Popular Radio

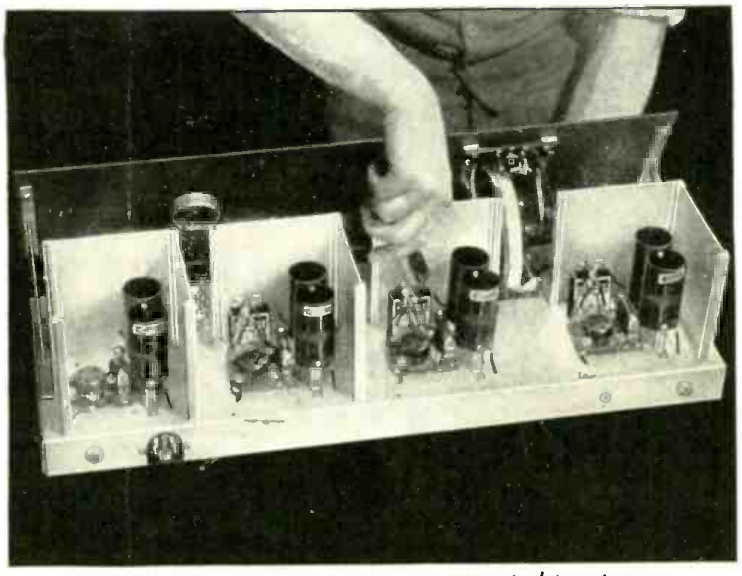
MARCH · 1928 ★

25¢

Socket Operation for Old Sets with the Jiffy A.C. Harness

"I have used ACME PARVOLT *Condensers for many years and have never had one break down."*

S. W. Tackaberry



Showing the well-known L. C. 28 wired for A. C. power supply. Only the finest parts are specified in this high class set, including PARVOLT *By-Pass Condensers.* ACME PARVOLT *Filter Condensers are also recommended for use in the power end.*

Whether You Buy or Build

a Power Supply Unit for Your Radio

PLAY SAFE WITH PARVOLTS!

WHEN you buy an electrified radio or power supply unit for your receiver, look for ACME PARVOLT Condensers; they are your guide to quality in all other parts. They cost the manufacturer a trifle more, but they are both his and your guarantee against costly condenser break-down.

Should you build your own power supply, be sure to use ACME PARVOLT Condensers and be safeguarded against the possibility of break down. Remember that poor filter condensers have caused untold thousands of dollars worth of loss in the past year or two, for blown out condensers mean blown tubes, burned out transformers and frequently the ruination of speaker units.

Just as PARVOLT By-Pass Condensers have been used for years in high grade receivers, so are PAPVOLT Filter Condensers rapidly replacing ordinary condensers in electrified radio. These condensers are wound with the very finest insulating papers combined with highest grade foils. Every detail produced in one of America's most modern plants and under the supervision of experts in condenser design and manufacture.

ACME PARVOLT FILTER CONDENSERS
In all required mfd. capacities for 200, 400, 600, 800, 1000, and 1500 Volt D C requirements. Supplied singly or in complete wired blocks for the important power supply units.

ACME PARVOLT BY-PASS CONDENSERS
Supplied in all required mfd. capacities and for all standard working voltages.

Uniformity of capacity and uniformity of sizes are two big features. Accuracy of all ratings, based upon the R.M.A. standards, is another guarantee of uninterrupted service. Play safe with PARVOLTS!

Made by THE ACME WIRE CO., New Haven, Conn., manufacturers of magnet and enameled wire, varnished insulations, coil windings, insulated tubing and radio cables.

ACME PARVOLT CONDENSERS

Made by the Manufacturers of

ACME CELATSITE WIRE

ENAMELED AERIAL WIRE
Enameled copper wire in both stranded and solid types. Also Acme Lead-ins, Battery Cables, Indoor and Loop Aerial Wire.

CELATSITE FLEXIBLE and SOLID
For all types of radio wiring. High insulation value; non-inflammable. 10 colors.

ACME SPAGHETTI
A superior cambric tubing for all practical radio and other electrical requirements. Supplied in 10 colors.

And now—
The BROWNING-DRAKE SPEAKER

WITH the introduction of the Browning-Drake Speaker another milestone in radio progress is marked. Based on a new principle of design and construction, this new speaker will reproduce the input with greater tonal accuracy and more positive fidelity over the entire audible frequency range than anything yet produced. There is no rasp or rattle and no distortion at any volume delivered by the best power amplifiers. The Browning-Drake tradition for fine radio apparatus is sustained in this new product which has passed the period of laboratory development and is now in production.

Licensed under Whitmore (Air-Chrome) Patents Pending

Mahogany or Walnut Duco-style finish are optional for the attractive table cabinet which houses the speaker. Rich tapestries to harmonize with almost any furnishing scheme are framed in the front and sides of the cabinet. The dimensions are 30½" high. 30¼" long and 14¾" wide. A ten-foot silk cord is attached to each speaker.

THE BROWNING-DRAKE TYPE A SPEAKER

Dealers: A unique and interesting method of distribution has been arranged to handle sales of these speakers. Write today and get the details of this proposition.

$65.00

See your nearest dealer or write direct, giving your dealer's name and address

The BROWNING-DRAKE SPEAKER SALES CO.

552 Massachusetts Ave., Cambridge, Mass.

NEWARK	PITTSBURGH	CHICAGO	SAN FRANCISCO
172 Emmet St.	910 Fulton Bldg.	53 W. Jackson Blvd.	905 Mission St.

BROWNING-DRAKE RADIO

Popular Radio

EDITED *by* RAYMOND FRANCIS YATES

FOUNDED 1911

VOLUME XIII March, 1928 NUMBER 3

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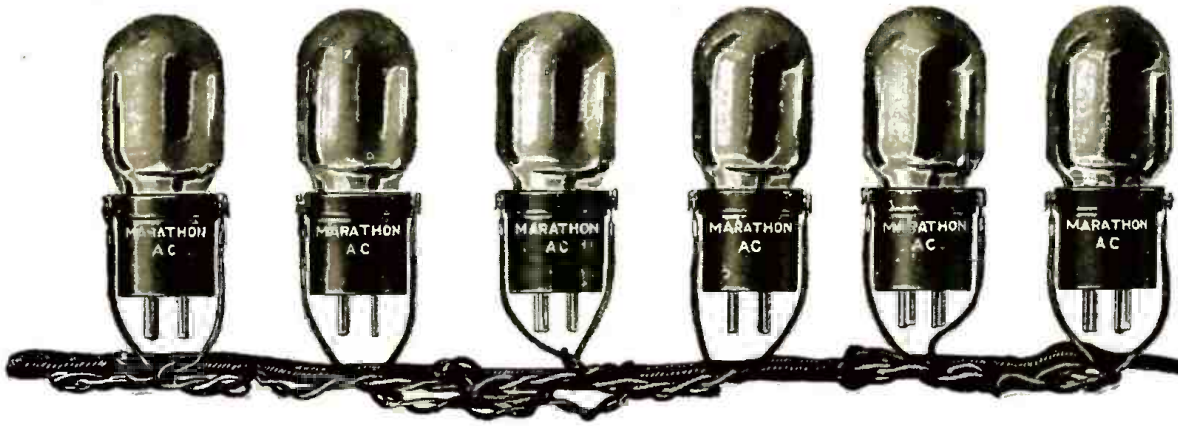
Printed in U. S. A.

LAURENCE M. COCKADAY, *Technical Editor*

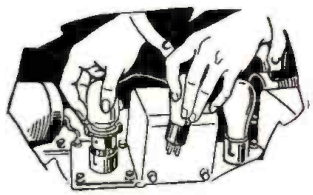
CHARLES L. DAVIS, *Managing Editor*

MARATHON A-C KIT

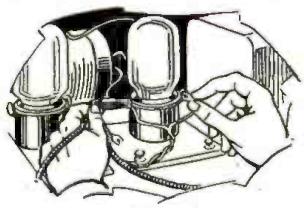
Electrifies any set



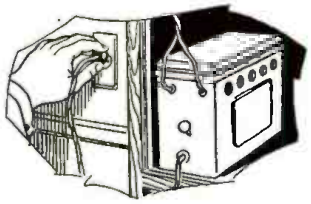
SIMPLE AS A-B-C



Replace your old Tubes with Marathon A-C Tubes



Connect the harness



Plug in the light socket

-that's all there is to do

YOU CAN'T MAKE IT COMPLICATED

No re-wiring—no adapters—no by-pass condensers—no center-tap resistors—no additional "C" Batteries

AT last you can electrify your set within a few minutes—without changing a single wire, without using by-pass condensers, adapters, center-tap resistors or additional "C" batteries.

The change from DC to AC is as simple as the illustrations to the left show—you can not make it complicated. Anyone, no matter how ignorant of radio, can do it.

Marathon AC Tubes Guaranteed for a Year

The amazing, self-biasing Marathon AC Tube—an entirely new development in the radio art—automatically takes care of every condition. No other tube is like it. It is built on an entirely new principle and guaranteed for a year!

Guaranteed to Operate Satisfactorily on Your Set

No need to wonder if the Marathon AC Kit will work on your set. If you have a set now operating from an "A" battery (drycells or storage), employing UX sockets, and 5, 6, 7 or 8 tubes we guarantee perfect satisfaction. We will not tell you about the increased efficiency the Marathon AC Tubes will give your set, but you will be agreeably surprised.

Complete Kit—Nothing Else to Buy

The Marathon AC Kit is complete. The six tube Kit, for example, includes 6 Marathon AC Tubes, a universal harness which fits all six tube sets, a Transformer which steps down the voltage to 6 volts (on which all of the tubes operate), and a volume control. Nothing else to buy.

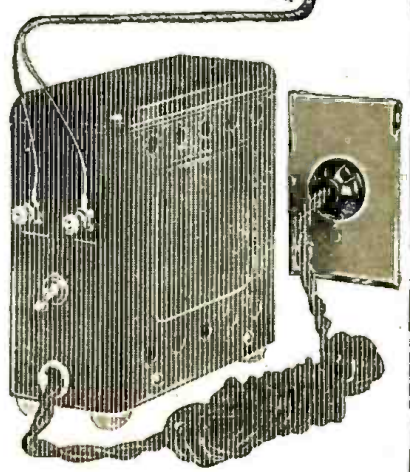
The five or six tube Kit is $30.00; 7 tube, $35.00; 8 tube, $40.00. Send the coupon below for complete information, if you have any difficulty in finding the Marathon AC Kit at your dealer.

Jobbers and Dealers

Write or wire for our interesting sales proposition. The Marathon AC Kit is one that you can recommend with safety.

NORTHERN MANUFACTURING COMPANY
Newark, N. J.

LIST PRICES
5 or 6 Tube Kit $30.00
7 Tube $35.00
8 Tube $40.00
COMPLETE



NORTHERN MANUFACTURING CO.,
380 Ogden Street, Newark, N. J.

Send me complete information on the Marathon AC Kit.

☐ Jobber ☐ Dealer ☐ Professional Set Builder
☐ User (Please check your classification)

Name .....

Address .....

.....

A Page With The Editor

Popular Radio has reason to feel elated over the generous and constructive response that has been received during the past two months from builders of the LC-28. Mr. E. Zimmerman, of the Aluminum Company of America, living in New Jersey, is one of the many enthusiastic users. Protesting that he is a man of sober habits, and that his dissipation on Saturday night takes the form of listening for long distance on the LC-28, he submits the following list of stations which he has logged: KFSD, KFI, KHJ, KHQ, KJR, KUIL, KFKX, CJCA, WHO, WLS, WLRD, WBAP, KDKA, WSM, KYW, WSAI, WOAM, KFUO, KSAC, WTBO, WJBT, WTAS, WRR.

* *

In this issue of Popular Radio there will be found an article on the new LC-28, using AC valves. Those who contemplate building a set for the first time can take advantage of the improvements of complete light-socket operation, greater distance getting ability and the best type of amplification and reproduction yet discovered. Users of the old set can easily make the change. Turn to page 198 before you read another paragraph.

* *

When Popular Radio first began to publish technical articles, every detail involved was treated in the most illuminating way, and the articles stretched out to four and five pages of description. Perhaps the present reader will have noticed that Popular Radio's articles have, during the past year, been reduced somewhat in length. For nearly seven years the magazine has been educating its readers, and now the Staff feels that it can take a certain amount of training on the part of its readers for granted, and that it is no longer necessary to treat trivial details. This new plan permits the Editorial Department to give its readers more articles and to maintain a more pleasing variety of material.

* *

If, perchance, any detail is not absolutely clear, the Technical Information Department stands ready and willing to extend a helping hand.

* *

In the February number of Popular Radio the editor suggested that the next logical development in radio would take the form of AC shielded-grid valves. Before the ink was dry on that paragraph, one of our genial friends popped into the office and proudly exhibited the finished article. Suggestions today, realities tomorrow!

If the data on these new valves is released in time, the details will appear in the April number.

* *

Valve developments have come so fast and furious during the past year that it is about all even the most alert experimenter can do to memorize the new type numbers.

* *

In nosing about the Laboratory the other day, the editor discovered that the Technical Staff is busy at work upon a real electric phonograph, operating directly from AC mains. It seems that the Technical Staff decided that perhaps not everyone wants a phonograph to operate in conjunction with a radio receiver, but would prefer having it as an independent unit. If at all possible, a description of this new phonograph will be included in the April number.

* *

It was somewhat reassuring to find that, in checking up the amount of advertising carried by radio publications for February, Popular Radio headed the list of the monthlies in the amount of *bona fide* advertisement. Advertising is what keeps the editorial mill grinding at maximum efficiency.

* *

What is an electric receiver? Although this should be a simple question to answer, there seems to be a great deal of confusion in drawing conclusions. Popular Radio holds that any receiver drawing its source of supply, both "A," "B" and "C," from the lighting mains through "A," "B" and "C" power devices without the use of batteries of any type, may be called an electric receiver. It would seem superficial to use this term only in connection with sets employing AC valves.

* *

The National Better Business Bureau came to us recently asking for help in arriving at the correct terminology. It was the object of this Bureau to standardize the terms used and to enlighten the public that it may guard itself against fraudulent advertising and extravagant claims.

* *

After all, the term "electric set" is more or less ambiguous, for all radios are certainly electric. Perhaps the term "batteryless receiver" would be more correct, although it is a negative term.

* *

The casual reader of Popular Radio will have noticed during the past few months that the Technical Staff has consistently held to the plan of running additional articles in connection with receivers that have previously been described. The object of this procedure is to permit the builder of the original sets to keep up to date and to milk from them every possible ounce of efficiency. The Technical Staff takes the position, and rightly so, that really good receivers representing real advancement in the art do not come out often enough to justify treatment. Popular Radio could easily fill its pages with a raft of mediocre receivers each month, but it could not do this and at the same time maintain the confidence of its readers. One good circuit is worth a half dozen trick ones, and it costs less.

* *

On page 225 of this issue there will be found a description of a special AC kit for use in converting old DC receivers to socket operation. Four minutes are required for the change. With this new equipment available, one wonders why we have so many mid-Victorian radio receivers.

* *

Just as these pages go to press, a new colossus of amplifying valves has made its appearance. This is known as the 250, and it is supposed to be a still bigger brother of the 210. Two of these valves are now in the Popular Radio Laboratory, and the Technical Staff is busy learning how to use these new amplifying tools to the best advantage. No doubt the data that they accumulate will be available in the columns of the April issue.

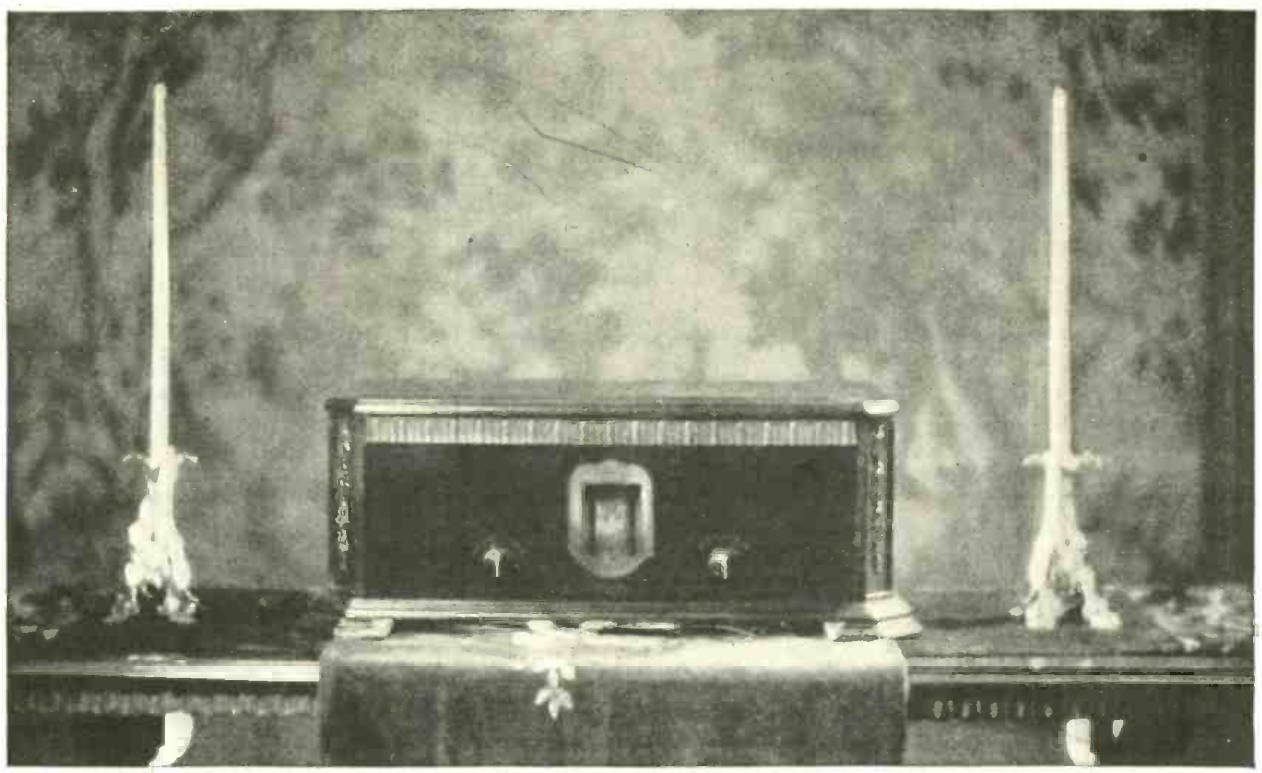
* *

R. del Valle Sarraga, an enthusiastic reader of Popular Radio residing in San Juan, writes as follows: "Please allow me to congratulate you with all my heart for your editorial on short waves in the January number of Popular Radio. You are hitting your hammer right on top of the nail. As I live within the tropical zone, I know what real static is, what good and bad reception means, and how different DX sounds in winter and summer. But with the short waves, either the 22 or the 32 meters from WGY or the 65 meters from KDKA, *is another story!* We get both stations throughout June, July and August with loudspeaker volume!"

* *

The list of satisfied users of short-wave receivers is growing.

Raymond F. Yates



The New Improved Hi-Q Six—the creation of ten foremost American Radio Engineers—a receiving instrument that is far in advance of its time.

Exclusively CUSTOM-BUILT

By Yourself at Home . . . from our Simple Instructions . . . and at Great Savings!

No ordinary standards can be applied to this latest improved Hammarlund-Roberts Receiver, for it is the result of a determination to produce America's very finest instrument—absolutely regardless of cost!

Every modern constructional feature has been incorporated. Each part is the most efficient known to radio science, and the entire group has been purposely selected for perfect synchronization. Complete isolation of four tuned circuits plus Automatic Variable Coupling effects maximum and uniform amplification over the entire wave band. Distortion is totally eliminated. Oscillation is utterly absent. Symphonic transformers and a power tube faithfully reproduce the full musical scale. Selectivity, even in crowded areas, is something to marvel at. And tonal quality simply MUST be heard to be appreciated!

Such a set, factory made, and sold through usual channels, would possibly cost around $300.00, but, through following our simple instructions, you can purchase all parts for only $95.80 and build this supreme receiver yourself—a CUSTOM BUILT set which gives you CUSTOM BUILT results at a saving of $100 to $150.

Get the complete Hi-Q Instruction Book from your dealer—or write us direct. Price 25 cents.

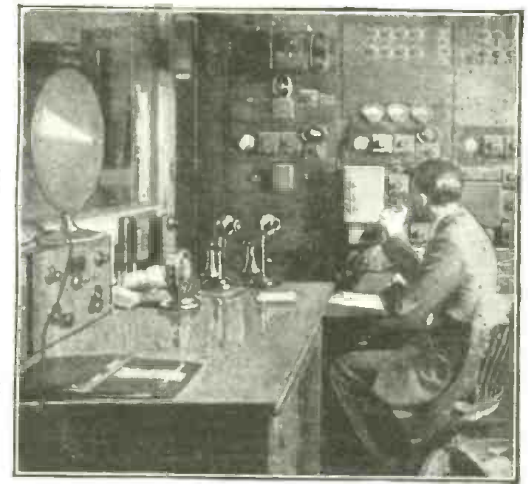
Completely drilled panel and sub-panel are foundation for easy building.

Hammarlund ROBERTS Hi-Q SIX

HAMMARLUND-ROBERTS INC. 1182 Broadway, Dept. B New York City

Associate Manufacturers

Get Your Share of the BIG MONEY in RADIO



Why be satisfied with $25, $30 or $45 a week when the good jobs in Radio pay $50, $75 and all the way up to $250 a week. The astounding growth of Radio has already created three hundred thousand jobs in a few short years. Small and large fortunes are coming out of this new business every year. Twenty different branches offer you work that's almost romance with practically no limit to the money you can make. Manufacturing, selling, repairing, servicing, assembling, installing sets, operating on board ship which gives you world-wide travel without expense, operating a broadcasting station, and many other lines of work are fully explained in "Rich Rewards in Radio," my 64-page FREE book. Send for it today.

I'll Show you how MANY MEN are MAKING $50 to $250 A WEEK in this New Business

Read What Big Money these N.R.I. men are making

High As $78 a Week

"I am only about half way through the course, but I have made as high as $78 in one week in a retail Radio store. I estimate my total income, as the result of my knowledge of Radio, around $3,000 to date. I know I could not have picked a better course." FRANK REESE, 304 Walnut St., Coatesville, Pa.

$70 in One Day

"I am in business for myself and recently made $70 in one day. I estimate that the Radio training I received from you will be worth tens of thousands of dollars to me in the future."—T. M. WILCOX, Belle Island, Newfoundland.

Learn Radio the Practical Fascinating Way

Learn At Home In Spare Minutes

No need to leave home. Hold your job. I'll bring your training to you. You can learn during your spare time. My easy-to-learn, practical course has put hundreds of fellows who had only a few minutes a day to study into big pay jobs. You don't have to be a college or high school graduate to become a Radio Expert. Many of my students and graduates now making big money didn't even finish the grades.

You Get Six Big Outfits Without Extra Charge

I teach Radio the right way—the practical way. I give you six big outfits of Radio parts (not toys) and show you how to build approximately 100 different circuits, locate, repair, and remedy all receiving set troubles. Three outfits you build are shown on this page. You build practically every type of receiving set known today. Thus you learn the "why" and the "how"—get a complete, thorough, rounded-out knowledge that shows its worth in your pay envelope. Full details in my big book.

Earn $15, $20, $30 a Week Extra While Learning

Deloss Brown, South St., Foxboro, Mass., made $1,000 from spare time jobs before he even finished his course. Frank Toomey, Jr., Piermont, New York, made $833. G. W. Page, 1807 21st Ave., Nashville, Tenn., says the course brought him $935 spare time profits. No need to scrimp, save and deny yourself good things to pay for this course. It's the world-famous course that pays for itself.

Your Money Back If Not Satisfied

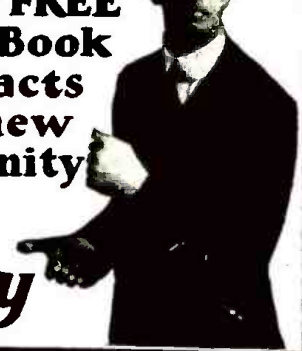
That's the agreement I make with you when you enroll. It's my way of showing you that I'll give you the training and service you need and want. You are the only judge.

64-Page Book FREE for the Asking

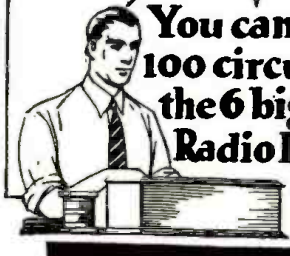
I will gladly send you my 64-page book of information on N. R. I. training and the money-making opportunities in Radio without a penny's cost to you. Send for it NOW. Clip or tear out the coupon today. Find out what Radio offers you and how my Employment Department helps you get into Radio after you graduate.

J. E. SMITH, President
Dept. 3K
Nat. Radio Institute, Washington, D. C.

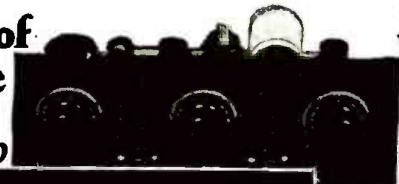
Send for FREE 64 Page Book giving facts on this new opportunity



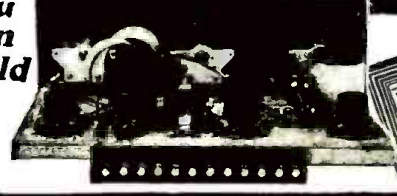
Act Today



You can build 100 circuits with the 6 big outfits of Radio Parts I give you



3 of the 100 you can build



Mail This FREE COUPON NOW

J. E. SMITH, *President*
Dept. 3K, National Radio Institute,
Washington, D. C.

DEAR MR. SMITH: Without obligating me in any way, please send me your Free book, "Rich Rewards in Radio," with information on your practical Home Study Radio Course.

Name.....Age.....

Address.....

City.....State.....

Occupation.....

Employment Service to all Graduates

POPULAR RADIO has always been alert to new trends.

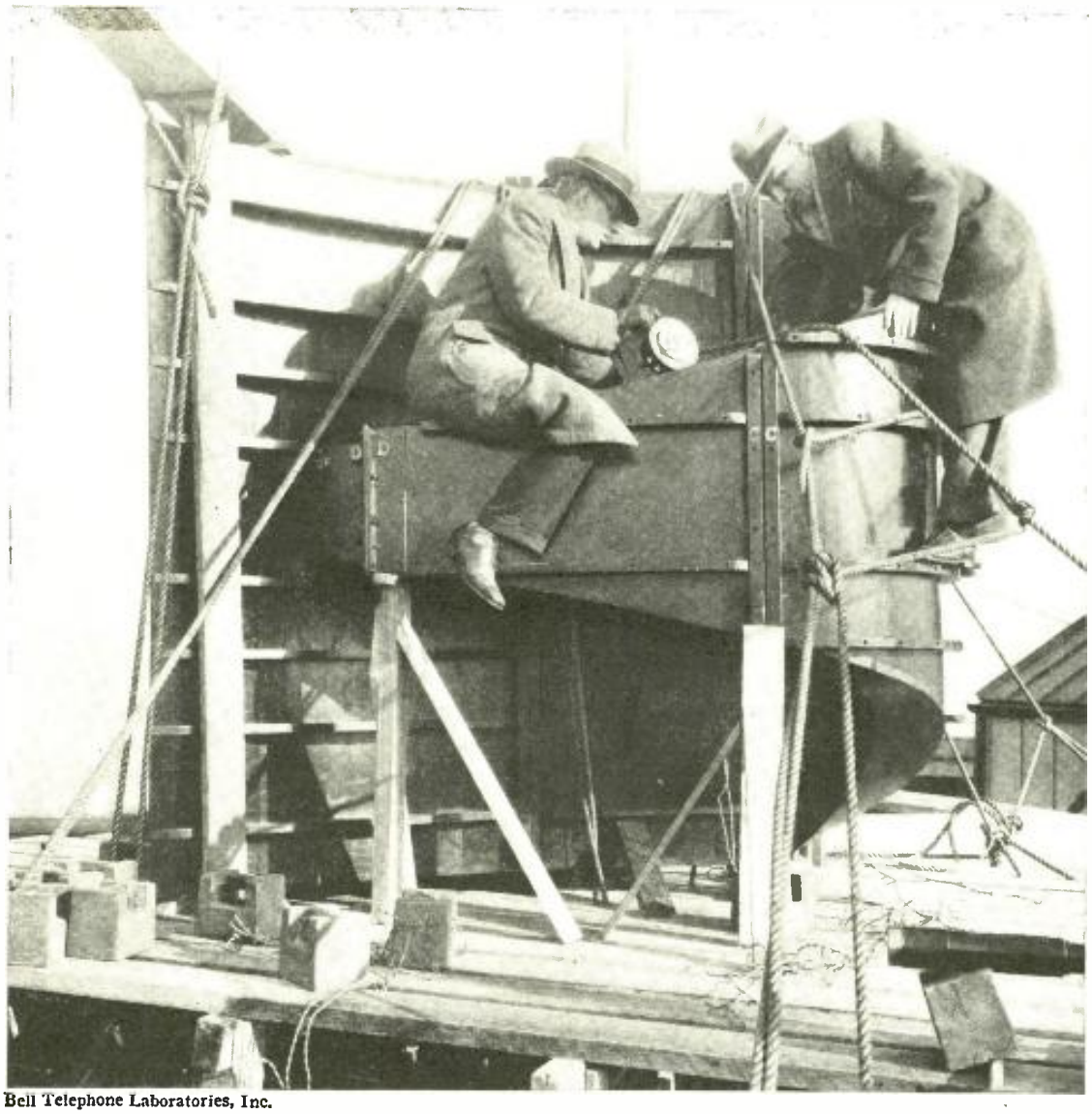
I have been a staunch follower of the editorial contents of POPULAR RADIO *for many years and feel that you have contributed much toward the development of the radio industry.* POPULAR RADIO *has always been alert to new trends and new developments, and has pioneered with those advancements that are really worth while. Your laboratory and technical department has been very helpful to me and, I am sure, to many other serious-minded radio enthusiasts.*

Leslie G. Biles.

SECRETARY,
HAMMARLUND-ROBERTS, INC.

LESLIE G. BILES

Leslie G. Biles started his career as an amateur in 1909. Then, after considerable laboratory experience, he became Technical Radio Editor of the Philadelphia *Public Ledger*. In this connection, Mr. Biles had an opportunity to do a great deal of research and experimental work. He then became Managing Editor of *Radio-in-the-Home*. He left this position to become Secretary of Hammarlund-Roberts, Inc. He has written for all the leading radio magazines and newspapers, through which he has established a reputation as an outstanding authority on many phases of radio.



Bell Telephone Laboratories, Inc.

A Radio Voice That a Million Could Hear

The amazing development work that has taken place in reproduction during the last two years is well typified by this giant speaker which proved capable of hurling a man's voice across the Hudson River at its widest point. Several years ago voice projection was measured in feet. Now, with the aid of this new Hercules of horns, which weighs several tons, the human voice can be flung over a mile. The horn is of the exponential type and is provided with a group of nine reproducers attached to its small end. Each reproducer is provided with a moving diaphragm of aluminum alloy, measuring only .0002 inch thick, and attached to this diaphragm is a small coil of aluminum strip insulated with varnish. The voice-modulated currents pass through this aluminum strip and, interacting with a powerful magnetic field, cause the diaphragm to respond in perfect sympathy with the voice current. A new record of efficiency has been established with this equipment. Frequencies as low as 60 and as high as 6,000 cycles are reproduced with amazing efficiency of 50 per cent. This means that 50 per cent. of the electric energy supplied to the horn is converted into sound. The horn and its accessory equipment has been developed by the engineers of the Bell Telephone Laboratories, Inc.

Popular Radio

VOLUME XIII March, 1928 NUMBER 3

Does Static Come *Up* From the Ground?

Since the inception of radio communication, engineers have accepted the theory that static interference is a phenomenon associated with the atmosphere and that the visitations of static impulses is the direct result of exposing parts of our receiving apparatus to the air. It has been insistently imagined that these rebellious gushes of static strike our aerials and rush pell mell through our receivers to the ground. How shocking it would be if we had to revise this conventional notion and picture static as a ground phenomenon, with terra firma as its abode in place of the sky. Such is the astounding theory of Dr. Richard Hamer, whose brilliant researches outlined in this article have supplied what would seem to be sound verification for this amazing conclusion.

By DR. RICHARD HAMER
Department of Physics, University of Pittsburg

STATIC, radio's arch enemy and all-pervading nuisance, has to date successfully eluded the efforts of our best engineers. It is still as rampant and capricious as it was when it surged through Signor Marconi's little coherers back in the infantile days of the art.

Although the presence of static is the most obvious thing imaginable, it is surprising how little is actually known about its ultimate nature and the source of its generation. Since it first manifested itself, it has been held that it was a phenomenon of the air, and that it took up its permanent dwelling in the wide-open spaces between the aerials of the world. That this method of reasoning might, after all, turn out to be a fallacy is suggested by experiments which the writer has performed.

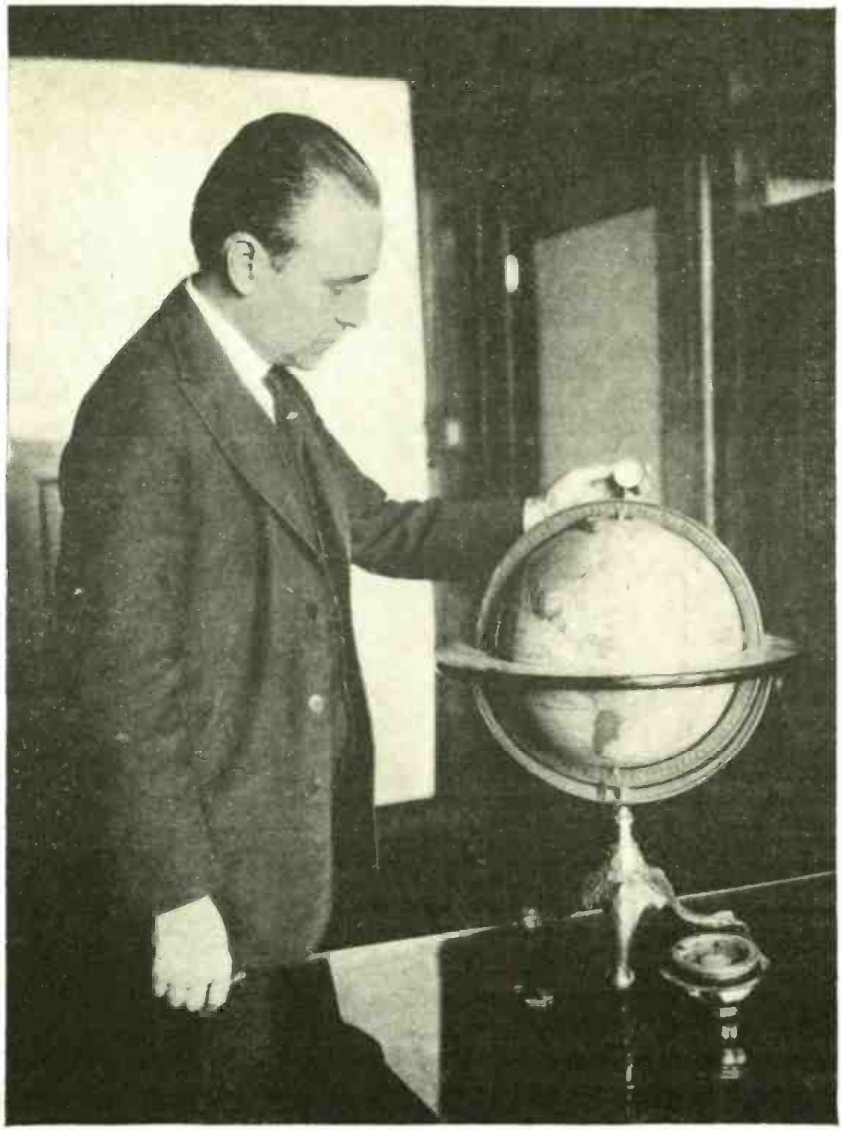
The theory is proposed here that fluctuations of atmospheric pressure and their consequent effect on the earth is one of the main causes of static, of earth currents, and of the variations in earth currents and in the magnetic field which the earth generates.

The ever-varying changes of atmospheric pressure due to meteriological conditions give rise to a varying potential of the grounding conductor with respect to the earth itself, or else actually cause a redistribution of electrons or ions in the regions near the locality where the pressure changes. They also seem to change the resistance of the earth considerably.

Experiments undertaken by the writer seem to indicate that all these factors possibly exist, and perhaps exert their own effects at the same time. In an experiment, a glass tube about one meter long was filled with moist earth. Two brass discs were inserted about ten centimeters from each end, with their brass rod connections insulated from the earth by glass tubes extending out through the rubber stoppers used to close the ends. These disc electrodes were connected in series with a sensitive galvanometer. Suitable tube connections were arranged at the top end so that the soil in the tube could be subjected somewhat suddenly to a reduced or increased pressure by means of an aspirator or an air compressor. Figure 1 shows the set-up used.

Changes in air pressure caused noticeable variations in the current which was found to flow, due to the fact that polarizable electrodes were used. Similar variations were observed when a battery was put in series. This would indicate that the soil acids gave rise to an electric current owing to their chemical action on the brass electrodes and that variations in pressure caused variations in the local concentrations at the surfaces of the electrodes, and so made the currents vary. Another view is that the pressure changes modified the resistance of the earth just as the agitation of the telephone transmitter diaphragm varies the resistance of the carbon granules.

An attempt was next made to eliminate the polarization and resistivity effects which were undoubtedly present, by using a quadrant electrometer instead of a galvanometer and separating



DOES STATIC HIDE IN THE EARTH?

The phenomena of earth magnetism and static, which seem to be related, have been the subject of some of the most ingenious experiments of modern science. Dr. Hamer's researches go a long way toward clarifying the known facts of terrestial magnetism, atmospheric disturbances and static.

the electrodes from the soil by glass. One end was earthed and the whole tube covered with tinfoil, which was also earthed. Figure 2 shows the second set-up. The same variations in pressure gave rise to deflections of the needle such as would be caused by a redistribution of electrical charges in the soil.

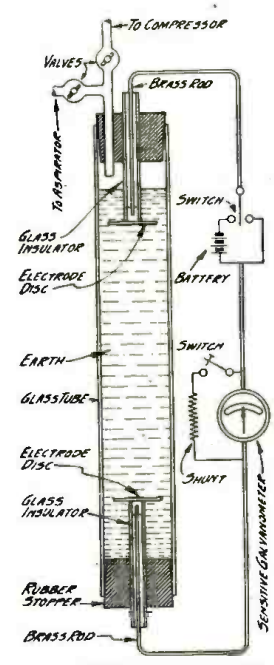
These latter experiments indicate that there is an actual redistribution of electrons or charged ions throughout the mass of earth when the air pressure is suddenly varied. It is quite possible that in the case of static and earth currents these factors (change of polarization, resistivity variation and ionic redistribution) are all present and exert an influence.

It is obvious that anything which tends to change the contact potential of a grounding wire with respect to the earth, or which causes a redistribution of ions or electrons in the earth, temporary or otherwise, will play a definite part in the recording of any instrument using a grounded connection. It would also follow that static would perforce affect all wavelengths more or less indiscriminately. That such is the case seems to be indicated by wireless experiments.

From these results it would seem that static due to local meteorological conditions may be reduced considerably by burying the grounding wire very deeply with the connecting wire insulated from the moist earth, or by using an extensive spider or mat of conducting wires either above the ground and not in actual contact with it, or else on or below the surface of the ground, but insulated from it. The spider device is generally used for transmission only and undoubtedly is a great improvement for the reason that local variations of the contact potential of the "ground" are considerably reduced.

All earth-current measurements obviously demand that the connections with the earth shall be stable and not liable to fluctuations, gradual or otherwise. The elimination or determination of these should be a first consideration before much reliance can be placed upon the apparent results. Non-polarizable electrodes should be used. These should help partially in the case of static.

It is difficult to suggest a means of reducing or overcoming the static or the fluctuations due to atmospheric pressure variations at a distant area. Perhaps inland points should endeavor to have good water connection, with as large a water area as possible, and so attempt to have complete water connection between transmitting and receiving stations. Experiments are planned to determine if pressure variations on fresh and salt water cause similar variations in currents and potentials. It would appear reasonable to expect that water connections considered as electrical conductors are more uniform than land, though this would not always be



THE APPARATUS FOR THE FIRST EXPERIMENT

FIGURE 1: *By means of the apparatus shown diagramatically above, Dr. Hamer discovered that the current flowing in the galvanometer at the right varied with the air pressure on the earth in the tube. The pressure was varied by means of an aspirator and compressor connected at the top of the glass tube.*

the case, especially at the delta of a river.

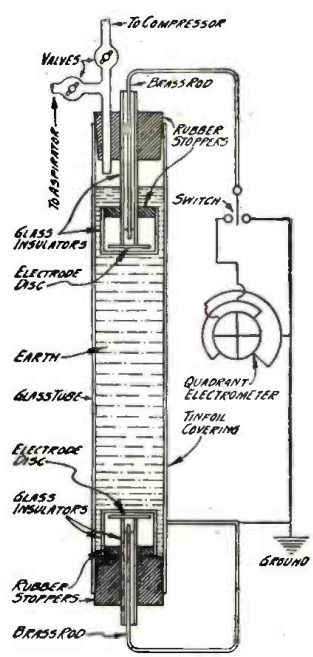
This theory of the cause of static affords a reasonable explanation of the greater prevalence of static in summer than in winter. During the summer months, in the northern hemisphere, pressure changes of short period are more frequent and more sudden than in winter. These are generally due to the prevalence of thunderstorms and similar disturbances. Their period is about half an hour or less and the magnitude is measured in hundredths of an inch of mercury. When condensation, such as rain or fog, takes places, there would be a rapid fall in the pressure and a wave of rarefaction would spread out from the rain area as center. If these pressure changes cause observable temporary disturbances of the electronic or ionic distribution in the earth's crust, then this would give rise to more static in summer than in winter. This is actually the case, as proved by experience.

In winter the pressure changes are of a much longer period, generally about two days, and are much greater in magnitude, being measured by about half an inch of mercury; but since they are more gradual, they are much less likely to be observed as disturbing factors in wireless reception. They should, however, be present as factors in earth-current and magnetic observations. The variations in these should be more or less parallel in occurrence and intensity.

Similarly, as regards the daylight hours and the hours of darkness, static and fading effects are more frequent in the former than in the latter. Possibly this is because as far as pressure changes themselves are concerned, a more turbulent state of the atmosphere exists generally during the day than during the night, very short period pressure variations being more frequent.

