condenser for R2, and also as a third-stage filter condenser. C7 is a 1-mf. by-pass condenser.

Resistors R2, R3, R4 and R5 constitute the voltage-dividing circuit. R2 is a variable resistance which determines the voltage at binding post "B+ Amp." R3 and R4 determine the voltage of "B+ Det." and R5 provides a 4-volt grid bias for the tubes in the receiver.

In order to protect the loud-speaker windings from the heavy plate current of the tube an output filter, which consists of the audio choke coil L1 and the 2-mf. 600-volt condenser C1, is used. The choke coil is connected in series with the high voltage and provides the path for the direct current to the plate of the power tube. The condenser C1 is connected in series with the loud speaker, between the plate and the ground.

ASSEMBLY

The assembly procedure is not difficult. Lay out the parts as illustrated in the working drawings and mark their positions on the baseboard. Ascertain that the tube sockets are far enough apart and from other instruments, so that when the tubes are inserted, they will be in the clear. Fasten down with wood-screws and you are ready to start wiring.

Make all leads directly from point to point, and as short as possible. Where a wire is particularly long, and apt to lie loose, fasten it to the baseboard with a tack or staple. Every connection must be soldered securely with a good rosin-core solder. Should a particular connection be hard to get at with the soldering iron, because the instruments are crowded, loosen those interfering from the base and replace them when the connection is completed.

The power unit (N) is equipped with a lead to be run to the light socket. In this unit it is attached to the cord leading to the "A" power unit so that both units may be connected to the light socket with the same wire and controlled with a single switch. Shorten the cord of the power unit (N) to the required length, bare the ends of the wire and splice them to the "A" unit cord, taping well when finished. Toward the end of the cord, a series "on-and-off" switch (SW) is inserted. This controls the entire unit and the set.

CONNECTIONS TO THE RECEIVER

The unit is now completed and ready to attach to the set. The power amplifier is connected by means of a long, flexible lead attached to the grid-prong of a tube base (P1) from which the bulb has been removed. This is then inserted in the socket of the last audio tube in the receiver.

The grid prong of the tube base may be determined by holding the pin on the side away from you. The prong on the bottom farthest away and to the left is the grid prong. "This can be determined also by inserting the base in a tube socket and tracing the connection marked "G."

The wire is attached to the prong by removing the solder with which the prong is filled, inserting the wire which has been already tinned, then reheating the prong so that a good, soldered connection is made between it and the wire. The base can now be filled with sealing wax or paraffin.

To attach the entire "A, B and C" power unit to the receiver, connect the various battery terminals of your set to their respective connections on the power unit. The "A" battery leads go to the terminals provided on the unit M. If you have a 180-volt or a 67½-volt lead, connect them with your 90-volt lead to the "B" amplifier terminal on the power unit. Disconnect the ground lead from your set and connect it to the ground post on the eliminator. If your receiver operates with a loop, provide a ground connection to a radiator or water pipe. This will not affect the tuning or efficiency of the receiver.

Now insert the tube base (P1) with the flexible lead from the amplifier into the socket of the last audio tube in the set. Should the set have previously used "C" batteries, these potentials may be obtained from the power unit, which is so constructed that it provides automatically a grid bias of approximately four volts without external connections when properly connected. This voltage exists between the "B" minus and ground binding posts of the power unit and in order to make use of it it is necessary to make a slight change in the wiring of the receiver. First, all connections between the ground binding post of the set and the filament or "B" minus wires should be removed. Then ground post should be connected with the "C" minus wires of the various stages. When the set is connected in this way the power tube receives a bias of 35 volts and all other tubes have a bias of 4 volts.

The loud speaker is disconnected entirely from the set and attached to the speaker terminals of the amplifier. You are now ready to operate the unit. Turn the filament switch on the radio set "on" and set the rheostats at their normal operating positions. Screw out the knob of the voltage control R2. Put the plug in the light socket and snap the control switch on. Note first that the tubes in the amplifier light. Then, that the tubes in the set light. Should they fail to do so, or should there be a spark of any kind, turn it off immediately and check your connections.

If the tubes light and everything seems O.K., slowly screw in R2 until a live sound is heard in the speaker, then tune in the set in the ordinary way. It is advisable to check the amplifier and detector voltages with a high-resistance meter, to be sure they are not excessive. As high as 135 volts can be used on standard tubes without danger, although it is better to operate the set at the lowest voltage at which satisfactory reception is obtained.

It is now merely a question as to whether your loud speaker will handle the volume of your new powerized set. There is no danger of burning it out or injuring it, as it is amply protected by the fixed-condenser-and-choke arrangement built into the amplifier. Any good modern speaker should handle the output nicely.

Should the speaker howl, it may be due to a faulty detector tube, excessive amplifier or detector voltage, or a defect in the speaker. A slight hum may be present for an hour or so *when the amplifier is first put in operation,* but, otherwise than that, no noise can originate in the unit itself.

The Silver Shielded-Grid Six

(*Continued from page* 902)

should be the variable condensers; placing the two long-shaft condensers in the extreme end compartments S1 and S4. On the bottom of the chassis, a soldering lug should be placed on the front mounting screw of the output transformer (T3) and under the rear mounting screw of condenser C2. These lugs are to be used for ground connections to the chassis. Under the front mounting-screw head of condenser C2, one end of the 2-ohm resistor (R5) should be fastened; the other end of this resistor being soldered to a lug on the binding post of the 20-ohm rheostat (R6). The two mounting screws of this same variable condenser serve to hold a 1-mf. condenser in position; while the two mounting screws of the left rear, or second, audio-tube socket, hold the second 1-mf. condenser in position.

The coil sockets in the various compartments should be put in and elevated above the chassis by means of the long mounting screws and studs provided; taking care that terminal "3" of each coil socket projects directly to the right.

WIRING

After all parts have been mounted upon the chassis, but before the front panel has been attached, the wiring should be put in place. With but three exceptions, all wiring is done with flexible insulated hook-up wire. A soldering iron, well heated and with a well-tinned tip, is required, in addition to a small can of non-corrosive soldering paste, and several lengths of rosin-core solder. Every joint to be soldered should have the wire and lug separately tinned, using the tiniest pin-point of soldering paste and an amply large drop of rosin-core solder. The wire end and lug may then be joined together, using a hot iron with a drop of solder.

The detail of the placement of all wiring in the receiver is not given here for it is clearly illustrated in the various illustrations and in the schematic and pictorial diagrams. The actual position of all battery wiring beneath the chassis is of little importance, though it should be kept as neat as possible. Certain leads in each stage compartment must be carefully handled, as follows.

The right stator lug of each variable condenser should be connected to terminal "3" of each coil socket. In the detector stage assembly, (S4), this post "3" of the coil socket and post "G" of the tube socket should be joined. In the S1, S2 and S3 R.F.-amplifier sections, a 4¼-inch length of wire should be allowed to extend from terminal "3" of each coil socket, and to the far end of this wire should be fastened one of the three small clips accompanying the kit. These clips are to be fastened to the top terminals of the 222-type shielded-grid amplifier tubes. Terminal "6" of the three R.F. coil sockets should connect to a lug held between the nearest mounting screw and the hollow collar holding the coil socket above the shield, thus grounding this terminal to the metal receiver assembly.

Three bus-bar leads are used in the receiver. One is soldered to the "B+135" binding-post lug of the terminal strip and carried straight across the chassis for a distance of 13 inches. To it, at various points, are soldered the leads from post "5" of the coil sockets in compartments S2, S3 and S4 and from other portions of the circuit. Another lead, soldered to the "A+" lug of the terminal strip, is carried directly across the chassis for a distance of 14½ inches; and to this wire, at various points, are soldered the flexible hook-up-wire leads from the "A+" posts of all tube sockets. A third bus-bar lead, soldered to the "B+45" lug of the terminal strip is carried to the rear for 3 inches, and then down the chassis for 15 inches; and to it, at various points, are soldered all "B+45" circuit leads of flexible hook-up wire, with as short connections as possible from terminal "G" of the three R.F.-tube sockets to this bus line. The rear by-pass condenser, which has one lug grounded to the chassis by means of a short wire, has its other lug soldered to this "+45" bus. All bus-bar wiring is insulated with lengths of spaghetti tubing, slipped over it.

The lead from post "P" of tube sockets in compartments S1, S2 and S3 should be a little longer than necessary, and should terminate in a lug so cut that it may be slipped under terminal screws "1," "2," and "4" of the coil sockets in compartments S2, S3 and S4, respectively, to regulate selectivity.

The "ground" can consist of a ground lead, terminated in a ground clamp on a well-scraped water, gas, or steam pipe. The aerial may be a bedspring for medium-range reception, or a 30- to 60-foot indoor or outdoor wire—preferably the latter.

PRELIMINARY TESTING

Connect the aerial and ground leads to the "aerial" and "ground" binding posts upon the terminal strip. Connect the "A" battery to the *"A Bat"* post upon the terminal strip, using the two heaviest wires in the battery cable. Connect the red, or plus, terminal of the battery to the "A+" post of the receiver. Connect the black, or negative, post of the battery to the A—" post of the receiver. Insert all tubes in sockets, turn rheostat to left, and turn switch Sw1. The detector and audio amplifier tubes should light to a cherry red if 112A-type tubes are used. The volume-control rheostat should be turned to the right gradually and, when all to the right, the filaments of the 222-type tubes should glow with a bright yellowish color. All tubes should extinguish with the switch Sw1 is tuned to the *"off"* position.

Remove the "A+" lead and connect it successively to all remaining battery posts upon the terminal strip. In any of these positions the tubes should *not* light, and they should only light with the "A" battery properly connected. Should the tubes light with any other connections, the receiver wiring is at fault and should be carefully checked. The 4½-volt "C" battery should have its plus lead connected to the black, or negative, lead of the "A" power unit. Its "3—" lead should connect to the "C—3" binding post of the terminal strip. The "C" battery for the last audio amplifier stage should preferably be of about 15 volts value when using a 112A-type tube on 180 volts, an extremely satisfactory operating value for this tube. The minus lead of the "C" battery should connect to the *"C-Amp"*

post of the terminal strip. If "B" batteries are used, they should first connect with the "—" lead to the black, or negative, post of the storage battery, and the plus lead to the "+45" post of the receiver. The second and third batteries should be connected in series; that is, plus to minus and the free minus post of one connected to the "B+45" post of the receiver. The second and third batteries should be connected in series; that is, plus to minus and the free minus post of one connected to the "B+45" post of the receiver. The free plus post of the second should connect to the "B+135" post of the receiver. The fourth battery should have its minus post connected to the plus 135 post of the receiver, and its plus post to the "B+Amp" post of the receiver.

If a "B" socket-power unit is used with the receiver, it is very important that it be only of the glow-tube-regulator, fixed-voltage type; for it is necessary that the values of 45 and 135 volts required for the receiver "B" circuit be accurate within 10 to 15 per cent—an accuracy which is absolutely impossible to obtain by guess-work with a standard "B" socket unit equipped with variable-voltage controls. Such units may be used with this receiver only when preliminary adjustment of their output voltage may be made with a good high-resistance voltmeter.

The operation of the receiver is ridiculously simple. It is necessary to simply turn it on with an *"On-Off"* switch, adjust the *"Volume"* knob to the maximum or full right position, and tune in stations; which will be received with the two dials rotating approximately alike. Volume may be regulated with the *"volume"* knob and a coarse regulation of the selectivity *"Selector I"* dial effected by throwing the antenna short-and-long switch from *"short"* to *"long"* position and *vice versa*.

