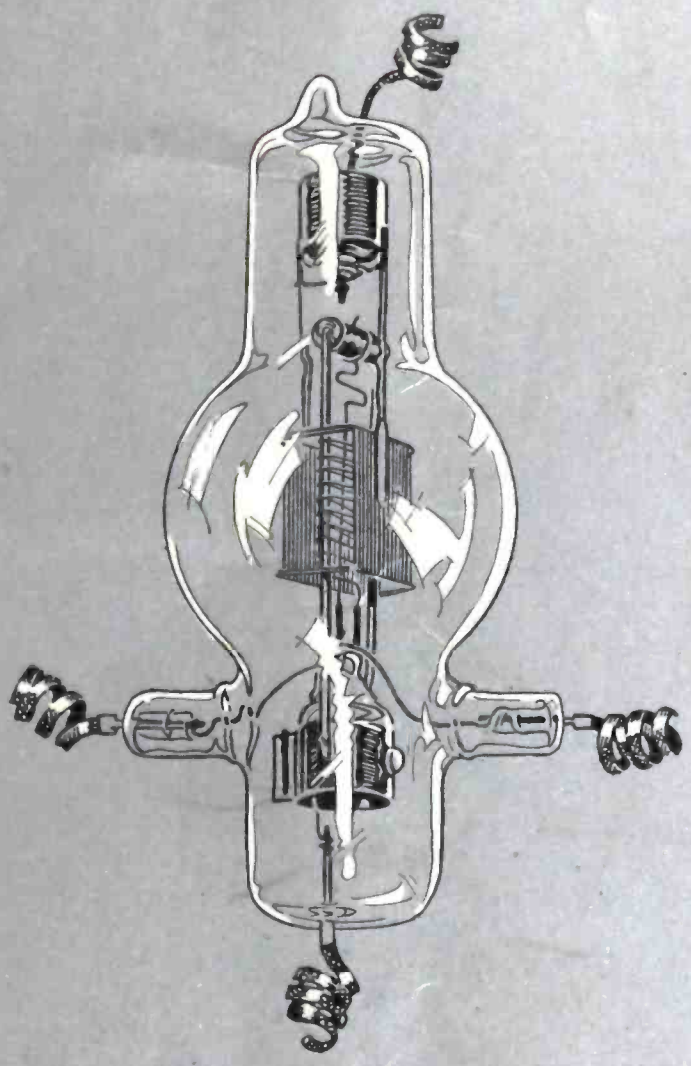
Popular Radio

SEPTEMBER · 1927

25¢



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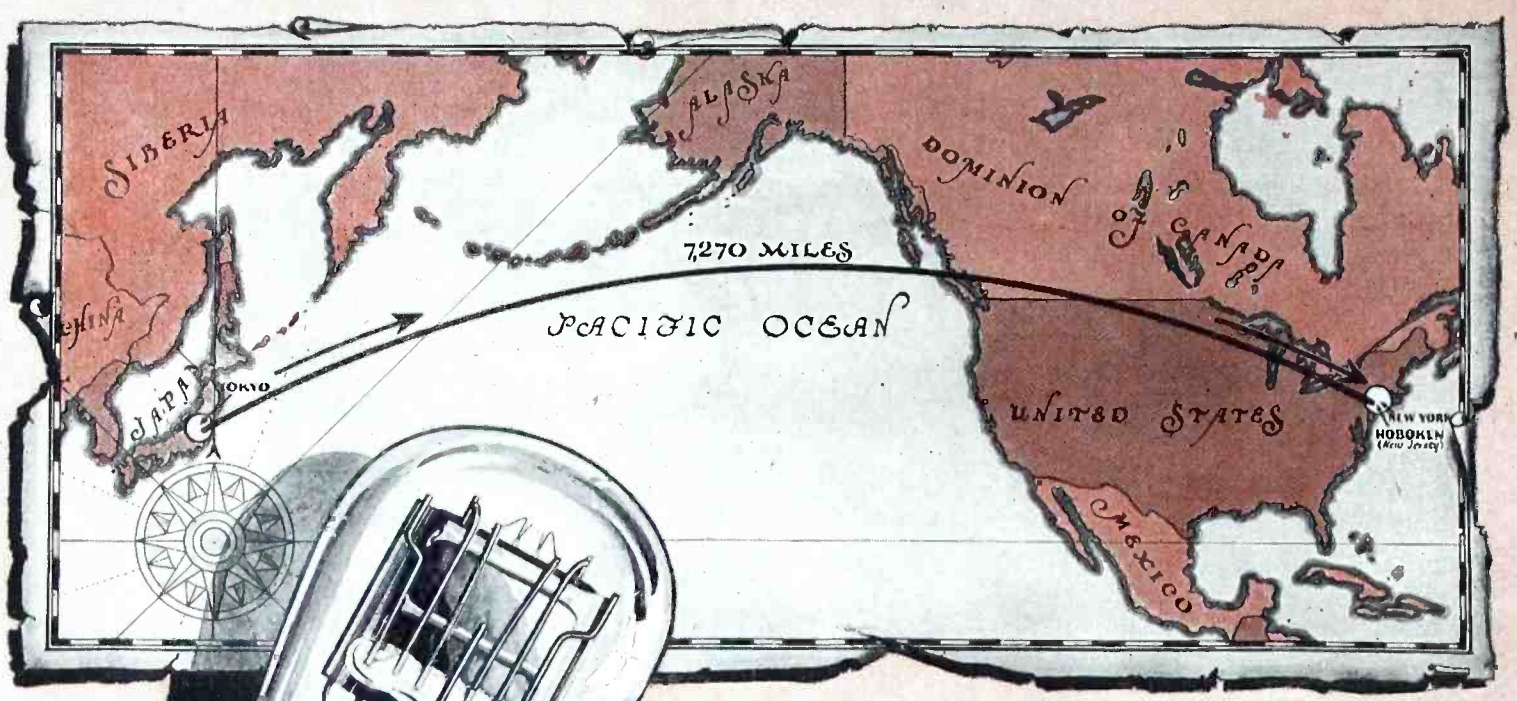
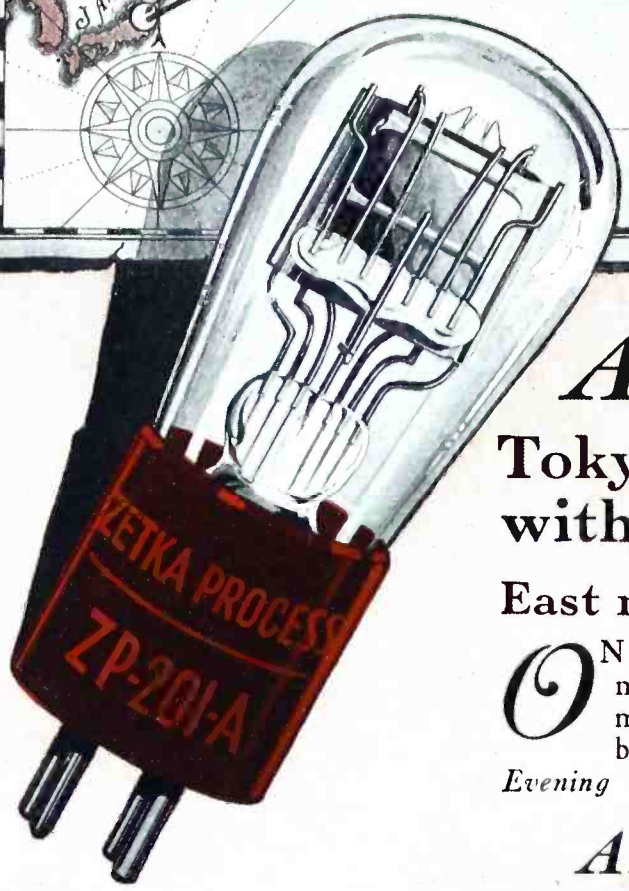




A World's Record!

Tokyo, *Japan* to Hoboken, N. J. with ZETKA *Clear-Glass* Tubes

East meets West in 7270 mile radio hop

ON April 15, 1927, Arthur Wald of Hoboken, New Jersey, made a new World's Record for DX reception—7270 air miles . . . Station JOAK of Japan—the longest distance bridged in radio history, according to the New York *Evening Telegram.*

"I recommend the use of Zetka Tubes to any one who is deeply enough interested in radio to want the best equipment it is possible to secure.

"Zetka Tubes have given me infinitely more power, greater distance, better tone qualities, and a complete freedom from microphonic noises, way beyond any other tubes I have ever used."

Arthur Wald

Announcement—3 Special Duty Tubes

With the cooperation of Laurence M. Cockaday, Zetka Laboratories have produced a new Radio Frequency Amplifier. The ZRF, another ¼ amp. clear-glass tube operating at 3 to 5 volts.
Price $4.50

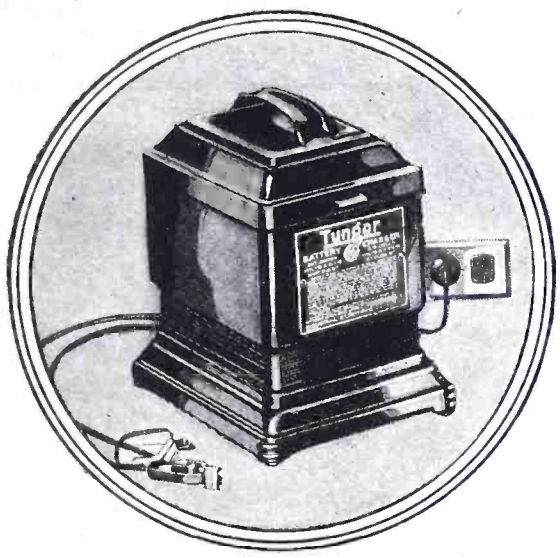
Z 200 A has been perfected as a super-sensitive detector. Unlike the usual 200 A, the Zetka clear-glass Z 200 A is free of the objectionable noise and hiss. *Price $4.00*

For Audio Amplification—ZP 201 A has been improved and made more rugged. Can also be used as detector with marked improvement over ordinary 201 A type tubes—but not quite as sensitive as Z 200 A. *Price $3.50*

ZETKA
The *Clear-Glass* Tube

ZETKA LABORATORIES, INC., 73 WINTHROP ST., NEWARK, N. J.

General Electric Battery Chargers



$10

$14

$24

New Prices
(East of the Rockies)

2 ampere Tungar . now $14
5 ampere Tungar . now $24
G-E Trickle Charger now $10

Tungar causes no radio interference. It cannot blow out tubes.

An overnight charge costs a dime.

It is a G-E product developed in the Research Laboratories of General Electric.

The 2 or 5 ampere Tungars charge 2, 4, and 6 volt "A" batteries, 24 to 96 volt "B" batteries in series; and auto batteries, too. No extra attachments needed.

KEEP your radio set ready—at all times—for all the good things that come over.

Just clip a Tungar [the name of the General Electric battery charger] to your batteries at night, leave it as you would the light in the hall . . . . . in the morning the batteries are pepped up and ready for active duty.

Your dealer can help you. Ask him to show you the popular 2 ampere Tungar that charges both "A" and "B" radio batteries. *It has a binding post for a trickle charge.* Charges auto batteries, too.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

Tungar
REG. U.S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

GENERAL ELECTRIC

Popular Radio

FOUNDED 1911

VOLUME XII September, 1927 NUMBER 3

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KENDALL BANNING, *Editor*

LAURENCE M. COCKADAY, *Technical Editor* E. E. FREE, Ph.D., *Contributing Editor*

7 Tube Set
Single Dial Radio

30 DAYS FREE TRIAL

Metrodyne Radio Sets
Are Equipped For
BATTERY or ELECTRIC operation

The Metrodyne
ONLY ONE DIAL TO TUNE

RETAIL PRICE
$75.00
Completely Assembled
Big Discounts to Agents and Dealers

Wonderful offer direct from the factory! The world's greatest radio! A perfect working, single dial control, 7 tube receiver! And just to prove our claims, we will ship it to your home for **30 days' free trial.** Test it under all conditions. Test it for distance, volume and tonal quality—and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

Three Year Guarantee

BIG PROFITS TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon, a letter or a postal for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. **Tested and approved by Popular Science Institute of Standards, Popular Radio Laboratory, Radio News Laboratory** and by **America's leading Radio Engineers.** Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet with beautiful, gilt metal trimmings. Very newest 1928 model, embodying all the latest refinements.

Easiest set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, **1,000 to 3,000 miles on loud speaker!** The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.

6 Tube Set $48.50 RETAIL PRICE Completely Assembled

30 Days' Free Trial—3 Year Guarantee

Metrodyne Super-Six

Another triumph in radio. Here's the new 1928 model Metrodyne 6 tube, two dial, long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station on same dial readings every time — no guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal 30 days' free trial offer, which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis.

MAIL THIS COUPON
or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer—
SAVE MONEY—WRITE NOW!

MAIL COUPON BELOW

Let us send you proof of Metrodyne quality—our 30 days' free trial offer and 3 year guarantee

Mrs. Wm. Leffingwell, Westfield, N. J., writes: "The Metrodyne Radio I bought of you is a wow! This is as good as any $225 machine I have ever seen."

N. M. Greene, Maywood, Ill., writes: "My time is up and the Metrodyne works fine. I got Havana, Cuba, Oakland, Calif., Denver, Colo., Toronto, Canada, all on the loud speaker."

J. W. Woods, Leadville, Colo., writes: "Received the 7-tube Metrodyne in fine condition. Had it up and working same day received. Was soon listening to Los Angeles, San Diego, Oakland and other California points; also St. Louis, Kansas City and other east and south stations—all coming in fine. Am more than pleased. Sure enjoying it."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer.**

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 6
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer.**

*Name*_____

*Address*_____

If you are interested in AGENT'S proposition, place an "X" in the square ➡ ☐

METRO ELECTRIC COMPANY
2161-71 N. California Ave. • *Dept.* 6 • Chicago, Illinois

A Page With The Editors

By the time this September issue of Popular Radio reaches its readers, the quiescent summer season of radio will be over and the fall season will be looming with greater promise—and with more and better cause for promise—than any season in the history of the radio art.

* *

Popular Radio believes that the coming radio year (which begins with the first cool days of September), will be the best year that radio has ever known. The reasons for this belief may be summarized thus:

* *

First.—Because the Federal Radio Commission, with commendable efficiency and dispatch, has been clearing up the broadcasting situation and has already brought order out of the ethereal chaos:

* *

Second.—Because recent important legal decisions have made material headway in clearing up the complicated patent situation—which has, in turn, helped to stabilize the radio industry, to the benefit and protection of the industry and of the broadcast listener alike:

* *

Third.—Because during the past few months new and greatly improved low-frequency apparatus has been developed and placed at the disposal of the radio public. (See the series of articles on this important subject now appearing in Popular Radio.)

* *

Fourth.—Because the current summer has at last seen the successful development of the electrical pick-up units that make possible extraordinary reproduction and amplification of phonograph records, by the use of radio apparatus—a development that is opening up new possibilities of entertainment to both the radio and the phonograph fan as well as to the radio and phonograph industries. (See the series of articles on this new subject now appearing in Popular Radio.)

* *

Fifth.—Because the past few months have witnessed by far the greatest and most significant development of special duty and AC vacuum valves that the industry has ever known—thereby opening up not only a limitless field of experimentation to the radio amateur, but greatly increasing the quality of reception for the broadcast listener. (See the July-August issue of Popular Radio, which was devoted largely to these new inventions.)

* *

Sixth.—Because of the advances made in the development of loud-speaker in general and of the new "exponential horn" in particular. (See pages 22-24 of the July-August issue of Popular Radio, as well as the constructional article in this issue.)

* *

Seventh.—Because of the progress that is being made in the development of radio circuits, made possible by the introduction of new inventions and apparatus—that places at the disposal of the broadcast listener better reception at less expense than ever before.

* *

That the staff of Popular Radio has been in intimate touch with all of this progress (indeed, that it has been responsible for a considerable part of it, through the activities of the Popular Radio Laboratory), has been demonstrated in the magazine itself.

* *

And that Popular Radio is destined to render an important service to the radio fan as well as to the radio industry, during the coming season, will be convincingly demonstrated with the introduction of the latest and best contribution that Popular Radio has yet made to the radio art in the remarkable new LC-28 Receiver—which is announced in this number (see page 148), to be followed up by the complete constructional details in the October number.

* *

Following these important contributions, Popular Radio will bring out a series of new features that will be of widespread interest and significance—features that serve as the practical expression of the optimism with which Popular Radio surveys the season that unofficially opens on Labor Day.

* *

The world-wide interest in the experiments recently made in England in "broadcasting telepathy," or mind reading, is due not only to the general belief that science has much to learn in this field, but also to the fact that these particular experiments were carried out on a large scale and under distinguished scientific supervision.

* *

For many weeks the results of these experiments were carefully studied and tabulated; they are finally summarized in the article by Sir Oliver Lodge, beginning on page 111 of this issue of Popular Radio.

* *

While the results of these particular experiments are termed "negative," other similar experiments have furnished more encouragement—according to the incomplete reports of those who conducted them.

* *

In 1923 what are claimed to be the first tests in the broadcasting of telepathic impulses were conducted by E. F. McDonald, Jr., from station WJAZ in Chicago.

* *

And during April, 1927, Pierson W. Banning, of Los Angeles, conducted like experiments from station KFXB at Bell, California.

* *

"Astonishing results were received from a distance of nearly 140 miles," reports Mr. Banning. "While further evidence from various distances will help build up a really remarkable report when released."

* *

W. Frank Sutherland, who wrote the article on pages 114-117 of this issue, "How to Make the Exponential Horn," is by profession an electrical engineer. His interest in music has drawn him into the problems of radio reception—particularly into the problems of quality reproduction. His exponential horn is a real contribution to the radio art.

* *

In Popular Radio for this month will appear the first and only authorized description of Popular Radio's latest and best contribution to the radio art—the new LC-28 Receiver.

* *

And in the October number will be published the complete constructional details.

* *

In its principles of operation, in its simplicity of design and construction, in its moderate cost, and above all, in the extraordinary quality of its reception, the LC-28 receiver represents a highly important contribution to the radio art—more important than the famous Four-Circuit Tuner, the remarkable LC-27, or the various other receivers that have been developed in the Popular Radio Laboratory.

—The Editors

You wouldn't stuff yourself tonight — then go hungry all next week!

DON'T expect your radio storage battery to bring in programs loud and clear when you work it day after day without replenishing the power. Keep the battery strong and active by feeding it regularly — with a Rectigon Home Charger.

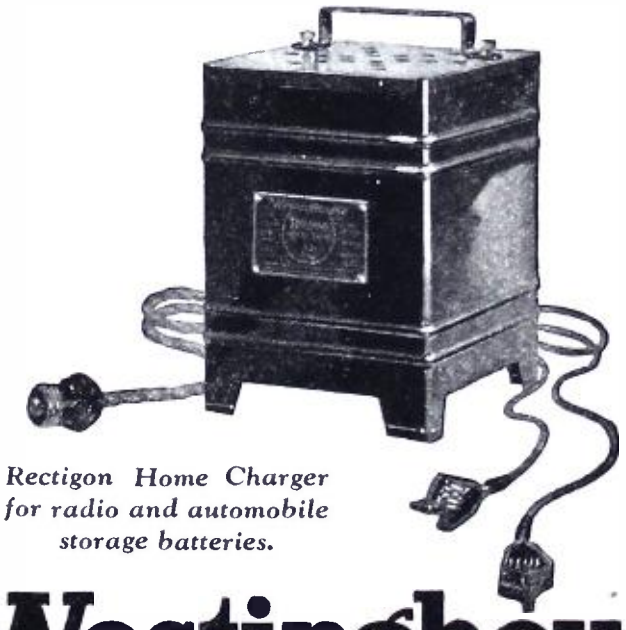
Charge at trickle or high rate — Rectigon does both.

With the Rectigon you can get a steady "trickle" to replace "A" power as you use it. In case of heavy drains due to prolonged use of the set, by a mere rearrangement of the leads you charge "A" or "B" batteries quickly, at a heavy rate. Either way, when you turn on your radio, you have power to spare. There are no acids or chemicals with Rectigon — no moving parts. You just attach the leads and plug into the light socket. It will charge your automobile battery the same quiet, "no trouble" way.

At your radio store, Rectigon, the many purpose charger. Look for the name on the plate.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PENNSYLVANIA
OFFICES IN ALL PRINCIPAL CITIES ' REPRESENTATIVES EVERYWHERE ' TUNE IN WITH KDKA—KYW—WBZ

BESIDES Rectigon for better battery charging, Westinghouse also makes Micarta Panels and tubing for better insulation, and radio testing instruments for better reception.



Rectigon Home Charger for radio and automobile storage batteries.

Westinghouse

The RADIO ALMANAC

September, 1927

Full Moon, 4th Day 5 h. 44 m., morning, W

D.M.	D.W.	Notable Events and Anniversaries
1	Th.	1896: GUGLIELMO MARCONI, a young Italian inventor, succeeded at this time in transmitting a radio message 100 yards; SIR WILLIAM PREECE referred to Marconi's device as "highly novel and very beautiful."
2	Fr.	1869: HIRAM PERCY MAXIM, scientist, inventor, founder and president of the Amateur Radio League, was born. *Good radio weather starts about now.*
3	Sa.	1921:. The first licenses to broadcast in the United States were issued by the Department of Commerce. *Tune in on sporting events.*
4	S	1897: Radio receiving apparatus was set up at Bath, England, and signals were received from Salisbury, thirty-four miles away.
5	M.	1914: PRESIDENT WILSON issued Executive Order No. 2042, providing for the taking over by the U. S. Government of certain high-powered station for transatlantic communication, as a war measure.
6	Tu.	1925: During this period the radio compass (or "direction finder") came into use on over 100 United States vessels. *Warm.*
7	W.	1840: JOSEPH HENRY, an American school teacher, first produced high-frequency electric oscillations and pointed out that the discharge of a condenser is oscillatory.
8	Th.	1892: SIR WILLIAM PREECE showed that in two completely isolated circuits of square form (each side 400 yards), placed one-quarter mile apart, telephonic speech was conveyed from one to the other by induction.
9	Fr.	1887: HEINRICH HERTZ made his first discoveries of the "Hertzian waves" that are now called "radio waves."
10	Sa.	1886: WILLIAM STANLEY devised his electric current transmission system. *Take the portable receiver along on that motor ride!*
11	S	1838: STEINHEIL discovered the use of earth return. *Church services will be broadcast this morning.*
12	M.	1906: DR. WILLIAM G. PICKARD discovered the rectifying properties of silicon crystals. This discovery formed the basis of the widely used crystal detectors.
13	Tu.	1913: During this month the radio station at Macquerie Island was the means of keeping DR. MAUSON, the Australian explorer, in touch with the civilized world.
14	W.	1926: Of the chief broadcasting stations in the United States, 124 were owned by mercantile concerns, 94 by schools and colleges, 43 by churches, 35 by publishing houses, 30 by manufacturers, 15 by states and cities and 15 by banks.
15	Th.	1926: A new record in broadcasting was established when a hook-up of thirty-three stations broadcast the proceedings of the Radio Industries' dinner in New York; the program included a speech by Vice-President Dawes.
16	Fr.	1926: During this year the sale of radio apparatus exceeded $4,000,000—an increase of 400 percent. over the year 1921.
17	Sa.	1899: The international yacht races which took place at this date were reported by radio for the *New York Herald.* *Kinder warm.*
18	S	1926: Radio amateurs played important and heroic rôles in rescuing the victims of the tornado that swept the eastern coast of Florida.
19	M.	1922: The Franklin Medal was awarded to SIR JOSEPH JOHN THOMSON, "in recognition of the immeasurable service he has rendered . . . in that domain of science especially related to a fundamental knowledge of electricity."
20	Tu.	1924: POPULAR RADIO brought out the two-tube reflex receiver, which was developed by its technical staff in the Popular Radio Laboratory. 1791: Michael Faraday was born.
21	W.	1926: DR. GEORGE WYETH, of the Vanderbilt Clinic, New York, announced that he had been able to perform successful operations in cases of cancer by means of a knife that uses a radio current.
22	Th.	1918: Radio messages transmitted from Carnarvon, Wales, were received in Sydney, Australia, 12,000 miles away—a record distance.
23	Fr.	1926: The Royal Typewriter Company paid a record price for the privilege of broadcasting the Tunney-Dempsey fight for the world's heavyweight championship in Philadelphia.
24	Sa.	1869: DR. JOHN STONE STONE, inventor of many radio appliances and winner of the Edward Longstreth Medal and of the Medal of Honor of the Institute of Radio Engineers, was born.
25	S	1889: DR. ELIHU THOMPSON, physicist and authority on radio phenomena introduced electric welding. *A good day to get the old receiver in working order.*
26	M.	1927: At about this time look on the news stands for the October number of POPULAR RADIO, which will contain the constructional details of the new and remarkable LC-28 radio receiver.
27	Tu.	1903: VALDEMAR POULSON, a Dane, invented the improved arc oscillation generator, using a hydrocarbon atmosphere and a magnetic field.
28	W.	1901: PROF. REGINALD A. FESSENDEN applied for a United States patent on his invention "for the wireless transmission of electromagnetic wave, relating to the transmission and reproduction of words or other audible signals."
29	Th.	1918: The installation of the radio apparatus on merchant vessels gained marked headway; at about this time over 2,500 ships of the British Merchant Marine carried radio sets.
30	Fr.	1926: The broadcasting of a warning reached a man in Birmingham, England, in time to prevent him from taking pills that contained arsenic, which had been sold to him accidentally by a local druggist.

Just Before He Broke the World's Altitude Record for Radio Broadcast Reception

What is believed to be the highest broadcast reception ever recorded was turned in recently by Capt. Hawthorne C. Gray, of the U. S. Army, in an ascent in a free balloon from Scott Field, Illinois. Up to the time that the aviator became unconscious at 31,000 feet, the receiver was working satisfactorily, "with a total lack of interference." The loop antenna made it possible for Capt. Gray to determine his bearings at all times; stations KMOX and KSD each indicated their true direction by the maximum volume obtained when the stations came in the plane of the loop. The apparatus used (as shown in the foreground of the picture above) was an Atwater Kent Model 32, a seven-tube, radio-frequency receiver with a single-dial control.

Popular Radio

VOLUME XII September, 1927 NUMBER 3

A BROADCAST EXPERIMENT IN SENDING

Thought-Waves *via* Ether

Does a thought, created by the brain, excite vibrations in the ether to which a distant brain can respond? If so, there is a close analogy between the "telepathic" process of transmitting messages and the radiophonic process. Certainly the subject is of vast interest and importance. Here is an authoritative report of the first important broadcast experiment in this field, in which 25,000 radio fans took active part, written by the eminent English physicist who officiated in it—

SIR OLIVER LODGE, F.R.S., D.Sc., LL.D.

AMONG scientific men there still persists some disbelief in the possibility of communication of mind with mind by other than the usual sense organs; but even among them there are many who believe that a telepathic faculty has been shown to exist; and, indeed, in some quarters there has been a tendency to press it unduly far, and to use it as a *vera causa* for the explanation of phenomena which may not really be thus explicable.

The object of the experiment conducted by officials of the Society for Psychical Research on February 16, 1927, at 11 P. M., with the essential assistance of the British Broadcasting Corporation, was not to prove the existence of telepathy, but to make a sort of psychological experiment as to the unknown conditions in which some kind of telepathy might possibly occur.

In my view, telepathy between relatives and between people in the same room had been fairly proven. But telepathy between unknown strangers at a distance had never been proven or even tested. It seemed desirable to utilize the facilities now afforded by twentieth century developments, and to make at any rate a preliminary test as to whether such telepathy ever really occurred, by trying whether any evidence could be obtained of the telepathic transmission of ideas from strangers about whom the receivers knew nothing, or about whom they only knew, as in the present instance, that they were in a certain place at a certain time.

The conditions of our broadcast experiment were, in fact, about as difficult as could well be imagined. Few of us had any hope of a clearly defined and positive result, still less of anything that could be called sensational. The word "expectation" is better than the word "hope" in such a case, for our only object was to ascertain the truth, whatever it might be; and without fuller knowledge than we possess we ought not to "hope" for any particular result, but simply put ourselves in a position to ascertain it.

It is very seldom that a laboratory experiment is conducted in public, except for purposes of demonstrating something already ascertained. Many experiments must fail, and these are generally either passed over in silence, or recorded in "Transactions" for the benefit of other workers.

In this case it was necessary to experiment in full view of the public, and without the kindly co-operation of the many listeners distributed all over England we could not have proceeded. To their co-operation we are indebted, and it seems only fair that they should be informed what the results were.*

I also think it is only right to say that an analysis of the results has been carried out by one of the members of the Society for Psychical Research, Mr. S. G. Soal, in very great detail; that not only successes have been attended to, but that the various unsuccessful guesses have also been classified, under such heads as lethal weapons, musical instruments, grotesque objects, medical suggestions, pictures of the Royal Family, Madonna, and other subjects.

The number of times each of the 52 playing cards appeared in the results has also been analyzed. Thus a good deal

* A more elaborate and detailed statement will in due time be published in the "Proceedings" of the S. P. R. by Dr. Woolley, the responsible conductor of the experiment.

of material has been accumulated which seems likely to be of interest to normal experimental psychologists.

Coming to details, I would remind listeners that two of the five objects exhibited were playing cards, chosen by cutting a pack at random, so that no one had the slightest knowledge of what the card would be, a second before it was exhibited.

Under these circumstances the chance of successful guessing would be 1 in 52 or 53. Consequently out of the 25,320 results sent in, about 500 ought to have been successful.

The result was unexpected, and was not fully demonstrated by the first count; a recount was necessary, and has now been made. Listeners were unaware of the method of selection, and hence probably felt in favor of some of the more striking cards, and often guessed an ace or a court card rather than the more plebeian variety. The result, being unexpected, is of some psychological interest, as tending to show that mere chance does not rule such guesses. The ace of spades, for instance, was chosen by no fewer than 2,255 contributors in Test One, and by 1,636 in Test Four. And had it happened that the pack had been accidentally cut at the ace of spades, we might have fallen into the unfortunate trap of thinking that this measure of success was decidedly beyond chance. Even the ace of clubs was selected by 1,027 contributors in Test One. Other aces were in intermediate favor. Fortunately the card cut in Test One was not any one of the aces, but was the two of clubs, while in Test Four it was the nine of hearts, and in both these cases the numbers given were decidedly below what we might have expected by chance; *viz.*, only 199 in Test One, and 150 in Test Four, whereas in each case 500 would have been the chance expectation.

We must not draw any conclusion from the deficiency, any more than from the surplus, except this perfectly normal psychological conclusion, which becomes apparent on a study of the numbers:

(1) That telepathy had nothing to do with the result, and

(2) That the choice made by people when asked to name a card is not truly regulated by chance alone, but by some curious predilection—a predilection not only for aces, court cards and jokers (for the numbers giving the joker were 900 in Test One, 2,581 in Test Four), but for odd numbers in preference to even.

For, taking a rough average, the number of odd numbers selected had an average in their favor of about 400 each, while the even numbers selected had an average in favor of about 150 or 200 at most, sometimes falling below 100. This is a fact which may be a useful caution in applying the laws of chance.

How the Experimenters

The experimenters at broadcasting station 2LO in London selected four subjects for the purpose of this test:

1. *A Japanese print of a human skull resting on the grass, with two birds;*
2. *A scented spray of white lilac;*
3. *Dr. Woolley himself, wearing a mask and a derby hat;*
4. *Two selections of playing cards.*

Exhibit No. 2, which was stated to be "a picture," was actually a print of a skull in a Japanese garden, with two birds, one on the skull and one on the ground.

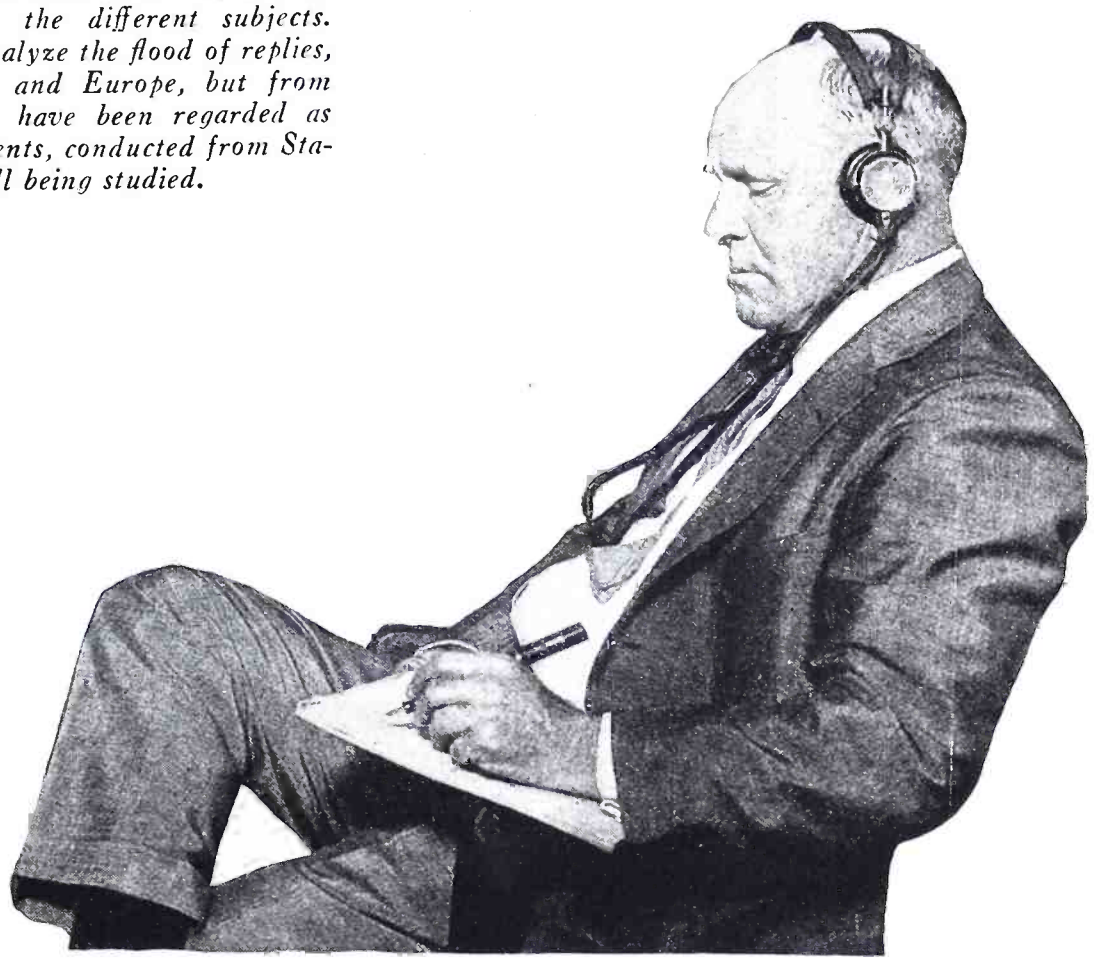
Exhibit No. 3, stated to be "an object," was a bunch of white lilacs. It is not possible to calculate numerical chances of success in such cases; nor, unless the numbers are overwhelming, would it be wise to assume the action of telepathy even in these cases. But I am inclined to think that an object like a skull gives a better chance to telepathic impression than a perfectly uninteresting object like a playing card. And, furthermore, once the picture of skull, garden, and birds has been shown to the agents, the impression would not evaporate at once, but would continue until something forcible displaced it. Moreover, a percipient, if he got any impression at all, might quite likely get it as a deferred impression, almost as likely to come out after the exhibit had been removed as at the time. If we were going to base any serious deduction on the results, this line of argument might be held in suspicion; but it has been previously suggested, as the result of private telepathic experiments, that an impression is often delayed, so that in analyzing the results this possibility ought not to be ignored.

It turns out that only four people definitely described Exhibit No. 2 as the picture of a skull, though one of them went so far as to say that it was a picture of a skull in a garden. But, oddly enough, for the next object, Exhibit No. 3, a skull was given by 714 listeners, while 1,036 gave flowers (which was correct); of this number 85 gave white scented flowers, though only three specified "white lilac," and 463 gave perfume.

It may be instructive to see if the idea of belated impression can be applied as far down the list as Exhibit No. 5, which

Called Upon Their Audience for Aid in the Tests

The experimenters concentrated their minds upon each subject, one at a time, and called upon their broadcast audience to do likewise—and to write down and send in descriptions of the mental images they received of the different subjects. Weeks were required to classify and analyze the flood of replies, which came not only from England and Europe, but from Australia and America. The results have been regarded as "partially successful." Later experiments, conducted from Station KFXB of Bell, California, are still being studied.



in reality was Dr. Woolley himself in a grotesque mask and bowler hat. For this object 523 gave flowers and 55 perfume. The only noticeable thing about those numbers is that they are decidedly smaller than those given for Exhibit No. 3, when flowers were the real object. The skull again seemed to persist, even down to Exhibit No. 5; for 166 recorded it in that case. The moderate amount of correct guessing for Exhibit No. 5 is given below.

Listeners were asked to record any emotion they felt in connection with the objects. Nine hundred and eighty-eight listeners recorded fear, horror, or detestation in connection with what we may suppose to be the skull. On the other hand in case of Exhibit No. 5, only 307 recorded those feelings, and 499 recorded amusement. Two hundred and two gave Exhibit No. 5 as a hat, 146 described it as one of the agents, while 236 said it was a person dressed up and masquerading—which it was. Whether it is wise to draw any deduction at all from these partial successes is very doubtful, and must be left for the present for more serious discussion hereafter.

It is of incidental interest to find that prominent and undoubted mediums, who good-naturedly took part in the test, were no more successful than any other members of the audience.

Meanwhile readers may be interested to hear of any striking individual successes that there may have been, however they choose to account for them. Among so great a number, I presume that one or two striking successes are inevitable. Here, then, is the record of one individual:

No. 1. Ace of clubs.
No. 2. Skull in garden.
No. 3. Flowers.
No. 4. Colored snap card.
No. 5. Some black object.

Of these, No. 4 is the only absolutely complete failure.

Again, a lady in Buckinghamshire, who gave Exhibit No. 1 as the joker, immediately corrected to the two of clubs, gave Exhibit No. 2 as "a cocoanut with a blue-tit upon it in Japanese print style." Seeing that the print was a Japanese garden, with birds in it and a round object, that amount of success is, at any rate, exceptional.

Another individual record gave Exhibit No. 2 as "a human head," and No. 3 as "flowers." Another gave for Exhibit No. 2 "Skull, very strong impression," and for Exhibit No. 3 "Bunch of blue flowers." Another gave for Exhibit No. 2 "a bird which became repulsive." And yet another "a picture of an awful-looking skull, which I clearly saw, and could not get rid of the whole at the time."

Finally, Dr. Woolley happened to detect, among the completely erroneous statements for Exhibit No. 5, an account of an incident which actually occurred, and which was thus described by the correspondent:

"Man pouring whisky into glass. Company present. Lady with dark hair and laughing face places restraining hand on the arm of the man pouring out the whisky."

How this could have been given as an attempt at what they were told was "an object," it is difficult to understand. But the episode quite certainly happened in the room, not at the time of the test, but immediately afterwards, and possibly while the record was being written. One of the Society's agents had thought that one of the two ladies present looked tired and faint, and was by her prevented from administering an alcoholic remedy—just as stated. The episode reminds one of some of Dr. Gilbert Murray's experiments in genuine telepathy, wherein he was able to describe in some detail an incident, historical or otherwise, which had been thought of by the company.

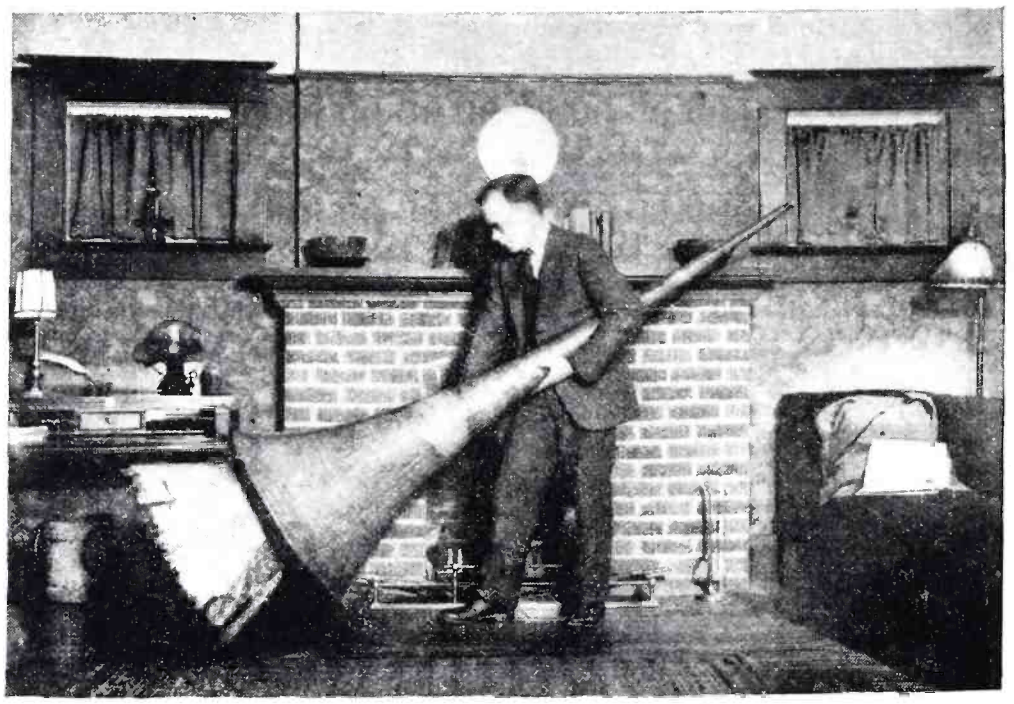
In conclusion, therefore, I would say that the results of the experiment are not unimportant from the point of view of experimental psychology. They do not confirm telepathy, neither do they deny it. They show that it is certainly not common and broadcast, but they leave open the possibility that a few individuals may have a percipient faculty more strongly developed than would be expected, and that their percipience may be delayed, and, as had been suspected before, that they may become aware of things present which were not intended to be transmitted to them.

Those who on *prima facie* grounds have made up their minds that telepathy is impossible will see in these sporadic results nothing but flukes and chance coincidence.

Those who are already convinced by evidence of the existence of a telepathic faculty under favorable conditions will

(*Continued on page 161*)

¶ Here is a home-made unit that any experimenter of ordinary skill with tools may build for himself; it will add materially to the quality of broadcast reception.



From a photograph made for POPULAR RADIO

A BIT UNWIELDLY—BUT WORTH THE SPACE IT OCCUPIES

The author of this article is shown here taking the completed horn off the framework upon which it was built, after the papier mâché has been allowed to dry and harden. Note that the flare of the horn follows the same mathematical law as that which nature observes in shaping the morning glory or the snail shell.

HOW TO MAKE THE

Exponential Horn

Here are the constructional details of the latest and (what many experimenters consider) the best type of reproduction horn—a horn that gives extraordinarily truthful reproduction of both the high and low notes.

By W. F. SUTHERLAND

TO-DAY, with the rapid improvement of low-frequency amplifiers and the present standards of broadcasting high-quality transmission from the better broadcasting stations, there is an increasing demand for loudspeakers that will reproduce with equal efficiency all of the notes of the musical scale.

It is seldom that the experimental radio fan is able to do much work with the reproducers or loudspeakers themselves.

First of all, radio fans have been taught very little about the principles of the loudspeaker itself; secondly, they have had little information about the design of either the cone- or horn-type units.

At the present, popular sentiment seems to be in favor of the cone-type unit, although the horn type of loudspeaker may be able to reproduce and transmit broadcasting signals with excellent fidelity both on the high tones and low tones.

A reproducer does not amplify energy, strange as this may seem. It, together with the pressure chamber in front of the diaphragm of the reproducer unit, merely enables the diaphragm to obtain a grip on the air around it.

This is true of the horn-type loudspeaker. The horn is supposed to load the diaphragm and facilitate the useful conversion of energy to a vibrating air column. If this loading is not uniform for all frequencies, two effects will creep in—either a decrease in the amplitude of the sounds transmitted with decreasing frequency, or a predominance of certain notes over others, due to resonance.

The first of these effects—or, rather, defects—is present in the straight conical horn; it reproduces the low notes poorly or not at all. It reproduces the middle frequencies better and the high notes best of all.

This is a condition that is not to be desired, as the lower frequencies are the most difficult to bring through the reproducer, while within the higher frequencies of the audible range, the whines, whistles and other disturbing noises are usually easy to bring through.

The exponential horn, on the other hand, has the peculiar characteristic of radiating all frequencies uniformly down to a certain point below which no radiation takes place. This cut-off point is determined by the length of the horn; the longer the horn is, the lower are the frequencies that may be transmitted.

Figure 1 illustrates the two types of horns used in the reproduction of sound. The initial or straight-wall type has been assumed as starting at a diameter of 1

inch and increasing in diameter 1 inch for every 10 inches in length. The final diameter for a length of 40 inches would be only 5 inches.

The exponential horn, on the other hand, starts with the same initial size, but doubles its diameter every 10 inches with a final diameter of 16 inches.

It will be noticed that the growth of a horn of uniform taper is almost negligible, while the exponential horn, based on the law of organic growth, not only rapidly increases in size, but is a thing of beauty. It follows, indeed, the same laws as the size of the growing spiral of a snail shell. It increases according to the laws of compound interest. It also follows the same taper as the morning-glory flower.

The mathematician calls such a growth a "logarithmic" of growing, and if this range is expressed in the form of a curve the curve is called an "exponential curve"; whence we derive the name of the latest development in the art of reproducing signals—the exponential horn.

This article gives specific data for building at home a low-priced exponential horn that will reproduce broadcasting (when it is used with a good type of reproducing unit) probably better than any other form of sound chamber or loudspeaking unit.

Any radio experimenter can build the horn and get these results.

How to Determine the Shape of the Horn

The throat should be as small as is practicable. The smaller it is, the more uniform will be the action of the reproducer diaphragm. There is a lower limit, of course, to this size because of frictional losses; beyond that point the average response of the horn suffers and a loss of volume takes place. About ¼ inch is as small as it is practicable to go and a diameter of about ⅜ inch is a reasonable size, particularly as this closely approaches the net diameter of the aperture in an average reproducer unit.

The large end should be made as big as possible, as with the increase in size the end reflections—the cause of all air column resonances—are thrown to the bottom of the scale and are minimized. It is generally of no use to carry the horn much beyond the point where the sides form a 45-degree angle with the central axis. This point can be calculated easily, as will be shown later.

A small percentage increase makes for a more uniform response to all frequencies and lowers the cut-off point so that lower notes are more easily radiated. If the diameter at the mouth and the rate of growth are correctly determined, the resonant point of the mouth or opening will be thrown below the point of cut-off, and no resonance will occur.

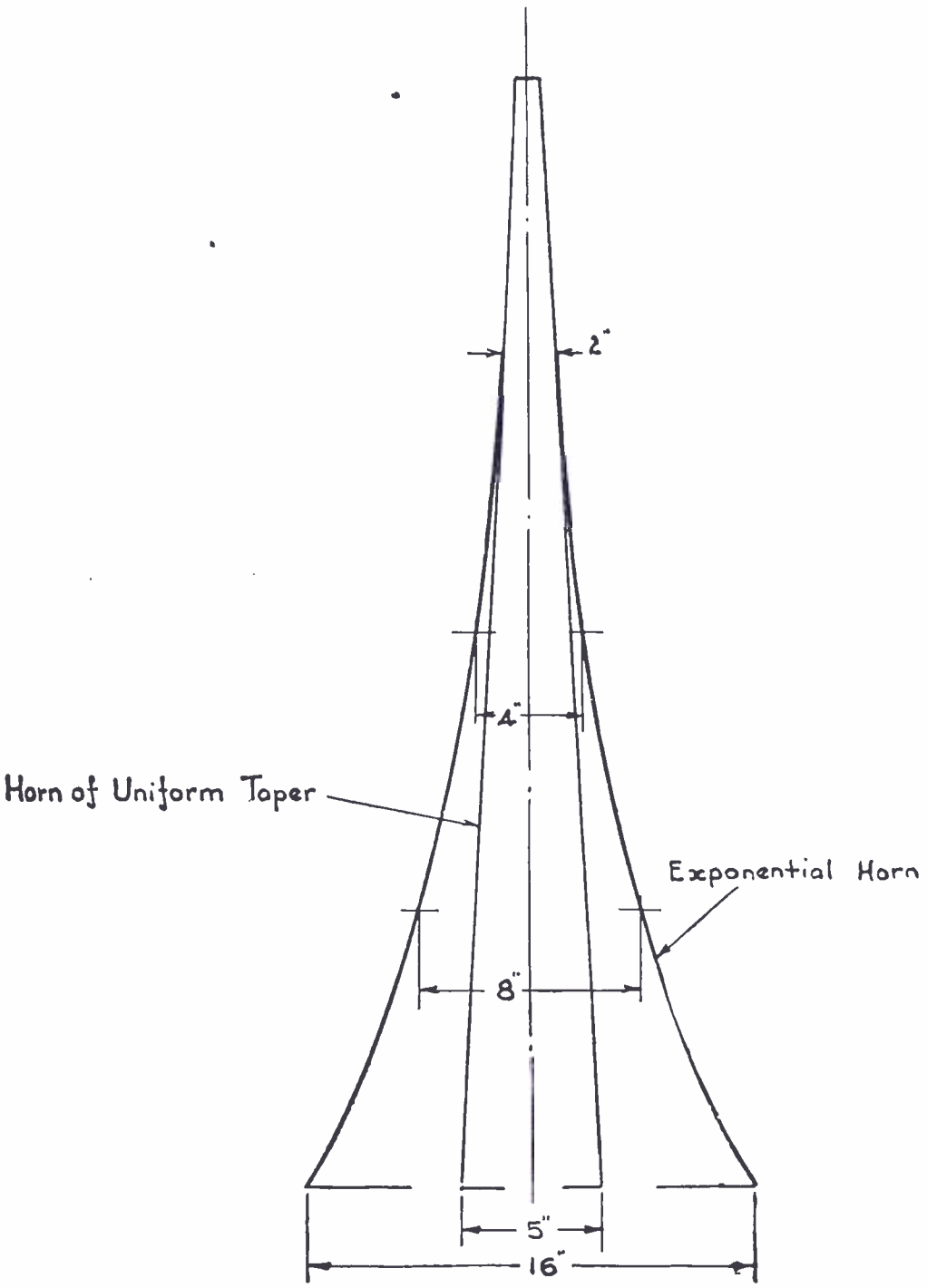
All of this makes for a long and large horn; practical expediency steps in with the limitations of house-room. Diameters ranging from 18 to 30 inches will be found satisfactory and rates of increase up to about 15 per cent per inch in length will also give excellent results without undue size.

The exact determination of the proportions for exponential horns is a matter that involves a certain skill in mathematics and physics that is beyond the scope of the average experimenter. This need not deter him from building such horns, however, as the aid of a few short-cuts and general rules will give surprisingly excellent results.

The term "percentage increase" may require a little explanation. Assume a small end diameter of ⅜ inch. This corresponds to an area of 0.11045 square inch. Assume also that we will let the horn grow at the rate of 10 per cent increase in area per inch in length. The area then at the end of the first inch will be .11045 + .011045 = .12150, and in tabular form for the ensuing inches of length as follows:

Distance along horn in inches	*Area in square inches*
Throat	.11045
1	.12150
2	.13365
3	.14700
4	.1617
5	.17787
6	.19565

This is rather a clumsy way of cal-



HOW THE OLD AND NEW HORNS COMPARE

FIGURE 1: *This drawing shows the difference between the older horn of uniform taper and the new exponential horn. Notice that the large end of the latter type has over three times the diameter of the more obsolete horn.*

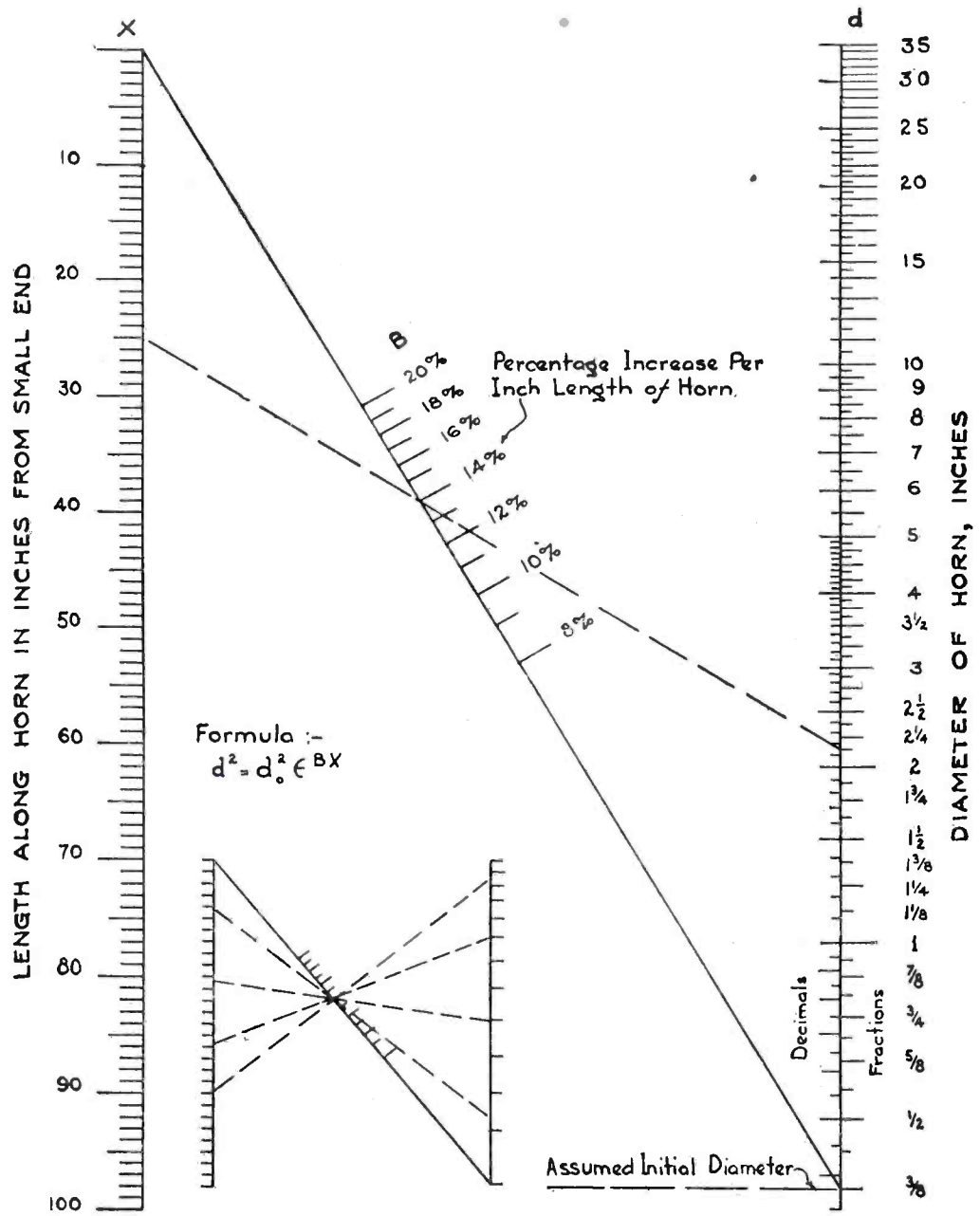
culating such a horn, and fortunately it is possible to construct a chart such as that shown in Figure 2, from which not only one horn, but any number and variety within reason, may be readily computed by the reader.

Three scales are shown. A scale marked x is seen on the left-hand side. This scale refers to the distance from the small end to any chosen point along the axis of the horn. The scale marked d gives diameters for various distances from the small end, while the scale B gives the percentage increase in area per inch of horn length, and is used in conjunction with the other two in the following manner:

Suppose, for example, that it is desired to lay out a horn that has an increase of 14 per cent per inch, starting from an initial diameter of 3/8 inch. A ruler is procured and laid on the chart. Starting at the small end, a line is drawn from the 10-inch point on the x scale through the 14 per cent point on the B scale. The point is noted where it cuts the d scale. This point gives the diameter at 10 inches from the small end. Similarly lines are drown for other distances and the results are tabulated.

Note on the chart that a dotted line has been drawn from the point, $x = 25$ inches, through the 14 per cent increase point on the B scale. This line cuts the d scale at the diameter 2 1/8 inches. This line is typical for all others. When the lines are drawn in pencil, the chart will have the appearance shown in the bottom left-hand corner.

Instead of a ruler and pencil, a thread stretched tightly may be used, or, better still, a piece of transparent celluloid with a line scratched on it.



THE CHART THAT HELPS TO DETERMINE THE DIMENSIONS OF THE HORN

FIGURE 2: *From this alignment diagram the experimenter may determine, with the aid of a ruler, the exact dimensions for making any type of exponential horn he wants. The use of the chart is explained in detail in the text.*

As an example, take the 14 per cent increase horn and determine the size all along its length. The following results will be obtained:

Distance X along horn from small end	*Diameter at Distance X from small end*
10	3/4
20	1 1/2
30	3 1/16
40	6 1/8
45	8 7/8
50	12 1/2
55	17 1/2
60	24 1/2
65	35

It will be noticed in Figure 2 that all horns start at a small end diameter of 3/8 inch. This is about as small as one can go for proper acoustics and anything larger can be obtained by eliminating such of the small end as may be necessary to bring it up to the proper size.

As stated before, there is little gained by making the large end of the horn of greater flare than 45 degrees. The constructor may easily determine for himself just what diameter corresponds to this point by remembering that a diameter equal to four divided by the percentage-increase, per inch, gives this angle. Thus for the 14 per cent increase the diameter corresponding to a 45-degree flare at the mouth will equal:

$$4 \div \frac{14}{100} = 28\tfrac{1}{2} \text{ inches approximately.}$$

How to Make the Form

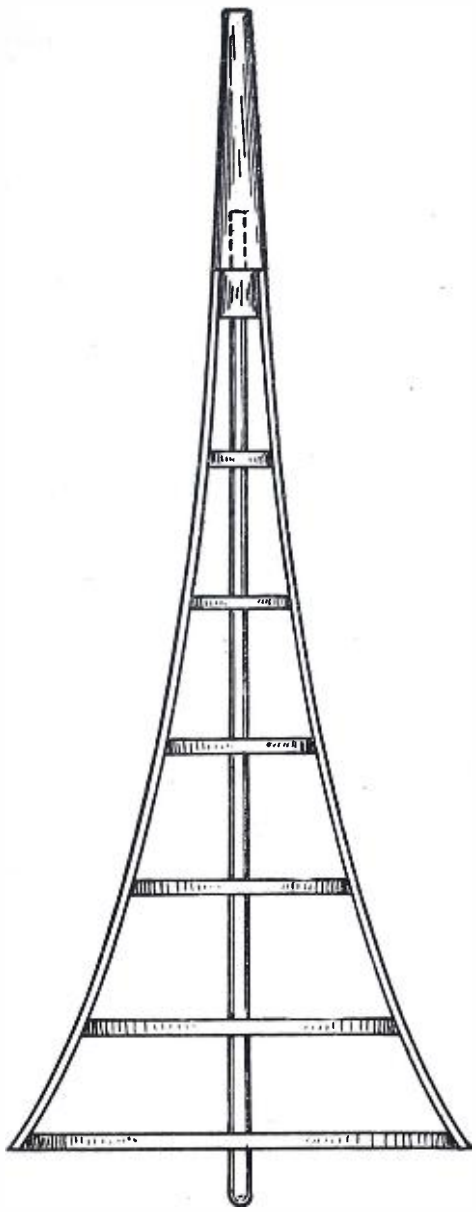
A form must first be constructed. A long, wooden rod the size of a broomstick should first be procured. This forms the backbone of the form.