The experiments with the earthed tube and non-polarizable electrodes support the theory that a redistribution of electrons or ions takes place in the earth's crust when a variation of atmospheric pressure occurs anywhere over the earth. If the electric current due to this redistribution is large enough to give rise to observable magnetic effects, as would appear from the results so far obtained, then the atmospheric disturbances will play a definite rôle in the magnetic variations, in the same way as it thus appears to be one of the main causes of the variations in the earth currents. Professor Sanford, of the Leland Stanford University of California, has already declared that these magnetic variations parallel those of the earth currents he has observed.

The theory as here proposed suggests that the sun by radiation effects and possibly by gravitational air tides, with the assistance of the moon in the latter case, indirectly causes at least a part of the variations which take place in the earth's magnetic field.



THE REVISED APPARATUS FOR THE SECOND EXPERIMENT

FIGURE 2: *In order to eliminate polarization and resistivity effects that might have been responsible for current changes in his first set-up, Dr. Hamer repeated the experiment, using electrodes insulated from the earth in the tube, as shown above.*

THESE LOOPS ADD TO OUR KNOWLEDGE OF STATIC

The giant double movable loops pictured here are used by the U. S. Bureau of Standards to determine the direction and intensity of static impulses. It is the theory of Dr. Hamer that static's real lair is in the ground and that it is generated by varying air pressure to which the earth is naturally sensitive.

And Now—An AC LC-28

Here is POPULAR RADIO'S premier creation for the professional set builder, the amateur and the music lover. The receiver described in this article embodies all the refinements that place the older model in the front rank of 1928 receivers, with the additional features of complete operation from the AC lighting lines and the best type of amplification and reproduction that it is possible to get at the present time.

By LAURENCE M. COCKADAY

THE new model of the LC-28 receiver described in this article incorporates all the outstanding features of the original set, described in the October, 1927, number of POPULAR RADIO, and in addition several new features and refinements that make it exceptional as a modern receiver for broadcast reception.

First of all, the new set is designed to operate without batteries, utilizing the new AC valves. It may be used with any good quality power amplifier that, in itself, is AC operated and that will furnish "A," "B" and "C" voltages to the LC-28 high-frequency pack itself.

In considering the design of the receiver itself from a theoretical standpoint the reader may refer to the schematic wiring diagram in Figure 3. It will be noticed that the general circuit arrangement is practically the same as in the DC LC-28. In place of the DC valves, however, are shown three AC filament valves in sockets P1, P2 and P3, while a heater type valve is employed in the detector socket, P4.

In the three high-frequency amplifier stages, O1, O2 and O3, where the straight AC valves are employed, it will be noticed that bridge arrangements, O1, O2 and O3, are used to balance out the AC potential in the grid circuits, carefully by-passed in each stage with suitable by-pass condensers, AA1, AA2 and AA3. The grounded chassis has been utilized for the "C" bias connection to the high-frequency stages, and the center tap on the resistors, O1, O2 and O3, has been raised by the amount of this "C" bias above the chassis potential. This makes a simple but thoroughly efficient job and simplifies greatly the wiring that would ordinarily be used on an AC receiver.

The connections between the high-frequency pack and the power-pack amplifier to be used to operate the complete receiver are laid out with a standard Yaxley cable and plug. Figure 6 shows the connections graphically.

The results that may be obtained with this new receiver are even better than those obtained with the standard DC valves, and set builders who are looking for the latest and most modern type receiver should find it in this new design.

The construction of the receiver is as easy a job as the original DC set, and the results that will be obtained will repay any experimenter. The set is thoroughly reliable and will give results that are really permanent, as the circuits for the AC valves have been carefully worked out with electrical constants that are conservative and that promote long life for the valves.

POPULAR RADIO WORK SHEET

The LC-28 for AC Operation

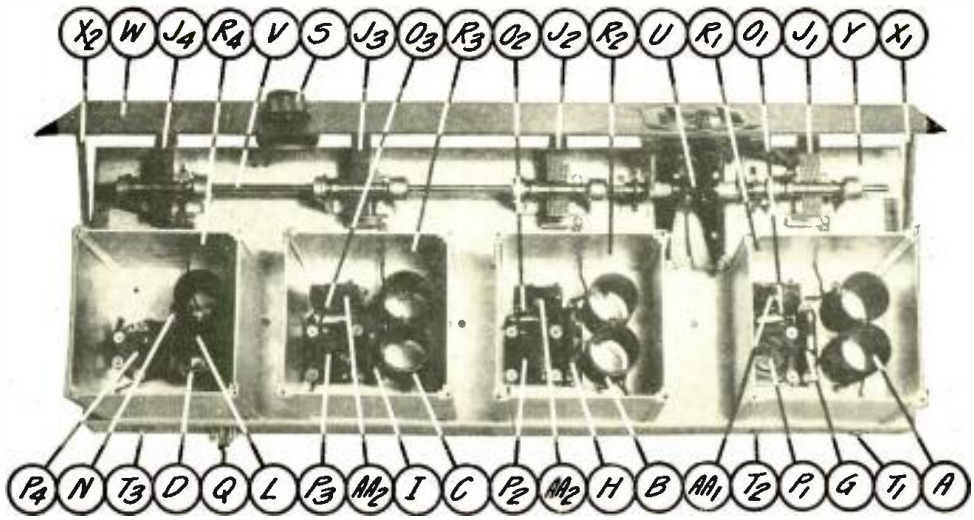


FIGURE 1: THE PANEL LAYOUT OF THE RECEIVER.

List of Parts for Building the Receiver

Cost of Parts—*Not over $95.00*

A, B, C and D—Precision high-frequency transformers, type 4-B;
E1, E2 and E3—Samson high-frequency chokes, type No. 125;
F—Samson high-frequency choke, type No. 85;
G—Lynch suppressor, 500 ohms;
H—Lynch suppressor, 600 ohms;
I—Lynch suppressor, 700 ohms;
J1, J2, J3 and J4—Hammarlund midline variable condensers, .000275 mfd.;
K1, K2 and K3—Aerovox moulded condensers, .02 mfd.;
L—Aerovox moulded condenser, .00025 mfd.;
M—Aerovox moulded condenser, .00075 mfd.;
N—Durham metallized resistor, 6 megohms;
O1, O2 and O3—Electrad center-tapped resistors, Type V-10, 10 ohms;
P1, P2 and P3—Benjamin 4-prong sockets;
P4—Benjamin 5-prong socket;
Q—Yaxley cable connector plug with cable, type 660;
R1, R2, R3 and R4—Special Junior aluminum box shields for LC-28, made by Aluminum Company of America;
S—Centralab resistor, 500 ohms, PR500;
T1, T2 and T3—Carter "Imp" plugs and tip jacks, marked "Antenna" and "Ground," and "Input," respectively, with insulating washers for the antenna and input jacks;
U—Hammarlund double-drum dial;
V—Brass extension shaft, 16½ inches long and ¼ inch in diameter;
W—Aluminum panel, 6 inches by 26 inches, drilled and decorated, made by Wholesale Radio Service Company;
X1 and X2—Tait brackets;
Y—Aluminum chassis for the LC-28, made by the Aluminum Company of America;
Z—Lynch single-resistance mounting;
AA1, AA2 and AA3—Acme Parvolt bypass condensers, ½ mfd.;
Corwico Braidite hook-up wire, screws, nuts, 1½-volt flashlight bulb, solder, etc.

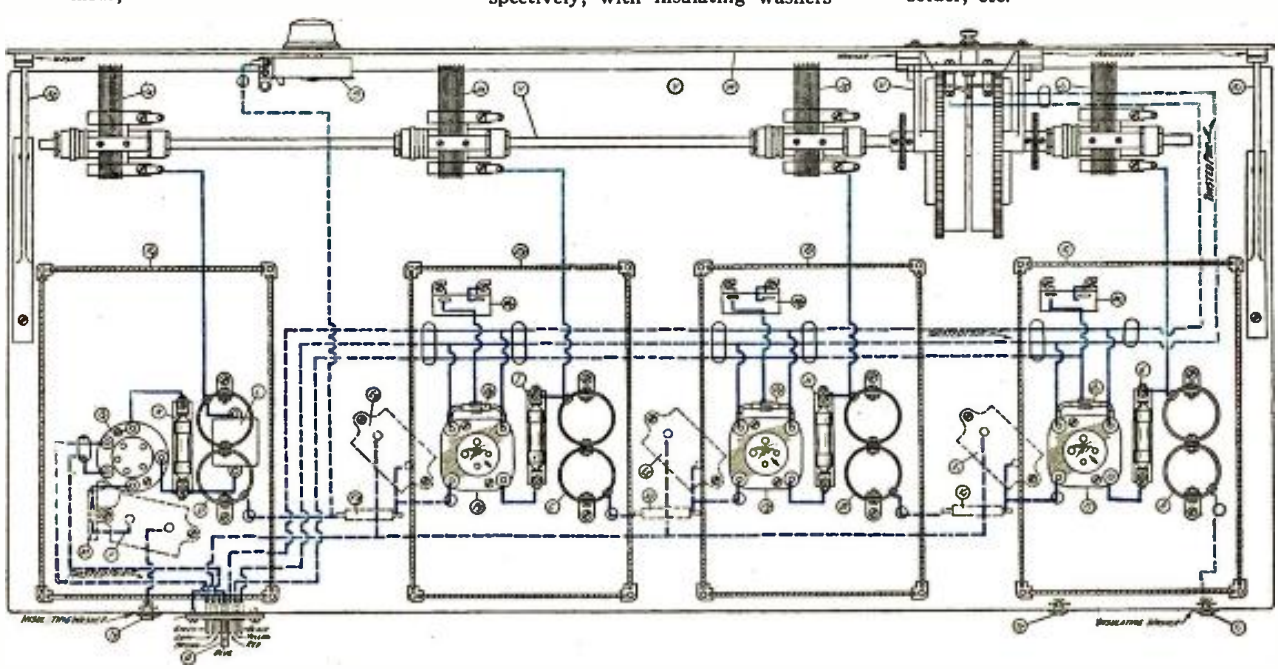
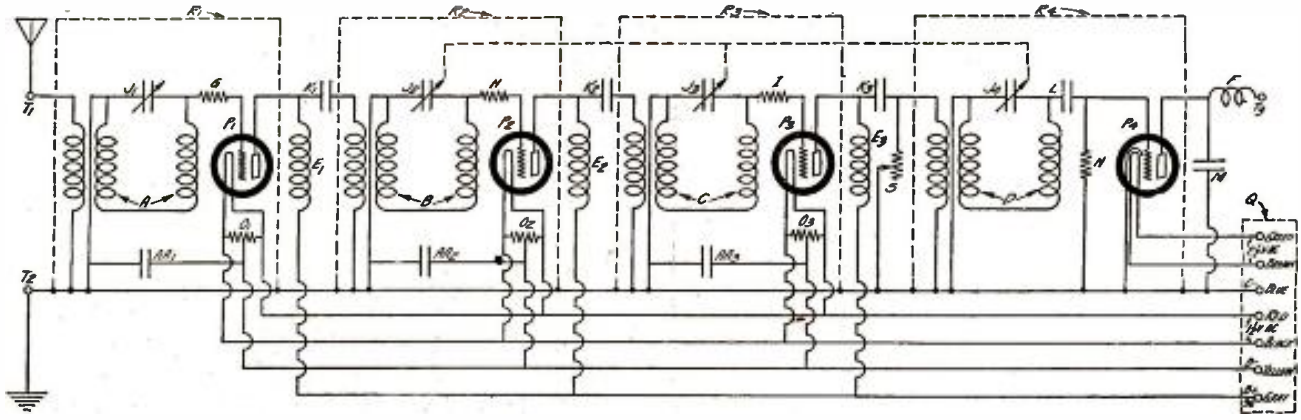


FIGURE 2: THE PICTURE WIRING DIAGRAM OF THE RECEIVER.



THE SCHEMATIC CIRCUIT OF THE NEW RECEIVER

FIGURE 3: *A comparison of the circuit shown above with that of the DC-wired LC-28, described in the October, 1927, number of* POPULAR RADIO, *will show how simple is the new circuit arrangement for using AC valves. This simplicity is the result of intensive study of the problems involved in the use of alternating current as a power source.*

The Construction of the Receiver

In building the receiver, the same general construction features should be followed as were outlined in detail in the October, 1927, issue of POPULAR RADIO.

The first job is to mount the instruments on the chassis in the holes drilled for them, as shown in Figures 1 and 4. Then fasten on the front panel and the shields, leaving off the covers of the latter. The detailed information given on this subject in previous articles need not be repeated here.

The addition of the by-pass condensers, AA1, AA2 and AA3, necessitates drilling a few extra holes in the chassis. One extra hole for the pilot light wiring and one for the extra jack are also necessary. The information for drilling the extra holes is given in the diagram in Figure 4. The by-pass condensers, AA1, AA2 and AA3, are mounted in front of the sockets, and the tapped resistors, which are V-shaped, are connected to the two filament terminals of each of the three high-frequency sockets, with the center terminal sticking up. These are indicated in the picture wiring diagram in Figure 2.

How the Set Is Wired

As with the first design of this receiver, the wiring is accomplished, in as many cases as possible, by the mere act of fastening down the various parts onto the metal chassis. This feature eliminates a good many feet of wiring and simplifies the connections so that any novice can accomplish the job. The complete set should be wired up with a heavily braided, insulated wire, such as Corwico Braidite hook-up wire.

If the set builder will refer to the picture wiring diagram in Figure 2 for the correct connections, he will make no serious errors.

It will be noticed that the wiring of the 1½-volt AC filament circuit from the Yaxley cable to the AC filament circuits of the three high-frequency valve sockets, P1, P2 and P3, and the connections to the pilot light are made with a double piece of hook-up wire twisted between each connection. This is shown very clearly in Figure 5. The same holds true of the 2½-volt AC connections from the Yaxley plug to the heater terminals of the 5-prong detector socket, P4.

In connecting up to the pilot light, the contact arm assembly is left off

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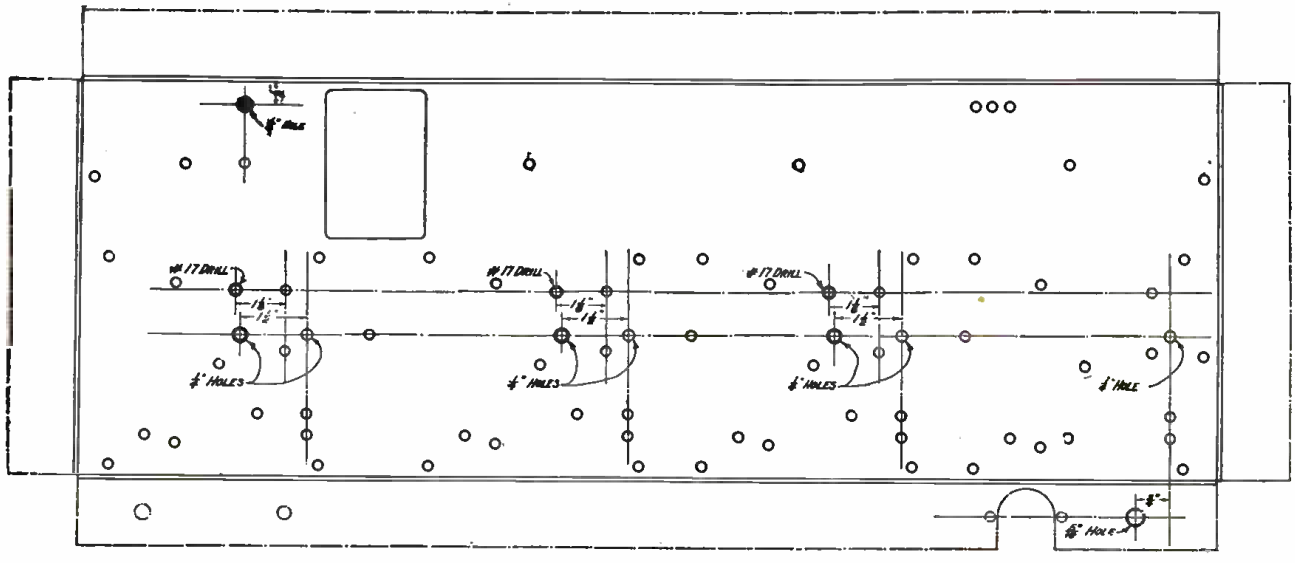


THE CHANGES NECESSARY IN THE LC-28 SUB-PANEL

FIGURE 4: *The holes drilled in the original LC-28 sub-panel are shown in light black circles. The heavy black circles indicate the new holes which must be drilled for the assembling and wiring of the AC model of the receiver. Note that four of the old holes are redrilled so as to be ¼ inch in diameter.*

PUTTING THE CONDENSER UNIT IN PLACE

In the lower battery compartment of the Radiola 28 the power unit and the condenser unit are placed as shown here; once installed they require no further attention.

PUT THIS "ABC" POWER BOX IN YOUR RADIOLA 28

By ROBERT W. TAIT

Complete socket operation for the Radiola 28 may now be accomplished by any fan in a very short time with the simple apparatus described here. In addition to doing away with the annoyances of battery operation, the change-over apparatus incorporates a 210 type valve power stage for the low-frequency amplifier.

RADIO fans who now own a battery-operated Radiola 28 receiver will be interested in learning that they can convert it to complete AC operation in a few minutes' time, as outlined in this article.

This conversion is made possible by an AC power-pack kit containing the parts listed in the list of parts given here:

A—Power unit;
B—Condenser unit with terminal board;
C—7-wire cable;
D—4-wire cable;
E—Resistance strip;
F—Resisistance rods;
G—Transfer plug;
H—Stirrups for mounting power unit;
I—Roundhead wood screws.

The AC adaption comprises changing over the filament wiring of the receiver by means of a cable, indicated in Figure 1 as C.

This change may be divided into four simple operations, as follows:

1. The removal of the operating panel.
2. Changes in the receiver unit.
3. Changes in the cabinet.
4. The replacement of the cabinet.

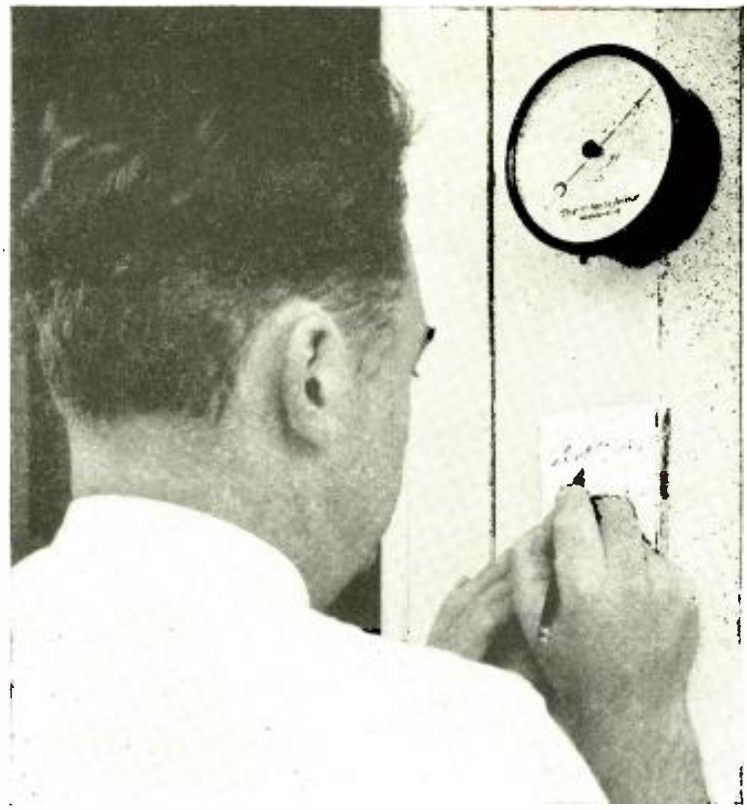
The Removal of the Operating Panel

The first job is to take the loop antenna out of its socket and remove all the vacuum valves from their sockets. Then raise the upper section of the cabinet so that it will remain open, revealing the battery compartment in the lower portion. Disconnect all the batteries and remove them from the lower compartment.

Now unscrew the four screws and lock washers on the bottom side of the raised section and then lower the top section.

When this is done, the upper lid should be raised and the complete panel assembly may be pulled out gently, about three or four inches. All of the screws holding the terminals of the battery cable at the rear of the sockets may now be loosened and the cable and its terminal strip removed. The receiver unit may then be completely taken out of the cabinet. Next remove the condenser in the upper right-hand corner of the cabinet and unfasten the clamps fastening the cable to the cabinet.

(*Continued on page 254*)



READING THE RADIO FUTURE

By the use of the simple and easily read aneroid barometer shown at the right, the possibilities of good or bad reception for the next twelve hours may be predicted with remarkable accuracy.

THREE SIMPLE INSTRUMENTS THAT WILL HELP YOU IN

FORECASTING STATIC

Here is a way for any fan to become a radio reception "prophet," with the aid of the three easily purchased and easily manipulated instruments described below. And there is great entertainment—and also a field for real scientific endeavor—in tracing the periodic weather conditions that are responsible for changes in radio reception.

By EUGENE VAN CLEEF

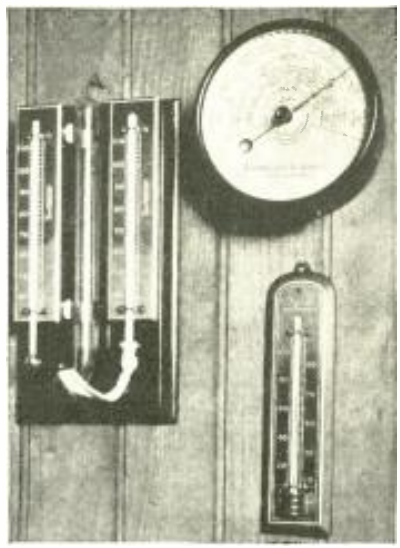
THAT radio reception fluctuates in quality with the variations in our atmospheric conditions seems certain. Some attribute to the weather too much influence on radio reception, and others now are ready to say that atmospheric conditions play no part. A number of persons have suggested a sun-spot influence, but according to recent press dispatches those in charge of investigations of the sun-spot relationships declare this theory exploded. In the face of these contradictory views, the writer is convinced, after a long period of observation, that the degree of static which interferes with our radio reception varies with atmospheric conditions—more particularly with *pressure*. Assurance of this relationship is based upon the correlation of reception conditions with the daily passing high and low pressure areas. The relationship is so clear-cut that definite statements may be set up which will serve as guides to those desirous of forecasting daily the probability of static. Before recording these conclusions we should first note the nature of Highs and Lows and some facts regarding their behavior.

If the reader will secure successive weather maps like that in Figure 2, and watch a given high pressure area on successive days, he will note that it moves across the country normally at about the average speed of a passenger train, so that in the course of about four 24-hour days it travels from the Pacific coast to the Atlantic. Accompanying the High is a Low which travels at about the same rate. No two Highs nor two Lows occur next to each other. The Highs and Lows generally occur in pairs, a High following a Low, or a Low following a High.

These passing pressure areas, or "storms," as the Weather Bureau sometimes designates them, indicate the nature of the weather which any locality is likely to have. Since they always travel in an easterly direction, and since their rate of motion is known, we can forecast the weather for a given locality if we know what the pressure and accompanying weather conditions are to the west, as shown by these areas. Space limitations do not permit of a detailed account of the special problems associated with the fascinating field of weather forecasting, but enough perhaps has been said to direct attention to the occurrence of these pressure areas which seem to be so intimately associated with our static troubles.

Some persons may already have acquired the impression that the situation here noted is too complicated for them, and consequently at this point are ready to give up the idea of forecasting for themselves. These fears, however, need not be further entertained, as the operation of forecasting may be reduced to fairly simple terms. One does not need to subscribe for the daily weather map, as desirable as that is for minute investigation, but can accomplish much in this work with the aid of three simple instruments—the barometer, outdoor thermometer and hygrometer.

Just what is a barometer and what does it tell? We have learned by experiment that at sea level on a normal day the atmosphere weighs 15 pounds to the square inch. This weight we call pressure. If a glass tube about 34 inches long were filled with mercury and the open end immersed in a cup of mercury, the mercury within the tube under the conditions just noted would fall to a height of 30 inches above the level of the cup basin. In other words, the weight of the column of mercury within the tube would equal the weight of the air pressing outside upon the mercury surface in the cup. This weight represents the air pressure and the length of the column is



THE THREE TOOLS OF THE RADIO PROPHET

FIGURE 1: *At the left is a hygrometer, by which the relative humidity of the atmosphere is determined. At the lower right is an ordinary outdoor thermometer, and at the upper right is an aneroid barometer, which registers the air pressure at the moment and thus gives warning of approaching Highs and Lows.*

interpreted as the air pressure. An atmospheric pressure of 30 inches has been adopted as normal. If the height of the mercury column rises above 30 inches the pressure is high; if it falls below 30 inches it is low. On the weather map the Highs and Lows to which we have referred mean exactly this.

The mercurial barometer is too expensive for most of us to possess and, furthermore, is rather awkward for a novice to use. So in its place the compact and convenient aneroid barometer, in which air is utilized, is recommended. It is calibrated according to the readings of the mercurial barometer, and is so arranged that anyone can read it easily and note whether or not the pressure is rising or falling.

Generally if the pressure reads above 30 inches static will be absent, and if below it will be present. If the barometer is just below 30 inches in the morning and has been rising all the preceding night, the prospect of no static for the evening is excellent. If, on the other hand, the reading is just above 30 inches and the pressure has been falling during the preceding twelve hours, then static is almost certain during the next twelve hours. That is simple enough; but exceptions creep in occasionally, and to make allowances for them the outdoor thermometer and hygrometer will assist us.

Everyone is familiar with the use of

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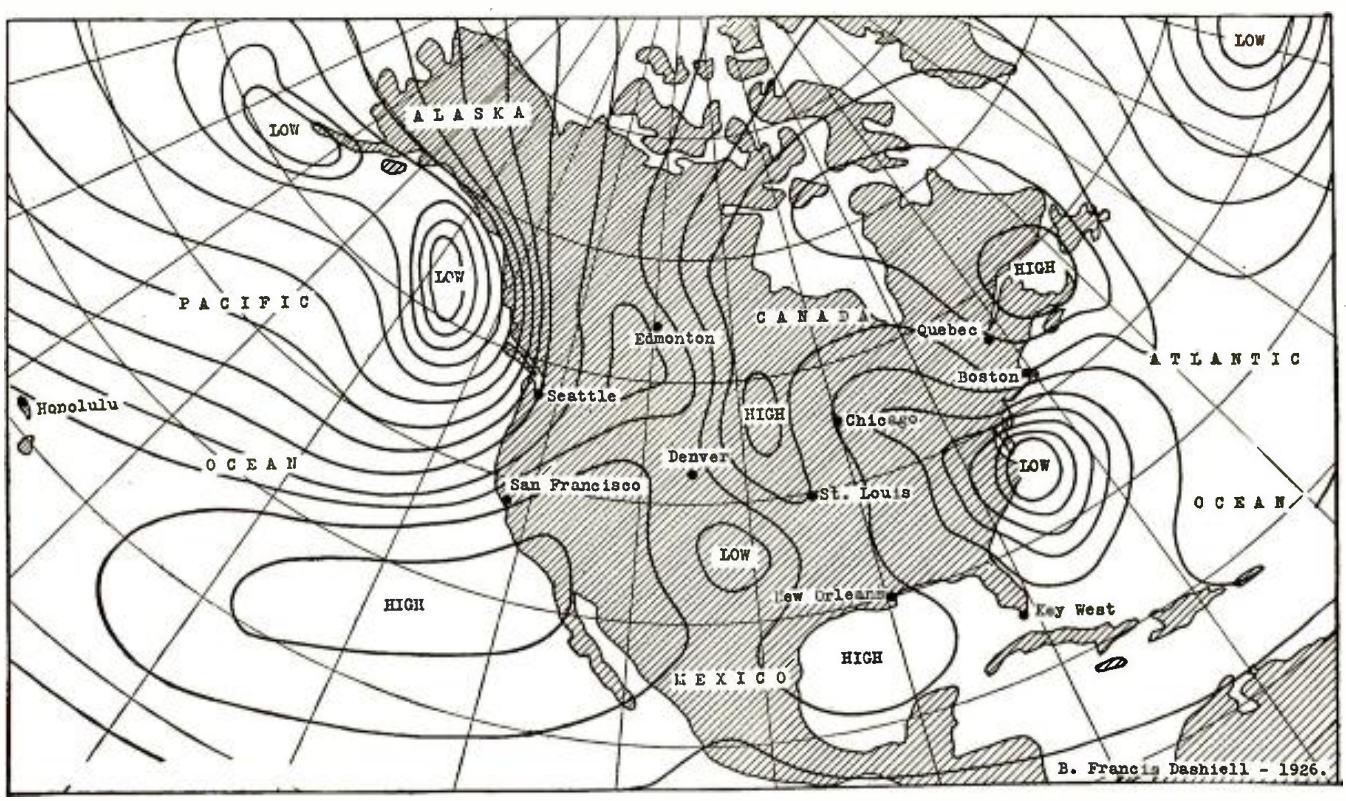
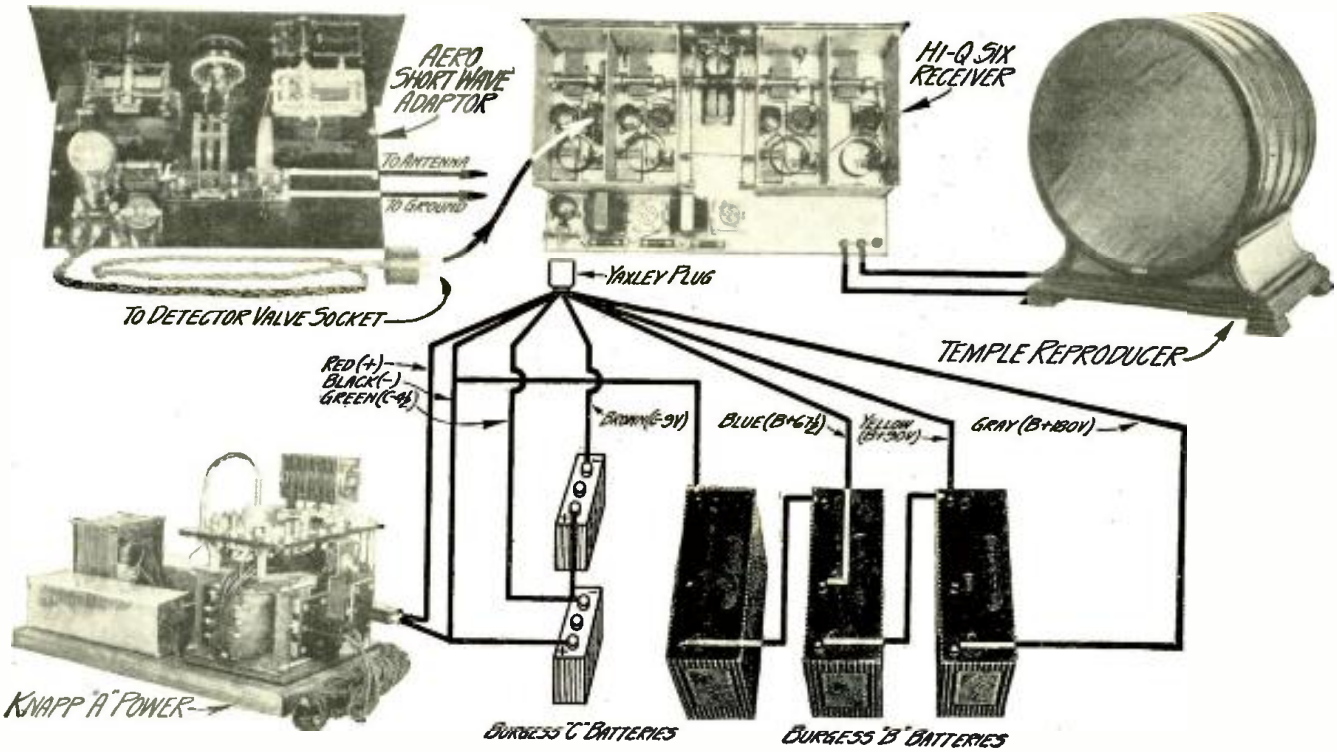


HOW GOOD AND BAD RECEPTION FOLLOW THE WEATHER

FIGURE 2: *In this weather the solid lines, or isobars, connect places of equal air pressure, and indicate in this way the positions of high and low pressure areas for a given time. Note that severe storms, with accompanying static, are indicated by the very low pressure areas on the northwest and eastern coasts, while the central part of the country is enjoying the good reception that generally accompanies high-pressure areas.*



A HOOK-UP FOR BRINGING IN THE SHORT WAVES

FIGURE 1: *In the photo-diagram above, the Hi-Q "Six" is shown as an example of standard broadcast receivers with which the Aero converter may be used for bringing in short-wave broadcasts. The converter draws all its plate and filament currents from the units that supply the receiver.*

Any Receiver Brings In *Short Waves* With

The Aero Converter

With the interest in short waves mounting daily, radio fans will welcome the constructional data given below for building a simple unit which will bring all the short wave-bands into the range of their broadcast receivers. The Aero converter is less expensive and easier to build than an ordinary receiver, and its operation does not require the addition of any batteries or power-packs whatsoever.

By CARL DORF

RADIO fans are turning their attention more and more toward the fascinating short waves, with which remarkable distances may be covered, and static, the great destroyer of reception, is practically eliminated.

There are now many short-wave stations within the range of even a simple converter of the type described in this article. The new field of reception opened up by this device will prove a revelation to the broadcast listener.

Reception of short waves may be accomplished by simply inserting the connector plug of the short-wave adaptor described here into the detector socket of any standard broadcast receiver.

The new adaptor unit consists of a regenerator detector circuit equipped with a triple coil unit consisting of an antenna coil mounted on a variable coupling and a set of three detachable coils that plug in for the various wavelength ranges that are to be covered. Each detachable coil consists of a secondary coil and a tickler coil of the correct size for the band that it is designed to cover. The tuning is controlled by two variable condensers; one tunes the coil to the proper frequency or wavelength and the other is used to control regeneration. These two condensers are mounted on the front panel, along with a variable resistor for operating at the correct filament temperature.

The complete job may be assembled and wired in less than one hour.

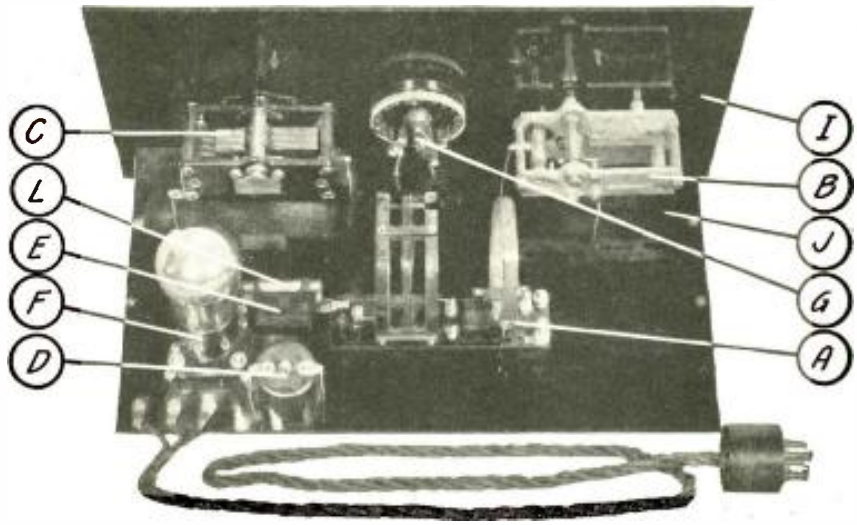
How to Assemble the Instruments

The best plan is to start mounting the instruments that are to be attached to the sub-panel, J. Figure 2, which is a top view of the adaptor, shows the relative positions for mounting the various instruments. The layout of the instruments is also shown in the picture wiring diagram in Figure 3. The construction will be a simple job, as there are only a few instruments to be mounted. It will be best to use

(*Continued on page 263*)

POPULAR RADIO WORK SHEET

The Aero Short-wave Converter



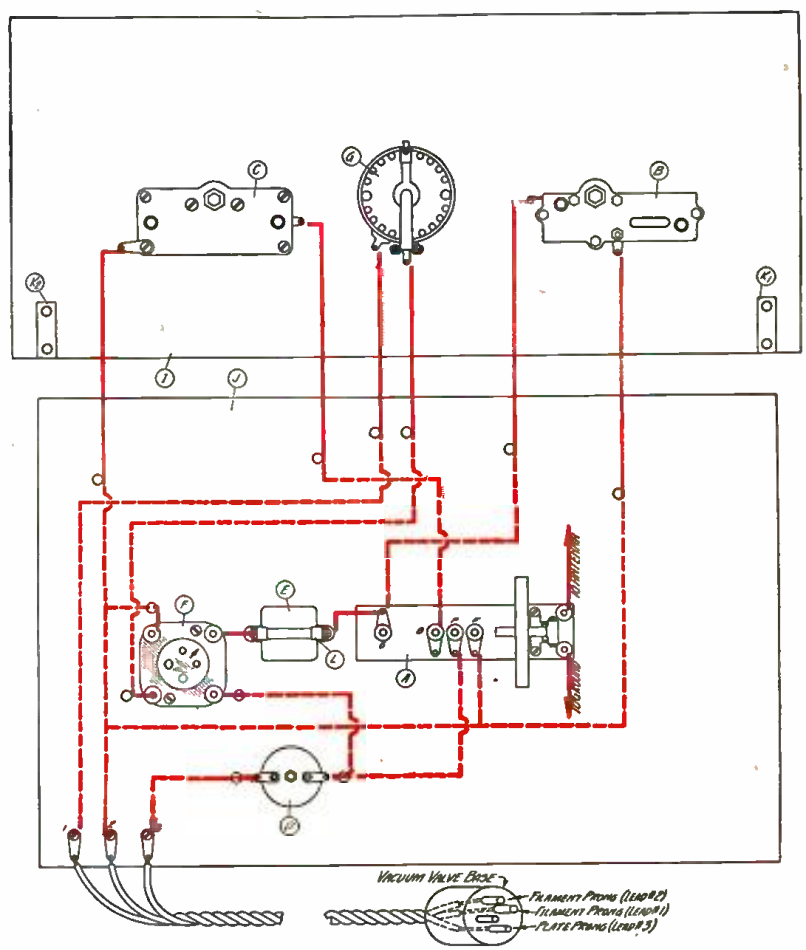
HOW THE INSTRUMENTS ARE MOUNTED

FIGURE 2: *As this view shows graphically, the complete job of mounting and wiring the instruments of the converter is extraordinarily simple, and could be completed by any novice in very short order.*

List of Parts for Building This Unit

Cost of Parts—*Not over $33.00*

A—Aero short-wave tuner, type LWT-125;
B—Amsco variable condenser, .00014 mfd.;
C—Amsco variable condenser, type 514, .00025 mfd.;
D—Aero high-frequency choke coil, No. 60;
E—Carter moulded condenser, .0001 mfd., with grid-leak clips;
F—Benjamin 4-prong socket;
G—Yaxley rheostat, 25 ohms;
H1 and H2—National type B dials;
I—Westinghouse Micarta drilled panel, 7 by 14 by ⅛ inch;
J—Westinghouse Micarta drilled sub-panel, 7 by 13 by 3/16 inch;
K1 and K2—Aero sub-panel brackets;
L—Tobe Tipon grid-leak, 5 megohms;
5 feet Celatsite insulated bus bar, old valve base, screws, nuts, etc.



HOW THE CONVERTER IS WIRED

FIGURE 3: *The wires are indicated in* RED *lines, solid for wiring above the sub-panel and dotted for wiring below. The detail at the bottom of the diagram shows exactly how to wire the discarded vacuum valve base that is used to plug into the detector socket of the broadcast receiver with which the converter is used.*

Radio's New Organ of Sight

Around the simple glass bulb with the vacuum valve base shown at the left have been built all the marvelous achievements of television that have so startled the world of late. Science can now make these photo-electric cells so sensitive to light that the glare of a match will destroy them.

HOW SCIENCE PERFECTED THE PHOTO-ELECTRIC CELL AND PROVIDED

Radio's "Sixth Sense"

How many people know just what a photo-electric cell is, how it functions, what principles underlie its action, or how it is applied to television? In this and in succeeding articles all these questions will be answered, and the whole fascinating story of photo-electric science and its development told.

Article No. 1

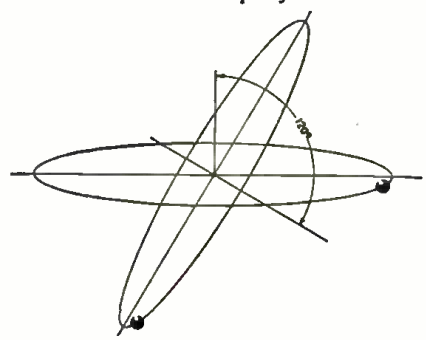
By DR. LEWIS KOLLER
Research Laboratory, General Electric Company

FEW scientific developments have ever caught the public imagination as quickly as the experiments in television wbich have been carried on during the past few years. These experiments, together with the successful use of talking moving pictures, have at last brought to the attention of the public a once little-known branch of electricity—photo-electricity, the science that treats of the relationship between light and electricity.

Most of the interest in photo-electricity has centered about the photo-electric cell, a vacuum valve device by means of which light can be made to control electric current. It has many uses in addition to television and talking moving pictures, such as in photometry, cigar sorting, control of paper quality, and control of street and sign lighting.

The development of the cell to the point where it is a reliable, reproducible, readily available device has opened up a new and fascinating field for the professional and amateur experimenter alike. And yet few people who are not experts on the subject know much about the history of the cell, the fundamental principles involved in its operation, or its manufacture in its present-day form. Yet these facts make a vastly interesting story.

The fundamental action of the photo-electric cell is illustrated by the diagram in Figure 2. A cell is connected in series with a "B" battery and a milliammeter. Light from an incandescent lamp falls upon the cell. The nearer the light is to the cell, the larger the current flowing through it, as can be shown by moving the light back and forth. If the distance between light and cell is measured at the same time that the meter is read, it will be found that the current varies inversely as the square of the distance, showing that the activity of the cell is directly proportional to the amount of light falling upon it.

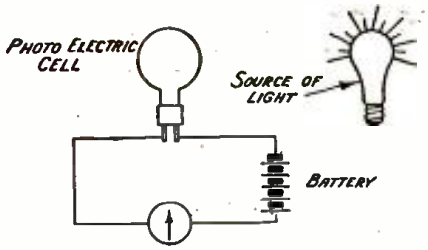


HOW SCIENCE PICTURES THE LITHIUM ATOM

FIGURE 1: *The planetary nature of the atom is clearly shown in this diagram. The lithium atom is quite simple in its construction, with two electrons revolving in their orbits around a central proton. Complex atoms, such as those of some of the metals, have many more electrons revolving about the positive proton.*

The vacuum valve photo-electric cell is a comparatively recent development. Its forerunner was the selenium cell. The element selenium was discovered by the Swedish chemist, Berzelius, in 1817. In 1873 an Englishman, Willoughby Smith, attempted to use selenium in making high resistances for use in transatlantic telegraph work. He found that these resistances were very erratic and changeable, and eventually discovered that this was due to the fact that the electrical resistance of selenium depends upon the amount of light falling upon its surface. The brighter the light, the lower the resistance of the metal. Smith was able to get around his difficulties by enclosing his resistances in a light-tight box. Following this discovery, cells were constructed of many different forms to make use of this interesting property. The selenium cell is still in use for some purposes, although it has many undesirable properties.