If the set is to be operated in a residential district three or four miles from a local broadcast station, the plate leads of the R.F.-amplifier tubes should be fastened under terminal screws "2" of the coil sockets in compartments S2, S3 and S4; this is the position of greatest volume together with extremely good selectivity. Moving the three plate leads to post "4" of the respective coil sockets increases the selectivity and decreases the volume very slightly. While connecting the plate leads to post "1" of the coil sockets gives an extremely high value of selectivity at the expense of a slight decrease in volume, this connection is recommended only where the receiver is located within half a mile or a mile of a broadcast station.

The three condensers in stage compartments S2, S3 and S4 should be ganged by fastening the link motion to them and adjusting it so that all three condensers begin to interleave and hit their stop rods at the same time. After the set has been put in operation, the aerial length should be cut down until some station at about 300 or 325 meters is barely audible. The right-hand condenser (C4) should then be loosened from the ganging and tuned individually. While condensers S2 and S3 are tuned together for loudest signal, the condition of loudest signal will be when condenser S4 lags slightly behind condensers S2 and S3. The link motion should be tightly locked in place at this point, after which no attention need be paid to ganging.

In operating this receiver, remember that it tunes exactly like any ordinary neutrodyne or non-oscillating tuned R.F. receiver, and that it will not oscillate if properly assembled (except in the case of very unusual operating conditions where it may oscillate with the plate leads connected to post "2" of coils L2, L3 and L4, and with no antenna connected to the receiver). With even a 15-foot aerial, the set will not oscillate at any wavelength. The set in operation should give loud-speaker signals upon stations barely audible upon other tuned R.F. or superheterodyne receivers, or equivalent volume with greater selectivity on any stations that may be heard with any standard tuned R.F. receiver operating on a 60- to 100-foot aerial. The Shielded-Grid receiver for this test should be equipped only with a 10- to 15-foot length of wire for an aerial. So operated, it will provide superheterodyne selectivity, surprising simplicity of operation, and volume equal or greater than that obtainable from a standard tuned R.F. and ordinary superheterodyne receivers.

A Remote-Control Radio System De Luxe

(*Continued from page* 893)

as fourteen different points by inserting the plug in special jacks. Until the lid of the box is raised, it is impossible for the current to be put through to the set; this operation is effected by the small plug attached to the lid of the box operating a switch under the panel. Four push-buttons, a dial for tuning and one controlling the volume, and a pilot light are all the controlling factors necessary.

The operation is simplicity itself. The top button is pushed, starting the amplifier which it shuts off, when pushed a second time. This is accomplished through an open-circuit remote-control switch. If talking-machine music is wanted, the button marked "Record" is pressed. If a record is already on the turntable of the machine, the pick-up travels to the start of the record, the amplifier functions, and the music pours from the loud speaker. At the end of the record, the pick-up travels back to the start of the record, the record is ejected from the turntable and a new one replaces it. If it is desired to stop a record in the middle, a button marked "Reject" is pressed; this replaces the disk playing by the next in the series.

TUNING IN

In order to get radio reception, the button marked "Radio" is pressed. The station-selector dial, which is marked in kilocycles and is always in synchronism with the set dial, is turned to the designated point and the volume is then adjusted with the smaller dial. The entire instrument can be shut off, at any moment, by pressing the "Start-Stop" button.

In the majority of systems, remote-control apparatus does not tune in the station exactly. For example, one type of apparatus controls the dials by pushing two separate buttons to revolve the condensers, clock-

wise and counterclockwise. The inertia of the motor makes it impossible to stop exactly on the station's wave. However, with the controller shown in the accompanying illustrations, it is possible even to vary the volume of the music by detuning the receiver slightly.

SPECIAL STUDY REQUIRED

As intimated before, the first requirement in an installation of one of these systems is that the reproduction of music shall be as nearly like the original as is possible. To do this, the engineers of the company which is exploiting these install temporarily a portable outfit, which can be varied in many ways to suit local conditions. Then an acoustical study of the house is made; so that the equipment to be installed therein will measure up to the requirements mentioned above. Not only are the acoustical conditions considered, but also local electrical disturbances, aerial and ground systems—everything that, from an engineering point of view, seems likely to affect radio reception. Naturally the result is a different installation in every case; for conditions in no two situations are ever the same.

One of the greatest problems was that of the reproducer itself, whether to use a cone, a horn or a combination of the two; the last was the final solution. A unit of the electrodynamic type is used with a modification of the exponential horn; and the results are astounding, to say the least. It is possible to vary the volume from a mere whisper to the full booming of a brass band—and without distortion.

Of course, any such instrument as that here pictured, with an installation involving such engineering research, is far beyond the pocketbook of the average man. Yet it will be of interest to readers of Radio News, for the simple reason that it has been found possible and practical to control radio reception from some remote point, exactly as you want it, and to have that reception of a quality hitherto unobtainable.

ADVANCEMENT

MY mother sang me lullabies
Before an open fire;
Though she had other chores to do,
She never seemed to tire.

DeForest and the others have
Relieved maternity.
Now mothers leave their lullabies
To Station KNZ?

—John McColl.

The Electrified Peridyne

(*Continued from page 907*)

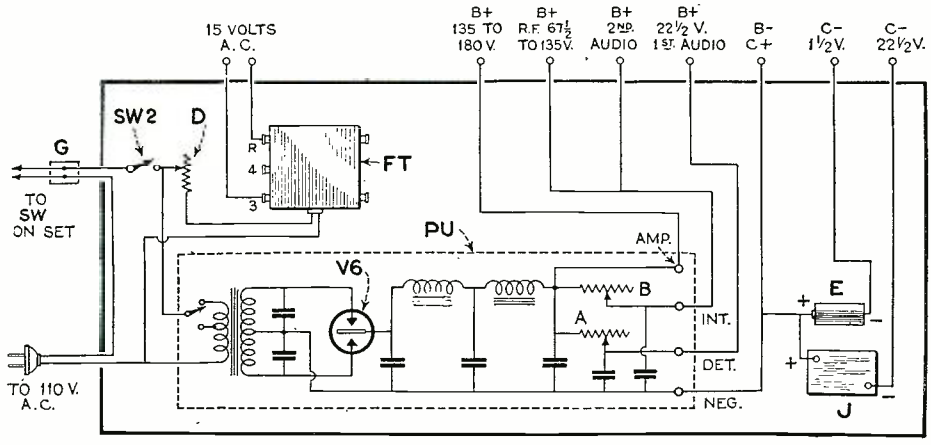
been tuned in. In this respect, the set works exactly like the battery set, and there is no difference here.

As the last audio stage in the receiver is a power tube equal to the 171-type, use of an output filter to protect the loud-speaker winding against the heavy plate current is advisable. This filter, which is indicated as F in the accompanying illustration of the front of the completed receiver, may be placed behind the set cabinet or inside a console, where it will be out of sight. It requires no adjustments of any kind, and once installed, may be disregarded.

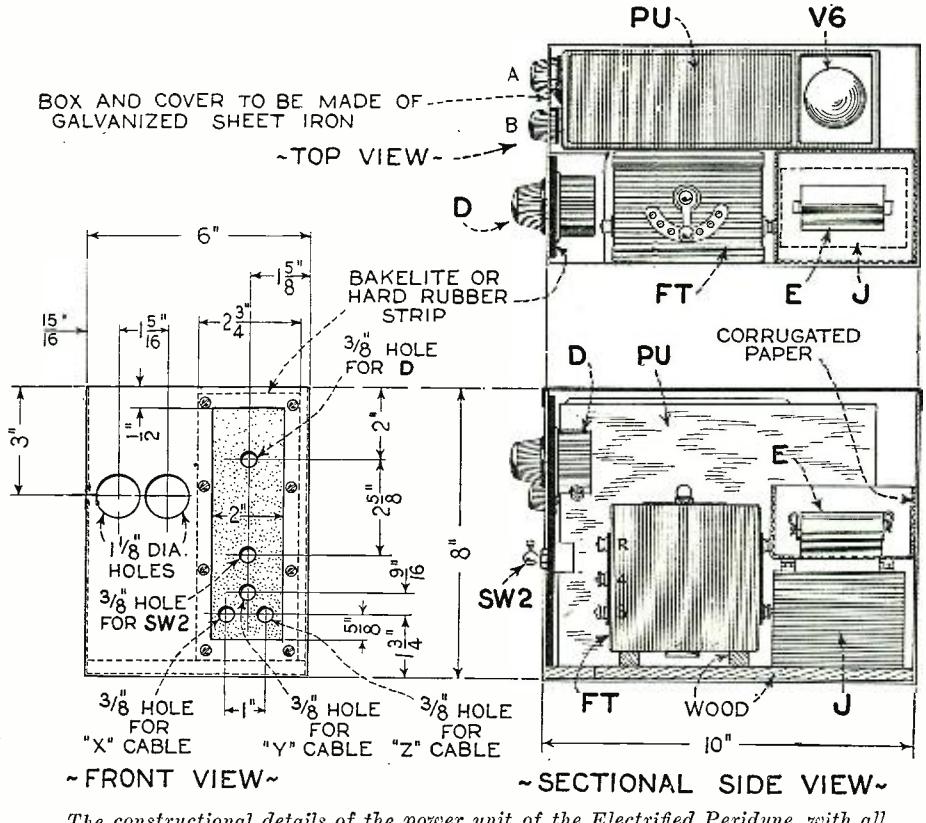
The particular filter illustrated consists of an audio choke coil and a high-capacity fixed condenser in one case; there are a number of such filters on the market. An 1:1 ratio output transformer will serve the purpose just as satisfactorily.

Nothing need be said about the Peridyne action, which remains the same as in the battery set. I went to great pains to explain the action in my former articles and nothing need be added here; because the Peridyne action is not influenced at all by the electrification of the set itself.

I was particularly well pleased with the results obtained, and I have been able to duplicate all of the excellent results obtained with the battery set. In a single evening,



The schematic diagram of the power unit specially designed for use with the Electrified Peridyne.



The constructional details of the power unit of the Electrified Peridyne, with all necessary drilling instructions and dimensions.

I have tuned in over thirty DX stations, as far West as Denver, with the local stations in operation. I am quite certain that the Electrified Peridyne set will give the exact results of the battery set, as far as distance and selectivity is concerned. The set remains unusually sharp, the same as it was before, and there is no reason for doubt that this set will be every bit as popular as the battery set; which so far, has enjoyed an astounding popularity in, not only this country, but a great many foreign countries as well.

In case any unforeseen trouble should arise in connection with the Electrified Peridyne Five, I shall be glad to give personal advice to those of you who have built this set.