Wooden discs cut out of 1/2- or 3/4-inch stuff are next to be strung on it. These discs should be spaced from 9 to 12 inches apart and should be somewhat smaller than the horn will be at their several locations, to allow for the wooden strips to be nailed on the outside. These strips may be of any convenient thickness (say, 1/8 inch), and should not be over 3/4 inch wide. They and the discs cut to the proper size may be procured at the local planing mill.

Four strips are to be nailed on the discs at equi-distant points around the circumference. These serve to hold everything in place. When the form is thus lined up, it may be covered with similar strips nailed to every disc and enclosing the whole surface.

The small end of the horn requires special attention. Our broomstick in itself will be far too large for the small end and the securing of the proper taper by means of circular discs is out of the question, owing to the small diameter.

This difficulty is overcome as shown



THE MOULDING FRAME

FIGURE 3: *The local planing mill will probably have to be called into service in making the wooden discs, but the frame may be easily built up at home by anyone of ordinary proficiency with tools.*

in Figure 3. A piece of wood of the right size and taper is turned up. A hole is bored in the end to admit the broomstick and a shoulder is also turned on the same end, so that such of the exterior lagging strips as reach that far may lie flat with the surface of the turned hub.

How to Build the Horn

Papier mâché is an excellent material for the home-builder to use in constructing the horn. It is hard, light, and when thoroughly dry stands up under a tremendous amount of abuse. It is made of two simple ingredients that are always available, paper and wheat flour paste.

"Stickfast" paste, a commercial preparation, can also be used with excellent results. A little glue may be added if desired, but the flour paste in itself gives an extremely hard composition, requiring the use of a wood saw for its cutting.

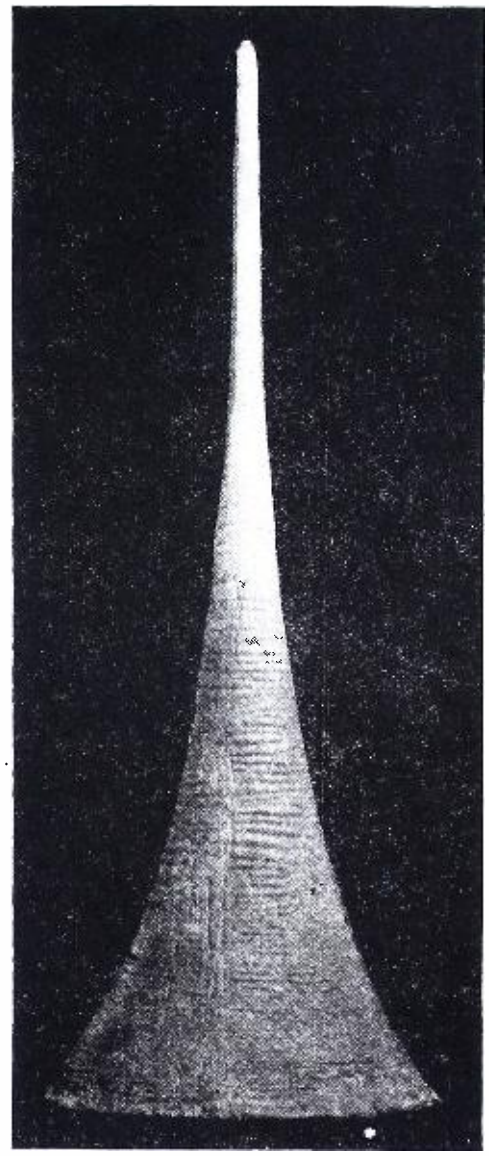
The following procedure is preferably adopted:

After the form is made as described above, it is covered with several layers of newspapers tightly shellacked down. About two more layers are next put on, lightly held in place by a daub of mucilage here and there. Outside the layer of newspapers is placed one or two layers of waxed paper, well greased with "Alemite" or other cup grease. The purpose of this paper on the form is to prevent the sticking of the horn to the form when it dries.

The horn proper is now begun. A roll of building paper is procured and a sufficient amount is cut off to make about four layers deep on the form. The paper is cut into pieces about a foot square. Enough for the first layer is soaked in hot water just long enough for it to become pliable. This first layer contains no paste and must be well lapped in order that the paste from the succeeding layers may not run through. The remaining layers (about three) are next laid on, one after another. Have handy a good-sized kettle full of fairly thick paste. Keep this kettleful hot. Soak the paper directly in the paste and apply it with the hands. Use plenty of paste; it will dry out.

When the horn is complete, it will be found advantageous to apply a wrapping of heavy string, at about 1-inch pitch, for the full length of the horn, starting at the small end. This serves to hold all together while drying. Stand it in a warm, dry place, preferably near the furnace, and allow it to dry for at least three or four days before attempting to remove it from the form. As the drying progresses, it will be noticed that the horn shrinks slightly and becomes hard to the touch.

On removal from the form, allow the horn to dry still further and then give it several coats of shellac inside and out. It may be found necessary also to tack down some loose corners on the inside with liquid glue.



READY FOR THE SHELLAC

FIGURE 4: *Before the horn is given its final coating of shellac, inside and outside, it may be painted with a color that will make it harmonize with the color scheme of the room where it will be installed.*

A ring of No. 4 copper or iron wire slipped down over the wet horn to the mouth will be found to reinforce it in a most satisfactory manner. The wet paper may be lapped up over the ring; this holds it in place and gives a neat appearance.

Of course, to make a complete job of the unit, a good-quality reproducer unit should be fastened tightly at the small end of the horn.

New Constructional Articles for Next Month

The October issue of POPULAR RADIO *will contain full constructional data on two new receivers, each of which embodies new theories in radio reception and fills a distinct need—the Magnaformer 9-8 Loop Receiver and the LC-28 Receiver. These constructional articles will be followed by articles on operation which will enable the fan and experimenter to realize every possibility in the receivers.*

J. Alden Weeks

ADVENTURES IN THE AIR

Dramatic, amusing and sometimes tragic experiences befall both the radio reception fan as well as the transmitting amateur and the professional operator. What strange experiences with radio have *you* had? POPULAR RADIO will pay one cent a word for true stories of strange incidents—preferably told in the first person.

I Help Capture a Crook by Radio

WHILE I was serving as the radio operator aboard the *S. S. Columbus* (WFJ), plying between Chicago and Milwaukee, a passenger rushed up to the radio cabin one afternoon and informed me that he had recognized in a deckhand a man for whom the police were looking. He explained to me that this man's business was to obtain employment in stores, learn the layout and location of the valuables and then, with the help of his pals, burglarize the place. The passenger told me that the suspect had jumped his bond and shipped as a member of our crew, apparently with the hope of evading the authorities.

My informant had had dealings with this man before and knew that the fugitive had a grudge against him; consequently he was very careful to keep out of the deckhand's sight.

I sent the passenger to the captain of the ship. For a time the captain was undecided as to whether or not he should lock the deckhand up to keep him from jumping ashore when we reached the dock. If the deckhand proved to be innocent he would of course have legal recourse against the captain, if taken into custody; if left free he might escape or might injure the passenger.

The captain finally wrote out the following message to the Milwaukee Police:

"MEMBER SHIP'S CREW WANTED BY CHICAGO POLICE. ARRIVE MILWAUKEE 2:30 P. M. ENTER FORWARD GANG PLANK."

I transmitted the message immediately.

Upon our arrival at the dock, two detectives forced their way aboard ship before the passengers were let off. The deckhand was at that time busy helping to make fast the stern line to the dock; he was taken by surprise when the officers showed their badges.

The last I saw of him was as he walked along the dock between the two detectives.

—C. H. ZELLER, *Chicago, Illinois.*

* *

A Transmission Test that Sounded a False Alarm

"BE carerul what you say to 'Mike,'" is the warning issued to its radio experimenters by the Air Service of the War Department.

This warning was the result of an amusing incident that occurred during the testing out of a radio sending set at McCook Field, Dayton, Ohio. Lieut. Lowell Johnson was the pilot and Mr. Studebaker, in the rear seat, was sending a constant, mellifluous vocal stream into the transmitter microphone. The stream of conversations is designed to be constant, as the checker on the ground cannot interpret silence, for there is no difference between the brand of silence that comes when the set is out of order and the brand that is intentional. After announcing "McCook Field Airplane, P-292," Mr. Studebaker had been valiantly reciting number series, words and phrases until his stock became exhausted; then he began to sing:

"London Bridge is falling down,
Falling down, falling down—"

Presently in the radio laboratory the telephone rang; a feminine voice was at the other end of the line.

"Is this McCook Field?" it asked. And being assured affirmatively, the voice went on:

"I have a very good radio set and I have just gotten in touch with one of your airplanes. There's a man in it who seems to be in distress; he keeps calling out that he's falling down. I thought you might want to send up another plane to help him."

The lady was thanked solemnly for her solicitude—but the story went the rounds of the McCook Field like wildfire.

Since then the radio experimenters have been extremely careful about what they say into Mike.

—S. R. WINTERS, *Washington, D. C.*

My Uncanny Experience with "Radio Spooks"

About eight years ago I had a pet crystal set in my home, which I used for code practice; of course, there were no broadcasting stations in operation at the time. It was rigged up in the dining room, and to the receiver unit I had cemented a paper horn. With it I could hear the local high-powered code stations (particularly NAH, the Navy Yard) all over the apartment, and with sufficient intensity for accurate copying, especially at night.

Everything went normally for a few months—and then things took a turn.

I had established the habit of leaving the set connected and tuned after I had finished an evening's listening. One night I was awakened by an extra loud volley of code characters, hurled from NAH. It was so loud and promised to continue for so long that I got up and shut off the set. A few nights later I was again abruptly awakened by a violent "da-dit-da dit-dit-dit-dit," followed by a long spasm of code, alternating in fast and slow measure.

Again I got up to turn it off; but to my amazement, *the switch was already off!* And upon putting my ear to the horn, the signals were apparently of no greater intensity than when I moved away from it!

After that, it was a common occurrence to awaken in the middle of the night and hear the rhythmic code signals shrieking away at full blast; even at times in broad daylight did this annoying phenomenon manifest itself. Unfortunately I was never a code fiend, and I never even tried to copy any of the messages; perhaps if I had they would have disappeared, as is the habit of dreams which we try to scrutinize more vividly. However, I can affirm that they were of the identical character of *bona fide* messages, for although I was never an expert operator, I had an operator's ability of "sensing" a character foreign to the regular radio alphabet.

An explanation of this extraordinary phenomenon cannot be more than a guess. Some might say that a direct impression was made upon the mind by radio waves, utilizing the sensitive and intricate mental apparatus much in the same manner as a receiving set. How this could be accomplished is beyond present comprehension; it may be possible, though it is highly improbable.

Having a telepathic consciousness, or hearing telepathically either the audible code sounds or their counterpart in the mind of an operator, would be a second hypothesis. This, too, is doubtful, although possible.

What I believe to be the true cause (in my particular case, at least) comes from within. It was probably a manifestation of subconscious impressions that had been stored up previously, and the nature was purely hallucinary. However, it was as perfectly real and obvious to me as I suppose are the horrible phantasms to an inebriate afflicted with the delirium tremens.

From whatever source such supernormal signals may come, they are nothing to worry over. I lost mine shortly after discontinuing the study of the code.

—Malcolm St. Denis, *Brooklyn, N. Y.*

* *

I Pick Up a Distress Call from an Unknown Ship

Suppose you were a radio operator sitting at the instruments, listening to the tangle of the ether traffic and wondering how much longer it would be before your relief came, and then suddenly, so faintly that you could hardly read it, you heard a distant ship calling frantically for help.

That was an experience that happened to me; indeed, I listened to all the details of the rescue. But I have never found out what ship it was. Can any of our readers help me out?

It was during the evening watch on December 6th, 1922. I was on duty at a Great Lakes shore station. I listened in on the bedlam of all the shipping and the crash of the freaking Atlantic stations, wondering if my eardrums would stand all the racket until midnight brought my relief.

And then suddenly a new note came in; it was the booming voice of WCY commanding all the stations to QRT, (stop transmitting).

WSA and WNY gave out the same command.

Quickly starting the motors, I silenced the lake shipping.

Then I switched on my receiver and listened again.

At first I heard nothing, but as the interference subsided, something began to come in. The dots and dashes were almost inaudible, but I managed to make out:

"North latitude 38 degrees, 31 minutes; West longitude 62 degrees, 12 minutes. Hatches . . ."

The sentence faded in the middle. That was all I could hear.

I tuned hastily to a slightly higher wavelength.

Silence.

I tuned to a lower wavelength. A violin wailed and a piano tinkled.

Then the telephone rang and I jumped to it. But it was the wrong number—"excuse it, please!"

By the time I got back to the instruments the signals began to come in again, but so faintly that I could not make them out at all. I wondered if anyone could read them. Judging from the first message, I surmised that the ships hatches were smashed in by the heavy seas. I thought of the poor fellows out at sea in the gale, and how they must be wondering if anyone would get to their rescue in time. The signals were still too weak for me to hear, but I thought I heard the operator sign DHK. What would happen to him?

After nearly an hour the note of WCY boomed out again. Help was on its way, it announced. Another ship was nearing them.

The lake traffic began to come in again. The ether began to fill up with sound again.

I wiped my face with my handkerchief. I never was able to find out what ship it was, but at the time I felt as relieved as if I had been rescued myself.

—T. C. Van Alstyne.

* *

I Deliver a Broadcast Death-Message

One time, while I was listening in on my single tube set, I heard the announcer make this peremptory demand upon all of his listeners:

"Every listener who is interested get a pencil and paper immediately. Ready to write? All right:

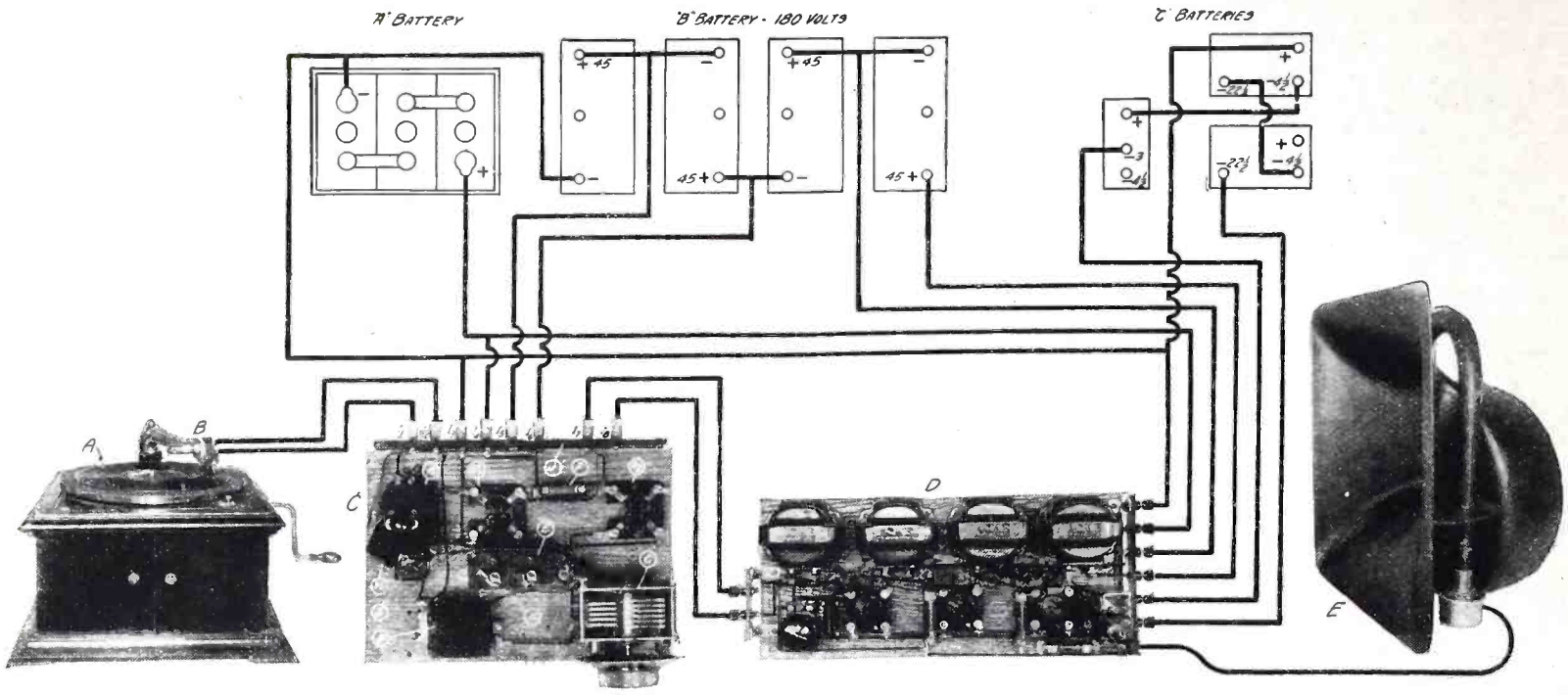
"John Redding of this city (Indianapolis) died at two o'clock this evening. John Redding's brother and wife and mother started for Florida at one o'clock. Please stop them by this method of instruction. They are going by the Michigan state road, through Greensburg, Madison, and Cincinnati.

"They are in a 1922 Buick touring car, license No. 340042, Ind., '22. Name, Myron Redding. Three people in car. The car has two extra tires behind."

With this information I set out for the Michigan road, which was about a quarter mile from my place. I watched for twenty-five minutes, but no auto that conformed to the broadcast description came by. About three o'clock I saw a Buick coming and stopped him, but it was not the wanted car. In about ten minutes another car came along and this proved to be the right one. I sent the occupants to Adams, Indiana, a nearby town, where they called up their relatives in Indianapolis and reported that they were coming back right away.

The next day I got a check for $5.00.

—B. F. Bower, *Greensburg, Ind.*



A MATCHED COMBINATION OF UNITS THAT PROVIDES EXCELLENT REPRODUCTION

FIGURE 1: *The pick-up unit, B, is of the condenser type; it is fully described in this article. The amplifier, D, is of the impedance-coupled type; it employs two UX-201-a type valves, with a UX-171 type valve in the last stage. It was described in the September, 1926, issue of* POPULAR RADIO. *The oscillator-detector unit, C, is described below.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any old phonograph;
B—El-tonic pick-up unit, capacity type;
C—Oscillator-detector unit;
D—Quality amplifier described in September, 1926, issue of POPULAR RADIO;
E—Racon spiral horn.

HERE IS A LIST OF PARTS THAT YOU WILL REQUIRE FOR THE OSCILLATOR DETECTOR UNIT—

A—Camfield coupling unit;
B—Benjamin high-frequency transformer;
C—Cardwell variable condenser, type E, capacity .0005 mfd.;
D1 and D2—Airgap sockets;
E—Burgess "C" battery, type 2370, 4½ volts;
F—Elkay Equalizer, type 2 (½ ampere);
G—Aerovox fixed condenser, .00025 mfd.;
H—Aerovox fixed condenser, .006 mfd.;
I1, I2, I3, I4, I5, I6, I7 and I8—X-L push type binding posts;
J—Composition binding-post strip, 11½ by 1½ by ¼ inch;
K—Hardwood baseboard, 12 by 8¾ inches.

HOW TO ADD TO YOUR OLD PHONOGRAPH

A New Amplification Unit

No. 2 of the series of articles on the new "electrical pick-up" devices that convert your old talking-machine into a reproducing instrument of a quality never before attainable.

If you already have a radio receiver and a phonograph (any type with a turn-table in running order will serve), all the new apparatus you need for hooking them up together is the newly developed electrical pick-up device that costs from $10 to $20; if you *don't* own a receiver, the same effects may be attained through a reproducer and amplifier—which will cost altogether from $40 up to $125. Demonstrations have shown that this invention gives better reproduction than has ever before been attainable.

By RAYMOND FRANCIS YATES

IN the July issue of POPULAR RADIO it was shown how easily and inexpensively an old talking-machine could be converted into an ultra-modern device that will produce music from records with the same remarkable clarity of reproduction as could formerly be obtained only with high-priced radio receivers.

In that issue it was shown that the phonograph, thus brought up to date and rejuvenated with the aid of new radio apparatus, is a distinct adjunct to any radio receiver and one that can bring a much greater range of enjoyment to the broadcast fan and the music lover. All that is necessary to make this change on your old phonograph—or new one, for that matter—is an electrical "pick-up" device, a power amplifier and a good reproducer.

Four arrangements of units for accomplishing these results were described in detail in the July issue.

The importance of the correct "matching" of the three elements—the pick-up device, the amplifier and the reproducer—was emphasized. All four of the combinations described in the July issue dealt with the type of pick-up device known as the *electromagnetic* type.

This second article on the subject takes up the *electrostatic* or *condenser* type of electrical pick-up.

In Figure 1 is shown the combination of a condenser pick-up with a simple oscillator, consisting of a single valve, coupled to a detector valve, exactly as used in a radio set.

The detector in this outfit is used to "rectify" the modulated electrical energy taken from the oscillator valve; it is coupled, in turn, to an impedance-coupled amplifier that was de-

scribed in detail in the September, 1926, issue of POPULAR RADIO. The output of this amplifier is then connected to a large Racon exponential horn.

In Figure 2 is shown the general construction of the condenser type of electrical pick-up; the method of its functioning is outlined in the caption.

The unit, C, in Figure 1, may be easily built of standard radio parts and at low expense. The results obtained will be found worthwhile.

How to Make the Oscillator-Detector Unit

Figure 3 is a schematic diagram of the circuit of the oscillator-detector unit. The instruments used are to be fastened down to the baseboard with wood screws according to the general layout shown in Figure 1; if all of the parts are connected as shown in Figure 3, the unit will be ready for use as soon as the valves are put in place.

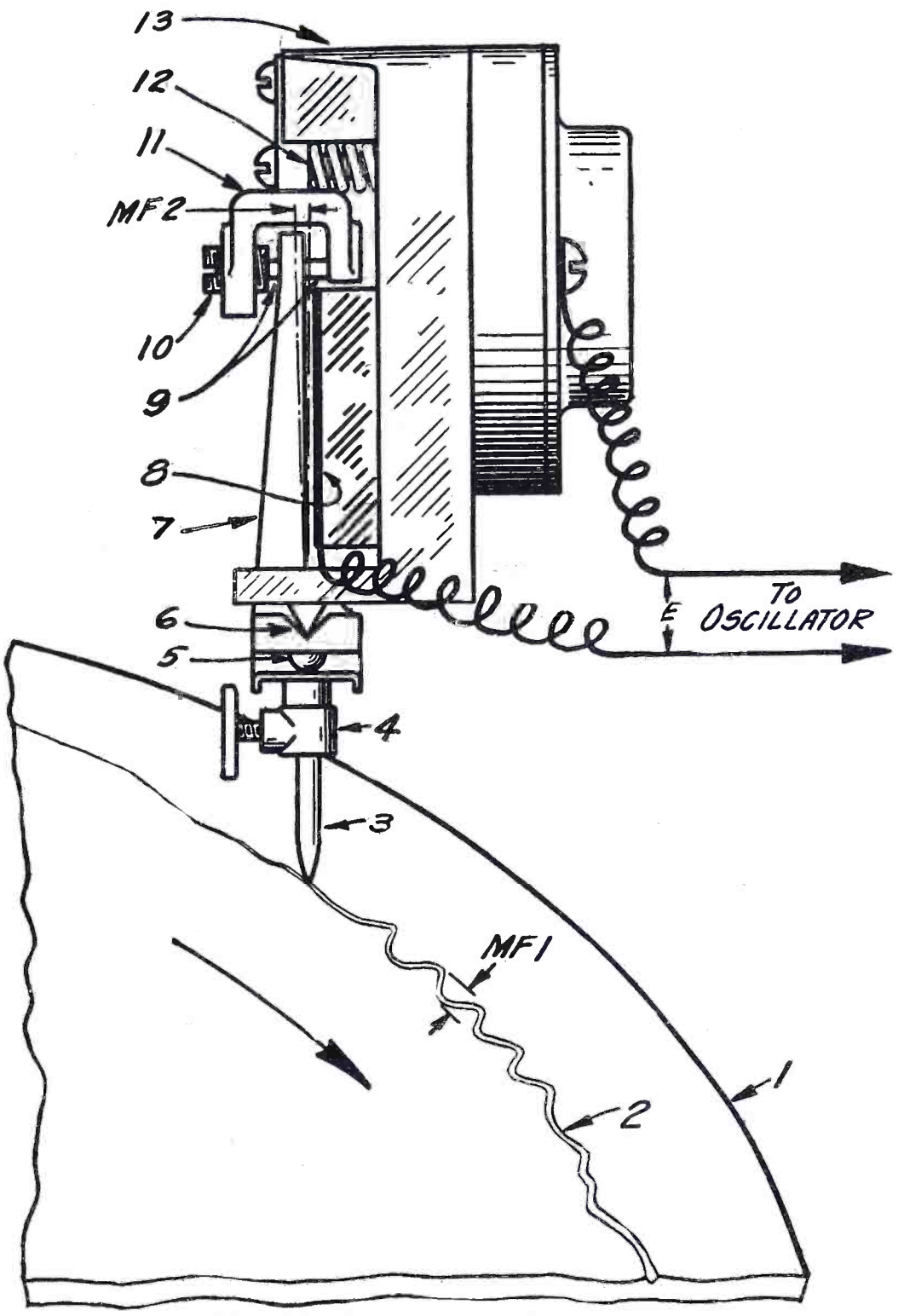
The two valves in the oscillator-detector unit, C, should be standard UX-201-a type valves. The first two valves at the left in the amplifier unit, D, are UX-201-a type valves, and the last valve, the one at the extreme right, may be a UX-171 type valve.

If this combination is to be mounted inside of the console of an old type phonograph, a single-pole, single-throw knife switch may be inserted in the "A" battery circuit to turn on the valves and put the set in operation.

When the unit is ready for operation this switch is closed and the variable condenser of the oscillator-detector unit should be rotated and set at the position where the loudest clicking noise will be heard in the loudspeaker, E, when the needle on the pick-up device is plucked with the finger. This condenser should then be left set in this position at all times. The volume of reproduction will be controlled by rotating the small knob on the coupling coil of the oscillator-detector unit.

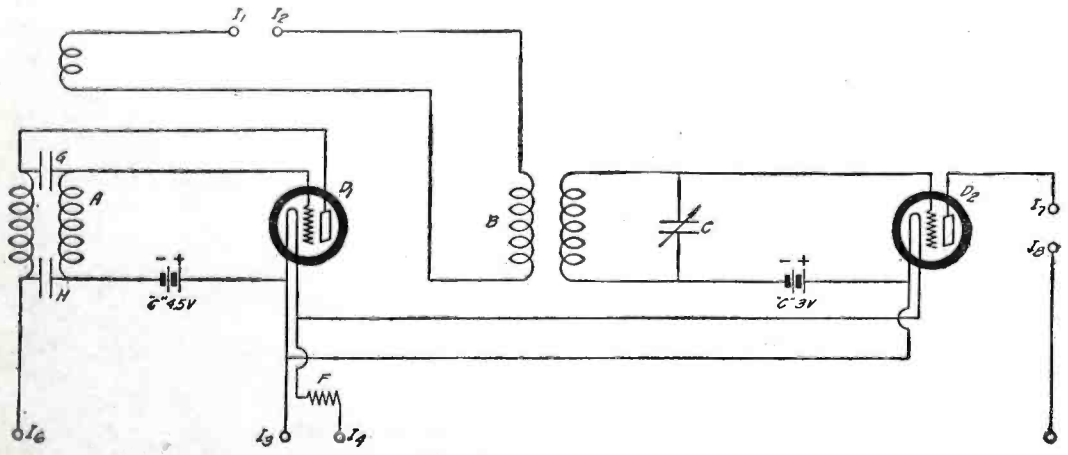
The quality of reproduction that may be obtained from the new electrically recorded records with this combination should please even the most critical ear.

In Figure 4 is shown a matched combination of units incorporating an electromagnetic pick-up device that was described in the preceding instal-



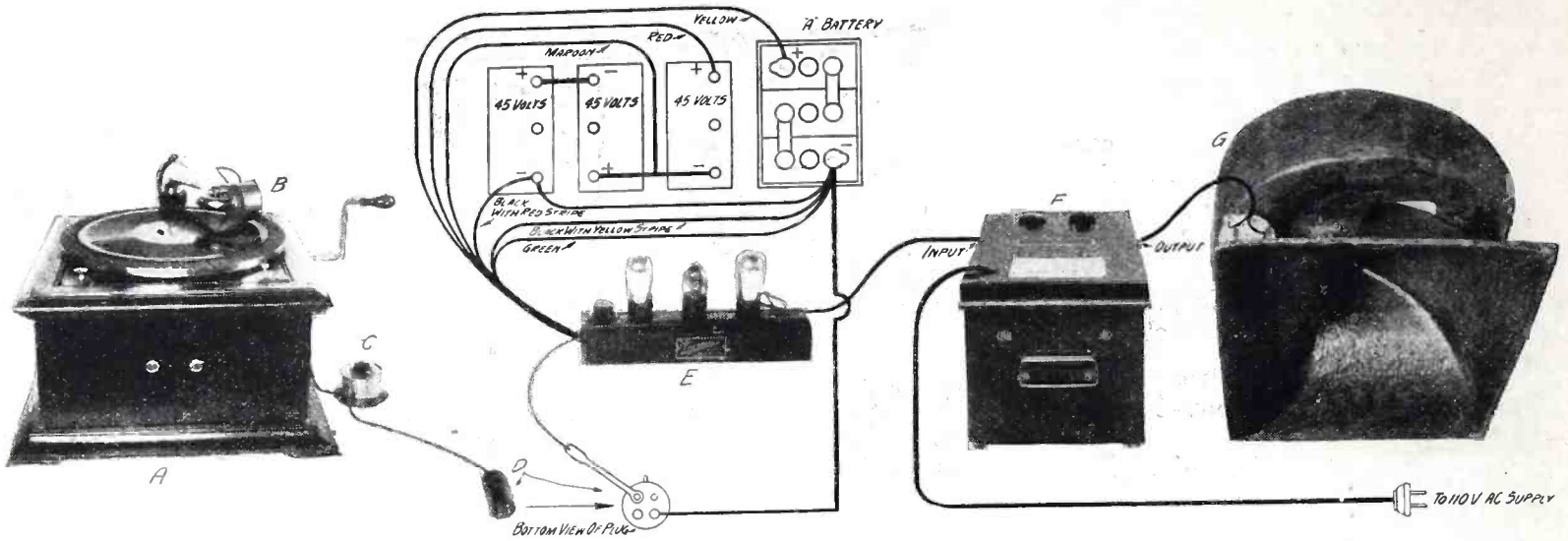
HOW THE CONDENSER PICK-UP WORKS

FIGURE 2: *The needle, 3, to which is attached the vibrating armature, 7, follows the vibrations, 2, imprinted on the record, 1. The vibration of the armature causes corresponding variations in the distance between its inner surface and the insulated metal surface, 8, of the fixed portion of the unit. These two surfaces serve as the two plates of a condenser, the capacity of which varies with the vibration of the armature. When the pick-up is connected to the oscillator-detector unit, this capacity variation modulates the oscillator output. The detector "rectifies" this modulated current, with the result that the detector output is an exact electrical reproduction of the recorded music or speech.*



SCHEMATIC DIAGRAM OF THE OSCILLATOR-DETECTOR

FIGURE 3: *The electrical details of the oscillator-detector unit, C, of Figure 1, are given here. The designating letters correspond with those in the list of parts at the head of the article.*



A MATCHED COMBINATION THAT EMPLOYS AN ADDITIONAL STAGE OF HIGH-POWER AMPLIFICATION

FIGURE 4: *This combination uses a standard "Truphonic" amplifier, followed by one stage of power amplification that employs a 210-type power valve to produce extreme volume without distortion in the quality of reproduction.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

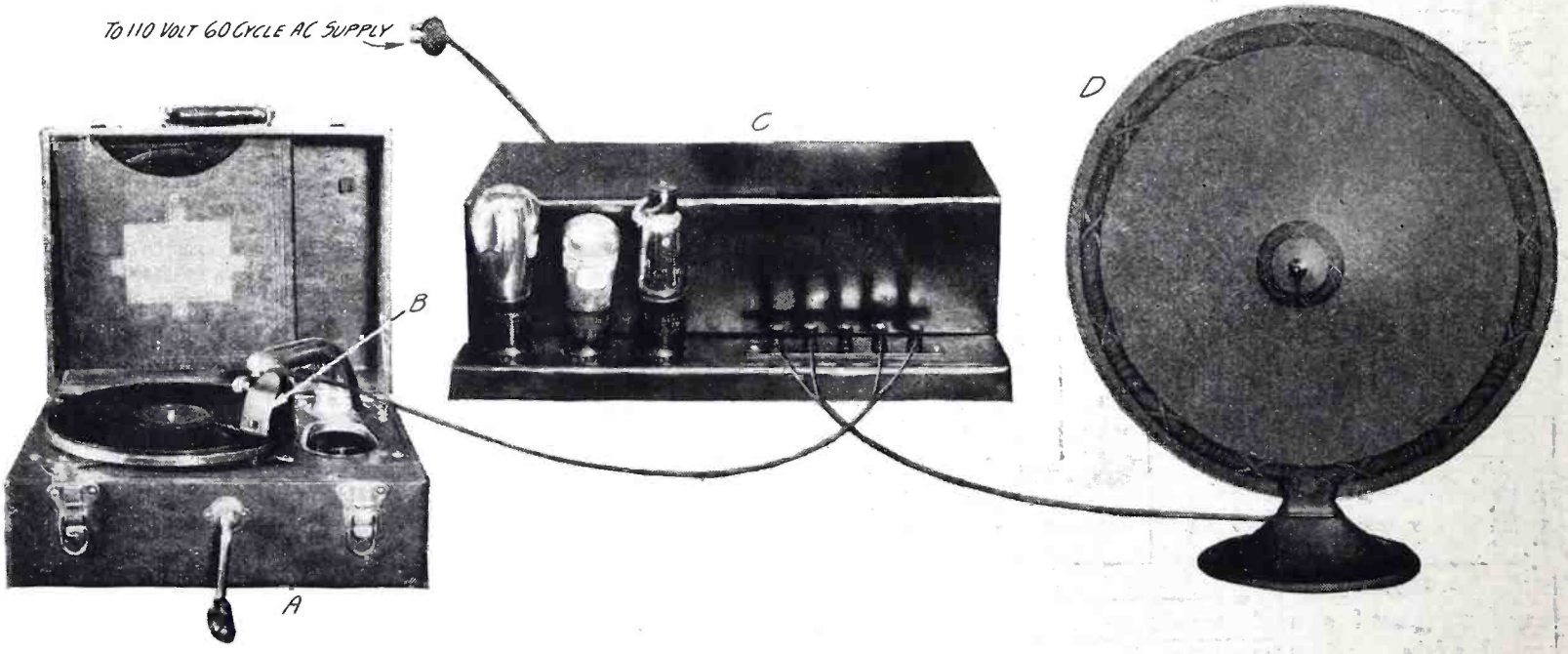
A—Any phonograph;
B, C and D—Warford reproducer, comprising pick-up, control unit and plug;
E—Truphonic amplifier No. 304, comprising three stages of low-frequency amplification;
F—Warford single-stage power amplifier that operates from the AC line;
G—Newcomb-Hawley reproducer.

ment of this series. In it will be found the pick-up device, B, volume control, C, a connection plug. D, amplifier, E, to which has been added a high-power stage of amplification, F, working from the alternating-current lighting lines.

A combination such as this gives a surprising amount of volume without distortion—in fact, enough to operate a number of exponential type horns for a large hall or auditorium. This combination has been found exceptionally well suited for use in public schools, dance halls, clubs, restaurants and other amusement places for supplanting the orchestra.

Another combination of an electrical pick-up unit in which all of the apparatus has been matched to produce the best tone quality is shown in Figure 5. This consists of the pick-up unit, B, an AC operated amplifier, C, that employs one 213-B type rectifier valve, a McCullough AC valve in the first stage of transformer-coupled amplification and a UX-171 type valve for supplying the power to the last stage of transformer-coupled amplification. This combination works entirely without batteries and is exceptionally well suited to home use.

Figure 6 shows a complete radio receiver that has recently been placed on the market incorporating "batteryless" operation with reproduction from either radio broadcasting or a phonograph pick-up. The set uses high-power rectifier valves of the UX-216-b type with a series of UX-199 type valves followed by a UX-210 type valve in the last stage of low-frequency amplification. No batteries are necessary with

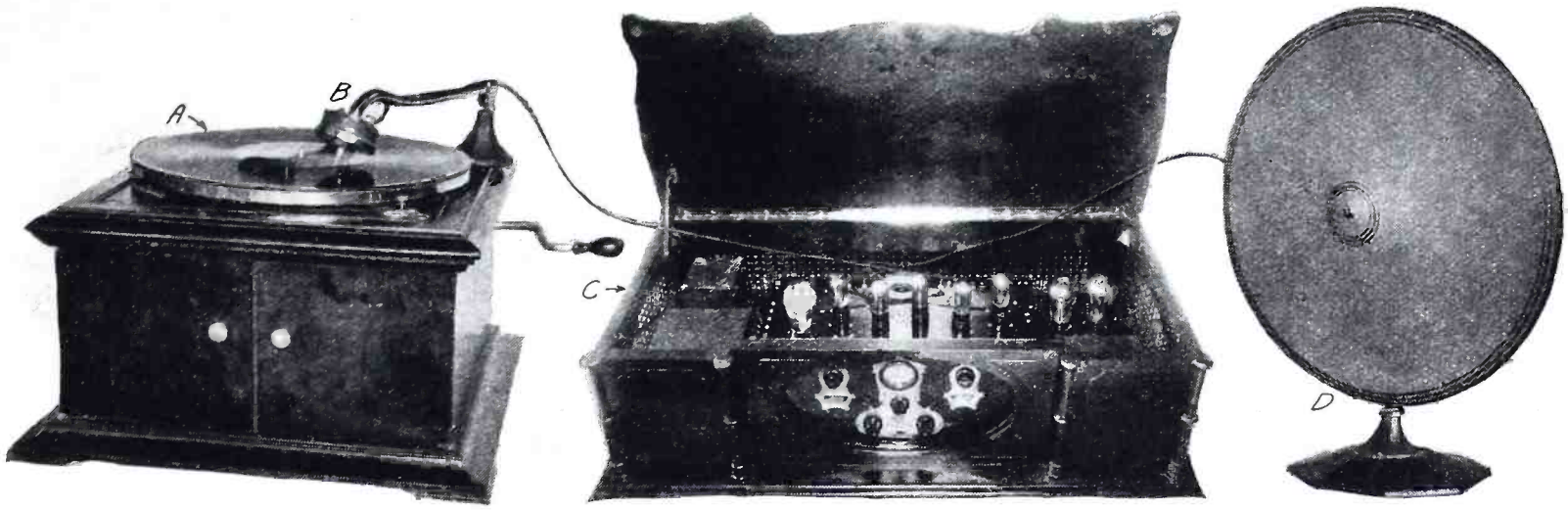


A MATCHED COMBINATION THAT OPERATES WITHOUT BATTERIES

FIGURE 5: *This group may be readily moved around to any location where an AC line socket is available, and the quality of its reproduction is excellent.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any phonograph (portable type shown);
B—Pacent Phonovox electrical pick-up;
C—Pacent two-stage AC amplifier;
D—Pacent 18-inch standard cone-type reproducer.



A COMBINATION WHICH REPRODUCES EITHER RADIO OR PHONOGRAPH PROGRAMS

FIGURE 6: *The radio receiver shown above draws its operating power from the light lines and contains a high-grade low-frequency amplifier. It requires only the push of a switch to change over from radio reproduction to phonograph reproduction.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any phonograph;
B—Argus pick-up unit;
C—Argus power radio, Model B-195;
D—Western Electric 540-AW cone-type reproducer.

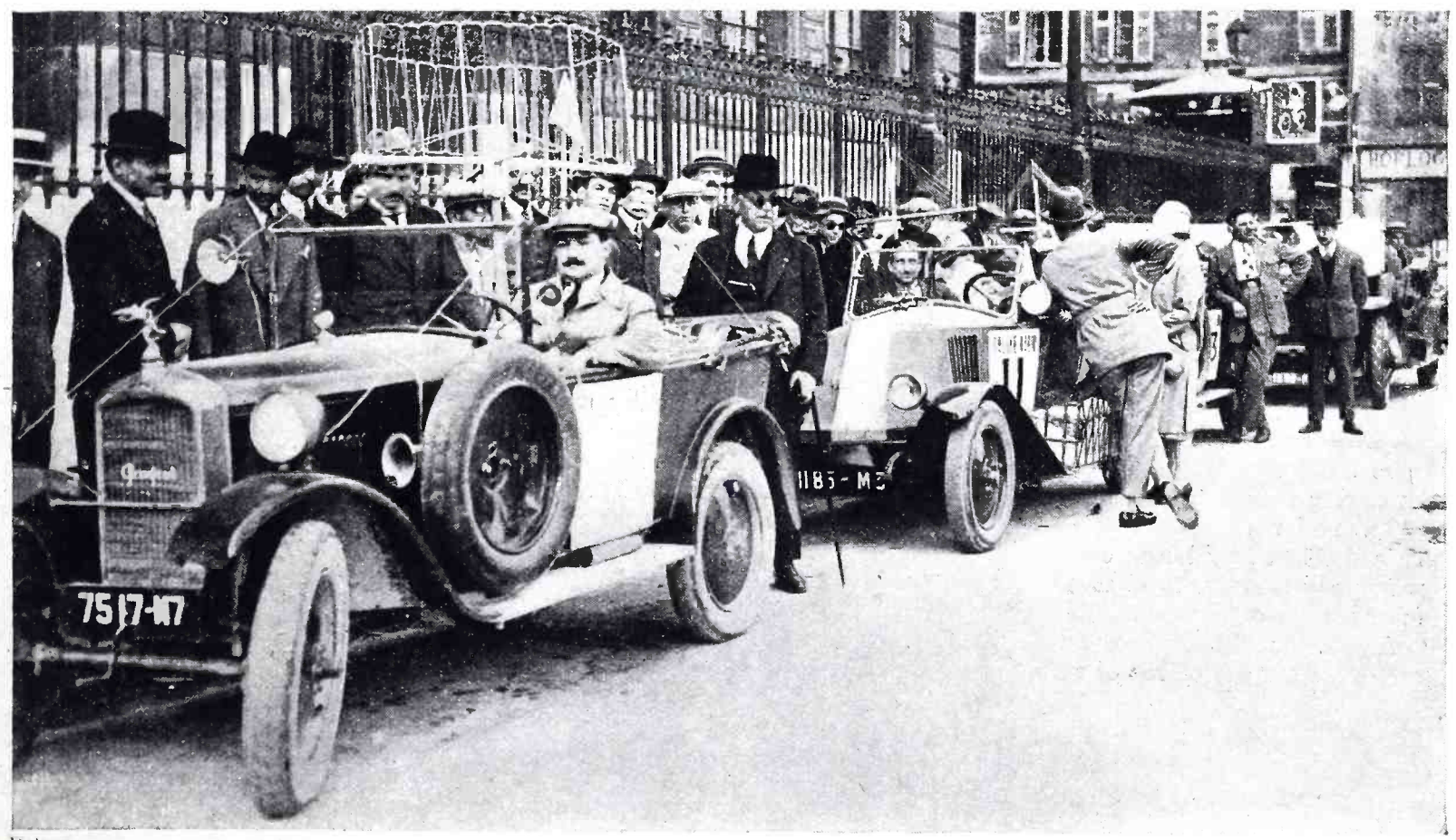
this receiver; it operates entirely from the 110-volt, 60 cycle AC lighting lines. A plug is furnished to connect to the house current, and the only other connection necessary is to an antenna. The set may be used to receive radio broadcasting by pushing "down" a small push switch at the rear of the set and may be used for phonograph reproduction by pulling "up" the same switch.

An electromagnetic pick-up device is furnished as part of the equipment and will work with any type of phonograph.

There are many music fans who have been reluctant to get rid of their old phonographs, vaguely hoping that at some time they may be useful. This new development enables any one to make a new instrument out of this old machine, with highly satisfactory results.

Another great advantage that can be obtained with the use of the same amplifiers, described in this and preceding articles, is the improvement of an old radio set. The amplifiers themselves may be incorporated as part of the radio set, to work with either the phonograph or broadcasting.

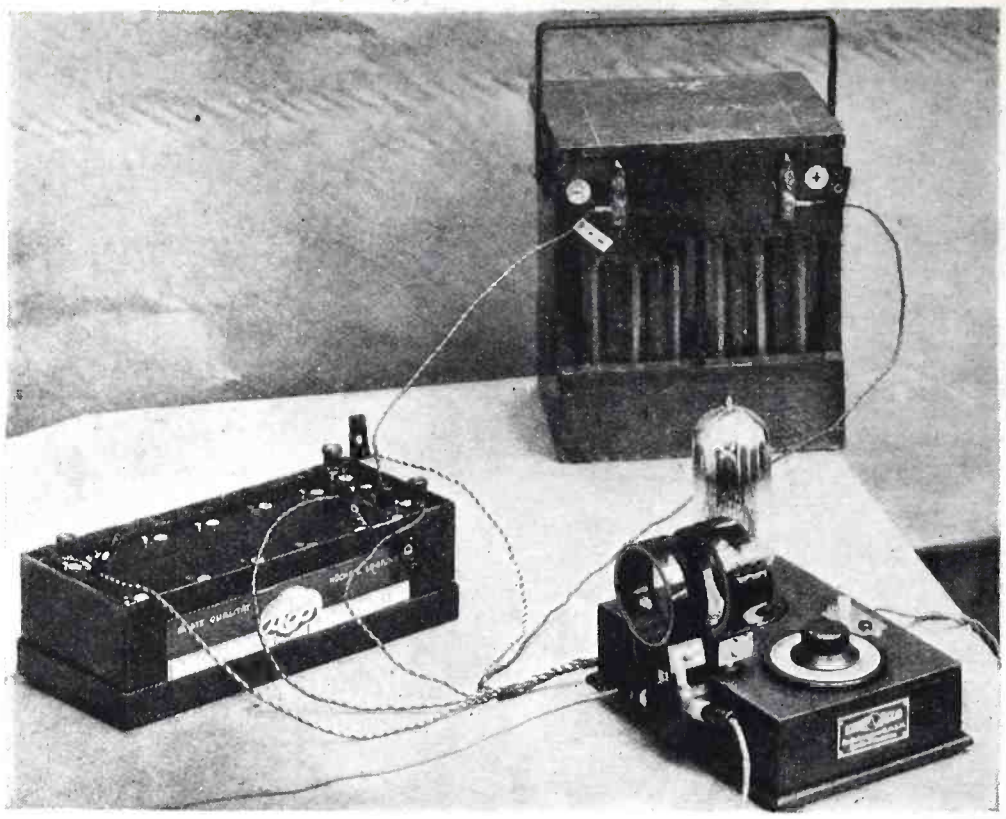
In following articles this phase of improvement will be described.



Delano

A RADIO AUTO MEET BRINGS FORTH UNUSUAL SET DESIGNS

Here are some of the contestants in a meet that auto owning radio fans recently held in Marseilles. Experimenters from all parts of France participated.



A SIMPLE SET-UP FOR A TRIPLEX VALVE

FIGURE 1: *At the lower right is shown the receiver itself, with the two tuning coils, the single variable condenser and the triplex valve mounted on the top. At the left are shown the "B" batteries in a block, and in the background is shown a portable "A" battery.*

The New "Multiplex Valves"

What They Mean to the Experimenter and to the Listener

This article, which tells of some of the new vacuum valves developed by Dr. Loewe and the author, both eminent German scientists, gives the experimenter some data that opens new lines of research and stimulates ideas well worth developing.

By MANFRED VON ARDENNE

EVERY set builder knows how much of the time that he takes in building radio receivers is spent in making the wiring connections between the various stages of high- and low-frequency amplification. In sets that employ a large number of valves this wiring job becomes a tedious business.

The new multiplex valves that have been developed by Dr. Loewe and the writer are designed to eliminate much of this trouble.

A single multiplex valve not only serves the purpose of two or more ordinary valves, but it also includes the coupling devices needed to provide interstage coupling between these valves.

In other words, one of these multiplex valves may be used as a complete amplifier in itself.

Furthermore, the multiplex valves accomplish this amplification in receiving-set construction without imposing undue limitations as to the variations in the circuits.

Just glance, for example, at the accompanying diagrams.

Figure 6 shows a simple arrangement with a low-frequency triplex valve; this hook-up is suitable for reception of the more powerful stations. For ordinary reception of the local stations on a cone- or horn-type reproducer, a small indoor or loop antenna should be sufficient. Should the reception of distant stations be desired, an outdoor antenna and a low-loss tuner are essential.

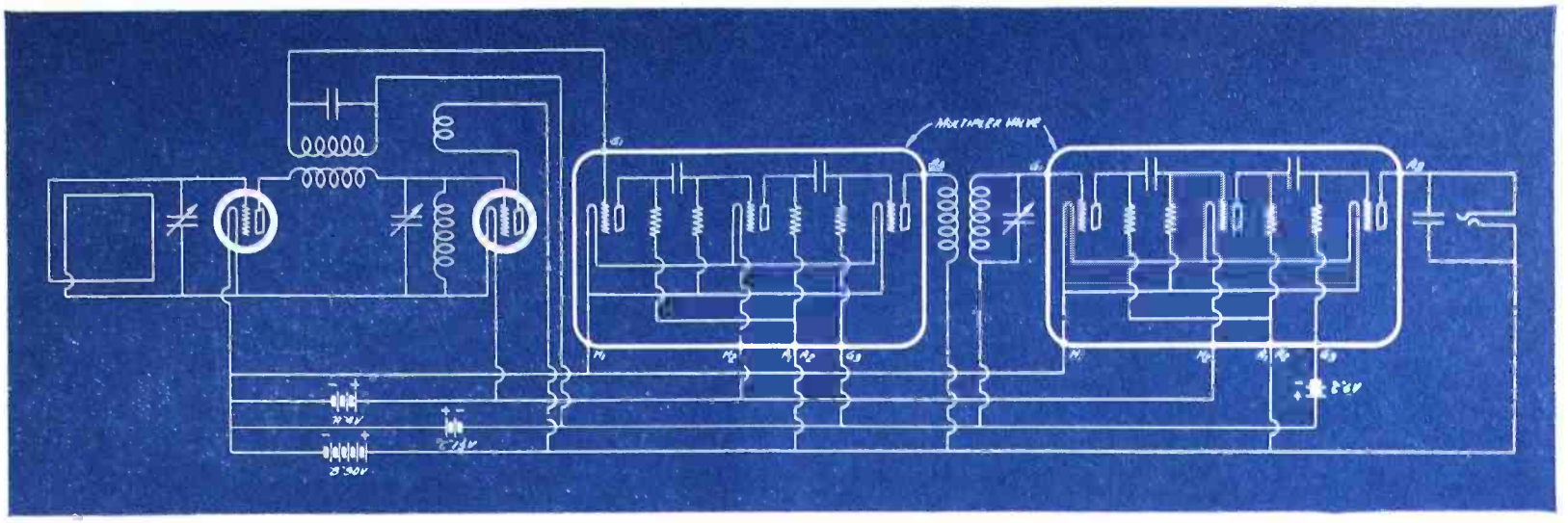
Rectification takes place in the first stage. This rectifying effect is dependent on the impedance of the capacity (stray or otherwise) that is included in the anode circuit. It is only obtained satisfactorily when this impedance is low; that is, at high frequencies. The amplification constant is between 20 and 30. Filament resistances are not necessary with these multiplex systems, as the filaments are correctly dimensioned for a 4-volt battery.

Figure 1 shows a view of a receiver that embodies the circuit shown in Figure 6.

Another circuit, much to be recommended, employs two ordinary valves as high-frequency amplifiers and one low-frequency triplex valve (shown in Figure 4).

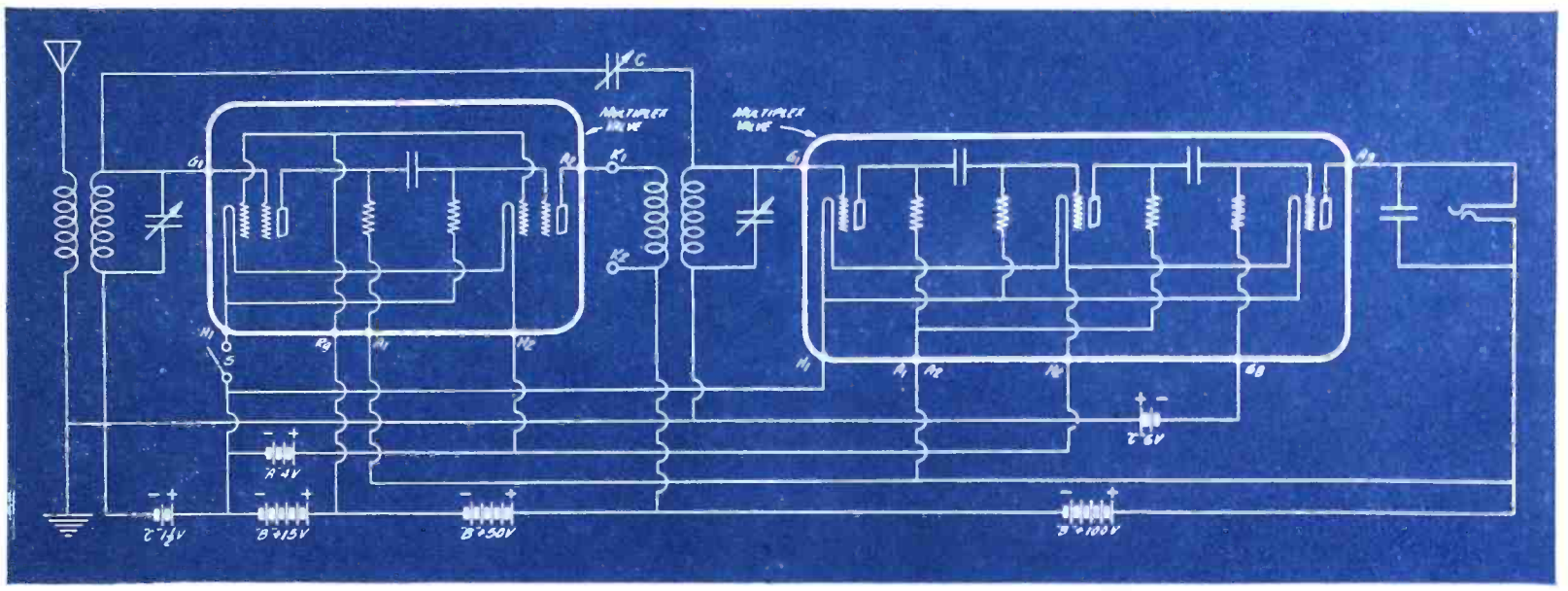
For reception of the local stations, the two high-frequency valves may be switched "off" by the switch S, and the antenna may be connected to K. Especially on the broadcast band of wavelengths excellent results in reception of distant stations may be obtained. The high-frequency amplifier may be any of the usual popular designs, with grounded shields and such devices.

Another excellent circuit is given in Figure 2. This set gives good distance



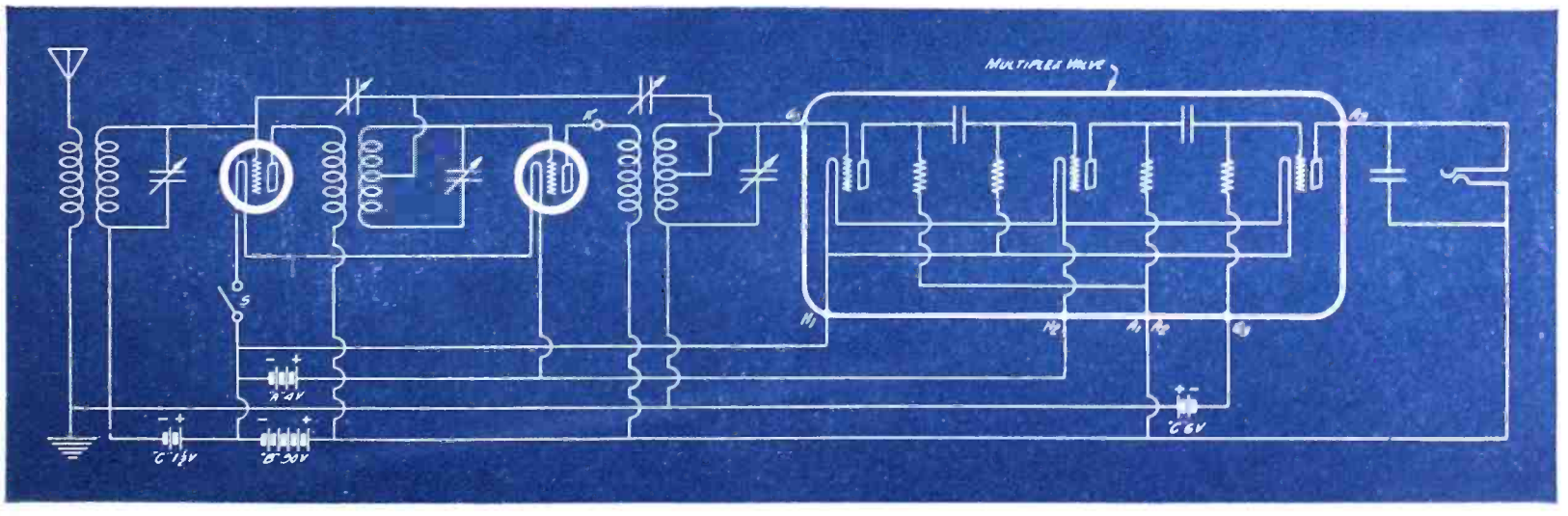
A SUPERHETERODYNE WITH TWO STANDARD VALVES AND TWO MULTIPLEX VALVES

FIGURE 2: *This receiver employs two standard valves as the detector and the oscillator and two multiplex valves as the intermediate and low-frequency amplifiers. The two multiplex valves are the equivalent of three stages of high-frequency amplification, a detector and two stages of low-frequency amplification.*



THIS CIRCUIT UTILIZES ONE DUPLEX VALVE AND A TRIPLEX VALVE

FIGURE 3: *In the first valve two stages of high-frequency amplification are obtained, while detection and low-frequency amplification is obtained in the larger or second valve; regeneration is controlled by the small variable condenser, C.*



HOW A MULTIPLEX VALVE IS ADDED TO A TUNED HIGH-FREQUENCY SET

FIGURE 4: *The first two stages are tuned with three variable condensers and are neutralized by a balancing scheme. The detection and low-frequency amplification is accomplished by means of a single multiplex valve.*

THE OUTWARD APPEARANCE OF A POWERFUL RECEIVER

FIGURE 5: *This is the set (the circuit of which is shown in Figure 4) which employs three valves that do the work of the average five-tube receiver.*

reception on a loop antenna. The intermediate frequency of this superheterodyne is amplified by the first triplex valve, while the second valve amplifies at low frequencies, after rectification has taken place in its first stage. The most important advantage of the receiver, in comparison with similar arrangements of more conventional design, is the extremely small plate-current consumption, due to the fact that the first valve does not receive any direct plate potential at all and four of the following valves have anode resistances of several megohms in series. The total plate-current consumption of this set corresponds to that of an ordinary three-valve set. The filament-current consumption is scarcely more than .7 ampere, in spite of the 8 filaments. Sufficient selectivity is obtained by the use of the variable coupling between the two triplex valves.