The action of the type of photo-electric cell that I am going to describe, however, is radically different. The underlying principle was first made clear by the German physicist, Hallwachs, in 1888. Hallwachs discovered that if he charged a zinc plate to a neg-



A SIMPLE PHOTO-ELECTRIC CELL CIRCUIT

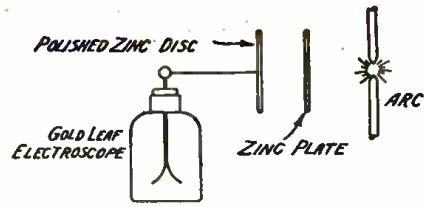
FIGURE 2: *The fundamental action of the photo-electric cell can be determined from such a set-up as this. The amount of current flowing in the milliammeter varies inversely as the square of the distance from the cell to the light source, showing that the current increases or decreases directly with the amount of light falling upon the cell.*

ative potential (by connecting it to the negative terminal of a battery) and then exposed it to ultra-violet light, it gradually lost its charge. When he exposed the plate in the same way after first raising it to a positive potential, it did not lose its charge. This phenomenon has been thoroughly investigated and it has been found that practically all substances exhibit it to a greater or lesser degree. This is the fundamental phenomenon of photo-electricity.

Figure 3 shows the experimental arrangement used by Hallwachs. He had a polished disc of zinc 8 cm. in diameter. In front of this was a large shielding plate of zinc, 60 x 70 cm., with an opening in which could be placed windows of various materials. The zinc disc was illuminated by the light of the arc lamp in front of the windows. The gold leaf electroscope connected to the disc tells what is happening to the charge on the plate. When it is charged with electricity the leaves stand out away from each other, and as the charge leaks off the leaves gradually collapse. Hallwachs found that when the plate was negatively charged the electroscope leaves stood out until light from the arc fell upon the plate. They then began to drop, showing that the charge was leaking off the plate. No such change was observed when the plate was positively charged.

The explanation in terms of present-day physics is simple. The light which is absorbed by the photo-sensitive surface causes the emission of electrons or negative charges. If the plate is negatively charged to begin with, these electrons are able to escape and so the plate loses its charge, while if it is positively charged they are unable to escape because of the positive potential of the plate, and it thus remains charged.

Perhaps before going further into the subject it would be well to say a little about the electron and modern views of the constitution of matter. The earliest conception of the atom was simply the smallest particle of matter that could exist. If one took a small piece of matter and cut it in two; took one of the halves and cut that in two, and so on, eventually one would reach a very tiny piece of matter that could not be any further subdivided. This was the atom. Now through the work of Thomson, Rutherford, Bohr and many others we have a picture of a vastly different structure which has much evidence to confirm it. Atoms are now believed to be small planetary systems with a massive nucleus in the center like our sun, and rotating about this center a number of electrons like the planets. The nucleus, which carries the positive charge, is made up of atoms of hydrogen, or protons, packed closely together. The electrons are nothing other than negative charges of electricity. The force of attraction between the positive and negative charges holds the system together, just as the gravitational forces hold our solar system together. Thus the atoms of all substances are made up of the same ultimate units, protons and electrons. The differences between different kinds of matter are due to the different arrangements of these two kinds of building material. Figure 1 shows the structure of one of the simpler chemical elements, lithium. This theory has met with great success in predicting the spectra produced by the different elements.

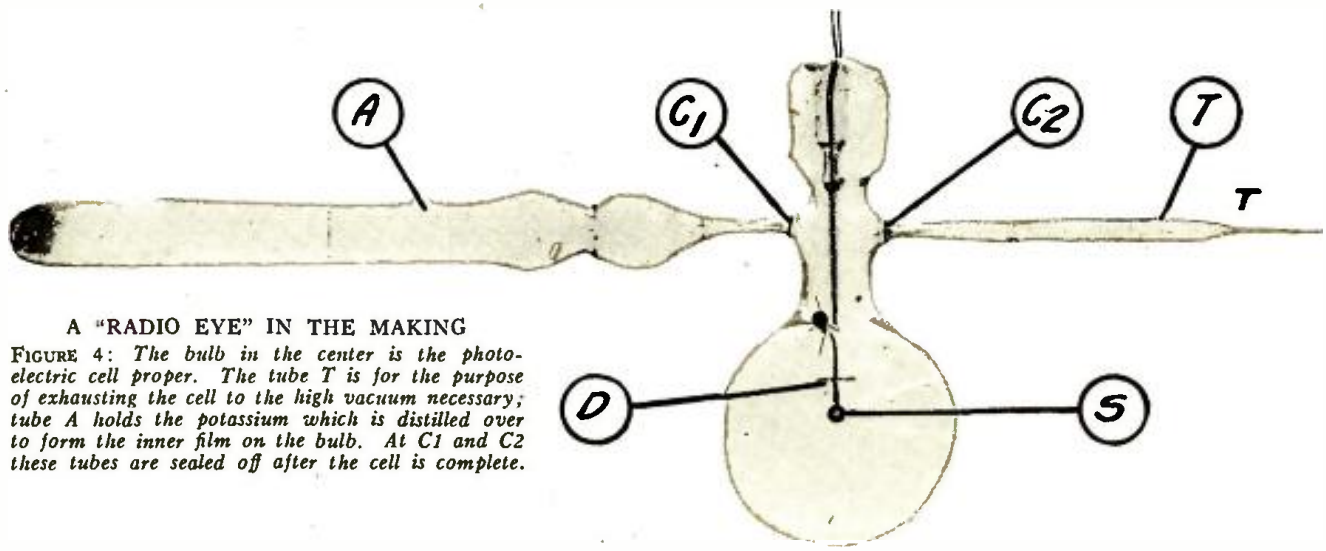


HOW PHOTO-ELECTRIC ACTION WAS DISCOVERED

FIGURE 3: *In the original experiment, light from the arc fell through a window in the zinc plate on the polished disc connected to the electroscope. When the electroscope was positively charged, this light produced no change, but when it was negatively charged, the light caused the leaves to fall, showing the charge was leaking off the zinc disc.*

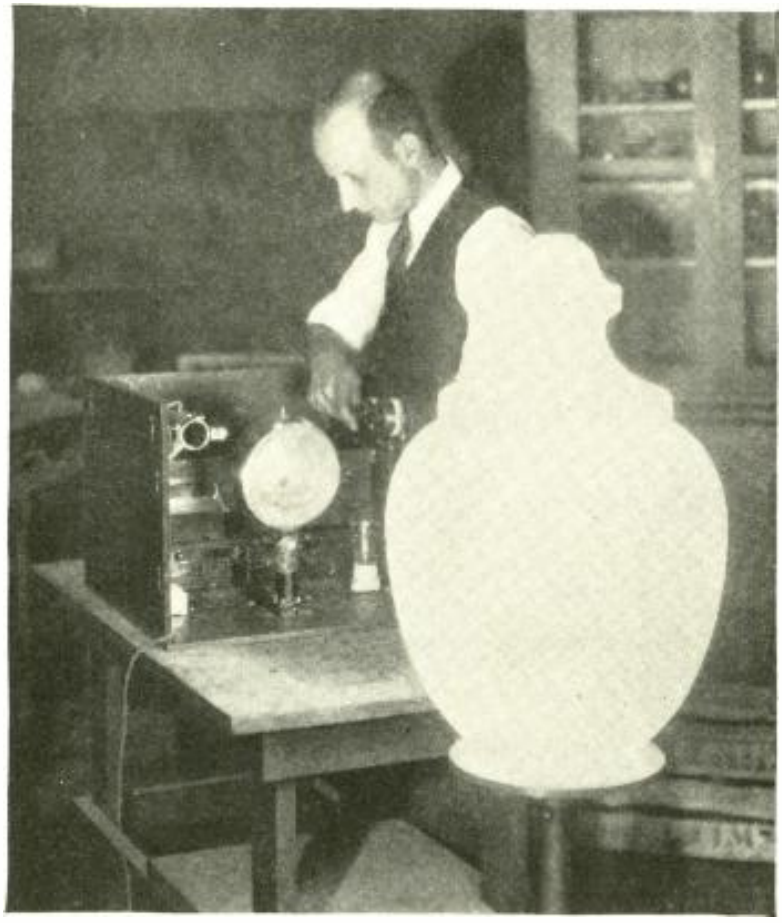
All matter, then, is made up of atoms like these. Some kinds of matter, notably the metals, have the power of readily conducting a current of electricity. We believe that in conductive elements there are a large number of free electrons—electrons in addition to the rotating electrons which are attached to each individual atom—and that these are free to wander through the metal in accordance with the impressed electric forces. It is the actual motion of these electrons that constitutes an electric current.

To return to the photo-electric cell, it can be represented diagramatically as shown in Figure 5. Light falls upon the surface of the metal plate, P, and



A "RADIO EYE" IN THE MAKING

FIGURE 4: *The bulb in the center is the photo-electric cell proper. The tube T is for the purpose of exhausting the cell to the high vacuum necessary; tube A holds the potassium which is distilled over to form the inner film on the bulb. At C1 and C2 these tubes are sealed off after the cell is complete.*



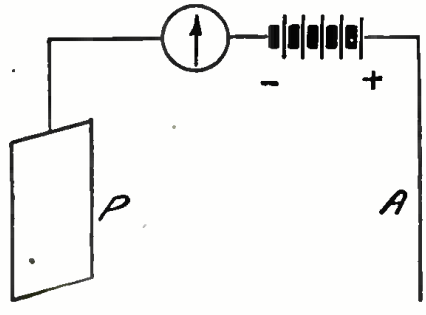
TESTING THE ACTION OF A PHOTO-ELECTRIC CELL

By means of this apparatus, the electrical characteristics of the photo-electric cell may be accurately determined. The light from the large lamp in the right foreground falls on the cell in front of the man, and the current changes may be read from the meters in the testing box.

causes photo-electrons to be emitted from it. The plate is connected to the negative terminal of a battery and the wire, A, is connected to the positive terminal. The positive charge on A draws the electrons across the space and so a current flows through the circuit. The electrode which emits the electrons must always be connected to the negative battery terminal, and is called the cathode. The positive electrode is called the anode.

This is purely a diagrammatical representation of a photo-electric cell. A more usual form is shown in Figure 4. The inside of the glass bulb is silvered and contact is made with the silver surface by means of a platinum flush seal. This silver surface is coated with a thin layer of some material such as one of the alkali metals, lithium, sodium, potassium, rubidium and caesium, which are particularly photo-sensitive. This takes the place of the plate of Hallwach's experiments. The other electrode projects through the base into the center of the bulb. A circular opening in the silver coating serves for the admission of the light. Details of construction may vary, but the essentials remain the same.

For those not familiar with high vacuum technique, the method of preparation of a cell will be of interest. Figure 4 shows the cell ready to be exhausted. It is sealed onto the exhaust system by means of the tube T. The exhaust system consists of two pumps



A SCHEMATIC REPRESENTATION OF THE CELL

FIGURE 5: *Light falling on the plate, P, of the photo-electric cell causes it to emit electrons, since it is negatively charged by the battery. The positively charged terminal, A, draws these electrons to it, and causes a current to flow in the circuit whenever light falls on P.*

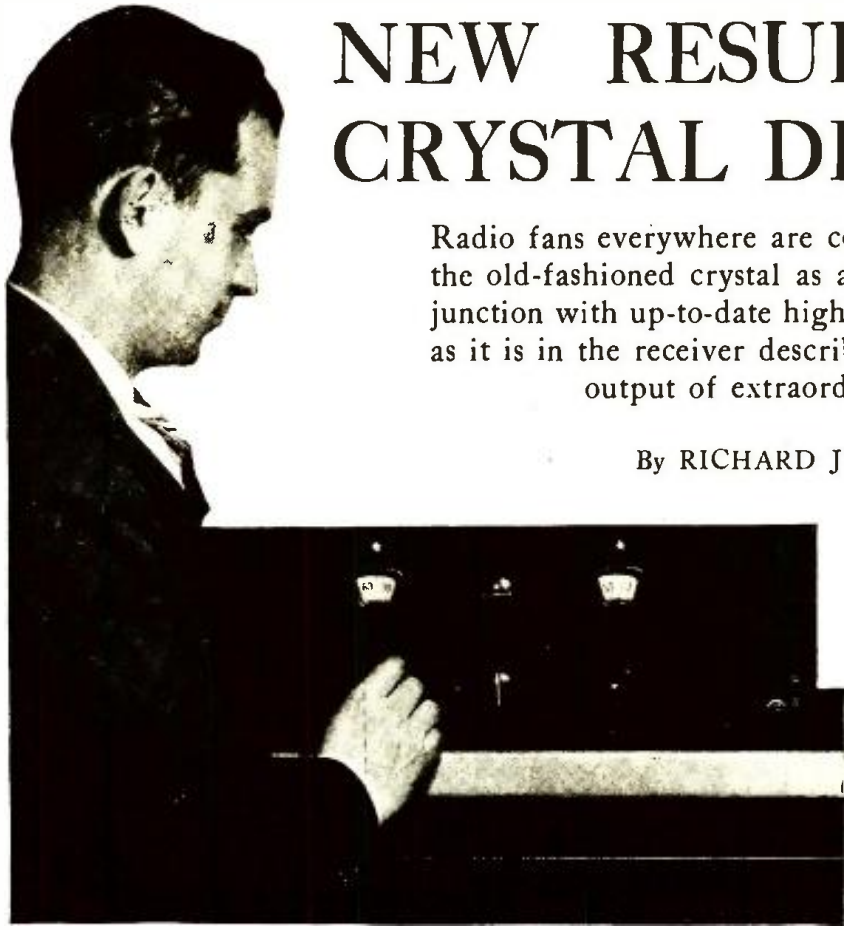
connected in series, a mercury vapor pump and a rotary oil pump, which works into a rough vacuum line. Between the cell and the mercury vapor pump is a liquid-air trap. The end of this trap is cooled by being immersed in liquid air at a temperature of —185° C., and any water or mercury vapor present is condensed on the cold walls of the trap. An electrical or a gas-heated oven is pulled down over the cell in order to heat the glass walls thoroughly and free them of water vapor and other absorbed gases. By this means the vessel is pumped down to a vacuum of a few hundredths of a micron. or about one one-hundred-millionth of an atmosphere. A McLeod gauge provides an easy and accurate means for measuring pressures of this order of magnitude. The next step is to silver the bulb. This is done by passing a current through the molybdenum spiral, S, which carries at its tip a small bead of silver. The heat causes the silver to evaporate and the silver atoms condense on the relatively cool bulb wall, thus providing the mirror-like silver coating. Since the atoms travel in straight lines, the little disc, D, causes a circular shadow where the silver has been prevented from reaching the bulb wall. This shadow forms the cell window. The potassium in the side arm, A, is now distilled over into the bulb by warming gently with a torch. The side arm is then sealed off by heating at the contraction, C1, and the cell is sealed off from the pump at C2 in the same way.

In some cells the sensitive surface is made of potassium hydride. This is formed by admitting a low pressure of hydrogen into the cell just before sealing off and passing a glow discharge between the electrodes for 15 or 20 minutes. This converts some of the potassium to potassium hydride.

Where the sensitive surface is of caesium it is introduced in still a different way. A mixture of caesium chloride and calcium filings is placed in a little nickel capsule or pellet and enclosed in the side arm. When this is heated by means of a high-frequency induction furnace, these two substances react and very pure caesium distills out into the bulb. Caesium cells have been specially treated so as to give a sensitive surface of caesium only one atom deep.

The particular value of the photo-electric cell lies in the fact that the current passing through it is directly proportional to the quantity of light falling upon it. Doubling the light doubles the current, etc. For this reason the cell can easily be used for measuring changes in light intensity.

NEW RESULTS WITH CRYSTAL DETECTION



Radio fans everywhere are coming back to the use of the old-fashioned crystal as a detector. Used in conjunction with up-to-date high-frequency amplification, as it is in the receiver described below, it delivers an output of extraordinary quality.

By RICHARD J. GRIFFITH

IN designing a radio receiver, it is always necessary to make some sort of compromise between conflicting excellences in receiver design. It is well known, for instance, that we cannot get the greatest possible selectivity without sacrificing quality, so that it is necessary to compromise between the two. Likewise, it is extremely difficult to design a receiver of extremely great sensitivity without destroying some of its tone quality.

In spite of these considerations, the present receiver is offered to the set builder as a close approach to the ideal set for ordinary use. It has to offer fine tonal quality and high selectivity, and it will give a good account of itself in distance reception. Added to this, it may be made regenerative or non-regenerative as the operator desires, simply by turning a knob in the rear of the set, without any delicate or critical adjustments.

While the high-frequency system uses three vacuum valves and gives sensitivity equal to three stages, it will be noted that it is controlled by only two dials, and does not require any ganging of condensers to accomplish this.

A carborundum detector is used for rectification, and this has been simplified so that no extra battery is required, the necessary biasing voltage being secured from the plate circuits of the high-frequency valves.

The low-frequency system consists of one transformer, one resistance and one transformer-coupled stage, in the order named. The transformers are of the quality type and are coupled with the resistance-coupled stage, giving excellent tone quality. The last stage employs a power valve with an output filter, so that the full volume delivered by the set can be put to use without overloading. The schematic diagram of the circuit is shown in Figure 2.

The battery connections have been simplified, so that there are no intermediate taps from either the "B" or the "C" batteries. The proper voltages are secured through the use of resistances in the set, and as a result it is only necessary to attach the full "A," "B" and "C" voltages to the set.

The Construction of the Set

The first step in the construction of the set is to prepare the panel, X1. A great deal of trouble may be saved by procuring the panel already drilled and finished. Next, the instruments are mounted upon it; but, before so doing, the condensers, C and D, are mounted upon the dial controls, T1 and T2, in such positions that the rotor plates swing downward when the plates are unmeshed.

When the condensers, C and D, are mounted upon the dials, all the instruments supported by the panel may be mounted thereon in the positions shown in Figures 1 and 3. The equalizer, V, is attached to the condenser, C, by bolting it to the rotor of this condenser with a 6/32 bolt.

The next step is the preparation of the baseboard, X2. After finishing with wood dye, the instruments may be mounted in their respective places, as shown in the diagrams, care being taken to see that all terminals are exactly in the positions shown.

The Polytrols, N1, N2 and N3, are furnished with mounts and no difficulty will be experienced in mounting them upon the baseboard. The resistors, O1 and O4, are mounted in the double mounting, while O2 and O3 are mounted in the single mountings. In mounting the detector, I, it will be necessary to bend the springs of the mounting outward, as the detector is slightly longer than the resistor which the mounting is designed to fit.

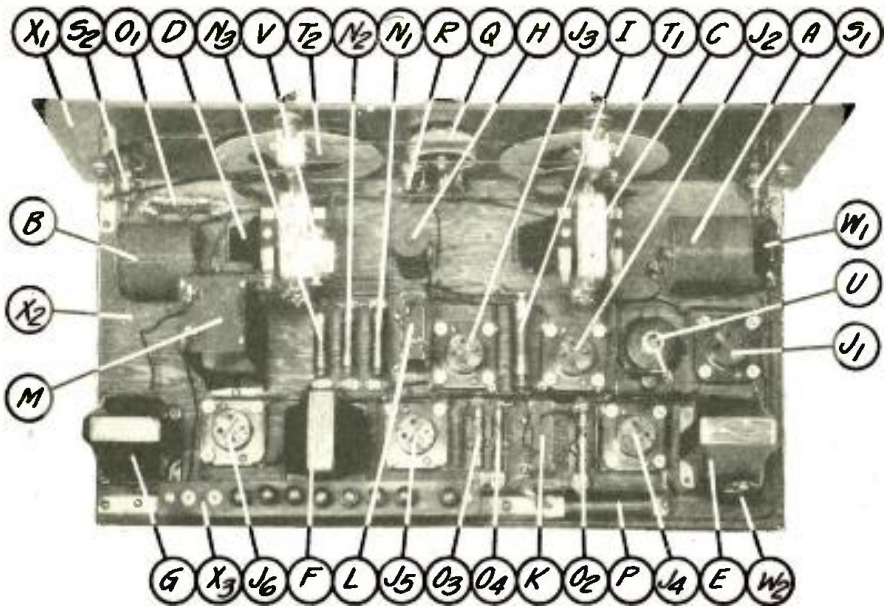
After attaching all the instruments to the baseboard, the panel may be fastened to the base by means of two brackets. The binding-post strip should also be mounted now.

Wiring the Receiver

If the picture wiring diagram in Figure 3 is carefully followed, no trouble will be experienced in wiring the receiver, so that a detailed description of this part of the work is unnecessary.

Any kind of stiff bus wire may be used, but it is advisable to use the spaghetti-covered type, such as Celatsite, as short-circuits are avoided more easily with it.

It is well to begin by connecting up the filament, pilot lamp and ground circuits first. In this connection, it might be well to call attention to the connection between the framework of dial



HOW THE INSTRUMENTS ARE MOUNTED

FIGURE 1: *The crystal detector, the heart of the circuit, is shown at I. The other parts are spaced evenly on the baseboard, X2.*

T1 and the terminal lug of the pilot light on this same dial; it should be noted that it is the rear lug to which the connection is made.

It should be further noted that the cases of condenser M and transformer E are connected to the ground or the "A" negative (—) lead.

It is important in connecting the detector, I, that the end marked "A" be connected to the "P" terminal of socket J3, and the end marked "G" be connected to the "B" positive (+) terminal of transformer E.

The bottom lead of coil H goes to resistor P, the middle terminal to the rheostat, Q, and the top to the "P" terminal of socket J3.

The long lug on top of the phasatrol is connected to the same point as the bottom terminal of coil H, that is to resistor P. The terminal marked "P" connects to the "P" post of socket J1, while the terminal marked "PC" is wired to the resistor, R.

As the rest of the wiring is self-evident from the diagram, no further description will be necessary here. After completing the wiring, the resistances, equalizers and detector may be placed in their respective clips.

The Installation of the Set

The construction and wiring of the set being finished, it is now in order to connect the batteries or power-pack and get the receiver ready for operation.

First insert the valves in their proper sockets. The following vacuum valves are recommended for the best results:

In sockets J1, J2 and J3 insert three Ceco type A valves. In sockets S4 and S5 place two Ceco type G valves. In the last stage is placed a Ceco type J-71 power valve.

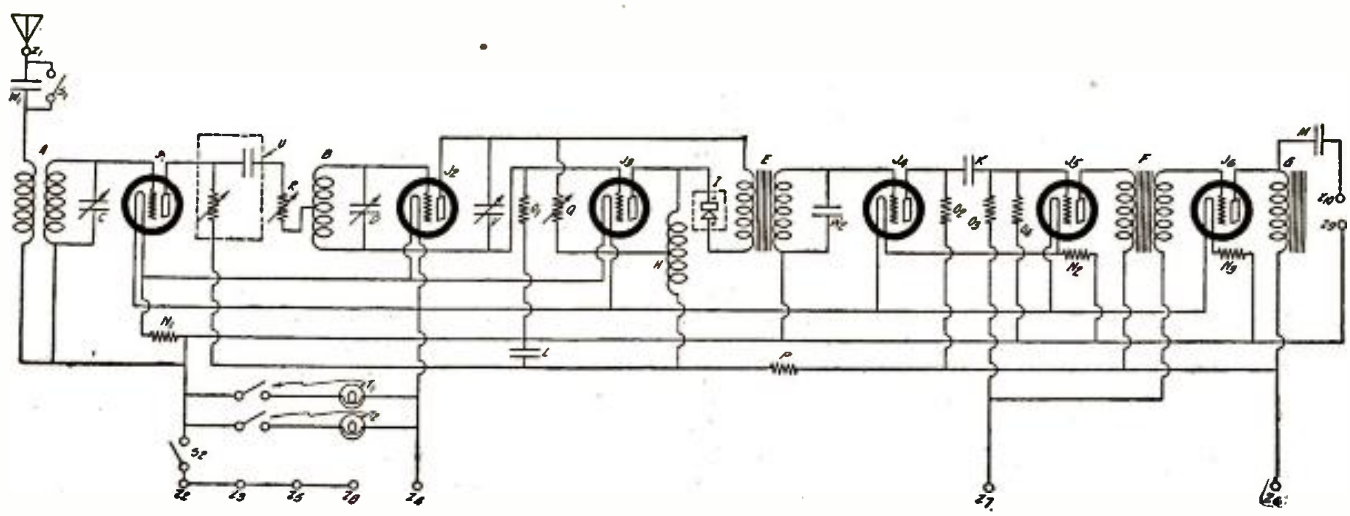
Next connect the "A" battery, being careful to get its polarity right, after which the filament switch may be pulled out to its "on" position, when the filaments in all the valves should light. As a further test, the "A" battery may be disconnected from its proper posts and connected to the "B" battery posts, and the filament switch operated, in which case the filaments should *not* light, if the set is correctly wired. The "A" battery is again connected to its correct place, and the "B" battery connected to its proper binding posts. For best results, a "B" potential of 180 volts should be used, furnished either by a good power-pack or batteries. If 135 to 150 volts is used, it might be well to substitute a 3,000-ohm resistor for the 5,000-ohm one at P, and if the set is operated on 100 volts of "B" battery this resistor may be short-circuited entirely.

The "C" battery should next be connected to its proper binding posts, and its voltage will depend upon the "B" voltage used. When using 180 volts, with a 171 type valve in the last stage, the "C" battery should be one of 40 volts. With 135 volts "B" battery, the "C" voltage should be about 30 volts or less.

When using a Ceco type F valve in the last stage, and 135 volts of "B" battery, the "C" voltage should be 9 volts.

The antenna and ground should now be connected to their respective posts and the speaker connected by pushing its cord tips into pup-jacks Z9 and Z10.

(*Continued on page 244*)

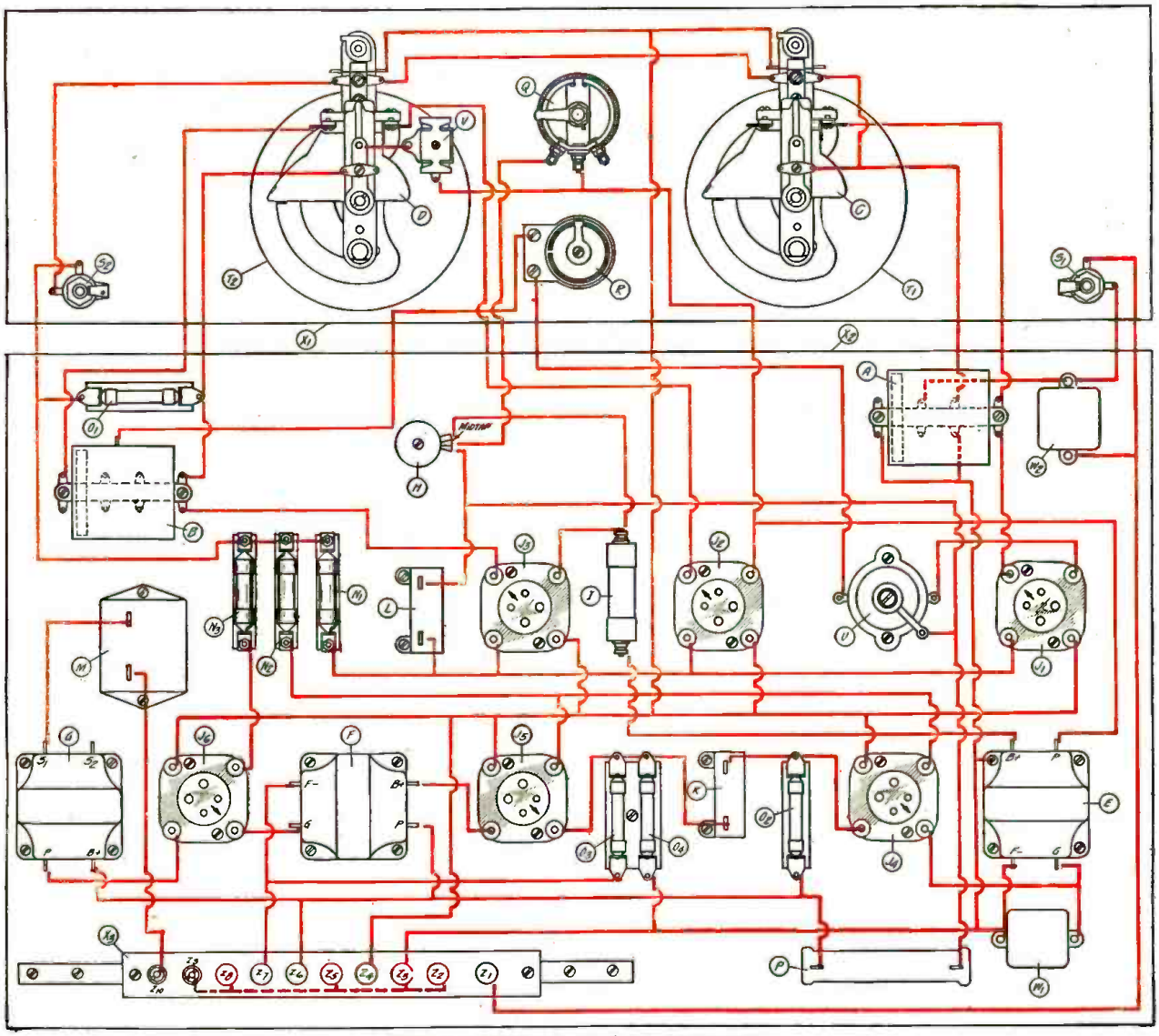


THE CIRCUIT OF THE NEW RECEIVER

FIGURE 2: *The high-frequency amplifier at the left works into the crystal detector at I. The low-frequency amplifier at the right combines resistance and transformer coupling.*

POPULAR RADIO WORK SHEET

The Griffith Orthophase Receiver



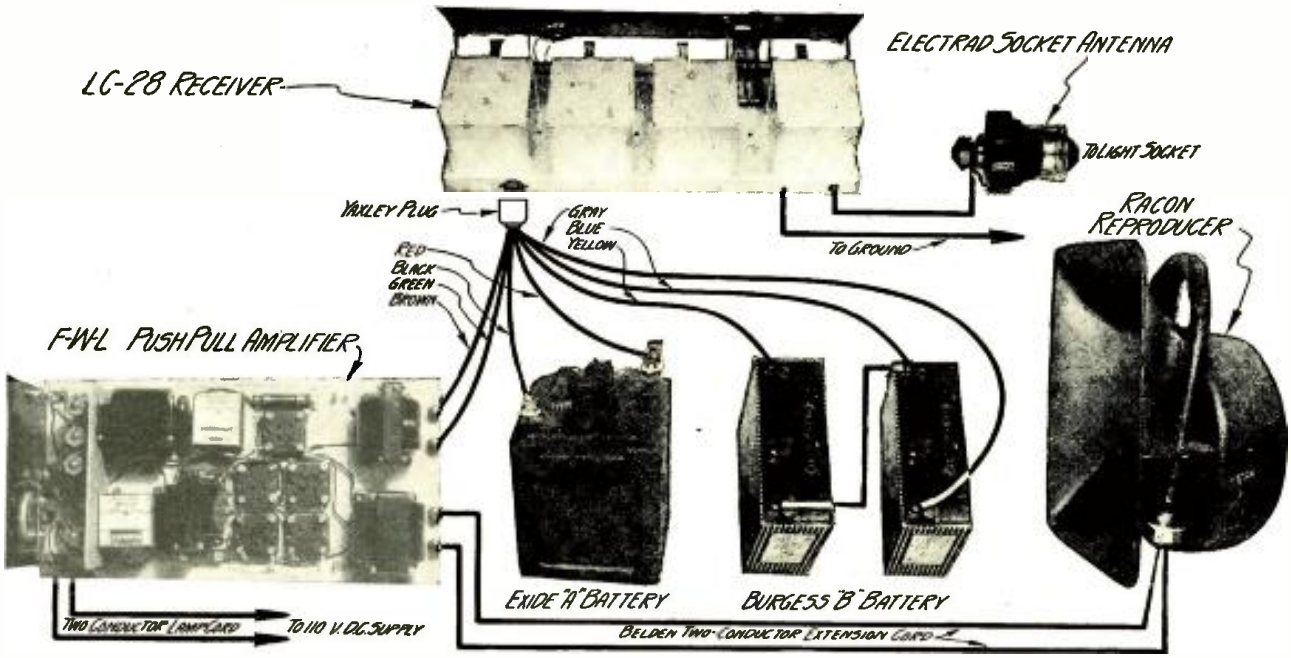
THE WIRING OF THE ORTHOPHASE

FIGURE 3: *All the wiring is done above the wooden baseboard, X2, and is shown here on solid* RED *lines. The instruments are outlined in* BLACK, *in the approximate positions in which they are to be mounted. The positions are not critical, but care should be taken to mount the units, E, F and G, turned in the positions shown.*

List of Parts for Building This Receiver

Cost of Parts—*Not over $79.00*

A and B—Hammarlund fixed coupling coils, type RF-17;
C and D—Hammarlund midline variable condensers, type ML-17, .00035 mfd.;
E and F—Samson symphonic low-frequency transformers;
G—Samson output impedance, type O;
H—Precision tapped choke coil, No. 380;
I—Carborundum crystal detector, type 30, equipped with Lynch mounting;
J1, J2, J3, J4, J5 and J6—Benjamin Cle-ra-tone sockets, No. 9040;
K—Polymet Hi-volt filter condenser, type A, .1 mfd.;
L—Polymet Hi-volt filter condenser, type A, .5 mfd.;
M—Polymet filter condenser, type B, 4 mfd.;
N1, N2 and N3—Polytrols, type Nos. 7, 5 and 5, respectively;
O1, O2, O3 and O4—Carborundum resistors, 2 megohms, .1 megohm, .25 megohm and .25 megohm, respectively, equipped with Lynch mountings;
P—Lynch heavy-duty resistor, 5,000 ohms;
Q—Electrad variable resistor, 200 ohms;
R—Electrad Royalty resistor, type H, 25,000 ohms;
S1 and S2—Electrad battery switches;
T1 and T2—Marco illuminated vernier dials;
U—Electrad phasatrol;
V—Hammarlund equalizer condenser, type EC;
W1—Polymet moulded condenser, .002 mfd.;
W2—Polymet moulded condenser, .00025 mfd.;
X1—Westinghouse Micarta front panel, 7 by 21 by 3/16 inch;
X2—Wooden baseboard, 10 by 20 by ½ inch;
X3—Westinghouse Micarta binding-post strip, 1 by 9 by 3/16 inch;
Z1, Z2, Z3, Z4, Z5, Z6, Z7 and Z8—Eby binding posts;
Z9 and Z10—Yaxley "pup" jacks;
4 brass brackets;
Celatsite hook-up wire, screws, solder, bolts, nuts, etc.



HOW TO HOOK UP THE DC AMPLIFIER

FIGURE 1: *The amplifier at the left operates entirely from the DC light socket; the "A" and "B" batteries shown above are for the operation of the LC-28 high-frequency pack with which the amplifier is used.*

High Quality with Low Voltage from the DC Socket!

A *DC* Socket Operated Amplifier

Here is a unit that all radio fans living in DC-wired neighborhoods have been long waiting for—a high-power, high-quality amplifier employing four 171-a type power valves in a push-pull stage that operates directly from the 110-volt DC lighting lines.

By WENDELL BUCK

EACH passing year has seen the man with alternating current in his home go merrily on his way towards the achievement of better tone quality. He can use 171 type valves in push-pull arrangement; or he may construct a stage of 210 type valve amplification which, used as the second of two stages, leaves little chance for improving tone and power.

But when it comes to direct current we find the problem a much more baffling one. On 110 volt DC lines, the maximum voltage obtainable through a power unit (after deducting the drop through the system) is between 90 and 100 volts. Now all of us know that 90 volts used on the plates of vacuum valves in the ordinary two-stage, transformer-coupled amplifier fails to give as much power and as fine tone as we like to have.

However, there is another method of securing fine tone and power which extends the opportunity of operating the power amplifier direct from the 110 volt DC lines without batteries.

The direct-current power amplifier described in this article will interest all radio fans whose home current supply is direct current at 110 to 120 volts. It is a complete two-stage DC light-socket operated unit designed for high quality of reproduction, with power enough to give a real punch and depth to music and speech.

No batteries of any kind are required; "A," "B," and "C" voltages are supplied to the five valves through a simple yet efficient system of four inexpensive resistors.

The circuit combines a stage of transformer-coupled amplification with a second stage of push-pull amplification employing four 171-a power valves. In the second stage, two vacuum valves are used in parallel in each side of the push-pull circuit. This system of dividing the power in the push-pull stage provides unusual handling capacity, real volume and power, as well as undistorted output to the speaker.

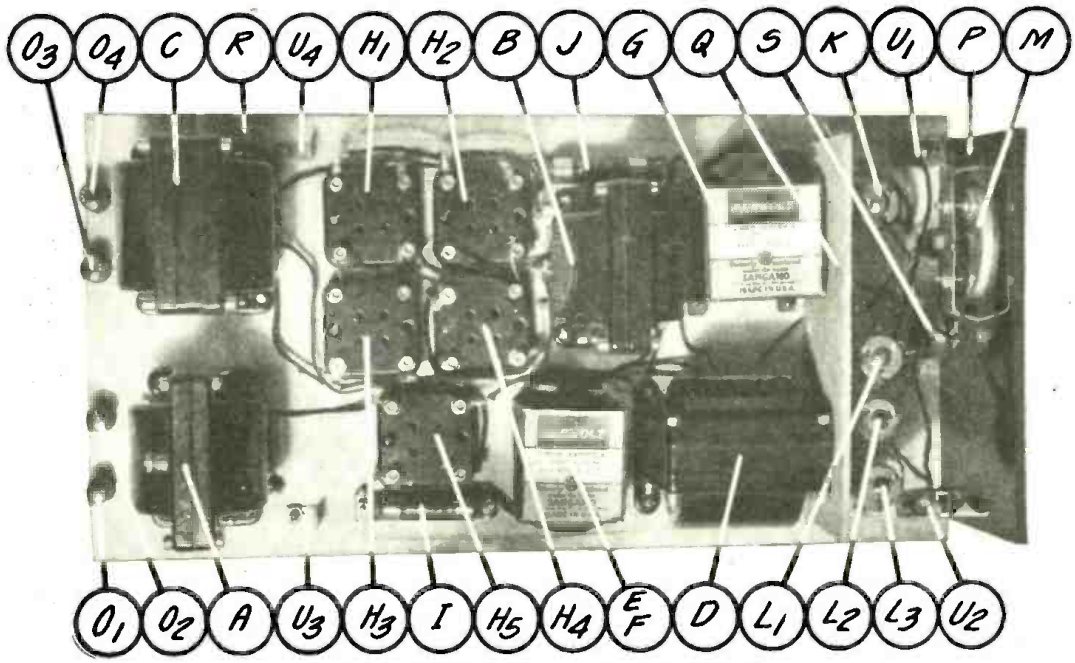
The complete eliminator-power amplifier is a compact, trouble-proof unit that once assembled and tested will give long service without attention of any kind. A perforated metal case is used to house all parts, except the first stage and output transformers.

It should be pointed out that resistor specifications are computed around a fixed filament load of 1.25 amperes, and that these specifications should not be changed. Five valves of the ¼-ampere type are employed for amplification, and with this knowledge an exact combination of resistor values is offered to handle properly this arrangement of valves. Voltage and current of the right value are delivered to each valve when all five are in their sockets. Should

(*Continued on page 256*)

POPULAR RADIO WORK SHEET

The FWL DC Push-Pull Amplifier



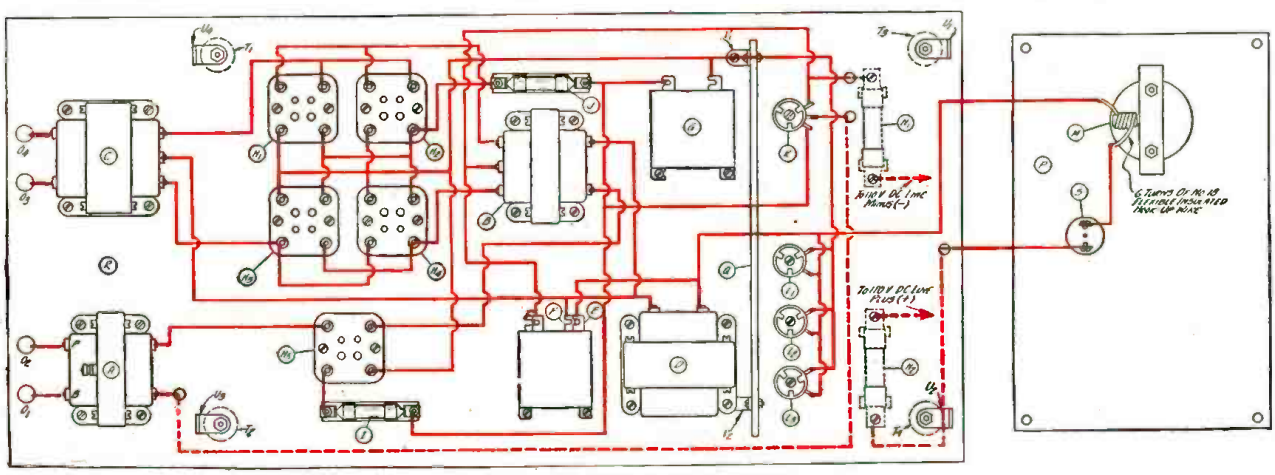
HOW THE UNIT LOOKS FROM ABOVE

FIGURE 2: *The unit is shown with the perforated metal cover removed, to reveal the mounting positions of the various parts.*

List of Parts for Building This Unit

Cost of Parts—*Not over $76.00*

A—Ferranti low-frequency transformer, type AF-3;
B—Ferranti input push-pull transformer, type AF-3C;
C—Ferranti output push-pull transformer, type OP-8(C);
D—Ferranti choke, type B-1;
E—Acme Parvolt condenser, 1 mfd., Series A, for 400 volts;
F—Acme Parvolt condenser, 2 mfd., Series A, for 400 volts;
G—Acme Parvolt condenser, 4 mfd., Series A, for 400 volts;
H1, H2, H3, H4 and H5—Frost sockets, No. 530;
I—Amperite, type 1-A;
J—Amperite, type 4-A;
K—Ward-Leonard mid-tapped A-tube resistor, 8 ohms;
L1, L2 and L3—Ward-Leonard B-tube resistors, 250 ohms;
M—Ward-Leonard battery-charging meter, type BT;
N1 and N2—Electric fuses, 10 amperes, equipped with fuse clips;
O1, O2, O3 and O4—Eby binding posts;
P—Formica panel, 7 by 4⅝ by 3/16 inch;
Q—Transite baffle board, 6¾ by 4½ by ⅛ inch;
R—Transite baseboard, 15 by 8 by ½ inch;
S—Cutler-Hammer toggle switch;
T1, T2, T3 and T4—Round wooden feet;
U1, U2, U3 and U4—Brass angle brackets, 1 by 1 by ½ inch;
V1 and V2—Brass angle brackets, ½ by ½ by ⅜ inch;
W—Ward-Leonard perforated metal cover, 11½ by 7 by 4½ inches;



HOW TO WIRE THE UNIT

FIGURE 3: *All the wiring above the transite baseboard, R, is indicated here in solid* RED *lines. Dotted* RED *lines indicate wires that run under the baseboard.*

The ABC of Filament Control

¶Modern receiver design demands simplicity in operation. By the use of the convenient data in this article any fan can eliminate one or more hand-operated controls on his receiver, and insure long life and efficiency for his vacuum valves.