SYMBOL	Quantity	NAME OF PART	REMARKS	MANUFACTURER ★	
C1,C2,C3	1	Triple Var. Cond.	.0005 mf. each section	1	2
L1,L2,L3	3	R. F. transformers	Special Peridyne units	2	
S1,S2,S3	3	Coil shields	Special Peridyne units	3	
T1,T2	2	A. F. Transformers	3:1 ratio	4	3,10,15,17,20,31,32,34,35,56
R1,R2	2	Rheostats	Carbon type	5	
R3	1	Variable resistor	0-100,000 ohms	6	7,13,44
R4,Sw	1	Switch-rheostat	75 ohms (new type with insulated switch)	7	
R5	1	Fixed resistor	60 ohms, wire wound type	7	13,40,43,44
D	1	Crystal detector	Carborundum type	9	
L4	1	R. F. choke coil	85 millihenries	10	2,3,17
C4	1	Fixed condenser	.001 mf., mica type	11	7,13,20,31,32,39,40,41,42,38
M1	1	A.C. voltmeter	0 - 25 volts (special)	12	29,30
M2	1	D.C. voltmeter	0 - 150 volts	12	17,29,30
J1	1	Jack	Single circuit type	13	7,40,44,45
Sw1	1	Jack-switch	Two circuit type (D.P.D.T.)	13	7,44,45
V 1-4	4	A.C. tubes	4-terminal heated cathode - type 28	14	
V5	1	A.C. power tube	4-terminal heated cathode - type 30	14	
Sw2	1	Snap switch	110 volt type	7	13,20,44,45,55
FT	1	Filament transformer	Jr. toy type, 15 volts output	15	54
PU	1	"B" power unit	180 volts maximum output	4	
F	1	"C" battery	1-1/2 volts	16	52,53
J	1	"C" battery	22½ volts, 4-1/16 x 2-9/16 x 2-3/4 inches	16	52,53
D	1	Rheostat	30 ohms	17	1,6,7,13,20,31,40,43,44,45,51
X	1	Battery cable	7-wire	18	13,33,50
Y,Z	2	Battery cables	2-wire (lamp cord may be used)		
G	1	Stage connector			
F	1	Output filter	Audio choke-fixed condenser unit	20	1,31,56
Vó	1	Rectifier tube	Full-wave, gaseous, 85 milliampere type	19	36,37
	1	Vernier dial		22	3,10,31,47,49
	5	Tube sockets	UX type	23	1,3,4,8,17,31,43,44,45,46,48
	4	Binding posts		21	1,8,17,31,45
	1	Front panel	24 x 7 x 3/16 inches	24	26,27,28
	1	Sub-base panel	23 x 8 x 3/16 inches	24	26,27,28
	1	Terminal strip	7½ x 1 x 3/16 inches	24	26,27,28
	1	Panel strip	7 x 2¾ x 3/16 inches (for power unit)	24	26,27,28
	1	Baseboard	10 x 6 x ½ inches (for power unit)		
A1,A2	2	Amperite mountings	(Not needed in A.C. operated set)	57	
	4	Rolls hook-up wire	Black, yellow, red and green	25	18,33
	4	Brackets	6¾ x 2 inches	24	
	1	Resistor mounting	For crystal detector	1	
	1	Sheet iron	22 x 26 inches, galvanized (for power box)		
	1	Sheet iron	7 x 11 inches, galvanized (for power box)		

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Aerco Products, Incorporated
2 Hammarlund Manufacturing Company
3 Silver-Marshall, Incorporated
4 All-American Radio Corporation
5 Allen-Bradley, Incorporated
6 Central Radio Laboratories
7 Carter Radio Company
8 H.H. Eby Manufacturing Company
9 Carborundum Company
10 Samson Electric Company
11 Agrovox Wireless Corporation
12 Jewell Electrical Instrument Co.
13 Yaxley Manufacturing Company
14 Arcturus Radio Company, Inc.
15 Jefferson Electric Mfg. Co.
16 National Carbon Company
17 General Radio Company
18 Belden Manufacturing Company
19 Raytheon Manufacturing Company
20 Leslie F. Muter Company
21 X-L Radio Laboratories
22 The National Company
23 Benjamin Electric Mfg. Company
24 American Hard Rubber Company
25 Acme Wire Company
26 Micarta Fabricators, Incorporated
27 Formica Insulation Company
28 Diamond State Fiber Company
29 Weston Electric Instrument Co.
30 Roller Smith Company
31 Electrical Research Labs. (ERLA)
32 Sangamo Electric Company
33 Carnish Wire Company
34 Thordarson Electric Mfg. Company
35 American Transformer Company
36 C.F. Manufacturing Co. (CeCo)
37 ORS Music Company
38 Dubilier Condenser Corporation
39 Tobe Deutschmann Company
40 Electrad, Incorporated
41 Polymet Manufacturing Company
42 Micamold Radio Corporation
43 De Jur Products Company
44 Herbert H. Frost, Incorporated
45 Hart & Hegeman Manufacturing Co.
46 Alden Manufacturing Company
47 Brooklyn Metal Stamping Co. (BMS)
48 Air Gap Products Company
49 Kurt Kasch Company
50 Howard B. Jones
51 Federal Radio Corporation
52 Burgess Battery Company
53 Diamond Elec. Specialties Corp.
54 Lionel Corporation
55 Cutler-Hammer Manufacturing Co.
56 Karas Electric Company
57 Radiall Company

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If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

A NON-POLITICAL SET

DEALER: "And this set has a very fine built-in speaker."

CUSTOMER: "Well, I don't want it. My husband doesn't like speeches; he only cares for music."—*William G. Mortimer.*

TOO FAR UP THE DIAL

DOCTOR (at stethoscope): "Say ninety-nine. Again. Again."

PATIENT (a fan): "Say doctor, are you getting any DX? I never had a station there."—*Adam Chrysostom.*

THE NEWEST GADGET

VAN: "Did you know that Phan has a new attachment on his radio set?"

DAN: "No, where did he get it?

VAN: "The sheriff brought it around."

—*Eugene Gilbert.*

SCIENTIFIC AGE

FREDDIE: "There's no sign of a new sled where Ma hides the Christmas presents, so I'm going to send a letter to Santa Claus."

JIMMIE: "You're too late, kid. Your only chance to get him in time is with a radio."

—*J. J. O'Connell.*

The "All-Wave Electric 9"

(*Continued from page 913*)

to even up the distribution of the current along these leads.

OPERATING THE R.E.L. 9

To operate the set, adjust all the resistors on the power unit so that the sliding arm is about in the center on each, and set the rheostat so that there is a distance of about one-half inch between the zero position and the slider. This should allow the set to work at first. The resistance should be readjusted, of course, according to the voltage on the line in which the power unit is plugged. This is easily found, if no voltmeter is available, by listening to the quality and volume of broadcast music through the loud speaker.

On the set, the upper left knob controls the volume on loud signals and also the sensitivity of the radio-frequency tube in the input circuit. It is of advantage to readjust this knob when receiving weak signals, in order to get the first radio-frequency tube to operate at maximum efficiency. The other knob controls the three amplifying tubes and should be adjusted until the signal is loudest and comes in best. The rheostat on the power-unit panel should also be reset for best results. The "B" and "C" voltages on all the taps increase as the knobs are turned to the left. (Anti-clockwise.)

The R.E.L. 9 will operate on any kind of an antenna, either indoor or outdoor; but, of course, for best results and maximum distance reception, a good outdoor aerial should be used. Any single wire about 50 to 120 feet long is ample. The ground connection taken on should be made on either a water pipe or a radiator. Before attempting to operate or even build this receiver, if you have not used other A.C. units before, make sure that the current in your house is 60-cycle alternating current. This receiver will not operate on anything else.

To receive short wavelengths, it is necessary merely to plug in the pup plugs in the two right pup jacks, and plug in a type-H1 coil in the left shield and a H2-type coil in the right shield. The coil at the extreme left should be taken out, since it is not used in this case. With these coils the wavelength range covered will be from about 40 meters to about 130 meters. The

List of Parts of Receiver

SYMBOL	Quantity	NAME OF PART	REMARKS	MANUFACTURER ★	
C1,C2,C3	3	Variable condensers	.0005 mf.	1	49
L1,L2	2	Plug-in coils	Type B1 (special)	2	
L3	1	Plug-in coil	Type B2 (special)	2	
L 4-7	4	Plug-in coils	Type F (special)	2	
L8	1	Audio choke	Plate circuit type	3	16,17,18,21,22,23
T1	1	Audio transformer	3:1 ratio	4	3,14,16,17,18,19,20,21,22,23
R1,R2	2	Variable resistors		5	
C4	1	Fixed condenser	.001 mf.	4	11,24,25,26,27,28,29,30,31
C5	1	Fixed condenser	.002 mf.	4	11,24,25,26,27,28,29,30,31
C 6-9	4	By-pass condensers	1/2 mf., 400 volts	6	24,25,26,27,28,29,32,33,34
C10,C11	2	By-pass condensers	1 mf., 400 volts	6	24,25,26,27,28,29,32,33,34
C 12-16	5	Fixed condensers	.00025 mf. (matched)	2	25
V 1-8	8	Vacuum tubes	A.C. type with heated cathod	7	
	1	Front panel	24 x 8 x 1/4 inches	8	35,36,37
	1	Sub-base panel	25½ x 12 x 1/4 inches	8	35,36,37
	10	Binding posts		9	19,38,39,40,41
	2	Stage shields		10	
	8	Coil sockets	(Special)	2	
	2	Tip jacks		11	19,26,44
	8	Tube sockets		12	9,19,20,31,39,40,42,43,44
R3	1	Fixed resistor	100,000 ohms	13	25,27,28,29,30,31,39,41,45,46
	1	Drum dial	Double type	14	50
	1	Grid leak mounting	For R3	13	27,28,29,30,31,39,41,45,46
		Hook-up wire		15	6,31,48
	2	Extension shafts	For C1,C2 and C3	1	
	2	Tip plugs		11	19,26,44
	12 ft.	Bus bar wire		15	

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Hammarlund Manufacturing Co.	2 Radio Electric Laboratories (R.E.L.)	3 Thordarson Electric Mfg. Co.
4 Sangamo Electric Company	5 American Mechanical Labs.(Clarostat)	6 Acme Wire Company (Parvolt)
7 Sovereign Electric Mfg. Co.	8 Formica Insulation Company	9 H.H. Eby Manufacturing Company
10 Aluminum Company of Amer. (Acola)	11 Yaxley Manufacturing Company	12 Benjamin Electric Mfg. Co.
13 Arthur H. Lynch, Incorporated	14 Tyrman Electric Company	15 Belden Manufacturing Company
16 American Transformer Company	17 Gennan Electric Company	18 Ferranti, Incorporated
19 General Radio Company	20 Silver-Marshall, Incorporated	21 Regent Electric Company
22 Jefferson Electric Mfg. Company	23 Bergen Electric Manufacturing Co.	24 Dubilier Condenser Corporation
25 Tobe Deutschmann Company	26 Carter Radio Company	27 Aerovox Wireless Corporation
28 Electrad, Incorporated	29 Polymet Manufacturing Company	30 Micamold Radio Corporation
31 De Jur Products Company	32 John E. Fast Company	33 A. M. Flechtheim & Company
34 Potter Manufacturing Company	35 Micarta Fabricators	36 American Hard Rubber Company
37 Diamond State Fiber Company	38 X-L Radio Laboratories	39 Amsco Products, Incorporated
40 Electrical Research Labs. (ERLA)	41 Hart & Hegeman Manufacturing Co.	42 Alden Manufacturing Company
43 Air Gap Products Company	44 Herbert H. Frost, Incorporated	45 (International Resis. Co.(Durham)
46 The Carborundum Company	47 Cornish Wire Company	48 Kellogg Switchboard & Supply Co.
49 The National Company	50 Pilot Electric Company	51
52	53	54

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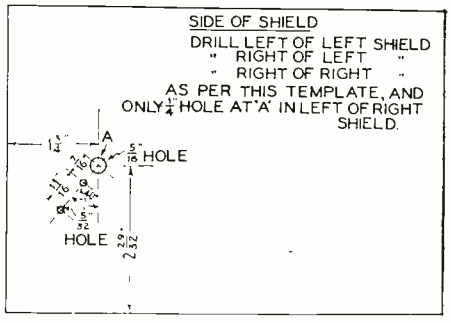

The above drawing shows the exact position for the condenser mounting holes in the shields.

short-wave stations (such as KDKA, WLW and others) are easily received; but of course, with their high-frequency carriers, they are much sharper than the regular broadcast stations, and great care should be exercised when turning the dials because the tuning is very sharp. Of course, once the set has been calibrated for the reception of the stations it is easy to find them again.