In comparison with receivers that employ tuned-intermediate-frequency transformers, this method has the advantage of greater simplicity, apart from the other advantages mentioned above. In the first two stages two similar valves with filament potentials of 2 volts and amplification factors of 10 should be used.

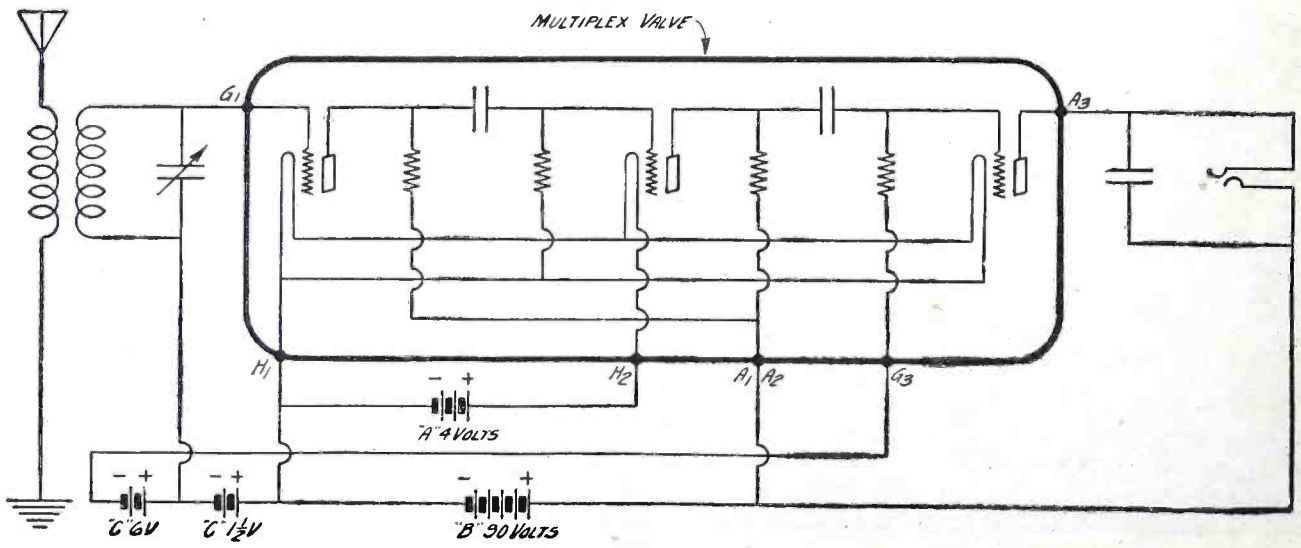
Excellent reception is also attained by the use of a high-frequency duplex valve and a low-frequency triplex valve in cascade. Such a circuit is given in Figure 3.

Regeneration is obtained by means of the small variable coupling condenser, C. But because of the high actual amplification factor of the first aperiodic high-frequency stage, regeneration need not be forced nearly so far toward the point of oscillation as is otherwise usual. Thus the set becomes simpler to operate, and the operator is less liable to cause interference to his neighbors. At the same time, the side-band distortion of the longer wavelengths, due to the use of excessive regeneration, is considerably reduced, so that, under favorable atmospheric conditions, distant stations may be received with practically the same purity as the local broadcasters. Because of the large amplification of this duplex valve, the maximum capacity of condenser, C, ought not to exceed about .000003 mfd.

Since these valves are scarcely larger than ordinary power valves, the receivers described above may be of comparatively small dimensions.

Figure 5 shows the exterior of a receiver that embodies the circuit given in Figure 4.

As yet it is too early to decide the question whether the multiplex systems will lead to special circuits that are not practicable with normally constructed valves and components, or whether the existing circuits will only be modified for use with multiplex valves and remain unchanged in principle.



HOW A SINGLE MULTIPLEX VALVE IS EMPLOYED IN A CIRCUIT

FIGURE 6: *In this circuit, that comprises detection and two stages of low-frequency amplification, a single multiplex valve does all the work. This valve has very low filament consumption and is easily installed.*

A NEW FORM OF

Radio Waves That Kill

From the laboratories of H. Grindell-Matthews and Dr. W. R. Coolidge have already come remarkable demonstrations of "death rays" that directly affect living creatures. But here is a new use of radio waves—waves that emanate from a broadcasting station and that this spring have indirectly destroyed 190 miles of tent caterpillars—and that offer a real menace to this scourge of the countryside.

By W. GORDON SWAN

LAST spring over 72,000,000 potential tent caterpillars were destroyed by a radio. This spring the number was increased to 300,000,000. One hundred and ninety miles of caterpillars!

Not that these insect pests curled up and died from the direct effect of power waves transmitted by radio and aimed specifically at them. The process was not quite as direct as that—but just the same it was tremendously effective within the broadcast range of station WBZ in Springfield, Mass., where the experiments in fighting this insect plague were made.

The commander-in-chief of this anti-caterpillar campaign was Thornton W. Burgess, creator and head of the Radio Nature League. Those of us who have not heard him broadcast from station WBZ on Wednesday evenings may know him through his newspaper syndicate articles and stories about animals and bugs and reptiles.

To Mr. Burgess came the idea of putting his army of members in the Radio Nature League to work exterminating the tent caterpillars. His army consisted of 143,000 enrolled members.

Standing before the microphone in the Hotel Kimball Studio of WBZ on February 9th, Commander-in-Chief Burgess talked to his army of the coming campaign, which would begin one week from that night and which would last three weeks.

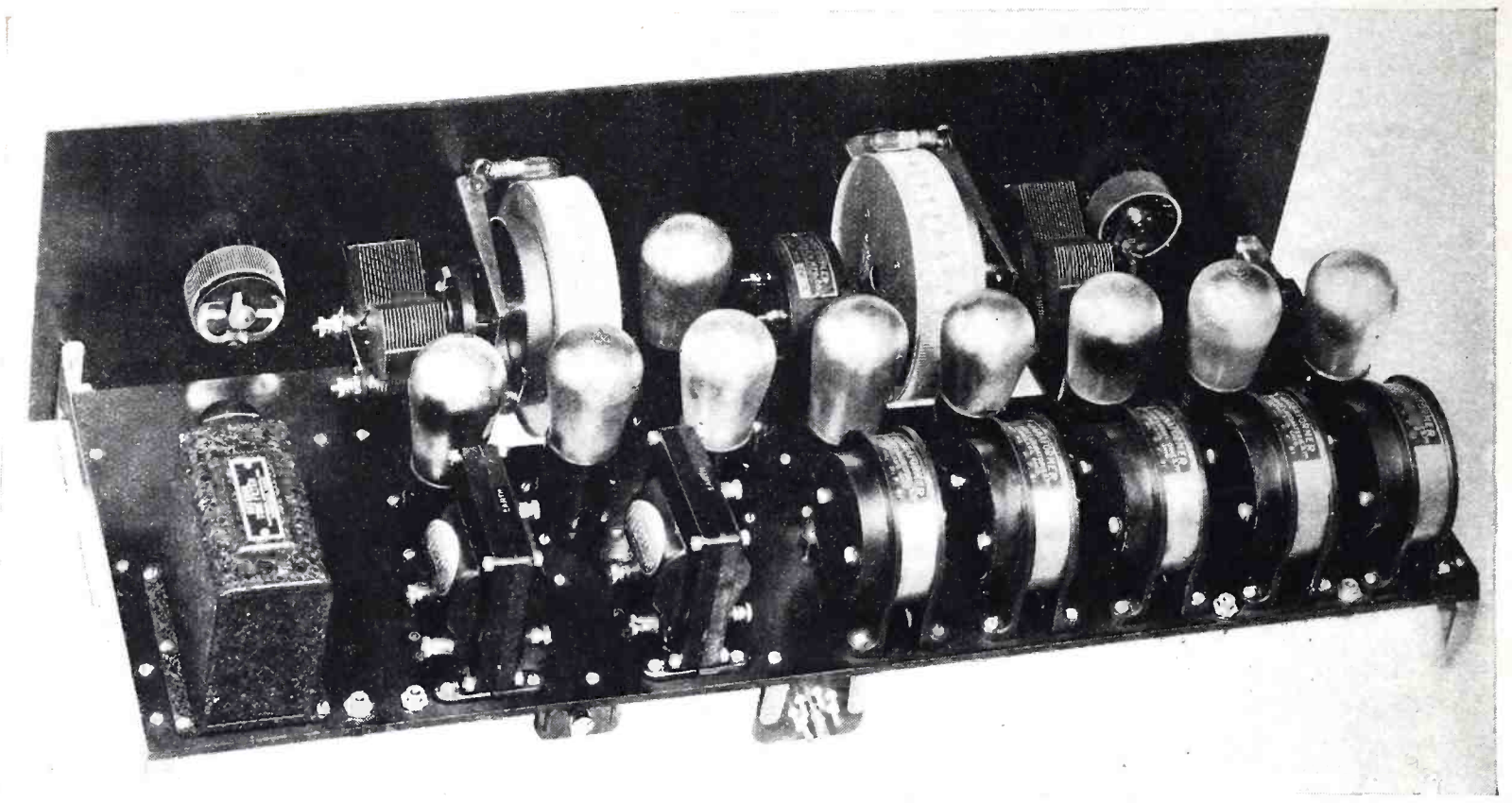
Seated about receiving sets in homes far and wide, children and grown-ups listened to the message. To the rich and the poor these words came from loud-speaker and headphone, from super-het and crystal set, like Paul Revere's call to arms:

"Everyone is familiar with the unsightly webs which appear along the roadsides in the spring and early summer. All know how unsightly the roadsides become with these webs, followed by the stripping of the foliage from the trees. A little careful work now will put an end to these pests. All winter long, on the twigs of the wild cherry and apple trees, the eggs of the tent caterpillar have been waiting for the approach of spring. Just as soon as the first leaf-buds show green, these tiny eggs will release hundreds of caterpillars. If these egg masses are collected now and burned, there will be no caterpillars. It is with the hope of destroying as many as possible of these egg clusters that we are conducting this campaign.

"These little eggs are very easily found. If you examine the twigs of wild cherry trees and of apple trees you will find little shiny masses completely surrounding a

(*Continued on page 159*)

¶ The latest developments in superheterodyne theory and construction are embodied in the Magnaformer 9-8 Receiver, about which this article gives advance information.



A REAR VIEW OF THE POWERFUL NEW SUPERHETERODYNE

FIGURE 1: *This picture gives a good idea of the neat and efficient layout of the nine-valve receiver that has been especially designed for tone quality and powerful reception, both distance and local, on a loop antenna.*

ADVANCE INFORMATION ON

The Magnaformer 9-8 Receiver

Superheterodyne fans will be more than interested in this advance article on the theory of a new receiver that should meet all their requirements for loop reception. The article gives an outline of the theory of the new set, with the reasons for its improved sensitivity and reliable operation. The feature of changing the receiver from a nine to an eight valve set by means of a simple switch lends itself admirably to all-around use where both distance and local reception are required.

By L. M. COCKADAY

WHILE experimenting in the POPULAR RADIO LABORATORY with this new set for the home builder, three notably interesting qualities were discovered; they may be tabulated as follows:

1. The capacity to get great distance on a loop antenna;
2. The simplicity and stability of operation;
3. Excellent tone quality.

Throughout the experiments conducted by the engineering staff of POPULAR RADIO on this new receiver, the operation of the Magnaformer 9-8 receiver was found to be an improvement over any of the superheterodyne receivers that as yet it had tested; the selectivity obtained in the crowded sections in New York City was all that could be desired.

A few minutes investigation into the methods employed to obtain these results will be interesting and enlightening to the experimental radio fan.

In the first place, the new circuit consists of an initial detector coupled to a simple oscillator that produces the necessary beat frequency and supplies it to the input transformers of the four stage, fixed-tuned, high-frequency amplifier. These transformers are peaked at about 72 kilocycles, or at about 4140

meters in wavelength. There is a switch on the front of the panel for cutting out one stage of high-frequency amplification, when this extra sensitivity is not necessary or advisable.

The output energy from the amplifier is then supplied to a second detector equipped with a high-frequency filter connected in the plate circuit. The rectified energy from this circuit is then applied to a high quality, low-frequency amplifier of two stages, and from there it is supplied to an output filter, in whose circuit may be connected a standard reproducer.

The first seven valves utilized in this receiver are of the standard UX-201-a type, while the eighth and ninth valves are of the UX-112 and UX-171 type respectively.

The schematic circuit for this new receiver is shown in Figure 4. At the left are shown the terminals for the loop antenna that is tuned by a variable condenser. It is connected to the first detector.

Notice that this valve's filament and the filament of the oscillator valve are controlled by means of a 10-ohm rheostat. This makes it possible to obtain the correct oscillator current and detector action for the highest efficiency. This rheostat is placed inside the set and need be adjusted but once.

The second variable condenser connected across the grid and plate of the oscillator valve (shown at the bottom of the diagram in connection with the three coils of the unicoupler) is the only remaining tuning control. It varies the frequency of the oscillator, so that a beat of 72 kilocycles may always be obtained between the loop tuner and the oscillator. This beat frequency is then applied to the high-frequency amplifier as described previously.

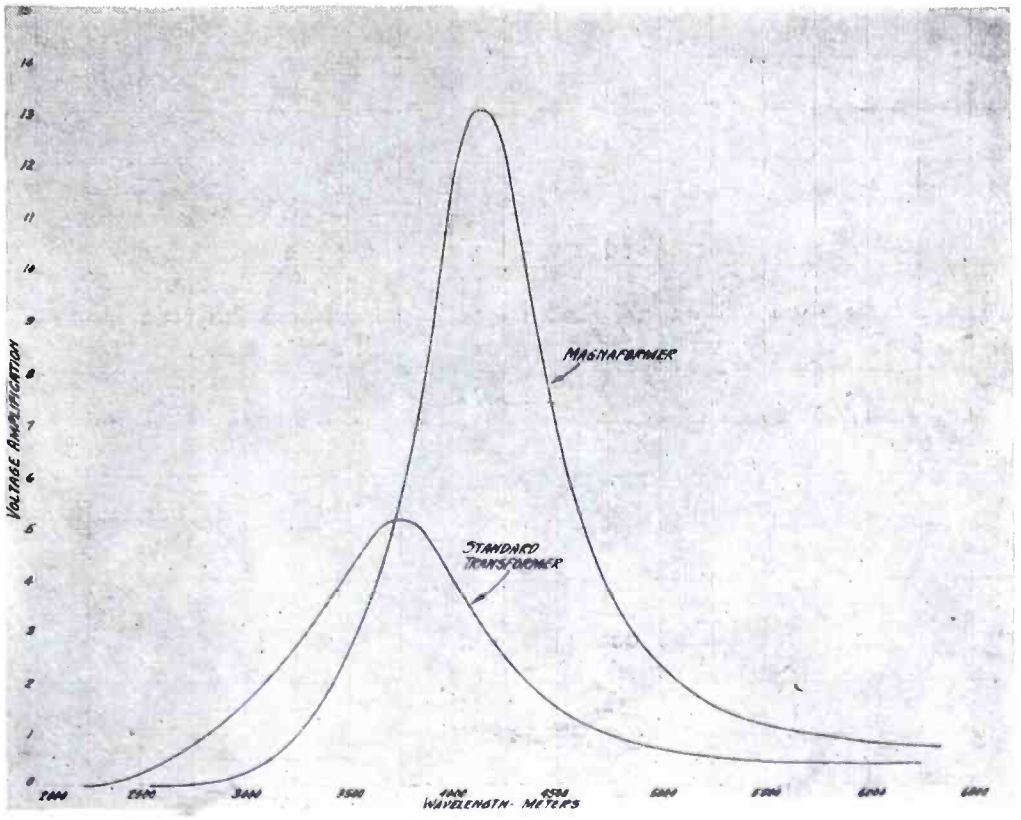
The second filament control, located inside the set, has a 30-ohm rheostat for controlling the current flowing into the filament of the second detector valve. This need be adjusted but once. The last two valves are controlled by automatic filament controls, and each passes one-half ampere to each of the last two valves.

On the front panel are the remaining two operating and volume control resistances. One of them is a 10-ohm rheostat that controls the filament current of the four high-frequency valves. This may be used as a volume control. There is also a 400-ohm potentiometer that controls the grid bias of the same four valves, to keep them stable and to give just the right amount of sensitivity and sharpness to the circuit that may be required.

The five air-core intermediate transformers each consist of a primary winding and a secondary winding (random wound on a bakelite spool). Across the secondary winding is connected a semi-variable condenser for the purpose of tuning the secondary coil to a predetermined and definite frequency. This condenser is constructed of brass plates, and is so designed that its capacity may be varied by simply turning a nut. Both the coil and the condenser are resonated and sealed inside their bakelite case and cannot be changed afterward. The condenser is outside the field of the coil.

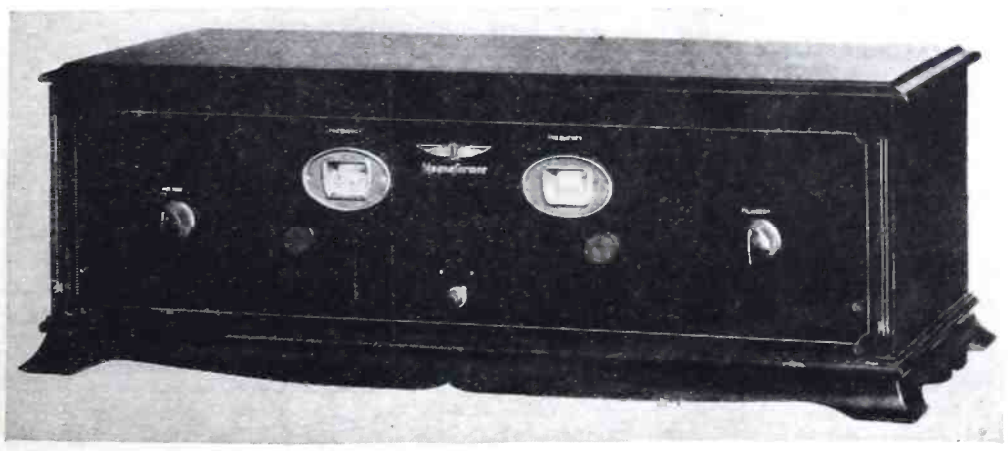
The mechanical characteristics of the Magnaformer have been given a great deal of thought and attention to make them physically rigid, and to forestall any chance of the tuning being varied after it has once been set. Two bolts are used through the coil and the ends are then locked into a metal band that extends around the unit, so that there is no possibility of their moving. The windings themselves are impregnated in wax, as well as the semi-variable condenser, after it has been adjusted. The metal band and a small plate that is placed along the side of this coil serve as a load that tends to suppress unwanted oscillation. The metal band also acts as a shield that allows the transformers to be placed side by side without serious interaction.

The efficiency of these new transformers is indicated by a comparison of the amplification curves, shown in Figure 2, of another standard make of intermediate transformer and the new Magnaformer coils.



THE RESONANCE CURVE OF A MAGNAFORMER COIL

FIGURE 2: *Notice the improved amplification obtained, as well as the sharper tuning, with the Magnaformer, which, in this case, has been tested against another standard transformer used for the same purpose.*



THE MAGNAFORMER RECEIVER COMPLETE

FIGURE 3: *This illustration shows the new set installed in its cabinet and ready for operation. A complete description of how to build this set appears in the October issue of* POPULAR RADIO.

This is one of the reasons for the great sensitivity that may be obtained without sacrificing tone quality.

The General Constructional Features of the New Receiver

A study of the illustration shown in Figure 1 reveals the neat and symmetrical arrangement of the apparatus. Most of it is mounted on a bakelite sub-panel that is in turn fastened to metal brackets that hold the front panel. The potentiometer is mounted on the front panel at the right and the combination rheostat and switch is placed at the left, with the two variable condensers affixed to illuminated drum dials and spaced in about the centre portion of the front panel.

All of the valves except one (the oscillator valve), are mounted in a straight line beginning at the right-hand edge of the sub-panel, looking at the set from the rear. The oscillator valve is mounted toward the front panel alongside of the unicoupler. These two pieces of equipment are spaced between the two front dials.

The five magnaformers take their place along the back edge of the sub-panel in line with the two low-frequency transformers and the tone filter. The choke coil and condensers and the miscellaneous resistances are mounted below the sub-panel, as is the Yaxley cable terminal.

The illustration shown in Figure 3 gives a front view of the set installed in a cabinet, showing the filament and volume controls and the two main tuning controls with their clear vision indicators. At the lower centre is shown a switch that changes the receiver from an eight valve receiver to a nine valve receiver for distance work.

In operation the set is normally left on eight valves except for extreme distance work. The set is usually used with a straight loop antenna and gives the best results with the Qualitone Loop, which has the correct inductance.

The set is really easy to build although it utilizes nine valves. For anyone who wishes to use an ultra-sensitive set without an outdoor antenna, the new Magnaformer 9-8 Receiver should be ideal.

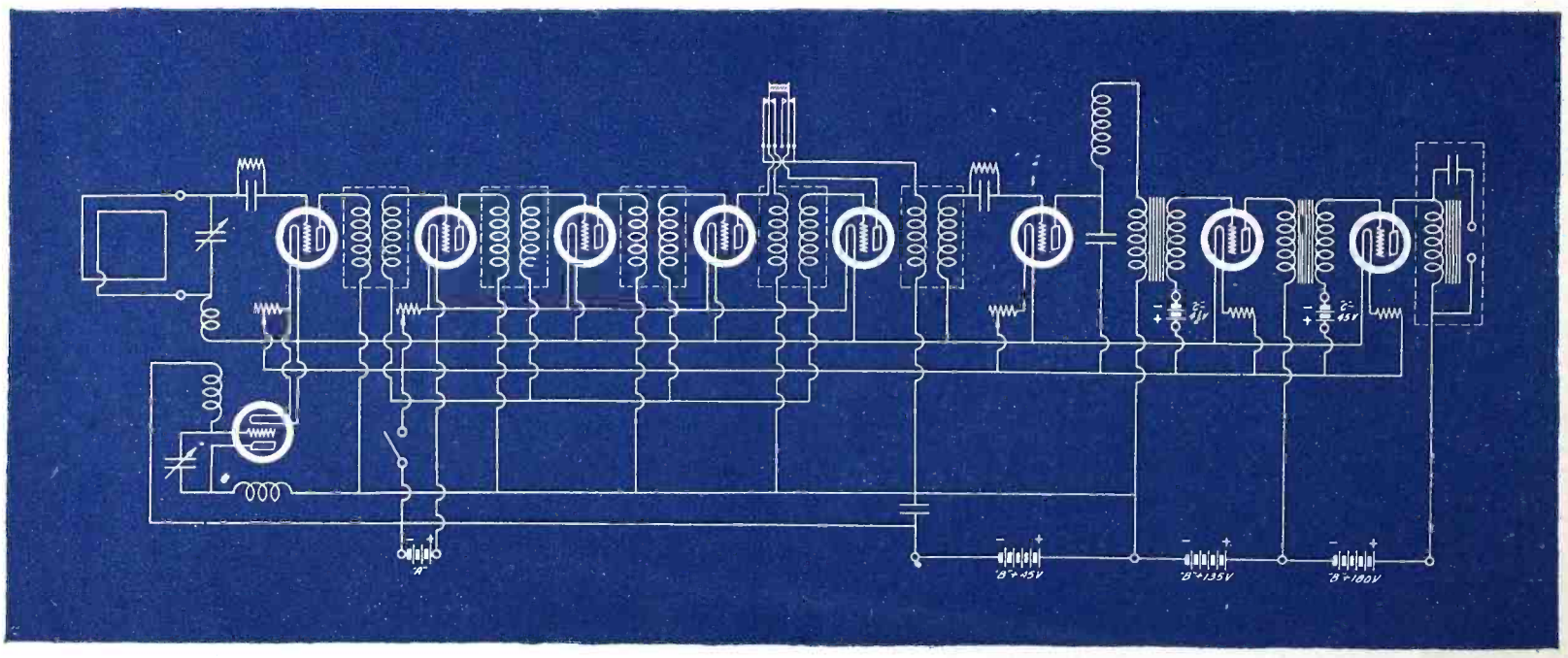
In the next issue of POPULAR RADIO will be found complete constructional details for building this set. For the benefit of the set builders who wish to purchase the instruments and accessories now, so that they will have them on hand when the constructional article appears, the list of parts necessary to build the Magnaformer is given here:

LIST OF INSTRUMENTS AND ACCESSORIES NECESSARY FOR BUILDING

The Magnaformer 9-8 Receiver

TO BE FEATURED IN THE OCTOBER, 1927, NUMBER OF POPULAR RADIO—

1 Formica front panel, 7 by 26 by 3/16 inch;
1 Formica sub-panel, 9 by 25 by 3/16 inch;
5 Magnaformer intermediate transformers, unit R. F. No. 61;
1 Unicoupler, unit C. U. No. 71;
2 Remler Universal drum type dials with controls, No. 110;
2 Remler .0005 mfd. variable condensers, No. 639;
9 Benjamin sockets, No. 9044;
2 Benjamin sub-panel brackets, 2 inches high, No. 8629;
2 Ferranti low-frequency transformers, A. F. No. 4 or A. F. No. 3—A. F. No. 4;
1 National tone filter;
1 Samson high-frequency choke coil, No. 125;
2 Aerovox .00025 mfd. grid condensers, type 1475, with mountings;
1 Aerovox .001 fixed condenser, type 1450;
1 Aerovox 1 mfd. by-pass condenser, type 200 short;
2 Durham 2-megohm grid-leaks;
1 Frost DeLuxe 400-ohm potentiometer, gold arrow knob, No. 1824;
1 Frost DeLuxe 10-ohm combination rheostat and battery switch, gold arrow knob, No. S1810;
1 Frost DeLuxe 10-ohm rheostat, No. 1810;
1 Frost DeLuxe 30-ohm rheostat, No. 1830;
4 Frost tip jacks, No. 253;
2 No. 112 amperites, with holders;
1 Yaxley cable connector plug, No. 660;
1 Yaxley radio jack switch, No. 60;
12 Feet Acme bus bar wire, No. 14, round tinned;
25 Feet Acme flexible spaghetti covered wire;
1 Quali-Tone loop—Duro Metal Products Co.;
1 5/8 by 5/8 by 2-inch wood block for sub-panel center support;
2 2-inch right-angle supports for supporting rear of sub-panel;
Wire, screws, lugs, nuts, bolts, solder.



THE SCHEMATIC DIAGRAM OF THE CIRCUIT EMPLOYED IN THE MAGNAFORMER RECEIVER

FIGURE 4: *At the left is the connection to the loop antenna, with the oscillator valve just below it. In the center of the diagram, at the top, is the change-over switch that cuts out one intermediate-frequency amplifier and thus converts the receiver from a nine-valve to an eight-valve set for local reception.*

"Embalming" Radio Programs in Wax

A new method for recording radio broadcast programs on talking-machine cylinders—a process that makes possible the collection of a radio broadcast "library"

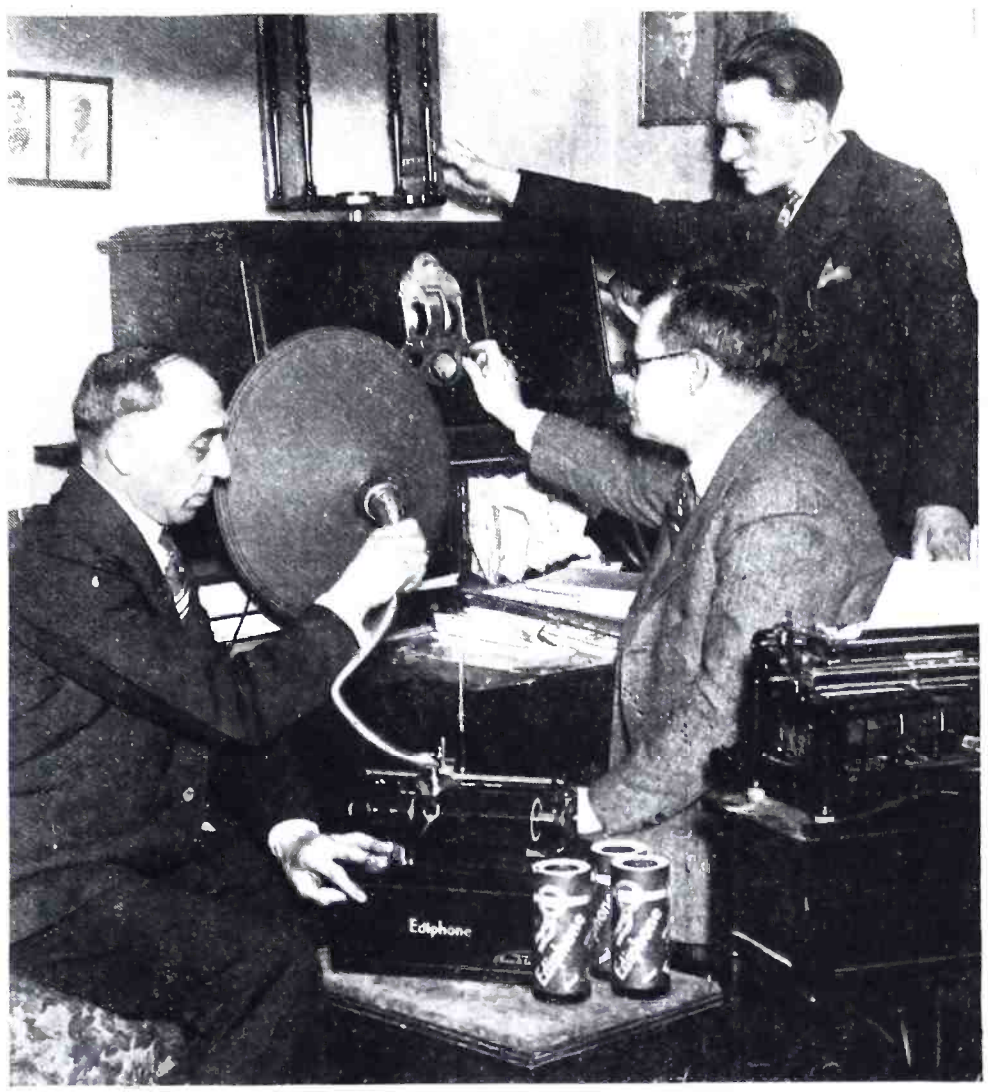
By S. T. WILLIAMS

WHEN President Coolidge speaks over the radio nowadays his voice is heard by millions in all sections of the country. And in 50 years from now this speech may still be heard, for a permanent phonographic record can now be made which may be reproduced with the clarity and volume of the original. The Victor Talking Machine Co. is doing this work at present, as a human institution and not as a commercial organization. The Victor radio programs broadcast during the past seasons have been recorded in their entirety. The purpose of these recordings was to provide both a permanent record and a means whereby the concerts might be adjudged.

The experimenter will be interested in the new system of electrical recording that affords a particularly simple manner of making records of broadcast programs without any sound reproduction taking place in the actual recording apparatus. A diagram of the recording system is shown in Figure 1.

A high-grade radio receiver is employed. The low-frequency output of this receiver is fed into the regular electrical recording amplifier, where it is further strengthened. The output of this amplifier is then connected to the electrical engraver which inscribes the electrical vibrations on a rotating wax disc, just as the regular artist recordings are made in the Victor laboratories. A metal matrix of the wax is then taken by means of an electroplating process, and from such metal discs the familiar black records are pressed.

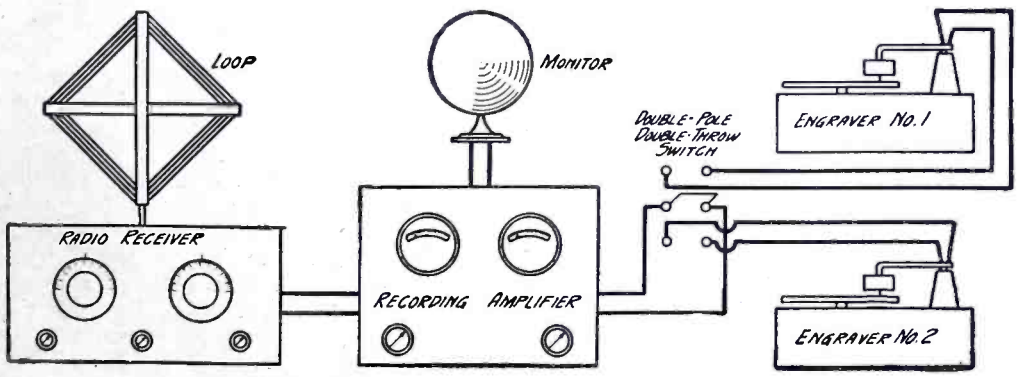
The recording is done at the standard speed for phonograph recording, 78 revolutions per minute. The records can thus be reproduced with perfect fidelity on the ordinary phonograph.



P. & A. Photos

HOW RADIO HOWLS ARE RECORDED

This particular apparatus was used by Eric H. Palmer (shown in the center of the picture) to record the heterodyning between stations from 200 to 2,500 miles apart; the records were made on wax cylinders and were sent to Washington, D. C., as evidence upon which the Radio Commission may base new allocations for radio broadcasting stations.



THE HOOK-UP FOR RECORDING RADIO PROGRAMS

FIGURE 1: *This diagram shows how the continuity of a long recording is obtained by the use of two electrical engraving systems with a change-over switch. These are shown at the right of the diagram. At the left are the standard receiver and the recording amplifier.*

Two turntables and two master wax records can be used as shown in Figure 1. This method eliminates any interruption to the continuity of a speech or musical program, for the two turntables with the two wax "masters" can be revolved simultaneously. Shortly before the one wax surface is completed, the second electrical engraver can be lowered to the surface of the other wax tablet, and the amplifier output thrown over at the proper time by means of a double-pole, double-throw switch.

A radio reproducer monitor is connected to the amplifier, allowing the operator to judge the volume and character of the program reception being delivered to the electrical engraver.

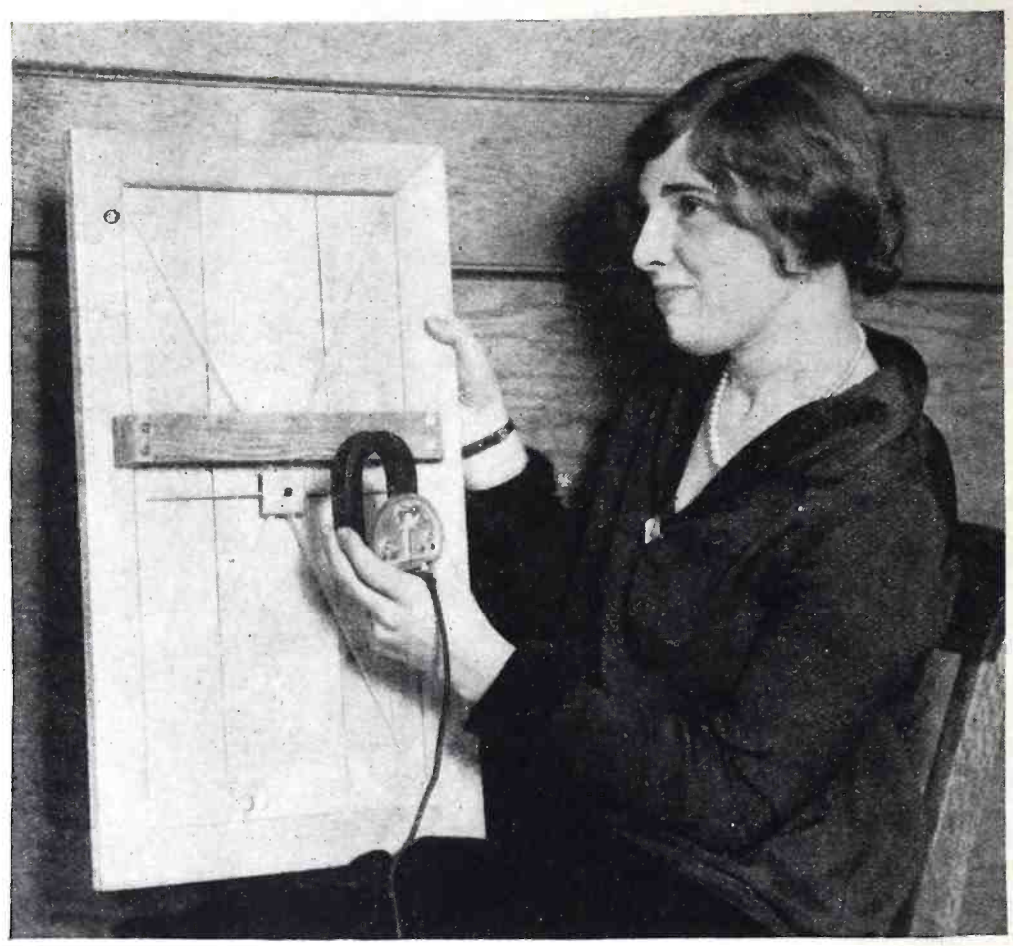
Here is a chance for the real fans to establish radio broadcasting "libraries" of wax cylinders. Collections of the recorded radio talks of great personages might some day have the value that we now place on collections of old books or letters or autographs.

What's New *in* RADIO

Conducted by

THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY, it will be duly recorded in this Department for the information and benefit of all.



Underwood & Underwood

A REPRODUCER SOUNDING BOARD SEVEN TIMES LIGHTER THAN CORK

This reproducer sounding board is made from Madera de Balsa wood, a material found in the jungles of Central America, and here cut to a thickness of three thirty-seconds of an inch. This device was designed to be hung on a wall and used as a mounting for a picture or tapestry.

A Handy Three-Way Socket

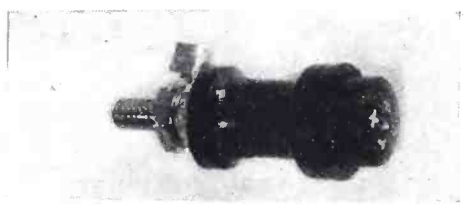
Name of instrument: Three-way convenience outlet for the house-lighting lines.

Description: This three-way outlet, sometimes known as the "table-tap," consists of a composition shell with accommodations for three standard electric cable plugs. Mounting holes are provided for screws to be used in mounting the device on the wall or baseboard; or it may be simply laid on the floor or table if desired. A fourth receptacle is provided for the cable, which is furnished with the unit, and is intended for use in connecting it to a light socket.

Usage: Where only a single outlet or socket is available for connecting the battery charger, "B" power-pack, etc., to the light lines, this unit may be used. It plugs into the single outlet, making three outlets available.

Outstanding features: Good appearance. "T" type slots to accommodate either type of standard plugs. All "live" parts completely inclosed within composition shell.

Maker: Harvey Hubbell, Inc.



No Chance for Shocks With This Terminal

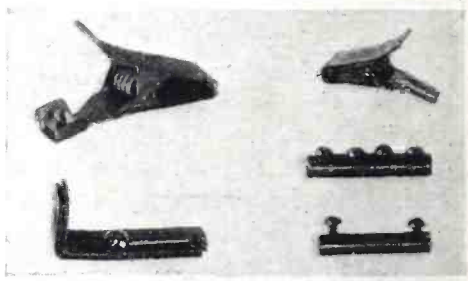
Name of instrument: Binding post terminal.

Description: This binding post consists of a solid metal rod that is imbedded for part of its length in a composition covering. The exposed part of the rod is threaded for attaching the post to a panel. When the spring collar is drawn up toward the cap, the brass rod is exposed and the connecting wire may be slipped into a hole provided in the rod. The collar may then be released and will spring back, to make a firm contact on the wire.

Usage: As a connection terminal to be mounted on any instrument to facilitate making connections between it and other instruments.

Outstanding features: Fully insulated. No twisting necessary in making a connection.

Maker: Frank W. Morse Co.



Handy Hardware for Every Radio Fan

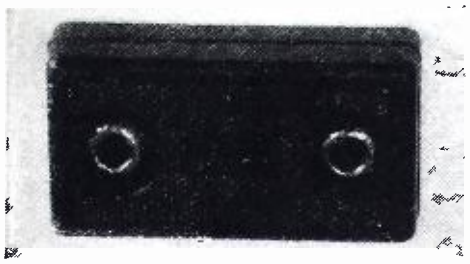
Name of instrument: Miscellaneous radio small parts.

Description: This group consists of brass wire connectors, clips and brackets. The wire connectors are brass tubes with set screws, so arranged that two wires can be joined by inserting their ends in the tube and tightening the screws. They are especially handy where soldering facilities are not available. The larger clip shown is for making connections to storage-battery terminals. It is lead galvanized to prevent corrosion, and it is equipped with strong springs which provide plenty of "bite." The smaller clips are for testing purposes and are nickel plated. The brackets are nickel plated and find many uses for supporting sub-panels, binding-post strips, and other duties.

Usage: For miscellaneous purposes in set construction.

Outstanding features: Well designed to meet the requirements of the set builder.

Maker: Frank W. Morse Co.



A Handy Cord Connector

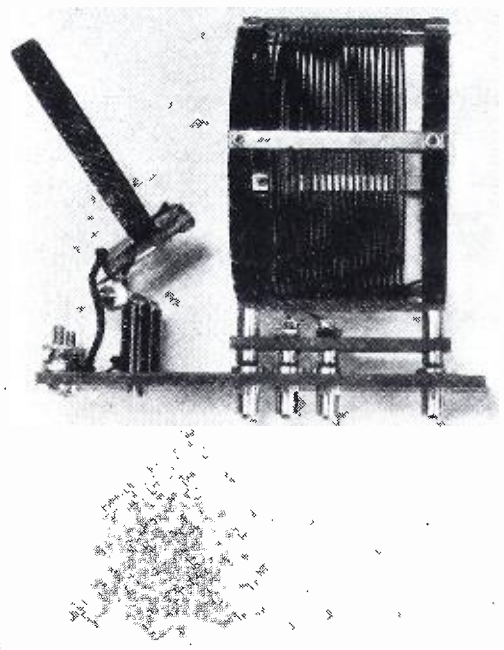
Name of instrument: Extension cord connector.

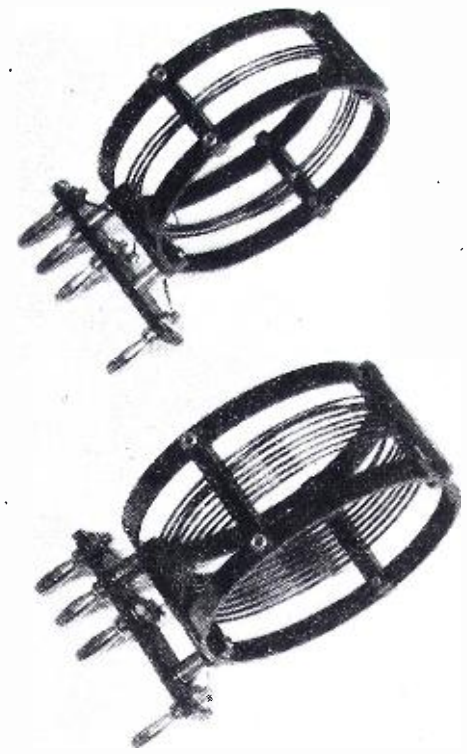
Description: The connector consists of two spring metal connectors inclosed in a composition block. There are two holes provided in each end of the block. The connector springs are so arranged that when a phone tip is inserted in one of them it is strongly gripped by the spring and a direct connection is made to another tip inserted in the corresponding hole at the other end of the block.

Usage: For connecting an extension cord to the end of the reproducer cord when it is desired to move the reproducer some distance away from the receiver. The two phone tips on one end of the extension cord may be inserted in the two holes in one end of the connector, and the reproducer cord terminals may be inserted in the holes at the other end, thus making a positive connection between the two cords.

Outstanding features: Firm grip. Small size. Insures positive electrical connection.

Maker: Frank W. Morse Co.





Reliable Coils for the Short-Wave Fan

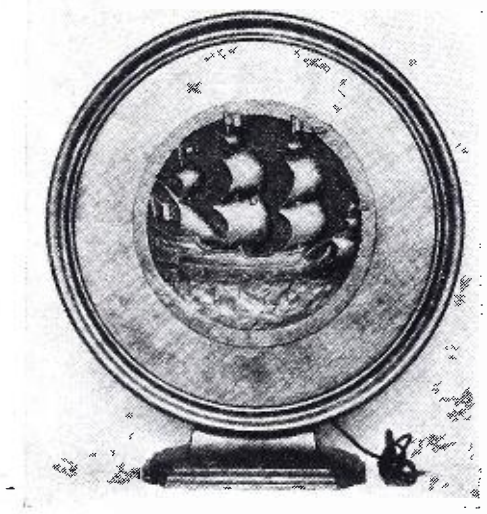
Name of instrument: Short-wave plug-in coils and mounting.

Description: This coil kit contains a mounting-strip which carries four small jacks and a movable primary winding. This strip is intended to be mounted on the baseboard or subpanel of a receiver, and for that purpose is equipped with insulated bushings that keep the strip well up off the baseboard. There are also three coils in this kit that cover three wavelength bands. The mounting strip, with one of the coils plugged into place, is shown at the left of the illustration above. In the short-wave range it is necessary to employ several coils of different sizes, if it is desired to cover any appreciable part of the wavelength band below 200 meters. The three large coils shown in the illustration cover a range of from 15 meters to 130 meters. The smallest coil covers the band around 20 meters; the medium coil covers the 40-meter range and the largest one covers the range from 80 meters to 130 meters. These coils are constructed on a skeleton insulated frame. The windings are clamped at four points by cross strips, and these in turn are supported by the insulating hoops. This method of construction provides good protection for the windings and makes for ruggedness and high efficiency. Similar plug-in coils are obtainable for use with the higher waveband up to 550 meters.

Usage: As the coils and mounting for use in the construction of a short-wave receiver.

Outstanding features: Highly efficient. Coils instantly interchangeable. Rugged and durable construction. Each coil unit consists of secondary and tickler windings.

Maker: Aero Products, Inc.



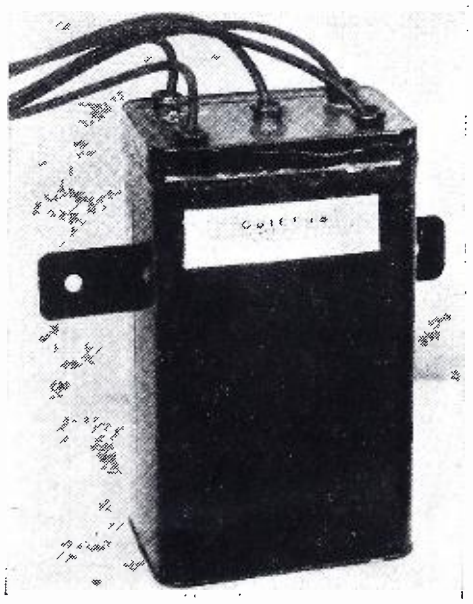
An Artistic New Cone

Name of instrument: Cone reproducer.

Description: The cone employed in this unit is of specially prepared fabric. The edge is bound with felt and rests on a wooden resonance sounding board, which serves as the front of the reproducer. The center of this wooden front is cut out and the opening is covered with a wrought iron medallion carrying the design of a sailing vessel, which serves as a grill. The whole reproducer is finished in mottled gold. An adjustment is provided, in the form of a small set screw, to permit regulation of sensitivity and quality of reproduction.

Outstanding features: Decorative appearance. Rugged. Low cost and good volume.

Maker: Algonquin Electric Company, Inc.



A Device That Stops Interference at Its Source

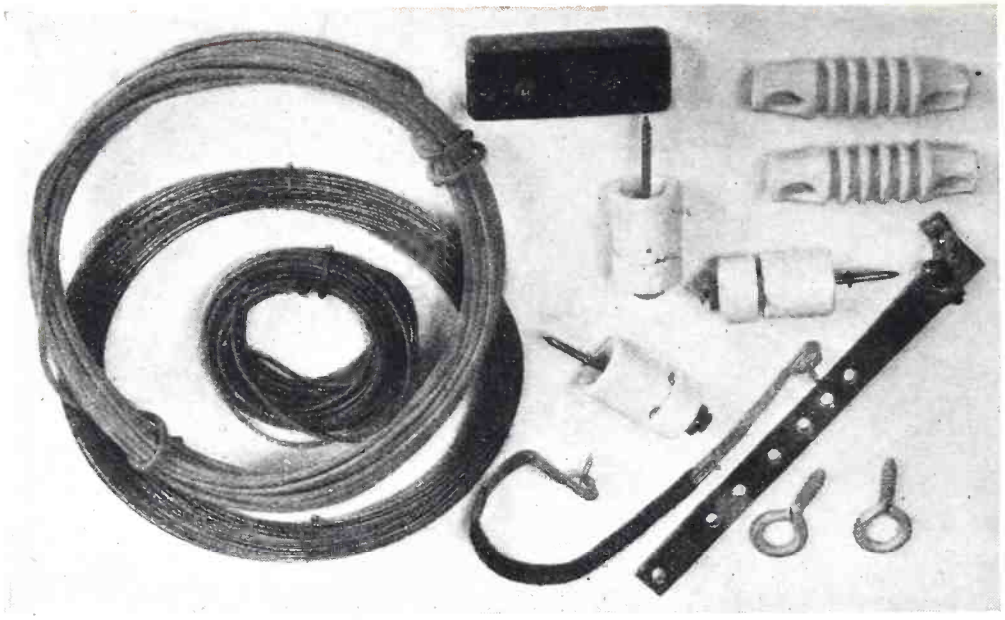
Name of Instrument: "Quietus" interference filter.

Description: This filter unit is sealed into a black metal can that measures approximately 4½ by 2½ inches by 6½ inches in height. At the top of this case are located five insulating bushings through which five wires are brought out. Two of these leads connect to the supply line; two connect to the input terminals of the machine that is causing the interference; the fifth is connected to the ground. The function of this unit is to provide a barrier to prevent the interference from getting out into the supply line, and to by-pass the interference to ground.

Usage: For connection between supply lines and electrical apparatus to prevent interference that originates in the apparatus from getting back into the supply lines where it would cause disturbing noises in nearby radio receivers.

Outstanding features: Reduces extraneous noises. Completely sealed in. For use where the supply is either direct or alternating current, at a voltage not exceeding 220 volts. Current carrying capacity is 8 amperes. Easy to install.

Maker: Day-Fan Electric Co.



No More Shopping Around for Antenna Parts

Name of instrument: Complete antenna kit.

Description: All of the parts required for the erection of an outdoor antenna are included in this kit. Complete instructions for the erection of an antenna are included in each kit, along with an explanation of the function and purpose of each item in the kit. Materials included in the kit are all of high quality.

Usage: In the construction of an outdoor antenna.

Outstanding features: Good quality materials. Complete in every detail.

Maker: Cornish Wire Co.

Sensitivity and Greater Volume from Your Present Receiver

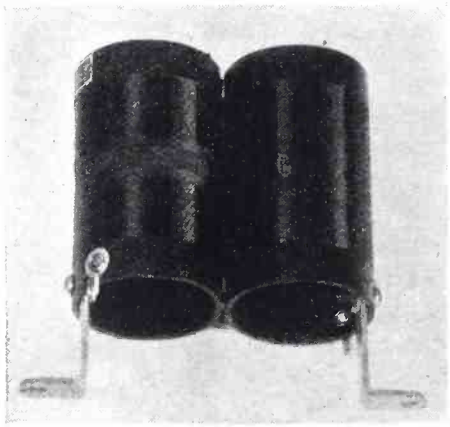
Name of instrument: "Mor-Volume."

Description: A coil and slider are inclosed in a small metal case to provide a variable inductance. The knob which controls the slider is mounted on a shaft that protrudes through the top of the case. The knob is equipped with a pointer which moves over a calibrated scale. Two binding-post terminals are mounted on the base of the instrument, and a two-conductor cable is supplied for making the connections between this instrument and the receiver with which it is to be used. The receiver end of this cable terminates in a composition disc with four holes to fit the prongs of a standard UX-type vacuum valve base. To connect the device to the receiver it is only necessary to remove the detector valve from its socket and slip the composition disc over the prongs in the base of this valve. The valve is then returned to its original socket, and all is in readiness for operation.

Usage: To be connected in the plate circuit of the detector of any standard receiver, to provide a tuned plate circuit.

Outstanding features: May be connected to any receiver without any alterations in the wiring or connections of the receiver. Provides greater sensitivity and volume than is obtainable with the receiver alone. Sold under a guarantee with a three-day trial offer and a cash refund of the purchase price if it does not justify the maker's claims.

Maker: Bruce Electric Co.



A Coil of Efficient and Accurate Characteristics

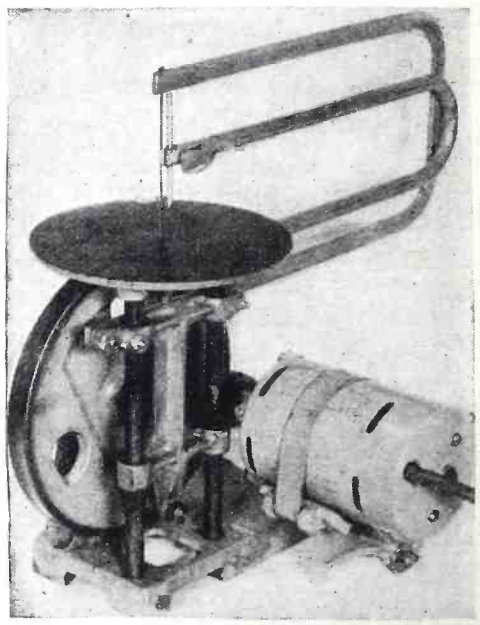
Name of instrument: Air core, high-frequency transformer.

Description: Enameled wire is space wound on a threaded composition tubing in the construction of this coil. The secondary winding is divided into two parts and one of these sections is split to provide room for the primary winding. The secondary sections do not contain the same number of turns, but are proportioned so that their inductance is equal. This disparity in the number of turns is accounted for by the fact that the section which is closely coupled to the primary has a higher inductance per turn, due to mutual inductance, and therefore requires fewer turns to equal the inductance of the other secondary section. The two coils are assembled in "binocular" fashion. Terminals are in the form of soldering lugs at the bottom of the coil form, and the mounting feet are higher than usual to allow ample clearance between the coil and the base in cases where a metal sub-panel or shield is to be used under the coils. The coil is designed for use in connection with a .000275 mfd. condenser for the present broadcasting band.

Usage: As an intervalve coupling device in a tuned high-frequency amplifier.

Outstanding features: Equal distribution of inductance practically eliminates external pick-up and therefore gives better selectivity and greater stability in an amplifier in which the coils are used. Neat construction. Careful design.

Maker: Acme Products Co.



Fancy Cabinets Can Be Made at Home With This Electric Saw

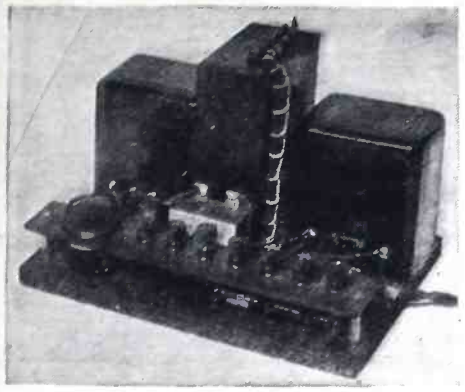
Name of instrument: Electric Jig Saw.

Description: This saw is designed to make use of a detachable motor. The saw consists of a heavy iron base and a flywheel together with a blade-holder guard and mechanical operating equipment. The motor is attached by means of a steel strap in a fixed position provided on the base of the saw. For this use a friction pulley is attached to the end of the motor driveshaft and the driving force is applied to the periphery of the large flywheel through its frictional contact with the motor pulley.

Usage: For cutting wood, rubber or bakelite into irregular shapes.

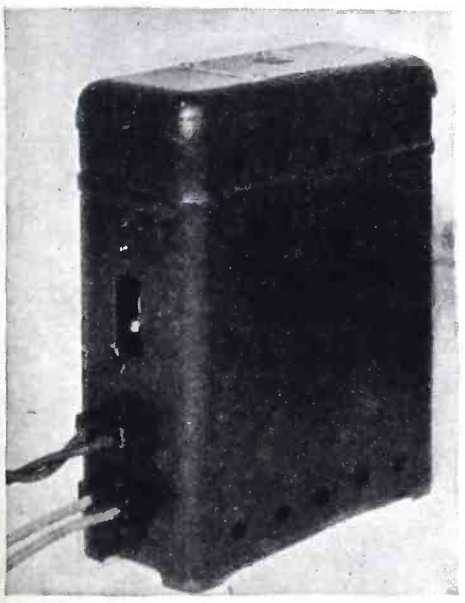
Outstanding features: Small in size. Uses detachable motor. Works rapidly. Easily and quickly assembled. Motor can be attached or detached in a few seconds. Strongly constructed. Simple to operate.

Maker: Electro Magnetic Tool Co.



This Kit Simplifies Home Construction of a "B" Power-Pack

Name of instrument: "B" power-pack kit.
Description: This power-pack is sold in kit form for the convenience of the fan who prefers to "build his own." The kit consists of all the necessary parts. When completed, this unit will deliver "B" voltages required for the operation of any receiver, including the high "B" voltage required for the operation of a UX-171 type power valve in the last stage. It also supplies the "C" and "A" voltages for this power valve. The power-pack is designed for use with a UX-213 type of rectifier valve, and also makes use of a voltage regulator valve to maintain constant voltage at the 90-volt tap.
Usage: To supply all "B" voltages to any receiver; also the "A" and "C" voltages for a power valve used in the last stage of the receiver.
Outstanding features: Unusual voltage stability. Variable "C" biasing voltage. Supplies filament current for power valve. Easy to assemble. Compact.
Maker: Silver-Marshall, Inc.