THERE seems to be a considerable doubt in the minds of some set builders regarding the proper use of valve filament control resistances, such as Amperites, Equalizers and Polytrols.

These resistances may be used with all types of vacuum valves in any receiver, to provide each valve with its proper operating current. Or, where the control of the filament current must be variable, as in the case of many high-fre uency amplifiers in which the volume is controlled by means of a filament rheostat, filament controls may be also successfully used in conjunction witb a rheostat to prevent excessive current from flowing in the filaments even when the rheostat is turned full "on."

The only exception to this practice is in the case of receivers wbich operate their valves from dry cells. There the oltage variation is too great to permit the practical application of filament controls. When the batteries are new, for instance, their total voltage is in excess of 1½ volts each, but at the end of their useful life their voltage has dropped to less than one volt eacb. The only logical means for providing proper current for valve filaments in such a case is to use a band-operated rheostat.

In the average receiver which employs 5-volt valves or 3-volt valves, and is to be operated from a storage battery, it is advisable to use a separate filament control for each individual valve, because it is only in this way that one can insure the proper current for all valves at all times. If a single control is used to regulate the current for two or more valves, it is necessary to turn "off" all filaments when changing valv s or in switching valves around, otherwise when one of the group of valves controlled by a single control is removed from its socket the current through the balance of the filaments is immediately increased, with the result that these filaments may be severely overloaded. But where all valves are controlled by individual controls, the removal of one or more valves from their sockets has absolutely no effect on the others, and it is therefore not necessary to turn "off" the filament current before removing one or more of the valves.

In some cases space does not permit the use of a separate filament control to each valve, or perhaps it is necessary to keep the cost of construction down to an absolute minimum. In that case it is possible to operate from two to four valves through a single control. These valves may be of different types or they may all be of tbe same type. The only requirement is that the controls used must be the proper type to supply the total current required by the group of valves used.

Take a resistance-coupled amplifier, for instance, with three stages in which two .25-ampere valves and one .5-ampere valve are used. The total current required by these three valves is 1 ampere, and this may be obtained through the use of a No. 1 Amperite. a No. 1 Equalizer or a No. 3 Polytrol. Or, again, there may be an amplifier

(*Continued on page 243*)

FILAMENT CONTROL CHART

TYPE OF VALVE	FILAMENT CURRENT IN AMPERES	BATTERY VOLTAGE	TYPE OF FILAMENT CONTROL NECESSARY
201-a	*.25*	*6*	*Amperite No. 1-A Polytrol No. 1 Equalizer No. 4*
200-a	*.25*	*6*	*Amperite No. 1-A Polytrol No. 1 Equalizer No. 4/3*
112	*.5*	*6*	*Amperite No. 112 Polytrol No. 5 Equalizer No. 2*
171	*.5*	*6*	*Amperite No. 112 Polytrol No. 5 Equalizer No. 2*
199	*.06*	*4 or 4.5*	*Amperite No. 4V-199 Polytrol No. 2 Equalizer No. 50*
120	*.125*	*4 or 4.5*	*Amperite No. 120 Polytrol No. 6 Equalizer No. 25*
WD-11	*.25*	*1.5*	*Amperite No. D-11 Polytrol No. 4*
Any 1 Amp. 5 V. Valve	*1.0*	*6*	*Amperite No. 1 Polytrol No. 3 Equalizer No. 1*
Any .75 Amp. 5 V. Valve	*.75*	*6*	*Amperite No. 3-A Polytrol No. 7 Equalizer No. 4/3*

STILL BETTER—the HI-Q WITH SCREENED-GRID VALVES

Fans everywhere are getting ready to make use of the marvelous possibilities of the new screened-grid valves, and the originators of the Hi-Q "Six" have kept up with the times by designing a new model of the Hi-Q for use with the screened-grid valves. The changes necessary for installing screened-grid valve amplification in the standard receiver are so few, and the results so satisfactory, that no radio fan should miss the change-over details given here.

By LESLIE BILES

MANY readers of POPULAR RADIO who have followed the series of articles on the Hi-Q "Six" receiver have written in asking whether the new screened-grid valves may be employed in the set. This development has been the subject of considerable experiment, both in the POPULAR RADIO Laboratory and in the laboratories that have developed this remarkable receiver. As the result of these experiments, a new model of the set employing two screened-grid type valves has been evolved and will be described in this article.

In the new model of the set the two screened-grid valves are utilized in the first two stages of high-frequency amplification. These two stages are tuned by the left-hand dial. The right-hand portion of the set, comprising a third stage of high-frequency amplification and a detector stage, are operated with standard vacuum valves, as in the earlier models.

The first stage of the set has been left substantially as before except that an equalizing condenser, CC1, in Figure 1, is added in parallel to the regular tuning condenser, C1. The filament resistor in this stage, R8, has also been changed to 10 ohms to take care of the different filament characteristics of the new valve. The connection from the high end of the variable condenser and coil has also been shifted off the grid terminal of the socket and replaced by a clip that will connect to the top terminal of the new type valve. Also, as may be noted in Figures 1 and 2, the grid resistors in the first and second stages are eliminated. The screened-grid connections are made to the regular grid terminals of the sockets.

In the second stage these same changes are made; in addition the primary of the tuning coil has been left out of the circuit. A connection is made through a .0001 mfd. blocking condenser to the top end of the secondary coil in this stage. Also a volume control has been inserted on the panel, consisting of a combination switch and variable high resistance shunted across the choke

POPULAR RADIO WORK SHEET

The Hi-Q "Six" With Screened-Grid Valves

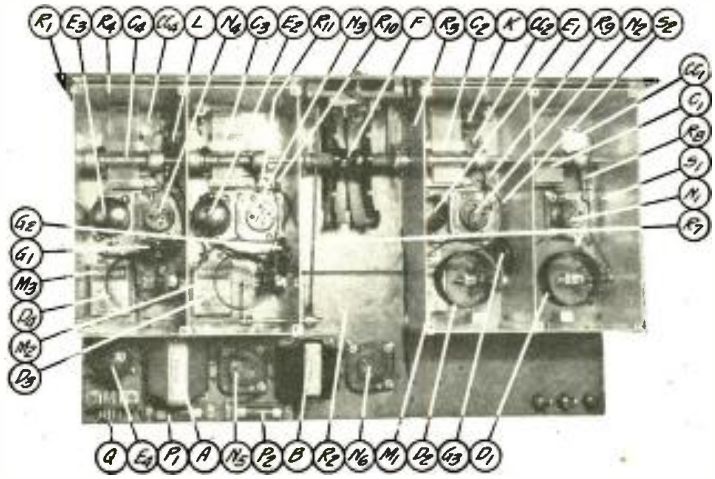


FIGURE 1: THE PANEL LAYOUT

List of Parts For Building This Receiver

Cost of Parts—*Not over $102.00*

A—Samson symphonic transformer;
B—Samson transformer, type HW-A-3;
C1 to C4—Hammarlund midline variable condensers, .0005 mfd.;
CC1 to CC4—Hammarlund equalizing condensers;
D1 to D4—Hammarlund auto-couple coils, type HQ-64;
E1 to E4—Hammarlund chokes, type RFC-85;
F—Hammarlund illuminated drum dial;
G1—Sangamo mica fixed condenser, .00025 mfd.;
G2 and G3—Sangamo mica fixed condensers, .0001 mfd.;
H—Sangamo mica fixed condenser, .001 mfd.;
I—Sangamo grid-leak clips;
J—Carter Imp rheostat, 6 ohms, type 1-R-6;
K—Electrad tonotrol and filament switch, 10,000 ohms, type WS;
L—Durham metalized resistor, 2 megohms;
M1 to M5—Acme Parvolt by-pass condensers; .5 mfd., Series A;
N1 to N6—Benjamin Cle-ra-tone sockets, No. 9040;
O1, O2 and O3—Eby engraved binding posts, marked *Speaker* +, *Speaker* — and *Antenna*, respectively;
P1 and P2—Amperites, No. 1-A;
P4—Carter fixed resistor, 1 ohm;
Q—Yaxley cable connector and cable No. 660;
R—Hi-Q "Six" foundation unit, containing:
R1—Drilled Micarta panel, 7 inches by 21 inches by ⅛ inch;
R2—Drilled metal chassis;
R3 and R4—Two-stage aluminum box shields;
R5 and R6—Brass extension shafts for variable condensers;
R7—One cam operating assembly;
R8 and R9—Grid biasing resistors, 10 ohms;
R10—Grid biasing resistor, 4 ohms;
R11—Grid suppressor (red);
R12—Grid-leak mounting block;
R13—Bakelite binding-post strip;
Clips for control grid;
Wire, screws, solder, etc.

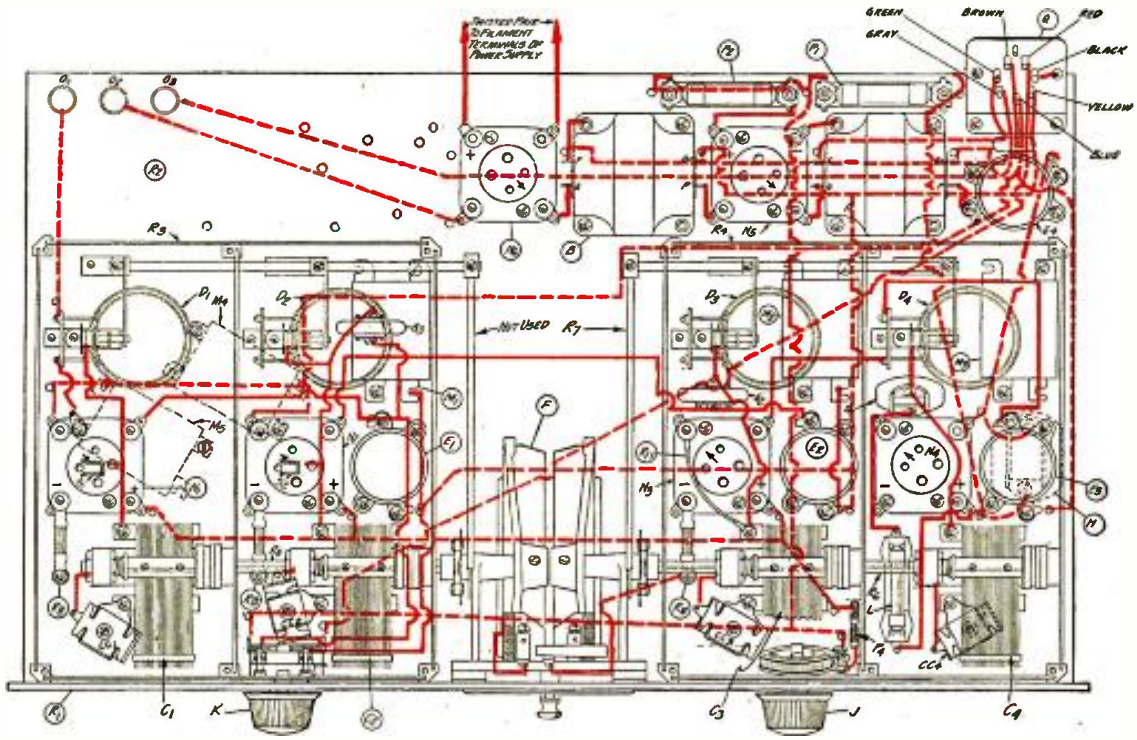
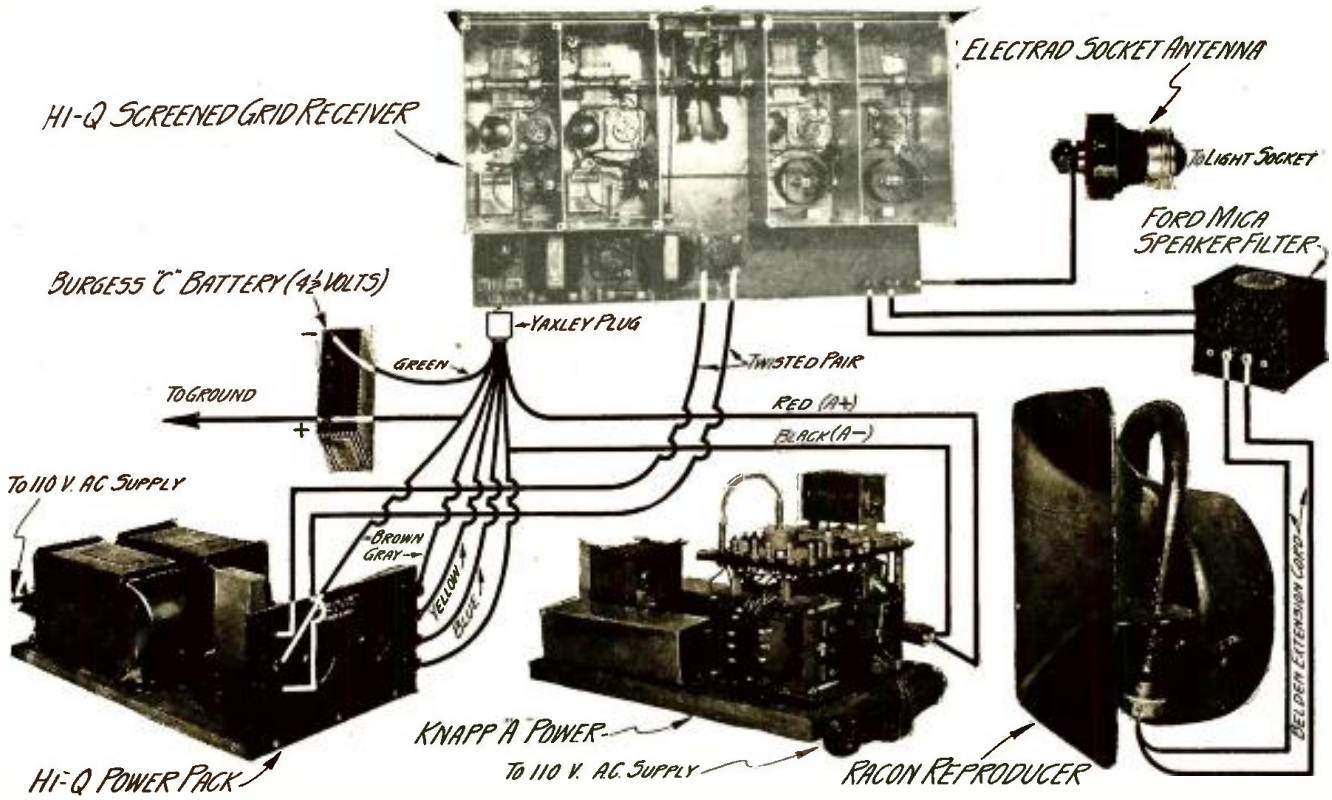


FIGURE 2: THE PICTURE WIRING DIAGRAM



HOW TO GET THE BEST FROM THE SCREENED-GRID HI-Q

FIGURE 3: *The operating hook-up shown above gives the utmost in efficiency and quality reproduction with the Hi-Q "Six" as remodeled for the use of screened-grid valves. It operates entirely from the AC lighting lines, with the exception of the small "C" battery shown at the left. The Hi-Q power-pack shown is the standard pack designed for use with the original model of the Hi-Q "Six."*

coil. This is a combination instrument that also acts as a filament switch when turned all the way "off." A by-pass condenser has been added between the shielding grids and the filament circuit.

The only change in the third stage of high-frequency amplification is that the primary coil has been left and a connection has been made between the plate circuit and the high end of the secondary coil and variable condenser through a .0001 mfd. blocking condenser. Of course, the four added equalizing condensers, CC1, CC2, CC3 and CC4, are to allow for balancing up the four stages of tuning. It will be noted that these changes rearrange the circuit so that conductive coupling is used in the screened-grid valve stages.

These changes are shown clearly in Figure 2. The two .5 mfd. by-pass condensers, M4 and M5, mounted underneath the chassis are shown in their relative positions in dotted black lines, in the picture wiring diagram in Figure 2.

All that is necessary is to build the set along the general lines prescribed in the original constructional article in the November, 1927, issue of POPULAR RADIO, with the additions mentioned above and following the exact connections give in the picture wiring diagram in Figure 2. The set itself may be entirely wired with flexible Celatsite and should be carefully checked before being placed in operation.

Operating Data for the Hi-Q Receiver Using Screened-Grid Valves.

First of all, the set, upon completion, should be placed in its Corbett cabinet, as shown in the illustration at the beginning of this article. Then it should be connected up by means of the Yaxley cable to the Hi-Q power-pack, as shown in the photo-diagram in Figure 3. This diagram gives the connections for the light-socket antenna, the ground, the "C" battery, the output filter and the Racon exponential reproducer. The home-built Knapp "A" power unit is also shown correctly connected, to furnish complete filament current for all the vacuum valves.

When these external connections have been made, insert two CX-322 type screened-grid valves in sockets N1 and N2, fastening the clips to the electrodes on top of the valves. Then insert a Zetka ZRF type valve in socket N3 and a Zetka ZD type detector valve in socket N4. Insert a standard CX-301-a type valve in socket N5 and a CX-371 type power valve in socket N6.

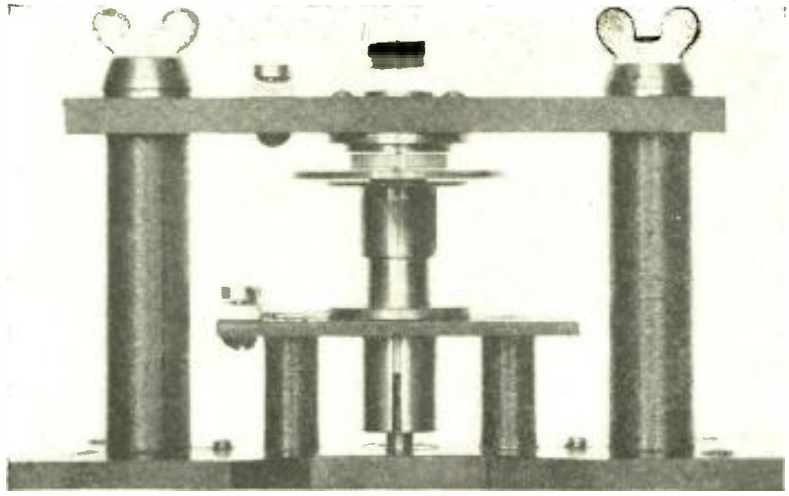
The set is now ready for operation and the combination switch volume control, K, should be turned "on" and a station should be tuned in. Then the equalizing condensers, CC1, CC2, CC3 and CC4, should be lined up, by turning the small screws with an insulated screw driver until the signals come in the loudest. At this setting the tuning stages will be lined up in synchronism.

It will be noted that the cam assembly on the first two tuning stages has been omitted, as it is not used when the screened-grid valves are utilized. The primary on the second stage is left out of the circuit and the first primary is to be fastened permanently by a string so that it is lightly coupled. Other operating hints on the receiver, such as the adjustment of the Hi-Q power-pack, will be found in the article in the January, 1928, issue of POPULAR RADIO on the Hi-Q "Six" power supply.

With this new model of the receiver much higher over-all amplification is obtained and the sensitivity of the set accordingly greatly increased.

Distant signals that might be received weekly with the original model come in with full local volume by the use of these new valves, and signals that could not be heard with a standard set are made clearly audible.

When the set has been finally balanced the two shield tops should be attached by means of six screws and the set will be ready to function satisfactorily for an indefinite period.



A 3-INCH RADIO MOTOR

FIGURE 1: *The moving element of the motor may be seen in the center of the picture, mounted between the upper and lower insulated frames. The two terminals by which the motor is connected into a high-frequency circuit may be seen at the left center of the crosspieces of these frames. This picture is approximately full scale.*

BROADCAST ENERGY OPERATES

THE RADIO MOTOR

A motor that may be run on the received signal energy of a broadcasting station is the novel invention of the German physicist, Dr. Alexander Meissner.

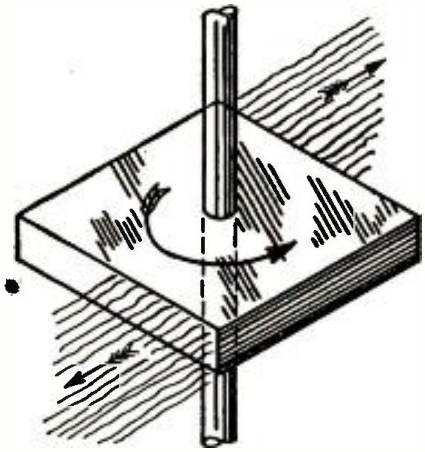
By HENRY SIMON

German Correspondent of POPULAR RADIO

AN electro-motor which can be connected in an ordinary radio circuit and made to operate by the broadcast energy of a transmitting station, has been invented by Dr. Alexander Meissner, an eminent radio physicist associated with the Telefunken Gesellschaft of Berlin. Worthy of particular note in this new radio device is the extraordinary simplicity, both of the principle employed and of the motor itself. A view of the invention, which, though an unquestionable success in so far as its working is concerned, has not yet borne practical results, is shown in Figure 1.

The motor consists essentially of a small quartz plate mounted on a fine spindle between two electrodes. The upper electrode is fixed in the insulating bar which forms the top member of the frame, while the lower electrode is rendered capable of fine up-and-down adjustment by being mounted on a movable column carried in the inner frame.

Any high-frequency current will operate the motor, provided the current is of a frequency corresponding to the period of vibration of the quartz plate, which is about 190 kilocycles. When the current admitted to the electrodes coincides with this frequency, the quartz plate starts to vibrate, and this vibration sets up rapid air currents on opposite sides of the plate. Now if these disturbances issued evenly over the entire area of the opposite sides, they would counteract each other, and nothing further would happen. As a matter of fact, however, the air currents are strongest near the corners of the square, as indicated in the diagram in Fig. 2, so that a torsional effect is created which causes the quartz plate to spin by the reaction of the air currents upon the surrounding atmosphere. An idea of what happens can be gained by comparing the action of these currents with that of the old water reaction wheel, which is driven by the reaction of the tangent streams issuing from oppositely-directed outlets.



HOW AIR CURRENTS ARE CREATED BY THE CRYSTAL

FIGURE 2: *This diagram shows how the air currents generated by the vibrating quartz crystal are stronger at the corners of the crystal, so that a torsional force about the spindle is created.*

The disc shown on the top of the spindle in Figure 1 serves merely as a convenient means of verifying the revolution of the motor. In a more powerful motor of the same type, assuming one could be built, it would be replaced by a regular pulley or other means of utilizing the motion. At present, the force created in the little model is sufficient only to cause the rotation of the motor, though some very delicate mechanism might, of course, also be driven by it.

The motor plate is about 5/8-inch square, and the height of the entire arrangement is approximately 3 inches.

AN ALL-ELECTRIC LC-27

The thousands who are still getting big results with their LC-27 receivers will want to try this new jiffy method of obtaining their filament current from the AC lighting lines. The cost of the new apparatus is small, the change-over is the simple matter of slipping adaptors and harness into the old sockets, and if a "B" power-pack is used for the plate supply, the results will put the LC-27 on a par with the newest of 1928 socket-operated receivers.

By LAURENCE M. COCKADAY

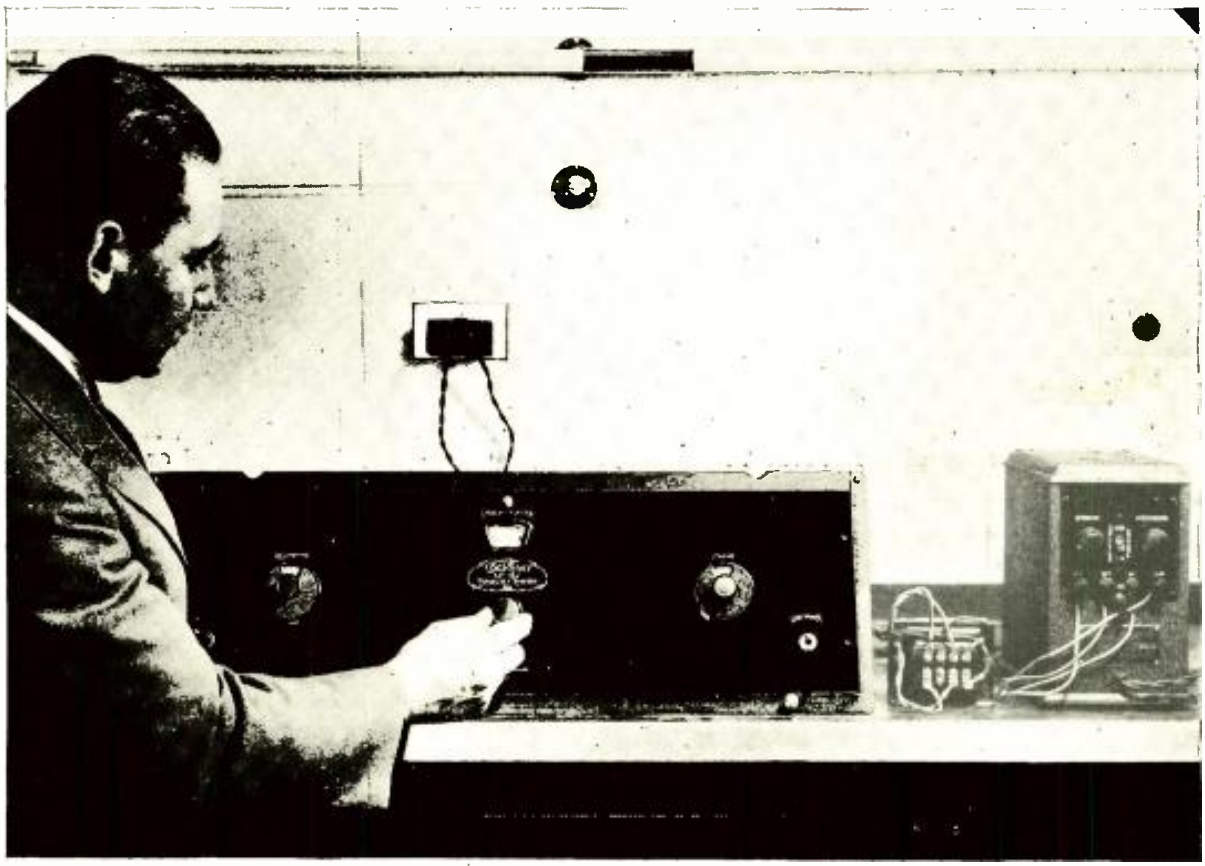
RADIO progress has now brought us to the point where it is an extraordinarily simple operation to convert any battery-operated receiver into a completely light-socket operated unit. With the development of AC valves, socket operation involves nothing more than an "A" power transformer and a "B" power-pack, together with suitable balancing devices necessary when AC current is introduced into the filament circuits of high-frequency amplifiers.

The problem of "B" power-packs was solved long before the introduction of AC valves, and there are now on the market suitable "B" power units for every kind of receiver, making possible complete socket operation.

The introduction of AC adaptors, such as the Na-Ald, Eby or Marathon, has made the change to light-socket operation a matter of only a few minutes. These adaptors are units which have prongs underneath for insertion in the socket of a battery-operated receiver and a socket above for receiving the prongs of an AC valve. In conjunction with the new AC valves and a small heater transformer, the adaptors furnish a very satisfactory method of "A" current supply from the lighting lines, without the use of any batteries.

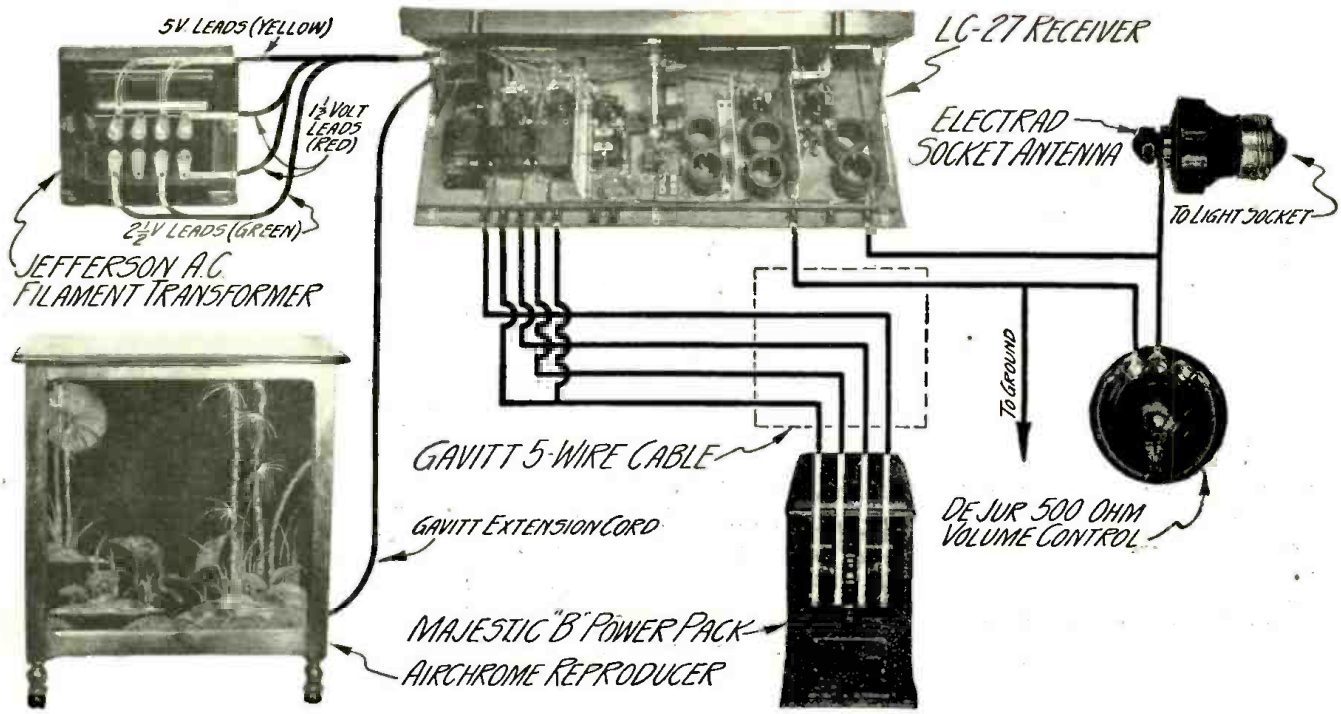
Furthermore, "C" bias is provided by a voltage drop across a resistance in the adaptors.

There are three general types of adaptors. In this particular instance Na-Ald connectoralds are used. In all of these the plate and grid terminals of the valves are connected through the connectoralds to the plate and grid terminals of the sockets in the set. Also, the filament and heater terminals of the valves are brought out to external binding posts on the connectoralds in all cases. In the No. 926 (red) connectoralds, the filament prongs are left unconnected. In the No. 927 UY (green)



1928 OPERATION FOR THE LC-27

By means of the new adaptors and the small transformer shown just to the right of the set, the lighting lines can be used for the filament supply for the LC-27. With the "B" power-pack at the right supplying the plate voltages, the LC-27 is made a completely socket-operated receiver.



THE COMPLETE AC OPERATING HOOK-UP

FIGURE 1: *The socket leads of the filament transformer and the "B" power-pack may be connected together and plugged into the AC lighting lines. The other connections between the receiver, power units, reproducer and socket antenna which may be used are shown clearly in heavy black lines.*

connectorald the cathode terminal of the valve is connected through the connectorald to one of the filament terminals of the receiver socket.

In the No. 924 G. T. (red) and the No. 926 G. T. (orange) conncetoralds both filament terminals of the receiver socket are connected through the connectorald to an external binding post between the other two external posts.

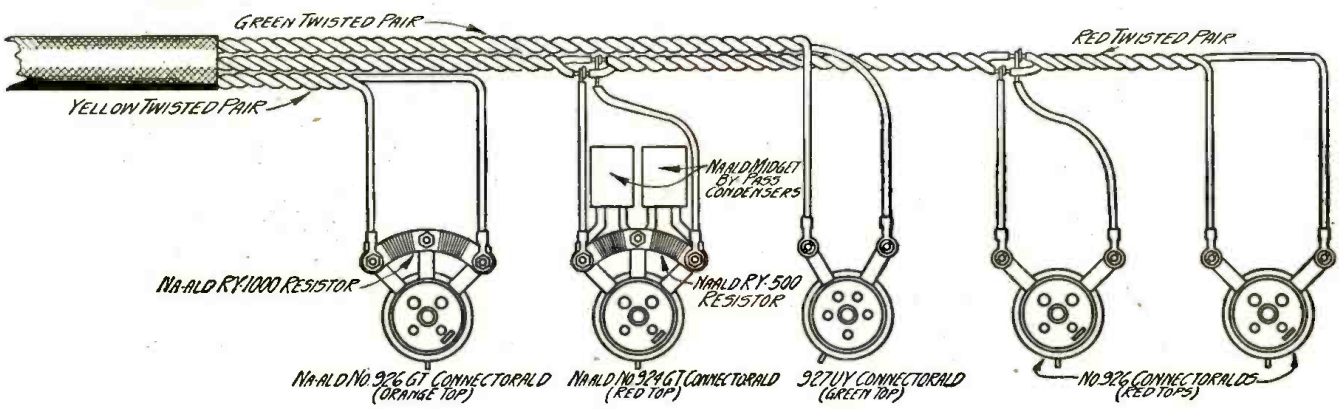
The Na-Ald RY-500 resistor really consists of two resistance windings; one is a center tap filament resistance which is connected across the external filament binding posts, and the other is a 500-ohm biasing resistance which is connected between the center tap of the filament resistance and the middle external binding post. These connections are automatically made when the resistor is tightened down on the three binding posts provided. The Na-Ald RY-1000 resistor is similar, but with a 1,000-ohm biasing resistance.

How to Wire the LC-27 Receiver for Socket Power Operation

In addition to a good "B" power-pack, such as the Majestic, the complete apparatus for the electrification of the LC-27 receiver consists of a Jefferson AC filament transformer, the Na-Ald AC connectoralds, center-tapped filament resistances, biasing resistances, by-passing condensers and a connecting harness.

Refer to Figure 2 for the connections to the Na-Ald connectorald system. Connect the red pair of wires of the harness to the two outside terminals of connectorald No. 924 GT. Using the most suitable red cable lengths, connect these last two terminals to those of each of the No. 926 connectoralds in turn. Then connect the Na-Ald RY-500 resistor to the three terminals of the No. 924 GT connectorald. Also connect two Na-Ald Midget by-pass condensers as shown. Following this, connect the yellow twisted pair of wires to the two

(*Continued on page 265*)



HOW THE ADAPTORS ARE WIRED

FIGURE 2: *The connectoralds shown above are, from right to left, for the two high-frequency valve sockets, the detector socket, and the two low-frequency valve sockets. Carefully follow the directions given in this diagram for cabling the leads.*

"I USED TO GIVE RADIO INFORMATION AWAY—NOW I SELL IT"

The Story of a Young Man Who Established a Reputation in Radio and Cashed In On It

By CHARLES A. KENNEDY

I CAN start this little radio story of mine by saying that no one knows how much he can make out of radio servicing and construction until he actually launches into it. For a long time I speculated as to the possibilities of this kind of occupation, but I had no idea of how much I could make until I dug right in and worked at my own business. It's the actual starting that counts.

New Albany, Indiana, where I live, is a city of 30,000 people, and, like a great many other American cities, its residents appreciate quick, intelligent radio service. This kind of service is difficult to get in a town of this size, for there are few men in it who have specialized in this kind of work, or who have had anything but a very superficial preparation. The dealers' service in New Albany is, in general, very bad, due to a lack of training on the part of repair men and service men. I fully realized this before I launched my little enterprise. At the same time, I saw the rare opportunity of constructing standard circuits, and of realizing a substantial profit on the sale of custom-made receivers.

"I am still a radio fan, but now I get paid for work that I enjoy and for work that I used to do for nothing. Two years ago I gave my radio information away—now I get paid well for it. There is a market for service, sets, and radio advice in every neighborhood in the United States, and I am surprised that more radio fans do not capitalize their technical knowledge."

CHARLES A. KENNEDY.

I think that many men are deterred from entering this kind of work simply because they feel that a large investment is necessary. This is by no means true. A very few simple testing instruments and a very modest supply of tools are all that is needed. I do not believe my investment in tools and equipment runs over $100, and I started on much less than this. I should say that a very good start can be made on a capital of $50 or even less, depending on the ingenuity and resourcefulness of the man.

Two years ago I was making $35 a week. Now I am averaging $75 and I have on my list many customers for whom I do work regularly. It is important to build up this list of customers, because it tends to stabilize one's income. In certain instances, I make periodic calls with regular service fees. In the case of the better class of customers, it is very easy to make some kind of an agreement on a weekly or monthly basis, as a sort of "consulting radio physician."

At the present time I am regularly employed as a service man in a large radio store in Louisville, which is but a

(*Continued on page 239*)

THE RADIO "PHYSICIAN" AT WORK

The most satisfactory arrangement that the professional service man can make, both for himself and his clients, is a regular servicing of sets on a weekly or monthly basis. This insures the proper care of the set and the prevention of any serious breakdown, and also gives the service man a steady, dependable income.

USE A "NEEDLE SCRATCH FILTER" FOR

Improving the Phonograph Pick-up

By MORRIS M. SILVER

THE new electrical pick-up is capable of reproducing, in an electrical sense, a much truer copy of the original sound than is possible with the old style of mechanical reproducer consisting of a vibrating diaphragm attached to a horn.

Of course, the electrical pick-up has other allies that help it to do its work. One of these is the low-frequency amplifier, exactly similar to that used for radio, and the other is a high-quality reproducer, whether it be a cone, an exponential horn, or one of the balanced-tension type.

One of the difficulties of phonograph reproduction, that has bothered the engineer, is the problem of the mechanical scratch of the needle as it passes along in the vibrating troughs in the record. This factor, of course, is just as troublesome in a mechanical phonograph as in the electrical type. A number of mechanical means have been developed to try to eliminate the scratch, some of them partially successful.

A careful study of the frequencies of these scratch noises has brought to light the fact that these frequencies are high enough in the musical scale not to be in actual competition with the necessary musical frequencies used in reproduction.

An ingenious device consisting of a tuned filter, with choke coils and condensers mounted in a small metal box, has recently been developed to deal with this trouble. This device, known as a scratch filter, may be connected in the line from the electrical pick-up and its purpose is to pass through it, to the amplifier, all of the musical frequencies necessary for good broadcast or phonograph reproduction, but to hold back and prevent the frequencies that make the objectionable scratch noise on the phonograph from entering the amplifier at all.

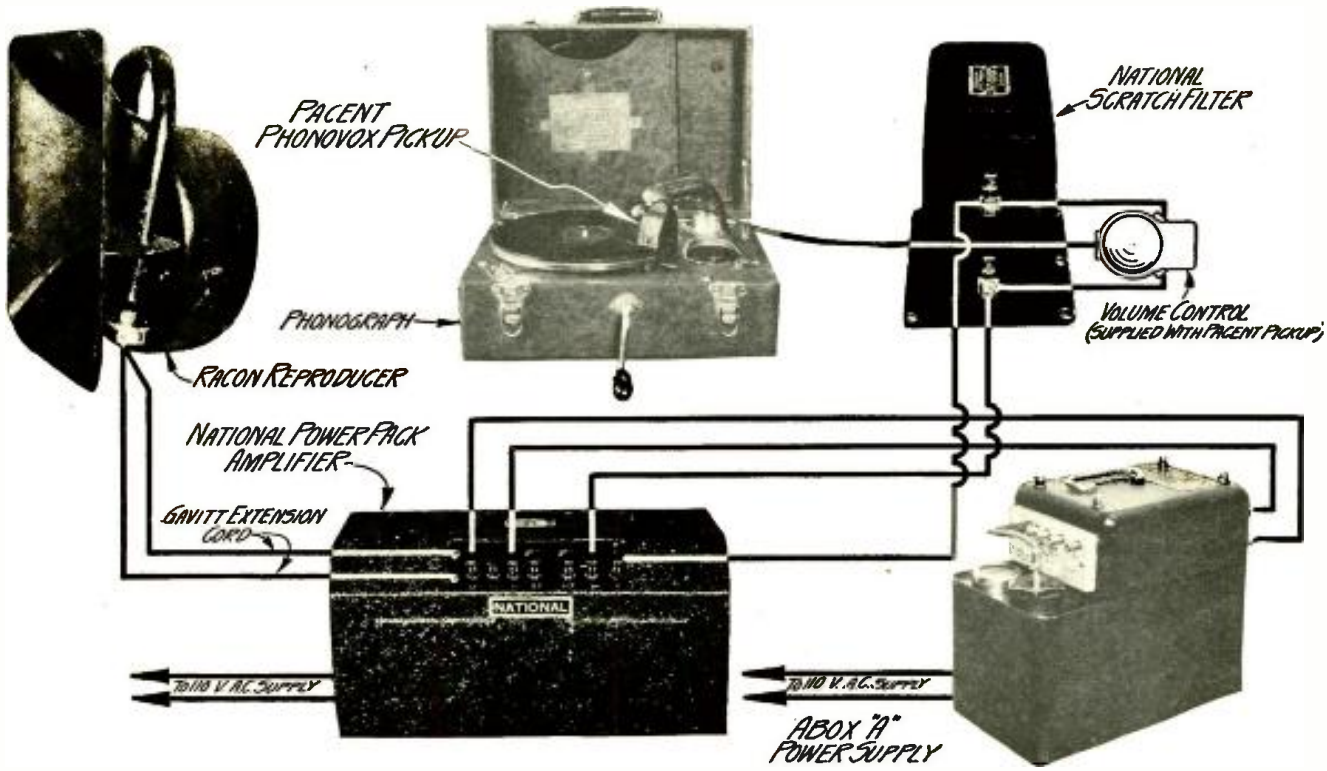
One of these devices installed will add much to the reality of reproduction of any phonograph installation that is operated electrically.