In order to get the full benefit of the high-quality audio amplifier and push-pull second stage, a good loud speaker must be used; because quite a few loud speakers will rattle or distort and will not do justice to the quality of the amplifier.

List of Parts of Power Unit

SYMBOL	Quantity	NAME OF PART	REMARKS	MANUFACTURER ★	
T1	1	Power transformer	Full-wave 210 type	1	19,23,47
T2	1	Audio transformer	Push-pull type	1	19,20,21,22,23,44
T3	1	Filament transformer	3-volt secondary	2	46
L1,L2	1	Audio choke unit	2 filter coils in one case	1	20,23,45,46,47
L3	1	Audio choke coil	Center-tapped plate circuit type	1	20,45
C1,C2,C3	3	Filter condensers	2 mf., 1,000 volts	3	4,10,11,12,13,14,15,16,17,18
R1	1	Fixed resistor	4,000 ohms, 50 watt (wire wound)	4	12,14,24,25,26,27,28,29
R2	1	Fixed resistor	750 ohms, 25 watt (wire wound)	4	12,14,24,25,26,27,28,29
R3,R4	2	Variable resistors	10,000 ohms (wire wound)	4	
R5	1	Rheostat	60 ohms	5	4,12,15,22,26,29,30,31,32
R6,R7	2	Variable resistor	500 ohms (wire wound)	4	
C 4-7	4	Fixed condensers	400 volts, 1 mf.	3	4,10,11,12,13,14,15,16,17,18
V1,V2	2	Power tubes	210 type	6	27,39,40
V3,V4	2	Rectifier tubes	281 type	6	27,39,40
	4	Tube sockets	UX type	7	22,23,26,29,31,33,34,35,36,8
	12	Binding posts		8	22,26,38,36,37
	1	Front panel	7 x 12 x 3/16 inches	9	41,42,43
	1	Sub-base panel	15 x 12 x 1/2 inches (wood)		
		Hook-up wire	Insulated	48	3,29,49, 33
M	1	110-volt receptacle	Standard porcelain base type		

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1 Thordarson Electric Mfg. Company	2 Transformer Corporation of America	3 Acme Wire Company
4 Electrad, Incorporated	5 Yaxley Manufacturing Company	6 C.F. Manufacturing Co. (CeCo)
7 Benjamin Electric Mfg. Company	8 H. H. Eby Manufacturing Company	9 Formica Insulation Company
10 Dubilier Condenser Corporation	11 Tobe Deutschmann Company	12 Polymet Manufacturing Company
13 Potter Manufacturing Company	14 Aerovox Wireless Corporation	15 Carter Radio Company
16 John E. Fast Company	17 A.W. Flechtheim & Company	18 Wireless Specialty Apparatus Co.
19 American Transformer Company	20 Samson Electric Company	21 Farranti, Incorporated
22 General Radio Company	23 Silver-Marshall, Incorporated	24 Ward-Leonard Electric Company
25 Arthur H. Lynch, Incorporated	26 Amsco Products, Incorporated	27 Daven Radio Corporation
28 Electro Motive Engineering Co.	29 De Jur Products Company	30 Federal Radio Corporation
31 Herbert H. Frost, Incorporated	32 Central Radio Laboratories	33 Kellogg Switchboard & Supply Co.
34 Air-Gap Products Company	35 Alden Manufacturing Company	36 Electrical Research Labs. (ERLA)
37 X-L Radio Laboratories	38 Hart & Hegeman Manufacturing Co.	39 Radio Corporation of America
40 E. T. Cunningham, Incorporated	41 Micarta Fabricators, Incorporated	42 American Hard Rubber Company
43 Diamond State Fiber Company	44 Tyrman Electric Company	45 The National Company
46 Jefferson Electric Mfg. Co.	47 Dongan Electric Manufacturing Co.	48 Belden Manufacturing Company
49 Cornish Wire Company	50	51
52	53	54

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Long Waves Less Certain

ONE of the advantages of short waves is that they pierce tropical static more successfully than the longer ones, hitherto believed preferable for international communication. Recently a $650,000 high-power station was put in operation at Ruysselede, near Brussels, and messages exchanged with North and South America, on 17,000 meters. No reply was received, however, to messages sent to the Belgian Congo, and the point has been raised that shorter waves will be more reliable for this service.—*L. Reid.*

A National Preference

JOHN BULL still clings to the headphone, and marvels at the American preference for the loud speaker, singly or in pairs. At last a writer in *Wireless Magazine* has solved the mystery:

"You can't wear phones comfortably and chew gum at the same time!"

Carrier-Wave Jumps Break

THE beam radio system, which connects India to England, uses a radio-frequency carrier current over telephone wires from Bombay to Poona. Recently the wires were broken, so that telephone communication was interrupted. However, the high-frequency carrier-current jumped the break, so that the Empire radio transmission, with the aid of the station's high-power amplifiers, went on uninterrupted.—*G. P. Gadgil.*

Austrian Listeners Strike

RADIO organizations of Carinthia, in southern Austria, recently served notice upon the official broadcasters that they will refuse to renew their listening licenses this year unless the government regulates the use of violet-ray and other electro-medical apparatus, which has been the source of severe interference.

Notes on the Tyrman Shielded-Grid Seven

THIS receiver, using the new shielded-grid vacuum tubes, which was described in the January issue of RADIO NEWS, can be used with an outside aerial instead of a loop, with only a few minor changes. Although the set as previously described is an excellent distance getter, with the adaptations described herein the results should be exceptional.

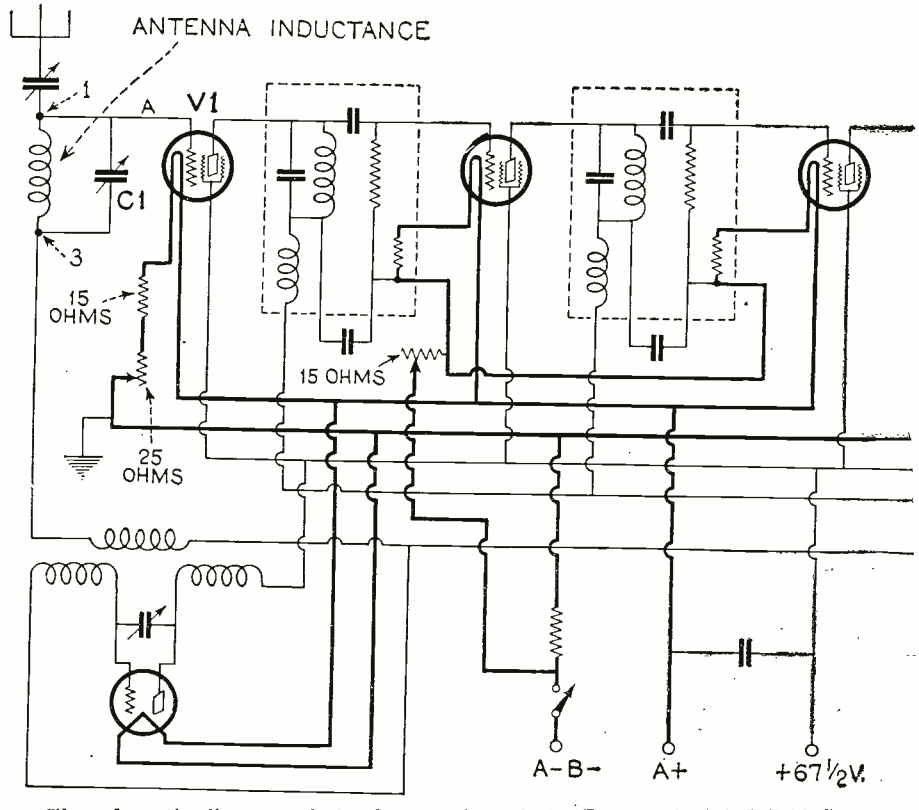
In the schematic diagram of the first detector and the oscillator tubes it will be seen that an antenna inductor is connected across the .0005-mf. variable condenser and in series with the aerial and the ground. Coast-to-coast reception has been accomplished with this set in their Chicago laboratory, by the manufacturers, using no aerial and with the ground connected merely to the aerial binding post. Connection of the tube shields to the ground binding post, however, is essential, especially those of the shielded-grid tubes.

The flexible lead, A, of the antenna inductor connects to the grid of the first tube. The filament of this tube is controlled by a 25-ohm rheostat, which is in series with a 15-ohm resistor. The filaments of the second and third tubes of the set are controlled by a 15-ohm rheostat. If these controls do not prove an adequate adjustment for the volume, their values should be increased to 60 and 25 ohms, respectively.

In the laboratory of the manufacturer it was found that six or eight feet of wire, used as an aerial, would give remarkable distance; and that, if a two-foot length of wire was coiled on the rear wall of the receiver's cabinet, it would function as a usable aerial.

If it is desired to operate the receiver, using only five or six tubes, the flexible lead A of the antenna inductor can be readily connected to the control grid of either the second or third tube with a clip, leaving off entirely the regular grid connections, which were illustrated in the article.

In case the operator of the receiver wishes to run it from the A.C. line, he can obtain a complete "A, B and C" power unit, fitted with a plug which fits on the cable connection on the set, reducing to a minimum the task of connecting battery wires. If regular batteries are employed it is recommended that a ground connection be used. However, if this particular power unit is used, the filament circuit is automatically grounded through the A.C. lines and no additional ground connection is necessary.



The schematic diagram of the first portion of the Tyrman Shielded-Grid Seven, using the 222-type tubes. This set, originally designed for loop operation, is shown here adapted to aerial operation.

Use of a Choke Coil as A. F. Grid Leak

IN impedance- and resistance-coupled amplifiers, an impedance coil instead of a resistor may often be used to advantage as a leak in the grid circuits of the amplifying tubes, especially in that of the last tube. The secondaries of some audio-frequency amplifying transformers are suitable for this purpose.

Portable Station Handy

IN addition to the short-wave relay stations which operate in connection with broadcast stations, some are equipped with transmitters for purely experimental use. Station WEEI, Boston, has a portable 100-watt transmitter of this nature, licensed as WTAT. When the recent floods took place in New England, this was rushed by truck to the scene of disaster to provide two-way communication.