This Unit Will Keep the Storage Battery at the Proper Charge

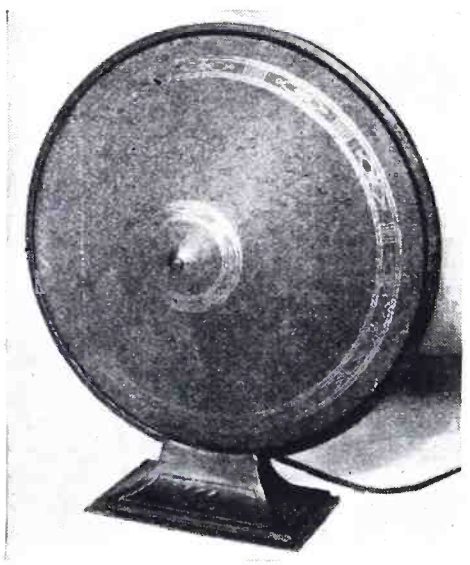
Name of instrument: Trickle charger.
Description: There are no acids, liquids or vacuum-valve rectifiers in this charger. Rectification is obtained through the use of dry plates which require no attention whatsoever. The unit consists of the usual step-down transformer and a new-type rectifier, inclosed in a perforated metal case. It is equipped with a switch on the outside of the case, by means of which the charging current may be turned "on" and "off" at will. It also has a cable and plug for connecting to the AC light lines, and a pair of rubber-covered wires by means of which the charger may be connected to the battery. The charging rate is self-regulating, in that the charger will operate at full capacity until the battery is fully charged; then the current will taper off to a lower value that cannot overcharge the battery.
Usage: For trickle charging 4 and 6-volt storage batteries from the 110-volt, 60-cycle lighting lines.
Outstanding features: Requires absolutely no attention other than turning it "off" and "on." Even this attention can be eliminated by the use of an automatic relay switch. Provides tapering charge that prevents overcharging of battery. The rectifier plates have a long life and when finally worn out may be replaced at nominal cost.
Maker: Elkon Works, Inc.

P. & A. Photos

A FRENCH COMBINATION OF PHONOGRAPH AND MOVIE
This apparatus was designed to combine the phonographic and the "cinema art" by recording sound in very fine grooves or scratches along the edge of a motion picture film. Its inventors, Mr. and Mrs. Francis M. Johnson (he is American, she is French) are shown with the apparatus.

Exact Regulation of Voltage Is Obtained with This Power-Pack

Name of instrument: "B" power-pack.
Description: An electrolytic rectifier is employed in this unit, in conjunction with a filter and the necessary output resistances. All are inclosed in a neat metal case that is finished in gold. Terminals are provided on the front for four different "B" voltages, three of which may be varied by means of the three knobs that are mounted just above the terminal strip. A switch is also provided, by means of which the AC supply to the power-pack is turned "off" and "on." The unit operates from the 110-volt, 60-cycle light lines and supplies adequate output voltage for the operation of practically any receiver, including those that make use of either a 112 or 171-type power valve in the last low-frequency stage.
Usage: In place of "B" batteries for the operation of radio receivers.
Outstanding features: Low cost. Neat appearance. Supplies adequate voltages. Various output voltages variable to meet requirements of any receiver.
Maker: Warren Electric Co.



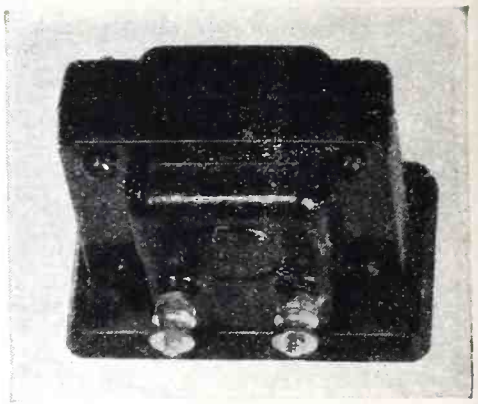
A Sturdy Cone Reproducer

Name of instrument: The O'Neill cone reproducer.
Description: This reproducer is of the semi-floating cone type. The cone is of parchment paper with the usual set screw and bushing arrangement for regulating the tension on the cone. The frame and base are of metal and are finished in a brown tone to match the color of the cone. The cone is decorated in gold to relieve the monotony of the otherwise large, unbroken cone surface.
Outstanding features: Neat in appearance, will not tip over, and distinguished by good overall performance.
Maker: O'Neill Mfg. Co.

P. & A. Photos

MILE-HIGH BROADCASTING

Aboard this radio-equipped airplane, John C. Thomas, baritone (shown at the microphone), recently broadcast his voice while speeding through the air a mile above New York City. A new invention gives to the radio set the clarity and amplitude necessary to broadcast above the roar of the airplane motor.

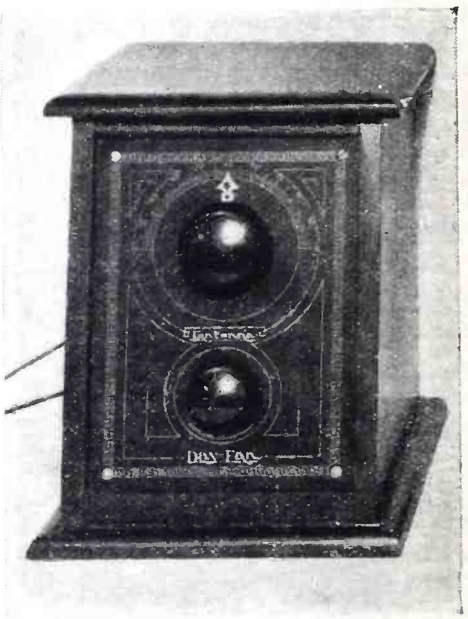


compact. It measures 2⅞ by 1⅞ inches, base dimensions, by 2½ inches in height. The windings and core are completely inclosed in a black composition case, with the four terminals brought out to binding posts which are located near the base of the instrument. Four holes are provided in the case for use in mounting the unit on a base.

Usage: As an intervalve coupling device in a low-frequency amplifier circuit.

Outstanding features: Compact size. Low price. Insulated case.

Maker: Pilot Electric Mfg. Co.



A Tuned Antenna Circuit for Your Receiver

Name of instrument: "Fantenna."

Description: A variometer and two variable condensers are included in a neat cabinet with a nicely decorated front panel. There are two control knobs with calibrated scales mounted on this panel, for use in tuning the device. The variometer and one of the variable condensers are mechanically coupled together to operate from a single knob. The other knob controls the remaining variable condenser. Three terminals are provided in the form of long wires which are to be connected to the antenna, ground and receiver.

Usage: To be connected between the antenna and the receiver to provide the advantages of a tuned antenna circuit.

Outstanding features: Neat in appearance. Provides greater signal strength and an ultra-sharp control over selectivity of reception.

Maker: Day-Fan Electric Co.

These Units Will Regulate Power-Pack Voltage

Name of instrument: Voltage control units for "B" power-packs.

Description: These units consist of specially prepared composition strips, upon which is wound high resistance wire of adequate current-carrying capacity. A set of these resistances for the average "B" power-pack consists of two units, which may be connected together in such a way as to provide two variable grid-biasing voltages, three variable intermediate voltages and a fixed high voltage for the operation of a power valve. The variable voltages are obtained through the use of sliders which make contact with a bare portion of the resistance windings. The over-all resistance of the double unit is approximately 10,300 ohms.

Usage: As the voltage control resistor for use in the output circuit of a "B" power-pack.

Outstanding features: The current-carrying capacity will take care of 80 milliamperes, which is more than adequate for average use. The use of sliders permits exact adjustment of the output voltages to meet the requirements of any receiver with which the power-pack is to be used. The sliders are so arranged that when their proper positions have once been found, they may be clamped into place by a turn of the insulated knobs.

Maker: Carter Radio Co.

A Compact Transformer for Small Receivers

Name of instrument: Low-frequency amplifying transformer.

Description: This transformer is decidedly

A New AC Operated Receiver Designed Especially for Family Use

Name of instrument: Zenith Model 17 receiver.

Usage: For the reception of radio broadcasting.

Outstanding features: Completely AC operated. Single-control tuning. Uses six standard vacuum valves. Contains no liquids and requires no attention to maintain. Complete in a console base or a spinet base, as desired.

Description: This receiver is entirely self-contained, except for the antenna and reproducer. The power-pack equipment is in the receiver cabinet; so there is no necessity for having a base with drawers or closets, unless one wishes to have the reproducer inclosed. In that case a console with a built-in reproducer, as shown in the illustration above, is available to match this receiver.

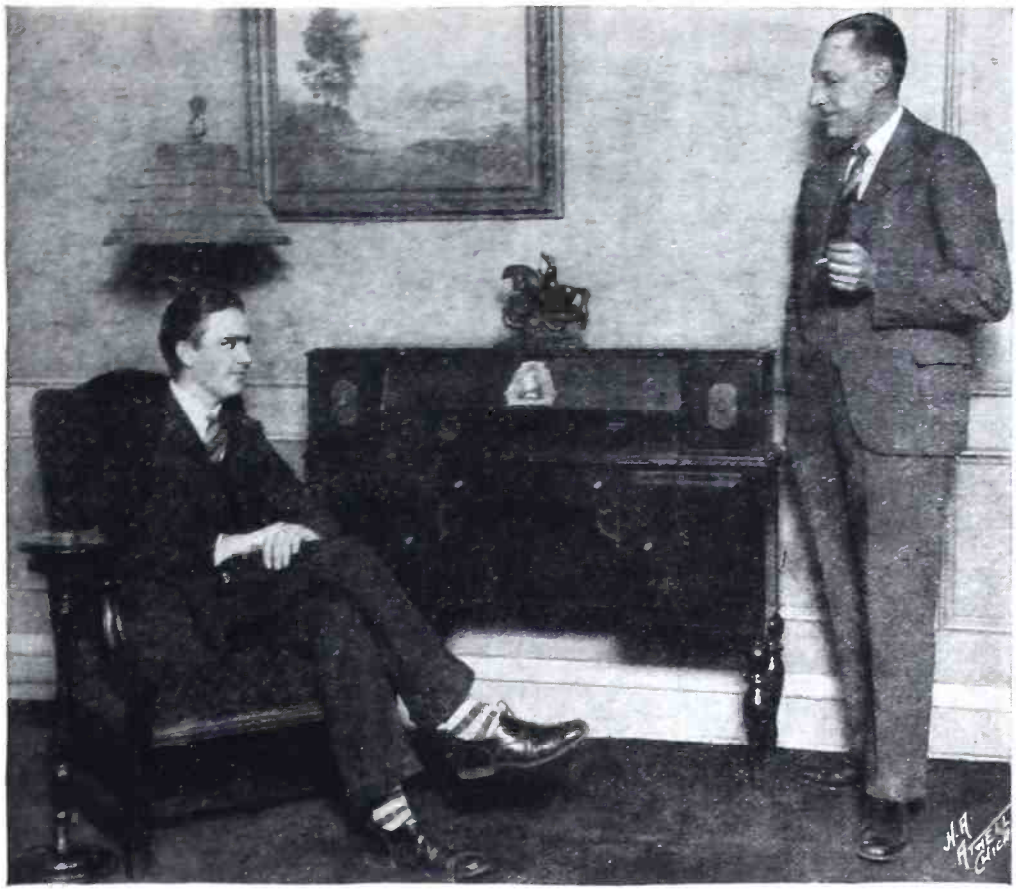
The cabinet is of mahogany, with insets of bird's-eye maple. These latter are of a fairly dark shade, to blend easily with the darker mahogany and provide a most pleasing exterior. The spinet and console bases are finished in the same way, and when the receiver is assembled on one of these bases the two units take on the appearance of a single piece of furniture. The spinet base consists of four slender legs with a narrow toprail.

Electrically, the receiver is carefully designed and executed. It is designed primarily for use as a home receiver and is extremely easy to operate, so that any member of the family can tune in the programs without the least difficulty.

The control panel contains a large knob for tuning to wavelength and a small knob for controlling the volume of reproduction. These two are the only controls used for ordinary reception. For out-of-town reception where the utmost in sensitivity is needed, there is a third knob, which brings the antenna circuit into exact resonance. As the tuning control knob is turned a calibrated scale passes beneath the small, illuminated window in the center of the front of the cabinet.

At either end of the receiver cabinet are two square compartments which are provided with doors that swing forward. The power-pack is in these compartments, the transformer and rectifier equipment at the right and the filter equipment at the left. All power is turned "on" by means of a four-position switch located behind the door of the right-hand compartment. To put the receiver into operation, this switch is turned to one of the four settings, which brings the hand of the meter on the receiver front to the position for correct operation; this position is clearly marked on the scale of this meter. Then the tuning control is turned until the setting shown on the tuning scale is correct for the station to which it is desired to listen. The volume is next adjusted to suit the listener. If the desired station is a distant one, it may be necessary to move the antenna tuning knob slightly.

The power-pack arrangement is unique in that it uses no storage battery, no charger and no liquid in any part of the rectifier or filter. And there is nothing that needs any attention on the part of the owner of the receiver. The rectifier consists of four Raytheon rectifier valves and operates through a filter that consists of the usual chokes and condensers. The use of the four rectifier valves, connected in parallel, provides sufficient direct current to operate the filaments of the UX-201-a type valves and also provides the current required by the plate circuits of the valves. This single power-pack provides the "A," "B" and "C" voltages required.



THE NEW ZENITH 6-VALVE RECEIVER

The receiver is here shown mounted on the console base, with all the accessories incorporated in the cabinet. The reproducers are in the two lower square compartments and the power-pack in the two smaller compartments at the ends of the receiver cabinet.

The receiver uses five UX-201-a type valves for the two high-frequency amplifier stages, the detector stage and for the first two low-frequency amplifier stages. The last low-frequency stage uses a power valve of the UX-171 type.

The ideal antenna for use with this receiver is an outdoor wire approximately 75 feet in length over all. A shorter antenna than this will produce excellent results, however, and an indoor antenna is all that is needed for local reception.

If a fine quality of reproduction is to be maintained, it is essential that a high quality reproducer be used. If the receiver is equipped with a Zenith console base, the question of reproducers is settled, because this console contains two reproducers. These are adjusted so that one reproduces the lower tones particularly well while the other reproduces the higher tones. Thus the two cover the entire musical range.

The sensitivity and selectivity of this receiver are excellent. During a test held in Chicago, and another in New York, a number of out-of-town stations were brought in while the local stations were going full blast.

For the man who wishes a radio receiver which his family can operate without any technical attention whatsoever, other than that of tuning in desired stations, and one which is fool-proof and absolutely safe even in the hands of a child, the Zenith receiver has much to recommend it—especially since these qualifications are coupled with fine quality of reproduction, good sensitivity and ample selectivity.

Maker: Zenith Radio Corp.

Brackets for the Sub-Panel Type of Receiver

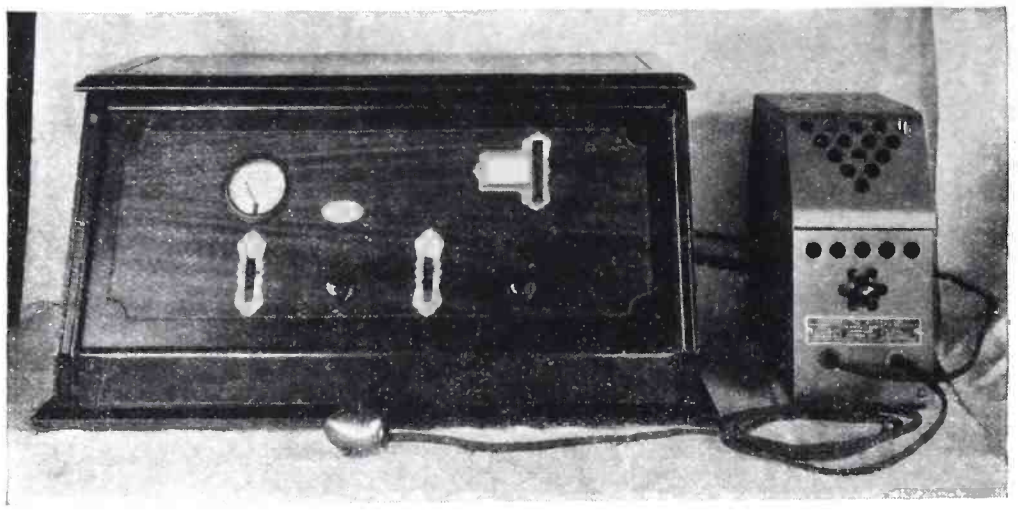
Name of instrument: Sub-panel bracket.

Description: The bracket pictured herewith is of heavy metal, 1/8 by 5/8 inch, and is heavily nickel plated. The over-all size of the bracket is 6 by 1 inch. Threaded holes are provided for attaching it to the front panel of the receiver and for attaching the sub-panel. These brackets are put up in sets of three, and when three are used to support the sub-panel they will provide excellent rigidity.

Usage: To be attached to the front panel of a receiver to furnish support for a sub-panel.

Outstanding features: Strong and durable. Drilled and tapped to accommodate mounting screws.

Maker: Karas Electric Co.



A Low-Priced, AC-Operated Receiver

Name of instrument: Crosley Model AC-7 receiver, equipped with the Crosley "ABC" power supply unit.

Usage: For radio broadcast reception.

Outstanding features: Requires no batteries. Low cost. Highly sensitive. Good selectivity. Neat appearance. Easy to tune.

Description: The AC-7 receiver is considerably more compact than the average 6-valve receiver. It is put up in an attractive cabinet that measures 21 inches in length by 12½ inches in depth by 11 inches in height. The cabinet is of mahogany, and is finished in a two-tone panel effect, with a gold pencil stripe between the panels and the darker border. All controls are mounted on the front panel of the receiver, which is also of mahogany. This panel slopes back from the base to permit clear vision and convenience of operation.

In addition to the AC-7, which is a table mounting model, there is also a console model which is known as the AC-7-C. This includes the same receiver as the AC-7 and also includes a built-in reproducer and space for the "ABC" power-pack. This description will be limited to the AC-7 model, inasmuch as the receiver units in the two models are identical.

Five of the vacuum valves used in the set are of the UX-199 type, with a UX-112 type valve for the last low-frequency amplifier stage. The receiver includes two stages of tuned-high-frequency amplification, a vacuum valve detector and three stages of transformer-coupled, low-frequency amplification. The input circuits are tuned by means of three variable condensers, which are mechanically coupled together to operate with a single control.

A metal sub-base serves as a foundation upon which the receiver is built up. It also serves the additional function of a shield. This sub-base is constructed like a box, open at the bottom, but with metal partitions separating the three high-frequency coupling coils, so that each is about three-quarters shielded from the others. All instruments except the milliammeter are securely mounted on this strong metal foundation. This practically precludes the possibility of connections working loose during shipment. It also aids materially in keeping the three variable condensers in alignment; although slight misalignment here would not be of extreme importance because of the flexible mechanical coupling between the condensers.

The circuit makes use of a special balancing scheme which provides great stability in the high-frequency circuits. Each receiver is balanced before leaving the factory and in this respect requires no attention whatsoever from either the dealer or the purchaser. This stability makes it possible to include regeneration in one of the circuits, with the result that the total high-frequency amplification is very high. The regeneration is under complete control of the operator at all times and can be increased or decreased at will by means of a small knob on the front panel. This is the famous Crosley "crescendon" feature.

The receiver is designed for use with the Crosley "ABC" power-pack. This design involves a special wiring of the valve filament circuits, *i. e.*, the filaments of the five UX-199 type valves are wired in series instead of the usual parallel method.

The "ABC" power-pack is not built into the receiver, but is a separate unit and is considerably smaller in size than the average storage battery. It supplies all voltages for the operation of the receiver. It consists of a transformer, a Raytheon-type BH rectifier valve, a suitable filter and the necessary resistances to provide the proper voltage distribution as required by this receiver. The 110-volt, 60-cycle, house-lighting supply provides the source of power for this unit, and the running cost amounts to only a few cents a week.

The power-pack is equipped with the necessary wires for connection to the receiver and to the AC supply line. There is also a switch on an extension cord, by means of which the current is turned "on" and "off." The entire power-pack is inclosed in a perforated metal case of neat appearance.

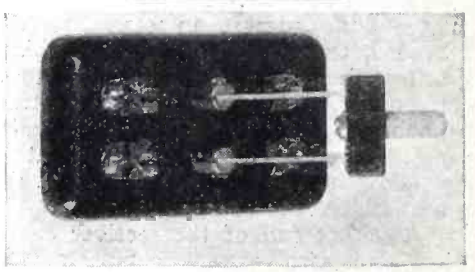
The tuning of the receiver is accomplished by means of a single control in the form of a knurled disc, the edge of which projects through a vertical slot in the front panel of the receiver. To this disc is attached a drum-type indicator scale that is calibrated in degrees. Two small auxiliary controls are provided. These are balancing controls rather than tuning controls and their function is to bring the three tuned circuits into resonance. Once this has been accomplished by tuning in a station and setting these two controls to provide maximum signal strength, then all other stations may be tuned in without further attention to these auxiliary controls. This applies to reception from local stations generally. In the case of extremely distant stations which require critical tuning, it may be necessary to resort again to the use of the auxiliary controls, but for average use this receiver will be found to function as a single-control set.

The meter on the panel enables the operator to maintain the right operating current at all times. The scale of this meter is calibrated in milliamperes with a section indicated in red. The pointer of the meter must be kept over this red marker for proper filament current supply and when so maintained there can be no damage to the valves from overloading the filaments.

The "crescendon" control mentioned before is found at the lower right-hand corner of the front panel. As this is turned to the right the sensitivity and selectivity of the receiver will be found to increase considerably.

An antenna for use with this receiver may be anywhere from 30 feet up in length. In locations where interference conditions are severe, the use of an antenna of around 30 feet in length will provide freedom from interference and the sensitivity of the receiver is such that an antenna of this length will give good all-around results. In out-of-town locations a longer antenna may be used.

In addition to its other good features, this receiver offers a particular appeal because of its low price. The receiver and "ABC" power-pack together sell for less than many of the standard receivers alone, and the upkeep cost of this receiver is almost negligible as compared with many of the battery-operated receivers.



A Quick Changeover Switch

Name of instrument: Pole switch.

Description: The switch is mounted on a black composition base that measures 1¼ by 2¼ inches. The switch arms and contacts are neatly arranged. The contacts are made of stiff spring material and the arms are sufficiently heavy to insure ample rigidity and to maintain proper alignments. The arms and contacts are anchored to the composition base by means of screws which extend about ⅜ inch beyond the bottom of the base. This permits the mounting of the switch on a panel, if desired, with the connections from the switch made to the screws that extend through the panel.

Usage: For use at any place where a knife switch is needed.

Outstanding features: Compact. Neat. Good contacts.

Maker: Frank W. Morse Co.

A Direct-Current Storage Battery Charger

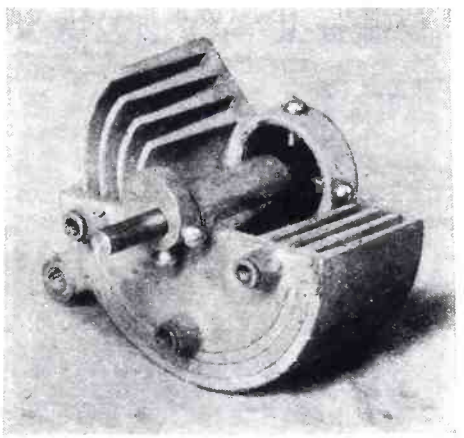
Name of instrument: Vitrohm trickle charger.

Description: This charger consists of a "Vitrohm" resistance unit which is inclosed in a cylindrical metal case. This case is perforated to allow free circulation of air while the charger is in service, at which time it gives off considerable heat. The mounting feet hold the instrument well off the table or floor for this same reason. A meter is included in one end of the case to indicate when the charger is functioning, and also to indicate the polarity of the connections. Two binding-post terminals are mounted on the sides of the case for connection to the terminals of the battery under charge, and the charger is equipped with a 6-foot extension cord and plug for connection to the 110-volt, *direct-current* lighting lines. This unit may be used to trickle charge batteries from 2 to 80 volts, and the charging rate varies from .3 ampere to .1 ampere, depending on the voltage of the battery. A standard 6-volt storage battery will be charged at the rate of approximately .3 ampere per hour.

Usage: For charging storage batteries from the DC house-lighting lines.

Outstanding features: Well insulated. Reliable and long-life resistance unit. Well ventilated. Equipped with an indicating meter.

Maker: Ward Leonard Electric Co.



A Variable Capacity Unit That Is Highly Efficient

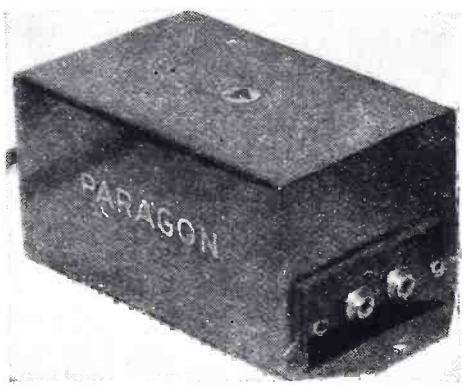
Name of instrument: Variable condenser.

Description: This unit is of entirely different construction from that of the usual types of variable condensers, as shown in the illustration herewith. Instead of the plane of the plates being at right angles to the length of the shaft, it is parallel to the length of the shaft. The rotor and the stator sections are each molded in a single piece. This is sure to guarantee uniformity. The rotor section is insulated from the stator section and from the shaft itself. The design is such that the insulating material used is extremely small. The single bearing is over an inch in length and presents no opportunity for working loose or becoming wobbly. Contact with the rotor section is obtained through a phosphor-bronze spring which presses firmly against the end cap of the rotor unit.

Usage: As a variable capacity unit for use in any tuned circuits, or for any other purpose that is served by a standard variable condenser.

Outstanding features: Low minimum capacity. Minimum high-frequency resistance. Low dielectric losses. Shaft grounded to stator unit and rotor entirely isolated.

Maker: Unitrol Condenser Corp.



A Unit to Protect Your Reproducer

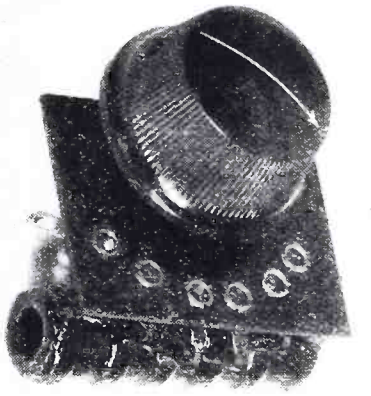
Name of instrument: Output filter.

Description: This unit consists of an impedance coil and a high-voltage, high-capacity fixed condenser. These are assembled in a metal box which is then filled with wax. An extension cord is provided, one end of which is connected inside of the filter unit; the other end is equipped with phone tips for connection to the output of the receiver. The output terminals of the filter are in the form of phone-tip jacks and are mounted on a composition strip at one end of the filter case. The case is finished in grey and is provided with drilled flanges at the bottom, for use in mounting the instrument.

Usage: To be connected between the output of any receiver which uses a power valve in the last low-frequency stage, and the reproducer. The purpose of the filter is to separate the direct current from the alternating current in the output of the receiver, and to permit only the alternating-current component to pass through the windings of the reproducer. The direct current, which serves no useful purpose in the reproducer, passes through the impedance coil in the filter unit and back to the receiver. The advantage of this arrangement is apparent when it is remembered that with power valves in the last low-frequency stage, the current flowing in the plate circuit may run as high as 30 milliamperes, and is sufficient in some cases to burn out the reproducer windings.

Outstanding features: Compact and rugged. Protects the reproducer windings. Often improves the quality of reproduction because it removes unnecessary strain from the reproducer unit and matches up the output impedance of the power valve and the reproducer impedance.

Maker: Paragon Electric Corp.



A Variable Detector Voltage from "B" Power-Packs

Name of instrument: Tapped resistor with tap-switch.

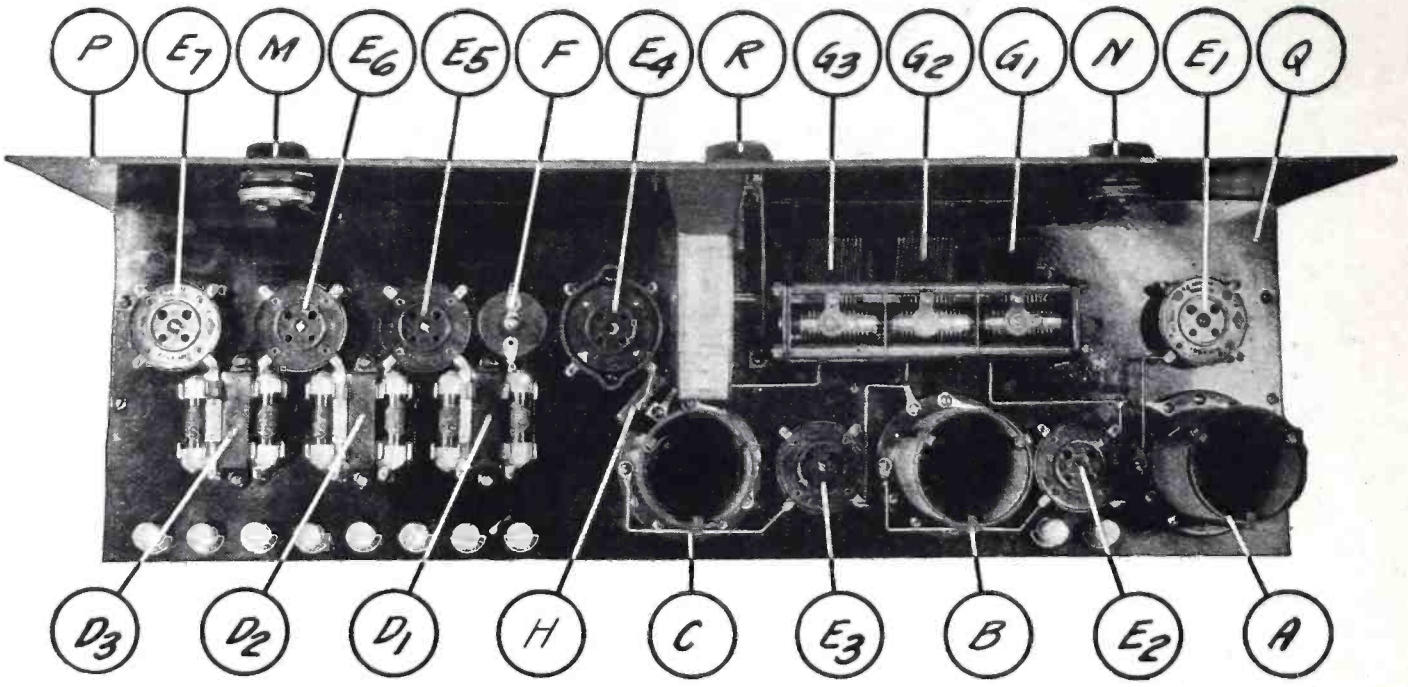
Description: This resistor consists of a "Kroblack" unit with a total resistance of approximately 30,000 ohms, and is tapped to provide suitable variations in resistance. These taps are brought out to rivet-studs on a small composition panel, on which is also mounted a switch to make contact with any desired stud.

Usage: Wherever a tapped resistance of 30,000 ohms is required. Especially intended for use in the output circuit of a "B" power-pack, in series with a fixed resistance, to provide variable voltage for the detector plate supply.

Outstanding features: Small in size. Adequate current-carrying capacity for the use specified. Good contact. Reliable resistance units.

Maker: C. E. Mountford.

The set builder who is looking for simplicity in construction and operation, along with high quality reception, will find this receiver an exceptional value—at a very low price.



THE RECEIVER AS IT LOOKS FROM ABOVE

FIGURE 1: *The mechanical layout of this receiver is extremely simple and logical. At the right of the single-control drum dial is the high-frequency amplifier section of the receiver, and at the left of the drum are arranged the detector and the three stages of resistance-coupled, low-frequency amplification. Note the simplicity of the above panel wiring connections.*

HOW TO BUILD

THE AERO 7 RECEIVER

Here is an exceptionally satisfactory receiver that embodies the principle of high-mu amplification in both the high-frequency and the low-frequency amplifiers. Although actual single control is employed, the tuning of the receiver is very sharp, and resistance-coupled stages in the low-frequency amplifier give reproduction of excellent quality.

By ZEH BOUCK

COST OF PARTS: *Not over $60.00*

HERE IS A LIST OF PARTS NECESSARY FOR BUILDING THIS RECEIVER—

A, B and C—Aero tuned, high-frequency kit of 3 coils, Code U-12;
D1, D2 and D3—Amsco resistance-coupled amplifier, "Aero Seven" kit;
E1, E2, E3, E5, E6 and E7—Amsco plain sockets;
E4—Amsco floating socket;
F—Aero choke coil, No. 60;
G1, G2 and G3—Amsco triple variable condenser, each section .0005 mfd.;
H—Carter .00025 mfd. fixed condenser;
I and J—Carter .5 mfd. by-pass condenser;
K—Carter resistor, type H-1000;
L—Amsco grid gate, 5 megohms;
M—Carter "Imp" rheostat, 6 ohms;
N—Carter "Imp" potentiometer, 200 ohms;
O—Carter filament resistor, type H-1;
P—Aero front panel, drilled and engraved;
Q—Aero sub-panel, drilled;
R—Silver-Marshall drum dial, complete;
S—Carter battery switch;
T—Amsco grid gate mounting;
U1, U2, U3, U4, U5, U6, U7, U8, U9 and U10—XL binding posts;
V1 and V2—Aero sub-panel brackets;
W—Carter .001 mfd. fixed condenser;
Bus wire, solder, screws, etc.

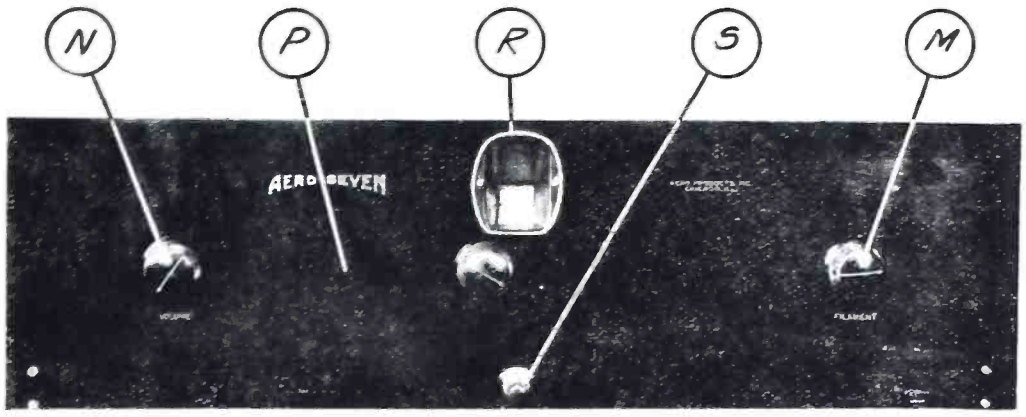
THERE are many prospective set builders who have heard their neighbors' home-built receiving sets and marveled at the excellence of the tone quality that they are able to get, as well as the simple operation and the beautiful appearance of some of these sets. However, quite a number of these would-be builders refrain from building their own sets because they believe it is beyond their comprehension, and too complicated an affair for them to make.

This receiver, in spite of the fact that it utilizes seven valves, which give it

great sensitivity and volume, is exceptionally well suited for the home set builder who is a novice, but who wants to get the most for his money. The receiver may be built with absolutely no previous knowledge of radio and without other directions than those following in this article.

The first three valves of the receiver are high-frequency amplifiers, and are coupled to three tuned circuits. The input circuit in untuned, using a fixed resistance to furnish the necessary voltage drop across the filament-grid circuit. The detector valve, as well as each of the first three valves, is a high-mu valve, and it is coupled to the input circuit of three stages of efficient resistance-coupled, low-frequency amplification, using a UX-171 type valve in the last stage, either a UX-112 type of valve or a UX-201-a type of valve in the second stage, and either a UX-240 or a UX-201-a type of valve in the first stage. The controls on the panel consist of a single knob for tuning, a potentiometer knob for stabilizing, and a series resistance knob for controlling the amount of amplification obtained in the three high-frequency valves.

The set, as tested out in the POPULAR RADIO Laboratory and in various other parts of New York and Chicago, proved to be adequately selective for tuning through the locals and bringing in distant stations with plenty of volume and without interference. The set is exceptionally easy to wire and



THE FRONT PANEL OF THE RECEIVER

FIGURE 2: *In the center is the drum dial, R; below it and slightly to the left is the knob that controls it. At the bottom of the panel, at S, is the filament switch. The controls, M and N, are for the regulation of the volume and filament current. The panel may be bought already drilled and engraved, thus saving the builder much uninteresting work.*

construct, and will repay anyone for his trouble, whether he be an experienced set builder or a novice.

How to Construct the Receiver

The front panel and the sub-panel are furnished cut to size and completely drilled; thus the most uninteresting work of receiver construction is eliminated. Holes are also provided for everything, and it is only necessary for the constructor to place the individual instruments in the positions shown in Figures 1, 4, 5 and 7. The mounting holes in the panels correspond exactly with the mounting holes in the instruments themselves.

Some of the mounting screws serve the dual purpose of attaching two instruments at once, one on the top of the sub-panel and the other beneath the panel. All such screws are indicated in the picture wiring diagrams, Figures 4 and 5, by a number that is prefixed by the letter X. In Figure 4, for instance, the mounting screw for the valve socket E1 is marked X1. Reference to Figure 5 shows that the resistance unit K is mounted on the under side of the sub-panel by means of this same screw.

A start can be made by mounting the few parts that belong on the front panel. These consist of the rheostat M, the potentiometer N, the switch S and

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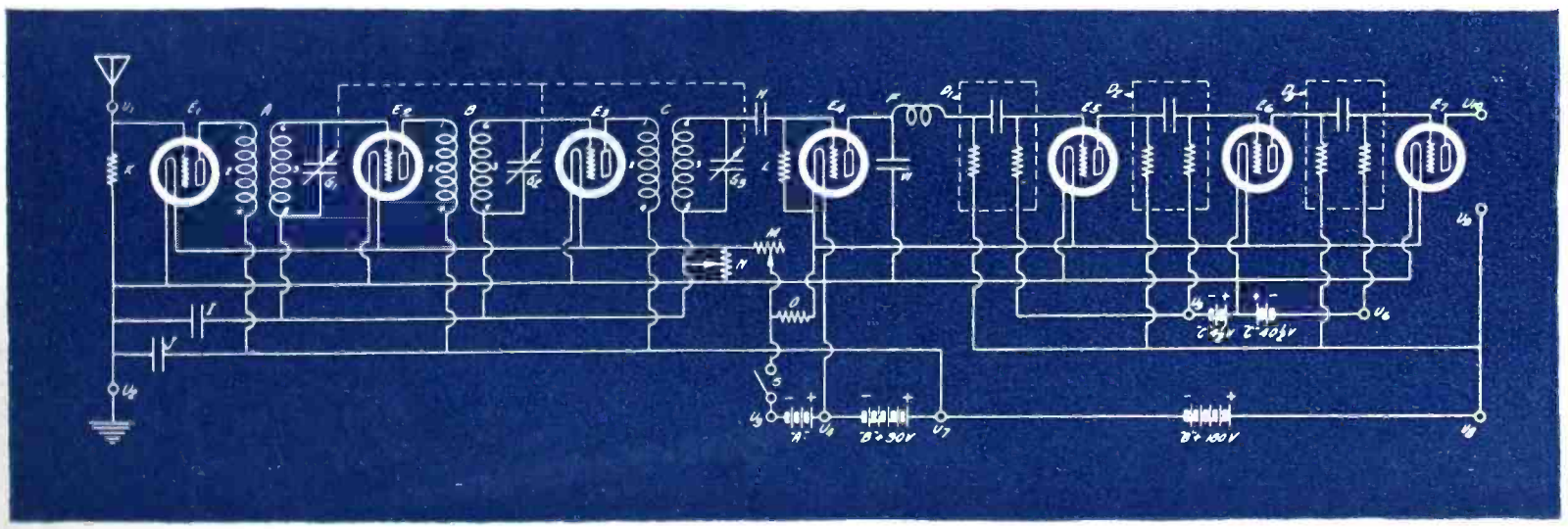
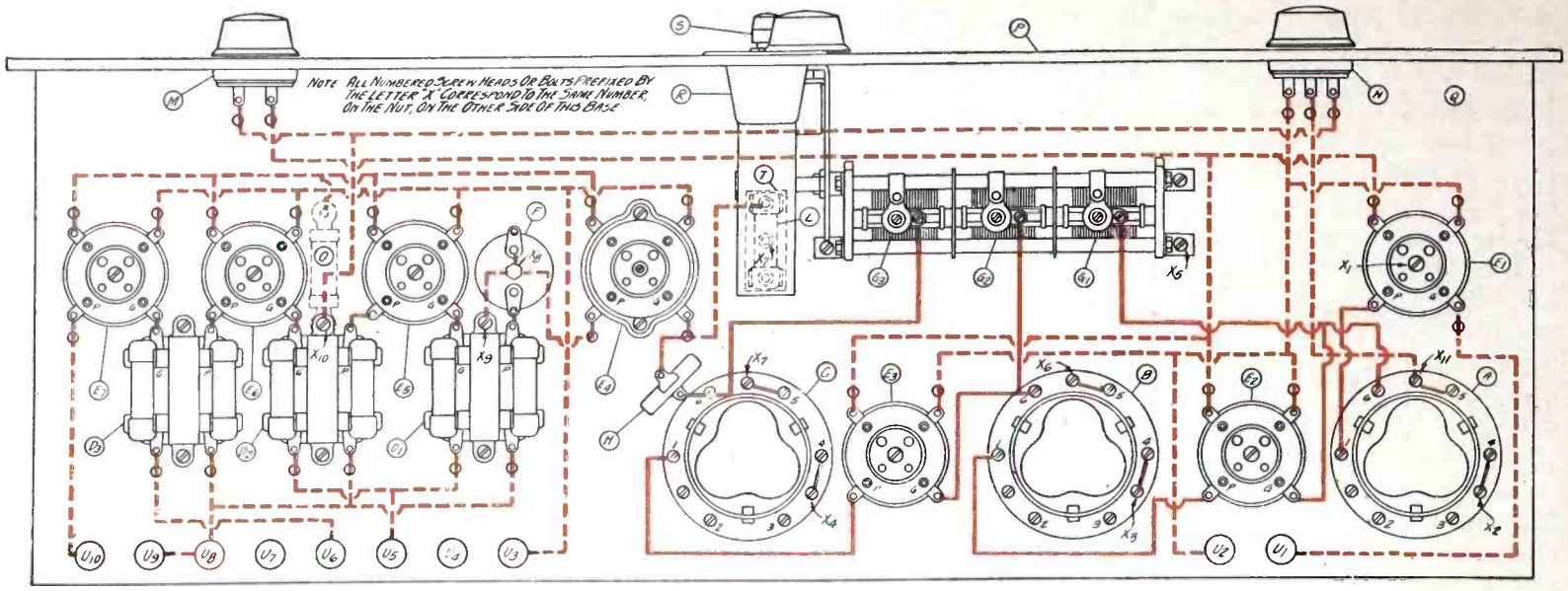
¶ *The list of parts given on page 140 includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE SCHEMATIC DIAGRAM OF THE CIRCUIT EMPLOYED

FIGURE 3: *In this theoretical hook-up of the receiver, notice that the antenna circuit, at the extreme left, is untuned, and that the three following stages of high-frequency amplification are tuned by a triple condenser, indicated by the dotted lines connecting the condensers, G1, G2 and G3. The low-frequency amplifier is at the right.*



THE PICTURE WIRING DIAGRAM OF THE CONNECTIONS ABOVE THE SUB-PANEL

FIGURE 4: *The instruments are outlined in* BLACK. *The solid* RED *lines indicate the wiring connections to be made above the sub-panel. The dotted* RED *lines indicate wires that have terminals or connections on the upper side of the sub-panel, but that run underneath the sub-panel.*

the tuning control and plate R. Figure 2 shows the arrangement of these instruments. The front panel may then be set aside while the instruments are mounted on the sub-panel.

The brackets V1 and V2 should be mounted first, on the under side of the sub-panel. This will serve to keep the sub-panel up off the work bench and protect the instruments which are later mounted on the under side of this panel. Then proceed with the mounting of the other instruments. It is wise to mount all of the small instruments first, because if the coils and the gang condenser are mounted first there is the possibility that they may be damaged from excessive handling as a result of a tool slipping.

As may be seen in Figure 7, the soldering lugs are fastened under some of the nuts on the under side of the panel. Time will be saved if these lugs are attached while the instruments are being mounted.

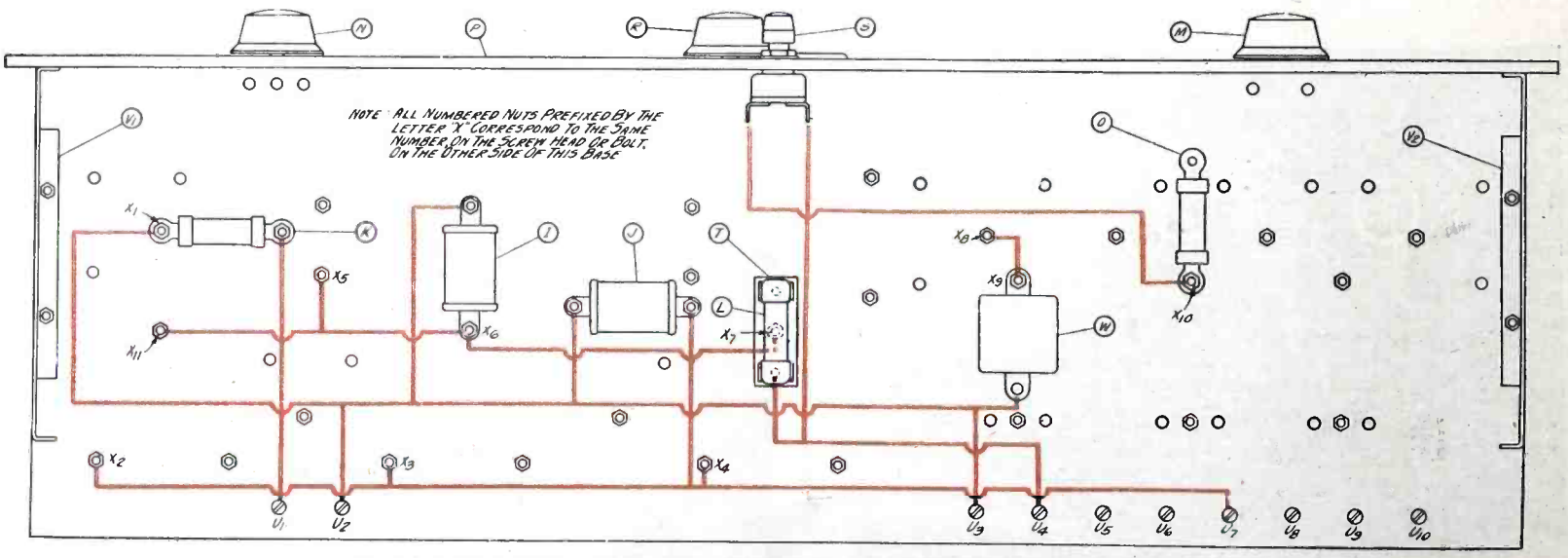
How to Wire the Receiver

When all of the parts have been mounted on the front panel and on the sub-panel, the wiring may be started. Much of the wiring can be completed before the front panel is attached to the sub-panel and it is recommended that this course be followed because the manipulation of the soldering iron can proceed unhampered.

All of the connections shown in the picture wiring diagram of the under side of the panel, Figure 5, may be made first, with the exception of the two wires which connect to the switch S. These two connections are left until after the front panel has been attached. Then the wiring shown by solid lines in the picture wiring diagram of the top of the sub-panel, Figure 4, can proceed.

The wiring that is shown by broken lines in Figure 4 represents wires that have one or more terminals above the panel, but which are carried down through holes in the sub-panel to run along underneath for the sake of concealment. This method improves the appearance of the receiver when viewed from above.

It will be noted that in a number of cases connections are made without the use of wire. The grid and plate terminals of the resistance coupling units D1 and D2, for instance, are connected direct to the corresponding terminals



THE PICTURE WIRING DIAGRAM OF THE PARTS MOUNTED UNDER THE SUB-PANEL

FIGURE 5: *The instruments are outlined in* BLACK. *The heavy* RED *lines indicate wires that are run entirely on the bottom side of the panel. The lettering on some of the mounting screws corresponds with lettering in Figure 4, and indicates screws that serve a purpose on both sides of the panel.*

of the valve sockets and the choke coil F, by means of their soldering lugs.

All of these "wireless" connections can be made at the same time as the other solid, above panel connections. Following this, the connections shown by the dotted lines should be made, with the exception of those that connect to instruments on the front panel.

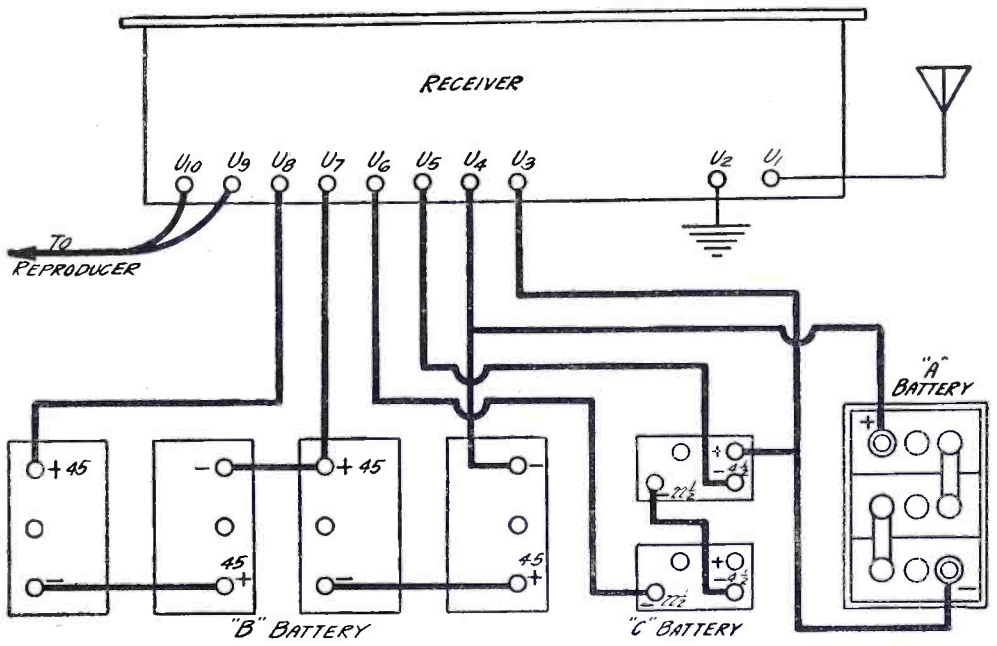
With the wiring completed to this point, the front panel may be attached to the sub-panel. This is accomplished by means of four bolts inserted through the front panel and the corresponding holes in the brackets V1 and V2. The drum control is attached and adjusted at this time to make sure that this tuning control equipment is all functioning properly.

The instruments on the front panel can now be wired; this completes the construction of the receiver.

How to Install the Receiver

The detailed connections for the antenna, ground, batteries and reproducer are shown in Figure 6. These are the connections for use when a CX-171 or a UX-171 type valve is to be used in the last low-frequency stage (valve socket E7). The use of this type of power valve is recommended because valves of the UX-201-a or UX-112 type are not capable of handling the power produced by this receiver when turned up "full."

Before inserting the valves in their sockets be sure that the switch S is turned to the "off" position and that the rheostat M is also "off." These precautions should also always be followed in removing one or more valves from this receiver, as the removal of one valve results in increased voltage being applied to the filaments of the other valves, all of which draw their filament current through the same resistance or rheostat.



HOW TO HOOK UP THE RECEIVER

FIGURE 6: *This figure shows the proper connections to be made to the "A," "B" and "C" batteries. The first two binding posts, U1 and U2, connect with the antenna and ground, while the last two, U9 and U10, are for the reproducer cord.*

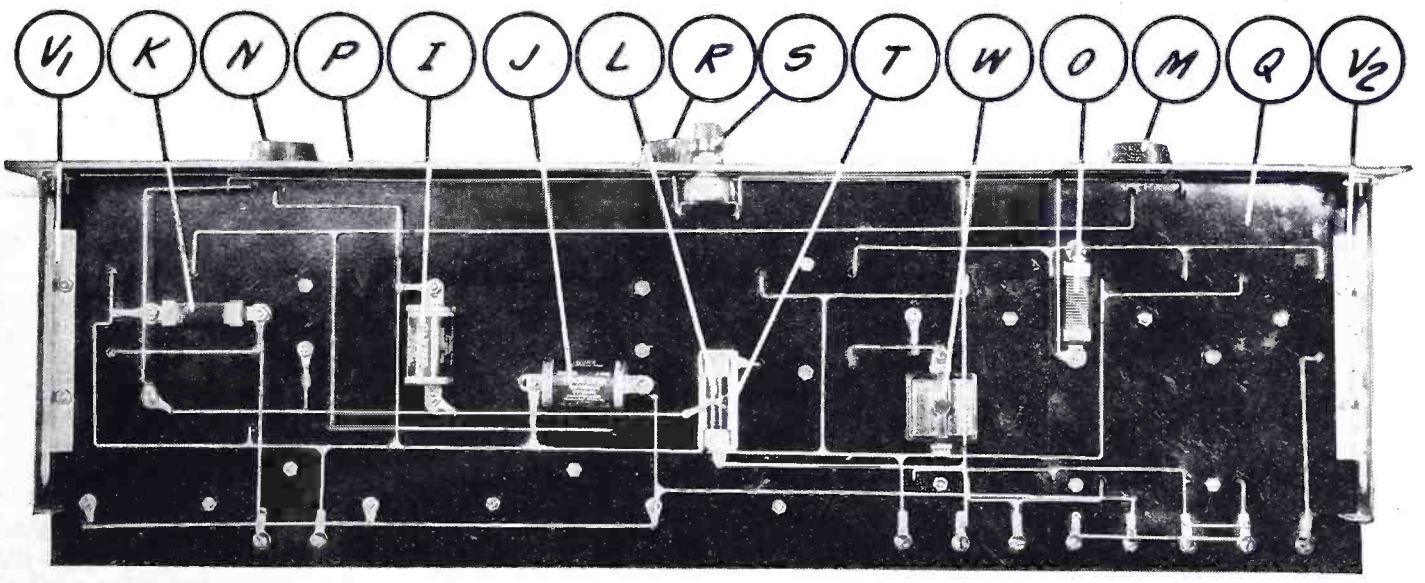
High mu valves such as the CX-340 or the UX-240 should be inserted in the sockets E1, E2, E3 and E4. In socket E5 either a UX-240 type valve or one of the UX-201-a type may be used. The former will provide somewhat greater volume but the latter is somewhat more satisfactory in general. Either a UX-201-a type valve or a UX-112 type is used in E6 and in E7 a power valve of the CX-171 or UX-171 type is required.

How to Operate the Receiver

There are no tricky neutralizing or balancing adjustments to be made in the high-frequency circuits of this receiver. When the batteries, antenna, ground and reproducer have been connected up and the valves inserted in their sockets the receiver is "ready to go." With the control knob of the rheostat M turned half way "on" the switch may be turned "on." All of the valves should now light up. The tuning control knob should next be turned slowly until the signals from a broadcasting station are heard and the station tuned in loudest by careful adjustment of this tuning control and of the knob that controls the potentiometer N. The rheostat can then be adjusted to a point where the reception is loudest. This should not be higher than three quarters of a turn in a clockwise direction.

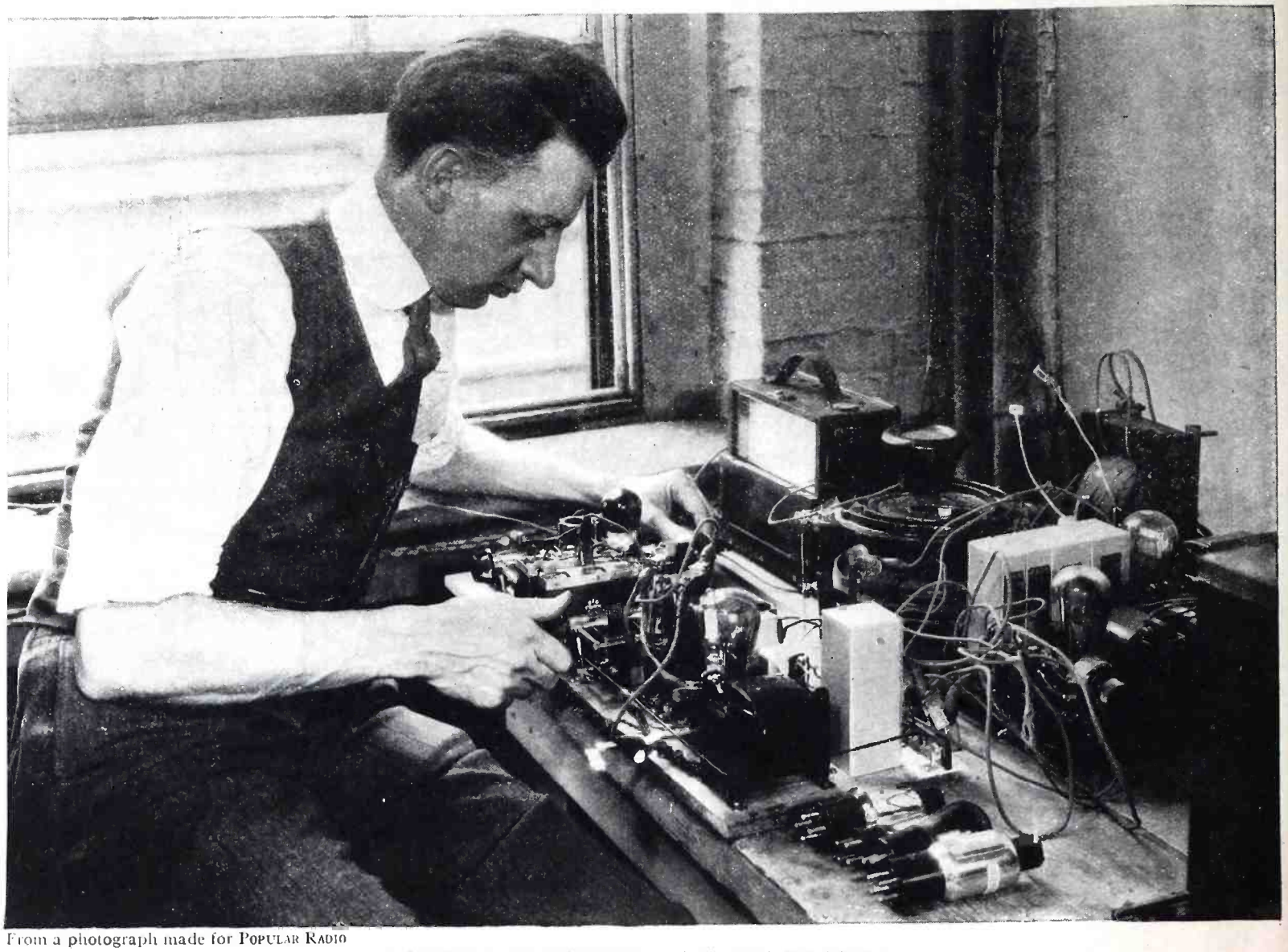
For reception from local stations the potentiometer can be adjusted to one position and left that way indefinitely.

Even in the case of long distance reception the operation is almost as simple, as this involves only the additional adjustment of the control N. The tone quality obtained should please the most critical ear.