In the photo-diagram in Figure 1 is shown, in the upper right-hand corner, one of these scratch-filters connected in circuit between the electrical pick-up and the input to the amplifier, which is, in this case, the National resistance-coupled power amplifier. This amplifier works directly from the 110-volt AC lighting lines for its "B" and "C" power. Its "A" power may be obtained through an "A" power-pack, as shown in the illustration.

An exponential horn, used in connection with this apparatus, will further tend to enhance the realistic qualities of reproduction that the combination is capable of.

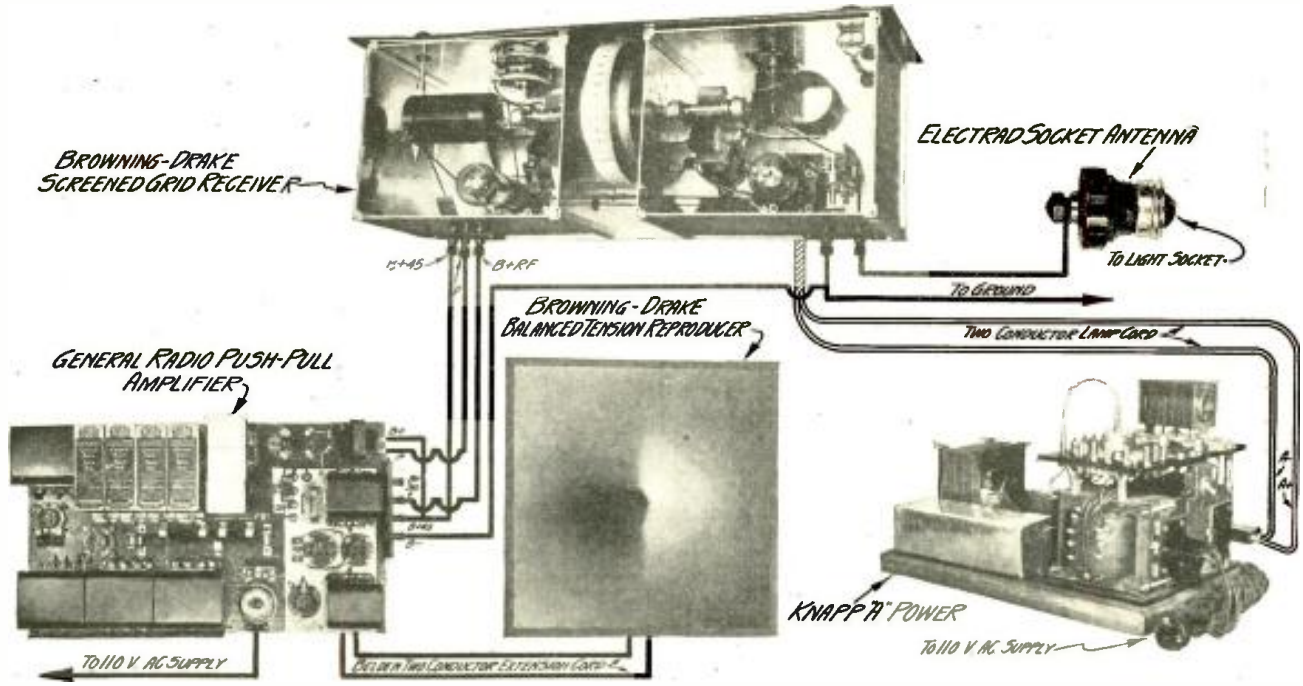
In this illustration a small portable phonograph is shown. However, it may be any type of existing phonograph cabinet that has a workable turntable.

The combination illustrated will reproduce the electrically cut records with a vitality and realism that is surprising. Anyone can make the installation. Try it on your old phonograph.



A COMBINATION THAT ELIMINATES THE NEEDLE SCRATCH

FIGURE 1: *The scratch filter at the upper right is designed to filter out the frequencies within which most of the needle scratch noises lie, and pass on to the amplifier only the frequencies of voice and musical reproduction. This combination has the further advantage of complete operation from the AC lighting lines.*



HOW TO INSTALL THE NEW BROWNING-DRAKE

FIGURE 1: *The installation of screened-grid valve amplification in the Browning-Drake tuner requires little change in the operating hook-up, as this diagram shows. All the necessary connections to the low-frequency amplifier, "A" power, reproducer, ground and antenna are clearly shown in* BLACK *lines.*

Screened-Grid Valves "Pep Up" *the* Browning-Drake

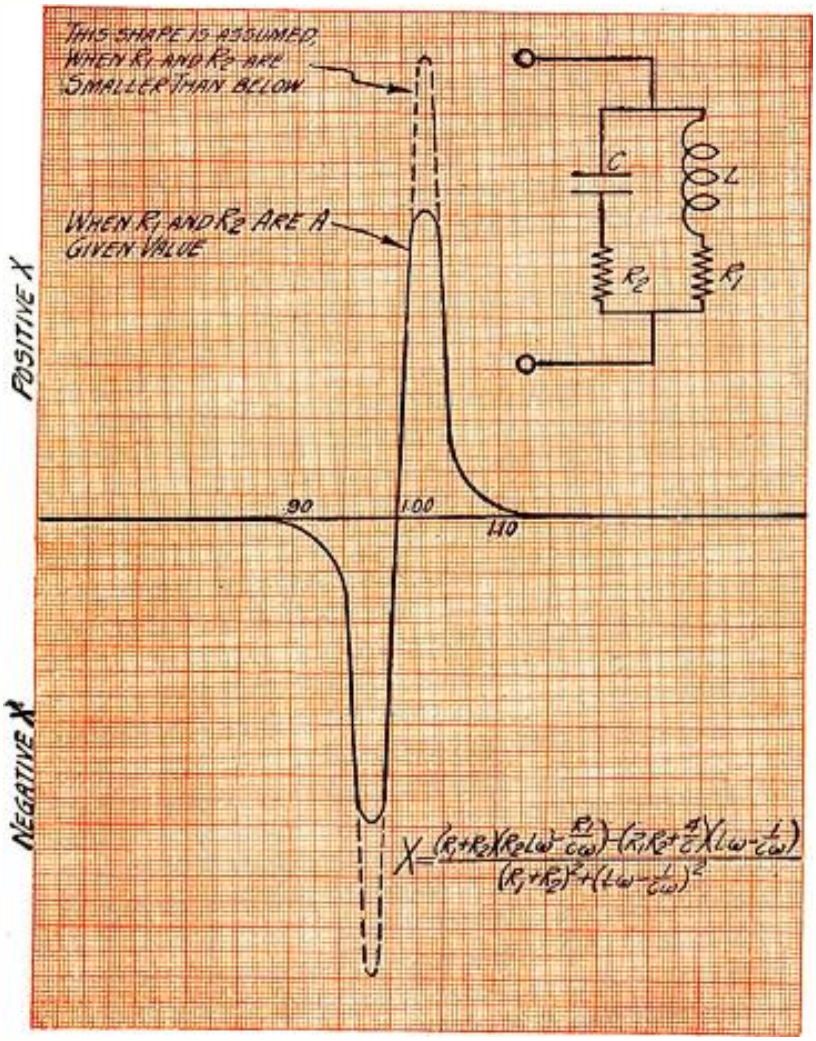
The design of the Browning-Drake receiver is so simple that the installation of screened-grid valve amplification can be easily done in a few minutes by any fan. The characteristics of the new valve have been carefully studied and the circuit of the Browning-Drake changed to give the utmost in efficiency from screened-grid valves.

By GLENN BROWNING

SO numerous have been the requests for data relating to the use of the new screened-grid valves with the Browning-Drake kit-set that it is thought advisable to give radio fans all the information possible at the present time. The circuit built around this valve has been experimented with for the last three months, but not until neutralization was used did the valve perform in a manner which came up to expectations. With the use of neutralization and a regenerative detector the high-frequency amplification obtained was tremendous, so that signals that were inaudible before were as loud as locals, provided the noise and interference was not such as to drown them out. The selectivity of the receiver with the ordinary antenna is somewhat inferior with this valve used as a high-frequency amplifier. However, with a short antenna the signal strength is decreased very little and the selectivity is much improved.

As most of the fans probably know, the screened-grid valve has two grids. One grid forms a complete shield around the plate, and screens the other grid. This second grid performs the same function as the grid of an ordinary valve. The screening grid is connected to a 45 volts positive tap, giving it a positive potential of that amount, thus lowering the valve impedance and at the same time breaking up the capacity between the plate and the control grid. The ordinary capacity between the plate and the control grid is detrimental when the valve is used as a high-frequency amplifier, for when a large positive impedance is built up in the plate circuit, energy is fed from plate to the preceding tuned circuit, through the above mentioned capacity, thus making it necessary to neutralize.

In the screened-grid valve this capacity is broken up into two parts, as is shown in Figure 3, consisting of a capacity between plate and ground, and a capacity between screen grid and working grid, which in turn is made up of the two capacities marked in the diagram. When two capacities are connected in series the resultant capacity is, of course, smaller than the smallest. Thus, if two equal capacities are connected in series, the resultant capacity would be one-half the capacity of either component. Therefore, it may



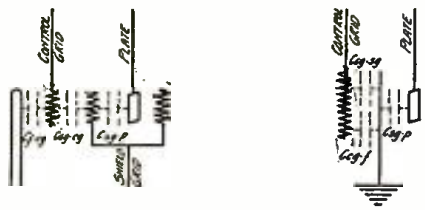
A REACTANCE CURVE FOR A TUNING CIRCUIT

FIGURE 2: *These curves show the reactances of the tuning circuit whose formula is given above, and indicates how the positive reactance will vary with the resistance in the circuit, R1 and R2. It is easily seen that the necessary high reactance of the tuning circuit for use with the screened-grid valve necessitate small values of the resistances, R1 and R2.*

be readily seen, by referring to the diagram, that although the screened-grid valve cuts down the capacity between the working grid and plate very materially, it is not eradicated entirely. Conesequently, in a circuit employing regeneration on the high-frequency transformer, it seems necessary to neutralize the high-frequency amplifier valve.

This may be readily seen by reference to Figure 2, where the reactance of the tuned circuit is plotted against the tuning ratio. The equations for this curve are given and it will easily be noted that the resistance of the circuit enters in, in such a way that the lower the resistance the higher the positive reactance. Thus, with regeneration, one can get almost infinite positive reactance just before the circuit goes into oscillation.

As most radio experimenters know, the higher the positive reactance in the plate circuit of the high-frequency amplifier valves, the greater tendency there is for the preceding tuned circuit to go into oscillation, due to the feed-back through the capacity between the plate and grid. Thus, even if the capacity between the plate and grid is extremely small, the preceding circuit will oscillate before the circuit regenerated on unless this capacity in the high-frequency amplifier valve is neutralized.



A SCHEMATIC REPRESENTATION OF A SCREENED-GRID VALVE

FIGURE 3: *This diagram shows how the capacities of the screened-grid valve may be shown schematically. At the right is the result of capacities that exist between the control grid and the plate.*

The screened-grid valve, as before shown, has a small capacity between the plate and the control grid which should be neutralized if the characteristic efficiency is to be obtained in the type of circuit shown. Incidentally, this capacity which must be neutralized is much smaller than is the case with the 199 type valve.

The screened-grid valve has another advantage by reason of its high amplification characteristic, due to the effect of the screening grid on the mutual conductance of the valve. This tremendous amplification results in great signal strength. On the other hand, the plate impedance of the new valve is very high, and greater efficiency can be obtained by using direct coupling in the tuning circuit, as shown in Figure 4. This makes it altogether imperative that the set-builder use some system of parallel feed.

A parallel feed system has been already adopted in connection with the Browning-Drake for the reason that it keeps the high-frequency currents out of the plate voltage supply, and makes neutralization with the ordinary 301-a type valve considerably easier; consequently adopting the new screened-grid valve as a high-frequency amplifier entails but few changes.

Another essential part of the set built around the screened-grid valve is complete shielding; for, if there is any magnetic feed-back from one tuning circuit to the preceding one, there is a tendency for oscillation to take place in the circuit.

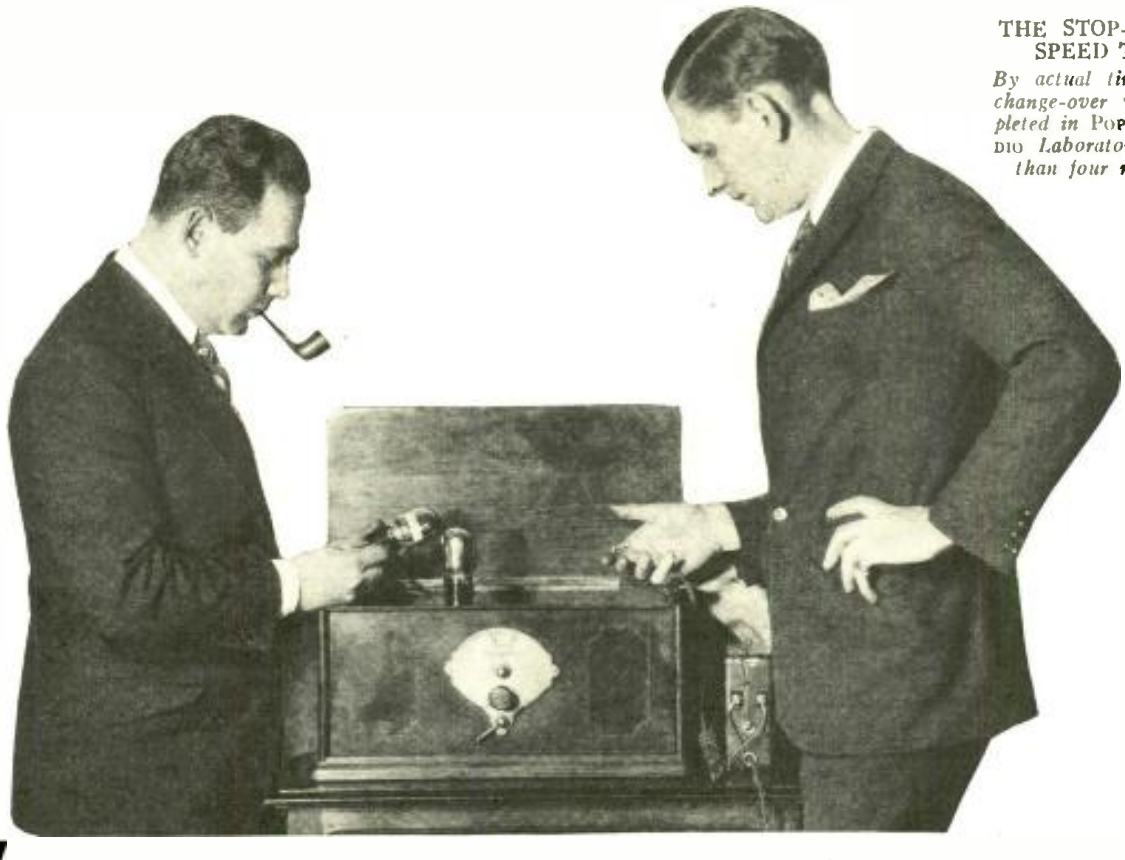
One of the few changes necessary is in the filament circuit, where a 10-ohm and a 5-ohm resistance must be placed in series with the rheostat for cutting down the 5 volts to 3.3 volts, which should be applied to the filament of the screened-grid valve.

A by-pass condenser of at least .5 mfd. should be connected between the screening grid and the ground of the receiver. The grid (G) on the usual four-prong UX socket is the connection for the screening grid, while the cap on the top of the valve connects to the control grid lead. In connecting up the circuit these wiring changes should be kept in mind.

When the connections from the screened-grid valve are made as shown in Figure 4, it will be noted that the capacity between plate and filament is placed directly across the tuning circuit. Thus, it is sometimes necessary to add an equal capacity of about 15

(*Continued on page 260*)

¶ Here, at last, is the "lazy man's adaptor," whereby the complete change from battery to socket operation for valve filament supply may be made by any fan in four minutes!



THE STOP-WATCH SPEED TEST

By actual timing, the change-over was completed in POPULAR RADIO *Laboratory in less than four minutes.*

4 Minutes to Socket Operation

By P. R. LECKY

WHILE there are hundreds of thousands of set owners who would enjoy the luxury and convenience of socket-operated sets, not many of them have the patience, or even the inclination, to equip their battery-operated receivers with AC valves.

The Marathon AC valve kit enables any novice to change his old receiver to AC operation in less time than it will take to read this comparatively short article. This outfit comes complete with valves, harness and a transformer—the transformer to take the place of the cumbersome "A" battery employed to supply the valves with their filament current. All that is necessary is to install these properly.

In applying this kit, there are absolutely no changes or new connections to be made. Each valve has on its base two special filament or heater connectors. Connecting spades are arranged on the harness, and it is only necessary to slip these spades into place on the special terminals. It will be found that the heater extension connections coming from the cable are twisted into pairs and it is only necessary to slip these onto the valve terminals, paying no attention whatsoever to polarity connections.

The first operation is simply that of slipping these connections in place. It will be noted that the bases of the AC valves, aside from the special connections, have four standard sized prongs. Two of these prongs are dead. It is these prongs that would normally be connected to the filaments of the valves. The dead prongs are left on the base simply to facilitate changing, and to make the valves fit standard UX sockets.

While all the AC valves require the same heater voltage, the characteristics of the detector are slightly different from those of the amplifier valves; consequently, it will be necessary to place the detector valve in the detector socket of the set.

With this done, all of the old DC valves are removed from their sockets and are replaced by the new group. Both the high-frequency and low-frequency valves have the same characteristics and, consequently, it is not necessary to make any distinction when placing them in the high and low-frequency sockets.

At the end of the AC harness two terminals will be found. These are connected to the output of the special transformer which is supplied with the kit and which is, in turn, plugged into the AC socket.

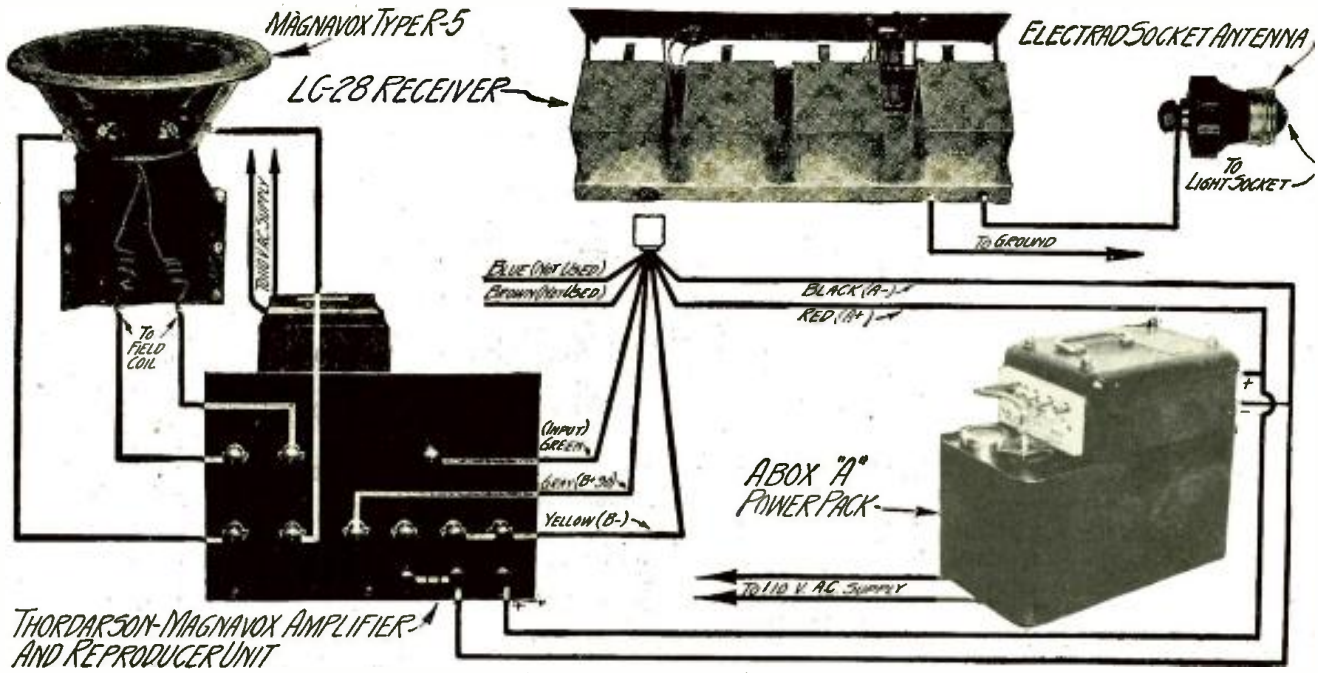
Like all AC valves of the heater type, these valves do not heat up instantaneously and about twenty seconds will be required before it is found that the set is in operating condition.

Just as in the case of the old valves that were employed, slightly better results might be obtained by shifting the high-frequency and low-frequency valves about until best results are had, although in the average case this will not be found necessary.

If the set with which these valves are used is provided with filament rheostats, it should be noted that these regulating devices are no longer operative.

With each kit there is supplied a vol-

(*Continued on page 262*)



HOW TO INSTALL THE COMBINATION UNIT

FIGURE 1: *The Thordarson-Magnavox amplifier and reproducer unit is here shown with the LC-28 high-frequency pack. It gets all its own operating voltages from the lighting lines, and in addition supplies the "B" voltages for the high-frequency pack. The other connections, to ground, antenna and "A" power device, are clearly shown in black lines.*

THIS NEW SPEAKER-AMPLIFIER COMBINATION GIVES

Radio Luxury in Power Units

Here are the constructional details for a low-frequency amplifier and speaker unit which is the last word in matched combinations for quality reproduction. The operating characteristics of all the parts have been carefully matched for the best results, and the complete unit operates directly from the light socket, and in addition supplies the "B" voltages for the high-frequency pack with which the combination unit is used.

By EDWARD COOMBES

THERE have been made, in the past, many thousands of experiments resulting in partial realizations of what might be termed the ultimate of sound reproduction through the medium of the radio broadcast receiver. These efforts have resulted in the regular broadcast receiver with which most people are familiar, varying in its excellence according to the price paid for the complete job and the excellence of construction in it.

For the man who seeks the ultimate in radio reproduction, there can be no substitute for power amplification. Just as reserve power is so essential for smooth operation of a motor vehicle, just so is a certain amount of reserve power necessary for the low-frequency output, if undistorted reproduction is to be obtained at all frequencies.

Quite naturally this type of amplifier can handle great volumes. Volume, however, is not the only objective, and it may not even be the main objective, any more than an 80-mile-an-hour automobile would ever be driven at full speed through traffic. Just as the excess power of an automobile gives easier control at average speeds, the reserve power of this amplifier provides greater fullness and richness of tone, with less chance of vibration or distortion.

Because the quality of reproduction in a radio set begins with the input to the low-frequency amplifier, excellent results can be achieved only when the entire system, starting from the detector valve and ending with the reproducer, is designed as a single, co-ordinated unit.

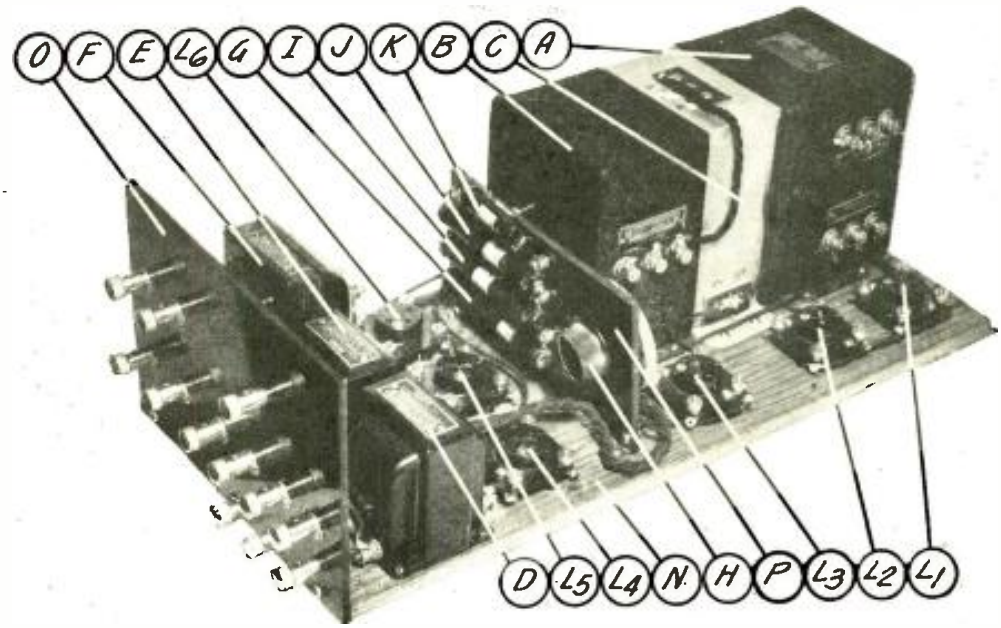
The new device described in this article is designed to operate from the 110-volt, 60-cycle house-lighting lines and consists of a single stage of transformer-coupled amplification, followed by a stage of push-pull amplification operating directly into a new reproducer that is especially designed to operate, without distortion, from an extremely large input. In addition, the unit furnishes all the "B" voltages necessary for the high-frequency pack with which it is used.

The new Magnavox reproducer is of the electro-dynamic type and utilizes a free-floating cone. The driving force necessary to put the cone into vibration is not applied to the cone by direct mechanical connection, but by magnetic reaction between a strong, permanently excited field magnet and a light coil

(*Continued on page 252*)

POPULAR RADIO WORK SHEET

The Thordarson Power-Pack Amplifier



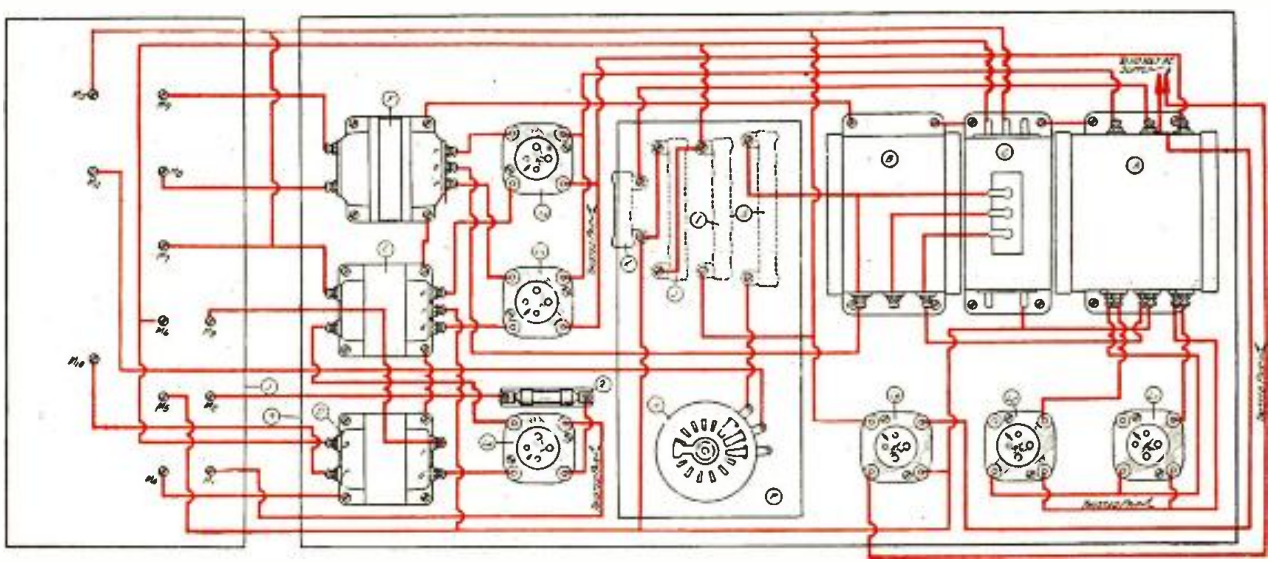
THE PANEL LAYOUT OF THE POWER-PACK AMPLIFIER

FIGURE 2: *The unit shown above incorporates a "B" power-pack and one stage of low-frequency amplification which works into the push-pull stage of the power speaker. Note the simplicity of the panel layout of the unit.*

List of Parts for Building This Unit

Cost of Parts—*Not over $94.00*

A—Thordarson power transformer, type T-2098;
B—Thordarson choke coil, type T-2099;
C—Tobe condenser, type R-210;
D—Thordarson low-frequency transformer, type R-200;
E—Thordarson input push-pull transformer, type T-2408;
F—Thordarson output push-pull transformer, V-2629;
G—Ward-Leonard fixed resistor, type No. 507-29, 4,000 ohms;
H—Ward-Leonard variable resistor, type No. 508-6, 4,000 ohms;
I and J—Ward-Leonard fixed resistors, type No. 508-4, 10,000 ohms;
K—Ward-Leonard fixed resistor, type 507-54, 750 ohms;
L1, L2, L3, L4, L5 and L6—Benjamin Cle-ra-tone vibrationless sockets;
M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11 and M12—XL push posts;
N—Baseboard, 8¾ by 18½ by ½ inch;
O—Formica connection panel, 6 by 8¾ by 3/16 inch;
P—Formica resistor-mounting panel, 4 by 7 by 3/16 inch;
Q—Lynch Equalizer, type 4;
Wire, screws, solder, etc.



HOW TO WIRE THE POWER-PACK AMPLIFIER

FIGURE 3: *All the wiring is done above the baseboard, and is indicated in this diagram in solid* RED *lines. The instruments are outlined in* BLACK. *The connections between this unit and the power speaker are shown in Figure 1.*

TESTING THE OUTPUT OF THE UNIT

It is most important, for the correct operation of valves, that "A" power units deliver a steady flow of current at all the required voltages. The engineer above is testing the Tobe "A" unit with a voltmeter and ammeter to ascertain these characteristics.

Dry "A" Power— *from the Socket*

With the increasing desire for the elimination of batteries in set operation, this compact "A" unit fills a distinct need. It is easy to build and install, and once installed requires absolutely no attention whatever, as it employs no parts which require servicing.

By STRATFORD ALLEN

WITH the constant advance of radio progress, the problem of converting alternating current from the lighting lines into direct current in sufficient quantity to furnish energy to the filaments of DC vacuum valves has become a relatively simple one.

Efficient rectifiers of the ionized vacuum valve type, and also of the dry and electrolytic types, have been developed to a point where they are thoroughly reliable and give a long period of service.

These rectifiers when operated in a full-wave circuit go a long way in producing the kind of direct current necessary for filament supply, but there is still a very considerable ripple left in the DC wave form, consisting ordinarily of pulsations in the amplitude of the direct current occurring at the rate of approximately 120 per second.

It is, therefore, necessary to use a filter circuit that will operate on low voltages to store up enough energy to furnish current for the filaments during the period when the amplitude of the rectified energy drops off. This necessitates capacities of very large values, compared with those ordinarily used in radio work, and makes the ordinary form of paper filter condenser too bulky and cumbersome to be economical.

It would need, possibly, 500 to 750 two mfd. condensers of the ordinary paper filter condenser type to reduce the hum to an unnoticeable value. Of course, this is impossible from an operating standpoint.

A recent development has resulted in a capacity that may be built in the size of the ordinary filter condenser, but that has a capacity thousands of times of that of the ordinary condenser.

This condenser has been incorporated into an "A" power filter known as the Tobe "A" filter. The filter itself contains a regular two-stage choke and condenser circuit utilizing the new type of high-capacity condensers. It is available in a compact form that needs but four connections to place it in operation.

In the following description of a rectifier unit to be used with this filter, a Knapp "A" power transformer and a Knapp full-wave dry electrolytic rectifier have been utilized with a switching arrangement for varying the taps on the transformer to get just the exact voltage necessary for the operation of sets utilizing from one to eight vacuum valves. The "A" power-pack described consists, then, of two items, the "A" filter and the rectifier, which will operate satisfactorily without any servicing whatsoever.

How to Construct the Rectifier Unit

The first job will be to cut two pieces of bakelite to a size of 7 by 4½ by 3/16 inch thick. These should be drilled for the holes necessary for mounting the transformer, as shown in the picture wiring diagram in Figure 2. It will be noticed that the panel, F, is attached to the transformer by four screws and nuts, and the panel, E, is attached to the transformer by four long screws and nuts slipped through four pieces of ¼-inch brass tubing 1½ inches long. The holes for mounting the rectifier, B, the switch, D, the two binding posts, H1 and H2, and the tap switch, C, should also be drilled, as well as the large hole for connecting the AC cord and plug.

After the instruments have been mounted, the wiring should be done exactly as shown in the diagram in Figure 2. It will be best to use a rubber-covered insulated hook-up wire, such as the Corwico brand, for making all of the connections, except the two power leads to the transformer indicated on the diagram by arrows. These should be made with a standard twisted lamp cord and a plug should be attached onto the end.

Check the wiring carefully after it has been completed, to be sure that no mistakes have been made.

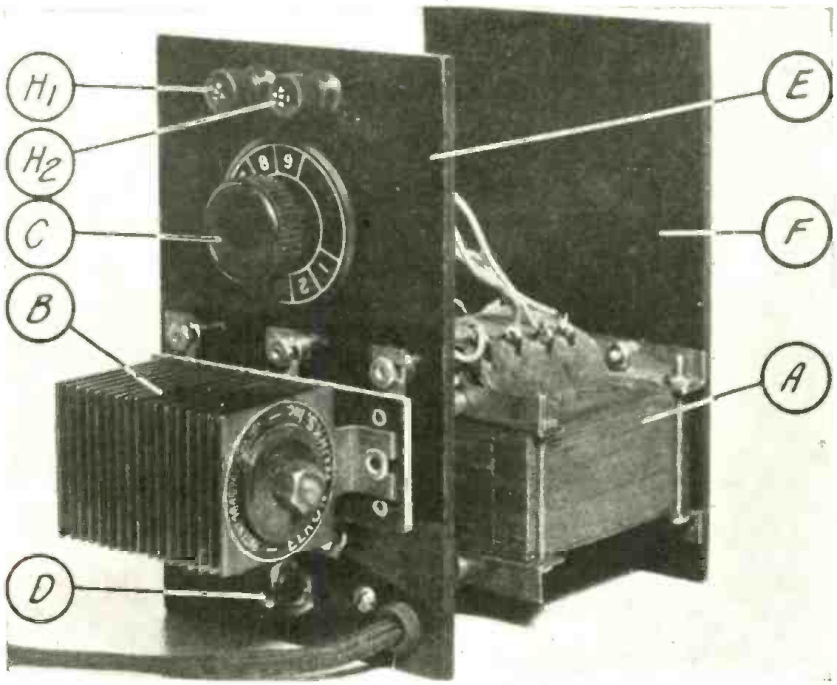
How to Use the Rectifier and the Filter

When all of the connections have been completed, the filter and the rectifier unit may be hooked up to the filament

(*Continued on page 252*)

POPULAR RADIO WORK SHEET

The Tobe "A" Power Unit



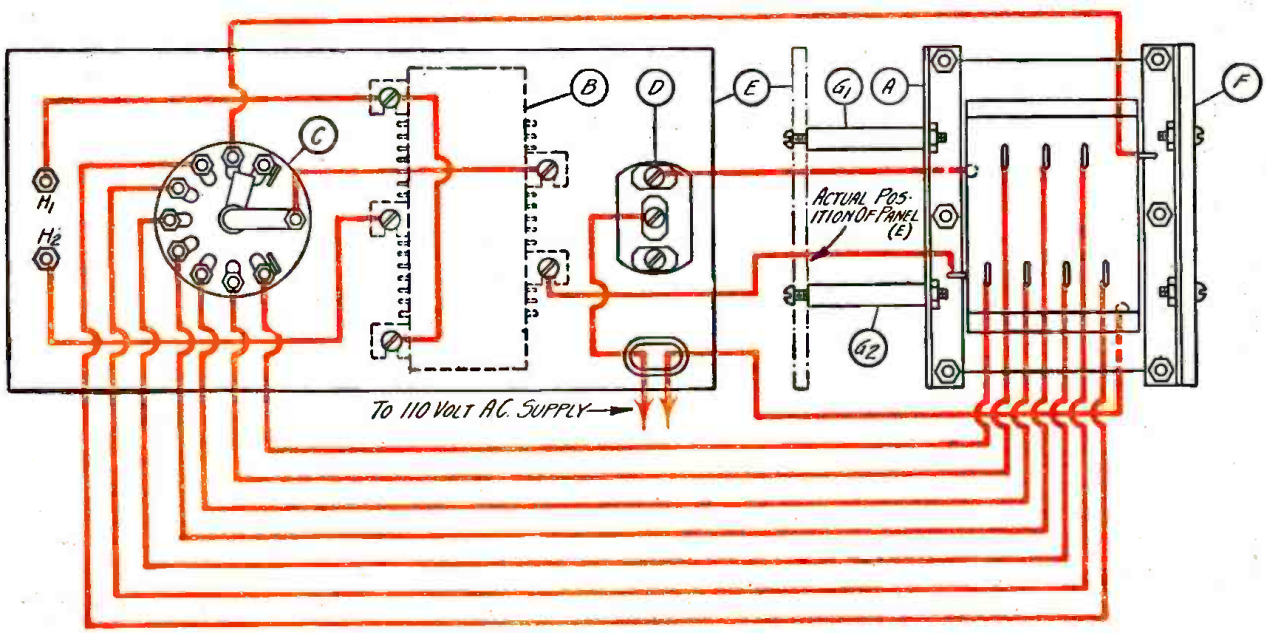
THE LAYOUT OF THE RECTIFIER UNIT

FIGURE 1: *The rectifier unit shown here may be assembled in a few minutes, as it consists of only seven parts, all of which are easily mounted and wired.*

List of Parts for Building This Unit

Cost of Parts—*Not over $16.00*

A—Knapp "A" tapped transformer;
B—Knapp full-wave rectifier unit;
C—Marco tap switch;
D—Cutler-Hammer toggle-switch;
E—Bakelite Micarta panel, 7 by 4½ by 3/16 inch;
F—Micarta panel, 7 by 4½ by 3/16 inch;
G1, G2, G3 and G4—¼-inch brass tubing, 1½ inches long, equipped with 2-inch bolt and nuts;
H1 and H2—Eby binding posts, marked "A" battery positive (+) and "A" battery negative (—), respectively;
Lamp cord and plug;
Corwico hook-up wire, screws, solder, bolts, etc.



HOW TO WIRE THE RECTIFIER UNIT

FIGURE 2: *The wires are shown in this diagram in solid* RED *lines and the instruments are outlined in* BLACK. *For purposes of clearness, the panel and transformer are shown in one plane. The actual position of the panel is shown in dotted lines.*

LISTENING IN

PRACTICAL *pointers from experimenters and broadcast listeners. What helpful hints can* YOU *offer to your fellow fan? Readers are invited to address their letters to the Editor of this Department.*

CONDUCTED BY DAVID LAY

How I Combined Radio and the Phonograph

I AM sending several diagrams (see Figures 1 and 2) of a successful scheme I have worked out, which I believe will be of interest to other readers. I have a Stromberg Carlson six-valve receiver and a Western Electric power amplifier with a 36-inch cone; I also have a Bristophon unit for use when I wish to reproduce phonograph music electrically through the power amplifier and the cone reproducer.

The value of this circuit lies in the fact that I can switch the power amplifier from the radio set to the phonograph by the simple expedient of throwing a single switch. Thus on nights when old man static is unbearable all that is necessary is to throw over the switch and use the phonograph for the evening.

When the switch is thrown to the "receiver" side everything is the same as in a normal installation, so that when the battery switch on the receiver is turned "on," the automatic relay is put into operation and thus connects both the "B" power-pack and the power amplifier to the AC line and at the same time cuts off the AC supply to the battery charger.

When the main switch is thrown to the "phonograph" side the receiver is completely cut "off" due to the breaking of the filament supply circuit and also the AC supply to the power-pack and to the relay. The power amplifier AC supply remains unbroken, however, and the phonograph output is fed into the power amplifier.

The diagram in Figure 2 shows the physical layout of the entire installation. The symbolic numbers used in this diagram represent the following instruments and parts:

No. 1—single-pole indicating snap switch;
No. 2—charger (trickle or bulb type);
No. 3—standard 6-volt storage battery;
No. 4—Western Electric power amplifier, No. 6025B;
No. 5—Stromberg Carlson 501, 502, 601 or 602 receiver;
No. 6—Stromberg Carlson power-switching relay, No. 301;
No. 7—Muter 5-pole, double-throw switch;
No. 8—Stromberg "B" power-pack;
No. 9—Bristophon electric phonograph amplifier, Model L;
No. 10—1½-volt dry battery;
No. 11—Western Electric No. 548-AW or 548-CW cone reproducer;
No. 12—any type of phonograph.

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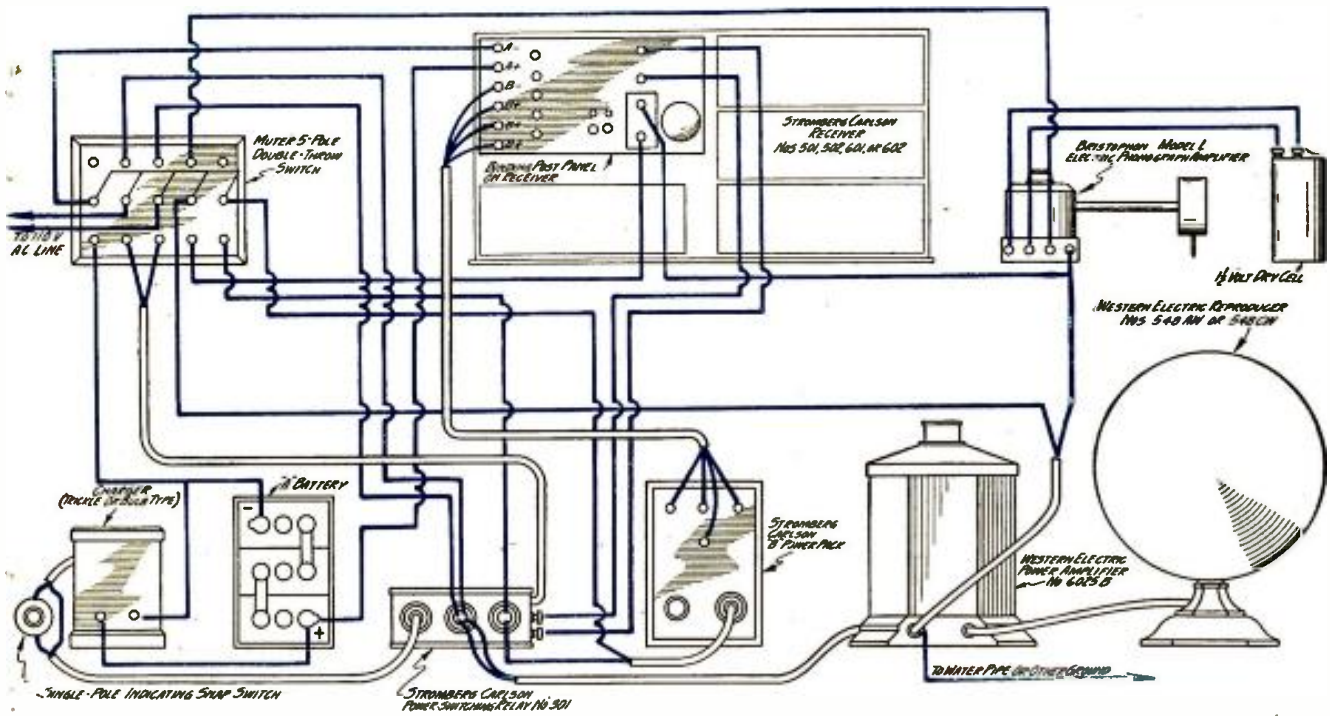


A HOOK-UP FOR ALL-ROUND PROGRAM REPRODUCTION

FIGURE 1: *Although this wiring scheme looks somewhat complicated, it could be duplicated by almost any fan in a short time, and the results, combining the best in broadcast reception and reproduction from phonograph records with radio clarity and volume, should be a pleasure to the most critical. As may be noted in the diagram, the hook-up is operated entirely from the light socket, and the change-over from radio to phonograph reproduction is accomplished by the single switch at the upper left.*

From a photograph made for POPULAR RADIO

PREPARING A TEST ON AMPLIFICATION TRANSFORMERS

The engineer is comparing the frequency of a standard 60-cycle tuning fork with a frequency of a sine-wave oscillator that is used to generate currents of a single frequency for obtaining amplification curves on low-frequency apparatus. Curves of this type are shown in Figures 1, 2 and 3.