Proper Arrangements for Oscillation Control

WELL constructed radio-frequency amplifiers, having either tuned or untuned radio-frequency transformers, are certain to oscillate unless some means is employed to prevent this. There are two general methods of preventing oscillation in radio-frequency amplifiers: By neutralizing (in effect) the internal tube capacity in some manner, as done by the Rice and Hazeltine methods; or by introducing into the circuit losses in the form of resistances ("lossers") of such value that oscillation is just barely prevented. These losses can be produced in radio-frequency amplifiers in three general ways: By adding resistance in the grid circuit, as here described; by adding resistance in the filament circuit, with a rheostat that has more resistance than is necessary for controlling

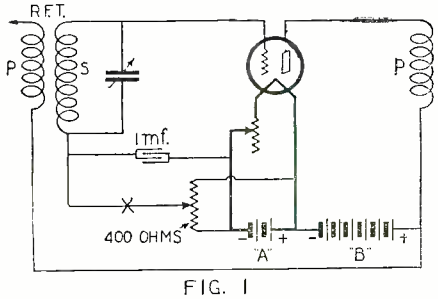


FIG. 1

A potentiometer may be shunted across the "A" battery, with its arm connected to the grid, for preventing oscillations.

the tube filaments, and which cuts down the filament voltage until the tube works inefficiently, and by connecting a variable high resistor in the plate circuit of the tube, in series with the "B" battery.

We will not here discuss the comparative worth of these different methods of preventing oscillation in R.F. amplifiers. Instead, we will consider merely the correction of one mistake commonly made in the introduction of losses into the grid circuits of some R.F. amplifiers.

AN UNSATISFACTORY EXPEDIENT

Most radio-frequency amplifiers, such as the untuned intermediate-frequency amplifiers in superheterodynes or the tuned R.F. amplifiers in some of the latest five- and six-tube receiving sets, have a potentiometer connected in the grid circuit to prevent oscillation, as shown in Fig. 1. With this arrangement, the potentiometer resistance winding is connected across the "A" battery terminals in the set, and the movable arm attached to the grid return lead of the radio-

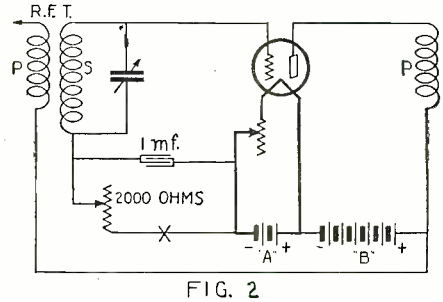


FIG. 2

A variable high resistor may be substituted for the potentiometer with satisfactory results.

frequency amplifier tube. By proper adjustment of the potentiometer, the R.F. amplifier can be worked very close to the oscillating point; thus making use of the regenerative action of the tube. The closer to the oscillating point the tube is worked, the more it will amplify; so the resistor must have the quality of very close adjustment. To keep the loud signals of local stations from overloading the tube and causing it to "block" and distort, a slight positive potential (voltage can be put on the grid of the tube by running the potentiometer arm toward the end of the resistor connected to the positive side of the "A" battery).

Because the tube is not designed to operate efficiently with a positive charge, or potential, on the grid, the radio-frequency amplification, and, consequently, the volume is very greatly reduced. That is what we wanted, in order that the volume of the local signals should not be so great. However, this placing of a positive charge on the grid has a very bad effect on the operation of the amplifier; it sets up a small current flowing from the filament to the grid in the tube. This has the same effect on the amplifier as if a resistance of many thousand ohms were connected directly across the amplifying transformer (or the loop, in the case of the first R.F. tube). The tuning is made very broad, and the selectivity of the set becomes extremely poor.

USE OF A SERIES RESISTOR

One of the easiest ways of getting around this difficulty is to connect in place of the potentiometer, a variable high resistor in series with the loop, or the R.F. transformer, as shown in Fig. 2. The resistance of the potentiometer, which is usually about 400 ohms, would not be sufficient to use in series with the grid in this manner; but there are on the market a number of other variable high resistor, 0-2000 ohms, which may be used. Any variable resistor with a similar range, *if it is non-inductive,* is all right for use as an oscillation control in the grid-return circuit of an R.F. amplifier.

With this series resistor, we can now add resistance in the grid circuit of the amplifier tube without making the circuit tune broadly, as occurred before. In other words, we can cut down the strong signals from local stations so that they will not overload the tube, and without impairing the selectivity of the amplifier. The amplifier will then be working at reduced efficiency, but the selectivity of the set will not be lessened. On weak signals, it may be necessary to cut the resistance entirely out of the circuit by sliding the lever to the end of the resistance winding which connects to the filament. In some R.F. amplifiers, a small fixed resistor is connected in the grid circuit of the tube; one with a resistance that is just great enough to prevent oscillation, but not enough to reduce the efficiency of the circuit too much. This method is less satisfactory, however.

USE OF BIASING BATTERY

A "C" battery should be used in the grid circuit of the amplifier tube, in series with the resistor, if the "B" battery voltage is over 67½ volts. The exact "C" battery voltage to be used depends upon the voltage of the "B" battery; a 4½-volt "C" battery should be used with a 90-volt "B" battery.

With more than one stage of R.F. amplification, the method shown in Fig. 3 is used to prevent oscillations.

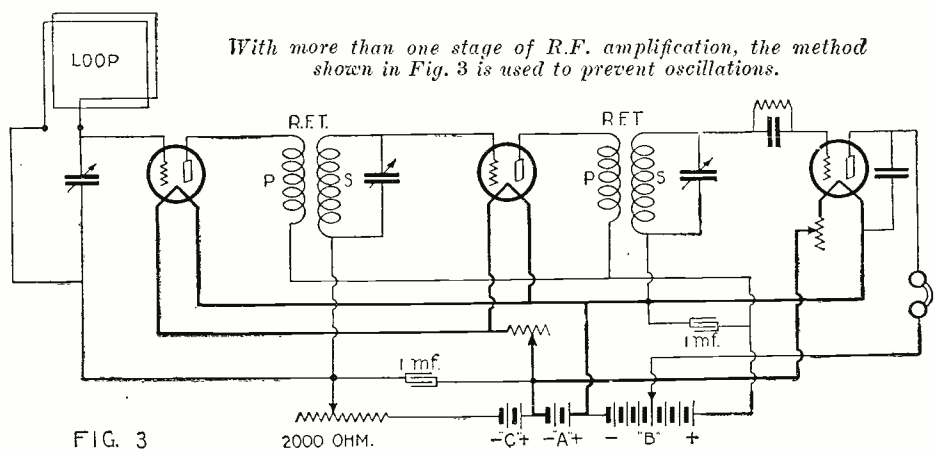


FIG. 3

The "C" battery may be connected in the circuit at the point marked X in both diagrams, with its "—" terminal toward the grid. In either circuit, a fixed condenser of 0.5 to 1.0-mf. capacity should be connected from the "—" side of the "A" battery to the grid side of the resistor, as shown, to by-pass the radio-frequency current in the grid circuit. It should also shunt the "C" battery, if one is used.

If more than one stage of R.F. amplification is employed, the grid-return leads from all of the R.F. stages may be connected to the grid end of the resistor in the manner shown in Fig. 3, which is the circuit of a two-stage radio-frequency amplifier and detector with a "C" battery added. A loop antenna is shown, but an aerial and ground, coupled to the secondary through a primary coil, may be used in its place, if preferred.
—*By Charles F. Felstead, 6CU.*

A Strange Broadcast

WE have been told by old-timers how much better things were in the old days. We shall never be able to judge the playing of Paganini or the voice of Farinelli, but future ages will be able to hear Kreisler and Caruso and compare them with their best. The possibility of a radio program to which artists who were not contemporary contribute will be available to our descendants.

The Berlin broadcast station shortly intends to make an experiment in the transmission of a complete opera in which the principal songs, duets, and quartets will be given from gramophone records, the whole production to be linked together by the station orchestra. By this means, points out *Amateur Wireless,* it is thought possible to produce a radio version of a famous opera to which famous singers, both dead and living, will contribute.

Radio Wrinkles

(*Continued from page* 916)

without cost in a few minutes from two pieces of scrap wood and two wood screws.

When making the separators, first secure a piece of soft wood 3/8 inch thick, one inch wide and twice the length of the binding-post strip of the receiver. Next cut it in half, in order to have two strips the same length as the binding-post strip; and on each strip make marks at the positions corresponding to the posts on the binding-post strip. With a saw slots should be cut across the strips, where the marks have been made, at a 45-degree angle and approximately 1/8 inch deep. The separator may now be attached to the battery cable with two wood screws, as indicated in the drawing; and each wire may be correctly marked on the wood of the separator with pencil or pen.

—Contributed by James A. Lynch

An Experimental Microphone for Home Use

AN inexpensive microphone, which can be used for several purposes and will be found to meet the requirements of the experimenter, may be constructed easily from scrap material found in almost any workshop. The essential parts are: an empty solder can, a mica diaphragm, a cap from a dry-cell carbon, a 1-inch No. 8 machine screw with three nuts to fit, two binding posts, and a few carbon grains.

In constructing the unit the first step is to drill a hole in the center of the can. This hole should be large enough to accept the screw on the battery-carbon cap, and the cap should be fastened to the can with a nut as illustrated in Fig. 1. Next the holes for the binding posts should be located and drilled; one binding post makes contact with the can and the other must be insulated with two fiber washers. Also, the sides of the battery-carbon cap must be insulated on the inside with gummed tape pasted in place.

The diaphragm mechanism is next prepared. First a metal disc is cut to fit inside the battery-carbon cap and this is fastened on one end of the one-inch screw. Next, the other end of the screw is fastened to the diaphragm with two nuts. Now the battery carbon cap is partly filled with carbon grains and a wire connected between

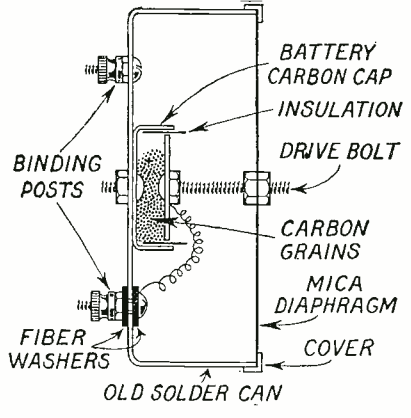


Fig. 1: Method of mounting the battery cap on the back of the can.

the insulated binding post and the brass disc. To complete the construction of the microphone a hole as large as possible is cut in the cover of the solder can and the latter is put in place to hold the mica diaphragm in the proper position. The construction will be found illustrated in Fig. 1.

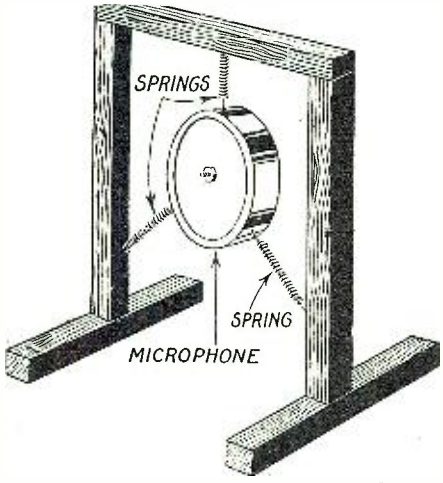


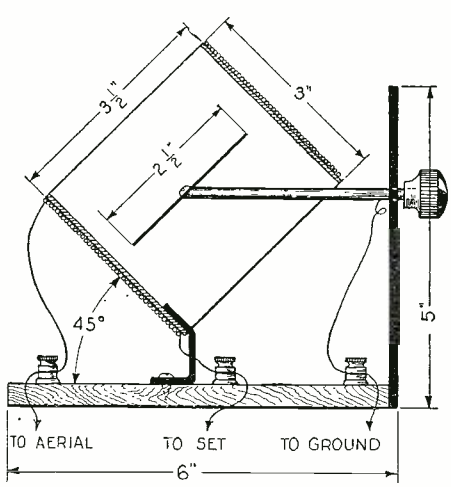
Fig. 2: By suspending the microphone from springs, as shown, results can be greatly improved.