A VIEW OF THE SET FROM BELOW

FIGURE 7: *Some of the screws used for mounting instruments on the top of the sub-panel hold soldering lugs underneath. These are clearly shown in this view of the receiver.*



From a photograph made for POPULAR RADIO

A HIGHLY SUCCESSFUL AC VALVE RECEIVER

FIGURE 1: *This set was developed in the* POPULAR RADIO LABORATORY *by Mr. Albert G. Craig. It is equipped throughout with AC valves and operates entirely from the lighting lines. Its output with AC valves is greater than with the use of standard battery valves.*

PRACTICAL HINTS FOR OPERATING

The New AC Valves

POPULAR RADIO was the first magazine to introduce to the radio public the AC valves and the AC operation of radio sets in general. It is peculiarly fitting, therefore, that it should now conduct, in co-operation with leading manufacturers, a series of experiments and tests of all devices that are suitable for operation with AC valves and of devices designed to operate standard valves from the house lighting lines. The Technical Staff of POPULAR RADIO believes that the advance information obtained in this research work is of such widespread importance to the radio experimenter and to the professional set builder that it is releasing it in installments—of which this is the first.

By ALBERT G. CRAIG

SOME of our readers may remember the June, 1925, issue of POPULAR RADIO, in which was described, for the first time, a radio receiver that employed AC valves that worked entirely from the lighting lines without batteries.

This receiver created a great deal of general interest. Some of the radio experimenters who did not try it rather scoffed at the idea of an AC tube. It was "too far ahead of the times," they said. To them it might be of special interest to learn here that the original receiver from which the description in POPULAR RADIO was made is still in good working condition and is giving satisfactory service with the same valves with which it was first equipped.

Now a number of manufacturers are making vacuum valves of this general type. Set builders in general, therefore, will be interested in the two AC-operated outfits that are described in this article.

To begin with, there are two types of AC tubes; both of them have a regular grid and plate design similar to that found in standard storage-battery valves.

One of these types, known as the "raw AC" type, has an oxide-coated filament and is operated with a potentiometer connected across the filament, with the center point connected to the grid return.

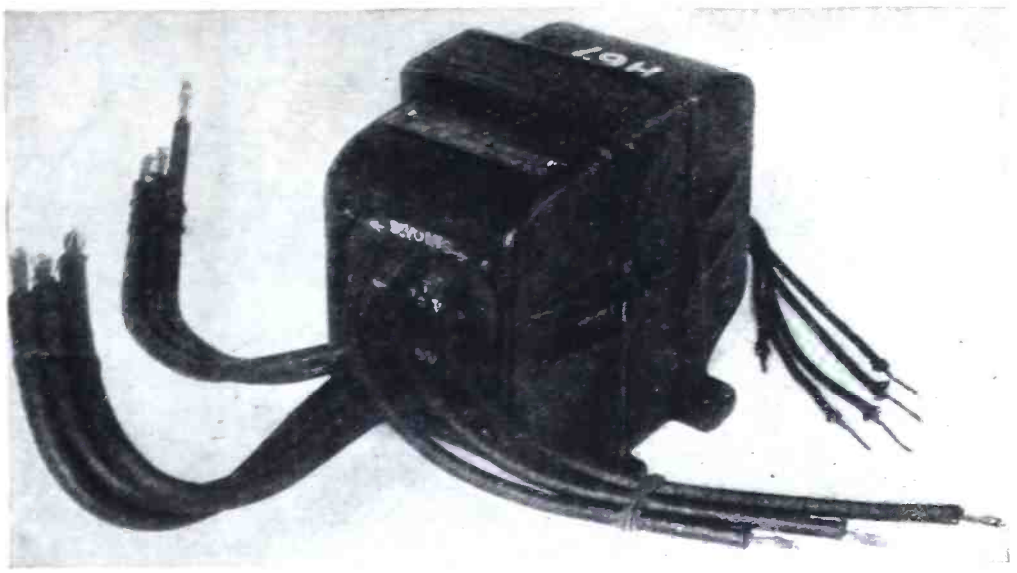
This type of valve is suitable for high-frequency amplification and (in some cases) for the first stage of low-frequency amplification. It is not generally used as a detector.

Under this general type of valve fall the new Radiotron UX-226 type valve (which is exactly similar to the CX-326), the Van Horne AC valve, the Armor valve and a few others.

The second type of AC valve, of which the McCullough valve was the pioneer on the market, includes such valves as the McCullough, the UX-227 (which is exactly similar to the CX-327), the Sovereign AC valve and others.

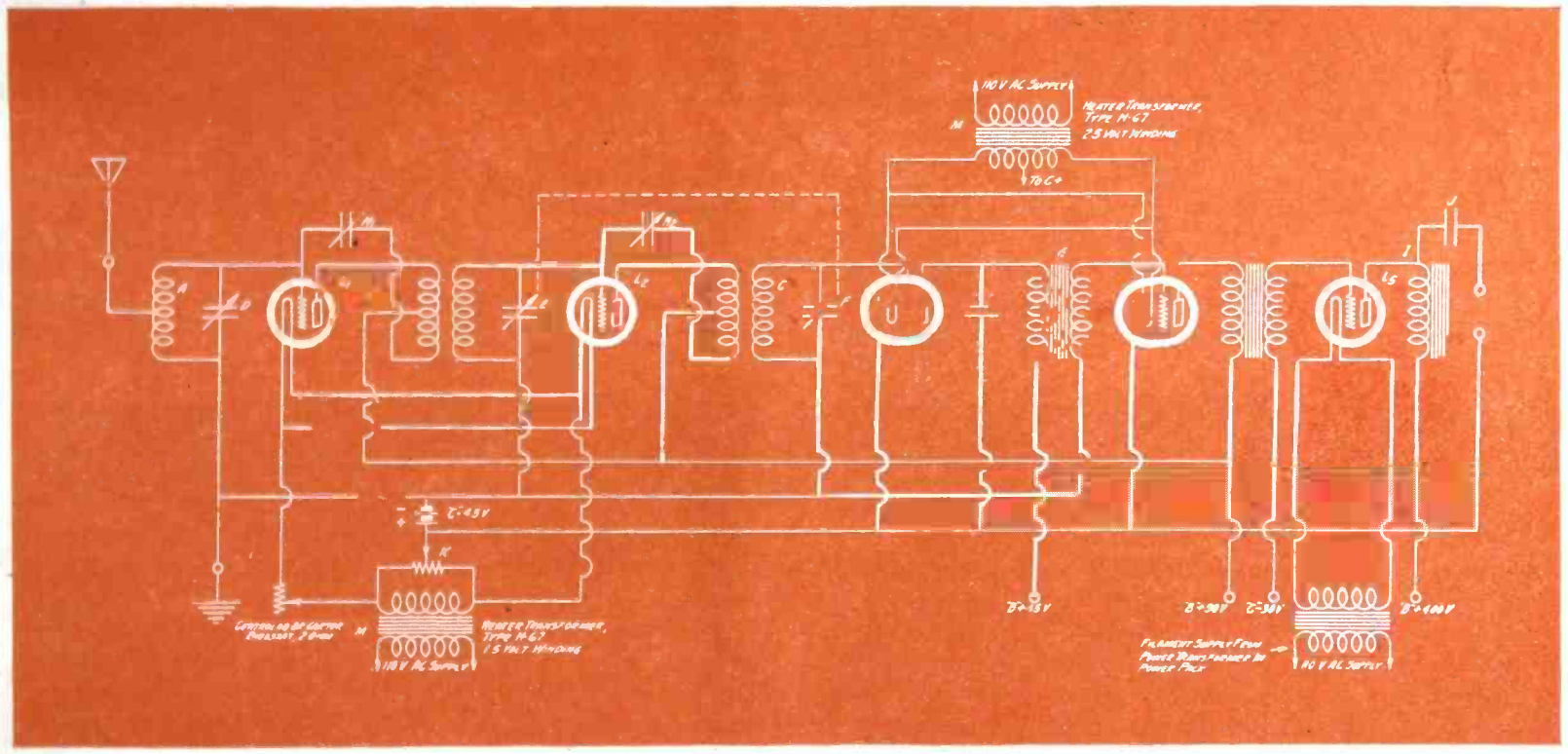
This latter type of valve contains a "heater" that is independent of the "cathode," which corresponds to the "filament" in a storage-battery valve. In this latter type, the hum, when used as a detector or as a first-stage low-frequency amplifier, is greatly reduced, if not entirely eliminated.

The first experimental set-up utilizes two of the "raw AC" types of valves and two of the "isolated cathode" type of valves, as well as a UX-210 type of



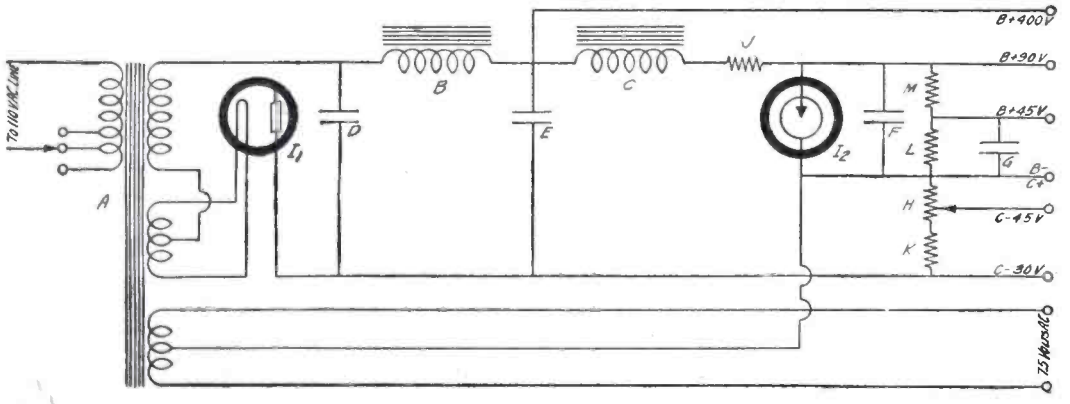
A FILAMENT LIGHTING TRANSFORMER

FIGURE 2: *The new H-67 type of heater transformer, shown above, steps down current from the lighting lines for operating the filaments or heaters of any type of AC valve. Each of the three sets of wires at the front end of the unit consists of two filament wires and a center tap.*



THE SCHEMATIC DIAGRAM OF AN AC CIRCUIT

FIGURE 3: *Above is the circuit employed in the set shown in Figure 6. Although the transformer, M, occurs twice in the diagram, a single transformer with two secondary windings is used.*



THE WIRING SCHEME OF A POWER-PACK FOR AC SETS

FIGURE 4: *At the right is shown the wiring scheme for the power-pack illustrated in Figure 5, that is used to supply energy to the receiver shown in Figure 6.*

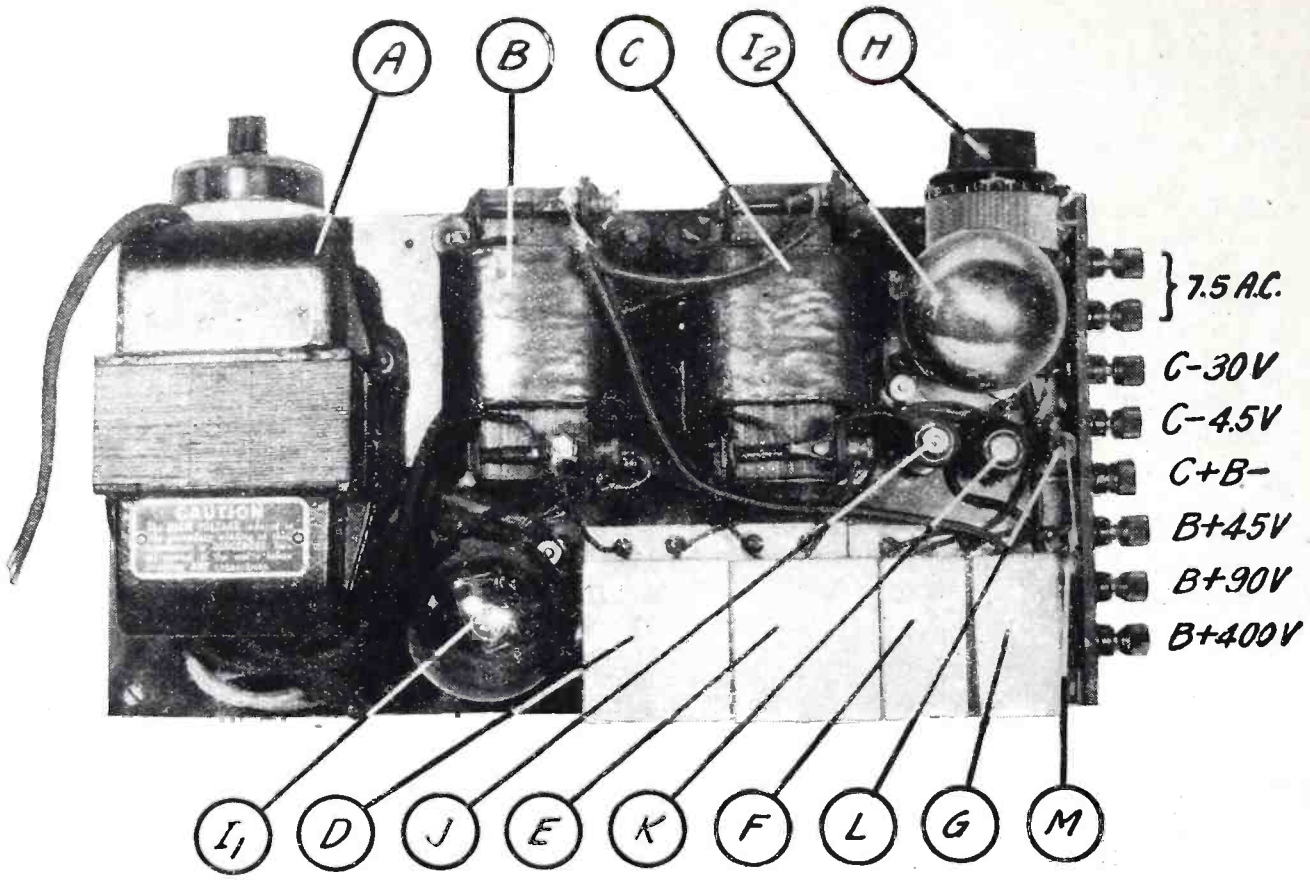


FIGURE 5: HERE IS A LIST OF PARTS FOR THE CONSTRUCTION OF THE AMERTRAN POWER-PACK—

A—AmerTran power transformer, type PF-52;
B and C—AmerChokes, type 854;
D—Aerovox filter condenser, 2 mfds. for 600 volts DC;
E—Aerovox filter condenser, 4 mfds. for 400 volts DC;
F and G—Aerovox filter condensers, 2 mfds. for 400 volts DC;
H—Frost variable resistance, 400 ohms;
I1 and I2—Benjamin Cle-Ra-Tone vibrationless sockets;
J—Ward-Leonard vitrohm resistance, 12,000 ohms;
K—Ward-Leonard vitrohm resistance, 300 ohms;
L—Allen-Bradley fixed resistance, 7,500 ohms;
M—Allen-Bradley fixed resistance, 12,000 ohms;
1 bakelite binding-post strip, 7 by 1 by 3/16 inch;
1 composition baseboard, 13½ by 7 by ¼ inch;
1 UX-216-b rectifier valve;
1 UX-874 voltage-regulator valve;
2 angle brass brackets, ⅝ by ⅝ by 1/16 by 13½ inches;
8 Eby binding posts;
Wire, screws, etc.

valve, the filament of which is operated on alternating current.

In Figures 1 and 6 is shown a successful set-up experimented with in the POPULAR RADIO LABORATORY.

The parts and instruments are designated with letters that correspond with the list of parts used in the experiment.

The schematic wiring diagram, that gives the correct circuit for this set-up, is given in Figure 3. In Figures 4 and 5 is shown the power-pack that operates this receiver.

The lettering in Figure 3 corresponds with the lettering in Figure 6 and the list of parts below it, so that the experienced radio fan will be able to duplicate it and get the same results. Such a set-up may be built according to the set builder's fancy into a cabinet or console. The parts should be arranged in a similar manner to that shown in Figure 6 for the best results.

This set gives more volume and better quality with AC-valve operation than is possible with the use of storage-battery valves. It operates entirely on the alternating-current lighting lines, and when once properly adjusted it should function for years without any extra expense, except for the small charge for power taken off the line.

There are no storage batteries to charge or run down.

Another type of AC set that has worked out favorably in experiments in the POPULAR RADIO LABORATORY is shown in Figures 8 and 9.

All the parts used in the "ABC" power-pack shown there are also designated by letters that correspond to the accompanying list of parts and to the schematic wiring diagram that is given in Figure 7. This unit relies upon a high-current rectifier valve similar to that made by the Q. R. S. Music Company. This type of valve will rectify enough energy to light the filaments of storage-battery valves, connected in series, as well as supply "B" and "C" potentials for necessary operation.

The set with which this scheme is to be used must have the filaments wired in series accordingly. The general scheme of series winding for filaments may be understood by studying the diagrams on page 526 of the June number of POPULAR RADIO.

Any four-, five- or six-valve sets may be operated on this principle, and any similar receiver may be converted to this method of operation easily by changing the filament wiring to accomplish this purpose.

This method of AC set operation has been found entirely satisfactory throughout extended use in the Laboratory, and may be built into an old set or into a new one. It is not difficult

The lists of parts given in this article include the exact instruments used in the apparatus from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by POPULAR RADIO *and which may be used with good results. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

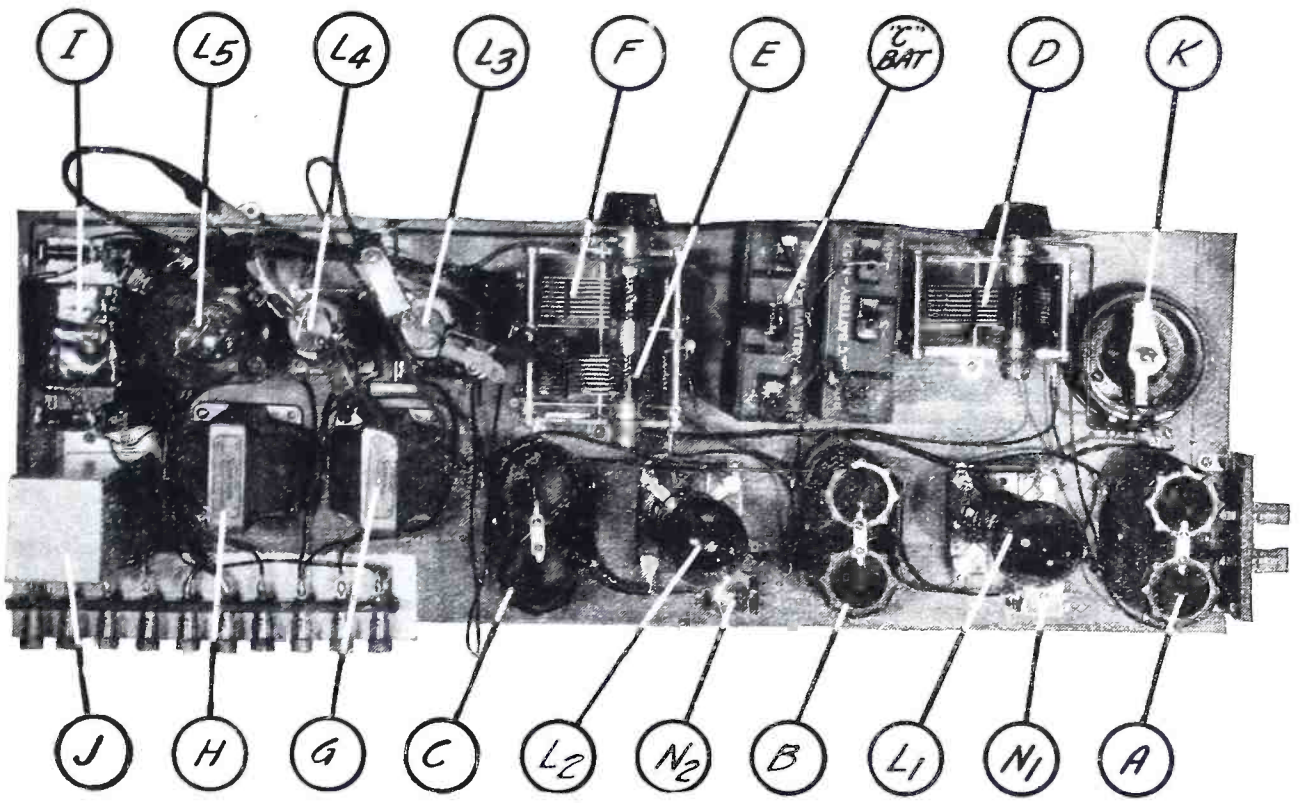


FIGURE 6: HERE IS A LIST OF PARTS NEEDED FOR THIS BATTERYLESS SET THAT USES AC TUBES—

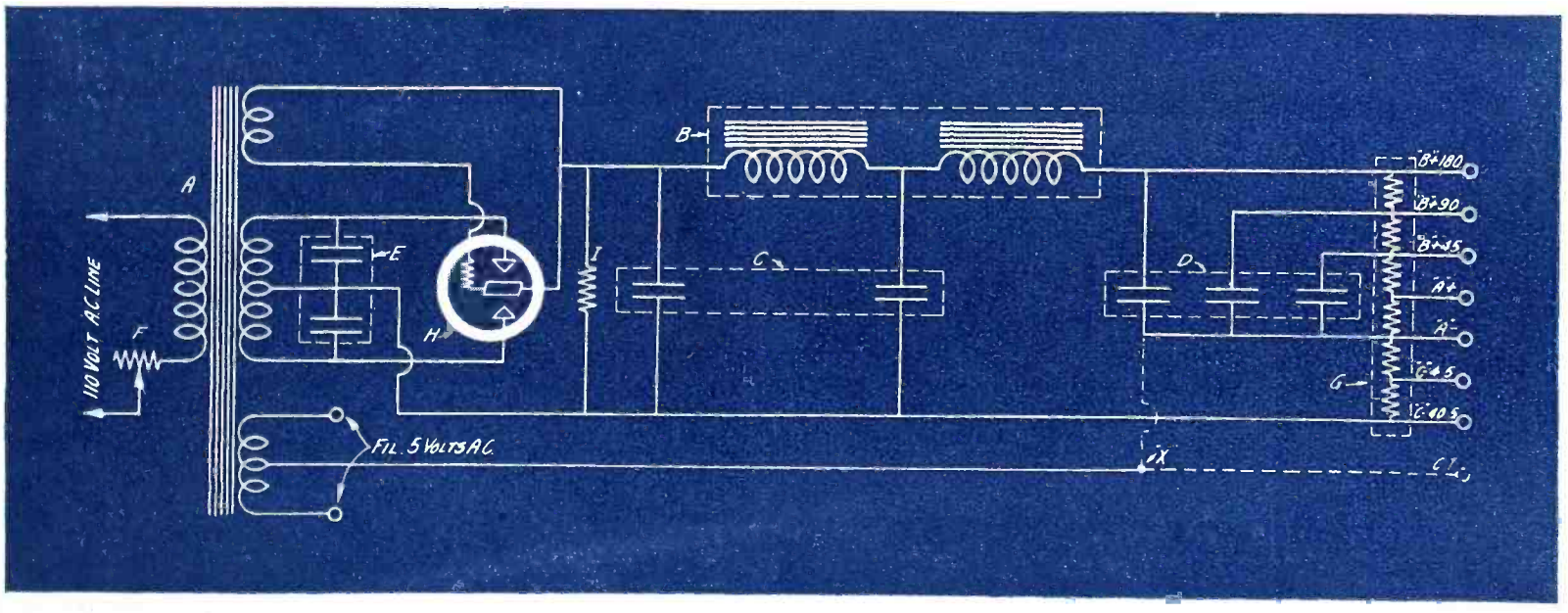
A, B and C—Camfield high-frequency coupling coils;
D—Camfield Equaltune condenser, .00035 mfd.;
E and F—Camfield Equaltune double condenser, .00035 mfd. each;
G and H—Samson Symphonic low-frequency transformers;
I—AmerChoke No. 854;
J—Aerovox high-voltage filter condenser, 2 mfds.;
K—General Radio potentiometer, 20 ohms;
L1 and L2—Airgap sockets;
L3, L4 and L5—Benjamin Cle-Ra-Tone vibrationless sockets;
M—AmerTran transformer, type No. H-67 for filament heating;
N1 and N2—Hammarlund balancing condensers;
O—Dubilier fixed condenser, .0005 mfd.;
12 X-L binding posts;
1 bakelite strip, 3½ by 1 by 3/16 inch;
1 bakelite binding-post strip, 8 by 1 by 3/16 inch;
1 wooden baseboard, 9 by 26 by 7½ inches;
4 small brass brackets for mounting binding-post strips;
2 "C" batteries, 4½-volt;
2 Van Horne AC valves;
2 McCullough AC valves;
1 UX-210 type valve;
Wire, screws, etc.

at all to get proper operation with increased volume and better quality than ever before.

Among other types of valves that may be used for this purpose is the new Raytheon high-current rectifier valve, and a special receiver incorporating this design will be described in the next issue of POPULAR RADIO.

We recommend that our readers who are experimentally inclined take this opportunity to experiment with these new hook-ups for AC valves and utilize the new forms of AC operation, so that they may keep ahead of the times and experience the benefits of these recent developments.

(*Continued on page 158*)



THE SCHEMATIC DIAGRAM OF THE Q. R. S. "ABC" POWER-PACK

FIGURE 7: *In this circuit a special transformer is used with a new high-power rectifier valve for supplying not only the "B" and "C" voltages, but the "A" power as well. This unit may be connected to any set in which the filaments of the standard valves employed have been wired in series.*

KYW
WNYC
WIP
WCFL
WEAF
WTIC
WJZ
WQJ
WOR
WTAM
WHN
WGY
WMCA
WEBH
WLWL
WQAO
WAAM
WLS
WBZ
WABC
WGBS
KDKA
WRNY
WBCH
WLIB
WODA
WSBC
WGCP
WPG
WBKN
WBMS
WOOD
WBBR
WEBJ
WAAT
WGB
WADC
WMSG

From a photograph made for POPULAR RADIO

CHECKING UP ON THE OPERATING CHARACTERISTICS

FIGURE 1: *The various measurements outlined in this article were made on the early models of the LC-28 in the Popular Radio Laboratory; this series of researches brought to light many interesting facts that are important in high-frequency amplification.*

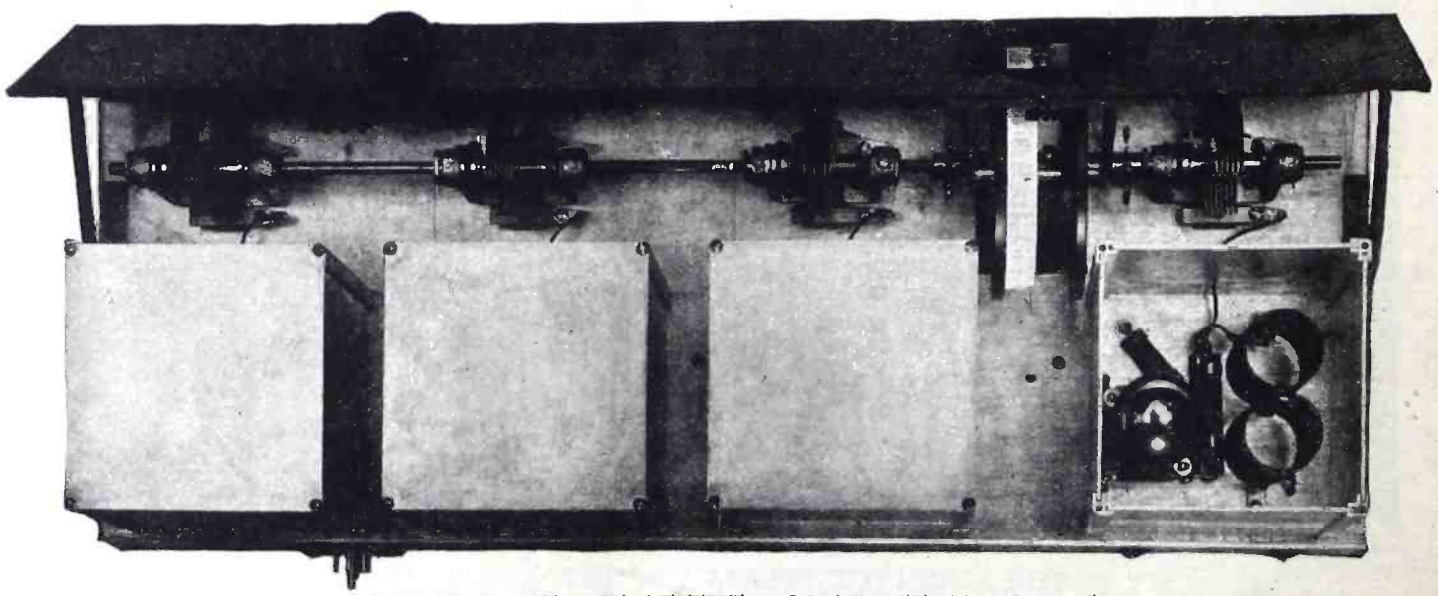
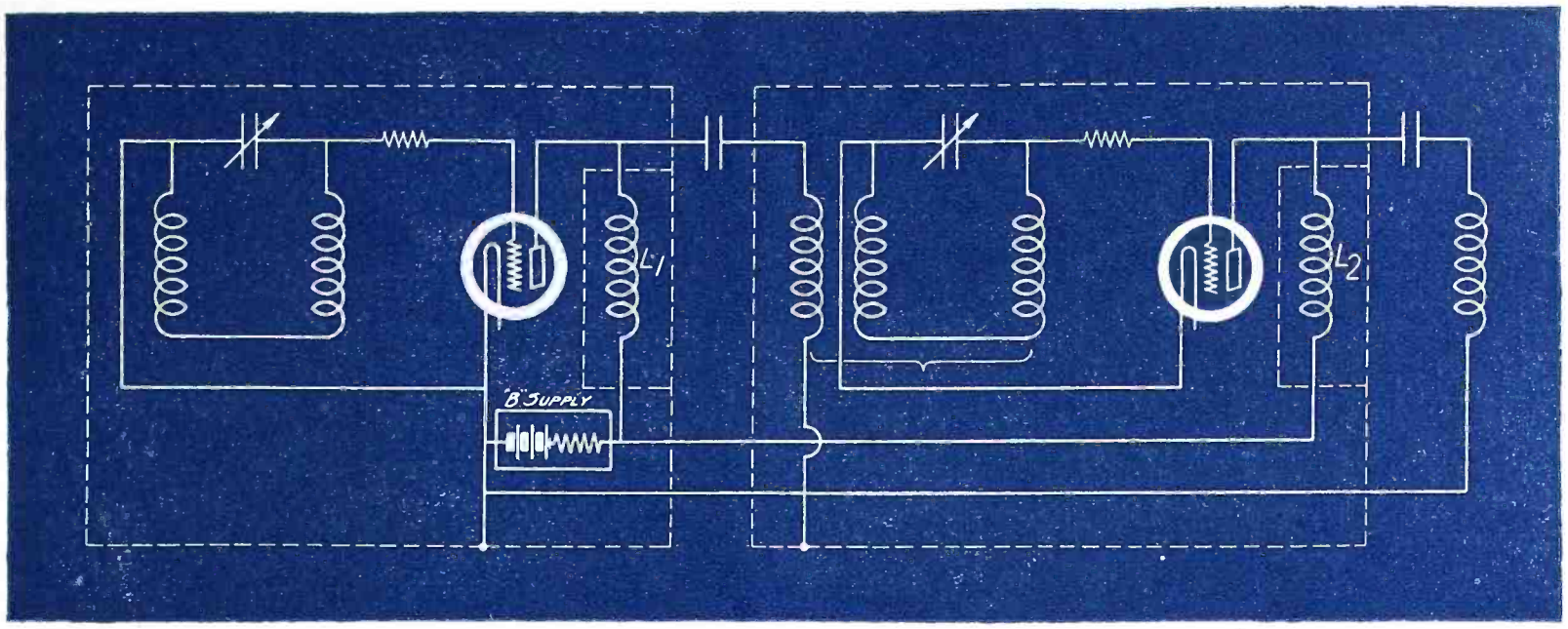


FIGURE 2: *A tuning calibration on the new set that was made at the time of the recent broadcast frequency changes.*

A TOP VIEW OF ONE OF THE MORE RECENT MODELS

FIGURE 3: *In this illustration is shown the layout of the metal chassis and the ganging arrangement of the four tuning condensers. The four shielded stages are also shown with the lid removed from the one at the extreme right. Notice the almost total absence of wiring.*



THE TYPE OF CIRCUIT USED IN THE NEW SET

FIGURE 4: *Here are shown two coupled high-frequency stages that are shielded and that are perfectly stable in operation, although the amplification obtained through the whole range of frequencies is of a remarkably high order.*

ADVANCE INFORMATION ABOUT THE NEW

LC-28 RECEIVER

Here are told some new and significant facts about efficient high-frequency amplification that were uncovered during the research work in the Popular Radio Laboratory on the new LC-28 Receiver. This information is of interest to engineers, experimenters and set builders alike.

By LAURENCE M. COCKADAY

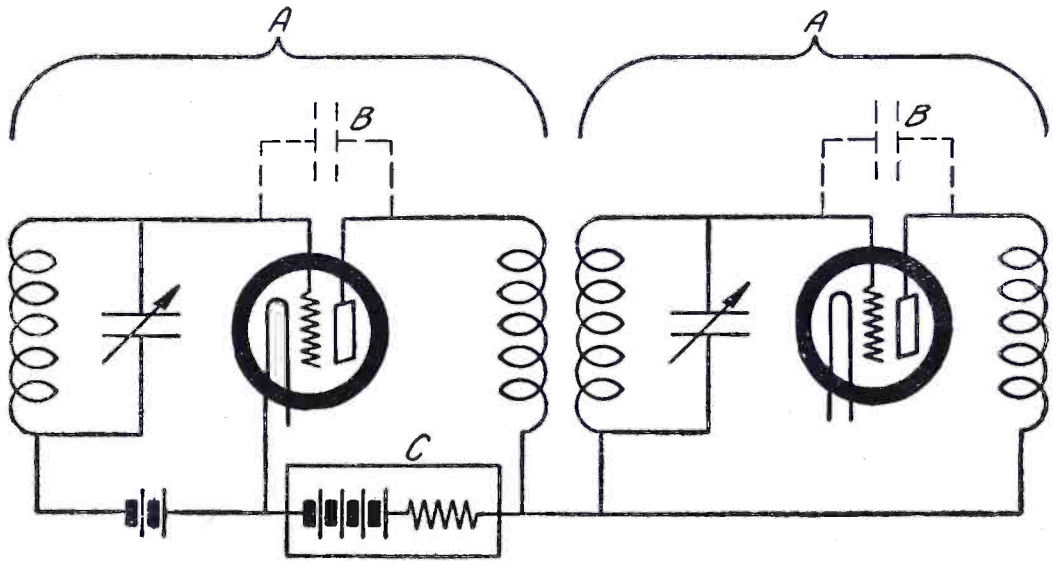
THE main thought back of the design of the LC-28 Receiver is a sound one, from both the engineering and economic standpoint.

To be most useful, a modern radio receiver should be a truthful reproducer of music and speech, and it should be capable of giving its owner not only selections at random, but specific selections that he wants to hear at particular times.

The modern radio receiver may be divided into the following five operating sections:

(A) The high-frequency pick-up;
(B) The phonograph pick-up;
(C) The low-frequency amplifier;
(D) The reproducer;
(E) The power apparatus.

The owner of a set outlined as above would use A, the high-frequency pick-up, to get his initial signals from the broadcasting stations. If he desired any particular selection at a certain time, he would use B, the phonograph pick-up. Both of these pick-ups should be capable of being switched to C, the low-frequency amplifier, that would amplify the electrical signals to the proper volume and pass them on to D, the reproducer, which should be either a high quality cone or an exponential type horn reproducer and which should re-



THREE MAIN CAUSES OF REGENERATION

FIGURE 5: *Coupling between the plate and grid coils that produce feed-back is shown at A. The capacitative coupling through an imaginery condenser formed by the capacity between the grid and plate is shown at B. The resistive-drop coupling in the "B" batteries is shown at C.*

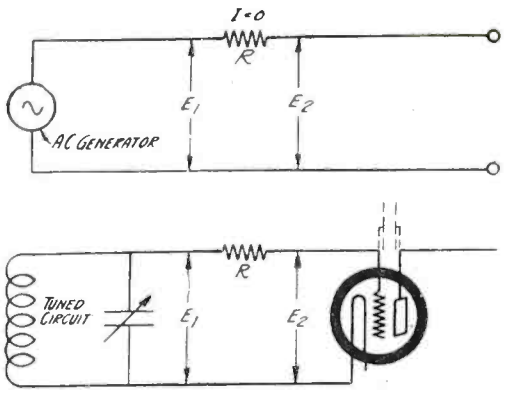


FIGURE 6: *The top diagram shows that there is no voltage drop in a resistor when no load flows through it. In other words, under this condition the output voltage E2 equals the input voltage E1. The bottom diagram shows this application to the grid circuit of a high-frequency amplifier. If the non-inductive, low-capacity resistance R is of a high enough value of resistance to prevent grid currents the grid voltage E2 will equal the initial voltage E1 without potential loss.*

produce the signals audibly and truthfully.

The power apparatus, E, is necessary to furnish the current for the filaments of the valves used, and the high voltage for the plate circuits of these valves.

Each one of these essential sections has a definite and separate function and the receiver can best be designed, built, and operated when their functions are separated and each unit is made to do its own work and nothing more.

In the old-time receiver, the set was built as a whole, and its separate functions were so interlocked that real efficiency was impossible.

Also, from the set-builder's standpoint, when formerly he had once built a set he could not take advantage of improvements in any particular section without discarding the whole set and building a new one. Obviously, this is a poor design, from an engineering point as well as an economical one.

This is the basic idea of the new LC-28: To give the set-builder a first-class high-frequency pick-up, consisting of three stages of high-frequency amplification that is stable, that gives the maximum in amplification, and that may be attached to a high-quality amplifier, any type of power-pack and a good reproducer. This system will allow the set-builder and the experimenter latitude in the choice of low-frequency amplifiers without changing the high-frequency end.

The Design of the LC-28 High-Frequency Pack.

The five main considerations taken into account in designing the LC-28 are the following:

1. Maximum amplification per stage;
2. Adequate stability throughout;
3. Adequate selectivity to meet all broadcast conditions;
4. Simple and easy tuning;
5. Smooth volume control from zero to maximum.

In order to get maximum amplification in a high-frequency circuit of the tuned-circuit variety utilizing vacuum valves, certain definite engineering laws must be satisfied. One of the greatest drawbacks encountered in obtaining a large amount of amplification in a single stage of high-frequency amplification is that unstable condition commonly called "oscillation," which usually interferes with and mars reception.

An unstable condition in a circuit

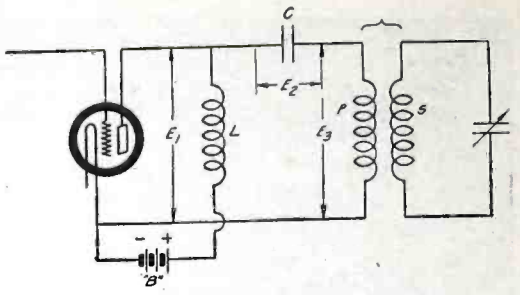
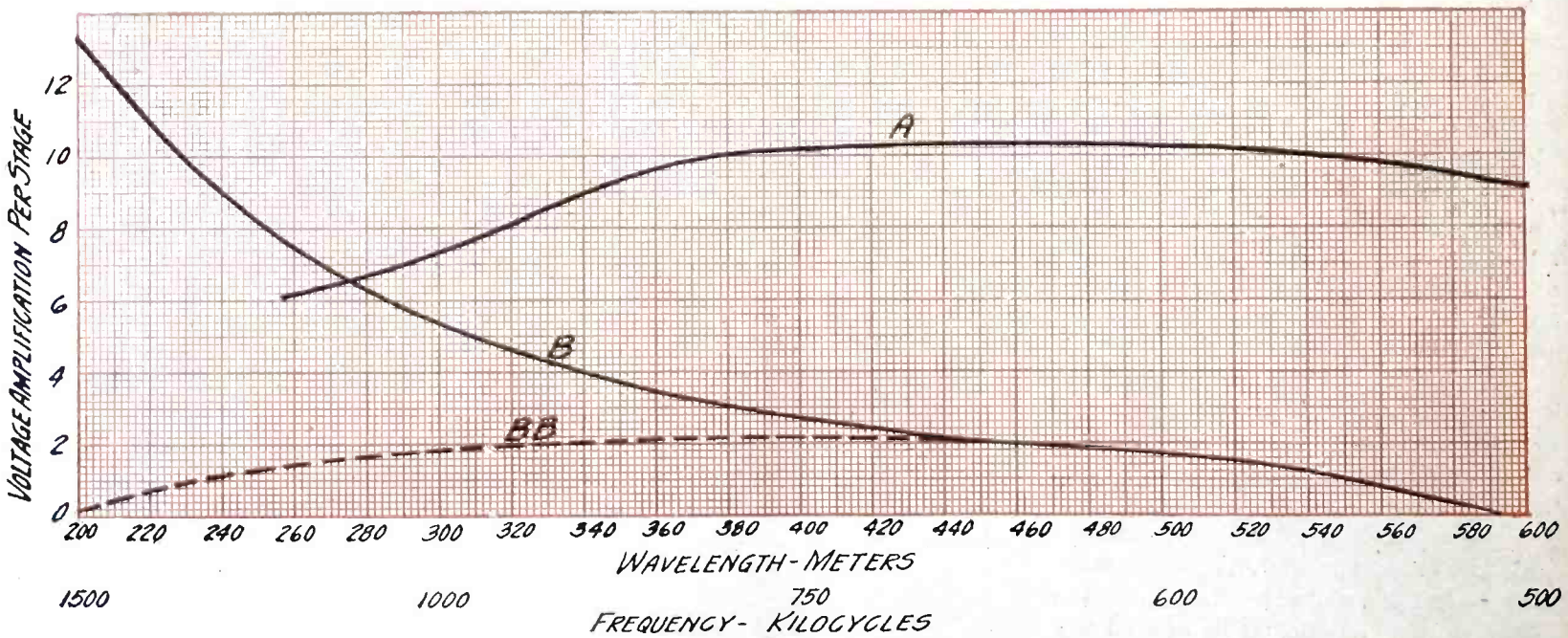


FIGURE 7: *The plate characteristics of a shunt-plate-feed amplifier circuit are best when the alternating-current voltage E3 across the primary coil P equals the alternating current voltage E1 induced in the valve from the preceding stage. This means that the voltage drop E2 across the coupling condenser C should be kept as low as possible for maximum efficiency.*

is caused by the phenomena known as regeneration. This regeneration is usually present in a tuned-high-frequency circuit, due to one or more of the three causes illustrated in Figure 5. In this schematic drawing are shown two stages of high-frequency amplification tuned with variable condensers connected in the grid circuit and shunted across the secondary coils. The coupling between the coil in the grid circuit and the coil in the plate circuit, in both stages, is shown at *A*. This coupling is one of the main causes of regeneration and inherent unstability. It is caused by electromagnetic feed-back from the plate coil to the grid coil.

The second important cause is due to the inter-electrode capacity between the elements of the vacuum valve itself; this is shown in dotted lines at *B* in Figure 5. Regeneration is introduced into the circuit by the feed-back of energy through the small condensers formed by the grid and plate.

(*Continued on page 178*)



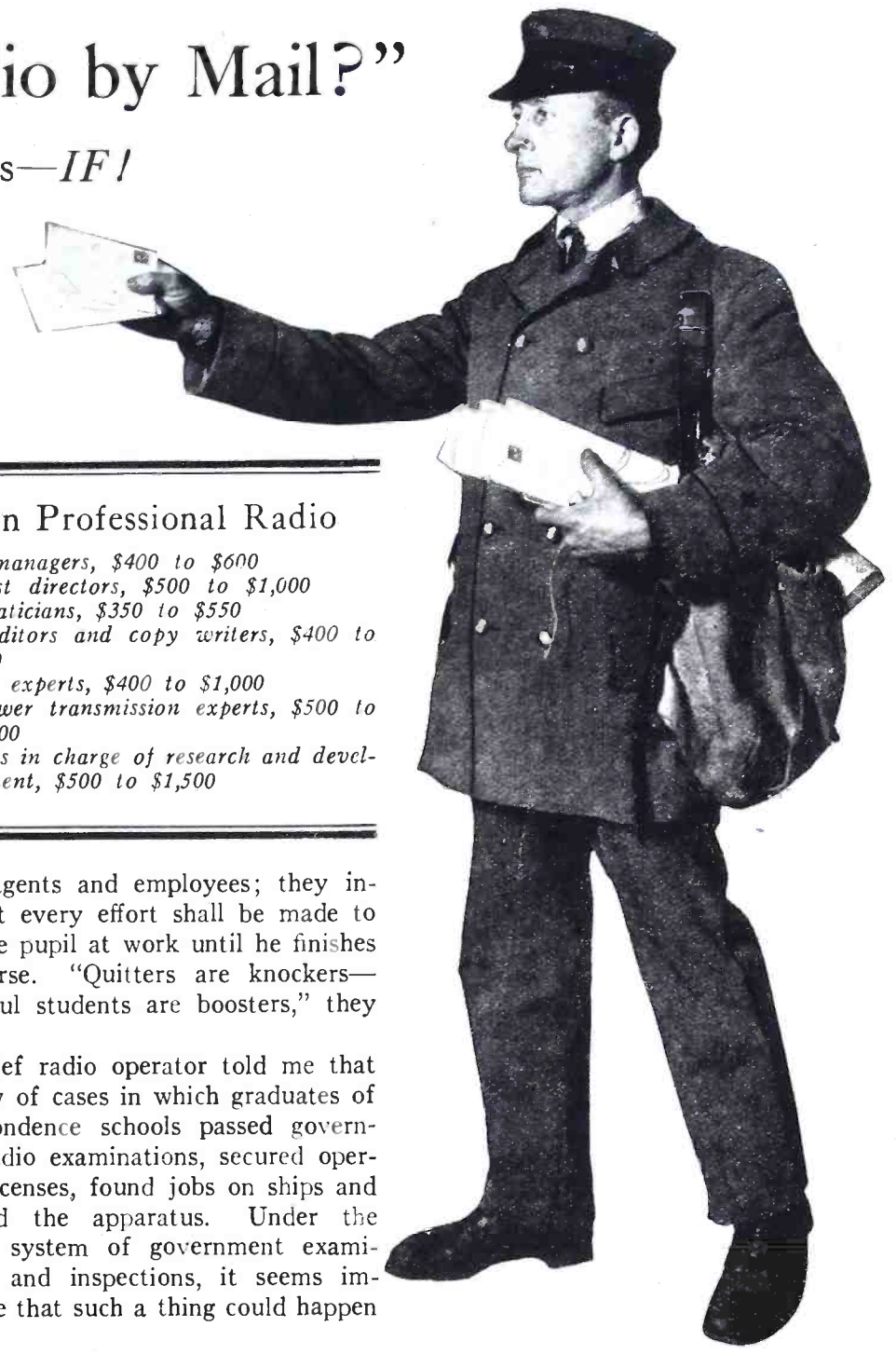
AMPLIFICATION CURVES THAT TELL A STORY

FIGURE 8: *The curve A shows the high amplification obtained with a new LC-28 Receiver. The curve B, shown for comparison, is of a standard high-frequency circuit. The quick rise in B at high-frequencies (low wavelengths) is harmful and is due to regeneration. If there were no regeneration in the set from which curve B was made, it would have a curve similar to that shown at BB.*

"Can I Learn Radio by Mail?"

The answer is yes—*IF!*

By ARMSTRONG PERRY



How the Monthly Salaries Range in Professional Radio

Radio telegraph operators, $100 to $200
Broadcast operators, $200 to $350
Broadcast announcers, $200 to $300
Trained mechanicians, $100 to $200
Radio inspectors, $200 to $400
Commercial engineers, $250 to $350
Designers of mechanical apparatus, $400 to $600
Acoustical experts, $350 to $650
Studio managers, $400 to $600
Broadcast directors, $500 to $1,000
Mathematicians, $350 to $550
Radio editors and copy writers, $400 to $800
Receiver experts, $400 to $1,000
High-power transmission experts, $500 to $1,000
Physicists in charge of research and development, $500 to $1,500

FOR the last five years one college after another has been offering correspondence courses in radio. This has led some persons to wonder if the colleges are looking for some of the "easy money" that the correspondence schools were said to be making, or whether the learn-by-mail system has been good in spite of the criticisms that once were made concerning it.

The business executive who employs radio men seems to care little how or where they got their education; all he wants to know is that they can handle the jobs he wants them to fill. If a man who wants a radio job can get the education he needs from a correspondence course, he may save time and expense.

Some correspondence schools that offer radio courses have been accused of attracting pupils by advertising results that most students never will attain. I believe that the possibilities suggested in correspondence school advertising are within the reach of the average man—provided that he completes the course and takes the next step. If he quits, no school can help him.

I have heard critics say that some of the radio correspondence schools try to discourage their pupils by giving them too much work and by writing disagreeable letters after they have collected the fees. If this were true, it would show a lack of common sense at least. There is no reason for a pupil permitting himself to be bluffed off. He cannot be compelled to proceed any faster than he wishes. I have seen the instructions given by a large correspondence school to its agents and employees; they insist that every effort shall be made to keep the pupil at work until he finishes his course. "Quitters are knockers—successful students are boosters," they say.

A chief radio operator told me that he knew of cases in which graduates of correspondence schools passed government radio examinations, secured operators' licenses, found jobs on ships and damaged the apparatus. Under the present system of government examinations and inspections, it seems improbable that such a thing could happen often.

Obviously, the only way to become thoroughly familiar with radio apparatus is to work with it. Correspondence schools improve their standing when they provide for and require practical experience as well as the study of theory. Some of them have residence schools where correspondence pupils get such experience before they receive their certificates. In any case, it is entirely possible for a student, even if his time and cash are limited, to construct and operate apparatus at home.

It has also been charged that correspondence schools sometimes collect for a complete set of books or for a complete course of instruction, knowing that the pupil will never complete the course unless he is exceptional. But real estate dealers, grocers and furniture stores have a similar habit. The real estate man collects the payments on my house whether I occupy it or not; the grocer presents his bill without asking whether I have eaten the things purchased; the furniture has to paid for whether I use it or not. It costs money to prepare and conduct correspondence courses. Even if 99 men out of a 100 go no further than the tenth lesson, it is necessary to have a complete course ready for the hundredth man. For legal purposes the school must be able to show that it can deliver the entire course.

The correspondence method of instruction has proven its value in ancient Rome, in Europe for two centuries, in the Chautauqua Literary and Scientific Circle that has enrolled thousands in the past half century, and in modern correspondence schools, one of which has enrolled over 2,000,000 pupils. The thousands of radio amateurs who have educated themselves in radio theory and practice by reading books and POPULAR

(*Continued on page* 188)

★ PROGRAM FEATURES *for* THE MONTH

Here is POPULAR RADIO'S *selection of the "star" broadcast features that are scheduled as regular weekly events for the month beginning August 22—program numbers of outstanding merit that are selected on the basis of intrinsic worth, as well as upon their importance as determined by the large audiences reached by powerful single stations and by the chain stations that now cover the country. Every radio fan has—or should have—a receiver good enough to tune in on most of the features that are listed.*

(THE PROGRAMS GIVEN HERE ARE SCHEDULED ACCORDING TO EASTERN DAYLIGHT SAVING TIME; FOR BROADCAST LISTENERS LIVING IN LOCALITIES THAT USE EASTERN STANDARD TIME, THE TIMES OF PERFORMANCE ARE AN HOUR EARLIER THAN EASTERN DAYLIGHT SAVING TIME.)

Mondays

ROXY AND HIS GANG; 7.30 P. M.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM, WBAL, WJR, WOC, WCCO, WHAM.

The musical masterpiece of each week and perhaps the greatest extravaganza on the air. This hour and a half is filled with music of a 110-piece orchestra, special studio symphony and scores of vocalists and instrumentalists. It is the essence of variety, charm and entertainment. Roxy also has plenty of surprises each week.

SCHWARZ HOMEMAKERS; 9.00 P. M.; *variety;* WABC.

Although this is a new WABC feature, it has been remarkably successful. There seems to be no set form of entertainment. It is usually made up of orchestral, vocal and instrumental music, well sung and well played.

WBAL ENSEMBLE; 9.00 P. M.; *chamber music;* WBAL.

The Staff of WBAL, Baltimore's first radio station, has in the past made a specialty of chamber music; and perhaps there is no better source in the country. This particular event is one to which the editor of this column always tunes.

SPOTLIGHT HOUR; 9.00 P. M.; *orchestra and features;* WJZ, KDKA.

LIDO VENICE DANCE ORCHESTRA; 10.10 P. M.; *jazz music;* WEEI.

The dance orchestra of the Lido Venice is New England's pride and all the youngsters of the great bean and pie country are ardent followers of this particular event.

WBAL DANCE ORCHESTRA; 11.00 P. M.; *dance music;* WBAL.

Late evening dancers do not need to search long for snappy one-steps if they are within easy reach of WBAL's well-modulated waves.

CORONADA ORCHESTRA; 1.00 A. M.; *dance music;* KMOX.

KMOX and the Coronada Dance Orchestra burn midnight tubes to supply the Middle West with a gold label brand of dance music.

Tuesdays

DINNER CONCERT; 6.30 P. M.; *classical and semi-classical music;* WGY.

If it were not for WGY and its dinner concerts from Hotel Ten Eyck many people in New York State and the western fringes of New England would have to eat musicless meals.

GEORGE OLSEN'S STROMBERG-CARLSON ORCHESTRA; 8.00 P. M.; *dance music;* WJZ, WBZ, KDKA, KYW, WBZA, WJR, WHAM.

George Olsen helping to sell radio receivers by giving samples of real radio music. George Olsen is one of the great captains of the jazz industry and it is said that he is as serious with his jazz as Wagner was with his operas—which is pretty serious.

EDISON ENSEMBLE; 8.00 P. M.; *classic and popular music;* WRNY.

A neat little ensemble supplying a good-will program for the New York Edison Company. The New York Edison Ensemble is said to amount to about half of WRNY's reputation, which is not far from true.

GRAND OPERA PROGRAM; 9.00 P. M.; *soloists and instrumentalists;* WJZ, KDKA, KYW.

The National Broadcasting shows how excerpts of the most popular operas should be handled on the air. These programs have been particularly well chosen and only the most popular music from each opera is selected for reproduction.

EVEREADY HOUR; 9.00 P. M.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WRC, WGY, WHAS, WSM, WSB, WMC, WDAF.

The Eveready program is ever good, ever entertaining and never trite. Although it runs on a light summer schedule, big things begin to happen at the end of September.

EDUCATIONAL PROGRAM; 9.00 P. M.; *lectures;* WLWL.

WLWL becomes a little high-brow with important lectures about this and that, but always about things that normal people are interested in.

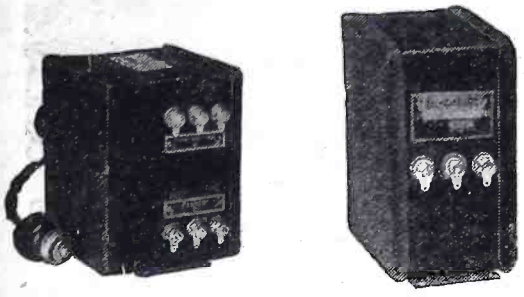
MIXED QUARTET; 9.00 P. M.; *popular ballads;* WBAL.

Although the editor is not particularly fond of quartets, he does listen to this one occasionally. This is not necessarily an endorsement, but the quartet fan will not make a great mistake by following his example.

SAM 'N' HENRY; 9.00 P. M.; *negro comedy;* WGN.

Negro comedy hot from the griddle and dished up by a couple of old-timers who probably have more laughs to their credit than any other team on the air. Since the Record Boys have left the air, Sam 'n' Henry reign supreme as the great masters of nigger comedy and psychology.

New!



THORDARSON
POWER
TRANSFORMERS

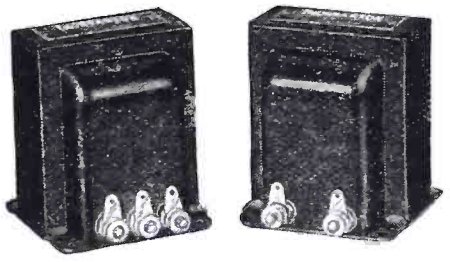
130 M. A. FULL WAVE RECTIFIER

Here is a power unit that will satisfy the ever increasing demand for improved quality of reception. A split secondary 550 volts either side of center, makes possible full wave rectification, using two 216-B or two 281 tubes. Current capacity, 130 milliamperes. The low voltage secondary, 7½ volts, will supply two UX-210 power tubes, enabling the use of push-pull amplification in last audio stage.

The Double Choke Unit 2099 is designed for this power unit. Contains two individual chokes of 30 henries, 130 milli-amperes capacity each.

T-2098 Transformer, 4½" x 5¼" x 5¾"
List Price, $20.00

T-2099, Choke Unit
3¼" x 4⅞" x 5⅝" high
List Price
$14.00



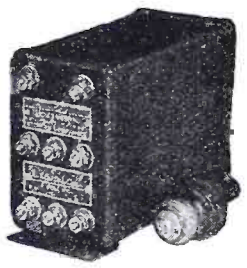
POWER PUSH-PULL TRANSFORMER and CHOKE

Quality reproduction that cannot be obtained with straight audio amplification, is made possible through the Thordarson power push-pull combination. This arrangement is designed for use with power tubes only and has sufficient capacity for all tubes up to and including the UX-210. Makes an ideal power amplifier when used with power supply unit T-2098.

Input transformer couples stage of straight audio to stage of push-pull. Output choke is center-tapped with 30 henries on either side of center tap. Dimensions of both transformer and choke, 2½" x 2½" x 3" high.

Input Transformer T-2408
List Price, $8.00

Output Choke T-2420
List Price
$8.00



A. C. TUBE FILAMENT SUPPLY

The new R. C. A. and Cunningham A. C. filament tubes will be very popular with the home constructor this season. The Thordarson Transformer T-2445 is designed especially for these tubes. Three separate filament windings are provided.

Sec. No. 1, 1½ volts, will supply six UX-226 amplifier tubes.

Sec. No. 2, 2½ volts, will supply two UX-227 detector tubes.

Sec. No. 3, 5 volts, will supply two 5 volt power tubes.

In addition to the above, this transformer is equipped with a receptacle for the B-supply input plug. Supplied with six-foot cord and separable plug for attachment to the light circuit. Transformer in compound filled, crackle-finished case. Dimensions — 2¾" x 5¾" x 4¾".