FACTS THAT FANS DO NOT KNOW ABOUT

Better Amplification

Do you know the factors in an amplifier that govern the quality of tone coming out of your loudspeaker? Do you know why some sets sound high and tinny and others sound full and robust? Do you know how to choose an amplification system that will give the best results for the money you wish to spend? Here is valuable information by an authority on this subject—

PROFESSOR E. L. BOWLES *

THE question will undoubtedly arise, "What transformer should I choose?" This question is no more readily answered in a few words than, "What automobile should I choose?"

In the first place there is the question of the turns ratio.

The designation of a transformer by "ratio" is no more complete than the arbitrary designation of an automobile motor's horsepower by its cylinder dimensions. Two transformers may have the same ratio of secondary to primary turns, and yet they may be *very different* in their operation. For illustration: it would be possible to make a transformer of 3 to 1 ratio with but one turn for the primary and three turns for the secondary winding. If this transformer were used, it would give no results, assuming an ordinary core were used.

In practice thousands of turns of wire are used as the primary winding and more thousands of turns of wire as the secondary winding. As a rule, the better transformers have a greater number of primary turns. Since copper is expensive, it is, of course, cheaper to use as little as possible. As a consequence, one 3 to 1 transformer may give a high amplification of the lower frequencies and another a very low or poor amplification of these frequencies.

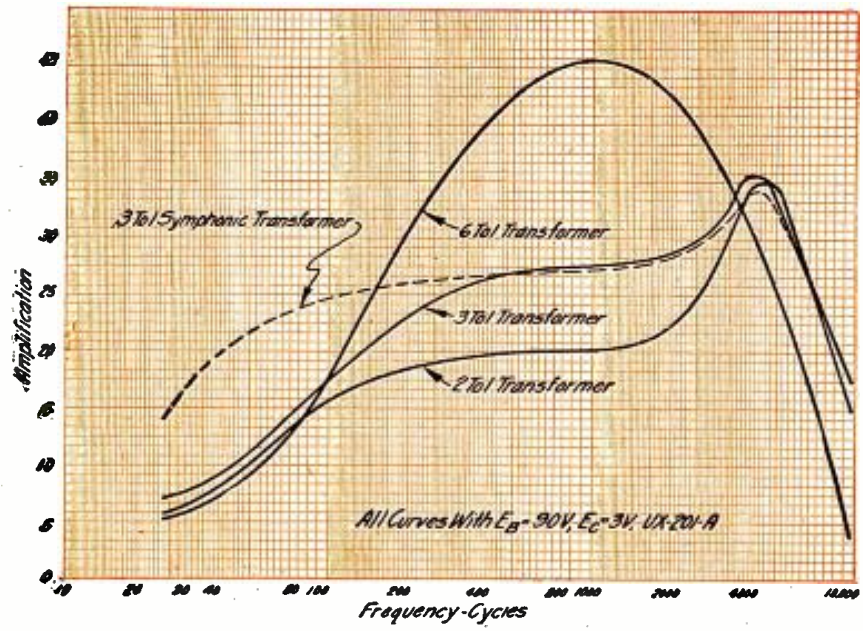
The lower the ratio of the transformer chosen, the less the overall amplification for a given number of stages, but the better the quality *if* the transformer is properly designed. The lower the ratio of the transformer, the greater the number of stages necessary.

However, a 6-1 ratio transformer does not give twice the overall amplification given by a 3-1 ratio. Futhermore, as the ratio is reduced, the relative amplitude of the lower notes increases, with the result that the apparent decrease in amplification is less than it would be if the amplification were reduced in the same proportion at all points. These facts are brought out in Figure 1.

In general, the 3 to 1 transformer will meet the needs of most users. A transformer of this ratio, coupled with the shunt resistor volume control across each transformer secondary, will give great flexibility as to quality and volume. For still better quality at the same volume, the special transformer in Figure 1 is without equal, in the author's opinion. In some cases two 3 to 1 transformers may give too much amplification, so that one 2 to 1 and one 3 to 1 may be used. Again, two 3 to 1 transformers may not give enough amplification, but three may give too much. A 2 to 1 transformer may be added, or three stages of 2 to 1 transformers used.

There is no particular argument to justify the use of transformers of composite ratios in an amplifier; that is, a 3 to 1 and a 2 to 1 and so on. Some have recommended this as standard practice; but often it will be found that the contender was not able to make two

* Dr. Bowles, whose articles on low-frequency amplification have been appearing in POPULAR RADIO during the past months, is on the faculty of the Massachusetts Institute of Technology, and is widely known as an authority on low-frequency amplification.



HOW TURNS RATIO AFFECTS TRANSFORMER AMPLIFICATION

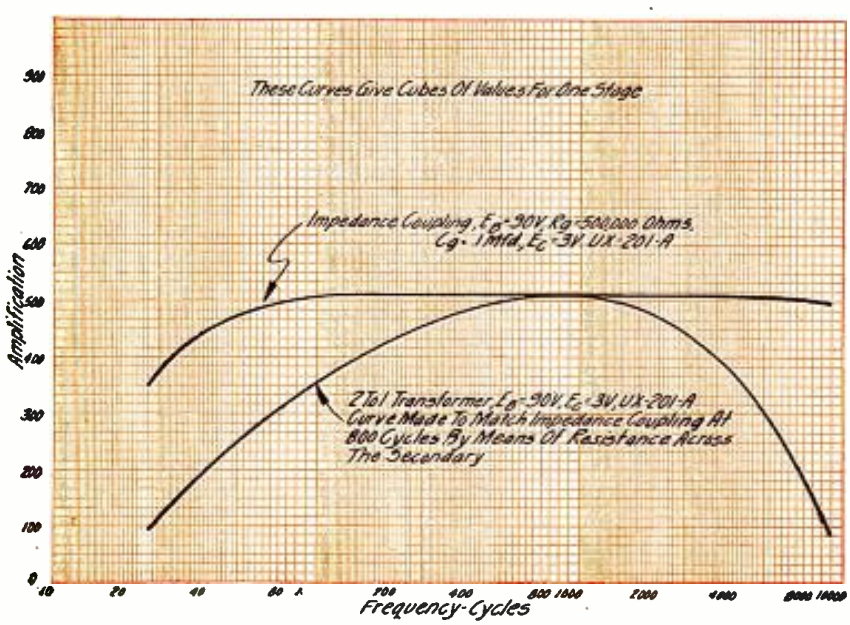
FIGURE 1: *Notice how the solid black curves for the three ordinary transformers flatten out as the turns ratios of the windings decrease. The dotted curve is for a symphonic transformer using special core material, and shows very efficient overall amplification.*

or more stages of the same ratio stable. It has often been suggested that if composite ratios are used, the high-ratio transformer should be in the first stage and the low-ratio transformer in the second stage.

Actually, from the viewpoint of uniform amplification of all frequencies, if the detector valve is operating on a low voltage, such as 22½ or 45, it is better to have the lower ratio transformer *immediately follow* the detector valve. The reason is that the lower the plate voltage, the higher the internal plate resistance of the valve. A low-frequency transformer will amplify the lower notes less and less as this plate resistance increases, whereas the amplification of the higher notes is not affected the same in this proportion.

In the case of the dry-cell valves, such as the UX-199 type, it will be found that the quality will be improved if lower ratio transformers are used. The 2 to 1 will do particularly well here, owing to the high primary impedance of the transformer and the high internal resistance of the valve combined with the lower overall amplification.

The high-mu valves should not be used between transformers, as they are not designed for this purpose, nor is the transformer designed to work with them.



CURVES FOR IMPEDANCE AND TRANSFORMER COUPLING

FIGURE 2: *A three-stage, impedance-coupled amplifier gave the curve shown at the top, and a transformer-coupled amplifier the lower curve. This curve does not, however, represent the best that may be obtained with transformers.*

Types of Transformer Distortion

There is distortion in all amplifiers. The problem is to reduce it to such a point that it is unnoticed and undetectable. Figures 1 and 2 illustrate what may be called *frequency distortion* in different low-frequency amplifiers. By frequency distortion is meant the relative difference in the amplification of electric waves of different frequencies. The curves show that the impedance amplifier is apparently more impartial than the transformer amplifier in its amplification of audible waves of different frequencies.

A comparison of a hook-up of three stages of impedance coupling with three stages of 2 to 1 transformer coupling is made in Figure 2. This figure will give some idea of the relative frequency distortion in the different cases.

Another type of distortion may be called *harmonic distortion*. By harmonic is meant the insertion of harmonics by the amplifier itself. That is, if a pure tone of 1,000 cycles per second is impressed on the microphone of a broadcast station, what comes out of the speaker of the receiving set may be a 1,000 cycle per second plus a 2,000 cycle per second tone, plus perhaps even more such frequencies which are integral multiples of the original pure tone. To be sure, these undesirable harmonics may be small in magnitude, but they do, nevertheless, affect the quality of a note.

Such harmonics may be introduced by the valves and by the iron in transformers. The better the transformer iron and the transformer design, the less this distortional effect.

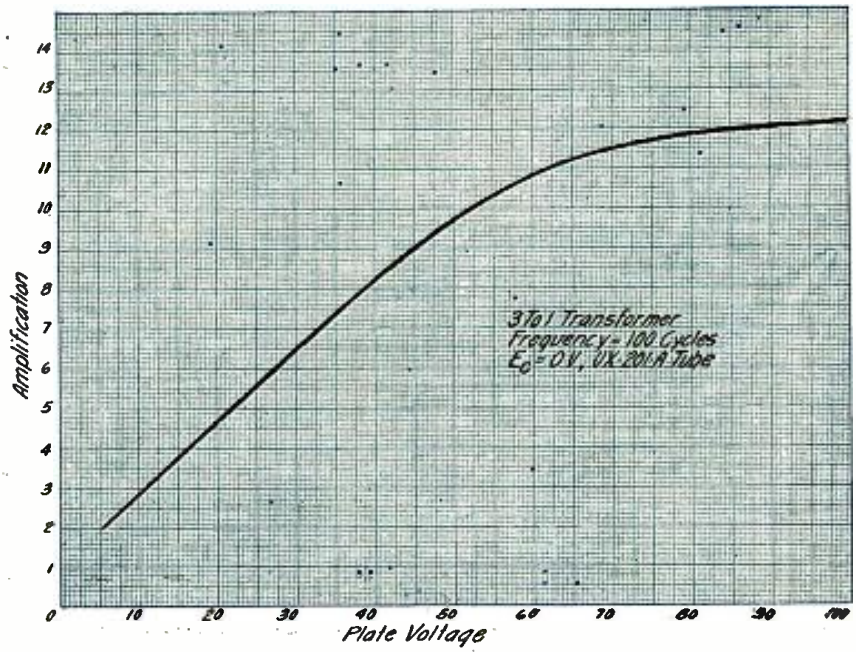
The louder the signal, the greater the tendency toward harmonic distortion. Oftentimes a distortion will not be noticed until the reproducer volume is increased. The consequent distortion, if noticeable, may be due to many things, such as poor broadcast station program apparatus and technique, too selective a radio receiving set, too much regeneration, regeneration at too many places, poor detection, poor amplification, poor reproduction, or a combination of these. The transformer is not always to blame.

Distortion which may creep into low-frequency amplifiers, or which may already be there, may be due to improper battery connections or improper

battery voltages. Too low a filament voltage will not only lower the output of an amplifier, but it will introduce serious distortions. For instance, in the transformer-coupled amplifiers of Figure 4, too low a filament current will cause the output from the reproducer to sound "tin-panny." If the operator should deliberately decrease the filament currents of the detector and low-frequency amplifier valves, he would observe that the lower notes would disappear first, and that the remaining bare tinny notes would disappear gradually.

The volume from any amplifier should *never* be controlled by varying the filament current of the low-frequency valves. The filament current or voltage should be kept at the rating specified by the manufacturer. Use a voltmeter to determine the proper value.

The "B" battery voltage should be that specified by the manufacturer. One may reduce the "B" voltage in the amplifier valves and say that it has no effect, but he is usually mistaken. This conclusion may be the fault of an insensitive ear, a prejudice or an incomplete test.



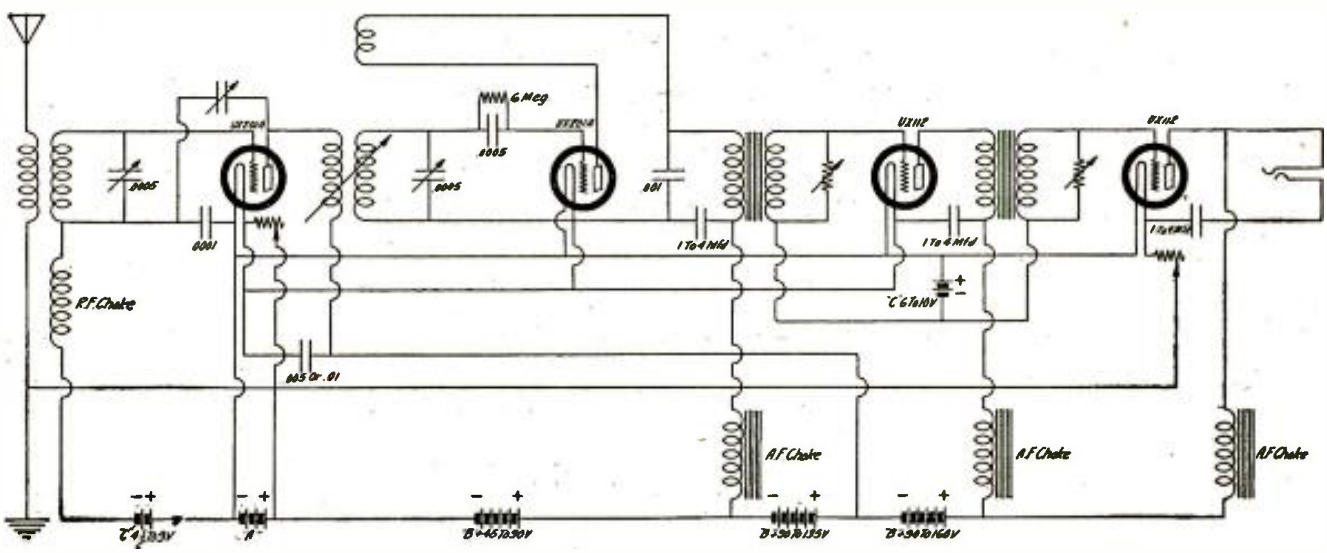
A PLATE-VOLTAGE AMPLIFICATION CURVE

FIGURE 3: *This graph shows the increase of amplification obtained with a standard vacuum valve as the plate voltage is increased.*

Figure 3 shows how the amplification varies with "B" battery voltage in a transformer-coupled amplifier utilizing UX-201-a type valves. As the "B" battery voltage is increased beyond 50 volts the amplification does not change so much. Actually this is only a part of the story, since the signal voltage applied to the amplifier was very small in this case. A larger signal voltage would show distortion with a "B" battery voltage of 60, whereas a perfectly clear signal would result with a "B" battery voltage of 100. That is, the larger "B" battery voltage, in addition to increasing the volume of the signal, enables the amplifier to handle more volume without distortion, or more volume with a given permissible distortion. There is the additional advantage that the larger voltage will cause a larger amplification of the low notes in proportion in a transformer or impedance-coupled amplifier. In general, for the best low-frequency amplification with given valves, they should be operated at the higher "B" battery voltage recommended by the manufacturer. The higher voltage will result in clearer tones and more brilliancy of reproduction.

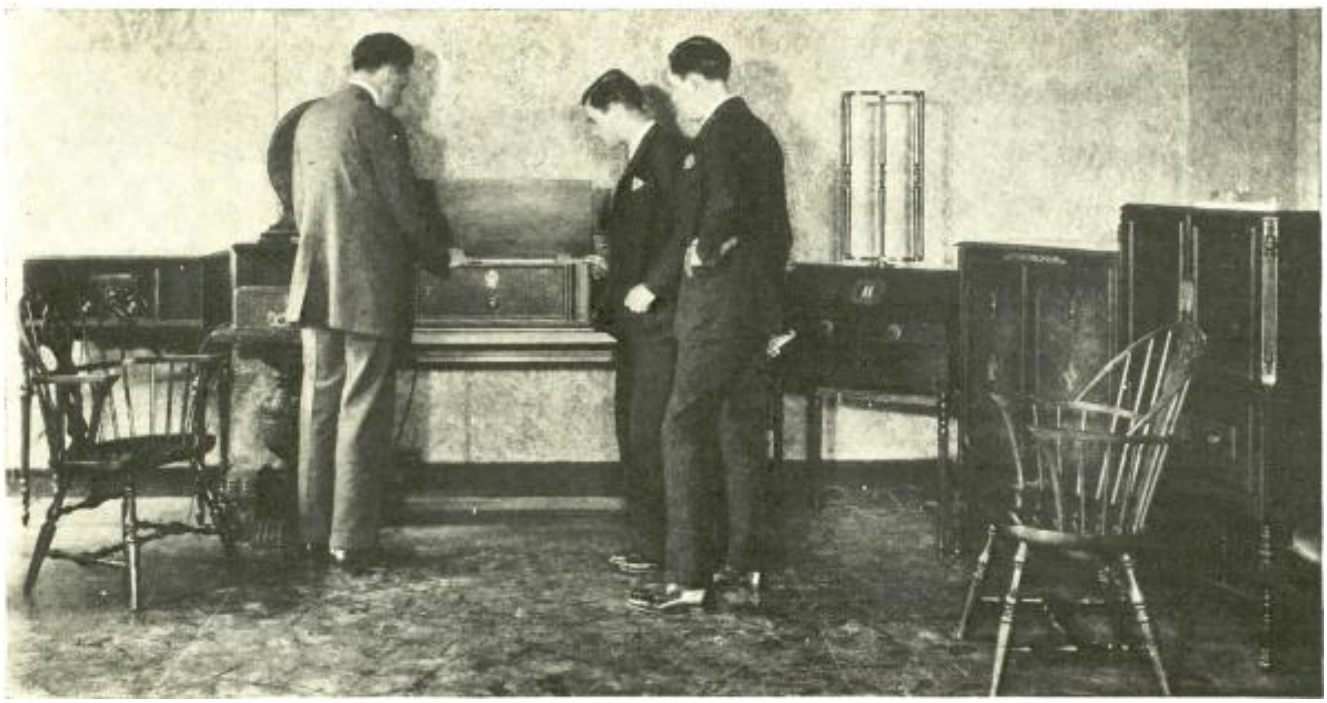
The detector voltages, in the case of hard detector valves such as the UX-112 type, the UX-201-a, and the UX-199 type are not critical, as these valves will detect efficiently at various plate voltages. Consequently, in the case of transformer-coupled amplification particularly, and in cases of all other forms of coupling, it is advantageous to keep the detector plate voltage high, for although this is not a requisite for the detector valve as a detector, it is advantageous for the valve as an *amplifier*. The detector valve (using grid-leak and grid condenser) acts not only as a de-

(*Continued on page 240*)



TRANSFORMER-COUPLED AMPLIFICATION IN A RECEIVER CIRCUIT

FIGURE 4: *Two stages of transformer-coupled low-frequency amplification are shown at the right in this schematic circuit of a receiver. The variable resistances across the transformer secondaries are for volume control.*



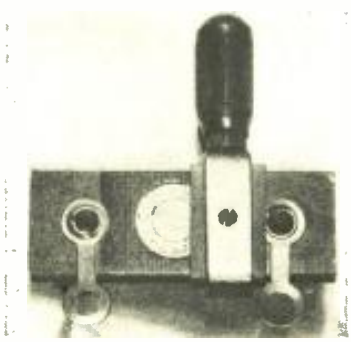
WHERE POPULAR RADIO SERVES ITS PUBLIC

This picture shows the demonstration room at POPULAR RADIO'S *headquarters, where the various receivers and accessories that are tested in the Laboratories are put through their paces before radio manufacturers. This co-operation between* POPULAR RADIO *and the radio manufacturers results in improved apparatus for the fan and set builder.*

What's New *in* Radio

Conducted by
THE TECHNICAL STAFF

The material listed in these columns has been carefully tested in the POPULAR RADIO Laboratory, which is acknowledged to be one of the most completely equipped institutions of its kind. Mention in the following pages signifies that the apparatus illustrated has met the approval of the POPULAR RADIO Engineering Staff.



A Compact "C" Biasing Resistor Unit

Name of instrument: "C" biasing resistor, variable.

Description: This potentiometer is wire wound on a bakelite strip. The winding terminates in soldering lugs and the slider is so designed that it can be locked in place after the proper adjustment has been made. The unit is made in various resistances so it can be used as a filament shunt resistor with variable center tap for mounting directly on the sockets of AC valves; or it may be used in power-packs to provide either one or two "C" biasing voltages.

Outstanding features: Small enough in size to mount directly on filament terminals of AC valve sockets. Simple and sturdy. Inexpensive. Available in resistances from 50 ohms to 2,500 ohms.

Maker: Carter Radio Co.

Handy Valve Sockets for the Home Constructor

Name of instrument: Na-ald valve socket, type No. 424.

Description: Moulded bakelite is used for encasing this socket. The socket is so designed that it may be mounted either above or below the sub-panel of a receiver. In the former case it projects about ⅜ inch above the sub-panel; when mounted beneath the panel, the top of the socket is flush with the top of the sub-panel. Mounting lugs extend out from two sides of the bakelite case and the contact springs extend out through the bottom of the case to provide connection terminals. Good contact is made with the valve prongs. The holes in the top of the case are set down in a depressed ring to facilitate inserting the valve; this ring is colored red for sockets for the 226 type valve, green for the 227 and yellow for power valves.

Outstanding features: Easy to insert valve. Good contacts. Small size. Universal mounting. Small jack included in socket for connecting grid suppressor resistance unit.

Maker: Alden Mfg. Co.

Small Size Resistors for Heavy Loads

Name of instruments: "Powerohm" medium-duty, high resistances.

Description: These resistances are designed to dissipate 2½ watts and are made in various values from 250 ohms up to 250,000 ohms. They have the advantage that at maximum load the resistance change is less than 10 per cent. The resistance element used consists of a glass filament which is coated with a conducting material that is baked on to form a homogeneous conducting surface of high resistance and permanent character. This permanency is aided by a coating of insulating varnish which protects the resistance coating from atmospheric changes. The whole unit is then inclosed in a glass cylinder with metal end caps which are connected to the extremes of the resistance element. In physical appearance these resistance units resemble standard grid-leaks. The smaller of the two sizes shown is the same length as an ordinary grid-leak, but of slightly larger diameter. The larger unit is of the same diameter as the smaller one, but about an inch longer. Both sizes have the same power rating.

Usage: As coupling resistors or as resistors in power circuits where they will dissipate not more than 2½ watts continuously.

Outstanding features: Accurate resistance rating. Resistance change less than 10 per cent under full rated load. Resistance value permanent.

Maker: International Resistance Co.

A Heatproof and Moisture-proof Condenser

Name of instrument: Mica fixed condenser.

Description: The condenser element is carefully prepared from high-grade mica and tinfoil and is thoroughly impregnated to bind it. It is then moulded under high pressure into a bakelite covering so that the completed condenser is a solid block of bakelite with the condenser element sealed in the center and connection terminals from the latter projecting out through the ends of the block. These terminals are carefully designed to afford ample surface for soldering. The capacity of each condenser is clearly stamped in the bakelite.

Usage: For any purpose which requires a fixed capacity within the range of .00004 mfd. to .02 mfd.

Outstanding features: Capacity constant regardless of atmospheric conditions, heat applied in soldering or rough usage. Neat appearance. Guaranteed accurate within 10 per cent.

Maker: Aerovox Wireless Corp.

A Complete Line of High-Grade Condensers

Name of instrument: Parvolt fixed, by-pass and filter condensers.

Description: This group of condensers represents the line formerly marketed under the name Sangamo.

The fixed condensers employ mica as the dielectric and are moulded in bakelite blocks. Thus they are moisture proof and of unvariable capacity. They are equipped with metal terminals in the form of threaded brass bushings, which extend through the block and permit connections to be made on either or both sides of the condenser terminals. These small condensers are accurately rated as to capacity. Clips, as shown in the picture, may also be obtained to attach to the condenser terminals where it is desired to mount grid-leaks or resistors in shunt with the condensers.

The small by-pass condensers shown are of the "wound" type and employ a high grade of condenser paper as the dielectric. They are inclosed in metal cases with lugs at the bottom for mounting in an upright position. The condensers are hermetically sealed in cans and are provided with soldering lug terminals which extend up through the wax in which the condenser windings are imbedded. These by-pass condensers are rated for continuous service at 400 volts DC, which is sufficiently high to permit their use for all by-pass work in receivers and in the output circuits of 180-volt "B" power-packs.

The filter condensers are similar to the by-pass condensers in construction, but are larger and will withstand higher potentials. They are obtainable in capacities from 1 to 4 microfarads. They also employ high-grade condenser paper as the dielectric. These condensers are rated at 800 and 1,000 volts DC continuous service. These high ratings permit the use of these condensers in heavy-duty "B" power-packs such as those used to supply the high operating voltages required for the 210 type of power valve. Heavy mounting feet are provided on the larger condensers.

Outstanding features: Each condenser accurately rated as to capacity and voltage at which it may safely be used for continuous duty. Easy to mount. Sturdy and durable.

Maker: Acme Wire Co.

A Transformer for "ABC" Power-Packs

Name of instrument: Power supply transformer, No. 3591, for power-packs.

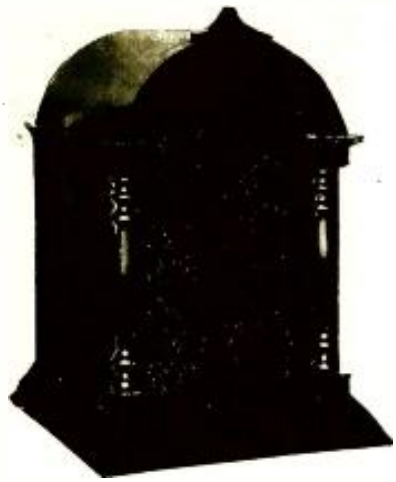
Description: This transformer is designed for use with the Raytheon BA-type rectifier valve, to supply the "A," "B" and "C" voltages for receivers that use standard UX-201-a type valves wired in series. This valve requires a transformer with a center-tapped secondary winding to supply 350 volts each side of the tap. This voltage is provided in this transformer, and in addition there is a 5-volt center-tapped winding to supply the filament current for the operation of a UX-171 type power valve in the last low-frequency stage of the receiver. This transformer is completely inclosed in an iron case with a black crackle finish.

Usage: To provide input voltage for a Raytheon BA-type power-pack; also filament voltage for the operation of a UX-171 type amplifier valve.

Outstanding features: Good construction. Neat appearance. Fully safeguarded against the danger of shocks.

Maker: Dongan Electric Mfg. Co.

New Results With



The Consomello Horn

A 3-Foot, Air-Column Horn in a Decorative Cabinet

Name of instrument: "Consomello" horn-type reproducer.

Description: In general appearance this reproducer is somewhat similar to many of the present-day inclosed cone reproducers. Actually it contains a horn with an air column which is approximately 3 feet in length. This horn is curled up into compact dimensions, which explains how it is possible to accommodate it in a cabinet of such small dimensions. The cabinet is well made and decorative in appearance. The open front is protected by a textile material which adds to the appearance of the reproducer without in any way interfering with the tone quality or volume.

Outstanding features: Design of horn permits it to be inclosed in comparatively small cabinet. Good reproducing qualities. Neat appearance.

Maker: Mazda Radio Mfg. Co.

An Enclosed Cone of Fine Appearance

Name of instrument: Vogue model 12 cone reproducer.

Description: This reproducer is of the drum type in outer appearance. It consists of a metallic case that is crackle finished in dull brown. It is open at the front and rear, with the openings covered with grille work that is finished in old gold and backed with silk material of the same color. The reproducer proper is of the cone type and is completely concealed within the metal case. This case serves as a resonance chamber to provide the full round tones so eagerly sought after.

Outstanding features: Pleasing to the eye and to the ear. Neatly finished and well designed.

Maker: Richard T. Davis, Inc.

The Vogue Cone

The Magnavox Power Cone Reproducer

A Power Amplifier and Speaker for Any Receiver

Name of instrument: Power cone reproducer.

Description: The Magnavox power cone consists of a stage of power amplification, employing a 210 type valve, a power supply unit to supply the filament and high voltage plate supply for this valve, a cone type reproducer and an output transformer. All of this equipment is mounted on a metal base and makes a compact unit which will easily fit into the reproducer compartment of a console receiver. The unit is intended for use in place of the last low-frequency stage of any receiver and when so used does not require any alterations in the receiver or wiring. An extension cord and plug supplied with the unit is connected into the receiver circuit by inserting it in the last valve socket.

Outstanding features: Provides a fine cone reproducer and a stage of power amplification for use with any receiver. Compact and easy to connect to receiver. Provides all of its own power requirements, including filament, plate and grid voltages.

Maker: The Magnavox Co.

A Horn for Full-Throated Reproduction

Name of instrument: Drum speaker No. 18, senior.

Description: This horn, if it were straightened out, would be 75 inches in length, but it is so designed, by curling the smaller part around the flaring output end, that it may be inclosed within a drum-shaped metal case that is only 18 inches in diameter. The reproducer itself is of a special composition material and is moulded to present a smooth internal surface to the sound vibrations. The inner diameter of the horn gradually increases at a carefully planned rate so as to provide natural reproduction with maximum volume, especially on the low base notes. The metal drum in which the reproducer is inclosed is done in a crackle-finished brown and the whole unit is mounted on a substantial base which adds considerably to its appearance.

Outstanding features: Natural reproduction with a well-rounded tone quality.

Maker: Temple, Inc.

The Temple Drum Speaker

The Amplion Cone

A Cone With a Wooden Rim and Backing

Name of instrument: Amplion cone reproducer, model AC-20.

Description: Made by one of the oldest manufacturers of devices for the electrical reproduction of sound, this reproducer comes to us well recommended. It consists of a specially prepared fabric cone which has approximately the stiffness of parchment, but is "dent" proof. The cone is finished in old bronze. The cone proper is inclosed at the edge and the back by a wooden sounding board, to which the reproducer owes its mellowness of tone.

Outstanding features: Wooden sounding board. Free-edge suspension. Built of dent-proof cone material. Contains a genuine Amplion unit.

Maker: Amplion Corporation of America.

1928 Loudspeakers

A Decorative Reproducer

Name of instrument: Shield speaker.

Description: Good quality of reproduction and unusually attractive appearance mark this new reproducer. It is a so-called "cone" type reproducer, inasmuch as the large shield-shaped part of the device constitutes the diaphragm and is connected to the driving unit by means of a short drive rod, after the fashion of the usual cone reproducers. The diaphragm is attached to the metal stand at only two points, top and bottom, so that the reproducer is of the free edge type. The pedestal and floor stand are of metal and so designed that the center of gravity is low and the unit is therefore not easily tipped over. The diaphragm is of a composition material similar to celluloid and will neither nick nor dent, as will most paper or parchment diaphragms.

Outstanding features: Good reproduction. Fine and novel appearance. Much less easily damaged than most reproducers. Neatly finished in blue and polychrome.

Maker: Shield Speaker Co.

The Shield Speaker

A Medium-Sized Cone of Good Characteristics

Name of instrument: Model 28, "Concerto" reproducer.

Description: The edge of the parchment cone of this reproducer is not rigidly supported. It receives a certain amount of support from the grooved metal band which incloses its edge, but it is permitted to vibrate freely. The reproducer unit is mounted on a metal framework which is rigidly attached to the metal base and also to the grooved ring which incloses the cone edge. The cone is approximately 14 inches in diameter and is attached to the driving rod of the reproducer unit by means of a bushing and a set screw.

Outstanding features: Free-edge action. Moderately price. Neat in appearance. Good reproduction.

Maker: Trimm Radio Mfg. Co.

The Concerto Reproducer

An Eight-Foot Horn in a Two-Foot Space

Name of instrument: "Console Grand" exponential horn.

Description: The air column of this exponential type horn is 86 inches in length, but the horn is so arranged that it occupies a space of only 25 inches by 19 inches, which is the size of the rectangular flaring bell of the output end. The horn is of composition material and is well designed as regards shape and material, both of which are factors of extreme importance in a horn-type reproducer. The reproducer unit is a Baldwin. The horn is obtainable equipped with any one of several different types of cabinets. These cabinets are of table height and if desired the radio receiver may be placed on top of the reproducer cabinet.

Outstanding features: Excellent reproduction over the entire range of audible frequencies. Free, natural reproduction of the low bass notes particularly noticeable. Presents a fine appearance when inclosed in any of the wood cabinets which may be obtained for it.

Maker: Racon Electric, Inc.

The North Vernon Horn

A Reproducer for Enclosure in a Console Cabinet

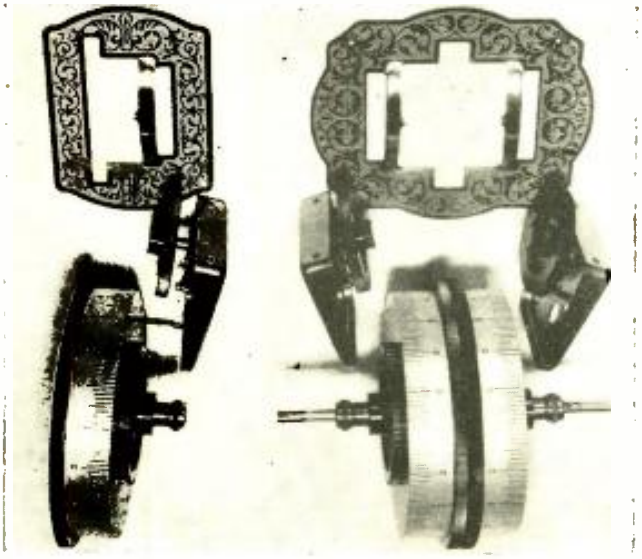
Name of instrument: Horn-type reproducer.

Description: This reproducer is intended to fit inside of console cabinets that have a compartment provided for this purpose. Some consoles already include reproducers of inferior quality, while others provide the space, but are not equipped with a reproducer when purchased. This reproducer is of the horn type, but is so designed that the more slender portion of the horn is curved and nestles around the expanding portion of the bell-shaped opening. The horn is of composition material and is inclosed within a wood case of rectangular shape. A hole is provided in one side of the case, through which the small end of the horn is accessible for attaching the reproducer unit. The front of the case is cut away over the mouth of the horn.

Outstanding features: Good quality. Plenty of volume. A convenient accessory for those who wish to conceal the reproducer.

Maker: North Vernon Lumber Mills, North Vernon, Ind.

The Racon Horn



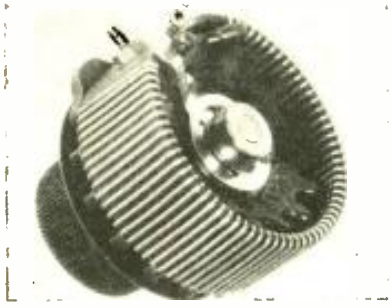
Drum Dials for the Home-Built Receiver

Name of instruments: Single or double drum dials.

Description: The single dial shown above consists of the large drum with a calibrated scale, knurled edge and gear wheel, a mounting bracket, and an escutcheon plate. In a single-control receiver all tuning condensers are mounted on a single long shaft, as is also the large drum. The mounting bracket is attached to the receiver panel in such a position that its small gear wheel meshes with the larger gear on the drum. Tuning is then accomplished by means of either of the knurled discs, the one on the mounting bracket or the larger one on the drum, both of which project through the slots in the escutcheon plate. The movement by means of the large control provides direct tuning, while the smaller one provides a high step-down ratio of vernier action. The double dials function in the same manner, except that they are on separate shafts to control separate tuning condensers or groups of condensers. These two drums may be manipulated independent of one another or together, in the latter case providing single control. This last is attained by bridging a finger across the adjoining knurled discs and revolving the two together.

Outstanding features: Fine appearance. Excellent workmanship. Smooth action, without back-lash. Provides either direct or vernier control of tuning.

Maker: Tyrman Electric Corp.



An Air-Cooled Filament Control

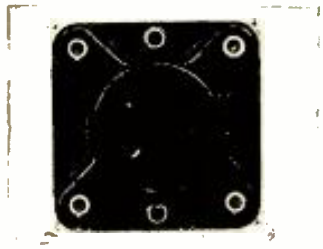
Name of instrument: Filament rheostat.

Description: The resistance winding of this unit consists of wire wound around a composition strip and assembled with this strip curved around the circumference of a corrugated composition block. With this arrangement only about 5 per cent of the resistance surface is in contact with the frame, thus leaving approximately 95 per cent of the resistance surface exposed to circulating currents of air for the dissipation of heat. A spring slider is provided for the variable contact arm and this operates smoothly and with light pressure but perfect contact. The instrument is equipped with a composition knob and may be mounted on a receiver panel with a single hole.

Usage: For the control of filament current for from one to ten valves.

Outstanding features: Well made. Permits free circulation of air around the winding. Made in various sizes from 2½ ohms to 75 ohms, with current carrying capacity up to 2 amperes in the case of the 2½-ohm type illustrated.

Maker: Herbert H. Frost, Inc.



A New Type of Vibrationless Valve Socket

Name of instrument: Cushion radio valve socket, type 3.

Description: The composition base of this socket is rectangular in shape and has a cut-out center in which the composition disc which actually holds the valve is suspended. Suspension is by means of a long double spring, which is entirely insulated from the four socket terminals and therefore from the valve terminals when the valve is in place in the socket. Contact between the valve prong clips on the under side of the suspended disc and the socket terminals is made through short cables of flexible wire.

Outstanding features: Unusually long suspension springs. Springs do not function as connectors, so there is little chance for poor contacts to valve prongs. Stops are provided to limit movement of suspended portion of socket; thus possible damage to spring is avoided.

Maker: Kellogg Switchboard & Supply Co.

A Handy Volume Control Unit for Any Receiver

Name of instrument: "Tonatrol" volume and tone control unit.

Description: This unit is a variable high resistance and is similar to a rheostat in appearance. It is equipped with an engraved knob and is designed for single-hole mounting on the receiver panel. When connected across the secondary of the low-frequency transformer in the first low-frequency stage, the volume of reproduction can be smoothly varied from zero to maximum. Also various shadings of tone can be obtained in this same way. The unit is also supplied in the "WS" model, which in addition to the function described above also serves as a filament switch.

Usage: To control the volume and tone of reproduction in a radio receiver.

Outstanding features: Smooth control of volume. Easily installed. In some old-fashioned receivers this unit will improve the tone quality appreciably.

Maker: Electrad, Inc.

A SPORT-MODEL RECEIVER

This unique French receiver that can be held in the palm of the hand employs two ring coils for an antenna and a crystal for detection. It is popular among French fans who take to their bicycles for sport.

I Used to Give Radio Information Away—Now I Sell It

(*Continued from page 221*)

short distance from New Albany. Here I service, during the daytime, standard receivers like the Radiola, Crosley, Atwater-Kent, and other makes of sets. This work, aside from its remunerative value, adds constantly to my experience and permits me to keep my ears to the ground for information that will better my own spare-time business. A radio service man must be familiar with all types of receivers and with the new developments made each year by the various manufacturers. Having a regular service job with an established dealer permits the operator to do this and to actually be paid for his efforts.

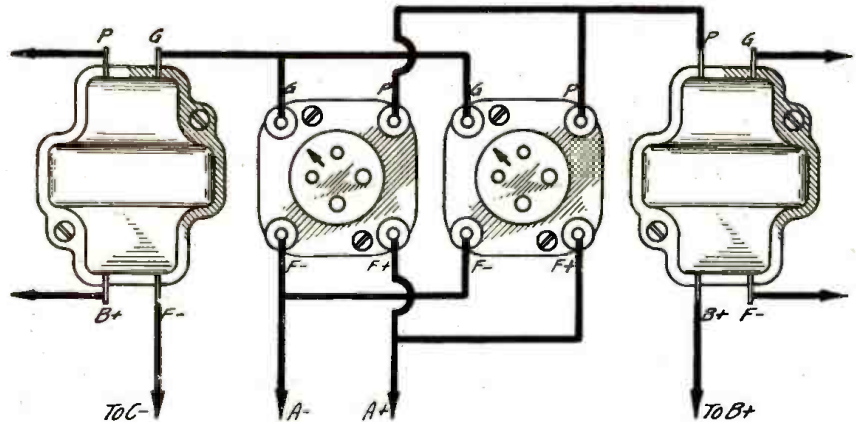
Last year, which was a particularly good one for me, I succeeded in booking orders for seventy-two receivers. which ran in size from three to eight valves. The profit on these receivers averaged between $15 and $60 per set. In many cases I could have realized a much greater profit on some of these sets, but I preferred to accept a modest profit, being primarily interested in getting satisfied customers. As time goes on and my reputation becomes very firmly established, I shall increase my margin of profit, bringing it up to a more substantial amount.