In placing the microphone in operation it is used in connection with a low-voltage battery, just as are all other microphones of the carbon type. After it has been used for a short time it may be found that the results may be improved by changing the quantity of carbon grains used, but this must be determined by experiment. Results may also be improved by suspending the instrument on springs, as shown in Fig. 2.

Contributed by Alden Leiby.

A Simple Inexpensive Wavetrap

WHEN operating a radio receiver in congested city districts or in close proximity to a powerful local broadcast



The dimensions for the construction of this home-made wave trap are given above.

station, the interference problem often becomes serious, even when an efficient set is used. One of the easiest methods of overcoming this interference is by connecting a wavetrap in series with the aerial lead to the set. In this way it is possible to

reduce the interference from any desired station, without making any changes in the receiving set.

There are many types of wavetraps which give very satisfactory results and which may be constructed at home. However, most designs require the use of a variable condenser and a special coil. In this article a new type of wavetrap is described which avoids the use of a variable condenser, and which may be assembled at a very slight cost.

In the drawing on page 969 the mechanical arrangement of the wavetrap is clearly shown. It consists of a coil of wire and a metal disc, which is rotated inside the coil to vary its inductance. To make the coil 40 turns of No. 24 D.C.C. wire are wound on an insulating tube, 3½ inches in diameter by 3 inches long. The metal disc is a thin round piece of metal, approximately 2½ inches in diameter, and may be an old diaphragm from a pair of phones or a loud-speaker unit. The other parts required for the unit are; a 4-inch length of brass rod, ¼ inch in diameter; a knob; three binding posts, a wooden base 4 x 6 x ½ inches, a front panel 4 x 5 x 3/16 inches and a brass strip 3 x ½ x ⅛ inches for mounting coil in position.

The parts should be assembled as shown in the drawing. The coil is mounted at an angle of 45 degrees, and the metal disc is mounted at one end of the metal rod at 45-degree angle. The length of the rod is adjusted so that the disc falls near the center of the coil. Wires from the two ends of the coil connect with two of the binding posts, and the third binding post connects with the metal rod.

After the construction has been completed, it may be placed in operation by connecting the coil in series with the aerial wire and connecting the third binding post to the ground wire. To eliminate the interference of a station, the knob is adjusted until the signals are at a minimum. When the disc is parallel to the winding of the coil, as shown in the illustration, the trap is tuned to the highest wavelength and, when the disc is at right angles to the turns of wire, the coil is tuned to the lowest wavelength.

Contributed by F. L. Ulrich.

New Frequency Allotments

All the practicable wavelengths down to the "twilight zone" of radiant heat in the whole range of radio frequencies have now been divided, definitely and officially for the first time in history, for the use of the various international radio services. The agreement upon the allocations of frequency bands from 10 to 60,000 kilocycles (30,000 to 5 meters) is perhaps the most noteworthy accomplishment of the international radiotelegraph conference which met in Washington early this winter, with delegates from 79 nations attending.

The spectrum has been divided into something like 60 bands, in each of which ship, aircraft, land, broadcast, amateur, and experimental stations will operate according to allotment. The designation of these bands was practically the last item of regulations to be written into the Washington Convention of 1927 which will govern all the international uses of radio, after ratification by the governments participating.

Six weeks or more were spent by the technical committee of the conference and its subcommittees in solving the problem of allocating the long and short waves, the low and high frequencies, to the services to which they were deemed most suited. Many divergent views were represented at the outset among the technical experts from all corners of the world who participated in these deliberations. As finally framed, the allocations represented their unanimous agreement.

AMATEURS FARE BADLY

Ship and shore stations get primary consideration, of necessity, in the allocations. But aircraft radio services and radio beacon and direction finding are not ignored; nor is broadcasting. In the short waves, however, the amateurs find themselves restricted to very narrow bands.

The American broadcast band is left untouched, while bands among the longer waves are assigned for Europe and other regions where the transmission of programs is mostly on the long waves. In the band below 1,500 kilocycles, or 200 meters, ample provision is also made for broadcasting, particularly with a view toward the development of international exchanges of programs such as the one already projected between the British Broadcasting Company and the National Broadcasting Company of the United States.

The status of the amateur is fixed, and he has been restricted to rather narrow low wavebands. The few bands that were obtained for the amateurs were allotted only after the American delegation and the delegations from Canada and other British dominions put up strong arguments, against the efforts of the British delegation and other European delegates to deprive the amateurs of any and all waves that might be suitable for international commercial services.

Through the whole range of frequencies, any country signatory to the treaty may operate as it pleases as long as it does not allow interference with the assigned international services. Thus, it is anticipated the amateurs will be enabled by assignments from the Federal Radio Commission to carry on communications between themselves in this country—17,000 of the world's 25,000 amateurs are in the United States—though on the low waves, which travel far, there is always the likelihood of interference.

Below 13 meters, the amateurs still have room for their experiments, for these channels are virtually unreserved. However, they are regarded to-day as the useless realm in radio. Yet so were the wavelengths below 200 meters not many years ago, and their possibilities were then demonstrated by the amateurs. On the "border of infinity," below 5 meters, the allegedly-useless channels may yet yield some good results.

NEW SCHEDULES

Following are the international wave allocations as agreed upon by the International Radiotelegraph Conference and to which practically all of the nations of the world employing radio services will adhere:

10 to 100 kc. (30,000 to 3,000 meters)—point-to-point services.

100 to 110 kc. (3,000 to 2,725 meters)—point-to-point and mobile services.

110 to 125 kc. (2,725 to 2,400 meters)—mobile.

125 to 150 kc. (2,400 to 2,000 meters)—mobile, maritime service, general public correspondence only.

150 to 160 kc. (2,000 to 1,875 meters)—(a) broadcasting, (b) point-to-point, (c) mobile. Subject to agreement as follows: All regions where broadcast stations now exist working below 300 kc. (above 1,000 meters)—broadcasting; other regions, (b) point-to-point; (c) mobile. Regional agreements will respect the rights of one another in this band.

194 to 285 kc. (1,550 to 1,050 meters)—(a) mobile, (b) point-to-point, (c) Broadcasting. Subject to regional agreement as follows: Europe (a) mobile (aircraft only); (b) point-to-point (air services only), (c) *point-to-point from 250 to 285 kc. (1,200 to 1,050 meters); (a) broadcasting from 194 and 224 kc. (1,550 to 1,340 meters); other regions, (a) mobile, except commercial ships; (b) point-to-point (aircraft only; (c) *point-to-point.

285 to 315 kc. (1,050 to 950 meters)—special (radio beacons).

315 to 350 kc. (950 to 850 meters)—mobile (aircraft service only). 333 kc. (900 meters) is the international aircraft calling and listening frequency.

350 to 360 kc. (850 to 830 meters)—*mobile.

360 to 390 kc. (830 to 770 meters)—(a) special (Direction Finding); (b) mobile, where it does not interfere with direction finding.

390 to 460 kc. (770 to 650 meters)—mobile.

460 to 485 kc. (650 to 620 meters)—mobile, except damped and radiotelephone waves.

485 to 515 kc. (620 to 580 meters)—mobile. Distress, calling, etc.). 500 kc. (600 meters) is the international frequency for ship distress signals and calling.

515 to 550 kc. (580 to 545 meters)—mobile (not open to general public correspondence) except damped and radiotelephone waves.

550 to 1,300 kc. (545 to 230 meters)—Broadcasting—mobile services use the band 550 to 1,300 kc. (545 to 230 meters) on the condition that they do not interfere with the services of any nation using this band exclusively for radiotelephone broadcasting.

1,300 to 1,500 kc. (230 to 200 meters)—(a) broadcasting; (b) mobile (on the frequency 1,364 kc. only, wavelength 220 meters.)

1,500 to 1,715 kc. (200 to 175 meters)—mobile.

1,715 to 2,000 kc. (175 to 150 meters)—mobile, fixed and amateurs.

2,000 to 2,250 kc. (150 to 133 meters)—mobile and fixed.

2,250 to 2,750 kc. (133 to 109 meters)—mobile.

2,750 to 2,850 kc. (109 to 105 meters)—fixed stations.

2,850 to 3,500 kc. (105 to 85 meters)—mobile and fixed.

3,500 to 4,000 kc. (85 to 75 meters)—mobile, fixed, and amateurs.

4,000 to 5,500 kc. (75 to 54 meters)—mobile and fixed.

5,500 to 5,700 kc. (54 to 52 meters)—mobile.

5,700 to 6,000 kc. (52.7 to 50 meters)—fixed.

6,000 to 6,150 kc. (50 to 48.8 meters)—broadcasting.

6,150 to 6,675 kc. (48.8 to 45 meters)—mobile.

6,675 to 7,000 kc. (45 to 42.8 meters)—fixed.

7,000 to 7,300 kc. (42.8 to 41 meters)—amateurs.

7,300 to 8,200 kc. (41 to 36.6 meters)—fixed.

8,200 to 8,550 kc. (36.6 to 35.1 meters)—mobile.

8,550 to 8,900 kc. (35.1 to 33.7 meters)—mobile and fixed.

8,900 to 9,500 kc. (33.7 to 31.6 meters)—fixed.

9,500 to 9,600 kc. (31.6 to 31.2 meters)—broadcasting.

9,600 to 11,000 kc. (31.2 to 27.3 meters)—fixed.

11,000 to 11,400 kc. (27.3 to 26.3 meters)—mobile.

11,400 to 11,700 kc. (26.3 to 25.6 meters)—fixed.

11,700 to 11,900 kc. (25.6 to 25,2 meters)—broadcasting.

11,900 to 12,300 kc. (25.2 to 24.4 meters)—fixed.

12,300 to 12,825 kc. (24.4 to 23.4 meters)—mobile.

12,825 to 12,350 kc. (23.4 to 22.4 meters)—mobile and fixed.

12,350 to 14,000 kc. (22.4 to 21.4 meters)—fixed.

14,000 to 14,400 kc. (21.4 to 20.8 meters)—amateur.

14,400 to 15,100 kc. (20.8 to 19.85 meters)—fixed.

15,100 to 15,350 kc. (19.85 to 19.55 meters)—broadcasting.

15,350 to 16,400 kc. (19.55 to 18.3 meters)—fixed.

16,400 to 17,100 kc. (18.3 to 17.5 meters)—mobile.

17,100 to 17,750 kc. (17.5 to 16.9 meters)—mobile and fixed.

17,750 to 17,800 kc. (16.9 to 16.85 meters)—broadcasting.

17,800 to 21,450 kc. (16.85 to 14 meters)—fixed.

21,450 to 21,550 kc. (14 to 13.9 meters)—broadcasting.

21,550 to 22,300 kc. (13.9 to 13.45 meters)—mobile.

*No general public correspondence.

22,300 to 23,000 kc. (13.45 to 13.1 meters)—mobile and fixed.

23,000 to 28,000 kc. (13.1 to 10.7 meters—not reserved.