A. C. Tube Supply, T-2445
List Price, $10.00

Realistic tone quality, that elusive but much talked of characteristic of radio reception — can be obtained only through the use of apparatus of the finest materials and workmanship. For years Thordarson transformers have been the choice of many discriminating manufacturers of quality receiving sets. Follow the lead of the leaders. If you enjoy good music *specify Thordarson transformers*

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

THORDARSON ELECTRIC MFG. CO.
500 W. Huron St., Chicago, Ill.

Gentlemen:
Please send me your booklets describing your new power supply transformers.

Name _____

Address _____

City _____ *State* _____

(3562C)

Wednesdays

BENJAMIN FRANKLIN ORCHESTRA; 6.15 P. M.; *popular music;* WIP and WGBS.

The Benjamin Franklin Orchestra is a Philadelphia musical institution of considerable importance, and now that WIP has joined WGBS in a little chain New York fans are coming to appreciate this good music from the Quaker City.

DINNER CONCERT; 6.45 P. M.; *chamber music;* WSM.

At 6.15 P. M. sharp on Wednesday WSM unobtrusively comes to the air with a little dining-room ensemble whose director is particularly clever in arranging his musical menu. This is a musical event that should be appreciated by everybody that likes chamber music.

RADIO NATURE LEAGUE; 7.30 P. M.; *nature talks;* WBZ.

Thornton Burgess with his nature league has been tremendously successful in awakening an interest in natural science. His lectures are filled with interesting observations and oftentimes he calls upon professors of entomology, botany, ichthyology and many other "ologies" to help him make natural science a popular subject with people of all ages. Mr. Burgess broadcasts direct from the studio of Hotel Kimball, where he lives.

KATZ AND HIS KITTENS; 8.00 P. M.; *dance orchestra;* WQJ.

Katz and His Kittens seem to be Chicago's idea of a pretty smart dance orchestra. We are inclined to share this opinion and believe that anyone dancing to this half-hour of rousing dance music makes just about the same decision.

STEINDAL STRING QUARTET; 8.30 P. M.; *semi-classical music;* KMOX.

The Spirit of St. Louis taking the form of a good program of classical numbers.

REMINGTON TYPEWRITER BAND; 8.30 P. M.; *typical band selections;* WGY.

The Remington Typewriter Company entertains the citizens of Ilion, N. Y., each Wednesday night at 8.30 P. M. with a band made up of Remington employees. The music from this band, which is under the direction of W. L. Daniels, is so good that the scouts of WGY discovered it and put it on the air.

IPANA TROUBADOURS; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD, WCCO, WGY.

The Ipana Troubadours are full of bombastic music that would do anything but remind one of the fact that his supply of toothpaste is low. As long as advertisers use such agreeable means for popularizing their products, the editor of this department should be very happy to listen to them.

MAXWELL HOUR; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WHAS, WSB, WMC, WSM, WJAX, WBAL, WJR.

The Maxwell Coffee Hour is an hour that needs no endorsement by this publication. The fact that Nathaniel Schilkret is its director is an endorsement of sufficient value for fans who know music. Perhaps no other single feature is followed so closely or more keenly by the music lovers of airdom.

GOODRICH SILVER MASKED TENOR AND ORCHESTRA; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC, WHAS, WSB, WSM, WMC.

Joseph Knecht and the Silver Masked Tenor return to the air supported by the famous Goodrich Orchestra. Both Mr. Knecht and the Silver Masked Tenor come to WEAF after finishing a vaudeville tour that took them over the major part of the United States of America.

SUNSET INSTRUMENTAL QUARTET; 10.00 P. M.; *popular numbers;* KFI.

Ray Fisher is "big guns" on the Coast and all of the people of California know it.

NATIONAL LIGHT OPERA COMPANY; 10.10 P. M.; *tabloid versions of well-known light operas;* WEAF, WEEI, WLIT, WRC, WCAE, WGY, WGR, KSD, WMAQ.

Carefully edited vest-pocket editions of light operas supplied by the National Broadcasting Company and a chain of associated stations.

WALDORF ORCHESTRA; 10.30 P. M.; *dance music;* WABC.

Harold Leonard gives the late listeners of WABC a good time with a lot of good tunes. This music brings back to memory the good old days when Joseph Knecht used to direct the snappy Waldorf Orchestra.

HERLIHEY'S DANCE ORCHESTRA; 11.00 P. M.; *dance program;* WOR.

Joe Herlihey takes the place of Hogan's Dance Orchestra with great success. WOR has always been rather fussy about its dance music and it usually manages to broadcast only the best.

BAMBOO GARDEN ORCHESTRA; 11.00 P. M.; *dance music;* WTAM.

WTAM trying to establish itself in the field of jazz. Although this music would not pass muster in New York, it sounds pretty good for Cleveland.

Thursdays

WBAL DINNER MUSIC; 6.30 P. M.; *classical and semi-classical selections;* WBAL.

Sunset music supplied by the WBAL ensemble. This is a period of old-fashioned music that you enjoy, providing you are not erratic.

CONCERT MUSIC; 7.35 P. M.; *classical selections;* WGN.

The capital of jazz steps out with a little contribution of chamber music. It is said that there are more jazz bands in Chicago per square mile than any other place on earth. How strange this chamber music must sound to Chicago listeners!

RCA RADIOTRONS; 8.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, WEBH, WBZA.

The R. C. A. popularizing its Radiotrons with a varied act of no small consequence. There is no set style to this program, as its originators have allowed this latitude for plenty of variety.

CLICQUOT CLUB ESKIMOS; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WRC, WCSH, WDAF.

Who can say that the Eskimos are not among the radio immortals and who can say that the Eskimos have not supplied as many watts of invigorating radio music as any other radio performance on the air?

FULLER ORCHESTRA; 9.30 P. M.; *popular music;* WGHP.

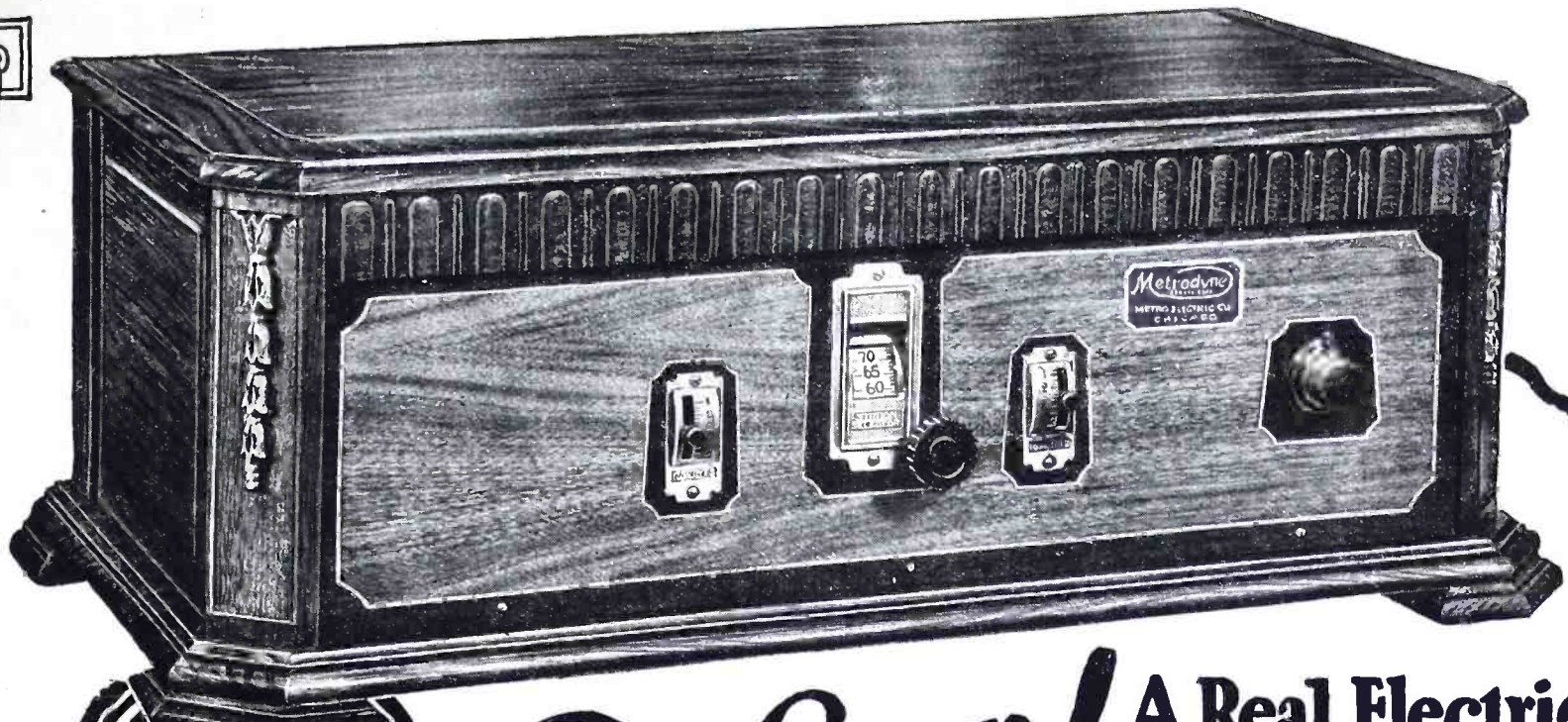
Any jazz band that can win in a competition with the other million jazz bands in the Chicago district must be good enough to win editorial support in POPULAR RADIO.

DAVID LAWRENCE; 10.00 P. M.; *"Our Government," lecture;* WEAF, WGR, WRC, KSD, WGY, WMAQ, WEEI, WTAG.

David Lawrence talks a lot about the United States Government telling him things that over a million people know absolutely nothing about. He is well able to make civic government and political economy a popular subject.

HOTEL BOSSERT ORCHESTRA; 11.00 P. M.; *popular dance orchestra;* WEAF, WGY.

Here's a refreshing hour of music from the Marine Room of Hotel Bossert in Brooklyn, N. Y. This is one of the most listened-to summer programs of WEAF. It is said that one can feel the harbor breezes come out of the loudspeaker—which is, perhaps, rank exaggeration.



30 Days Free Trial

Now! A Real Electric Radio Set

Three Year Guarantee

Shipped direct from our factory at rock bottom prices—cost less than most battery sets

No Batteries, Chargers or Eliminators

No Acids; No Liquids—Plug In—Press Button—"Tune In'

Metrodyne
ALL ELECTRIC RADIO

7 Tubes—Single Dial Set

100% Electric Radio

At last! The radio you've dreamed about! If you have electricity in your home you can now really enjoy coast to coast radio reception without the care, bother and muss of batteries, chargers, eliminators, etc. The Metrodyne All Electric is a real, genuine batteryless radio set. Simply insert the plug in the socket, press the switch button and "tune in." You could not possibly buy a better radio set than the Metrodyne All Electric, no matter what price you paid.

BEAUTY—EFFICIENCY DEPENDABILITY

The Metrodyne All Electric Radio is a 7 tube, single dial set. Only the highest quality low loss parts are used throughout. Solid walnut cabinet, beautiful two-tone effect, with handsome gilt metal trimmings. Size of cabinet, 28 inches long, 13 inches deep, 10 inches high. Has electrically lighted dial so that you can log stations in the dark. Only one dial to tune in all stations. Excellent tone qualities — wonderful volume — very selective.

Costs Less Than Most Battery Sets

Do not confuse the Metrodyne electric radio with ordinary light socket sets, because the Metrodyne is truly an **all electric radio** — consumes less than 2c worth of power a day. Comes to you **direct from the factory.** Its low cost brings it down to the price of an ordinary battery set. We are so confident that you will be delighted with this wonderful, easy-to-operate **batteryless radio** that we offer to ship it to your home for **thirty days' free trial** — you to be the judge.

AGENTS! DEALERS! BIG PROFITS!

Make big money taking orders for Metrodynes. All or part time. Metrodyne All Electric Radios are in a class by themselves. Unequalled for quality, performance and price. Demonstrate at home and take orders. Lowest wholesale prices. Your demonstrating set on 30 days' free trial. Mail coupon below for details.

Gorgeous Console Electric Radio

Here is the Metrodyne All Electric Console Radio — a gorgeous, genuine walnut cabinet, in a beautiful two-tone finish. Has a built-in genuine Metro-Cone large size speaker. Brings in programs with great volume, reproducing the entire range from the lowest to the highest notes with remarkable clearness and distinction. All metal parts are finished in old gold. Wonderful electric radio, in a cabinet that will beautify the appearance of any home.

Mail This Coupon

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer,** which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis — **WRITE TODAY!**

METRO ELECTRIC COMPANY
2165 N. California Ave., Dept. 611
Chicago, Illinois

Gentlemen:
Send me full particulars about Metrodyne All Electric Radio and your **thirtydays'free trial offer.**

Name_____

Address_____

If you are interested in AGENT'S proposition place an "X" in the square ☐

MAIL COUPON NOW!

METRO ELECTRIC COMPANY

2165 N. California Ave. *Dept.* 611 Chicago, Illinois

KFI DRAMA HOUR; 11.00 P. M.; *varied program;* KFI.

Booming drama supplied by the station that has a reputation for being rather flighty.

Fridays

HOTEL BRETTON HALL ORCHESTRA; 6.30 P. M.; *chamber music;* WOR.

Hotel Bretton Hall's orchestra has been replaced by that of the Sheldon, and WOR can be justly proud of its choice in either case.

DINNER ORCHESTRA; 6.30 P. M.; *popular selections;* WBAL.

WBAL with another one of its popular dinner concerts, supplied by its own musical organization.

HAPPINESS BOYS; 7.30 P. M. (beginning in September); *songs and jokes;* WEAF.

The Happiness Boys are now helping to put over a new Happiness restaurant at 44th Street and Fifth Avenue, New York City, and every Friday night they sing before the diners. WEAF picks the event up by remote control and broadcasts it just for old time's sake.

HOTEL WHITEHALL TRIO; 7.45 P. M.; *string trio playing classics and semi-classics;* WABC.

Hotel Whitehall Trio supplies a little program of choice classical and semi-classical music for the listeners of WABC. This trio is more than the average hotel trio.

CHELSEA CONCERT ORCHESTRA; 8.00 P. M.; *chamber music;* WPG.

A Great Atlantic City boardwalk hotel permits listeners of the United States to sample its dinner music.

ROYAL HOUR; 8.30 P. M.; *orchestra and soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WBAL, WJR.

The Royal Typewriter Company out for customers with a half-hour of music that has set up new standards.

PHILCO HOUR; 9.00 P. M.; *vocal and orchestral;* WJZ, WBZ, WBZA, KDKA, KYW.

Another radio manufacturer trying to pay its debt to broadcasting.

LA FRANCE ORCHESTRA; 9.30 P. M.; *popular orchestral music;* WEAF, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF, WMAQ, KSD.

Anna Byrne still at it with her very, very, very popular orchestra.

DANCE ORCHESTRA; 11.00 P. M.; *dance music;* KDKA.

Real good dance music emerging from the smoke of Pittsburgh.

Saturdays

JACQUES RENARD'S ORCHESTRA; 6.45 P. M.; *dance music;* WEEI.

One of two particularly good dance orchestras broadcasting from the Bean City.

MEDITERRANEAN DANCE ORCHESTRA; 8.30 P. M.; *dance selections;* WJZ.

HOTEL TRAYMORE CONCERT; 9.00 P. M.; WPG.

An Atlantic City hotel supplying the public with a lot of good concert music.

BENJAMIN FRANKLIN ORCHESTRA; 10.05 P. M.; *chamber music;* WIP.

Benjamin Franklin Orchestra has been one of the favorites of the editor of this column for a long time and he can recommend it with a feeling that he cannot be taken as an easy musical customer.

COLORADO ORCHESTRA; 12.30 A. M.; *dance music;* KOA.

KOA stirs the midnight air with a big dance band.

KFI MIDNIGHT FROLIC; 3.00 A. M.; *musical jamboree;* KFI.

KFI breaks loose with an after-theater show of pretentious proportions. This air entertainment takes the form of an air vaudeville show, with many actual vaudeville entertainers involved.

Sundays

ROXY STROLL; 2 P. M.; WJZ, KDKA, KYW, WRC, WOC, WJR, WBZ, WBZA.

CROSLEY RADIO FEATURE (beginning third week in September); 5.30 P. M.; *Moscow Art Orchestra;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.

The Crosley Radio Hour with the Moscow Art Orchestra calls for applauding with elevated hands and shouts of "Bravo."

ESTEY ORGAN RECITAL; 7.00 P. M.; *organ and vocal;* WJZ, WBAL.

The old WJZ stand-by, with Park Hogan, the official Estey organ concert-master, at the console.

THE CAPITOL GRAND ORCHESTRA (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG, WHAS, WSB, WSM, WMC.

The big Sunday feature, with a 100-piece symphony and all kinds of vocal and instrumental talent turned loose. Major Bowes is Master of Ceremonies. Among Major Bowes' outstanding artists is Wee Willy Robyn, often called the "little man with the big voice."

HOTEL SHELTON CONCERT; 7.45 P. M.; *chamber music and solos;* WOR.

Here is a restful hour of music well fitted to a Sunday afternoon mood.

COOK'S TOURS; 8.00 P. M.; *travelogue with music;* WJZ.

Here's an opportunity to learn something about the other half of the world and how it likes its music.

AMBASSADOR CONCERT; 9.10 P. M.; *chamber music;* WPG.

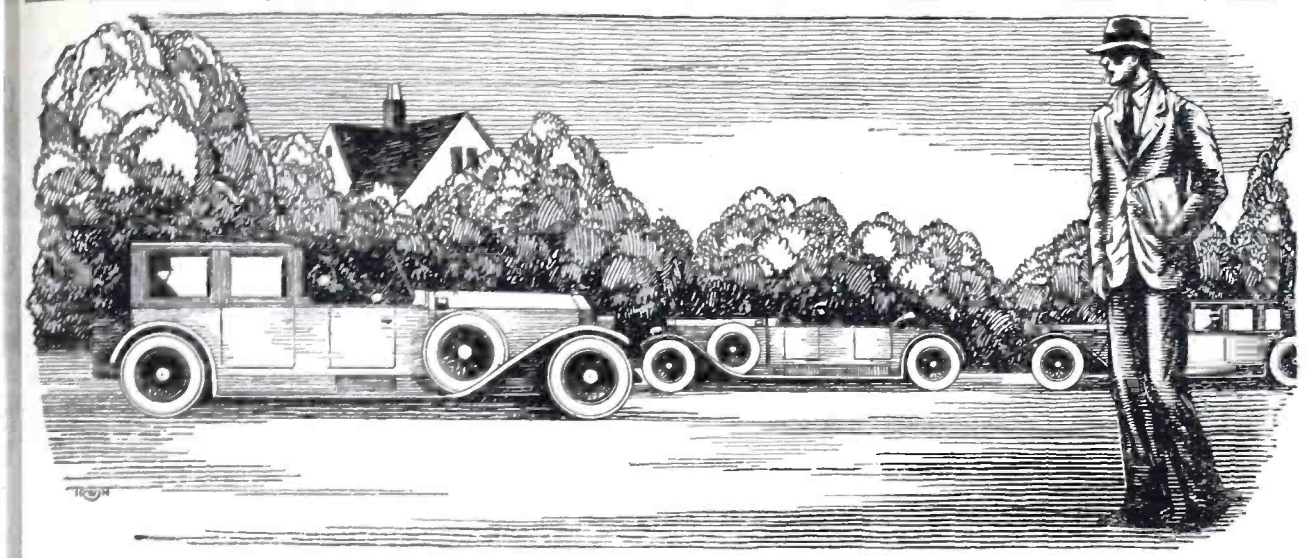
WPG must have a hard time trying to find room for all the Atlantic City hotel orchestras on its program.

ATWATER KENT HOUR; 9.15 P. M.; *star soloists;* WEAF, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSB, WMC.

Although the Atwater Kent Hour is not as good in the summertime as in the wintertime, it is good enough in the summertime to listen to regularly. The conductor is Niccoli Berezowski.

WABC HOUR OF DANCE MUSIC; 11.00 P. M.; *popular dance music;* WABC.

WABC deals in nothing but high-grade dance music.



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

I Thought Success Was For Others

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. K-86, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. K-86, Washington, D. C.

Dear Mr. Smith:

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

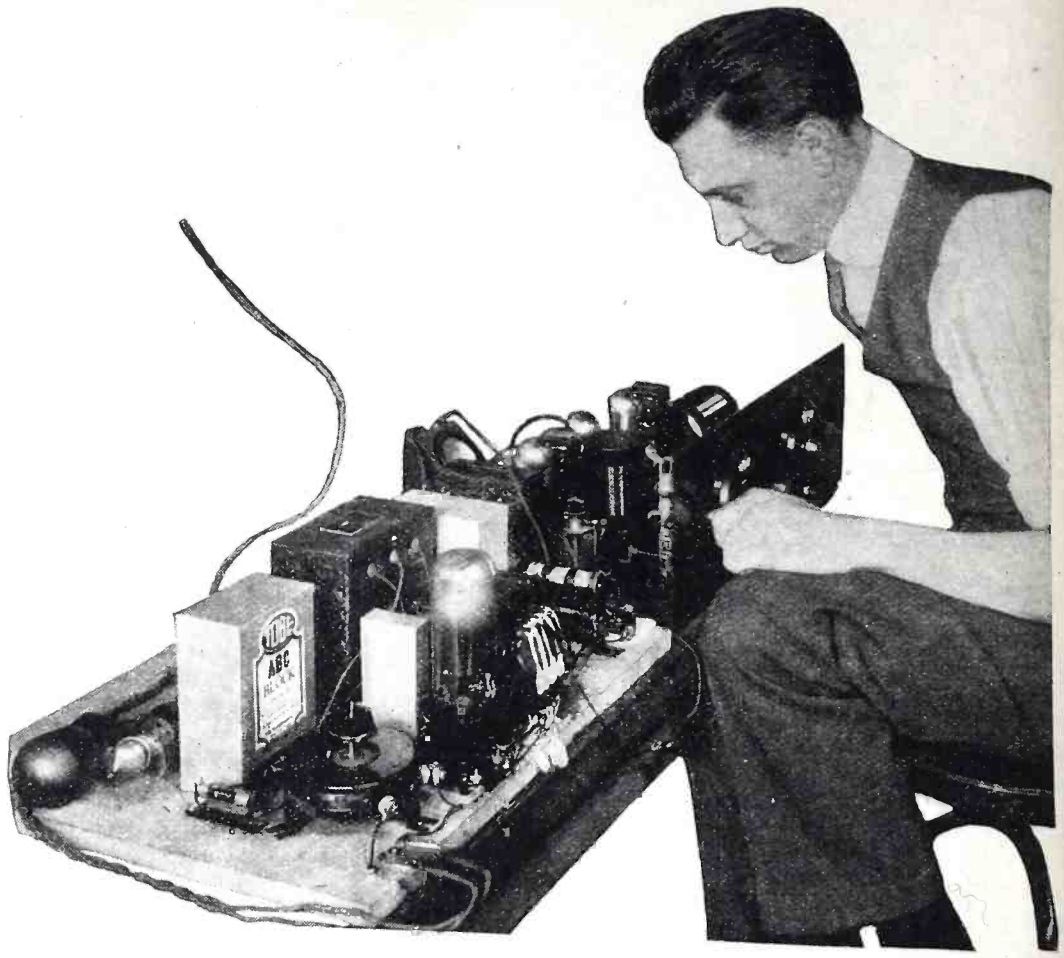
Name.....

Address.....

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

Practical Hints for Operating the New AC Valves

(Continued from page 147)



THE STANDARD BROWNING-DRAKE RECEIVER OPERATING FROM THE Q. R. S. POWER-PACK

FIGURE 8: *The power-pack shown here supplies all the "A," "B" and "C" power necessary for the operation of the receiver. The schematic wiring diagram of the unit shown above may be found in Figure 7. Below is a view of the same unit in which all of the parts are designated with letters that correspond with the list of parts at the bottom of this page.*

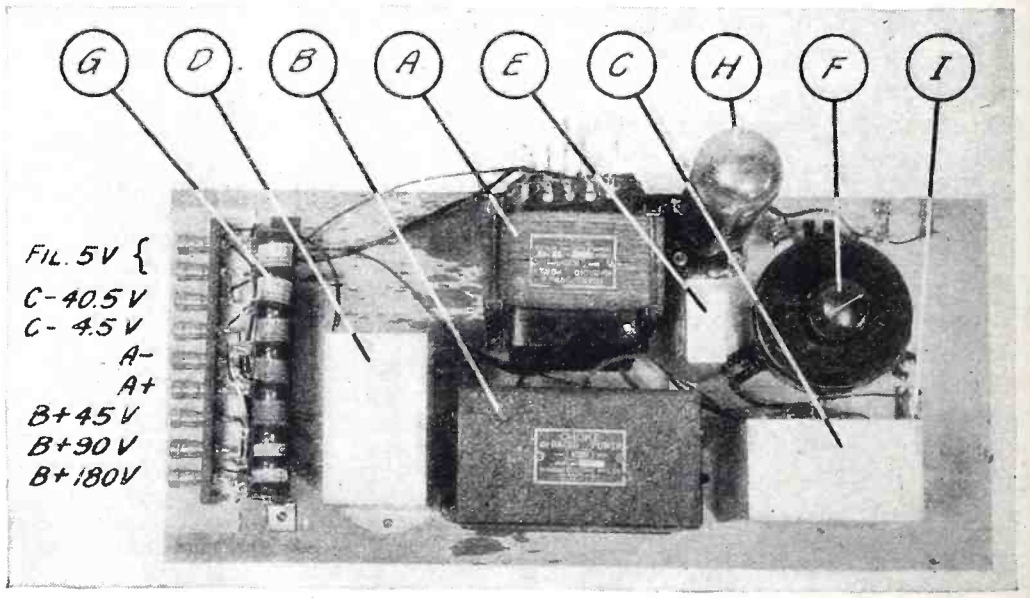


FIGURE 9: HERE IS A LIST OF PARTS NEEDED FOR THIS "ABC" POWER-PACK FOR USE IN FIVE-TUBE RECEIVER OPERATION WITHOUT BATTERIES—

A—Dongan power transformer for 400 m.a. rectifier valve;
B—Dongan choke coil assembly for 400 m.a. rectifier valve;
C—Tobe "ABC" condenser block unit No. 1 for 400 m.a. rectifier valve;
D—Tobe "ABC" condenser block unit No. 2 for 400 m.a. rectifier valve;
E—Tobe special buffer condenser for 400 m.a. rectifier valve;
F—Ward-Leonard vitrohm special variable resistance, 50 ohms at 1 ampere;
G—Ward-Leonard special tapped resistance for 400 m.a. rectifier valve;
H—Benjamin Cle-Ra-Tone vibrationless socket;
1 Amsco fixed resistance, .1 megohm;
1 Q. R. S. 400 milliampere rectifier valve;
2 Fahnestock clips;
1 binding-post strip, 7½ by 1 by 3/16 inch;
1 wooden baseboard, 19 by 9½ by ¾ inch;
9 X-L binding posts.

NOTE: *This "ABC" power-pack is shown here connected to the* NEW *Browning-Drake receiver as described in the April, 1927, issue of* POPULAR RADIO.

A New Form of Radio Waves That Kill

(Continued from page 127)

twig. Some one has compared these masses with the shiny black head of an old-fashioned hatpin. Collect these now; break or cut off the twig containing the egg masses, count them and burn them. For the individuals, schools, Boy Scout Troops and Girl Scout Troops collecting the greatest number, prizes donated by prominent citizens and organizations will be awarded."

This was the message that was received, and which started a peace-time army to work. For three weeks the army labored on. Each Wednesday evening they received new directions from Mr. Burgess.

To stimulate interest a caterpillar parade was started from the State House in Boston and headed for the Pacific Ocean. Taking the measurement of one full-grown caterpillar as two inches, six would be needed to make one foot. Mr. Burgess suggested that the parade start double-file, making twelve caterpillars to the foot. As the egg masses of the tent caterpillar average two hundred and fifty eggs to the cluster, he figured about seventeen feet of caterpillars for every egg mass. For every thousand egg masses destroyed the parade moved forward a little over three and one-half miles.

So week after week the parade went on. Across the breadth of our country, inch by inch, foot by foot, went crawling a line of furry caterpillars. The first week the parade reached New York State, the second week it was out among the Dakotas, and when the contest was ended it was out in the Pacific Ocean, 3,859 miles from the starting place!

Over 1,102,659 egg masses had been destroyed and over 300,000,000 potential caterpillars were robbed of a life of destruction.

The ace of the entire army of workers was Timothy Golden, an eleven-year-old lad of Washington Depot, Conn. He received the degree of "C. C. C." (Champion Caterpillar Collector), and $20 in prizes. His return for the three-week period was over 20,000 clusters, or over 5,000,000 potential caterpillars. He picked the caterpillar nests every day after school and on Sundays, using a long pruner eight feet long.

It has been pointed out by prominent agricultural experts that following the splendid example of Mr. Burgess and the Radio Nature League, the extinction of many of the pests so prevalent in our country to-day may be worked out. Maybe they will, now that Mr. Burgess has shown how the trick may be turned.

RADIO announcers are gittin' t' be jest like temporary chairmen—they seem t' fergit who th' audience is waitin' to hear.

—*Abe Martin* in INDIANAPOLIS NEWS

The obverse of the medal; the original is two-and-one-half inches in diameter.

The reverse; the name of each recipient will be engraved in the space provided.

The Popular Radio Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio, in that it shall be awarded not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An Advisory Committee, which shall co-operate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.
7. The medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.
8. All considerations not specified herein shall be left to the discretion of the Committee of Awards.

All communications to the Committee of Awards may be addressed to—

The Secretary of the Committee of Awards, POPULAR RADIO Medal for Conspicuous Service, 627 West 43rd Street, New York.

The Committee of Awards

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E. F. W. ALEXANDERSON, *Chief Consulting Engineer of the Radio Corporation of America.*
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JOHN R. MOSS, *President, Kiwanis International.*
W. D. TERRELL, *Chief Supervisor of Radio, Department of Commerce, Washington, D. C.*

Thought-Waves *via* Ether

(*Continued from page 113*)

realize that the conditions of this experiment were unfavorable, but will think it possible that every trace of this faculty has not evaporated, among sufficiently sensitive people, even under these untoward conditions. Though surely it must need an odd kind of concentrated attention to arrive, by any means, at the ideas of a small group in a London room, rather than at those of a myriad other people, relatives and others, in every part of the kingdom.

There *is* a sort of hypothesis which might account even for this special kind of information, but it would be regarded by the great majority as too wildly speculative—as perhaps it is.

A Radio Fan Captures a Flying Lunatic

During the World War, Stephan Gasoith was a distinguished pilot in the Hungarian air force. One day, while flying over Ampezzo, he crashed to the ground. He had a miraculous escape from death, but when the wounds in his head were healed it was found that he was bereft of reason.

Through the inattention of a warder, he escaped from his prison and made his way to an airdrome five miles away, where he stole an airplane and swiftly vanished toward the south.

When the alarm was given at the asylum, he was traced to the airdrome, where it was discovered that he had escaped by air. A telephone call to this effect from the airdrome to the Budapest radio station induced the operator to broadcast a warning to all stations that this dangerous lunatic was flying about—somewhere.

In the town of Turnu Severin on the Danube, just below the iron gates at the foot of the Carpathian Mountains, was only one radio set; it belonged to one of the masters at the local *lycee*. This fan's small boy, aged twelve, was listening in that night to see what he could pick up, and he caught the Budapest call.

The boy understood the French message and in great excitement ran to the nearby station where he told the chief of police what he heard.

Orders were given to keep a lookout on the whole district. And as fate would have it, a little over an hour later, an airplane was seen coming over the crest of the Carpathians from the north. It volplaned gracefully down and landed on a flat piece of meadow on the left bank of the Danube, just below the remains of Trajan's bridge. A couple of officials were rushed to the spot in a motor car.

And there stood the lunatic aviator, ruefully examining his stolen motor!

—BERTHA STREETER.

WITH THE EXPERIMENTERS

CONDUCTED BY S. GORDON TAYLOR

A Micro-Condenser Measuring Set

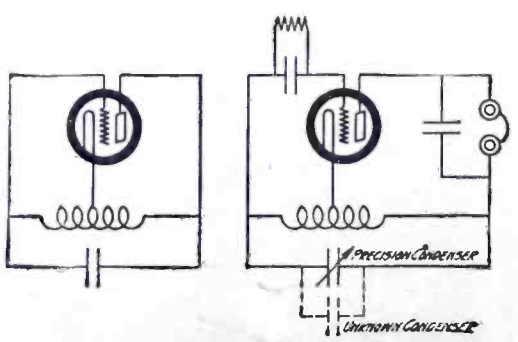
THE determination of very small capacities, such as those which exist between the electrodes in a vacuum valve, is an important matter to the radio experimenter and engineer, and is often inadequately done with a resulting error due to the unsatisfactory methods employed.

For several reasons the ordinary resonance methods are useless in making such measurements.

The usual method of measuring these capacities is known as the "substitution method," in which the output of a high-frequency generator is used to excite a wavemeter circuit. The condenser to be measured is shunted across the main condenser in the wavemeter circuit. Resonance is obtained in this way, as indicated by the thermo-galvanometer. The unknown condenser is then removed and resonance is again obtained. The difference between the two capacity settings of the main condenser is then the capacity of the unknown condenser.

This method is simple and can be applied accurately to large condensers, but when it comes to measuring small condensers—of the order of, say, 50 micromicrofarads or less—the broadness of tuning will introduce inaccuracies which are often greater than the capacity to be measured.

Another method of measurement utilizes the phenomenon of "zero-beat." A high-frequency oscillator is set at a convenient frequency. An oscillating receiver with a pair of headphones in the output is then coupled to it and so tuned that the audible beat between the two is reduced to zero. A calibrated precision condenser is used for tuning the oscillating receiver. The unknown condenser is then shunted across the terminals of the precision condenser, and the capacity of the latter is decreased until "zero-beat" is again obtained. As before, the capacity of the unknown condenser is then equal to the difference between the two capacities of the precision condenser.



A HOOK-UP FOR CAPACITY MEASUREMENT

FIGURE 1: *The diagram shows an oscillator coupled to a regenerative receiver for producing "zero-beat."*

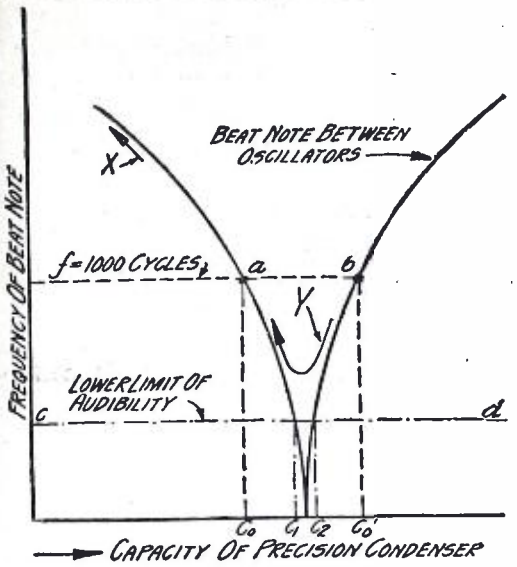
Even in the case where capacity bridges are available the precision obtained depends upon the resistance of the condenser being measured. Due to the fact that these measurements are invariably made at low frequencies (generally 1,000 cycles per second) at which frequencies the resistance of condensers is relatively high, the resistance arms of the bridge must be variable throughout a great range, if the bridge is to be applied to the measurement of condensers of various types.

The method described here is an extension of the "null" or "zero-beat" method described above. It was originally used by Prof. Whiddington of the University of Leeds, England, for use in special research work.

Before describing the method it will be well to point out some difficulties of the "zero-beat" method.

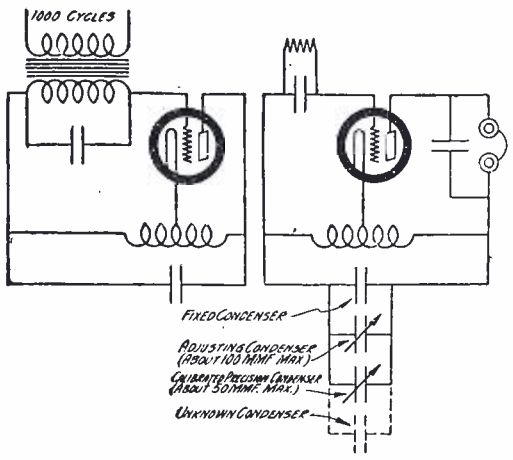
Glancing at Figure 1, we see at the left a fixed-frequency generator. At the right we see an oscillating receiver with a pair of headphones in the output. The precision condenser is tuned until "zero-beat" is obtained. It will be found that as the precision condenser is tuned the beat note will come into audibility as a high note and will then become steadily lower until it goes below audibility. This infra-audible condition will continue as the condenser is turned further until at last the beat note is heard again as a low note. But this time it is rising in pitch until it reaches the upper limits of audibility again.

Now, somewhere between the points where the beat note disappears on its way down, and where it appears again



A CHART SHOWING THE RANGE OF A BEAT NOTE

FIGURE 2: *This chart illustrates the improved method used in balancing two capacities to a greater degree of accuracy.*



A MODIFIED SCHEME FOR CAPACITY MEASUREMENT

FIGURE 3: *The diagram shows a modification of Prof. Whiddington's scheme in which a 1,000-cycle buzzer modulates the output of the fixed oscillator.*

on its way up, is the "zero-beat" point. The silent or infra-audible range occurs when the beat note is below audibility, or below about 32 cycles per second. The amount of change in the capacity of the condenser which is made while passing over this silent range may often be as great as 5 or 10 micromicrofarads; so it is evident that in measuring vacuum valve capacities the error may be as great as the unknown capacity itself.

This idea is represented graphically, in an exaggerated way, in Figure 2. The curve shows how the beat note varies as the tuning condenser is varied. The broken horizontal line *cd* is the lower limit of audibility. The graph shows clearly that no beat note will be heard between the values C_1 and C_2 of the tuning condenser, and since it is difficult to tell just when we lose track of the beat note and when we hear it again, we cannot even tell approximately where the "zero-beat" occurs.

This difficulty is avoided by using a *datum frequency* as *f* on Figure 2. This may conveniently be placed at 1,000 cycles, as this is generally available in most laboratories. This *datum frequency* is made to beat against the beat note produced by the two high-frequency oscillators. When the beat note (due to the oscillators beating together) is not exactly 1,000 cycles, a secondary beat will be heard, just as if we had two sounds differing in frequency by a small amount.

As a matter of fact, this is what Prof. Whiddington did; he amplified the beat note of the oscillators and passed it into a loudspeaker. Then another frequency, such as 1,000 cycles, was made to operate a second reproducer. When the reproducers were placed close together; beat notes were heard.

The method is therefore apparent. By noting the disappearance of the secondary beats from the two horns, the oscillators are adjusted until the beat note coincides exactly with the 1,000-cycle note. Then the condenser to be measured is connected in shunt with the precision condenser in the oscillating receiver and the latter is again adjusted until the secondary beats again disappear. The difference between the two capacities of the precision condenser is then exactly equal to the unknown capacity. In making such measurements one must be careful to stay always on the same side of the "zero-beat" or silent spot. The reason for this may be seen in Figure 2.

Suppose we have the unknown condenser connected to the precision condenser and we resonate the beat note with the 1,000-cycle note, making the secondary beats zero.

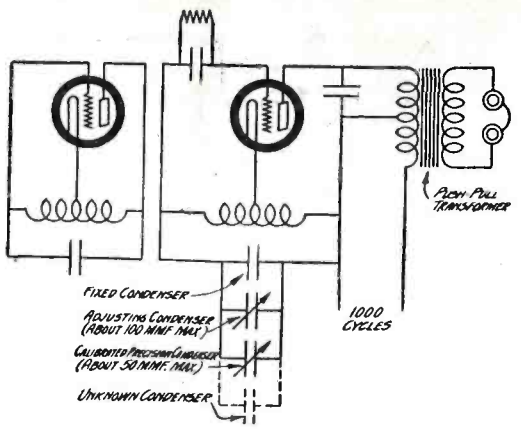
This places us at the point *a* of Figure 2.

Next, we remove the unknown condenser. The total capacity being decreased, the beat note will rise as indicated by the arrow *x* and, in general, will go out of audibility. In order to bring the beat note back to where it was, the capacity of the precision condenser must be increased to the value C_0, corresponding to the point *a*. If by mistake we cross the silent region C_1-C_2 and resonate to the point *b*, we shall make an error in the measurement equal to the difference between C_0 and C_1.

On the other hand, if we resonate at *b* with the unknown condenser "on," when we remove the latter the beat note will travel as indicated by the curved arrow *y*, and in order to come back to *b* we shall have to pass over the region of silence.

This may appear to be complicated, but after a few trials it will be found to work out simply, especially because the error created by making a wrong choice of the points will be so great as to tell us immediately of that error.

Furthermore, we generally have a fair idea of what the unknown capacity is going to measure. For instance, in vacuum valves of the ordinary type, we can expect to have capacities somewhere



ANOTHER MODIFICATION OF FIGURE 1

FIGURE 4: *This diagram shows a method for utilizing a push-pull transformer for mixing the beat note and the 1,000-cycle note used in obtaining a precision balance.*

between 5 and 20 micromicrofarads.

The method of using the two reproducers is not entirely satisfactory, not only on account of the extra equipment necessary, but also because the secondary beats may not be defined sharply enough. There are two modifications of Prof. Whiddington's scheme in use by the writer, both of which have been found satisfactory. In the one case the fixed oscillator at the left of Figure 1 is modulated by the 1,000-cycle buzzer in any of the customary ways.

This is illustrated in Figure 3.

The other method is illustrated in Figure 4.

In the latter case a push-pull transformer is used as a mixing transformer for combining the beat note and the 1,000-cycle note. The two notes are by this means heard simultaneously in the phones, and the secondary beats are sharply defined. As a matter of fact, it is possible to distinguish even a few of the secondary beats resulting from the harmonics of the 1,000-cycle buzzer and of the oscillators.

The next item to consider is the precision condenser.

The one used by the writer and found to be satisfactory is a semicircular two-plate variable condenser having a maximum capacity of about 50 micromicrofarads. This was calibrated at several points by making extremely careful measurements on a capacity bridge. A semicircular plate condenser was selected in order to be sure that the calibrating measurements fall in a straight line. The condenser should not be used on the first and last ten divisions of the dial.

The oscillating receiver is adjusted to approximately the same wavelength as the oscillator by means of the fixed condenser. A two-plate condenser is used to make the initial adjustment for zero secondary beat. The procedure is as follows:

Set the precision condenser fairly high on the dial; tune the adjusting condenser until zero secondary beat is obtained. Connect the condenser to be measured in shunt with the latter and tune the precision condenser until zero secondary beat is obtained again. The amount which the precision condenser has to be changed is equal to the capacity of the unknown condenser.

The set built by the writer is used most for obtaining the capacity of vacuum valves, and for this reason a valve socket was mounted on the panel and a switching arrangement provided in order to connect the various elements in shunt with the precision condenser. All the wiring must be made rigidly, and every time a switch is thrown the initial adjustment must be made again. The instrument is extremely sensitive to small changes of capacity; the change of capacity of a single piece of wire 5 or 6 inches long attached to one terminal of the precision condenser can be easily detected. Using a 50 micromicrofarad condenser, it will be seen that a quarter of a division change means ⅛ micromicrofarad change. The accuracy of the measurements depends upon how accurately the precision condenser has been calibrated.

Care must be taken that body capacity does not influence the measurements. In the set-up used by the writer, 12-inch bakelite rods were used to operate the dials.

The instrument proves to be serviceable and accurate. Furthermore it is easy to operate; a single measurement requires only about half a minute to make. The whole test set is housed in an ordinary radio receiver cabinet.

—SYLVAN HARRIS.

Rejuvenating Weak "B" and "C" Batteries

RADIO "B" and "C" batteries that are partly run down can be temporarily pepped up by drilling a series of small holes into the battery and then filling the holes with a solution composed of either sal-ammoniac, vinegar, or diluted sulphuric acid. The battery should be allowed to stand idle for several hours before using, after which additional acid should be added. The holes can be plugged up with sealing wax or soft soap.

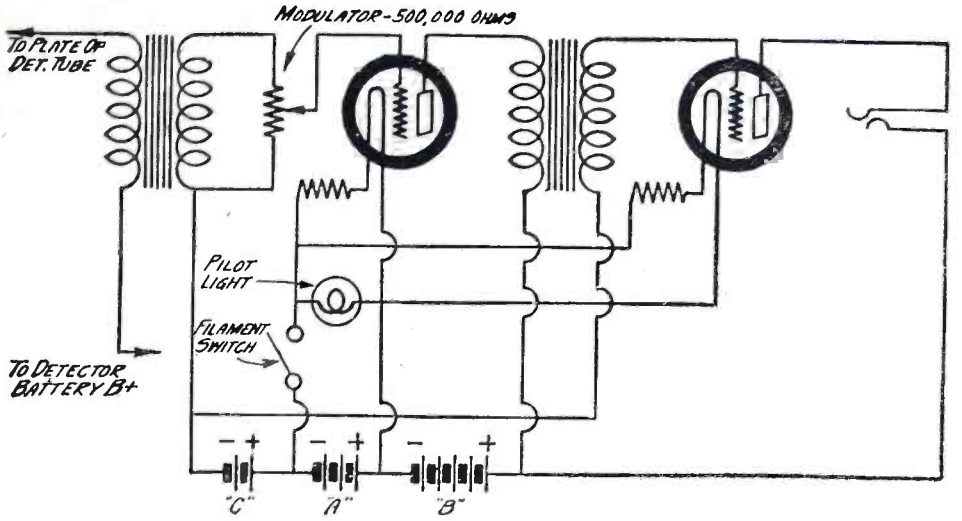
—L. C. FERGUSON

Corroded Connections Decrease Sensitivity

I EXPERIENCED some trouble with the coils of the LC-27 receiver that I built when the hollow rivets that hold the soldering lugs became corroded. The corrosion made them poor conductors and the sensitivity of the receiver decreased accordingly. I scraped the terminals and soldered them over again, taking care to solder rivets, lugs and wire into a solid connection.

As a result the set is now working better than ever and is more selective.

—J. E. FAUNCE.



A COMBINATION DEVICE THAT SIMPLIFIES RECEIVER OPERATION

FIGURE 5: *A single control operates the modulator at the upper left of the diagram and the filament switch below it.*

Audio Volume Control

SIMPLICITY is the vogue in modern set design. The new switch-type modulator is one of the latest devices with that object in view. It can be added to any type of low-frequency amplifier, and will provide a volume control, besides taking the place of the regular filament switch. If some form of automatic filament control is used, this improved modulator is the only control that is necessary to be put on the panel of the amplifier. The modulator is a potentiometer which has a resistance that can be varied from zero to 500,000 ohms, thus giving complete control over the degree of amplification. A switch that automatically turns the filaments of the tubes "on" and "off" is incorporated in the new modulator. When the modulator knob is turned to the left, it brings the grid connection nearer to the filament end of the resistor winding and decreases the volume. The filament circuit is broken when the modulator knob is turned to the extreme left. When the blade is in the center of the resistor, the volume is one half the full value. Rotating the modulator toward the right lights the filaments of the tubes and increases the volume. When the knob is turned to the extreme right, the amplifier is operating at its full output. The modulator is connected in a transformer-coupled amplifier in the manner shown in Figure 5. If the amplifier uses impedance or resistor coupling, the resistor winding of the modulator can be substituted for the grid-leak on the second tube and the blade of the modulator connected to the grid of the same tube. All that is needed on the panel of a low-frequency amplifier is a modulator of this type, and a single filament-control jack connected to the output of the amplifier. A pilot light connected across the filaments of the tubes and mounted behind a ruby lens in the panel will serve to show when the tubes are lighted, so that there will be no chance of the operator accidentally leaving the set on.

—CHARLES F. FELSTEAD.

Improving the High-Frequency Receiver

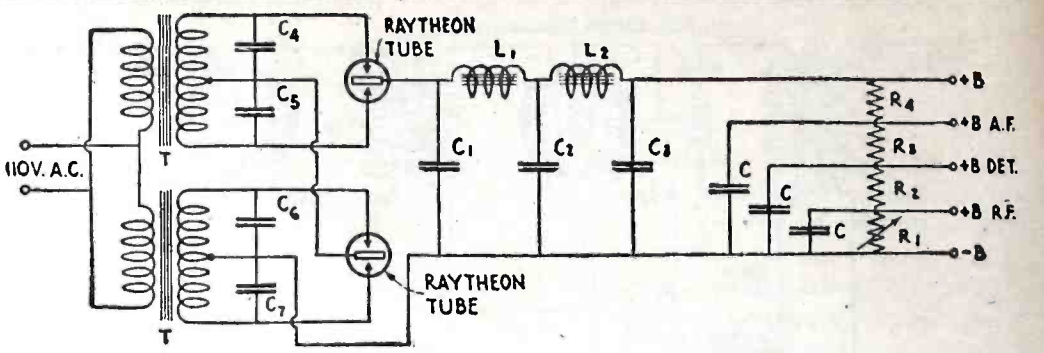
THE present-day high-frequency receiver leaves little to be desired in the way of simplicity, selectivity and sensitivity, provided it is properly built, balanced and perhaps shielded when employed in cities and particularly in the vicinity of powerful broadcasting stations. However, to realize the utmost sensitivity and volume it is sometimes helpful to be able to adjust the plate voltage of both the high-frequency and the detector valves. In fact, many of the present-day manufactured receivers of the high-frequency type are employing variable plate voltage for at least the high-frequency valves.

High-frequency valves are very susceptible as regards the effects of carefully adjusted plate voltage. Instead of employing 67½ or 90 volts, as is the standard practice, it will be found advisable at times to increase the voltage to well over 100, particularly when striving for generally weak signals. On powerful signals, on the other hand, it may be advantageous to reduce the high-frequency plate voltage to 45.

A most satisfactory arrangement in this connection, irrespective of the type of high-frequency receiver, is to tap the full B-battery output for the high-frequency amplifier plate circuits with an efficient variable resistor. This should be connected between the battery terminal and the high-frequency "B" plus (+) terminal of the receiver.

The variable plate voltage for the high-frequency tubes provides a definite means for compensating between the overload signals from the local broadcasters and the very weak signals from distant stations, by a suitable balancing of the plate voltage.

—CHARLES GOLENPAUL.



A POWER UNIT HOOK-UP FOR HIGH PLATE SUPPLY

FIGURE 6: *The diagram shows a schematic hook-up for a power supply unit that utilizes two rectifier valves to furnish up to 435 volts DC at 85 milliamperes for plate potential.*

Rectifier Tubes for High Plate Supply

As the trend in receiver design seems to be toward higher operating voltages, especially in connection with the UX-210 or CX-310 types of super-power amplifier valves, there is often a desire for doubling the voltage of the usual Raytheon radio power unit. The outputs of two standard Raytheon rectifier valves, connected in series as shown in Figure 6, will furnish plate voltages up to 435 volts DC at 85 miliamperes, when using the type BH Raytheon.

In the set-up shown in this figure, standard designs of transformers and choke coils are employed—the same that are found in the usual "B" power unit employing a single valve. However, two transformers are required, one for each rectifier valve.

The condensers are of the same values as in the standard Raytheon circuit, namely, C-1 and C-2, 2 mfd.; C-3, 8 mfd.; C-4, C-5, C-6 and C-7, 0.1 mfd. However, the condensers should be designed for a *working voltage of* 750. The necessity of having condensers designed and built for this working voltage is to take care of the high voltage which would be delivered if there were no load on the radio power unit, such as when the filament of the UX-210 power valve is not lighted. In fact, care should be exercised that the filament of the power valve is always turned "on" while the "B" power is turned "on." If the "B" power and filament circuits are under one control, this is automatically arranged for; otherwise, peak voltages, even in excess of 750 volts, may be encountered, severely straining the filter condensers, when the radio power unit is working on no load.

The filament of the UX-210 may be operated from raw alternating current supplied by a separate transformer capable of delivering a current of at least 1.25 amperes at 7.5 volts.

While the grid bias can be obtained for the power tube by means of a suitable resistance drop, it is simpler to employ a tapped "B" battery with from 28 to 35 volts in the grid circuit. Since there is virtually no drain on the battery, it should last for a year or more.

Various voltage taps may be obtained by the use of suitable resistance units and by-pass condensers as shown in Figure 1. The resistance bridge may consist of any one of several output resistance units now on the market for use with high-voltage power-packs.

Remarkable volume, together with extreme depth and utmost realism, may be obtained through the use of the UX-210 valve, operating with this double Raytheon arrangement. There is ample voltage available for operating a high-power resistance-coupled amplifier with the UX-210 power valve in the final stage.

—LAURENCE MARSHALL

The Life of Paper Condensers

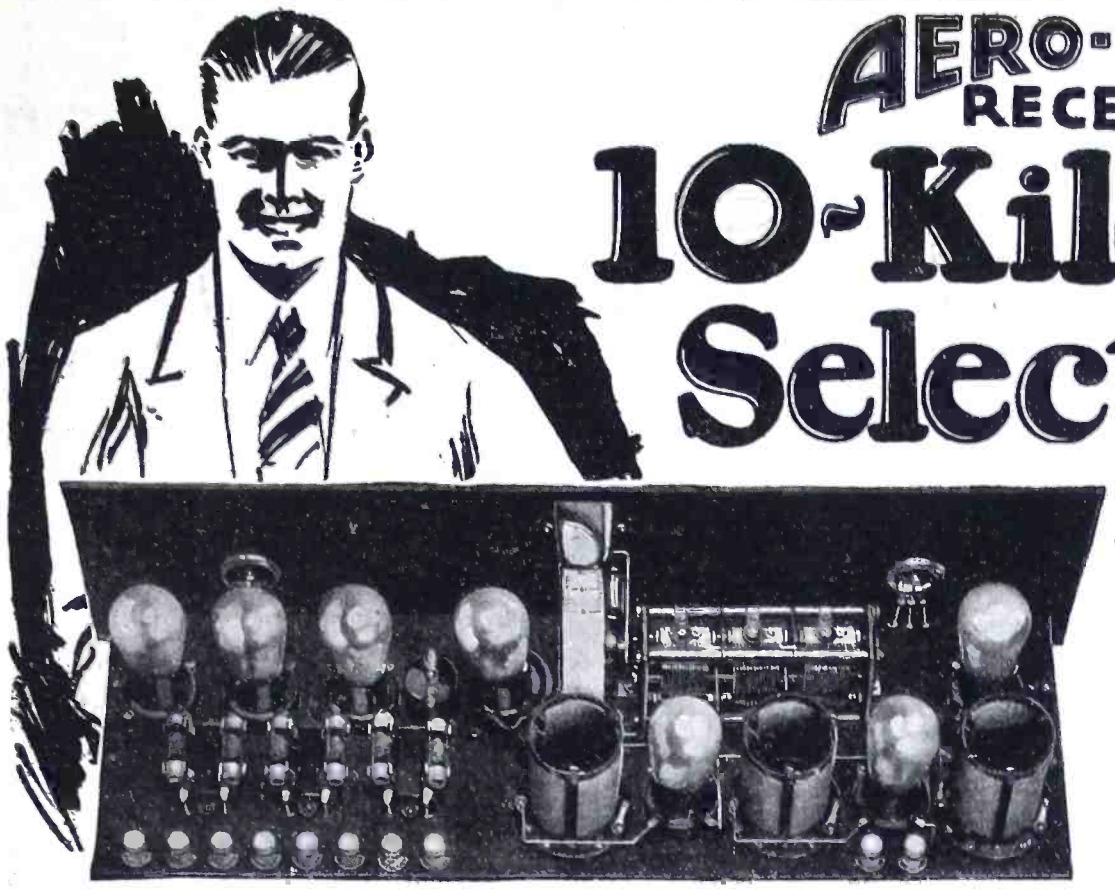
PAPER condensers do not last forever. They have a definite life based on their materials, construction and design, and on the use or abuse to which they are subjected. Mica condensers, by contrast, have a virtually non-ending life, due to the small load handled in proportion to the strength of the dielectric.

The properly designed and constructed paper condenser, properly applied within its rated voltage, should last over a long period. Good paper condensers, for instance, are designed and constructed for a minimum of 10,000 hours of service at their rated voltage. In actual life tests these condensers usually last for a period corresponding to from 30,000 to 60,000 hours of actual service. In normal use, a minimum life of 10,000 hours represents ten years of typical radio service.

There is no piece of electrical apparatus that is more susceptible to the evil effects of overload than the paper condenser. In fact, a 10 per cent overload on the paper condenser cuts down the life by 50 per cent. If the voltage is doubled, the life is reduced to one-thirtieth of the normal life.

In order to secure long life from the paper condensers used in any assembly, the condensers employed should be of a *working* voltage rating that is ample for the work to be done. It is even preferable to use oversized paper condensers. Under no circumstances should undersized condensers be employed.

—HARRY F. HOUCK.



AERO-SEVEN RECEIVER

10-Kilocycle Selectivity

Utilizing New 340 Tubes

Unique Features

The Aero-Seven Receiver, which is being featured in the prominent radio magazines and newspapers, is a new tried and tested tuned R. F. circuit, incorporating the most modern radio improvements at a popular price. It is a distinct innovation in a tuned R. F. receiver, utilizing three stages of R. F. and three stages of resistance-coupled audio. Circuit is built around the famous improved Aero Universal Coils, with improved Amsco S. L. tuning 3-gang condenser, S-M single-control drum dial and the tried and tested parts of other famous manufacturers. Such names as Carter, X-L, Westinghouse, Aero, Amsco and Silver-Marshall assure you of a circuit that is the final word in perfection.

Distinct features are: the new Hi-Mu tube at input and in R. F. stages, potentiometer control, higher amplification, 10-kilocycle selectivity and true single control.

The Aero-Seven has a broadcast range from below 200 meters to over 550 meters (1500-500 kc) and requires no shielding as with the small Aero coils, direct pick-up is negligible and coupling between coils is the very minimum. The coils are twice-matched at both high and low frequencies of the broadcast band, thus eliminating many difficulties in single dial control and overcoming one of the principle causes of disappointments.

The adjustable compensators on the Amsco condensers facilitate the equalization of circuits, solving the major problem of tandem tuning.

The extremely sharp selectivity of the Aero-Seven circuit is due to the low resistance of the coils. The high voltage gain per stage, due to the extremely low loss construction, assures extreme distant reception and greatest volume and sensitivity is assured through the high efficiency of the coil windings.

New and Unique Hookup 3 Stages of Radio Frequency 3 Stages of Audio Amplification

The Aero-Seven has a new and unique hook-up that incorporates three stages of R. F. and three stages of Audio. There are two stages of tuned radio frequency and a special coupling stage, the secondary function of which is to prevent antenna detuning, thereby giving single control which is both theoretically and practically perfect. This independent antenna circuit is of a new and efficient design and employs a resistance connected between the antenna and ground inputting to the first grid circuit. Five CX340 tubes are used—3 in the R. F. circuit, one detector and one in the audio.

In the three audio stages, one 171 power tube is used, one 201A tube and the one CX340 tube in the input.

The circuit, therefore, is different from the usual 7-tube R. F. circuits, which variations contribute to its optimum selectivity, perfect quality and thrilling volume.

The combination of all the various parts, the matching of the Aero Universal Coils, together with the Amsco compensating 3-gang condenser, with true single control and potentiometer control, greatly simplifies operation and tuning, while adding efficiency to the circuit.