As I look back over my several years of effort in this field, I realize that my business would have grown more quickly if I had been able to do some advertising in our local newspapers. If a man has a moderate capital to start on, this might be a wise thing to do. But I have worked on the theory that it is the satisfied customers who bring the invaluable "word of mouth" advertising, which, after all, is the very best kind. The only money that I have spent has been in the form of business cards, which I distribute freely to prospects and to customers who might wish to mention my name to friends.

Some day, perhaps, I shall own my own radio shop, and if my present rate of income increases steadily I do not believe that this will be far off. My experience in servicing has proven that it does not make very much difference what receivers you sell, providing you can give them intelligent service. I believe that the whole foundation of radio merchandising rests upon sound dealers' service. And a man starting out in retailing radios with a good knowledge of radio will be found to do more business than the opportunist around the corner who is primarily interested in making initial sales, and who is inclined to look upon servicing work as a necessary evil, when he should look upon it as a means of establishing more intimate relationship with his customers and creating a firmer foundation for his business.

Better Amplification

(Continued from page 233)



DOUBLING UP AMPLIFIER VALVES

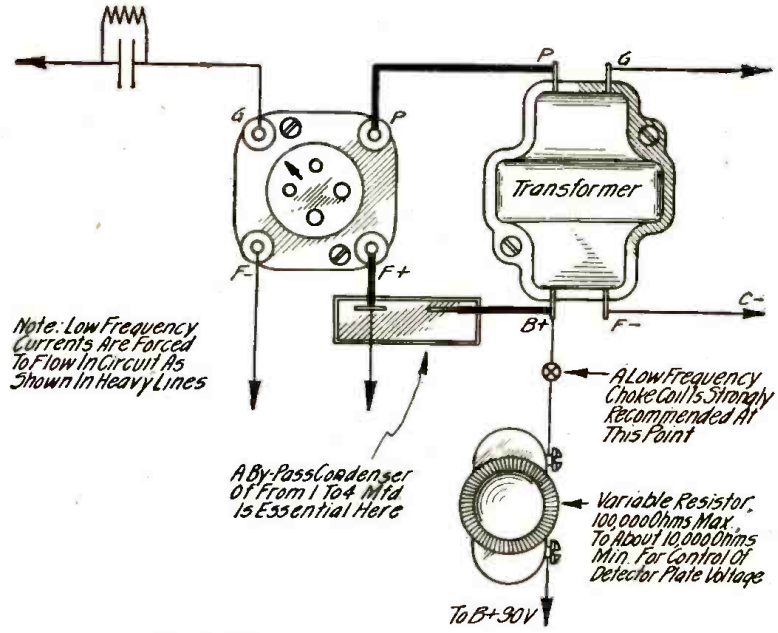
FIGURE 5: *Here is a simple method of paralleling two standard vacuum valves for obtaining greater power, so that distortion due to overload may be eliminated.*

tector of high frequencies, but also as an amplifier of low frequencies. Often operating a UX-200-a valve as a detector with 80 volts on the plate results in much clearer reproduction with only a slight effect on the detector action.

The sensitivity of a set may often be increased very much by the use of a sensitive detector valve. The old UV-200 type valve was such a valve and the Sodion was another. These valves were both noisy. Today two good valves are available, one the UX-200-a type and the other the "Donle-Bristol." These valves are very sensitive and they are not so noisy as their prototypes. For proper results these valves require a plate voltage control such as that of Figure 6.

A variable resistor is used to adjust the "B" battery voltage. In this case a by-pass condenser is essential to the proper operation of the set. By adjusting the resistor to its maximum resistance, the "B" plate voltage will be a minimum. By adjusting the resistor to its minimum resistance, the detector "B" plate voltage will be at a maximum.

By this scheme the set may be made most sensitive for a weak or distant station. By listening to the station and at the same time starting with a minimum detector plate voltage and grad-



AN EXCELLENT TRANSFORMER CIRCUIT

FIGURE 6: *This diagram shows a circuit for a detector that is hooked up to a first stage of low-frequency amplification. The low-frequency currents that produce audible signals must flow from the plate through the primary of the transformer and then directly through the by-pass condenser to the filament circuit without going through the battery leads. This is a great improvement over the older and more familiar hook-up.*

ually increasing it until the detector action or signal strength is best, good results may be obtained. Where the signal is strong enough, the resistor may be adjusted to the smallest value. The plate voltage will then be highest and will be best for the quality of amplification. This arrangement works splendidly in the case of "soft" detector valves which are critical to plate voltage adjustment, for by adjusting the resistor, any desired plate voltage may be obtained.

The "C" battery voltage adjustment is exceedingly important. The bias voltage values recommended by the manufacturer of the valve used should be followed. In general, the higher the plate voltage the higher "C" battery voltage, or negative bias.

Everyone who is interested in obtaining the best results from a low-freque. cy amplifier should carefully and frequently check the "A," "B" and "C" battery voltages by means of a voltmeter; in fact, there is no better sentinel for one's set than a permanently installed "A," "B" and "C" battery voltmeter. Poor or low-voltage batteries cause "grief" in the most excellent sets.

The "C" battery should be varied for the best results and the best value so chosen. In a case where two values of "C" battery voltage seem to do equally well, always choose the more negative value, since it results in "B" battery economy.

Much distortion is introduced when the grid of a valve is not properly biased (negatively), due to the current taken by the grid. A reversed "C" battery will cause a set to be almost inoperative. An improper value of "C" battery will allow the grid to take current for positive halves of the impressed voltage alternation. This effect is known as rectification. This undesired current causes distortion, since it is not proportional to the signal voltage. The proper "C" battery voltage reduces it to a minimum.

To those who have the extra sockets and valves it is often a revelation to take a two-stage amplifier and place an extra tube in parallel between the two transformers and another in parallel with the output valve. For example, two UX-201-a type valves in parallel instead of single one in these two positions may improve the quality of a broadcast program very much in the case of transformer-coupled amplification. This last example is practically the same as using single UX-112 type valves in each stage, since a single UX-112 valve has about the same amplifier characteristics as two UX-201-a type valves in parallel. The wiring arrangement of two sockets in parallel is shown in Figure 5. In the case of dry-battery sets such as those using UX-199 type valves, it may be found advantageous to use two valves in parallel between the low-frequency transformers.

Forecasting Static

(*Continued from page 203*)

the thermometer, but fewer persons have an acquaintance with a hygrometer. This instrument, which is made in numerous forms, one of which is illustrated in Figure 1, responds to changes in the moisture content of the air. Many are familiar with toy devices of this sort, such as a girl with a paper dress whose color-changes from day to day forecast the weather. These color-changes are effected by the atmospheric moisture. A good hygrometer furnishes similar information, but much more accurately, and gives us definite figures. usually in percentage, indicative of the amount of moisture the air contains, compared with what it could contain if saturated at the given moment. With the help of thermometer and hygrometer, we can forecast static still more effectively, with the aid of these pointers:

1. If the barometer reads above 30 inches and has been rising during the preceding twelve hours, and if the temperature and relative humidity are falling, static is not likely within the next twelve hours.

2. If the barometer reads below 30 inches and has been falling during the preceding twelve hours, and the temperature and relative humidity are rising, static will prevail during the next twelve hours.

3. If the barometer is constant while the relative humidity falls, static is likely to reduce in intensity if it has been current.

4. If the barometer is constant while the relative humidity rises, static may increase if it has been current.

5. If the relative humidity and temperature remain constant while the barometer rises or falls, a change from the prevailing intensity of static will be effected less quickly than if the relative humidity and temperature changed as indicated in statements (1) and (2).

The reader is cautioned here not to take these statements too literally. They represent merely guides to probable occurrences, and will occasionally be found to be inaccurate, because quite exceptional atmospheric conditions happen from time to time. For example, there are times when the barometer is high, that is, above 30 inches, but begins to fall while the relative humidity rises. It may not yet have reached 30 inches when rain or snow begins, yet static will not make itself known. At all times pressure is the dominant influence, while temperature and relative humidity, if operating according to rules 1 to 2, merely help to strengthen the forecast which the pressure-change indicates.

These last statements call attention to the popular misconception that whenever it rains or snows static will be prevalent. This is not at all true. The writer has experienced some of the best reception during such storms, but in these instances atmospheric pressure was higher than is customary when rain or snow occurs. On the other hand, much static has been experienced on some clear nights under high pressure conditions, when on these occasions abnormally high relative humidity was accompanied by a sudden drop in temperature. Since these cases are exceptional, although not always rare, perhaps we should not allow them to impress us too strongly.

While we have attempted here to suggest a simple instrumental method enabling the average person to forecast for himself the probability of static, we refer again to the utilization of the daily weather map by those desirous of making a detailed study of the whole problem. The writer has found many relationships between the location of the receiving and sending stations with respect to the extent and intensity of a high or low pressure area, and the probability of static. The details cannot be presented here, but a few major conclusions may be noted. [By way of explanation of the term isobar, the reader is referred to the map in Figure 2, on which he will see concentric lines outlining high and low pressure areas. If these are close together the pressure is intense or strong, but if far apart it is weak. If close together, the pressure area as a unit moves more rapidly than when the isobars are far apart. Any line drawn at right angles across a series of isobars indicates the isobaric gradient.]

Here are some conclusions drawn from a study of these maps:

1. If a line connecting the receiving station with the broadcasting station crosses the intervening isobars at right angles, reception is at its best.

2. The steeper the isobaric gradient (that is, the closer the isobars to each other), the stronger the reception.

3. The more nearly the transmitted waves approach parallelism with the isobars, the weaker the reception. Under these conditions fading occurs.

4. Reception is weaker when the transmitted waves cross from one pressure area into another than when they travel only within one area.

5. Reception is better in winter than in summer because the cyclones (Lows) and anti-cyclones (Highs) are more intense in the winter period.

6. Shallow or flat pressure areas favor much static.

We need more investigation in the field of the relationship of static to atmospheric conditions. Here is an opportunity eminently worth while for both the experimenter and fan.

The ABC of Filament Control

(*Continued from page 214*)

which employs only two valves, both of the 201-a type. The total current consumption of these two filaments is .5 ampere, and a No. 112 Amperite, a No. 5 Polytrol or a No. 2 Equalizer is the proper unit.

The table given herewith shows the proper filament controls to use for different valves. This table will permit the experimenter to select the proper controls to meet all of his valve requirements and eliminate all his obsolete filament control rheostats.

Where an old receiver is equipped with rheostats, it is a good plan to add controls in series with the rheostats. Thus, if a single 201-a type valve is controlled by a rheostat, a No. 1-A Amperite, a No. 1 Polytrol or a No. 4 Equalizer may be connected in series with the rheostats. The maximum current this control will permit to flow through the filament of this valve is .25 ampere, so it becomes impossible to overload the filament, regardless of how the rheostat is adjusted; yet the rheostat will provide any desired variation downward, as required where the rheostat is used as a volume control, or where the valve it controls is somewhat critical in its filament current adjustment.

The value of this plan is most evident in the fact that it makes the filament current adjustment a fool-proof process, and this is a particularly necessary feature in homes where the receiver is operated by all the members of a family.

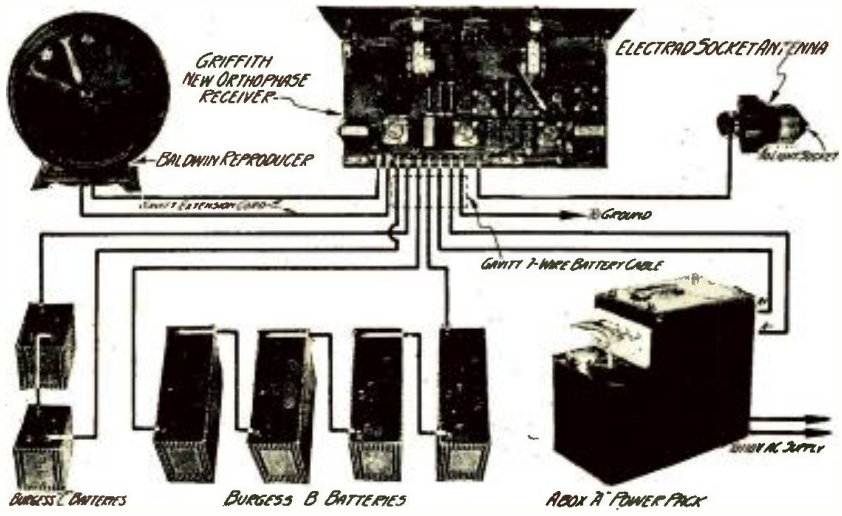
Ship to Have Public Radio-telephone Service

FACILITIES for radiotelephone service from ship to shore will soon be offered to all passengers aboard the Hamburg-American liner *Columbus*, according to *Radiowelt*, a German radio magazine. The new service, which is announced to begin in May, will enable those aboard the ship to sit in the comfort of their cabins and converse with parties in New York or Berlin, as easily as one converses over an ordinary telephone. Only first-class cabins will be equipped with private connections; second and third-class passengers must use the radio room or telephone booths which are provided on the ship.

People on shore will also be able to talk to passengers aboard the vessel. A friend in Berlin picks up his telephone and says: "Please connect me with Mr. X, aboard the *S. S. Columbus.*" A while later Mr. X is called from the dining-room to the telephone and hears: "*Achtung, Berlin kommt*" (Berlin on the wire), and the conversation from ship to shore begins.

New Results With Crystal Detection

(*Continued from page 210*)



FOR BEST RESULTS

FIGURE 4: *In the above operating hook-up batteries are used with great success for the supply of the "B" voltages, while an Abox "A" power-pack furnishes the filament current. A standard outdoor antenna may be substituted for the socket antenna.*

The composite diagram in Figure 4 shows the proper connections, as well as the recommended accessory apparatus for this receiver.

The next thing to be done is to adjust the phasatrol, which is done as follows: Pull out the battery switch, lighting the filaments; turn the two center knobs (on the panel) to the *right* as far as they will go, and set the dials at 90 degrees. Now, set condenser, C, so that its plates are half meshed, that is, so that the edge of the rotor plates is at a right angle with the edge of the stator plates. Then, with a screw-driver, turn the screw-head in the phasatrol around in a clockwise direction as far as it will go, which should cause the reproducer to give forth a sound similar to that known as "motor-boating." Then the phasatrol adjustment should be turned back slowly until the noise stops, at which point the phasatrol should be left permanently, as it has been found that this adjustment gives best results.

Now, if it is desired to operate the receiver with controllable regeneration, reset the dials to 100 degrees and turn the screw of condenser V "in" slowly until the noise above referred to reappears. This condenser may now be left in this position, and the oscillation of the set (which is indicated by the noises as above) is controlled by the high-resistance, R.

If it is desired to operate the set without regeneration, reset the two dials to about 50 degrees, and turn the screw of condenser V slowly back until the above noted noise stops; it will now be found that the set will not oscillate at any setting of the panel controls, and the high resistance, R, is used as a volume control.

By noting the settings of condenser V, it is easy to convert the receiver from an oscillating to a non-oscillating one, or vice versa, at any time.

Tuning the Set

In tuning in a station, the volume control should be at maximum, if the non-oscillating arrangement is used, or if the oscillating setting is employed the volume control should be kept at a point just below that of oscillation.

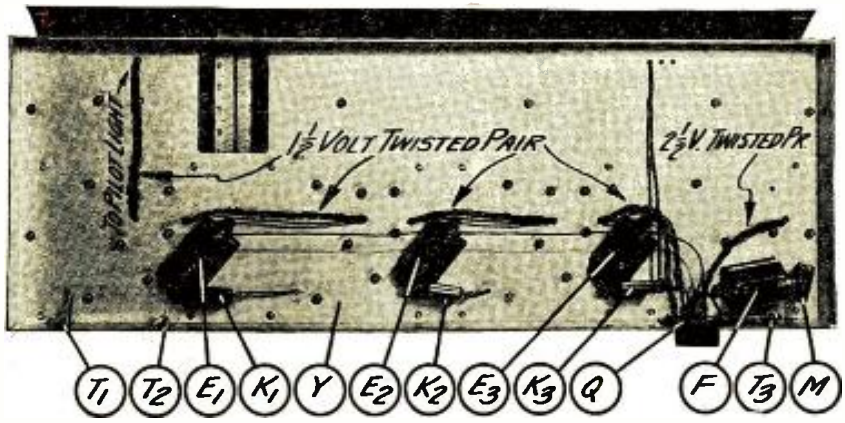
If a loud hiss is present, it may be eliminated by adjusting the rheostat, Q, which controls the bias of the detector. If it is already in the maximum position (as far to the right as it will go), turn it back slowly until a point is reached where the hiss ceases; a further motion will cause the hiss to reappear. It might be noted here that the silent point is at zero bias, so that turning the rheostat toward maximum applies a current in the conducting direction of the crystal, and turning the rheostat back from the silent point applies a current in the opposite direction to the crystal. It will be found that the most sensitive adjustment will lie between the silent spot and maximum on the rheostat.

The switch, S1, at the left of the panel is for the purpose of short-circuiting the antenna condenser, W1, and is only used in exceptional cases. For average reception the switch is pushed in, and need only be pulled out when receiving weak signals from stations above 60 degrees on the dials; or it may be pulled out at all times if an antenna under 15 feet is used.

It will probably be noted that the selectivity of the receiver is greater when the condenser switch, S1, is pushed in, and the selectivity of the set may be further improved, if necessary, by using a smaller condenser, such as .0005 or .00025 mfd., at W1.

And Now—An AC LC-28

(Continued from page 200)



THE UNDER SIDE OF THE AC LC-28

FIGURE 5: *This view of the new model shows clearly how the twisted cables for the AC filament leads should be run. It is the size of these cables that necessitates the redrilling of the holes in the chassis indicated in Figure 4.*

the dial, so that both binding posts and the dial light are at all times insulated from the metal panel. The switch on the front of the dial is unused. A 1½-volt flashlight lamp is to be substituted for the one that comes packed with the dial.

The connections for the bridge circuits in the filament part of the high-frequency stages are clearly shown in both the schematic and the picture wiring diagrams and no trouble should be experienced at this point.

It will also be noticed that the grid-leak connection, the cathode connection and the filter condenser connection of the detector valve are all made to the chassis, which, of course, is grounded. The output circuit of the detector valve does not go to the cable, as in the earlier model, but is brought out to a separate jack, T3, to be connected to the power-pack amplifier by a separate wire.

After the connections have been completed it is advisable to check them over with both the wiring diagrams to be sure that no mistakes have been made. When this is done the set is ready to be installed and placed in operation.

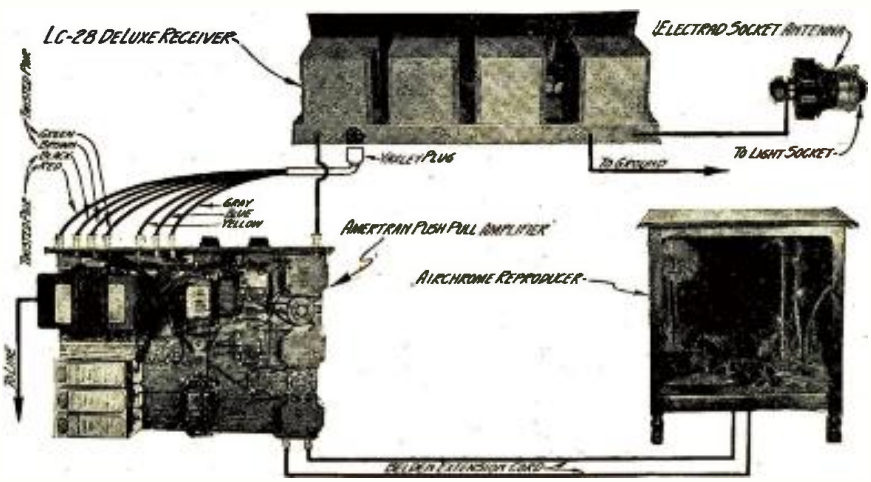
Installing the AC Operated LC-28

The completed LC-28 high-frequency pack may now be placed in the Corbett console, in the top portion of which it is designed to fit snugly.

The power-pack amplifier may then be inserted in the lower portion of the console.

The completed job is shown installed and in operation in the picture on page 198, with the Air-Chrome reproducer alongside of it.

In the photo-diagram in Figure 6 are shown the exact connections to be made between the various units. In this case the AC de luxe receiver is shown connected to the AmerTran push-pull amplifier, the constructional details of which were given in the January, 1928,



THE LAST WORD IN RADIO REPRODUCTION

FIGURE 6: *The use of the AmerTran power-pack amplifier and the Air-Chrome balanced-tension reproducer in conjunction with the LC-28 high-frequency pack has given such astonishing results in severe laboratory tests that* POPULAR RADIO *can recommend it as a radio reception combination that cannot be surpassed.*

issue of POPULAR RADIO. The colored wires of the Yaxley cable are to be connected to the binding posts of the push-pull amplifier, as shown in Figure 6. The braided covering of the cable should be cut off and the black and red wires should be twisted together. Then the green and brown wires should be twisted together and finally the complete assembly of wires twisted back into cable form. The diagram also shows the connections from the detector output jack on the high-frequency pack to the single binding post that acts as the input to the push-pull amplifier.

The diagram also shows the ground connection for the receiver and the connection to the light-socket antenna, with which the receiver operates in a very satisfactory manner, without an outdoor antenna. Of course, a regular indoor or outdoor antenna may be used, if so desired. The connection between the Air-Chrome reproducer and the amplifier may be made by means of a standard Belden extension cord, so that the reproducer may be placed on the opposite side of the room.

The power leads from the amplifier are indicated by a line-and-arrow marked "to line" on the diagram. This line should be equipped with an "on" and "off" switch and connected to a light socket of the 110-volt AC lighting lines. The set will then be turned "on" and "off" by means of this switch.

The valves recommended for the receiver are three CX-326 type AC valves in the first three sockets, which are the high-frequency amplifier stages, and one CX-327 type detector valve in the detector stage, in which is located the fourth socket. The valves recommended for use with the AmerTran amplifier were enumerated in the constructional article on the amplifier itself.

It must be remembered that there is approximately a thirty to forty second wait between the time the receiver is turned "on" and the time that it begins to function. This is because of the period required to heat the AC valves to their operating temperature.

If a separate "B" power-pack and a separate low-frequency amplifier are used with the LC-28, it is recommended that a Karas AC-Former be used to supply the AC filament current.

In tests on the new receiver during the last three months the new AC job has demonstrated its ability to reproduce broadcast programs effectively and with fidelity and all in all has proved itself to be considerably in advance of the other models of this receiver. In operation its upkeep is extremely low and requires no service work of any kind to keep in first class working condition. This factor alone makes it an indispensable item for the professional set builder, and its outstanding operation should make it popular with every radio enthusiast.

In the Professional Set Builder's Shop

Practical pointers and kinks to increase efficiency and earning power of those who construct, repair or service receivers for profit. If there is a better and easier way to do it, this department of POPULAR RADIO, *aided by a well-equipped Laboratory, will find it and present the details to our readers in a practical and concise manner.*

The Service Man's Tool Kit

IF professional set builders are to be successful in building up their clientele, they must live down the bad reputation established by plumbers, who always seem to be minus some important tool when they are making repairs. To help radio repairmen to solve this problem, the Laboratory of POPULAR RADIO has assembled what it believes to be the ideal tool kit—a kit that will meet practically every emergency that repairmen may have to solve. The ideal repair kit should contain not only hand tools, but a few spare parts as well, so that emergency repairs may be made in urgent cases.

The outfit shown in Figure 1 is complete in practically every detail and small enough to be easily carried in a Boston bag. The more rugged material is fitted into the bottom of the bag, while there is sufficient room left on the top so that the meters can be placed in a position where they will not be damaged.

This ideal tool kit contains the following items:

1 soldering iron with holder;
1 8-inch round file;
1 counter sink;
1 square (6 inches);
1 scriber;
1 automatic center punch;
1 6-inch ratchet screw-driver;
1 8-inch ratchet screw-driver;
1 small compass;
1 pair side cutting pliers;
1 pair flat-nose pliers;
1 8-inch round brush;
1 folding rule;
3 drills (¼ inch, Nos. 28 and 31);
1 hand drill;
1 0-15 volt AC voltmeter;

THE RADIO "FIRST AID" KIT

FIGURE 1: *With the testing equipment and spare parts shown above, which may be conveniently carried in a Boston bag, the service man can take care of most of the emergencies that he is likely to encounter; or, if a serious breakdown has occurred, he can ascertain the approximate nature of the trouble.*

1 0-50 milliammeter (DC);
1 0-600 high-resistance voltmeter (1,000 ohms per volt);
1 pair 2,000-ohm phones;
4 small fixed condensers;
3 by-pass condensers;
6 grid-leaks (miscellaneous values);
1 filter condenser (2 mfd.);
1 roll solder;
1 roll friction tape;
1 jack knife;
20 feet connection wire (flexible);
6 testing wires with clips;
1 hydrometer;
1 Boston bag.

The price of this model kit will depend somewhat upon the quality of the tools and meters used. While good meters are recommended, the beginner can probably struggle along with less expensive ones. In outside work, the most important thing is to establish the source of trouble, and a meter does not have to be extremely accurate, since a rough estimate of the voltage or output current is usually sufficient as a check-up. It will be noticed that small condensers and filter condensers are included. With modern high-power amplifying equipment, it often happens that condensers are ruptured. In such instances, a second trip can easily be saved if the repairman has the necessary replacement parts in his kit.

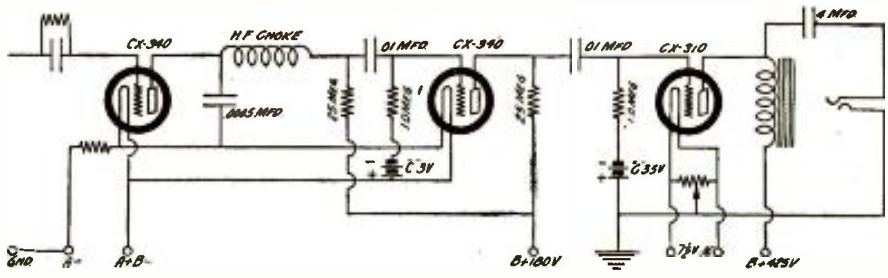
The kit described can be made still more complete by the addition of one of each of the popular types of vacuum valves used. For instance, one 201-a, one 171, one 112, one 226 and one 227. Also one Raytheon rectifier valve would prove extremely valuable in cases where defective rectifier valves are encountered.

One of the most important items in the kit shown above is a set of flexible connector wires provided with spring clips. With these clips temporary connections may be made quickly, which is a great asset in checking up troublesome circuits, and in applying meters for current measurement and open-circuit tests.

Controlling Oscillation in High-Frequency Circuits

THE potentiometer method of stabilizing the usual high-frequency amplifier, in which the grid return is varied so that a variable positive potential may be placed on the grid, is not the best method, according to many radio authorities. The chief objection is the heavy plate current taken by the valve when the grid is positive. A more satisfactory and certainly more efficient method now coming into wide favor is to insert a precise variable resistance, such as the volume control Clarostat, in the "B" positive (+) lead of the amplifier valve, thus lowering the effective plate voltage. This method has other advantageous features, one being the saving in "B" current effected.

—IRVING CALKINS



A SIMPLE RESISTANCE-COUPLED HOOK-UP

FIGURE 2: *With high-mu valves in the detector stage at the left and the two low-frequency stages, this resistance-coupled amplifier will give all the volume necessary for home use.*

More Data on Resistance Coupling

WITH the advent of better high-mu vacuum valves, reliable resistors and high-voltage socket-power operation, the resistance-coupled method of amplification has once more come into its own as a means of obtaining excellent tone quality, together with ample volume, at low cost.

In the first place, the all-important thing with resistance coupling is to employ high-mu amplifying valves. Today there are several makes available for this very purpose, such as the Ceco or CX-340, with a mu or amplification constant of from 20 to 30, as compared with about 8 for the standard type of valve.

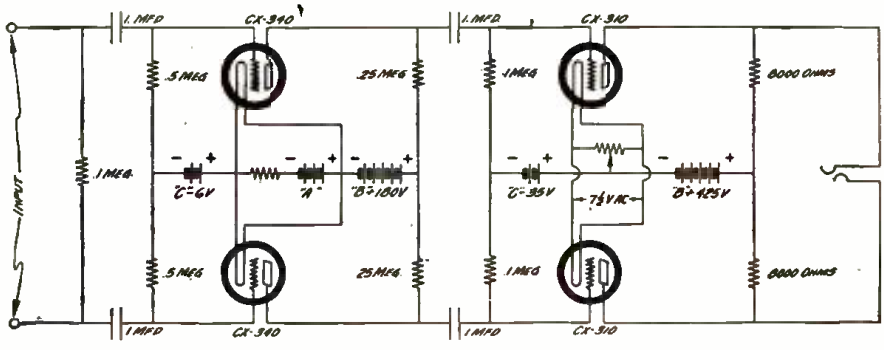
The second consideration is the use of proper resistances, not only in the matter of correct values, but particularly in stability of operation. Resistance coupling is particularly susceptible to changes in resistance which alter the results and sometimes introduce serious noises. For this reason it is essential to employ high-grade resistors which are capable of providing accurate and lasting resistance values, even when handling considerable currents, without the danger of resistance changes causing noises.

The third consideration, and one of great importance, is to have sufficient plate voltage available. It is generally overlooked in resistance coupling that the plate voltage impressed on the plates of the vacuum valves must pass through the plate-coupling resistors, the value of which is usually 100,000 ohms or more. In the case of the high-mu valves, the plate-coupling resistor is 250,000 ohms. Obviously, to overcome this high resistance in the circuit and still have sufficient voltage to operate the valve efficiently, it is necessary to start out with sufficient voltage, preferably 180 volts, on the plate-coupling resistor—that is, the maximum voltage tap of the usual "B" power-pack. If "B" batteries are employed, there should be four blocks of 45 volts each.

The ideal resistance-coupled amplifier, using present-day components, is shown in Figure 2. It will be noted that, due to the high-mu valves now available, the three-stage amplifier is no longer required, provided a high-mu detector is employed. Also, it will be noted that an output filter is employed, preferably in the form of a choke coil and series condenser, so as not to introduce distortion and also in order to keep the direct current out of the reproducer.

The resistance values here given are based on tests, and do not run as high, in the case of the grid-leaks, as those generally specified for the present high-mu valves. While there is a slight loss in volume, which is certainly not noticeable, there is better assurance of ample grid-leakage so as to avoid any possibility of "blocking" or the piling up of successive signals.

The layout shown in Figure 2, comprising a high-mu valve for the de-



RESISTANCE COUPLING IN A PUSH-PULL AMPLIFIER

FIGURE 3: *With the hook-up shown above it is possible to achieve astounding volume and clarity, and the compactness of the unit recommends it additionally to those seeking the best in power-operated, low-frequency amplification.*

tector and for the first stage, and a 171 or 210 type of power valve for the second stage, will provide as much volume as the usual transformer-coupled amplifier, with excellent tone quality.

The use of a high-mu detector valve serves to obtain considerable amplification, as well as signal rectification. A 3-megohm Durham metallized resistor may be employed for the detector grid-leak, in combination with a .00025 mfd. grid condenser.

For those seeking enormous volume together with a remarkable depth and detail, resistance coupling presents many interesting possibilities in conjunction with present-day high-voltage socket-power operation. In Figure 3 an interesting development in the way of a powerful push-pull amplifier with excellent tone quality is shown. Indeed, this amplifier provides the volume of a small orchestra.

The diagram is virtually self-explanatory. All resistors employed are of the metallized resistor type, of the values indicated in megohms, except where they are followed by the "ohm" sign. However, it is best to use 2½-watt "power-ohms" for the 8,000-ohm resistors employed in coupling the output with the reproducer, in order to handle the considerable current without material change of resistance value. Because of the power handled with this amplifier, none other but reliable resistors should be employed. It will be noted that the plate current must be supplied by a "B" power-pack capable of supplying 425 volts for the 210 valve plate supply, while the filaments of these large valves operate on 7½ volts raw alternating current. One 216-b type rectifier valve will be rather heavily taxed if made to supply two 210 power valves, and the plate voltage is apt to drop down below the necessary value for operating these valves at the proper efficiency. A 281 rectifier, substituted for the usual 216-b, will help out in this connection. However, for best results the "B" power-pack should have two 216-b or 281 rectifiers arranged for full-wave rectification; such a hook-up will supply ample plate voltage and current for the operation of two 210 power valves.

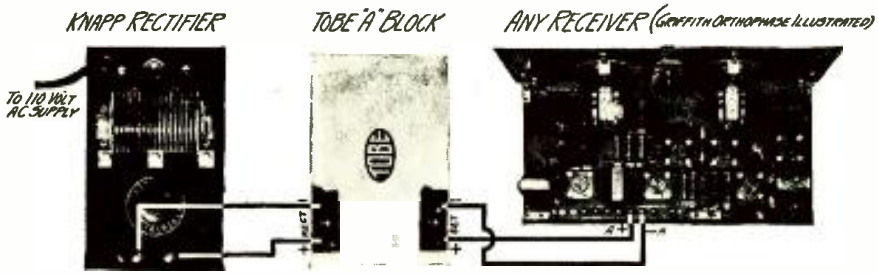
By changing the "C" battery to 45 volts and the plate voltage to 200 volts, with output plate resistors of 5,000 ohms each, good results will be obtained with two 171 type valves in place of the 210's for those who must operate on "B" batteries.

Incidentally, in Figure 3 we have not indicated the filament supply current; but it goes without saying that the first stage valves are of the high-mu type, while the two power valves are operated on 7½ volts, if the 210 type valves are used, and 5 volts, if the 171 type valves are used.

—F. R. EHLE

Dry "A" Power from the Socket

(*Continued from page 228*)



HOW TO INSTALL THE "A" POWER UNIT

FIGURE 3: *The connections between the rectifier unit, the filter unit and the receiver with which the "A" power-pack is used are shown here in heavy* BLACK *lines.*

circuit of any standard set by following the photo-diagram in Figure 3. Note that binding post H1 is positive (+) and H2 is negative (—). It will also be noticed that two wires go from the output binding posts, H1 and H2, of the rectifier unit to corresponding binding posts on the filter unit, and two more wires from the filter unit go directly to the "A" circuit of the receiver with which the "A" power-pack is to be used. The switch, C, on the rectifier unit should be rotated until the correct filament voltage is obtained for the number of vacuum valves utilized in the receiver. This had best be done with a voltmeter and when once determined needs no further adjustment.

The operation of the new unit will be found to be silent and steady; and, as there are no liquids in the unit, no servicing is necessary outside of an initial adjustment of the switch, C. The complete "A" power unit can be placed in the lower portion of the console and left without further consideration.

The life of the unit should be indefinite, as there is nothing to wear out and no moving parts that need servicing or replacement.

Radio Luxury in Power Units

(*Continued from page 226*)

fastened to the apex of the cone that carries the low-frequency currents. Because of the small size of the cone used, and because of its almost unlimited freedom to move to and fro, the new reproducer must be mounted upon a suitable baffle board for reproducing the extremely low frequencies which the amplifier is capable of producing. In nearly all cases this baffle board may be the front of a console or cabinet in which the speaker is mounted; or, again, it may be the wall of a room.

The general appearance of the complete amplifier is shown in Figure 2. It is completely mounted on a wooden baseboard and is so simple in construction and wiring that anyone may complete the job satisfactorily in an hour's time.

How to Construct the Power-Pack Amplifier

It is best to start by mounting the transformer, A, the condenser, C, and the choke coil, B, alongside of each other on the baseboard, as shown in Figure 2, and in the picture wiring diagram in Figure 3. Be sure that they are turned in the directions indicated in these illustrations.

Next mount the three transformers, D, E and F, in a similar manner, as well as the six sockets, L1, L2, L3, L4, L5 and L6. These are screwed to the baseboard with ordinary brass wood screws.

Next mount the binding posts, M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11 and M12, as indicated in Figure 3, on the connection panel, O, and fasten the connection panel to the baseboard, N, by wood screws inserted through the panel and into the edge of the baseboard.

Next mount the resistors, G, H, I, J and K, on the resistor mounting panel, P, in the relative positions shown in Figure 2. The resistor mounting panel should then itself be mounted by means of small brass brackets, according to the instructions given in the illustrations. The set is now ready to be wired up.

In making the connections on the new unit, it is advised that the constructor follow exactly the details and wiring given in the picture wiring diagram in Figure 3. In this drawing the various panels, the baseboard and the instruments themselves are outlined in black lines, while the connecting wires are designated by heavy red lines. Follow out these connections explicitly and no mistakes will be made.

It is recommended that an insulated wire, such as Corwico rubber-covered hook-up wire, be used for this purpose.

After the complete connections have been made, it is advisable to check them over, to be sure that they are all correctly connected and that there have been no omissions.

How to Install and Operate the Amplifier and Reproducer

First of all, the set with which the amplifier is to be used should be installed in its cabinet and then the amplifier itself may be placed in the lower portion of the console or in the radio table.

In Figure 1 is a photo-diagram showing the connections between the LC-28 high-frequency pack and the amplifier.

Of course, any receiver including a high-frequency amplifier and detector may be used with the power-pack. The connections in the illustrations show exactly how the amplifier is to be hooked up to the set, as well as to the Magnavox reproducer. Notice that four wires run to the reproducer, two of which are for the field winding and two are for the moving-coil winding.

Standard vacuum valves are used and the following are recommended: Two 381 type valves in sockets L1 and L2. a standard 374 type regulator valve in socket L3, a 301-a type valve in socket L4, and two 310 type valves in sockets L5 and L6.

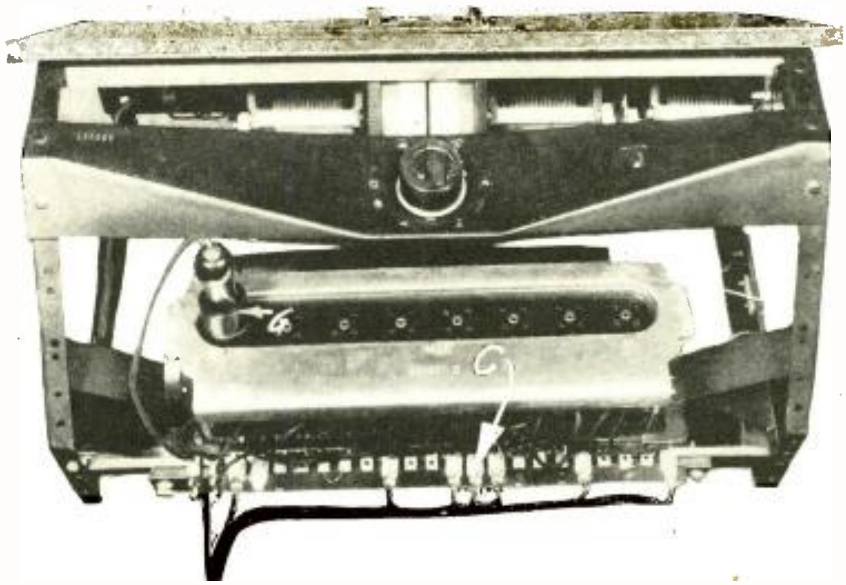
The reproducer may be installed and attached to the inside of the radio cabinet, with a hole cut in the cabinet slightly smaller than the periphery of the cone. A suitable grill work may be fastened on the outside for decoration. The cabinet itself will then act as a baffle board. Or a deep hole may be cut directly in one of the walls of the room and the reproducer may be installed in it with a decorated covering. In this case the wall itself will act as the baffle. This last idea gives exceptionally fine results and produces low tones with true volume and realism.

The voltage adjustment may be made with the variable resistor, H, on the power-pack until the correct conditions are obtained throughout. In making this adjustment, it is recommended that a high-resistance voltmeter with a scale reading of zero to 600 volts be utilized. The adjustment should be made with the set and the power-pack amplifier in operation and when once adjusted will need no further attention.

With this apparatus a new receiver may be built for giving exceptionally large volume and improved tone quality, or an old receiver may be improved. The power-pack amplifier furnishes complete "B" voltages for the receiver with which it is to be used and a suitable "A" power-pack used in connection with both will give complete operation from the AC lighting lines, except for a small "C" battery upon which there is so slight a drain that its working life is almost equal to its shelf life.

Put This Power Box in Your Radiola 28

(*Continued from page 201*)



THE INSTALLATION OF THE RESISTANCE STRIP

FIGURE 1: *The receiving unit proper of the Radiola 28 is here shown clear of the cabinet, in order to make plain the installation of the resistance strip, C, and the transfer plug, G.*

Changes in the Receiver Unit

In the rear of the socket strip, and slightly underneath, will be found a connection strip that is fastened to the receiver unit with 19 screws. Loosen these and slide the connection strip out at the end, without damaging adjacent wiring.

Then substitute the resistance strip, E, that is supplied with the new AC apparatus. Place this resistance strip so that its terminals are in line with the original screw holes and fasten them all back again so that the new strip is held in the place where the old one originally was.

Next remove the wire-wound resistance rods from the "battery-setting" and rheostat and replace it with one of the new rods marked "F" in Figure 3. Be sure that the rod is turned so that the contact arm rubs on the bare portion of the winding.

Next take out the remaining resistance rod from the "volume-control" rheostat and replace it with the remaining new rod "F." The contact arm of the volume-control rheostat will be found to be connected by a flexible spring to one of the metal brackets supporting its resistance cartridge. This spring should be reconnected to the bracket located nearer the outside edge of the wooden panel. This will reverse the volume control so that it will work in the right direction.

Next unsolder one of the two leads connected to the filament switch and reconnect it to the same prong that the other lead is connected on.

Remove the leads connected to the voltmeter clip, solder them together and tape up the ends. Connect this voltmeter clip to the bracket on the nearer side of the volume-control rheostat with a piece of insulated wire. Do not touch the connections to the voltmeter clip that are on the side near the volume control rheostat.

Changes in the Cabinet

First lift out the battery pan, bending the two ends "inward" and then bending "in" the back of the pan, using a screw driver underneath the cabinet to pry it loose, if necessary. Then fasten in the two brackets, H, in place of the battery pan, placing them about six inches from each end of the cabinet. Now install the condenser unit, B, in place in the right-hand front portion of the battery compartment, using four screws to fasten the brackets to the floor and to the front side of the cabinet.

Replacing of the Unit

Close the upper compartment and insert the panel so that it sticks out about three inches. Connect the terminal strip of the seven-wire cable, C, to the receiver terminal board. The cable terminals should be lined up with the receiver terminals so that the yellow lead with the red tracer connects with the terminal at the extreme left. Then tightly secure all screws on the terminal board and especially the eight screws fastened to the cable terminals. Now push the other end of the cable down through the hole at the back of the cabinet and slide the complete receiver into the cabinet and close the lid. Open up the battery compartment and replace the four screws and washers which fasten the receiver unit securely into the upper portion of the cabinet.