28,000 to 30,000 kc. (10.7 to .10 meters) not reserved.

30,000 to 56,000 kc. (10 to 5.35 meters)—not reserved.

56,000 to 60,000 kc. (5.35 to 5 meters)—amateurs and experiments.

60,000 kc. up (5 to 0 meters)—not reserved.

NEW QRAS

5*FF*, Herschel R. Caler, Box 14, R. 2, Springdale, Ark. 40 and 80 meters, 201A.

5*ARY*, Elmer M. Prather, 2721 Bessemer Blvd., Birmingham, Ala.

8*AWV*, Herbert Chrysler, Homer, N. Y. 7½ watts.

Mr. N. Miyake, Minamihoribata St., Tsu City, Japan, informs us that several new ham stations on 38 meters have started. All are 4 watts or 2 watts. They are jxax, jxbx, jxcx, jxdx, jxex, jxfx and jxhx.

Set Builders' Letters

(*Continued from page* 920)

Zealand, and four in Japan. Of course, with the exception of the small ones, this is nothing wonderful, as there is nothing but water between us, and no land to absorb their energy, as in the States.

I constructed one of your short-wave broadcast receivers, described in RADIO NEWS for October, 1927, and get WGY and KDKA nearly every afternoon. At 1 a. m., almost every morning, I hear a station in Khabarovsk, Siberia. They give RSN as their call, transmitting news in Russian, and also music. I get them very good.

C. A. BLACKINGTON,
Wrangell, Alaska.

(*Mr. Blackington's time is an hour earlier than Pacific Standard Time. The Siberian transmitter of which he speaks is a super-power short-wave station recently acquired by the Soviet Union. We have not definite information of its wavelength.*—EDITOR).

Radio News Laboratories

(*Continued from page* 919)

RADIO RECEIVER CHASSIS

The "Pierce-Airo Model B" receiver shown, submitted by the United Scientific Laboratories, Inc., 82 Fourth Avenue, New York City, is a six-tube single-control radio receiver having two stages of tuned radio frequency, a tuned detector, and three stages of audio frequency. The first two audio stages are resistance-coupled, while the last employs a transformer. Three tuning condensers mounted on the same shaft are controlled by an illuminated friction-type drum dial. Two small knobs on the front panel permit

of finer tuning, by varying the positions of the rotors of the two outer condensers. This receiver is built almost entirely of metal; the amount of insulating material used is brought to a minimum. The metal front panel is 7 x 18 inches and has a walnut finish. This receiver has been found selective and of good reproducing qualities.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2239.

FILTER CONDENSERS

The fixed condenser shown, submitted by A. M. Flechtheim & Company, 275 Broadway, New York City, is of the paper type and is designed for use in filter systems of "A" and "B" power-supply units. It has a nominal capacity value of 4 mf. and is rated at 450 volts D.C. working voltage. The condenser is enclosed in a sheet-iron shell and provided with mounting brackets; the external dimensions are 4½ x 1¾ x 1¾ inches.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2240.

The high-voltage condenser shown, submitted by the same company, is of the paper type and can be very conveniently used in connection with power packs operating UX-281-type tubes. It has

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Classified advertising rate twenty-two cents a word for each insertion. Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Names and addresses must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisements for less than 10 words accepted.

Objectionable or misleading advertisements not accepted. Advertisements for the April issue must reach us not later than February 1st.

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Sell subscriptions to magazines known the world over. Steady monthly income with absolutely no investment required. Hundreds of selling arguments every month. Start now. Full information sent free, no obligation. Agency Division, Experimenter Publishing Co., 230 Fifth Avenue, New York.

"Superkeen! Amazing New Patented Magnetic Blade Sharpener! Sharpens all razor blades instantly, magically, by powerful magnetic force! New! Absolutely different! Sensational Demonstration! Whirlwind seller! Write for Pocket Sample!" SuperKeen, Dept. B-14, Salisbury, N. C.

$40.00 Suits for $23.50! All one price. Union-made, of finest quality Virgin Wool. You don't have to know anything about selling clothing. We guarantee your success if you are honest and willing to work. Write at once. William C. Bartlett, 850 Adams, Dept. 724, Chicago.

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Make your receiver do all the manufacturer claims it can! The answer is a practical, proven fact—Scott's Single Pole Tuned Radio Antenna—no trick—description FREE. Scott, 719 First St., New Orleans, La.

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Inventions Commercialized. Patented or Unpatented. Write Adam Fisher Mfg. Co., 278 Enright, St. Louis, Mo.

67 Ways to Increase Income. 96-page book "Spare-time Money Handbook" contains 67 practical and complete plans to operate sparetime business. For everyone who wants more money. Price only 50c. Conrad Company, Inc., 230 Fifth Avenue, New York.

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I am in touch with hundreds of moneyed men and manufacturers who wish to buy good inventions. Hartley, 38 Court St., Bangor, Maine.

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Earn $25 Weekly Spare Time, writing for Newspapers and Magazines. Experience unnecessary. Copyright Book, "How to write for Pay" Free. Press Reporting Inst., 973, St. Louis, Mo.

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Learn Chemistry at Home. Dr. T. O'Conor Sloane, noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our full-page ad on page 937 of this issue. Chemical Institute of New York, 16 E. 30th Street, New York City.

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$2 to $500 each paid for hundreds of Old or Odd Coins. Keep all old money, it may be very valuable. Send 10c for New Illustrated Coin Value Book, 4x6. Guaranteed prices. Get posted. We pay Cash. Clarke Coin Company, 14 Street, LeRoy, N. Y.

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Old Money Wanted. Will pay Fifty Dollars for nickel of 1913 with Liberty Head (no buffalo). We pay cash premiums for all rare coins. Send 4c for Large Coin Folder. May mean much profit to you. Nimismatic Co., Dept. 112, Ft. Worth, Texas.

$2 to $500 each paid for hundreds of Old or Odd Coins. Keep all old money, it may be very valuable. Send 10c for New Illustrated Coin Value Book, 4 x 6. Guaranteed prices. Get posted. We pay Cash. Clarke Coin Company, 14 Street, LeRoy, N. Y.

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Patents—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine, Registered Patent Attorneys in United States and Canada, 269 Ouray Bldg., Washington, D. C.

Patents—Send drawing or model of your invention for examination and instructions. Advice and booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 724 9th Street, N.W., Washington, D. C.

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Your Horoscope, as calculated by the science of Astrology, will reveal some very interesting facts. Send One Dollar with your birthdate, year of birth, and place. Staet if married or single and occupation. (Trial readings, 25c, coin only, no stamps). Address Astro Analysis Bureau (Suite D), Barbados, British West Indies.

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200 Letterheads and 100 Envelopes, $1.10, postpaid. OBERMAN COMPANY, Box 1268, Chicago.

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Radio Sets Built to Order. Sets repaired. Superhets a specialty. Sweeney Radio Shop, Pearsall, Texas.

Press and public concede it to be the best ever produced. "Radio Theory and Operating," by Mary Texanna Loomis, member Institute of Radio Engineers, Lecturer on radio, Loomis Radio College. Thorough text and reference book; 886 pages, 700 illustrations. Price $3.50, postage paid. Used by Radio Schools, Technical Colleges, Universities, Dept. of Commerce, Gov't Schools and Engineers. At bookdealers, or sent on receipt check or money order. Loomis Publishing Company, Dept. B, 405-9th St., Washington, D. C.

Five-Tube Gang Sockets, all bakelite, UX or UY, 70c. Parts and supplies for Edison Element storage "B" Batteries. Send for list. Zied, 834 North Randolph, Philadelphia, Pa.

"Peridyne" adjustable shields and coils. Star Radio Mfg., Indianapolis, Ind.

Adjustable Core Chokes. Range 30H to 100H. 150 M. A., $5.75. 650-volt Transformers, $7.25; 550, $3.50. Write for complete lists. Radio Parts Sales Co., Orange, N. J.

Be the Licensed Radio Doctor of your community. $7-$10 spare-time evenings. Our co-operative plan procures all the work you want. Secure franchised territory now. Write for booklet. Co-Operative Radio Doctors, Dept. R, 131 Essex St., Salem, Mass.

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Large Manufacturer of popular priced Radio Cabinets wants representatives selling radio dealers. Models listing at $13 and up. Well made in large modern plant. Quantity sellers. Straight commission basis. For full details, address Drawer E 10, Boonville, N. Y.

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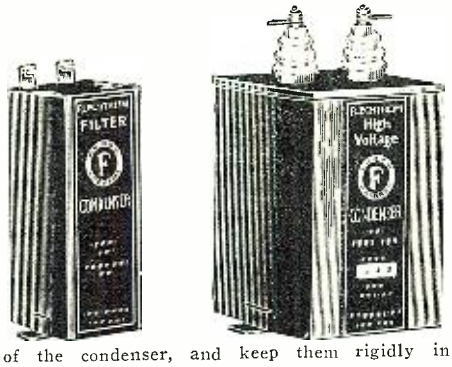
a nominal capacity value of 4 mf., and its rated working voltage is 1,000 volts D.C. It is completely enclosed in a sheet-iron case, whose external dimensions are 4½ x 3⅛ x 3⅛ inches. Two porcelain insulators carry the outgoing leads



of the condenser, and keep them rigidly in proper position.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2241.

TRANSMITTING CONDENSER

The transmitting condenser shown, submitted by the same company, uses paper as dielectric and is similar in construction to the condenser just mentioned above; but has a higher rated

working voltage; namely, 1500 volts. It can, therefore, be used in connection with transmitting apparatus. The capacity of this condenser is 1 mf. and its external dimensions are 4½ x 1⅜ x 4⅜ inches.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2242.

LOUD SPEAKER

The loud speaker single-cone type shown) submitted by the Fergus Co., 235-249 Elizabeth Ave., Newark, N. J., is of the wall type and has a 36-inch free-edge paper cone. A special built-in flexible disc protects the cone from becoming distorted through changes in temperature or atmospheric conditions. The driving unit of

the speaker is of the double-element type, which was described in the January issue of RADIO NEWS, on page 759. A hanger and wall brackets are attached to the base of the speaker unit. The reproduction of music and speech is good, and especially noticeable is the presence of the lower tones which unfortunately are completely cut out in a great many reproducers.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2243.

For use on
110-120 Volt A. C. Lines

ONLY
$12.45
Direct from factory TO YOU!

The PEERLESS is small, thin and compact. Slides into small spaces, table type cabinets, etc. Case is heavy steel, maroon crackle finish. Comes complete with cord and separable plug.

The MOST Sensational "B" Eliminator Announcement *ever* Made!

Now—you can buy as good a "B" Eliminator as is possible to build—at a price that won't cramp your purse. Now—you can enjoy the thrill of louder, clearer, better reception that a good "B" Eliminator affords. And you buy the PEERLESS without risk of any kind, for it is backed with a

2 Year Guarantee

This astounding offer is without a precedent. Never before has such a value been offered. A "180" volt "B"—a "B" that will run your set and a power tube too—and guaranteed for two long years—at the ridiculously low price of only $12.45.