First Use of New CX340 Tubes— 1-6/10 Times Better

Utilizing the new CX340 Cunningham tubes in place of the usual 201A, gives the Aero-Seven the distinction of being the first circuit using this superior method. CX340 tubes are 1-6/10 times more effective than 201A tubes, having a 5-volt filament and .25 amperes; plate, 180 volts maximum. In this receiver 90 volts is used constantly on the plate for the R. F. circuit, something seldom attempted but efficiently worked out here. It is a High Mu tube, having a high amplification factor (Mu-30) and is used both as a detector and as a radio and audio amplifier. The Aero-Seven is specially designed to operate with this new and better CX340 tube and the results secured will be a pleasing revelation to you. It is surprising what tone and volume is secured with a minimum use of current.

Resistance Coupled Audio Amplification

Resistance coupled audio amplification in the Aero-7 attains a quality of reproduction unapproachable in other systems. It preserves the extraordinary quality consistently achieved by Aero-7's 10-kilocycle selectivity.

10 Kilocycle Selectivity Now a Real Fact

Ten kilocycle selectivity is OPTIMUM Selectivity. It means a receiver that tunes sharply enough to eliminate interference and yet does not tune so sharply as to cause distortion. It is the ideal tuning characteristic. "Optimum tuning," says the engineer, when he means a perfect set.

Why bother with anything but the best? Why put up with anything but 10-kilocycle selectivity, as represented in the Aero-Seven circuit?

Due to the low-loss construction of the coils and condensers in the Aero-Seven and the great selectivity introduced into the circuit itself, you get selectivity so sharp that you cannot get two stations at one time under present broadcast regulations, at the same time providing adequate frequency margin to prevent high "cut off"—distortion.

Imagine what this means in perfect radio reception. Selectivity, the ability to time in clearly, sharply, without fear of disturbance in getting the station you want whenever you want it—that's something every radio fan has long desired. It is an actuality in the Aero-Seven—a feature that is necessary in an up-to-date circuit—a feature that you get in the Aero-Seven when you build it.

New, Modern, Proved Features in Aero-Seven

10 Kilocycle selectivity.
Resistance coupled amplification.
Uses new CX340 tubes instead of 201A.
3 stages of R. F.
3 stages of audio amplification.
Extreme D-X reception.
Potentiometer control.
Silver-Marshall single drum dial.
True single control.
Aero Coils are twice matched at both high and low frequencies.
Amsco adjustable condensers.
Carter resistances.
Westinghouse Foundation Unit.
X-L Posts.
High quality parts throughout.
Range below 200 to above 550 meters (1,500-500 KC).
Low loss characteristics throughout.
Perfectly compensated—variation in antenna circuit doesn't affect it.
Wiring underneath sub-panel.
Simple construction.
Easy to build in quick time.
The most popular-priced 7-tube circuit.

See article in this issue

The Aero-Seven-tube Receiver assures you of the very latest in radio. It has everything—beautiful tone, 10 kilocycle selectivity—extreme long range and a volume at your command that can be raised to music-hall proportion or lowered to slumbering whispers. The particularly meritorious application of resistance coupling creates a most remarkable tone. It gives you a receiver that is in a class all its own—a real conqueror of space—a companion that you can depend upon absolutely in any emergency. It delivers quality that is quality, and yet its construction is so low in cost as to be almost unbelievable.

An Opportunity for Set Builders

The set builder will find the Aero-Seven a most profitable receiver to build. It is an extremely simple circuit—efficient, high grade and having a record of exceptional performance. It could hardly be duplicated in a factory-built set at double the cost.

You can make big money building this set for your friends and get a real "kick" out of it yourself.

Complete parts, drilled and engraved panels and foundation units are being distributed through the jobbing trade and are available at leading radio stores everywhere. If your dealer cannot supply you, order direct giving your dealer's name and we will see that you are supplied promptly.

A full-size working blueprint and booklet of assembly and operating instructions with complete data is furnished, which makes it both practical and easy to build this circuit quickly. Build yours early—get the jump on the other fellow.

Get the facts. Mail the coupon and 10c stamps for this valuable booklet. Send today—NOW!

Aero Products, Inc.
Dept. 209, 1768 Wilson Ave., Chicago.

Dear Sirs: Enclosed find 10c for which please send me life-size blueprints, assembly diagrams, construction data and all the facts in building the new Aero-Seven Receiver.

Name .....

Address .....

Get the Facts—MAIL NOW→

AERO PRODUCTS, INC.
1768 Wilson Ave., Dept. 209, Chicago, U. S. A.

Associated Manufacturers—Amsco, Aero, Carter, Westinghouse-Micarta, Silver-Marshall, X-L

IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

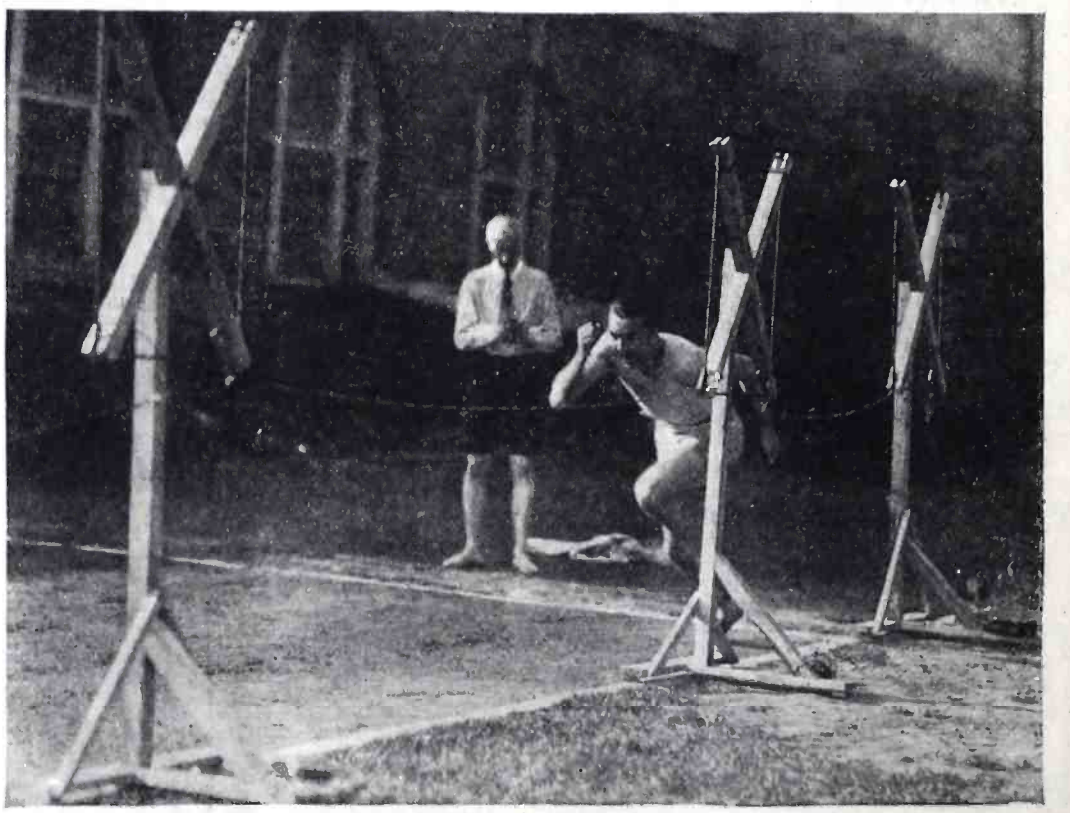
Timing Racers by Radio

PROFESSOR A. V. HILL, distinguished physiologist of the University of London, now lecturing at Cornell University at Ithaca, New York, has contributed to American athletic sports both some new devices and some new ideas. Among the devices is a novel apparatus for timing the races, not only at the finish, but at as many points as desired along the course. This is done by an electric method, depending essentially upon radio waves.

Among Professor Hill's new ideas is one that the performance of a racer, and the record that he can make, will be determined not by any such indefinite factors as "will-power" or "endurance," but by the facts of physiological chemistry—especially by the ability of the racer to supply oxygen to his rapidly breathing muscles during the race.

For several years Professor Hill has been studying this matter of the expenditure of oxygen in the muscles during exercise. The details of the research lie outside the scope of this Department, but it may be said, in briefest outline, that the essential thing is the formation and disposal of a chemical called lactic acid—the same acid that is formed in milk when it sours. This lactic acid is produced in the muscles during exercise. It is disposed of by being oxidized, the necessary oxygen being supplied by the blood. There is also a muscle "food" material, named glycogen. This must be supplied; the lactic acid must be removed.

The bodily machinery for doing these things includes the heart, the blood, the lungs, probably certain glands, and so on. For details, the interested reader must consult Professor Hill's numerous



J. P. Troy, Ithaca

HOW ELECTRIC WAVES ARE USED TO MEASURE THE SPEED OF ATHLETES

The runner carries a small magnet, sewed into his clothes. As he passes each of the wired frames alongside the track the inductive action of the magnet produces a pulse of current in the wire. These pulses are registered on an electric chronograph to which the connecting wires run. In the center, with the notebook, is Professor A. V. Hill, of London, who has been experimenting with this apparatus at Cornell University, Ithaca, New York.

papers, mainly in the *Proceedings of the Royal Society* (London), or some recent textbook on physiology.*

The Department of Chemistry of Cornell University, presided over for many years by the distinguished American chemist, Professor L. M. Dennis, has the good fortune now to possess the Baker Fund, the purpose of which is to bring to America, at intervals, distinguished foreign scientific men who become for a time guest professors and lecturers at Cornell. Professor Hill is here as one of these scientific visitors. While at Cornell he has been extending his work on muscles and other bodily structures† and has put his ideas to the test of practice with members of the Cornell track team and with other athletes of the university.

To readers of POPULAR RADIO the most interesting part of Professor Hill's American investigations will doubtless be the methods devised for timing the exact speed of a runner between any two selected parts of the course.

The usual methods of a tape stretched across the course cannot be used, except at the end of the race, without interfering with the runner, nor are such methods accurate enough for the timing of speed over short portions of the whole race. Human observers, stationed along the course with stop-watches, cannot be depended upon for very small time differences. Errors by the observers are always probable, and there is the "reaction time" needed by each observer to see the runner pass and to press the stop-watch, all of which must be taken into account and corrected for. An electric method is far better.

The electric system installed for Professor Hill's experiments at Cornell is shown in the accompanying illustration. Frames, like loop antennas for radio use, are set up alongside the path which the runner will traverse. The passage of the runner affects, momentarily, the constants of such a loop circuit. This may be registered as an electric signal on recording apparatus at any convenient point.

Although the records actually obtained by Professor Hill were made with an ordinary direct-current galvanometer, it is obvious that any one of many methods of detecting and recording the inductive disturbance of the passing runner might be used. Body capacity effects are perhaps the easiest ones.

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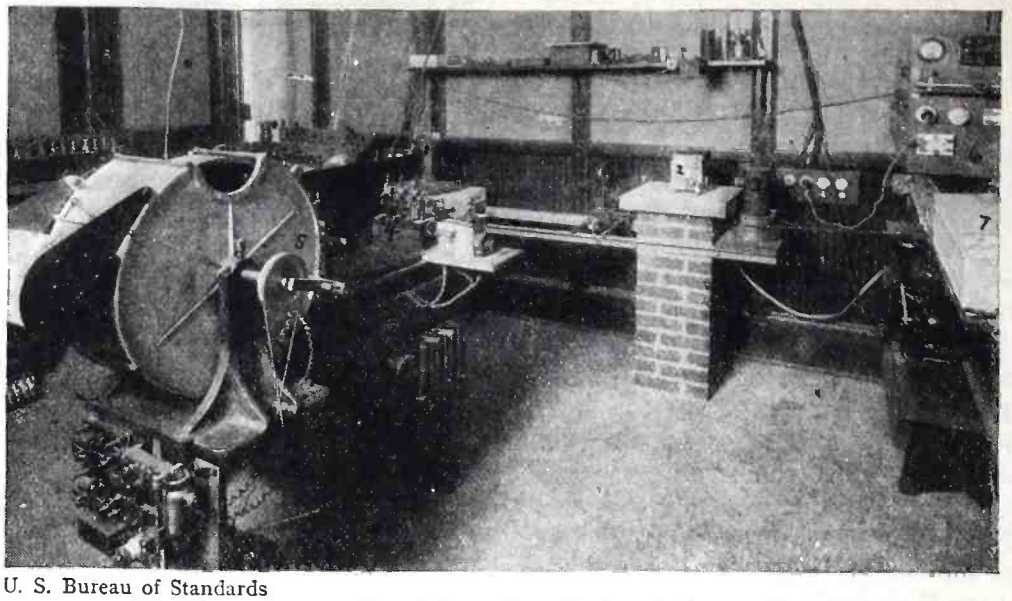
* The best recent text, in English, is "Principles of Human Physiology," by the late Professor Ernest H. Starling. Fourth edition, 1926, 1074 pages, Lea and Febiger, Philadelphia, Penna. A good account of recent investigations on the physiology of muscular action will be found also in "Recent Advances in Physiology," by C. Lovatt Evans. Second edition, 1927, P. Blakiston's Sons and Co., Philadelphia, Penna.

† His success in measuring the exceedingly tiny amounts of heat emitted by a living nerve when a nervous message passes over it was described by Professor Hill at the meeting of the National Academy of Sciences at Washington, D. C., in April, 1927. See *Science* (Lancaster, Penna.), volume 65, page 452 (May 6, 1927).



U. S. Bureau of Standards

WHERE THE PENDULUM TIMES THE TUNING FORK

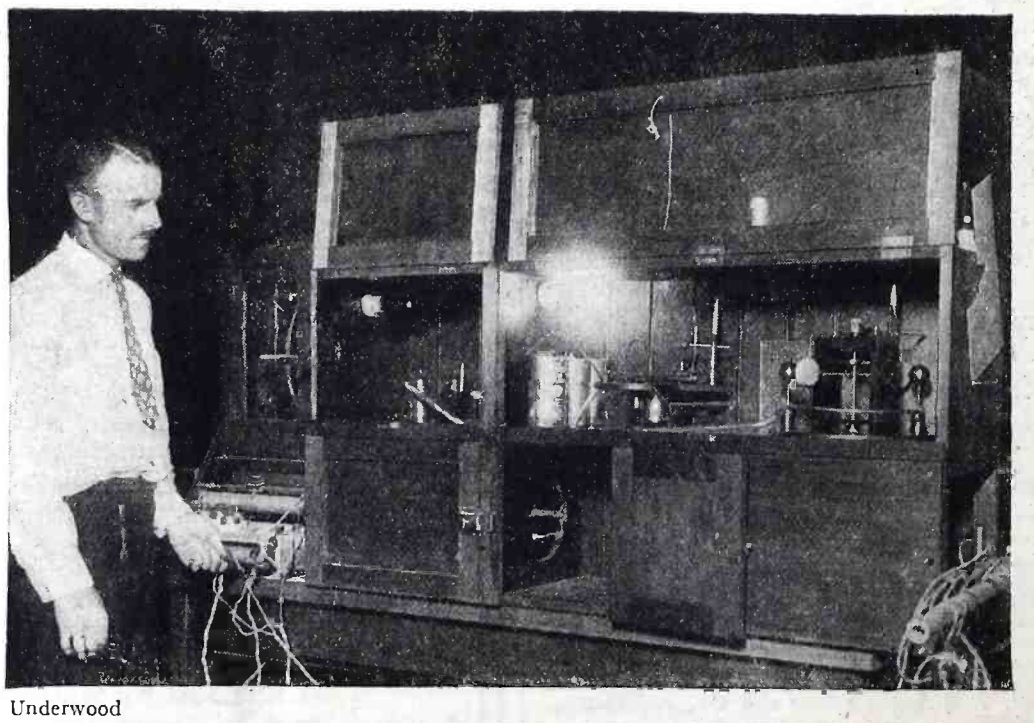
The fundamental standard of audio-frequency provided by the new work at the Bureau of Standards is a short pendulum which swings inside a vacuum in the small case resting on the brick pillar and marked 2 in the photograph. At the right of this is the case, marked 3, containing the photoelectric cell. The figure 4 indicates the oscillograph by which the records of fork and pendulum are combined, and 5 marks the camera which photographs the joint record.

Taming the Tuning Fork

ALTHOUGH several standards of audio-frequency are available, the most convenient remains the tuning fork. It is interesting to record, therefore, that the Sound Section of the United States Bureau of Standards has perfected a method of comparing the frequencies of tuning forks with that of a swinging pendulum, with an accuracy involving a probable error of less than one part in 40,000. The results are published by Mr. Philip P. Quayle,* of the Bureau, already well known from his work, two years ago, in photographing the flight of bullets.

A freely swinging pendulum, like the pendulum of a clock, is probably, as Mr. Quayle remarks, "the most accurate timekeeper known at present." With proper precautions as to swinging in vacuum, the elimination of outside forces and vibrations, and so on, such pendulums are used not only for the precise clocks of the astronomical observatories, but for the determination of gravity and for many other physical and chronological purposes. Ordinary pendulums swing, however, in a period of from one second to a fifth of a second, or only a little less. The comparison of these relatively slow vibrations with the two hundred or three

* "A Note on the Measurement of Small Time Intervals," by Philip P. Quayle. *Journal of the Franklin Institute* (Philadelphia, Penna), volume 203, pages 407-412 (March, 1927). POPULAR RADIO is indebted to Director George K. Burgess, of the Bureau of Standards, for further information concerning Mr. Quayle's investigations, as well as for one of the photographs reproduced herewith.



Underwood

WHERE FLYING BULLETS HAD THEIR PICTURES TAKEN

Mr. Philip P. Quayle, who recently perfected the Bureau of Standards' method of comparing the vibrations of a tuning fork with the swings of a pendulum, attracted attention some months ago by photographing bullets shot from a gun. This photograph shows him with the camera which accomplished this remarkable feat.

hundred vibrations a second of the usual tuning fork offers great difficulties. Tuning forks are used, in turn, to standardize other rapidly vibrating systems, like musical instruments or low-frequency oscillators. That is why it is so desirable to have a precise way of comparing the rate of a tuning fork with the slower, but more dependable, pendulum.

This is what Mr. Quayle and his associates in the Buréau of Standards have accomplished. A standard pendulum, of the type used by the United States Coast and Geodetic Survey for the determination of gravity, was allowed to swing back and forth between a source of light and a sensitive photoelectric cell of the potassium-hydrogen type manufactured by the General Electric Company. Each interruption thus created in the light beam produced a stoppage of the electric current through the photoelectric cell. This electric effect, after amplification by vacuum-tube amplifiers, was impressed on the record of an oscillograph, which was also recording the vibrations of the tuning fork. This photographed on the same film a record of the pendulum strokes and a record of the vibrations of the fork.

Thus the number of fork vibrations between each two swings of the pendulum could be determined with a high degree of accuracy, providing what is probably the most accurate, as it is certainly the most direct, method of comparing them.

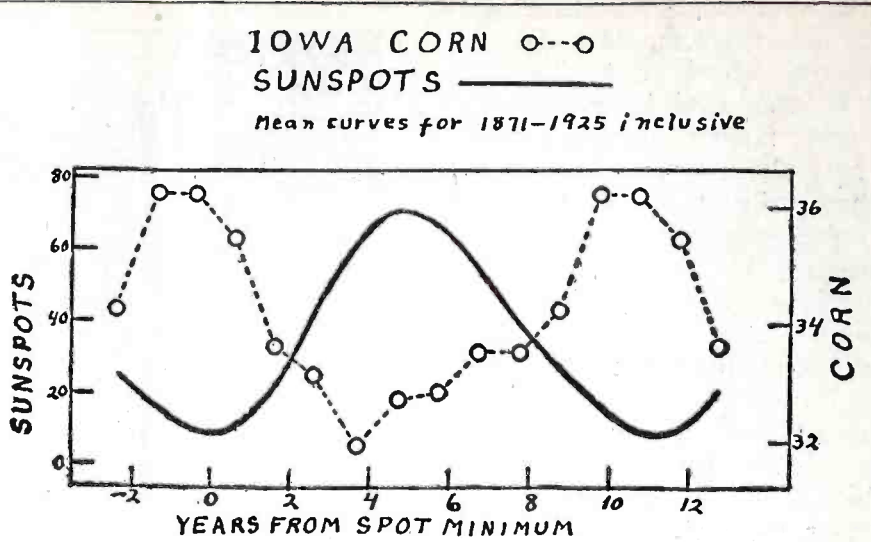
An Innovation in Vacuum Valve Construction

ONE of the few real innovations in the fundamental design of vacuum tubes is mentioned in a recent issue of the English scientific periodical, *Nature*.* This is the reported use, by the British Navy Department, called the "Admiralty," of transmitting vacuum tubes the bulbs of which are made of fused silica instead of glass.

Silica is another name for that same quartz or rock crystal which is now so much used to make mercury arc lamps and other devices for producing ultra-violet light. Silica is transparent to these rays, as well as to heat rays, and possesses the other property valuable for use in vacuum tubes, that it can be highly heated without fusing or cracking, as glass does. A silica vacuum tube for high-power transmitting duty may be operated, therefore, at a much higher temperature than is possible for one with a glass bulb. Blasts of cold air, or even of water, may be directed against the outside of the hot silica, for cooling purposes, without danger of a crack. The transparency of the material for heat rays also assists cooling.

At a meeting of the Institution of

* In a news note on page 757 of the issue for May 21, 1927, volume 119.



From *Popular Astronomy*

THIS CURVE CAN SERVE FOR STATIC AS WELL AS CROPS

Records analyzed by Professor C. C. Wylie, of the University of Iowa, show how the yield of corn from Iowa farms varies with the number of sunspots visible on the sun. When there are many sunspots, the crop is poor; when there are few, it is good. The dotted line, instead of indicating the corn crop, might be used, equally well, to indicate the quality of radio transmission, for static increases with the sunspots as the corn crop decreases.

Electrical Engineers in London on May 4, 1927, Messrs. H. Morris-Airey, G. Shearing and H. G. Hughes are reported to have described a series of these new high-temperature tubes constructed in this way, as well as a method of sealing in the electric connections with metallic lead, applied to the silica as a molten liquid and allowed to cool —almost a soldering method.

The Effect of Static on the Corn Crop

THE influence of sunspots on static is well established; for the internal condition of the sun that produces the spots also disturbs earthly weather and increases the number of the atmospheric electric sparks and lightning flashes which so annoy the radio listener. Sunspots are being blamed nowadays for almost everything else, from epidemics to wars; apparently not because there is any real evidence connecting them with such catastrophes, but merely because *something* must be held responsible and the sunspots are visible and undefended.

Amid this haze of loose statement it is important to distinguish, as the real facts come to light, any earthly circumstance with which the solar conditions seem to have indubitable connection.

One of these, as might be expected, is the weather.

A new instance is the relation, recently unraveled by Professor Charles Clayton Wylie, of the University of Iowa, and his students, between the sunspot cycle and the yield of corn on an average acre of Iowa farm land.*

During the thirty-three years between 1892 and 1924, the years of minimum sunspots are clearly marked as years of unusually good yields of corn. Conversely, the high parts of the sunspot curve are times when the corn crops have averaged poor or below normal. The relation is due, Professor Wylie feels, to a temperature effect. Comparison of the weather records shows, he reports, that years of many sunspots tend to be years of average low temperature. In years of few spots the summer temperatures are somewhat higher; the corn grows better and crops are larger. Although crops and static lack the direct relation of effect and cause, it is probably safe to say that the summers in which the Iowa farmer finds his radio set staticly afflicted are apt to be also the summers in which his annoyance will be increased by a shortage in the yields of his cornfields.

* "The Solar Cycle in Temperature and in Crops," by Charles Clayton Wylie. *Popular Astronomy* (Northfield, Minn.), volume 35, pages 253-256 (May, 1927).

An Amplifier of Unique Design

A constructional article on an amplifier that embodies the ideas of Manfred von Ardenne, the youthful German expert on low-frequency amplification, will be a feature of the October number of POPULAR RADIO. *Resistance-coupled amplification is employed in a way that gives an amplification equal to transformer coupling. In addition, the amplifier is one of the most compact units of its kind ever designed.*

Short-Wave Radio for the Treatment of Disease

ONE of the most remarkable scientific developments of recent months is the enormous increase in the use of radiations of one kind or another in the treatment of disease. The ultraviolet ray, well known to readers of the Department as merely a variety of light wave slightly shorter in wavelength than the visible kinds of light, is now an all but universal tool in hospitals and sanitaria.

Almost as much use is being made of the infra-red rays—light rays which are longer than the waves of visible light, just as the ultraviolet rays are shorter. The latest development, still experimental but interesting, is the use of very short radio waves, approximately eight-tenths of a meter in wavelength, on patients suffering from disease.

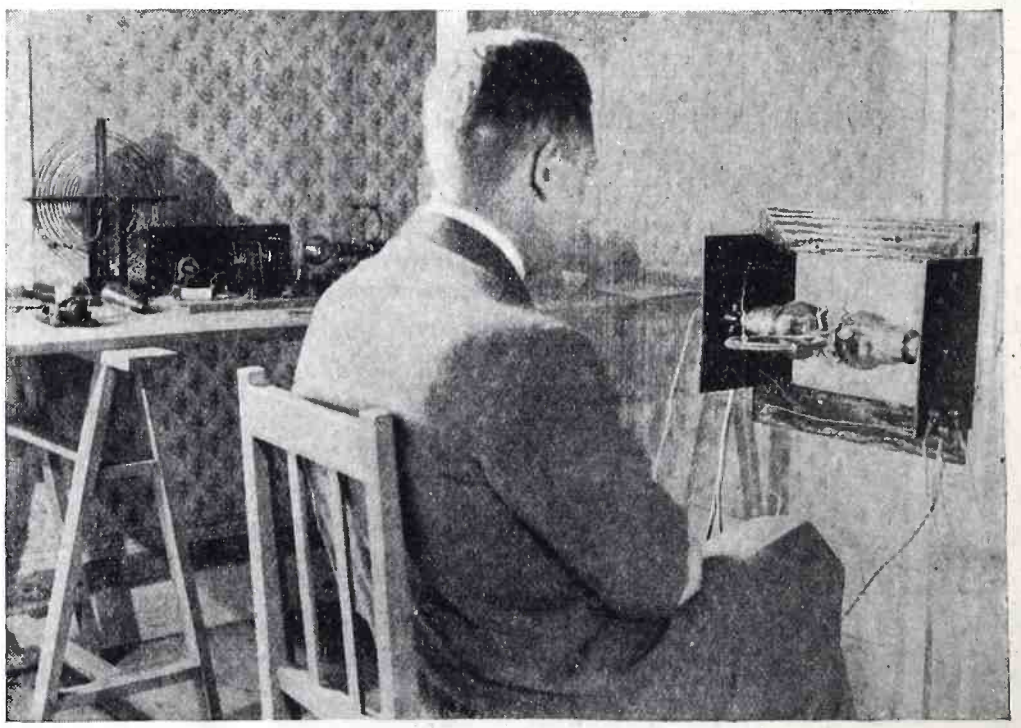
The experiments with these waves are being conducted at the Institute of Actinology, in Paris, where the Director of that Institute, Dr. Jean Saidman, has installed many kinds of apparatus for the production and test of different varieties of radiation.* The eighty-centimeter radio waves are produced by a small vacuum-tube oscillator not essentially unlike the well-known short-wave oscillators used by radio experts both in France and in America. The output of this oscillator is discharged from a small loop of heavy copper tubing and may be focused on the patient by a suitable reflecting mirror. If desired, the radio energy may be concentrated on a single part of the patient's body, such as an arm or a leg, by surrounding that member with a coil of wire or of copper tubing like that used on the oscillator itself.

From the information now at hand, it is not apparent how the new procedure differs in physiological essentials from the so-called "diathermy" processes, in which electric currents of high frequency, not much less than those corresponding to the eighty-centimeter waves, are fed into a selected portion of the body. Whether or not these high-frequency currents have special electric effects is unknown, but they certainly have heating effects. It is to this local heating of the affected tissues that most of the physicians who are experimenting in this field of endeavor ascribe the benefits obtained.

In the standard diathermy methods the electric waves are applied as currents, not as radiation. Furthermore, the electric frequencies employed are by no means pure, often including waves of many different frequencies mixed together. It is conceivable that a pure, eighty-centimeter wave, applied as radiation rather than as actual electric current, may have unexpected physiological effects. It is excellent that the matter is to be tried.

In this entire field of the effects of radiations on the human body there is a dearth of information about pure radiations. The so-called ultraviolet rays which physicians use are not pure rays of this variety, but consist of varying amounts of the ultraviolet radiation mixed with much larger amounts of vis-

* Information from the Delano Service, Paris. The equipment and work of the Institute of Actinology are described briefly in the *British Journal of Actinotherapy* (London), May, 1927, page 31.



From a photograph made especially for POPULAR RADIO by Delano, Paris

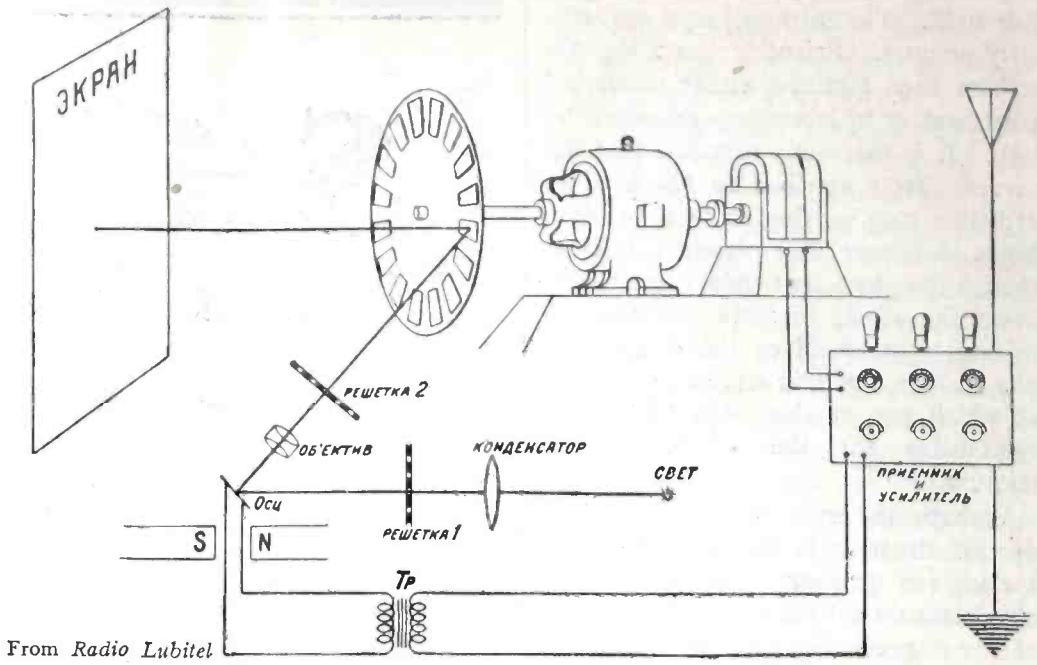
TESTING CURATIVE POWERS OF SHORT RADIO WAVES

This short-wave oscillator, discharging waves approximately eighty centimeters long, will be used by Dr. Jean Saidman, of Paris, to test the possible effects of these waves on sick persons and on the human body generally. The radiation is emitted by the horizontal loop of copper tubing in front of the vacuum tube. Metal wires behind the wooden frame reflect the waves toward the patient, seated in front of the oscillator loop.

ible light. The infra-red rays are similarly impure. Scientific precision has seldom been attained, either in clinical treatment or in laboratory experimentation. It is extremely probable that observed effects ascribed to one kind of radiation may be due, in fact, to other kinds that were also present. It is as though the physicians endeavored to discover the effects of some new drug by mixing together all of the drugs from one shelf in the drug-store and guessing at which one of them was to be held responsible for the effects of the mixture.

Perhaps the most dangerous feature of this situation is that it has opened a door for quackery. When orthodox physicians do not really know what kind of ray is producing the curative effects that they observe, there is room for unscrupulous quacks to claim impressive knowledge which they do not possess. That is one danger to be guarded against in public mention of the use of the new eighty-centimeter waves by Dr. Saidman. This is an experimental use, admirable because it attempts, for the first time, to see what the physiological effects of a reasonably pure electric radiation really are. It emphatically is not something to be copied by the quack who knows neither radio nor physiology, merely because such words as radio now impress the ignorant or because the short-wave oscillators which produce these eighty-centimeter waves are spectacular bits of machinery in the stage-dressing of quackery.

To his experiments on the real function of these one-frequency short radio waves Dr. Saidman proposes to add experiments on pure radiations in the ultraviolet, infra-red and visible fields. To produce these pure radiations of any selected wavelength, he has constructed what is said to be the largest spectroscope in the world. Its prisms are nearly ten inches in face and will produce a spectrum of visible and invisible rays enormously more powerful than is possible with ordinary spectroscopes. Glass prisms cannot be used, as glass is opaque to many of the rays which it is desired to test, including the ultraviolet ones. Dr. Saidman's prisms are made of quartz plates, but are hollow, the interior being filled with water. It would be better to use large prisms of solid quartz or rock crystal, this material being fully transparent to all of the rays involved. Dr. Saidman believes such large, solid prisms of quartz to be unobtainable, but this is no longer the case. Thanks to some recent technological developments in America, a spectroscope with solid prisms almost as large as Dr. Saidman's hollow ones is now under construction. POPULAR RADIO hopes soon to be able to report further details of progress in this branch of electrical science.



From *Radio Lubitel*

A DIAGRAMMATIC VIEW OF THE RECEIVING END OF TERMEN'S TELEVISOR

The radio receiver is at the right, its impulses acting to tilt the small, moving-coil mirror in the lower left-hand corner of the diagram. The percentage of the light ray which passes the two screens is determined by the angle of tilt of the mirror. The numerous small mirrors mounted on the revolving disk then reflect the varying light intensities onto the screen at the left to make the units of the scene. The motor runs synchronously, with a similar motor at the transmitter carrying a similar mirror-studded disk.

A New Russian "Televisor" Enters the Field

ONE of the limitations of the Telephone Company's process of television, reviewed elsewhere in this Department this month, is that it is not suitable, at present, for viewing scenes illuminated by ordinary diffuse light. One cannot look out of a distant window by the Ives-Gray televisor. Instead, the scene to be transmitted is limited to near-by objects, like the face of a sitter, which objects can be illuminated largely, if not exclusively, by the moving spot of light upon which the operation of the process depends. Although this limitation is probably only temporary, there being several conceivable ways of overcoming it, its present existence gives interest to a Russian television process not thus limited and which has been worked out in one of the Soviet scientific institutions.

This Russian process, the invention of Mr. L. C. Termen, of the Physical-Technical Institute at Leningrad (St. Petersburg), Russia, divides the scenes to be viewed into units by means of small mirrors mounted on a revolving disk, obtaining its light from the general illumination of the object being viewed.* It compares, therefore, with the processes of Baird and Jenkins, which also make use of the general illumination of the scene, either from mere daylight or after artificial augmentation with lamps. Baird obtains the division of the scene into units by a series of viewing cells which permit the sensitive photoelectric cell to "see" only one unit at a time.† Jenkins uses, instead, a system of rotating, prismatic lenses which split up the scene optically.§ Ives and Gray use the moving spot of illumination. Doubtless still other ways are possible and probably many will be tried.

Aside from the use of small reflecting mirrors to obtain the necessary units of view for transmission, the Termen process follows lines which are now almost conventional. The varying light from the mirrors is converted into an electric signal by a photoelectric cell, amplified transmitted by wire or radio and received by a standard receiver.

The reconversion of the electric signal into the visual scene is not accomplished, as in the other processes mentioned, by a lamp varying in intensity, but by a moving mirror which increases or decreases the portion of a light ray passing through two systems of slats, like Venetian blinds. This device also is not new, having been used in some of the early experiments in talking over beams of light.

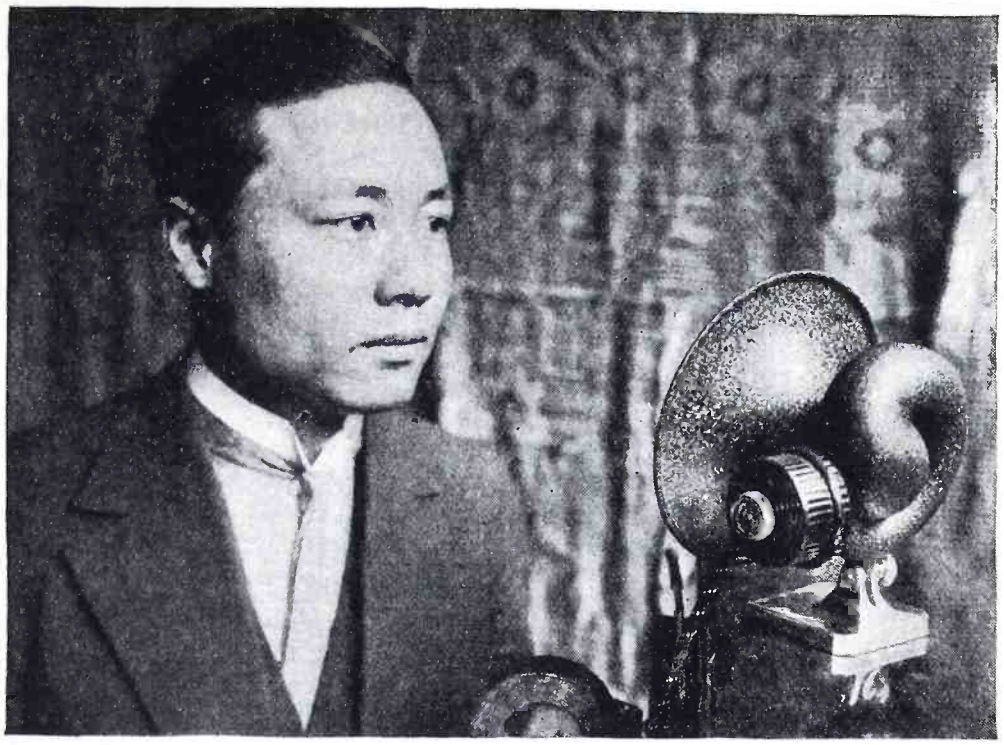
There seems no present reason to expect that the Termen system will excel the Ives-Gray one, but its idea of the unit-forming reflecting mirrors may be worth further attention.

Of course, any experimentation along the lines of this new development is a help and may uncover some important details that would have far reaching effects on the final outcome.

* "Television: Transmitting Moving Pictures by the Process of L. C. Termen" (in Russian), by V. Ginsburg and V. Pulver. *Radio-Lubitel* (Radio-Amateur) (Moscow), volume 4, pages 13-16 (issue number one for 1927, not otherwise dated).

† "The Latest Experiments with Television and 'Black Light,'" by John L. Baird. POPULAR RADIO for May, 1927, pages 447-451, 498.

§ "The New Radio Movies," by Watson Davis. POPULAR RADIO for December, 1923, pages 437-443. "Radio Transmits Weather Maps to Ships," by S. C. Hooper. POPULAR RADIO for November, 1926, pages 655, 698.



Delano, Paris

A CONTORTIONIST AMONG HORNS

This young Chinese inventor, Lu Feng Chai, now residing in Paris, has constructed an unusual loudspeaker horn, in which space is economized without reducing the length of the horn. In spite of its many bends, the horn enlarges gradually from the inner end to the outlet, in approximate correspondence with the exponential principle explained elsewhere in this issue of POPULAR RADIO.

Home-Made Loudspeakers

THE manufacture of one's own loudspeaker is not an exercise to be recommended to the average radio listener who desires merely to hear the entertainment that broadcasting provides; it is easier, and usually cheaper, to buy some one of the many admirable instruments which radio manufacturers have perfected. There are far lighter tasks than that of avoiding the many pitfalls, electric and acoustic, which beset the hopeful amateur in this field. For the experienced constructor, however, there are interesting problems in designing and building exactly the kinds of loudspeaker needed for this or that special purpose. The experience will be both amusing and profitable, even if the result is merely amusing. To those who wish to try their hands in this field there is to be recommended a pair of recent articles by Professor N. W. McLachlan, a well-known English physicist.* The principles which control the design and construction of the new type of moving-coil instrument are well described.

A New Direct-Current Transformer

THE principle of the transformer, by which a current of one voltage can be changed to one of higher or lower voltage, is usually assumed to be applicable only to alternating currents. Certainly the passage of a direct current through one of the two familiar coils of the electromagnetic transformer produces far from the desired effect.

There exist, however, several theoretical ways in which a direct-current transformer might be built. The old-fashioned static machines which physicians used to keep in their offices and which high school teachers still use sometimes to illustrate the properties of static electricity, may be considered as direct-current voltage-raisers of a kind.

A principle somewhat similar, in theory, to these has been used by Mr. Preston B. Carwile, of the University of Virginia, in a recent device capable of producing a potential of over 1,600 volts from the usual source at approximately 110 volts.*

The idea is to take a series of condensers, connect these in parallel to the low-voltage source, then connect these same condensers in series for discharge.

In Mr. Carwile's device a rotating commutator so manipulates the connections of four condensers that this principle receives still further increments, resulting in the increase of voltage mentioned. No large amount of current can be delivered and the details of uniform operation must still be studied. It seems conceivable, however, that some such device might be useful to produce relatively high potentials from which the current draft is to be slight.

That the device might be utilized in radio operation is a contingency that is at present very remote, but Mr. Carwile's idea is practical enough to be watched with interest.

* "Coil-Driven Diaphragm Loud-Speaker Design," by N. W. McLachlan. *The Wireless World* (London), volume 20, pages 372-377 (March 30, 1927), and pages 440-446 (April 13, 1927). See also "How to Build the New Exponential Horn," in this issue of POPULAR RADIO.

* "A Direct Current Potential Transformer," by Preston B. Carwile. *Journal of the Optical Society of America* (Manesha, Wis.), volume 14, pages 323-327 (April, 1927).

YOUR RADIO PROBLEMS SOLVED

POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, which will, without charge, answer by personal letter any question or problem submitted by a subscriber.

In writing please confine your questions to one general subject, writing on one side of the paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently; look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

May, 1926
—How to Draw Up Your Own "Tuning Graphs."
—How to Build the Improved Raytheon Power-pack.
—How to Build an Antenna Mast for $15.00.
—Fifteen Ways to Reduce Static.
—Do Your Coils Broadcast?

June, 1926
—How to Build the New Home Receiver.
—How to Put Up a Good Outdoor Antenna.
—How to Get the Most Out of Your Ready-made Receiver.
—Audio-frequency Amplification. How to Get it Without Distortion.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.

July, 1926
—How to Get the Best Reception in Summer.
—The Best Crystal Set for $13.00.
—How to Build the Newest Portable "Town and Country" Receiver.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.
—How to Get the Most Out of Your S-C Receiver.

August, 1926
—A New Method of Using Harmonics for Determining Frequencies.
—POPULAR RADIO Circuits.
—How to Build the Improved Browning-Drake Receiver.
—How to Pick Out a Loudspeaker.
—How to Get the Most Out of Your "Town and Country" Receiver.
—Three Vacuum Tubes in One.

September, 1926
—Foretelling Radio Reception from the Weather Map.
—How to Build an Impedance-coupled Amplifier.
—A Radiant Crystal Pilot.
—POPULAR RADIO Circuits.
—How to Simplify Your Set with Automatic Filament Controls.
—Inside Information on New Radio Receivers.
—How to Wire Your House for Radio.

October, 1926
—How to Build the New LC-27 Receiver.
—The Radio Road Hog.
—POPULAR RADIO Circuits.
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power-pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC-Junior Power-pack.

February, 1927
—The Coming of the "RADIO UNIVERSITY."
—How to Get Quality Amplification.
—How to Build and Use a Portable Test-Board.
—How to Assemble the All-Amax Senior Three-tube Reflex Receiver.
—What's New in Radio.

March, 1927
—How to Build the Univalve Receiver.
—POPULAR RADIO Circuits.
—How to Increase the Range of Ammeters and Voltmeters.
—How to Build Your Own 36-Inch Cone Loudspeaker.
—What's New in Radio.

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Dept. 48
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Advance Information About the New LC-28 Receiver

(Continued from page 150)

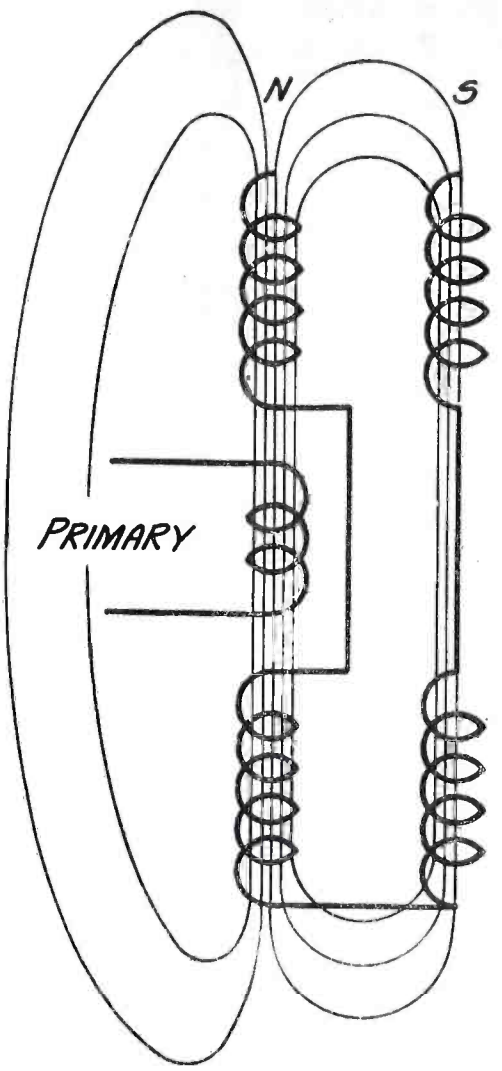


FIGURE 9: *The top drawing shows a symmetrical double-solenoid coil with its large external field. The bottom drawing shows the unsymmetrical solenoid coil used in the LC-28, which is so constructed that it has practically no external field.*

The third condition that makes many circuits unstable is due to the resistances of the batteries or power-pack used as the plate-circuit voltage supply. If both the plate coils are coupled through the same battery, a varying alternating current from the plate circuit of the second stage, passing through the resistance of the battery, shown at *C*, in Figure 5, causes a voltage drop across the resistance that effects the plate circuit of the first stage, which is coupled to the grid circuit of the second stage, thus causing feed-back, regeneration and ultimately an unstable condition.

In designing the LC-28 the problem was to find a method for eliminating, practically and simply, all of these effects, so that regeneration would not be present in any dangerous quantity. It was decided that if this could be accomplished without using load or loss methods, that the coupling could be increased, as well as the step-up ratios between valves, so that a heretofore unattained amplification might be obtained.

Starting with the problem of electromagnetic feed-back through the resistances of the batteries, shown at C in Figure 5, it was decided to use the shunt plate feed arrangement, shown in Figure 4. In this system, two choke coils, L1 and L2, are inserted in parallel with the plate circuit of each valve. These choke coils pass the direct current through to the plates of the valves, but they eliminate any chance of high-frequency alternating current running down through them to the resistances of the "B" supply, and in this way they also eliminate any feed-back that might otherwise occur at this point.

After a good deal of experimenting, a new type of coil with double secondaries was designed that had practically no external field. During the experiments with this type of coil, it was found that the two secondaries, on account of their uneven coupling to the primaries, had to be wound with a different number of turns in order to produce a true balanced coil with a minimum of external field. The part of the secondary coil wound upon the leg opposite the primary had to have a greater number of turns, due to the greater mutual inductance between the primary and the remaining part of the secondary that was wound on the same leg as the primary. When this was satisfied, both secondary coils had the same number of lines of force threading through them and the field of the coil was then limited to the dimensions of the coil itself. This effect is shown in Figure 9, and in this way the coupling shown at A in Figure 5 was also eliminated. Another precaution,

which also helps selectivity, is the shielding of each of the stages, as shown in Figure 4. Notice that the two choke coils are again shielded from their respective stage tuning coils.

The third cause of feed-back—inter-electrode capacity—was reduced by the use of non-inductive, low-capacity resistances inserted in the grid circuit of each high-frequency valve.

These resistances must be of extremely low capacity or they will not be suitable.

In spite of the general opinion that this is a "losser" method, a careful study will reveal that it entails no loss when properly designed and used.

In Figure 6, at the top of the diagram, is shown an alternating current generator with a resistance connected in upper leg of the circuit. If the circuit is left open, as shown, the current flowing through the resistance R will be zero. If the current flowing through it is zero, the voltage drop across it will also be zero, and the output voltage E2 will equal the input voltage E1. This is only true when no load is applied across the output.

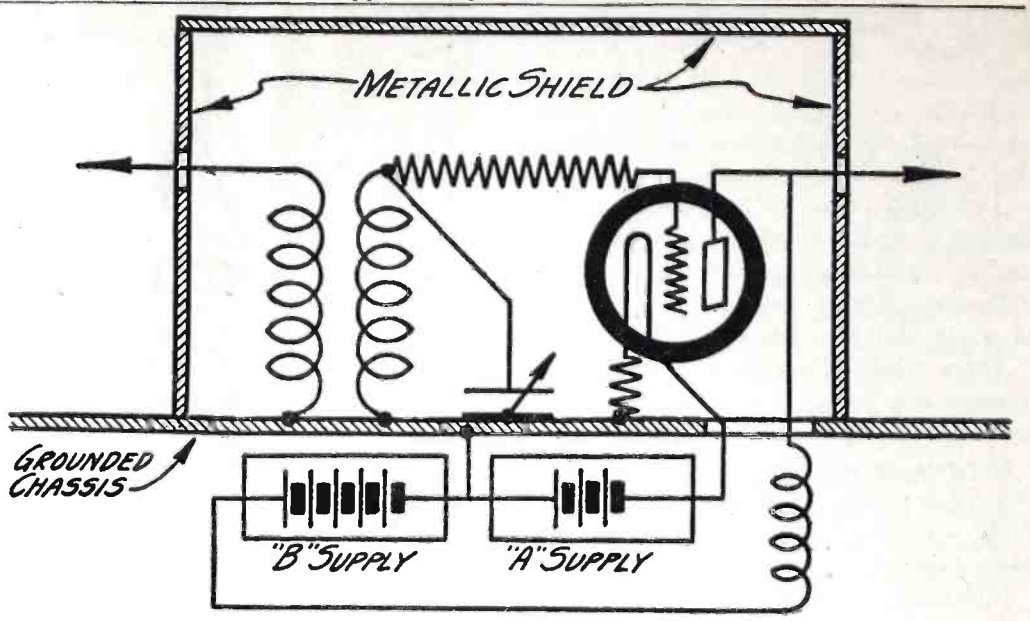
Referring to the bottom diagram of this same figure, we see the same principle applied to a vacuum valve circuit. If the resistance R is of large enough value to reduce the current due to the circuit feed-back through the small condenser shown in dotted lines to substantially zero, the drop across the resistance R will be of such low order that the input of voltage, E2, will equal the voltage, E1, across the tuning circuit. In this case the tuning is not broadened, and the circuit is not what is commonly called "a losser."

Having eliminated unwanted regeneration from the circuit, the next job in designing the set was to get the greatest amount of energy output from each valve in the high-frequency stages, and to apply as high a voltage variation as possible to the grid circuit of each following valve.

As stated before, the shunt-plate-feed system is employed. In this system it is necessary to use so-called "blocking" condensers, shown at C in Figure 7, in series with the primary coil shown at P.

Notice that the low end of the primary coil P is connected directly to the filament circuit of the preceding valve, thus giving perfect "by-passing" to the circuit from the primary coil back to the filament of the valve with which it is used.

An alternating current voltage of high frequency induced from the preceding stage is indicated at E1. This voltage variation represents the total power output of which the valve is capable. The high impedance of the choke coil L resists alternating current flow, and practically no current can flow through the "B" batteries or a



THE ARRANGEMENT OF A SINGLE STAGE IN THE LC-28

FIGURE 10: *This schematic drawing gives the general arrangement for one stage of high-frequency amplification in its shield. Notice how the wiring is simplified.*

"B" power-pack, if one is used. All of the current, therefore, must flow through the condenser C and through the primary P. The condition for the greatest transfer of energy, with a given amount of coupling between the coils P and S, is obtained when the voltage E3 across the primary coil P equals the voltage E1 across the plate to the detector. This means that the drop in voltage E2 through the condenser C should be kept as low as possible. In the design employed in the LC-28, the impedance of this condenser at the highest wavelengths is approximately only 16 ohms, whereas the impedance of the primary is hundreds of times that amount when the circuit is tuned, so that the plate circuit has extremely high efficiency.

The coupling between the coils P and S, in the case of this new receiver, is probably greater at the high wavelengths than has ever been used heretofore in this type of design, and this is accomplished with perfectly stable operation.

Also, the step-up voltage ratio between the primary and the secondary is greater than heretofore used, giving a maximum amplification averaging 9 per stage for the whole frequency range used in broadcasting. This great gain has usually been considered almost impossible for a high-frequency amplifier that uses no neutralized circuits. It might be interesting to note as a comparison that the average amplification in last year's LC-27 was about 3.5 per stage.

Figure 8 shows at B a curve of the amplification factor of an ordinary standard high-frequency stage of amplification. Notice that at about 750 kilocycles and above the curve extends in a rapidly rising line. This is due to regeneration, and it is this effect that brings about the unstable condition and unwanted oscillation. If regeneration were eliminated from this same circuit, the curve would be smoother and stable operation would follow the general line of the curve BB.

The amplification curve of the new LC-28 is shown at A, and it will be noticed that there is little or no regeneration present. The curve falls off at high frequencies to an average value of about 7 from 750 kilocycles to 1,500 kilocycles, which is more than ample amplification. From 750 kilocycles to the top of the broadcast range a value of about 10 per stage is obtained, which gives great sensitivity.

Another interesting feature of the new circuit is that by the use of valves such as the new Zetka Z-112-a, having an unusually low plate impedance, the maximum amplification is obtained. The plate circuit is much more readily tuned to the frequency of the following grid circuit when the impedance of the valves is of a low order. It was found that in this system of amplification, the *mu* of the valve played a very small part in obtaining this great amplification, due to the large effective capacity of high *mu* valves at high frequencies. The main factors are a low input capacity between the elements (which goes with a low *mu*) and a low plate impedance.

In Figure 10 is shown the general arrangement of the condenser, the coil, the choke and the grid resistance inside the shielded stage used in the LC-28.

It might also be interesting to note that the whole circuit, consisting of three stages of this type of high-frequency amplification, may be wired up with less than 5 feet of wiring, including the wiring to the detector stage.

The plate circuit of the detector is by-passed and a high-frequency choke inserted in the lead of the low-frequency amplifier, so that it is impossible for high-frequency currents to

get in along this lead and on to the low-frequency amplifier. The high-frequency currents are kept in the "can" housing the detector tuning circuit, and in this way "over-all regeneration" back to the first valve is eliminated.

A simple tuning scale showing the separation of stations is shown in Figure 2.

The volume control consists of a variable resistance connected in series with the positive lead to the filaments of the three high-frequency valves. By this method, the volume may be controlled from a whisper to maximum.

What this control unit really does is to increase the impedance of the valve as the filament current is reduced, thus cutting down the amplification obtained and, consequently, the volume of the received signals.

In the next article on the LC-28 constructional details will be given for building this amplifier which, it is believed, will give the kind of results long looked for by the experimenter and set-builder, but not often found.

For the benefit of the set builder who wishes to purchase the parts necessary for building the LC-28 Receiver now, in order that he may have them on hand when the constructional article appears in the October issue of POPULAR RADIO, the list of instruments and accessories is given below:

LIST OF PARTS FOR THE LC-28 Receiver

TO BE FEATURED IN THE OCTOBER, 1927, ISSUE OF POPULAR RADIO

4 Hammarlund mid-line variable condensers, .000275 mfd.;
1 Hammarlund double drum dial;
1 Precision high-frequency transformer (4 coils), type 4-B;
3 Samson high-frequency chokes, type No. 125;
1 Samson high-frequency choke, type No. 85;
3 Aerovox moulded condensers, .02 mfd.;
1 Aerovox moulded condenser, .00025 mfd.;
1 Aerovox moulded condenser, .00075 mfd.;
1 Yaxley combination switch and rheostat, 6 ohms, No. 906-K;
1 Yaxley cable connector plug with cable, type 660;
4 Carter fixed resistances, 4 ohms, type H-4;
2 Carter Imp plugs and tip jacks, marked "Antenna" and "Ground," respectively, with insulating washers for "Antenna" jack;
4 Benjamin vibrationless sockets;
1 Lynch single-resistance mounting;
1 Lynch suppressor, 500 ohms;
1 Lynch suppressor, 600 ohms;
1 Lynch suppressor, 700 ohms;
1 Durham metallized resistor, 6 meg.;
2 Tait brackets;
1 Alcoa aluminum chassis;
4 Sets special aluminum box shields for LC-28;
1 Aluminum panel, 6 by 26 inches;
1 ¼-inch extension shaft.

Jim: Do you know how to eliminate static?

Bill: No.

Jim: Turn off your radio.

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

The Tungar Valve in a New Rôle

THAT the ordinary Tungar rectifying valve, commonly used in battery chargers, has marked photoelectric properties, is a fact that few would suspect. The writer happened to discover it while experimenting with a burnt-out 6-ampere valve having a very short break in the filament—a break so short, in fact, that a corona-like discharge or glow appeared in the valve on connecting it to the 120-volt light circuit.

But, strange to say, no glow would appear if the room were darkened before closing the circuit! It was evident that some sort of photosensitive effect was at work, which made the valve a better conductor when exposed to strong sunlight than when placed in the dark.

A closer examination of the valve revealed the secret. The familiar discoloration which all Tungar valves exhibit, and which is due to the purifying agent or "getter" employed in exhaustion, in this particular case took the form of a mirror-like deposit of metal on the upper hemisphere of the valve. The lower portion of the glass was relatively clear, so that light entering from below struck the spherical mirror surface and, to a certain extent, was focussed on the broken filament.

Now, the magnesium metal used as "getter" in the Tungar valve is definitely photoelectric, that is, it liberates electrons on exposure to light. Ionization is thus produced in the argon gas filling the valve, which lowers the critical voltage required for the production of a glow discharge. Light falling on the valve "triggers" off the 120-volt discharge, thus giving rise to the phenomenon described above. More consistent results were obtained by connecting a tapped "B" battery in circuit so as to boost the applied voltage to just below the critical potential.

Many experiments are possible—as, for example, the control of power by a light ray—by making use of this interesting property.

The writer demonstrated the last mentioned possibility by connecting the secondary of a telephone induction coil in series with one filament lead, while to the primary was connected a 2-volt flashlight lamp. On reflecting a beam of light on the tube in an otherwise darkened room, enough current was passed to light the lamp to full brilliancy.

More impressive experiments using a relay are quite feasible and might prove to be useful.