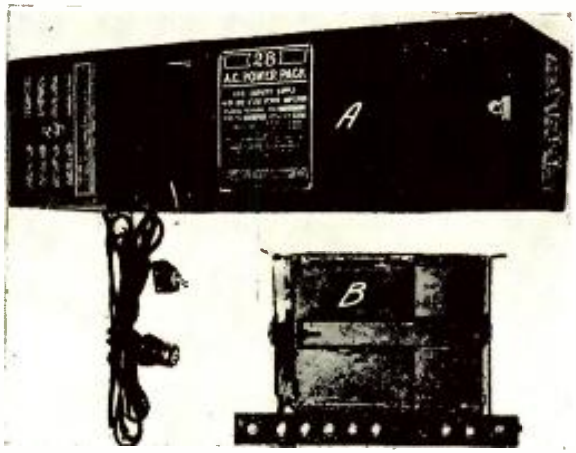


FIGURE 2: THE POWER AND CONDENSER UNITS

The next job is to connect the four-wire cable to the terminal board on one end of the power unit, making sure that the markings on the metal tags agree with the markings on the panel. Now place the power unit, A, in position in the brackets in the lower cabinet. Next connect the leads of both the seven-wire cable from the receiver terminal board and the leads from the four-wire cable of the power unit terminal board to the terminal strip of the condenser unit, being sure that the markings on the metal tags on each cable lead agree with the markings on the condenser terminal board. Next connect the reproducer to the power unit terminal board.

The single wire brought out at the top of the power unit near the valves should pass up through the same hole in the bottom of the set through which the seven-wire cable passes. Insert the transfer plug, G, in the valve socket No. 8 at the extreme right, in which the power valve is usually used, and insert the tip of the single wire into the top of the transfer plugs. Next insert the CX-310 type power valve at the rear of the new power unit and insert the CX-380 type valve at the front. This allows the last stage of amplification to be obtained through the CX-310 type power valve in the new power unit.

It will be noticed that a small switch is connected in the power-supply cord. This switch should be mounted at any convenient point on the under side of the cabinet by means of wood screws, so that it can be easily turned "on" and "off." Insert the seven original CX-299 type valves in the sockets Nos. 1, 2, 3, 4, 5, 6 and 7, then close the lid of the cabinet and reinsert the loop. The attachment plug on the power-supply unit should be placed in a lamp socket near by.

Operation of the Unit

It is only necessary to turn the light socket switch "on" or "off" to place the set "in" or "out" of operation.

The operation of the receiver will be now identical with the battery-operated job, except for the following details:

1. The original filament switch is not used to turn the set "on" and "off."

2. The battery-setting rheostat will not turn the current "on" and "off."

This rheostat should be set at a minimum value consistent with good quality reproduction.

There is a toggle switch marked "high" and "low" mounted on top of the power unit. This is designed to take care of variations in the lighting line voltages. For voltages of 105 to 115 volts, this switch should be set at "low," and for voltages of 115 to 125 volts the switch should be set at "high."

The set should now function for a long period of time without any fuss or bother with batteries, as it will be operated solely from the lighting lines.

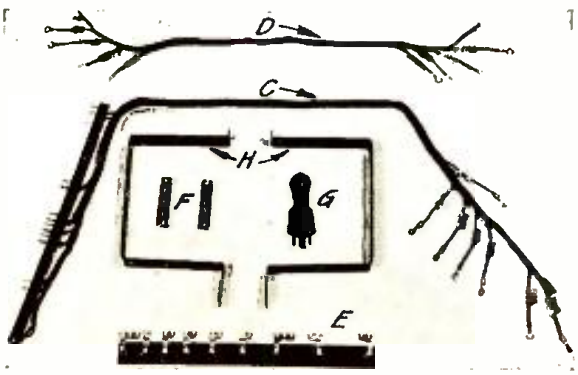
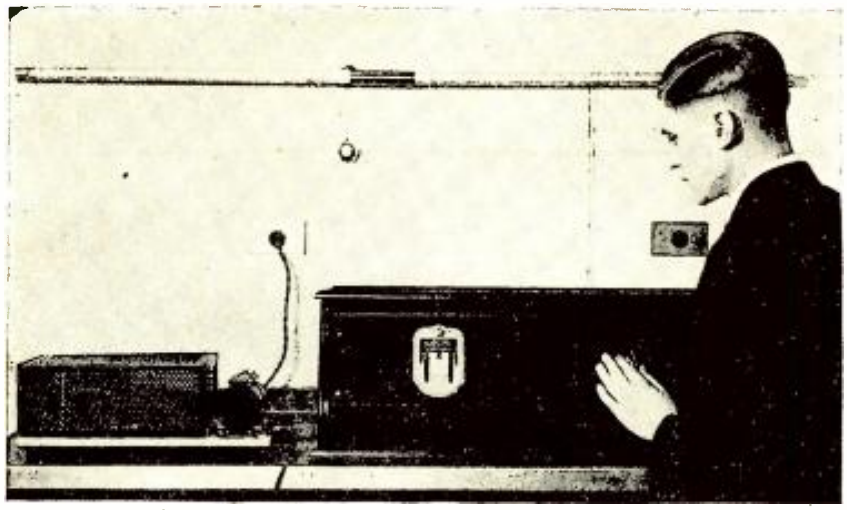


FIGURE 3: THE ACCESSORY APPARATUS

A DC Socket-Operated Amplifier

(Continued from page 212)



THE UNIT IN OPERATION

FIGURE 4: *This view shows the unit in operation with the LC-28 high-frequency pack. The perforated metal cover protects the user from contact with the hot or live parts of the unit, and prevents the withdrawal of any of the valves while the apparatus is operating.*

one or more be removed while the unit is operating, damage to the remaining valves is possible, due to overload.

The unit embodies two line fuses at the input from the light socket to prevent damage in case of short circuit in the amplifier.

In all direct current units a certain amount of heat must be dissipated. A heat baffle plate of transite is used in this unit to separate the heat-dissipating resistors from the remainder of the assembly, and at the same time to force the heat rapidly upwards and out of the unit. As a matter of fact, the heat will not be found in any way troublesome or excessive, but it is always well to provide for a quick and effective dissipation of such heat as may be generated in any DC unit.

How to Construct the Amplifier

First drill the panel, P, for the battery-charging meter, M, the battery switch, S, and for the mounting holes in each lower corner. Then fasten down the meter and switch in position.

Next place the remaining parts for the amplifier in their correct positions, as shown in Figures 2 and 3, and mark the location of the mounting holes of each instrument on the transite base, R, either with a pencil or a scratch awl. Then remove all the instruments and drill the required number of holes in the transite base.

First fasten the wooden feet, T1, T2, T3 and T4, underneath the base and fasten the mounting brackets, U1, U2, U3 and U4, in position above these feet with machine screws through the base. It may be noted that all the parts are mounted with brass machine screws and nuts.

Then fix the fuses, N1 and N2, in place under the transite base.

Next mount the sockets, H1, H2, H3, H4 and H5. Sockets H1 and H2 have the plate and grid terminals towards the near edge of the base. Sockets H3 and H4 have their filament terminals towards those of the sockets just mounted. Socket H5 has the filament terminals towards the near edge of the base.

Fasten the automatic filament control, I, near socket H5 and fasten the filament control, J, in position on the opposite side of the base.

Place the 1 mfd. condenser, E, on top of the 2 mfd. condenser, F, and fasten them to the base. Two terminals of these condensers are connected together and a drop of solder on the opposite side will hold the top condenser in position. Then fasten the 4 mfd. condenser, G, in place.

Mount the low-frequency transformer, A, with the plate and "B" positive (+) terminals towards the near edge of the base. Mount the input push-pull transformer, B, with the three terminals towards the sockets and the output push-pull transformer, C, with the three terminals also towards the sockets.

Place the choke, D, in position with the terminals away from the near edge of the base and fasten it down.

To mount the 250-ohm resistors, L1, L2 and L3, place a mounting washer on a stove bolt of the proper length and run the bolt through the center of the resistor and through the base and fasten with a nut. Mount the 8-ohm mid-tap resistor, K, in the same manner.

Place the heat baffle between the resistors and the main part of the amplifier and fasten it to the base with the small brackets, V1 and V2.

Mount the panel, P, on the small

angle brackets, U1 and U2. Fasten the input binding posts, O1 and O2, adjacent to transformer A and the output binding posts, O3 and O4, on the opposite side of the base.

How to Wire the Amplifier

A type of wire such as Corwico braidite should be used in connecting up this amplifier, which must be wired exactly according to the picture wiring diagram in Figure 3.

It is suggested that the power circuit from the fuses to the filaments of the amplifier valves be wired up first. Then the "B" supply circuit, or filter circuit, can be connected. After this is finished the plate and grid terminal connections can easily be made.

A cable of two-conductor flexible wire should be run from the unconnected ends of the fuses to an attachment plug at the nearest light socket.

How to Install the Amplifier with the LC-28 Receiver

Refer to the photo-diagram in Figure 1 for the complete connections of the installation. Connect the red and black terminals of the Yaxley plug to the positive and negative terminals of the Exide "A" battery, as usual. Connect the yellow, blue and gray terminals to the negative, "B" positive (+) 45 and "B" positive (+) 90 terminals, respectively, of the Burgess "B" batteries. These batteries supply the high-frequency part of the circuit, the LC-28 receiver. Connect the green and brown wires from the Yaxley cable to the plate and "B" positive (+) terminals of the first stage transformer, A, of the DC-operated amplifier. Connect the output binding posts of the new amplifier, O3 and O4, to a quality reproducer, such as the Racon horn.

Insert an Electrad socket antenna in a nearby electric light socket and connect to the antenna binding post of the LC-28 receiver. Ground the receiver on a water pipe.

Insert a CX-301-a valve in socket H5 and a CX-171-a valve in each of the sockets H1, H2, H3 and H4.

Fasten the perforated metal cover, W, in place.

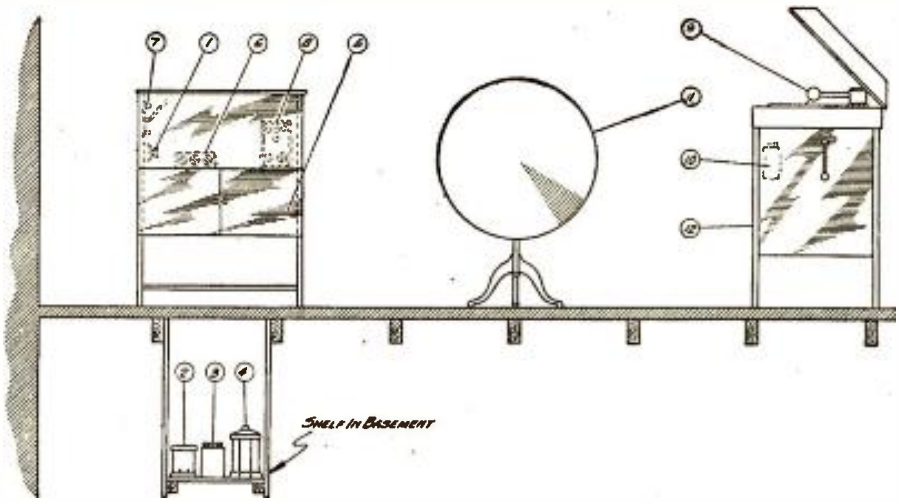
Operating the Amplifier

On the front panel of the assembly is the polarity indicating meter to give a quick check on the polarity of the plug in the light socket or wall outlet. When the unit is first tried, the polarity of the plug may be incorrect and the amplifier will not function. Reverse the position of the prongs of the plug in the receptacle. Once the correct position of the prongs is found, note the reading of the indicating meter on the front panel. Then you can always tell when the plug is in the right position in the DC outlet.

The "on-off" snap switch on the front panel controls the entire unit.

Listening In

(*Continued from page 230*)



THE ARRANGEMENT OF THE INSTRUMENTS

FIGURE 2: *The numbers in the diagram correspond to the list of parts in the text. As the diagram shows, there is no necessity for unsightly exposed wiring or instruments.*

The battery charger will only function when the five-pole switch is thrown to the receiver side, the switch on the receiver is thrown to the "off" position, and the snap switch, No. 1, is turned "on." The five-pole switch should therefore always be left set on the "receiver" side except when the phonograph is being used. Then, when it is desired to charge the battery it is only necessary to turn "on" switch No. 1; or, if a trickle charger is used, this switch may be left "on" all the time, or may even be eliminated entirely. This will leave the battery on charge at a slow rate during the time that the receiver is not in use.

—C. C. CLARKE, *Iowa Falls, Iowa.*

* *

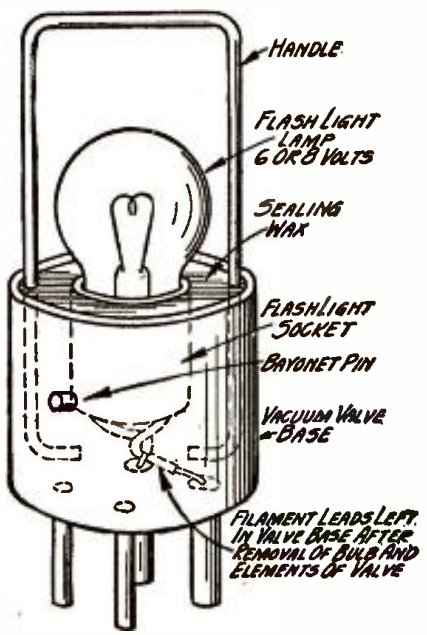
How One Reader Safeguards His Vacuum Valves

IN connection with my experimental work I have devised a small device which can be made by any fan at practically no cost, and which safeguards vacuum valves against burning out in case the "B" battery should be incorrectly connected across the filament terminals, or in case a short circuit should develop between the high voltage side of the "B" battery and one side of the "A" battery.

Before the valves are inserted in their sockets in a new set, but after the batteries have been connected, this "valve saver" should be placed in each of the sockets in turn. If the filament circuits are properly wired and the "A" battery is properly connected to the receiver, the flashlight lamp in the "valve saver" will light. If it fails to light, I know at once that there is something wrong in the filament circuit wiring of the receiver or with the "A" battery. If by any chance the "B" battery voltage is short-circuited to the filament, the "valve saver" will burn out. These flashlight bulbs are cheap—certainly a great deal cheaper than the set of valves that would burn out if I had not used the device.

The construction of this "valve saver" is extremely simple, as reference to Figure 3 will disclose. The only materials required are a worn-out "B" battery (to supply the required sealing wax), a burned-out vacuum valve (only its base is used) and a 6-volt flashlight lamp, with socket.

The first step is to break all of the glass out of the vacuum valve, including the glass stem which contains and supports the internal elements. The two wires which run from the filament prongs of the socket to the ends of the



A CONVENIENT VALVE SAVER

FIGURE 3: *Note that the parts which go to make up this testing plug are such as almost any fan would have in his possession.*

filament should be left intact. The filament prongs are the two most distant from the bayonet pin on the side of the valve base. If these two wires should be broken, they should be replaced with others.

The flashlight socket is next placed within the valve socket and the two wires from the filament prongs are connected to the socket terminals.

To make the assembly rigid, heated sealing wax, taken from a worn-out "B" battery, should be allowed to flow into the valve base, so that the lamp socket will be solidly imbedded when the wax cools. If no blow-torch is available for melting the wax, this purpose may be accomplished by breaking the sealing wax up into small pieces and packing them into the socket with a hot soldering iron until they melt into one another.

—H. B. CLOSSON, JR.,
Philadelphia, Pa.

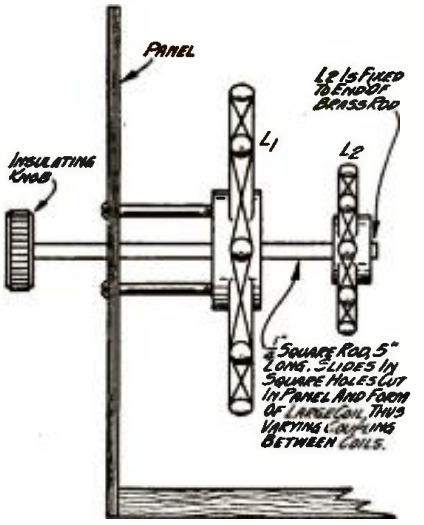
* *

The Old Haynes Circuit With Home-Made Coils

HERE is a three-circuit tuner which provides both sensitivity and selectivity and which can be constructed at a very low cost for parts. I have been using this circuit for some time and have tuned in 18 Chicago stations on the loudspeaker, as well as numerous other station located throughout the eastern and mid-western states.

The receiver has only one tuning control and a regenerative control which consists of a rod that slides in and out through the panel to move the tickler coil, L2, toward and away from the tuning coil, L1. This detail of the coil mounting is shown in Figure 4. The schematic circuit is shown in Figure 5.

The variable antenna coupling provided by the tapped portion of the coil, L1, gives the high selectivity of this circuit. By this means the antenna portion of the coil can be varied from three to fifteen turns, thus providing plenty of pick-up on the high waves and selectivity on the low waves. A switch lever with five switch points provides a convenient method of varying the coupling in the circuit.



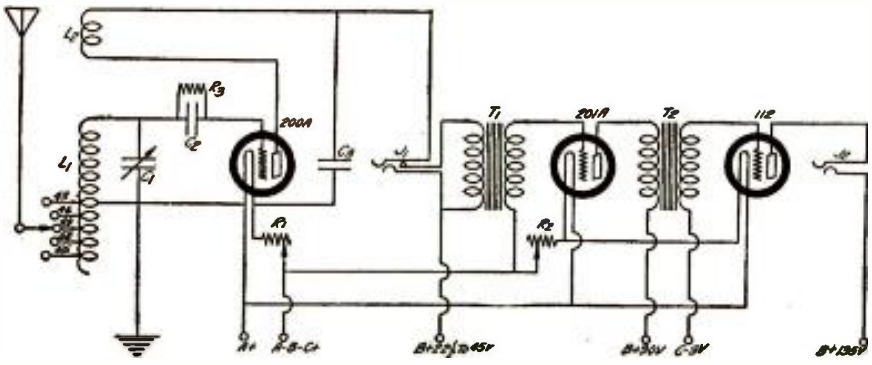
THE COIL DETAIL

FIGURE 4: *The home-made coil constructed according to these specifications gives extraordinary results, according to its designer.*

I am passing this circuit along to other readers of POPULAR RADIO who may be interested in a small, cheap and easily constructed job that will produce real results—better results per dollar than any other receiver I have seen. There are no tricks about the circuit. The only caution to be given is to reverse the tickler leads if the receiver refuses to oscillate when it is first put into operation. Here is a list of parts used:

C1—.0005 mfd. variable condenser;
C2—.00025 mfd. fixed condenser;
C3—.001 mfd. fixed condenser;
L1—Spiderweb coil wound on a 3-inch form with 13 pegs; total of 55 turns of No. 20 DCC wire, with taps taken off at every third turn beginning with the forty-third;
L2—Spiderweb coil wound on a 2-inch form with 17 pegs; 35 turns of same size wire as used for L1;
J1—Double circuit, closed type jack;
J2—Single circuit, open type jack;
R1—20-ohm rheostat;
R2—6-ohm rheostat;
R3—Variable grid-leak, 2 to 9 megohms;
Composition panel 18 inches by 7 inches by 3/16 inch;
Binding-post strip, binding posts, etc.

—SILENT E. A. NEGUS.
Block Island, R. I.

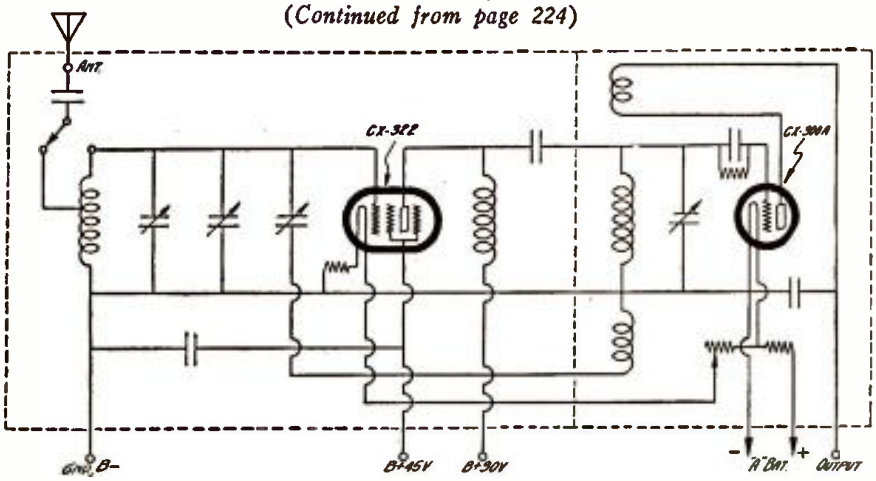


A CIRCUIT FOR DX WORK

FIGURE 5: *The regenerative detector is at the left. By means of the jack, J1, the two-stage low-frequency amplifier may be plugged in or out, and head-phones inserted.*

Screened-Grid Valves "Pep Up" the Browning-Drake

(*Continued from page 224*)



THE SCHEMATIC CIRCUIT OF THE RECEIVER

FIGURE 4: *This is the diagram of the circuit to be used with the two-valve tuner when a screened-grid valve is used in the high-frequency amplifier stage. Notice that a by-pass condenser is inserted between the shielding grid and the filament circuit. Also two small fixed resistors are added in series with the filament of the screened-grid valve, 10 ohms in the negative side and 5 ohms in the positive side.*

micromicrofarads, across the antenna tuning system of the circuit, so that the trimmer condenser will completely compensate all over the wave-band. Sometimes it is not necessary to add this small condenser, for this result may be obtained by connecting the .0001 mfd. condenser in series with the antenna to the stator plates of the first tuning condenser. This puts the capacity of the antenna across the antenna tuning system, and as a result the compensating condenser has sufficient variation to take care of the difference in tuning of the two condensers which are operated on the same shaft.

Neutralization.

When the receiver is completely constructed and connected up as shown in Figures 1 and 4, neutralization may be done in the following manner:

The compartment which contains the detector circuit should have the shields completely on and fastened down tightly. The rear shield on the first compartment may be left off until after the neutralization process takes place.

The best way to neutralize is to set the dial at about 20 on the scale and then turn the tickler either in one direction or the other, until a distinct click will be heard in the reproducer. This means that the detector circuit is oscillating. Adjust the tickler coil until this circuit ceases to oscillate. A test to determine whether or not the circuit is oscillating is to place the finger on the terminal of the .5 mfd. blocking condenser, which is connected to the stator plates of the second tuning circuit, when a distinct click will be heard if this circuit is oscillating. Now turn the tickler back until oscillation just ceases. Turning the trimmer condenser will then throw this circuit into oscillation if the neutralizing condenser is not properly set. The neutralizing condenser should be then set until the above test is satisfactory and the trimmer condenser has no effect on oscillations produced in the second circuit. It will be found that the neutralizing condenser is then almost at a minimum value.

In this article a little different viewpoint from that generally accepted has been given on the use of screened-grid valves. The writer believes this to be scientifically correct, and it is sincerely hoped that this data may be helpful to experimenters as well as those who desire to build an up-to-date and sensitive radio receiver.

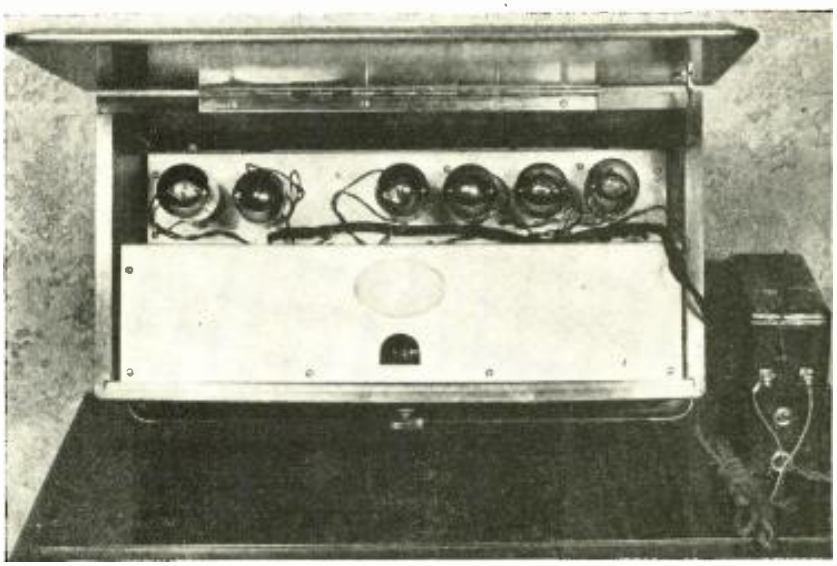
The receiver, of course, may be used with any good low-frequency amplifier and in the photo-diagram in Figure 1 it is shown connected to the General Radio push-pull amplifier, from which excellent results may be obtained, both as to quality and volume of reproduction. The diagram gives complete details for installation with specific recommendations as to the accessory apparatus that has been found satisfactory in tests made in POPULAR RADIO Laboratory.

A New Use for Screened-Grid Valves

Screened-grid valves make their début as low-frequency amplifiers in the new Thordarson Inductor receiver, the construction of which will be featured in next month's issue of POPULAR RADIO. Here is something that the wide-awake fan will sit up nights playing with. Don't fail to get the constructional details.

4 Minutes to Socket Operation

(Continued from page 225)



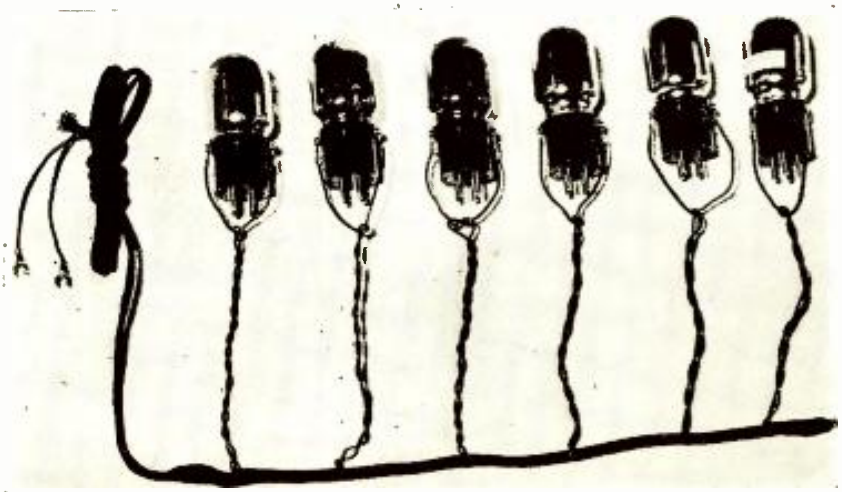
THE AC VALVES IN PLACE

As this view shows, the installation of the valves and harness does not require any tampering with the inner mechanism of the set. A person knowing nothing of radio could make the change.

ume control. This takes the form of a high resistance which is connected directly across the antenna and ground. The volume is, consequently, controlled by regulating the strength of the signal on the grid of the first high-frequency valve, and it will be found that very satisfactory results can be had with this simple arrangement. In no case should the user attempt to insert any variable resistances in the heater circuit of the AC valves. The heater current on these valves is critical, and any attempt to bring it below the normal operating value might prove harmful.

In special cases, the more serious kind of radio experimenters may desire to know something about the operating characteristics of these valves, for the purpose of experimental work.

The valves are offered in two types—the 608 and 608-a. The 608 valve is a detector and operates with a plate voltage somewhere between 45 and 90 volts. It has a plate impedance of approximately 8,000 ohms, a mutual conductance of about 1,000 and a voltage amplification between 7 and 9. The 608-a Marathon valve is intended for both high-frequency and low-frequency use. The plate voltage in this instance may be anywhere between the limits of 90 and 180. The plate resistance is approximately 9.000 ohms and the amplification factor between 7 and 9. This valve is self-biasing and requires no "C" battery in the grid circuit, except when the valve is used in the last low-frequency stage, where the usual 4½-volt "C" bias may be applied.



HOW TO APPLY THE HARNESS

The application of the adaptor harness to the AC valves is the simple matter of attaching the leads from the twisted cables to the special filament terminals on the sides of the valve bases.

The Aero Converter

(Continued from page 204)

6/32 machine screws ¾ inch long and nuts for fastening the instruments to the sub-panel.

Mount the coil frame of the coil, A, the socket, F, and the choke coil, D. Then fasten down the grid condenser, E, that is equipped with clips that may be fastened directly to the grid terminal of the socket and the adjacent coil terminal lug on the coil frame. Then attach the brackets, K1 and K2.

Next proceed to mount the two variable condensers, B and C, and the rheostat, G, on the front panel, I. The sub-panel, J, is then fastened to the front panel, I, by means of machine screws and nuts inserted through the front panel into the sub-panel brackets.

The mounting of the dials, H1 and H2, should be carried out in accordance with the instructions packed in the carton in which they come.

When all the construction work has been completed as shown in the illustrations, the unit is ready to be wired.

Wiring the Short-Wave Adaptor

The wiring should be done according to information given in the picture wiring diagram in Figure 3. This diagram shows the exact connections to be made to all the instruments and to the connector plug.

The next job will be to prepare the two filament leads and plate lead from this unit to the connector plug. This plug may be made from the base of a burnt-out UX type of valve. Remove the glass and other matter from the base and solder the three leads to their respective prongs. To avoid mistakes, check these instructions against the detail diagram in Figure 3.

When the wiring has been completed, the grid-leak, L, should be inserted in the grid-leak clips and the unit is now ready for connecting to the broadcast receiver.

How to Install and Operate the Short-Wave Adaptor

Insert the connector plug in the detector socket of any standard broadcast receiver with which it is to be used. In Figure 1, which shows graphically all the connections necessary in installing the unit, the Hammarlund Hi-Q "Six" is taken as an example of standard receivers that may be used. There will be no extra batteries required for operating this unit. The connector plug may at any time be disengaged, the detector valve placed in its socket and the broadcast receiver restored to its use for reception on the regular broadcast band between 200 and 550 meters.

If a rheostat controls the filament voltage of the detector valve of the broadcast receiver, it should be set all the way "out," so that the filament voltage may be regulated by the rheostat, G, on the short-wave adaptor.

The antenna and ground connections are to be taken off of the receiver itself and applied to the antenna and ground posts of the adaptor. Refer to Figure 1 for these details of connection.

The antenna coil is loosely and variably coupled to the grid coil. These two coils are part of the coil assembly, A. The grid coil is tuned by the variable condenser, B. Regeneration is controlled by the condenser, C. For the most satisfactory reception, it should be turned up until oscillation in the circuit just starts and then it should be turned back just below this point.

For maximum results, it is recommended that a Zetka ZD valve should be placed in the valve socket in the adaptor and a Zetka ZAF valve for the first stage and a Zetka ZAO valve for the last stage sockets in the Hammarlund Hi-Q "Six" receiver. These valves are of low impedance and provide exceptionally high amplification.

By interchanging the coils, the various short-wave ranges may be covered. The dial settings of all stations received should be recorded, along with the size of the coil used for each particular station. This complete data should be kept so that the station may be tuned in again by referring to it.

The unit may be placed in a standard Corbett cabinet measuring 7 by 14 inches.

When this device is properly installed and when the operator becomes familiar with the method of tuning, stations literally thousands of miles away may be picked up on short waves.

Screened-Grid Valves Make *Still a More Powerful LC-28—*

Keeping up with radio progress is a strenuous business, but POPULAR RADIO feels that the LC-28 receiver is so splendid an instrument that it deserves the best that radio can give. Accordingly, next month, constructional data will be given for installing two stages of screened-grid valve amplification on the LC-28, thus making it the most modern receiver available to the fan and set builder.

BROADCASTS

Radio Ranks Sixth in U. S. Industries

RADIO'S total volume of business last year was $550,000,000, ranking it sixth among the industries of the country, according to J. L. Limes, of the Crosley Radio Corporation. This astounding total has been reached in a seven-year boom from the $2,000,000 business of 1921—the most phenomenal industrial growth in history. In 1921 the business consisted largely in crystal sets and three-circuit tuners. In 1922 came the neutrodyne receiver, using four and five valves, raising the business to a $60,000,000 level. In 1923 the total was $150,000,000, in 1924 $350,000,000, and in 1925 $410,000,000. In 1926 the manufacture of six, seven and eight-valve receivers brought the total to almost the half-billion mark, and 1927 took the total well above that level. During 1927 six-valve receivers proved to be the best sellers.

* *

Where is the Radio "Saturation Point?"

TWENTY times as many sets as are now being used would be needed to satisfy fully the potential world radio market, according to the estimate of the Department of Commerce. The 18,000,000 receiving sets now in use throughout the world serve about 90,000,000 of the earth's inhabitants, or approximately 9 per cent of the population of existing zones of constant radio reception. If the zones of broadcast service were extended to include the whole world, 350,000,000 sets would be required. So the bugbear of radio "saturation" is still a good many decades in the future.

* *

From Bananas to Bach in Radio Taste

RADIO fans who once clamored for jazz of the very hottest sort are now listening—with favor—to the classic compositions of Bach, Mozart and Hayden, says Victor Saudek, of the KDKA Little Symphony Orchestra. Mr. Saudek, who has been making programs for broadcast fans almost since broadcasting began, has observed a steady rise in taste since the time when he organized the first orchestra ever formed for the exclusive purpose of broadcasting. After the first cry for red-hot jazz had cooled down somewhat, the day of the ballad and heart song came. Light opera followed, with Victor Herbert bringing in floods of fan letters. Then, about three years ago, such standard pieces as the Overture to "William Tell" and "Poet and Peasant" began to be called for. Mr. Saudek states that at present most of his letters call for the various classical serenades, minuets and shorter works of Mozart, Schubert and Hayden. With such phenomenal progress in the past, Mr. Saudek is now looking towards a future in which the public will demand complete symphonies by the classic masters, and the works of modern orchestral composers.

* *

The Future for Socket-Operated Sets

WITH seventeen out of every twenty-six homes in the United States wired for electric lights, the future of the all-electric sets in this country looks roseate in the extreme. The seventy-five million people whom these homes represent are a market that has barely been touched by the newly developed all-electric receivers and other power devices that operate from the lighting lines. And since the number of electrically wired houses is increasing yearly (the increase in 1927 was 7½ per cent) it can be seen that socket operation for radio receivers is in for a long and happy period of prosperity.

* *

Radio; Necessity or Luxury?

WORLD-WIDE tax information indicates that radio is classified in almost every nation on the earth as a necessity, and not as a luxury. France and Spain alone classify radio as a luxury in their taxation programs; France levies a 12 per cent tax on more expensive sets, and a 2 per cent tax on cheaper products, while Spain has a 5 per cent *ad valorem* rate. About a dozen countries levy a sales, or excise, tax, imposed generally on almost all products, including radio.

An All-Electric LC-27

(*Continued from page 220*)

external filament terminals of the connectorald No. 926 GT. Place the Na-Ald RY-500 resistor on the three terminals provided. Now connect the green twisted pair of wires to the external heater binding posts of the No. 927 UY connectorald.

Place the Na-Ald No. 926 GT. connectorald in the last or power valve socket of the LC-27 receiver and the remainder of the connectoralds in order and insert a CX-326 type valve in the first, second and fourth (red) connectorald sockets, starting from the high-frequency end of the set. Insert a CX-327 valve in the third (green) or detector socket. Insert a CX-371 valve in the fifth (orange) or last socket. The set itself is now ready for AC operation.

Having accomplished the above operations, the builder may now connect the 5-volt (orange) filament leads, the 2½-volt (green) heater leads and the 1½-volt (red) filament leads of the harness to the terminals of the Jefferson AC filament transformer as shown in Figure 1.

Run wires from the negative, detector, amplifier and power binding posts of the Majestic power-pack to the corresponding terminals of the LC-27 receiver, using a Gavitt 5-wire cable. Also connect the "C" negative (—) power binding post of the receiver to the "B" negative (—) binding post, since "C" bias is provided by the resistors in the connectoralds. Join the antenna binding post of the receiver to an Electrad socket antenna, and the ground binding post to a water pipe.

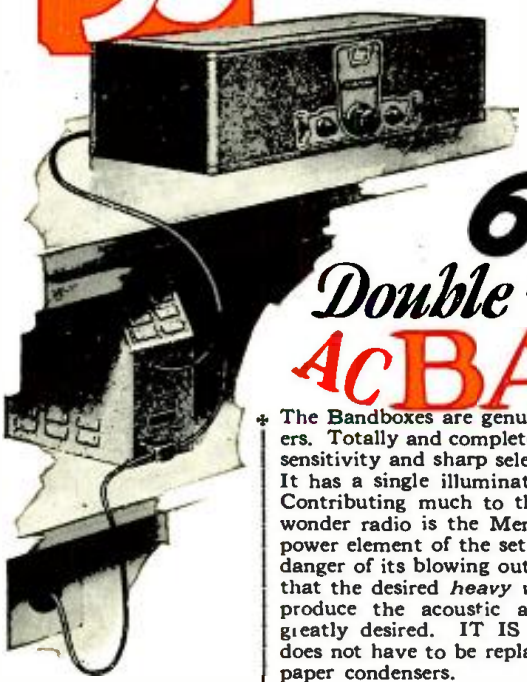
A DeJur 500-ohm variable resistor is placed across the antenna and ground binding posts as a volume control. Use a good reproducer, such as the Air-Chrome balanced tension reproducer, for best results with power operation.

Plug the AC power supply cords of the Majestic "B" power-pack and the Jefferson AC filament transformer into a double socket and the receiver will operate as soon as the heater type detector tube warms up. It will be found that the new AC valves will give improved results over the older DC valves, aside from the complete AC electrical operation, and the receiver should now compare favorably with the latest type of AC receiver.

The electrification of other sets of similar characteristics may be done in a similar manner. If any set requires an additional grid resistor for stabilizing the high frequency stages, the Na-Ald resistor No. R of any value from 500 to 1,000 ohms may be inserted in the slots of the connectoralds. The diagrams in this article apply to any set using two stages of high-frequency amplification, a vacuum valve detector and two stages of low-frequency amplification with a power valve.

The radio leadership of 1928

NOW $90



Power! Power! POWER! A feature of the Crosley AC Bandbox that lifts it head and shoulders above competition!

170 to 185 volts on the plate of the power output tube!

Comparative checkings of competitive radios show interesting figures. Under identical testing conditions the Bandbox shows a full 170 to 185 volts on the plate of the 171 power output tube. Other radios show from 100 to 110 and 130 to 140 volts on the plate of the output tube. The 171 power tube should have around 180 volts. This better than 40% superiority in one case and 25% in the other is the difference between *today's* radio and yesterday's.

MUSICONE—Type D
$15

Crosley Musicones are famous for their value. This new style is no exception. Its low price of $15 is in keeping with Crosley traditions. It instantly demonstrated its soundness by immediate and enormous sales

602 Double Unit AC BANDBOX

The Bandboxes are genuine Neutrodyne receivers. Totally and completely shielded, their acute sensitivity and sharp selectivity is amazing.

It has a single illuminated dial.

Contributing much to the success of this 1928 wonder radio is the Mershon Condenser in the power element of the set. Not being paper, the danger of its blowing out is entirely removed so that the desired *heavy voltage* can be used to produce the acoustic and volume results so greatly desired. IT IS SELF-HEALING. It does not have to be replaced as is the case with paper condensers.

The capacity of smoothing condensers in Crosley power units is 30 mf. Other sets use only a fraction of that condenser capacity. Undersize condensers, transformers, etc., are used in order to build down to a price. Crosley builds up to a standard.

The AC Bandbox is purposely made in two models—the 602 in a double unit—the 704 self contained. This is to provide maximum adaptability in all sorts of surroundings and uses.

The 602 double unit provides console cabinet installation in ALL kinds of consoles.

Single Unit 704

SELF CONTAINED $95

The 704 is for those who want the entire set in one cabinet. The two sets are identical in elements, design and performance. The physical difference is solely to meet the human difference of taste, necessity and price! The size of the 704 is 17¾ inches long by 12¾ inches wide and is 7½ inches high.

Battery Type Bandbox $55

This celebrated model needs no picture, for in appearance it is identical to the 602 receiver pictured above. Its amazing performance has won the radio world this season, and its value is as outstanding NOW as the day it was first presented!

New
401 Dry Cell Type
BANDBOX
JUNIOR
$35

A new dry cell receiver with all the features of the Band-Lox — selectivity, sensitivity, volume and appearance. For places where AC current or storage battery service is not available or desired.

Approved Console Cabinets manufactured by Showers Brothers Co., of Bloomington, Ind., and Wolf Mfg. Industries, Kokomo, Ind., are sold to Crosley dealers by H. T. Roberts Co., 1340 S. Michigan Ave., Chicago, Sales Representatives.

NEUTRODYNE

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"You're *there* with a Crosley"

CROSLEY RADIO

Finer Performance
than you've ever enjoyed!

Light-Socket Power ~
Fidelity of Reproduction
made dependable by complete

AMERTRAN *Units*

The AmerTran ABC Hi-Power Box. List price $102.50, east of the Rockies. Complete with rectifying tube.

AN average receiver can be made one of the finest of modern instruments by the use of AmerTran products. For quality reproduction—limited only by the perfection of the speaker—for noiseless reliable power without the nuisance of batteries or chargers—these companion units set a new high standard of performance. Be sure to see them before you consider a new receiver this year. Cased in compact cabinets, they may be installed in a console, where your batteries used to be, or placed wherever convenient.

The A B C Hi-Power Box requires no attention or adjustment after installation. It delivers uniform, dependable power from the house-current—supplying sufficient voltage and current for Push-Pull 210 tubes and all other A C tubes required in a modern receiver. The complete unit contains AmerTran designed equipment with a power transformer having separate windings to provide AC filament current for power tubes, the 281 rectifying tube, heater current for three or four UY-227 AC tubes, and current for four or five UX-226 raw AC tubes.

See these new AmerTran products on demonstration at any store displaying the sign "Authorized Amer Tran Dealer" or, if you cannot obtain them, write direct to this Company. Both wired units are licensed under patents owned or controlled by R C A and must be sold complete with tubes.

With either an AC power supply system or batteries, you'll find the fidelity of reproduction brought to your set by the AmerTran Push-Pull Power Amplifier actually limited *only* by the perfection of the speaker. This Amplifier introduces a new standard of quality to audio amplification. It connects to the detector of any good receiver and may be entirely AC operated. The input to the speaker is free from distortion and objectionable AC hum—the energy output is increased especially at the lower musical frequencies bringing greater clarity at high or low volume. Furnished with cable and plug the amplifier connects directly with the ABC Hi-Power Box.

These two units are designed to work together, and when used with a good tuner and speaker will reproduce without exaggeration a philharmonic orchestra or pipe organ as though actually present.

The AmerTran Push-Pull Power Amplifier. List price $60. east of the Rockies. Price of Amplifier complete with tubes depends on tubes specified.

AMERICAN TRANSFORMER CO.
178 Emmet Street : : : : Newark, N. J.
"Transformer Builders for Over 27 Years"