Uses
85 MIL. TUBE
Delivers

180 VOLTS

Because of its very low price, don't confuse the PEERLESS with Eliminators which deliver only 90 or 100 volts. Also, don't confuse it with chemical type Eliminators. The PEERLESS uses the standard 85 milliampere gas-filled Raytheon or Q. R. S. rectifying tube. It is dry. No water, no acids to add. Requires no attention whatever. Delivers pure, hum-free "B" current of 22½—45—90—135 and 180 volts. Out-put Voltage taps are fixed. No adjustments. Will run *any* set. Will operate any power tube requiring no more than 180 volts. Will not "motor-boat" on superheterodyne receivers. Operates resistance-coupled audio amplifiers, when other "B" Eliminators fail. In every sense of the word, the PEERLESS provides the finest kind of "B" Eliminator performance—at only $12.45. Why pay more?

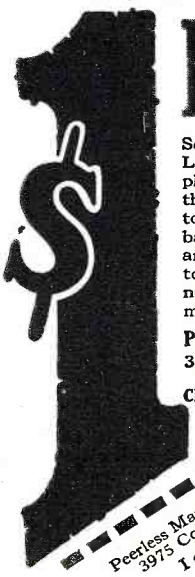
TUBE FREE

SPECIAL INTRODUCTORY OFFER

This is the first announcement of this new, super-powered, better quality guaranteed "B" Eliminator. Its regular price is $12.45 without the rectifying tube. But, as a special introductory offer to get thousands of these units out on sets, we will include, for a limited time only, a genuine $4.50 Q. R. S. 85 Mil. Tube free with your order. Think of it! A 180 Volt "B"—a 2 year guarantee—the privilege of trying it 30 days at our risk—and a $4.50 tube free—all for $12.45. Mail coupon now.

30 DAY TRIAL

Read all about this great new, better, tube type "B" Eliminator in the left column of this page. Then order it at once. Hook the PEERLESS up to your set. Compare the reception you get to that which you got before, or to that which you can get from any other "B" Eliminator. Put the PEERLESS to every test you can. Make it drive a "171" power tube, if that's the tube you use in your set. Enjoy this "B" for 30 days. Then—send it back, if you think that any other "B"—at any price is as good. We'll refund your money instantly.



$1 DOWN Mail Coupon TODAY

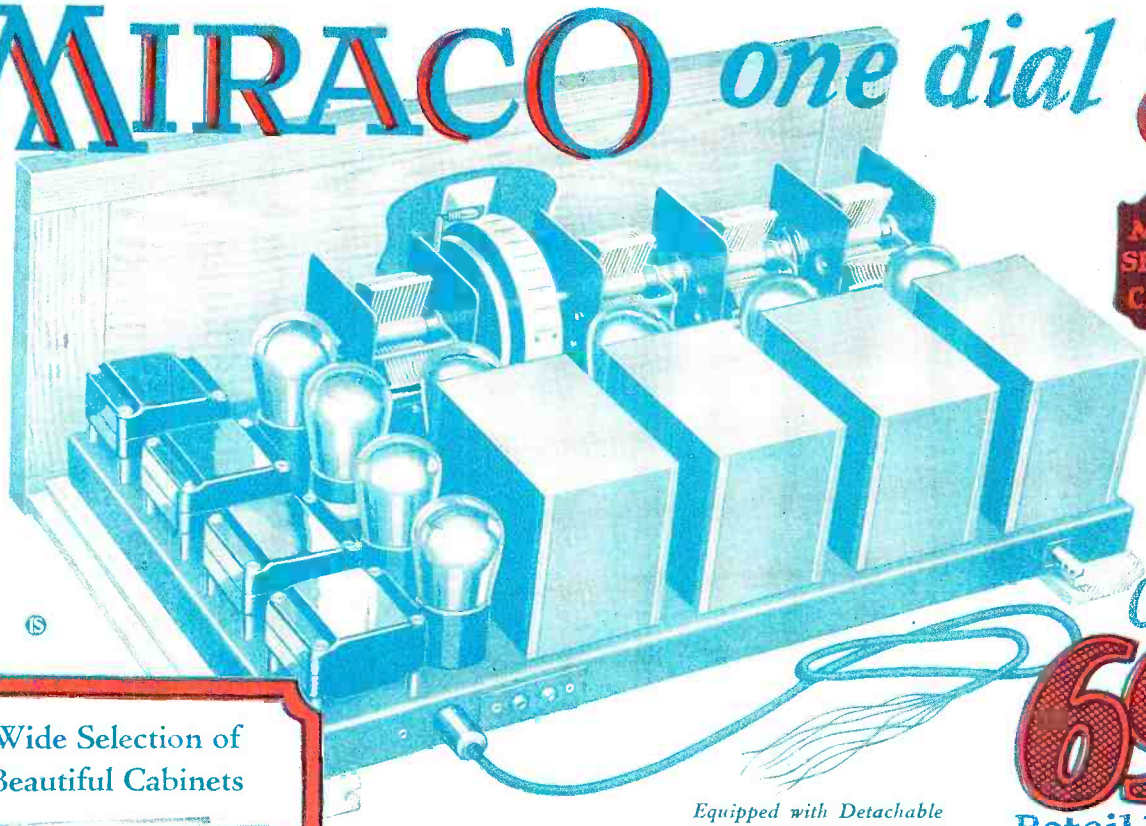
Send only $1. A dollar bill will do. We'll ship the PEERLESS "B" Eliminator at once. Pay the expressman $11.45 plus small express charges. Remember—you order the PEERLESS entirely at our risk. It is yours to test for 30 days. You get your money back promptly if within that time, for any reason whatever, you don't want to keep the PEERLESS. Order now. Fill in the coupon and mail today.

PEERLESS MFG. CO.
3975 Cottage Grove Avenue
Chicago, Ill.

Peerless Manufacturing Co.,
3975 Cottage Grove Ave., Chicago, Ill.
I enclose $1. Send me the 2 YEAR GUARANTEED PEERLESS "B" Eliminator and free 85 Mil. tube for 30 days trial. I agree to pay expressman $11.45 plus express charges.

(Name) _____
(Street) _____
(Town) _____
(State) _____

MIRACO one dial 8



ALL METAL SHIELDED CHASSIS

Only 69.75 Retail List

Equipped with Detachable Jones Multi-Plug and Cable

30 DAYS FREE TRIAL

—3 Year Guarantee If You Buy

All Electric—or Battery Set!

Big Discounts to User-Agents: 6, 7 and 8-Tube Miracos

America's big, old, reliable Radio Corporation* (8th successful year) guarantees in its big, powerful, latest 6, 7 and 8 tube Miraco sets "the finest, most enjoyable performance obtainable in high grade radios." Unless 30 days' use in your home fully satisfies you a Miraco is unbeatable at any price for beautiful, clear cathedral tone, razor-edge selectivity, powerful distance reception, easy operation, etc.—don't buy it! Your verdict final. Save or make lots of money on sets and equipment; write for testimony of nearby users and Amazing Special Factory Offer.

Miraco's work equally fine on "AC" electric house current or with batteries. Take your choice. Many thousands of Miraco users—who bought after thorough comparisons — enjoy programs Coast to Coast, Canada to Mexico, loud and clear—with the magnificent cathedral tone quality of costliest sets. Don't confuse Miraco's with cheap, "squawky" radios. Miraco's have finest parts, latest approved shielding, metal chassis, etc.—as used in many $200 sets.

Deal Direct with Big Factory

Your Miraco reaches you completely assembled, rigidly tested, fully guaranteed. Easy to connect and operate. 30 days' trial free. 3 year guarantee if you buy. You take no risk, you insure satisfaction, you enjoy rock-bottom money-saving prices by dealing direct with one of radio's oldest, most successful builders of fine sets. 8th successful year in the radio manufacturing business.

MIRACO "Powerplus" sets—both in 8 and 7 tube models—have magnificently beautiful, clear cathedral tone quality. Turn one dial for stations everywhere. Ultra-selective. Miraco multi-stage distance amplification gives "power-plus" on far-off stations. Latest all-metal shielded chassis. Illuminated dial. Fully guaranteed. *Try one free for 30 days!* Choice of beautiful cabinets.

7 tube one dial METAL SHIELDED CHASSIS $49.75 RETAIL LIST

Electrify Any Radio with MIDWEST NO-BATTERY "AC" Light Socket Power Units

"A", "B" and "C" power, direct from light socket, without batteries! Write for Midwest prices and discounts. Midwest Units are highest grade—lastingly dependable, quiet in operation, fully guaranteed.

BIG DISCOUNT TO User-Agent

USER-AGENTS! Make big profits showing Miraco to friends. Get our Special Wholesale Prices

Dealers Write! MIDWEST RADIO CORP'N
404-J Miraco Building, Cincinnati, Ohio

Free! *Send for Beautifully Illustrated Catalog and Amazing Special Offer*

*Special Wholesale Price Offer to User-Agents. Bank References — testimony of nearby Miraco users—all the proof you want—sent with catalog.

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
404-J Miraco Building, Cincinnati, Ohio.

THIS COUPON IS NOT AN ORDER

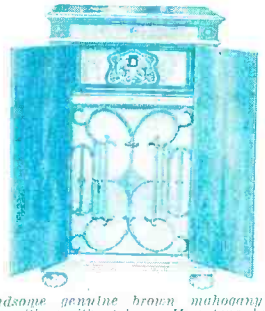
Without obligation, send free catalog, AMAZING SPECIAL OFFER, testimony of nearby Miraco users. ☐ User ☐ Agent ☐ Dealer

NAME

ADDRESS

Wide Selection of Beautiful Cabinets

DeLuxe table cabinet of solid mahogany. Two tone panel, richly ornamented.



Handsome genuine brown mahogany consoles, with or without doors. Huge tone chamber.

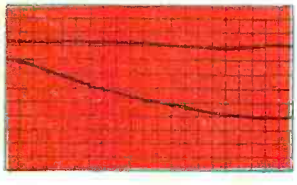
Beautiful Hi-Boy with large tone chamber. Antique mahogany finish.

Attractive Lo-Boy, with Cathedral Tone chamber. Two tone walnut finish.

Spanish treasure chest console, of beautiful walnut with large tone chamber.

More Tube Mileage

Chart showing longer life and steadier performance of CeCo Tubes.



There's a CeCo Tube for Every Radio Need

General Purpose Tubes
Special Purpose Tubes
Power Tubes
Filament Type Rectifiers

A. C. TUBES

Your money will buy more tube mileage if you demand CeCo radio tubes from your dealer.

Buy tubes as you do other merchandise—on a basis of value. You want clearer reception, full volume, natural tone. These CeCo tubes will give, to a greater degree than any other tubes you have used in your set. IN ADDITION, CeCo tubes will give extraordinarily longer life of steady, unfailing performance. (See above graph.)

CeCo is the scientifically engineered tube, the laboratory tested tube, the tube endorsed by great radio authorities including Browning, Lynch, Cockaday, Harkness, Hurd, Best, Bernard, Henney, Millen, and others.

Your radio dealer will help you select the types of CeCo tubes best suited for your receiver. Ask him.

Write for complete data of CeCo tubes.

CeCo RADIO TUBES

ORDER FROM YOUR DEALER THIS SPECIAL COMBINATION OF Ce Co RADIO TUBES

for Maximum Efficiency in the New "IMPROVED ARISTOCRAT" Circuit, as Specified by the Designer, Arthur H. Lynch

1 Type "K" Spec. R.F.
1 Type "H" Spec. Det.
2 Type "G" Hi-Mu 20
1 Type "F" Power (112)

$14.50

Complete

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Largest Exclusive Tube Manufacturers in the World