—CHARLES D. SAVAGE, *Portland, Ore.*

* *

How to Eliminate Home Interference

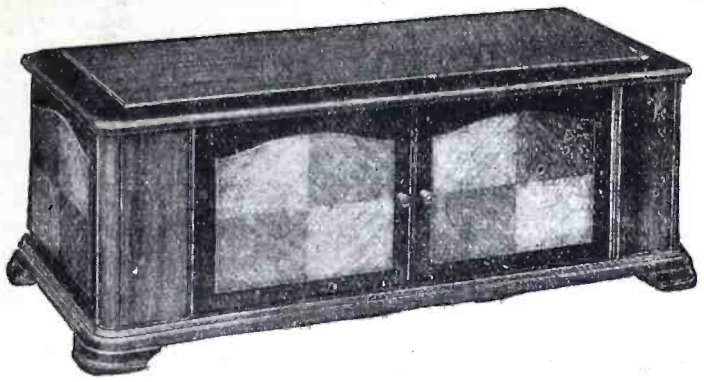
THERE are many devices in the average home that may ruin the reception of the finest set on the market. A vacuum cleaner, an electric refrigeration plant or any other general utility device within the house may not only ruin the reception in the home where they are being used but they may disturb the reception in the entire neighborhood. The interference may be louder at some house in the next block than it is at the place where the interference is being propagated.

The making and breaking of a circuit in a motor, or moving parts in other devices cause small sparks which generate radio waves. This spark transmission, which has no definite wavelength, will use distant wiring as a form of antenna, and is very hard to tune out of any set.

Several manufacturers have put out appliances to eliminate this disturbance, or interference.

The real solution, however, is to correct the trouble at its source. This may be done by using high voltage condensers, shunted across the line and grounded at their midpoint.

—G. D. PRESTON, *El Centro, Cal.*



PRESENTING THE NEW BROWNING-DRAKES

AFTER several years of intensive research by Prof. Glenn H. Browning and Dr. Frederick H. Drake, the laboratories of the Browning-Drake Corporation have brought to commercial form, a new conception of the world-famous Browning-Drake.

The ability of the new receivers to demonstrate remarkable distance performance, to give fine tone and cut through the strongest local interference, gives them an unmistakable appeal.

Model 7-A above and model 6-A below are the first Browning-Drakes to use more than five tubes.

These new models embody many mechanical refinements, including a highly efficient and novel tuning drive system.

LOOK FOR THIS

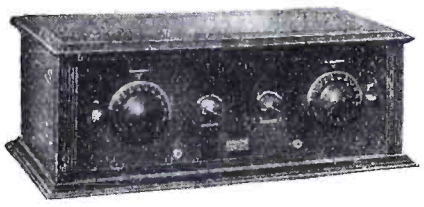
BROWNING-DRAKE CORPORATION RADIO

TRADE MARK

Model 7-A has the following features: Single Dial, Seven Tubes, Completely Shielded, Illuminated Drum Control, Super-Selectivity. This model can be had in either a two tone mahogany or walnut. Size: length, thirty inches; depth, fifteen inches; height, eleven inches. A console base is available for this model if desired. List price without tubes $145.00; with console $185.00.

DEALERS: Browning-Drake now offers a complete line of receivers and kit parts. Almost three times as many Browning-Drake parts are sold as those of nearest competitor. Write or wire for further information TODAY.

BROWNING-DRAKE CORPORATION, Cambridge, Mass.

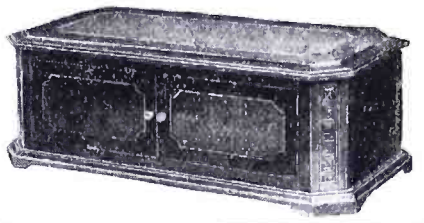


Model 5-R

This five tube model is still very popular. Famous Browning-Drake slot wound radio frequency transformer is used. Provision for power tube in last stage. Cabinet is two tone Duco mahogany finish. List without tubes and batteries $95.00.

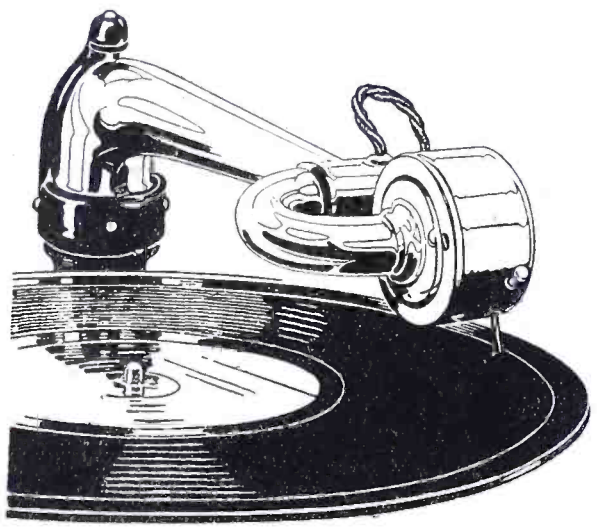
Model 6-A

Six tube. Uses conventional Browning-Drake circuit with slight modifications. Four tube audio amplifier gives greater volume. Single Dial. Illuminated Drum Control. Cabinet is two tone Duco mahogany. 27 inches long; 15 inches deep; 11 inches high. List without tubes $105.00.



THE PERFECT WARFORD REPRODUCER

Makes Possible an Electric Phonograph at Small Cost



Replaces the regular reproducer on any old or new phonograph (without the use of tools) and makes it possible to play your favorite records through your radio set. In designing this reproducer, H. P. Donle, the famous radio inventor, made it possible to transform your old phonograph into a life-like recreator of music. It operates on the same principle as the latest and most expensive types of talking machines.

Price $11.50

This is also furnished with a volume control at $16.00. The use of a scientifically designed volume control eliminates any chance of distortion and insures the purity of tone. We strongly *recommend this to the music* lover. We also furnish a supporting bracket for those who do not wish to attach reproducer to tone arm. Side Arm Bracket $2.00

WARFORD ELECTRIC, Inc.

42 WHITEHALL STREET

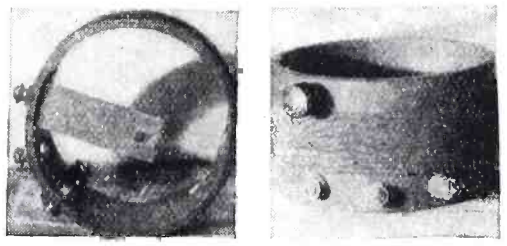
NEW YORK, N. Y.

How I Got Rid of the Bulky Loop in My Superheterodyne Receiver

THERE are in use today numerous superheterodynes and other types of radio sets that operate with a loop antenna.

It is possible to discard the usual type of loop and substitute for it a small coil that may be enclosed in the radio cabinet. The only change necessary is the addition of a ground wire, which connects with one of the loop terminals of the set.

One of the easiest to construct and one of the most efficient types of coil is the solenoid. This consists essentially of a layer of magnet wire wound on a cylinder of bakelite, hard rubber or other insulating material, with provisions for varying the amount of wire in the circuit.

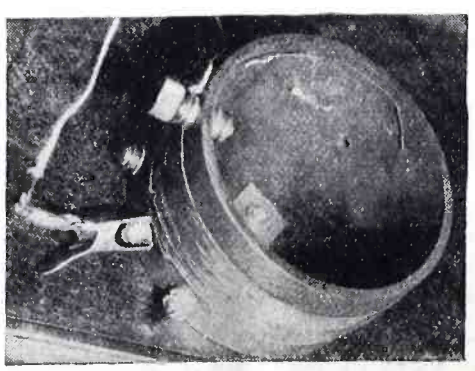


A COIL ANTENNA

FIGURE 2: *The left-hand picture shows how the brass mounting strip is attached; at the right is shown the arrangement of the four terminals on the coil form.*

The coil shown in Figures 2 and 3 was wound on a 3½-inch hard rubber cylinder. One end of the coil was connected to a binding post fastened near one end of the cylinder; the other terminal was formed by passing a small bolt through an ordinary battery binding post nut and then through the hole in the cylinder bored for that purpose. The wire was fastened to the terminal in the usual way with a nut on the inside of the cylinder. Two taps, one at five turns and the other at ten, were taken off, and provided with similar terminals.

This method of making terminals, that is, with the use of bolted-on binding post nuts, is employed so that a clip may be provided on one of the loop terminals of the set. The wavelength of the coil is varied by moving the clip from one terminal to another. This adjustment, however, usually will have to be made but rarely.



THE COMPLETED COIL

FIGURE 3: *The wavelength of the coil may be varied by moving the clip from one terminal to another.*

An alternative way of providing for the varying of the coil wavelength is by using a switching device, such as the switch point and lever combination common to radio sets of a few years ago.

The completed coil is fastened to the interior of the radio cabinet by means of a small screw and a brass angle strip. One of the coil terminal bolts serves to hold the cylinder to this strip. The coil may be fastened to the sub-panel of the set, if space permits.

Actual dimensions of the coil antenna such as the number of turns, number of taps, and so forth, will vary with the type of radio set with which the device is to be used. The method of trial and error is perhaps the best in finding the most efficient combination. The wire used need not be of any particular size, and may be insulated with cotton, silk, enamel, or by air spacing. Generally speaking, the wire should be as large in diameter as practicable. Stranded wire, such as "Litz," is perhaps the most desirable.

The coil described should be grounded at one end for reception of low-powered or distant stations.

The use of a ground wire eliminates the directional properties of the coil antenna, and greatly increases the volume.

This type of antenna is small in size, is practically non-directional, and therefore requires no adjustment.

In use, the coil will be found to function best on the lower wavelengths with fewer turns of wire in the circuit, and on the higher wavelengths, with a larger number of turns.

—WALTER E. BURTON, *Kenmore, Ohio*

* *

An Easy Way to Make a Vernier

A NON-REMOVABLE, top binding post, with but only a little alteration, will serve as a first-class vernier for radio dials.

Obtain a post of generous size. If you have one around the workshop, which you discarded because of the corrosion of its brass parts, it will do nicely. Screw the top down very tightly, closing the gap permanently.

Cut a piece of fine-grained cork to the same diameter as the base of the binding post, and 3/16 of an inch thick. Cut a hole in it to allow for the passage of the screw. Apply a little good glue to base of the post and force the piece of cork on; the pin will hold it in place. A small brass washer is needed between the cork and the panel.

After the nut is adjusted behind the panel, an extra nut should be put on to lock the vernier at a fixed tension.

—JOHN C. HEBERGER, *Rochester, N. Y.*

A Condenser-Antenna for the Automobile Radio Set

A CONDENSER-ANTENNA is one of the best types of pick-up devices to use with a radio set in an automobile. The idea of the condenser-antenna is old, and it is surprising that it is not more used by the experimenter who wants an antenna that will give a maximum of signal strength with a minimum of size. The condenser-antenna, as its name suggests, is formed of two plates of metal suspended several feet apart, with the upper one well insulated. The lower plate is used for the ground, and the upper one for the antenna. This antenna may be modified for use in an automobile by fastening the upper plate just inside the top of the car, and using the body of the car for the lower plate. The upper plate may be of almost any kind of metal. The larger this upper plate the better will be the results. Medium-mesh copper or brass screening, or a piece of thin sheet copper or brass will make the most efficient and best looking antenna. Even ordinary tin foil or lead foil may be used by fastening a large sheet of it to the top of the car and sewing a piece of cloth over it to keep it from getting torn. An insulated wire should be soldered to the metal plate and brought down to the antenna binding post on the set, taking care that the plate and the lead to it do not touch any of the metal parts of the car body. The ground binding post should be connected to the metal body of the car, or to the grounded terminal of the storage battery. (See Figure 4.)

—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*

* *

How to Use the Same Panel More than Once

FREQUENTLY, a set builder desires to change the location of instruments on the panel of his set and is deterred from this either by the unsightly appearance of the open holes left where the instruments originally were, or by the expense occasioned by the other alternative—buying a new panel.

There is, however, one way of reusing a panel several times which may, if done neatly, actually improve on the looks of the original panel.

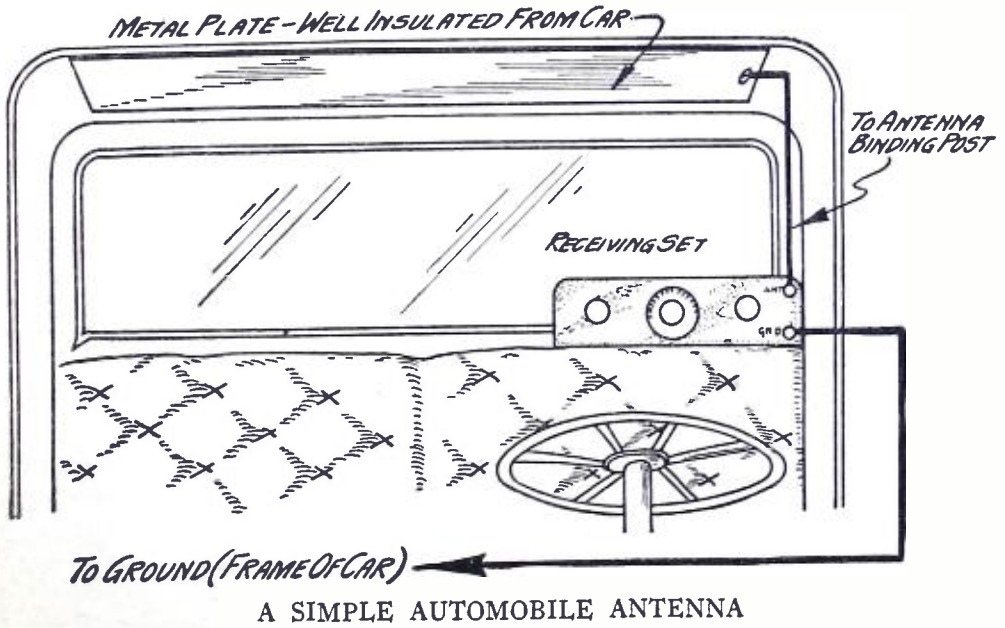
Lay out and drill the panel as desired, disregarding the previous drillings. Then, with sealing wax, fill all the holes that are not to be used in the new layout, being sure to smooth the wax flush with the panel front. Then, with coarse sandpaper, go over the front of the panel thoroughly in all directions to slightly roughten it. Next, secure from your local book-binder a piece of leather or leatherette such as is used in binding ledgers. Color, of course, is optional and he will have several varieties from which you may make your selection. Then with a thin layer of shellac cover the face of the panel. The leather is then applied to the panel and ironed out with some smooth object—a flat iron is good for this purpose—to eliminate wrinkles and air bubbles between the leather and the panel. Then, place the panel, leather side down, on some flat surface and pile weights on the panel so as to apply as even a pressure as possible and leave it there for twenty-four hours. At the end of this time place the panel, leather side down, on a board and with the point of a sharp, thin-bladed penknife trim the leather to the size of the panel, drilling the leather out of the new holes.

—C. J. SHUTTLEWORTH, *Clarksburg, Va.*

* *

Trouble Caused by a Dial Telephone

I RECENTLY had an interesting case of interference from the dial telephone that caused me much trouble and cost me some little money before I discovered the cause.



A SIMPLE AUTOMOBILE ANTENNA

FIGURE 4: *A large sheet of copper or brass screening fastened to the top of the car forms an efficient and inconspicuous antenna for the portable radio receiver. It must be well insulated, however, from the body of the car, which is used as a ground.*

I have been using a resistance-coupled Four-circuit Tuner because I like its tone better than that of any other set that I have built. Some months ago it started to behave as if something was radically wrong with it. It would stop suddenly in the middle of a concert, and then, just as suddenly, come on. Sometimes it would go on and off repeatedly, as if some one were playing with a switch. I went over it thoroughly for loose connections—took out all the jacks and replaced them with new ones—got new B batteries—but all to no avail. By experimentation I found that when it went off, the low-wave stations, which normally came in on the third or fourth tap, could be brought back by placing the switch on the 7th tap; but nothing would bring back WOO and WIP when they went off.

After several months I discovered that the result was produced in some way by the dial telephone, and that all that was necessary to bring a station back when it went off was to lift the receiver of the telephone and hang it up again. As soon as it was put back on the hook the station came back with a bang. (Sometimes it was necessary to dial one number while the telephone was off the hook.

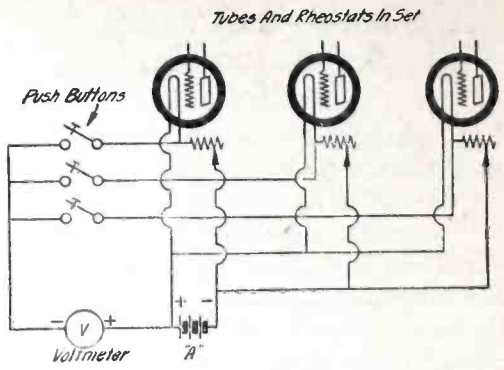
With this discovery I thought I had things fixed. But recently it has been getting harder and harder to bring the stations back. The tap for the low-wave stations has been permanently advanced to the 5th, and WOO and WIP have been permanently advanced beyond the 7th tap. Hanging up the receiver only brings the station back for a second or so, when it immediately goes off again; and sometimes no amount of fooling with the telephone will bring it back. The interference which at first was only temporary has become permanent for the higher wavelengths, and is becoming permanent on the lower ones. Sometimes for two or three days at a time it is impossible to get any station on five tubes with sufficient volume to be worth listening to.

I have not had time to experiment fully, and so do not know what effect would be had by changing the position of the radio set or the lead in; but I am under the impression that trouble I had with a set that was not located anywhere near the telephone was probably due to the same cause.

—JOHN J. CAMPBELL

EDITOR'S NOTE: The symptoms of this trouble indicate an open grid circuit in either the detector or one of the amplifier tubes.

A solution would be to check over the values of all the grid-leaks and substitute lower values of resistance where a tube may be blocking, due to the large surge generated by the strong impulse induced by the action of the telephone.



A VOLTMETER HOOK-UP

FIGURE 5: *The voltmeter may be used, by means of push buttons, in this circuit, to measure the filament voltages of the various tubes in a receiver or transmitter.*

How to Make a Voltmeter Hook-up for a Transmitter

WHEN a separate rheostat is used for each tube or valve in a transmitting or receiving set, an individual voltmeter should also be used for each separate valve if its filament terminal voltage is to be read correctly. If only one voltmeter and no switch are used, the only reading that it is possible to get is the battery-terminal voltage; and that does not tell much about the voltage the valve actually receives. An ammeter may be used, of course; but, as is well known, it is much better and much less hard on the valves to use a voltmeter. By using white-top, nickel-plated push buttons, one to each tube, and connecting them as shown in Figure 5, a voltmeter may be used; and, by pushing the proper button, it will give the filament-terminal voltage of the valve connected to that button. Each push button and rheostat should be numbered to correspond to the valve to which they are connected, so that there will be no mistake in adjusting the rheostats.
—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*

* *

A Fan Who Logged 402 Stations in 1926

CLAIMING a word's record in number of stations heard, Mr. William McDonald of Chula Vista and Los Angeles, challenges all DX hounds to equal his achievement. He has logged 402 stations during the past year, including all stations of any size in every state in the Union, and the large stations of practically every foreign country; besides this he had logged hundreds of small stations which broadcast for local reception. Mr. McDonald's book of stamps and verifications is insured for two thousand dollars.

Mr. McDonald has received all of his stations on a loudspeaker. He sometimes sits until dawn with his ear tuned for foreign signals. No special section or conditions have been responsible for his success, as some of the stations were logged in Chula Vista, and others in Los Angeles.

—G. D. PRESTON, *El Centro, Cal.*

"Can I Learn Radio by Mail?"

(*Continued from page* 151)

RADIO, and building and operating their own apparatus, prove that the printed page can convey instruction in radio even without the assistance of an instructor. The addition of the instructor, the lesson sheets and the correction of papers only increases the chances of success.

Correspondence study in universities and colleges had become so well established by 1920 that the Bureau of Education, United States Department of the Interior, issued a pamphlet on the subject. A reading of this bulletin will remove any doubt as to the practical value of correspondence instruction. The names of 73 institutions that offer correspondence courses are listed, and 61 of these are supported by public funds. The following statement is made by J. W. Scroggs, Director of Extension, University of Oklahoma:

> "Diligent inquiry has failed to find a single instance where a competent, conscientious instructor has taught the same subject both in class and by correspondence who does not find words of commendation for correspondence study. Many testify to getting better results by correspondence teaching than in class instruction. Advanced students are competent witnesses and their testimony is overwhelmingly favorable."

Another significant statement is:

> "Correspondence study is an invaluable method of instruction, almost the only one now practised on a large scale. Except in correspondence study, individual instruction has given place to the class method, save for the favored few who are able to meet the higher cost of private teaching."

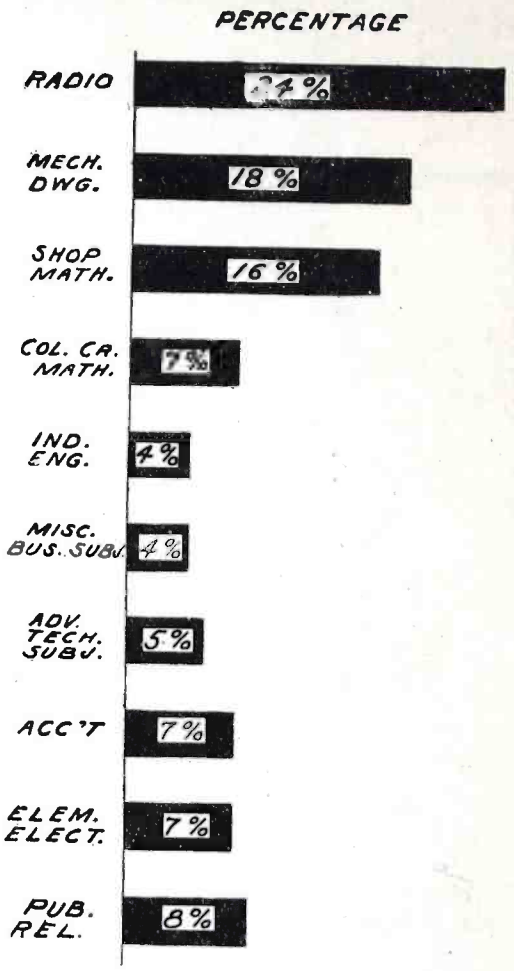
Still another:

> "Correspondence students in general are serious persons, not childish in years or mind. Most of them are adults. The small minority of minors are old for their years, capable of learning and eager to learn. For those wishing intensive study in a single branch or two, classroom work is not adapted. Students must often take three or four studies to get the one they wish; they must not go faster than the class and the work must be managed in the interest of the group, not the individual. Practically all of the courses given in colleges and high schools and many that are not can be and are taught by correspondence."

The demand for correspondence instruction in radio is active. Astute men and women have grasped the fact that when several million persons suddenly begin to use radio it means a growing demand for radio experts in factories, ship and shore stations, schools, colleges, laboratories and wholesale and retail houses. Even the Morse code is taught by mail, though it is improbable that any student ever was able, without previous experience, to copy code messages at commercial speed.

Pennsylvania State College, which had more than 25,000 correspondence pupils in twenty-five years, never enrolled so many in so short a time as it did for the first radio course it offered.

With reputable correspondence schools and such institutions as the Y. M. C. A., and the many colleges that offer correspondence courses in radio, there is no reason why anyone who wants education in radio should not have it.

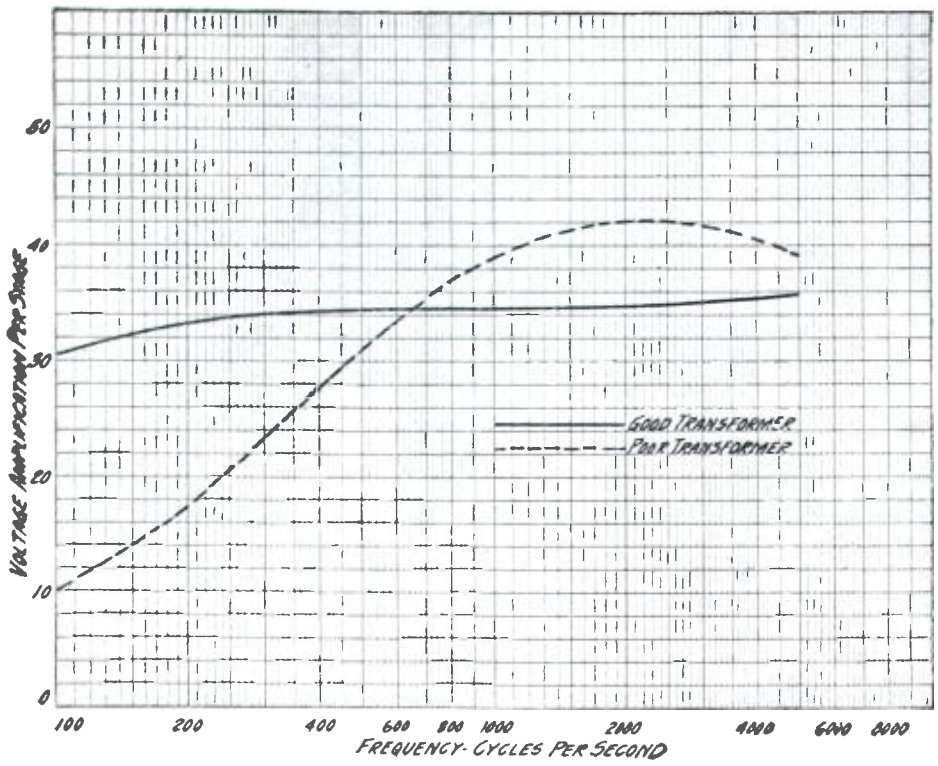


24 PER CENT OF THE STUDENTS LEARN RADIO BY MAIL

The above table shows the enrollment in the Miscellaneous Correspondence courses conducted by the Department of Engineering Extension of Pennsylvania State College, July 1, 1925, to January 1, 1926. The success of this form of instruction depends not only upon the school, but—and perhaps more particularly—upon the work of the student himself

Moonlight and Radio

Can the moon, which has been blamed for so many human frailties, be blamed also for any effect on radio reception? An English experimenter has investigated the subject scientifically, and his findings will be reported in an article in the October issue of POPULAR RADIO.



WILL YOU PERMIT POPULAR RADIO TO HELP YOU BUY A GOOD AUDIO TRANSFORMER?

THERE are three principal devices that determine the nature of the reproduction of any radio receiver.

The audio transformer is perhaps the most important one of these; it is the gateway through which *all* of the music-laden current must pass if good reproduction is to be had. If this gateway is too narrow; if it interferes with the easy passage of these currents, the best tubes, the best circuits or the best loudspeakers cannot compensate for the losses in quality sustained. The damage to reproduction is *irreparable*.

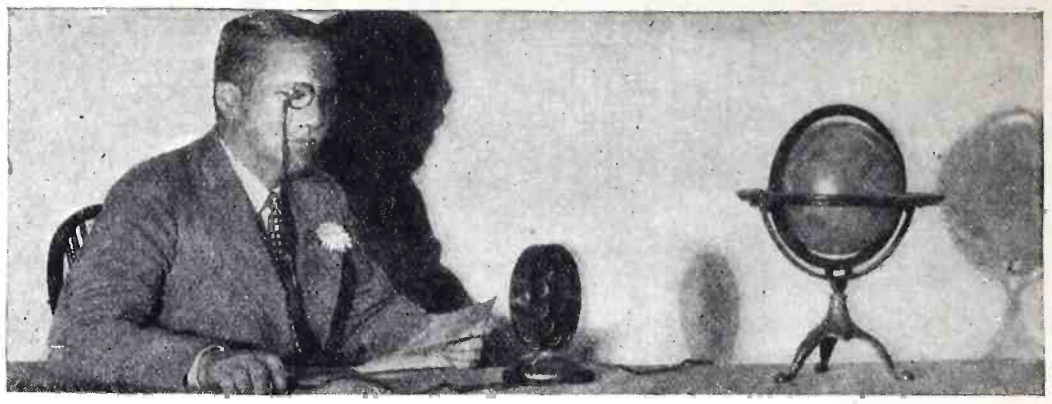
Transformers are judged not by the finishes on their containers but by their performance curves; the width of the gateway they open for the passage of the delicate, vibrating currents from the detector. Determining the measure of this gateway is a precisely scientific job, calling for the use of instruments and calculations that are beyond the laboratory or mathematical equipment of the average fan.

For over three years the laboratory staff of POPULAR RADIO has been determining the audio-frequency response curve of transformers through the use of a special and highly accurate audio-frequency oscillator, and no transformer that does not come within the tolerance limits set by the Laboratory Staff can be advertised in the magazine.

The purchase of audio transformers advertised in POPULAR RADIO may be made with every assurance of satisfaction, for they have survived a most rigid and painstaking examination. This is another instance of POPULAR RADIO'S conscientious vigilance that its readers may spend their money wisely and without fear of disappointment.

A list of Approved Audio transformers will be mailed to those making this request and enclosing a stamped and self-addressed envelope.

POPULAR RADIO, Inc.
627 West 43rd Street
New York N. Y.



BROADCASTS

A Receiving Set for Every Eighteen People

ACCORDING to unofficial estimates, this country leads the world in the per capita ownership of receiving sets, with one set for every eighteen people. England claims second place, with a set for every twenty people. Sweden, Austria, Denmark and Germany follow, in the third, fourth, fifth and sixth places.

* *

City Broadcasters Cannot Usurp the Ether

WHEN a broadcasting station from Chicago appealed to the Federal Radio Commission to be allowed to appropriate a wavelength from Omaha, the Commission refused permission. This action gives evidence that the Commission will not allow the large city broadcasters to usurp the broadcasting channels at the expense of the country at large. The separation of wavelengths in large cities is now established as at least 50 kilocycles.

* *

Radio Weather Maps Speeded Up

RADIO weather maps are now being sent four times as fast as they formerly were. The 45 or 50 minutes formerly required to transmit a complete map was found to be too slow to be of use to the Navy dirigible *Los Angeles*. C. Francis Jenkins, inventor of the slower method, has now devised a method whereby a complete map, 7 by 10 inches, may be transmitted in about 12 minutes.

* *

Radio Bootlegging in China

ADMIRAL BULLARD reports that the war lords of China are not all enthusiastic over the idea of radio broadcasting. Their feelings on the subject are so strong, in fact, that bootlegging radios into China is becoming almost as profitable as the kind of bootlegging practised on this side of the Pacific.

* *

Germans Prefer Crystal Sets

THE use of crystal and one-tube receivers still predominates in Germany. This is partly due to the lower cost of these types; also the fact that at present there is only one broadcasting station in each German city makes it unnecessary that receivers be highly selective.

* *

Doctors Ban Broadcasting as "Unprofessional"

AFTER considerable debate, the House of Delegates of the American Medical Association passed a resolution declaring it unethical for a physician to give a medical talk by radio except under the auspices of a medical society. Although it was considered proper for a doctor to give a broadcast talk anonymously, it was ruled that the doctor was to be held responsible if his name became public in any way. The opposition held that the resolution restricted too greatly the legitimate broadcasting of health talks by recognized physicians.

* *

Fans to Oppose Direct Advertising by Radio

BECAUSE the Federal Radio Commission does not have jurisdiction over the broadcasting of direct advertising, the United States Radio Society of Cincinnati has undertaken to find out how the broadcast listeners themselves may combat this evil.

"Through a recent questionnaire sent to listeners by the Society," states Mr. Paul A. Greene, the secretary, "a bitter opposition was found against broadcasting stations engaged in direct advertising over the air. The United States Radio Society immediately started a campaign against direct advertising over the air. Although complete plans have not been made to combat this evil, it is believed that through legitimate broadcasting stations, radio listeners and the press cooperating with the Society, this form of broadcasting will be exterminated."

* *

Who Provides Our Broadcast Programs?

ACCORDING to Radio Commissioner Bellows, only 21 per cent of the nation's broadcasting service is provided by manufacturers of radio sets and dealers in electrical apparatus. Over three-fourths of our broadcasting is provided by interests outside the electrical field.

VITROHM RESISTORS and RHEOSTATS

cover every resistance requirement in current supply unit circuits

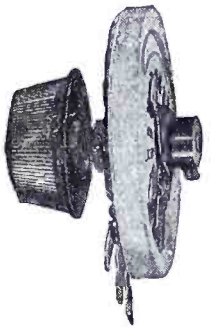
CHOOSE to build the power circuit you will this year and there is a *dependable* Vitrohm Resistor and Rheostat exactly engineered to meet your requirements.

Resistance is the heart of power circuits. Assure yourself of quiet, permanent, and unfailing service by insisting upon Vitrohms for radio. Each of the 95 Vitrohm Radio Resistors and Rheostats is guaranteed unconditionally for continuous duty in any circuit where it operates within its watts-dissipation rating. And Vitrohms have the highest watts-dissipation rating without resistance change of all resistance units.

The Adjustat

The Adjustat is a new Vitrohm Rheostat designed for use in radio current supply unit circuits.

Each Adjustat has 15 steps of resistance and is arranged for potentiometer connection. Its compact size, 2¾ inches in diameter, permits the use of several Adjustats in circuits where adjustable resistance is desirable.



Like all Vitrohm Products, the resistive element, wire having a low temperature coefficient of resistivity, is embedded and permanently protected by a fuse-on coating of vitreous enamel.

11 Types are available as listed below. The Adjustat is priced at $3.00.

{ 507-79, 1 ohm, 4 amp.—507-71, 2 ohms, 3 amp.—507-72, 6 ohms, 1.5 amp.—507-73, 20 ohms, 1.0 amp.—507-74, 30 ohms, 0.75 amp.—507-80, 50 ohms, 650 m.a.—507-81, 600 ohms, 180 m.a.—507-75, 1000 ohms, 125 m.a.—507-76, 2250 ohms, 90 m.a.—507-77, 10,000 ohms, 40 m.a.—507-78, 25,000 ohms, 10 m.a. }

Raytheon and QRS ABC Units

Three new Vitrohm Radio Products are immediately available for use in the Raytheon 350 m. a. and QRS 400 m. a. ABC Current Supply Units. Vitrohm Resistor 507-62, priced at $7.50, is tapped for all voltages needed in the QRS Circuits.

Vitrohm Resistor 507-70, priced at $7.50, is officially approved by the Raytheon Laboratories for use with their rectifier. (Illustrated.)

Vitrohm Rheostat 507-59, priced at $5.50, is designed for series primary control in both circuits.

Vitrohm Grid Leaks for Transmitting Circuits

Vitrohm Transmitting Grid Leaks are now available for the R.C.A. UX 852 and De Forest P and H transmitting tubes.

Ward Leonard has developed a complete standard line of transmitting grid leaks and rheostats covering all circuits up to and including those of 1,000 watts input. If you are interested in this and other radio apparatus, write for Radio Bulletin 507 (1927–1928). It will be sent without charge.

Ward Leonard Electric Company

31-41 SOUTH STREET MOUNT VERNON, N. Y.

resistor specialists for more than 35 years

Transoceanic Calls Heard

POPULAR RADIO *has now completed arrangements for forwarding to transmitting amateurs in England, France, Germany, Austria, Ireland and Italy all calls heard (QSL) cards that may be addressed to them by American amateurs care of this magazine. These cards will be delivered through local agents in those countries, who have or can obtain knowledge of the present address of the foreign amateurs. Plans have also been completed by this magazine for forwarding to transmitting amateurs in this country in turn all QSL cards that may be addressed to them by amateurs from those countries. American amateurs are invited to send their cards to foreign amateurs through this office, which will not only assure safe delivery through the special agencies which are thus provided, but which will publish a monthly list in a "Transoceanic Calls Heard" department.*

Address your cards to the foreign amateurs by call numbers and enclose them in envelopes to—

The Calls Heard Editor
POPULAR RADIO
627 West 43d Street, New York

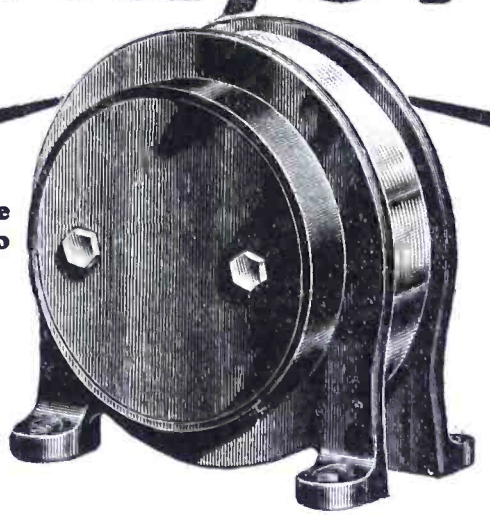
THE following stations were received and logged at the amateur station EF-8TIS, Rugles (Eure), France, using a Bourne receiver with one stage of audio and a single wire antenna:

NU-1NI—May 13, 1927; signal strength R3; DC note; interference and fading;
NU-2CS—May 19, 1927; signal strength R3; DC note on 30 meters; no fading;
NU-1ALR—April 29, 1927; signal strength R4; very good DC note; interference;
NU-2CX—May 23, 1927; signal strength R5; DC note; interference and slight atmospherics;
NU-8CPF—May 22, 1927; signal strength R7; good note; slight atmospherics;
NU-3AFW—May 21, 1927; signal strength R6; very good rectified AC note; some static;
NU-1ID—May 20, 1927; signal strength R7-8; very good rectified AC note; no fading;
NU-3AFW—May 19, 1927; signal strength R3; steady DC note; no static;
NU-8ALY—March 25, 1927; signal strength R6; DC note; atmospherics;
NU-5JF—May 7, 1927; signal strength R6; very good rectified AC note on 35 meters;
NU-1MV—April 4, 1927; signal strength R8; good note on 30 meters; no fading.
NU-8AZY—March 8, 1927; signal strength R2; DC note; interference;
NU-1ZV—March 6, 1927; signal strength R6; very good rectified AC note; interference;
NU-2AFV—March 6, 1927; signal strength R5; very good rectified AC note; interference;
NU-2AKJ—March 26, 1927; signal strength R7-8; good rectified AC note; interference and static;
NU-2CS—March 26, 1927; signal strength R6; DC note; no fading;
NU-8XE—March 24, 1927; signal strength R7-8; unsteady rectified AC note;
NU-1AL—March 13, 1927; signal strength R3; interference; fading;
NU-2CYX—Feb. 2, 1927; signal strength R5; good rectified AC note; no fading;
NU-2RG—Feb. 2, 1927; signal strength R3; good rectified AC note;
NU-8CCM—Feb. 22, 1927; signal strength R2; rectified AC note; interference and static;
NU-1QL—Feb. 22, 1927; signal strength R4; rectified AC note; static;
NU-1BDW—Feb. 27, 1927; signal strength R2-3; atmospherics; fading;
NU-9CPM—March 5, 1927; signal strength R5; good rectified AC note on 30 meters; no fading.

THE following stations were received and logged at the amateur station EF-8NOX, Paris, France, using a Schnell receiver with one stage of audio and a single-wire antenna:

NU-3CKL—March 30, 1927; signal strength R7-8; very good rectified AC note on 39 meters; no fading;
NU-4OY—April 3, 1927; signal strength R5; good DC note on 39 meters; bad interference;
NU-1KK—April 25, 1927; signal strength R5-7; good DC note; no fading;
NU-1ASA—April 3, 1927; signal strength R6; DC note on 41 meters;
NU-8ACU—April 27, 1927; signal strength R5; rectified AC note on 36 meters;
NU-8AFQ—April 4, 1927; signal strength R5; DC note on 38 meters; slight fading;
NU-8DRJ—March 30, 1927; signal strength R6; steady AC note on 41 meters;
NU-5OA—April 27, 1927; signal strength R6; steady DC note on 37 meters;
NU-4TZ—Feb. 9, 1927; signal strength R6; DC note on 38 meters;
NU-8ALY—March 23, 1927; signal strength R6-7; very fine DC note on 38 meters; interference;
NU-8BBE—Feb. 6, 1927; signal strength R7; steady DC note on 41.5 meters; slight interference;
NU-8CCQ—Feb. 4, 1927; signal strength R3; rectified AC note;
NU-8ES—March 25, 1927; signal strength R5; rectified AC note on 41 meters; slight fading;
NU-1AJX—March 5, 1927; signal strength R6; DC note on 39 meters; slight interference;
NU-1AKR—March 4, 1927; signal strength R5; steady rectified AC note on 43 meters; slight interference;
NU-1AXA—Feb. 5, 1927; signal strength R7; good DC note on 39 meters;
NU-1AVF—Feb. 5, 1927; signal strength R6; rectified AC note on 42.5 meters; slight interference;
NU-1ALS—Feb. 7, 1927; signal strength R3; steady rectified AC note on 35 meters;
NU-2QU—March 11, 1927; signal strength R7; very good rectified AC note on 43 meters;
NU-2MD—March 5, 1927; signal strength R6; DC note on 42 meters; slight interference;
NU-2CVS—March 4, 1927; signal strength R5; DC note on 42 meters; slight interference;
NU-2BM—Feb. 2, 1927; signal strength R8; good rectified AC note on 42 meters; slight interference;
NU-2AVB—March 5, 1927; signal strength R5; rectified AC note on 43 meters;
NU-1XM—Feb. 9, 1927; signal strength R7; rectified AC note on 39 meters; slight interference;
NU-1NL—March 6, 1927; signal strength R5; rectified AC note;
NU-1KK—Feb. 7, 1927; signal strength R7; DC note on 38 meters; slight interference;
NU-1IC—Feb. 10, 1927; signal strength R6; rectified AC note;
NU-1GR—Feb. 6, 1927; signal strength R6; DC note on 41.50 meters; slight interference;
NU-1DI—March 4, 1927; signal strength R7; rectified AC note on 38 meters;
NU-1CX—March 8, 1927; signal strength R6; DC note on 42 meters.

Magnaformer



Magna—The dictionary definition of "magna" (Latin) is "great"; the definition of "former" is "creator". Thus, we have the **Great Creator**, truly a name emblematic of the astonishing accomplishments of the Magnaformer.

Price $8.50

Two Years Ahead in Design

At the Radio Trade Show in Chicago, the announcement of the Magnaformer was one of the few startlingly new ideas in radio development. We know from actual observation that the Magnaformer is two years ahead in design, for it incorporates advanced and evolutionary ideas throughout. It is distinctly different, with its self-shielding, matched units, double amplification for each R. F. stage and excellent laboratory construction. It is a fresh idea—the very heart of the new and better receiver in which its remarkable qualities are given full range. Coming, as it does, when the air has been cleared by the new rulings of the federal radio commission, it makes it possible to secure exceptional results, accomplishments heretofore unknown to radio fans.

THE new Magnaformer 9-S Receiver has won the instant approval of radio experts. It has created a new standard of all-around radio efficiency. It is the season's feature circuit in Radio, Citizens Radio Call Book, Popular Radio, and other well-known magazines. This widespread acceptance and enthusiasm is due to the inherent excellence of the circuit—its hair-splitting selectivity, perfected, superb tone, great volume and extremely long range. During the first test of the Magnaformer Receiver this Spring, 43 D-X stations were logged from Chicago, including three on the Pacific Coast. The engineers present during the test were astounded. Subsequent performances have shown that the Magnaformer does the amazing thing consistently. Winter reception will see many additional record performances, according to the experts. The enthusiastic reception accorded in Chicago is now being given the Magnaformer the country over. Its performance is sensational. It is the talked-about circuit in radio professional and amateur circles. One of the real thrills and joys in truly exceptional radio performances is in store for the man who "builds his own," and it is impossible to duplicate the work of the Magnaformer in any other way.

The secret of the Magnaformer circuit's efficiency lies in the new Magnaformer intermediate long-wave transformers with which it is equipped. These transformers are a distinct innovation in radio. They are refreshingly new in design, in workmanship and in performance. This new and superior construction meets the present-day demand for greater radio efficiency, a demand far more critical than ever before, due to radio's rapid advancement in factory-built receivers. The circuit throughout is new and modern. It has the latest lighted drum dials, controlled by knobs instead of the fingers; unique Ferranti transformers give equal amplification of all audio frequencies; output tone filter insures retention of tone quality.

Thus, in the Magnaformer you have a precision-built instrument that ranks foremost in laboratory circles and which is available to set builders in the perfection of a truly remarkable radio receiver, a receiver that is designed from the best available parts possible to produce, all matched perfectly into a compact, high-quality receiving set of the first order.

Truly, it has well earned its name, Magnaformer, the "*Great Creator.*"

Magnaformers are different, outstanding and unusual in four vital respects

FIRST—Magnaformers are precisely and unalterably tuned in the laboratory to exactly the same wave length in such a manner that they always positively pass the full and complete signal-wave with all of its harmonic carrying side-bands intact; result—surprisingly beautiful tone quality.

SECOND—The combined elements of technical engineering design of Magnaformer Intermediates are such that the incoming signal receives double the usual amplification in each R. F. stage; result—a very powerful output perfectly controlled from a whisper to volume enough to fill a large hall—every sound clear and distinct.

THIRD—Magnaformers are thoroughly and scientifically shielded—so that the tubes to which they are connected will not oscillate, no matter how closely together or in what position they are placed in the receiver—a very important factor of its superior design; result—no fuss, no fuming, no squeals, squawks, blurps nor hisses. Just beautiful, natural reception, clear, full-toned, quiet, powerful.

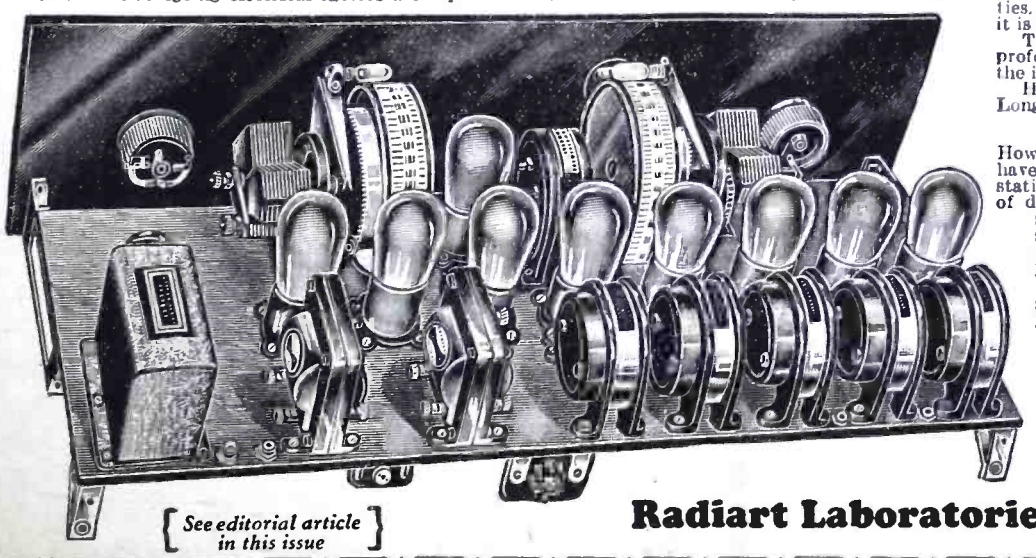
FOURTH—Mechanically, Magnaformers are as nearly perfect as engineering skill can make them. The three foregoing electrical factors are dependent on perfection of Mechanical Design to insure their unvarying performance. The primary and secondary coils of each Magnaformer are wound on pure Bakelite and are permanently fixed so that their inductances cannot possibly change. The secondary inductances are exactly tuned in the laboratory by small variable condensers which are fixed and locked after the tuning is done. These small condensers are locked in entirely separate Bakelite compartments and are ENTIRELY outside the electrostatic fields of the coils. No jar or jolt can disturb or change the inductances or capacities of Magnaformers after they leave the laboratory. The coils also are locked in entirely separate Bakelite compartments. Both coils and condensers are specially treated before being locked in their separate compartments. They cannot possibly be affected by moisture, atmospheric or climatic changes; result—a permanency of vital tuning factors that insures a uniform and unalterable reception for the Receiver, year in and year out—a rare achievement.

Permanent, Unalterable, Fixed Construction

The size, the shape, the built-in quality features—these three elements incorporated in the Magnaformer intermediate transformer, makes it surprisingly efficient and practical.

It is the best-balanced, most critically adjusted and fixed unit that can be had. It is the correct size for ease in handling and mounting side by side. It is the one unit in a radio set upon which the performance of everything else is dependent. Therefore, it is constructed with precision, exactness and fixed, adjusted and sealed in manufacturing to insure perfect operation continuously. It will never need adjustment, taking apart or tinkering. It is as fixed and final when it reaches you as anything can be.

It is fool-proof and trouble-free—features that will be appreciated by both the amateur and experienced set builder.



See editorial article in this issue

An Appreciation to the Set Builder

We take off our hats to the set builder, the man who has really made radio what it is today. Without set builders—the makers of custom-built receivers, the science of radio would still be in the infant stages. The inspirations, the innovations, the continuous streams of new ideas, advancement and accomplishment in radio—these are all due to the set builder. It was the set builder who was the first to recognize radio's possibilities. It is to his untiring zeal that radio is what it is today.

The set builder deserves the respect of every professional radio engineer and manufacturer in the industry.

Here's to the Knight of the soldering iron! Long may he carry on!

Enjoy This Thrill!

How many times have you wished that you could have a radio set that would bring in almost any station you desired, loudly and clearly, regardless of distance, and without squeals and howls? A set you could operate with perfect ease? A set that reproduces naturally, sweetly, delightfully, just as if you were listening to the program in the studio?

Now the opportunity to actually hear the supreme achievement in radio is afforded to you through the Magnaformer. It will be a new and pleasing experience for you and will furnish you with a new and novel radio thrill.

10c brings you full-size visualized circuit blue-prints, novel wiring diagram, complete wiring instructions and detailed story of development and accomplishments of Magnaformer. Be the first to get it.

Radiart Laboratories Co. 19 S. LaSalle St., Dept. 46 CHICAGO, ILLINOIS

30 Days FREE TRIAL

Single Control 7-Tube

$77

RETAIL PRICE
Completely Assembled

The Randolph
SINGLE CONTROL – ILLUMINATED DRUM

POWERFUL seven-tube radio at factory price. Test it without spending a cent. We claim the Randolph Seven will out-perform any radio and we want you to satisfy yourself that it will. To do this, we will send you this powerful radio to try for 30 days. Test it for distance, clearness, ease of operation, tone and every other way you can. Unless it more than satisfies you, return it to us. **Every Randolph set must make good before it is sold.**

Battery or ALL ELECTRIC OPERATION

The Randolph Seven is sold for use with batteries or connected for operation direct to electric light socket—absolutely batteryless—no chargers or batteries—just **plug in** socket and **tune in.** 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities and leading radio and scientific publications.

Single Control—Illuminated Drum

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a 7-tube tuned radio frequency receiver with power transformers and power amplification. Space wound solenoid coils Full and completely shielded. A real receiver of the highest quality. Tremendous distance, wonderful tone quality, simple to operate.

The Randolph cabinets are in themselves beautiful pieces of furniture made of carefully selected solid burl walnut. Bas-relief bronze escutcheon plates are mounted on the dial panel. In design and appearance it is a cabinet worthy of the high-quality radio it contains. Solid walnut beautifully shaped surrounds the soft verdi-green panel.

Nothing has been spared to make the Randolph Seven the leading radio receiver. We are so sure that it will surpass even your best hopes that we know how safe we are in making the **30 day free trial offer.**

Read What Owners Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas.

I have logged 52 stations from Cuba to Seattle—the set is a world beater.—J. Tampkinson, Detroit, Mich.

Your set is a revelation—has all others tied to the post for distance and selectivity.—Waldo Powers, Vergennes, Vermont.

On strength of its performance sold two more sets this week. T. Scanlow, Orlando, Florida.

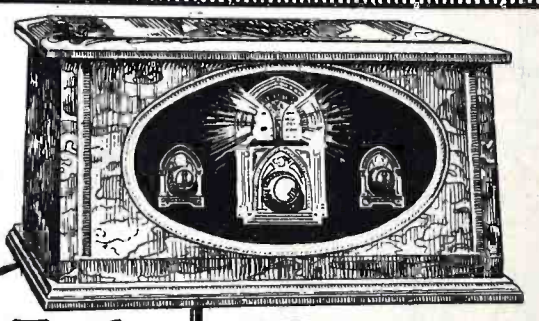
Beautiful Ampliphonic Console Set

Made of the finest carefully selected solid walnut. Two-tone shaded finish. Has built-in cone loudspeaker that compares with any on the market and accurately reproduces high and low notes. Send for the folder today that shows this beautiful console in full colors and gives complete details. **Compares with most table sets in price.** For **battery** or **all-electric operation** ready to **plug in** and **tune in.** Write for complete descriptions.

Randolph Radio Corporation
711 W. Lake St. Dept. 56, Chicago, Ill.

BIGGEST DISCOUNTS to AGENTS and DEALERS

WORK either full or part time and make big money. Tremendous advertising campaign helps you sell. Regardless of whether you have ever sold before, be sure to get our proposition. The Randolph sells on first demonstration. Men and women both can make money this easy way. Get your demonstration set for thirty days FREE TRIAL.



6-Tube $55
Retail Price
SINGLE CONTROL

The Randolph

Now you can have a **new, modern, single-control, six-tube radio.** Do not compare this set with old style 2-dial 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers.

Comes in a beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated Drum with space for logging. Absolutely dependable and very selective. **Sent for 30 Days Free Trial. You test it before you buy.**

Mail Coupon Now

The Randolph Radio Corporation are pioneers in the manufacture of radios. All of its vast and unlimited resources have been used in making and perfecting of the Randolph Receivers. Because of our long and successful experience in the radio business, we are perfectly confident in sending out a Randolph Radio on trial. We know what it will do. Mail us the coupon now for the greatest radio offer ever made.

USE THIS COUPON TODAY!

Randolph Radio Corporation,
711 West Lake Street, Dept. 56
Chicago, Illinois.

Send me full particulars about the RANDOLPH Six and Seven-Tube Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name.....

Address.....

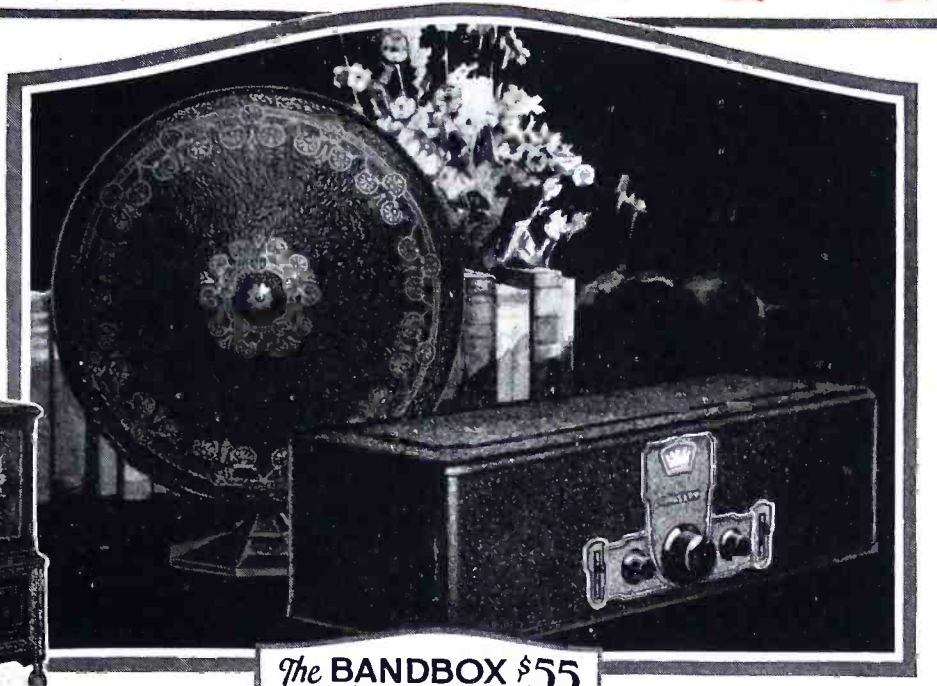
City..... State.....

Mark here ( ) if interested in Agent's proposition.

"....You're *there* with a Crosley"

$35

$85



The BANDBOX $55
A 6 tube Receiver
Brown frosted Crystalline finish—
Bronze Escutcheon.

$65

These approved cabinets have been selected by Powel Crosley, Jr., as ideal consoles, acoustically and mechanically, for the installation of the Crosley "BANDBOX." Genuine Musicones built in. Crosley dealers secure them from their jobbers through

H. T. ROBERTS CO.
914 S. Michigan Ave.
Chicago, Ill.

Sales Agents for Approved Console Factories:

SHOWERS BROTHERS COMPANY
THE WOLF MFG. INDUSTRIES

A tremendous Crosley Radio achievement *for* 1927-28

Recent court decisions which clarified the radio patent situation have paved the way for still greater Crosley triumphs.

Now—completely available to Crosley—and amplifying Crosley supremacy in fullest measure, are the enormous resources, great discoveries and ideas embodied in patents of

1—The Crosley Radio Corporation.
2—The Radio Corp. of America.
3—The Westinghouse Co.
4—The General Electric Co.
5—The American Telephone & Telegraph Co.
6—The Hazeltine Corporation.
7—The Latour Corporation.

under which Crosley is now licensed to manufacture.

Here are the seven big things which represent radio's greatest advancement, brought together by Crosley and combined with the experience, mass production method and leadership of the Crosley organization. No wonder a waiting radio world pronounces the "Bandbox" at the unprecedented price of $55, Crosley's paramount achievement.

The Bandbox Is Shielded

Radio coils are surrounded by magnetic fields similar in every respect to the magnetic field around the earth that moves the needle of a compass but around radio coils these fields make nuisances of themselves by feeding back on each other. Heretofore it has been customary to make inefficient coils with inefficient fields to prevent such feeding back. The Crosley Bandbox incorporates copper shields around each coil to prevent such feeding back. The coils consequently can be made and are very much more efficient. The amplification of the receiver is, therefore, much higher—the sensitivity is greatly increased. Condensers are also completely shielded from each other in separate metal compartments. Hitherto, only high priced sets have enjoyed this super radio advantage.

There Is No Oscillation

The Bandbox employs completely balanced or neutralized radio frequency stages to prevent oscillation, instead of the common form of losser method. More costly, to be sure, but extremely necessary in achieving such results as are obtained by this marvel of radio reception.

For Sharpness--The Acuminators

"Bandbox" acuminators enable "fishers" for distant stations to bring them in loud and clear. As powerful telescopes magnify distant scenes, acuminators increase the volume of far-a-way signals so they seem like local programs.

Volume Control

This is another big "Bandbox" feature which permits full brass band power for those who want their dance notes strong and loud. For others, it cuts volume down to a soft and gentle murmur, without distortion.

Illuminated Dial

A Master Station Selector has an illuminated dial for easy reading in shadowy corners. A single knob permits full tuning for ordinary reception of local, nearby and super-powered stations.

Installation Simplified

A woven cable, containing varicolored rubber covered leads, makes installation and hook-up easy for the veriest novice. No waiting for the radio service man, should the batteries be changed.

Easily Adapted to Consoles

Simply remove screws in escutcheon and in base of set. Lift off metal case. Chassis now stands ready for installation in console cabinet. Opening in console cabinet permits control shafts to protrude. Escutcheon screws in place and—Presto! the console radio is complete.

For A C Operation a special Bandbox is available at $65, wired specially for use with the Crosley Power Converter at $60. This special Bandbox utilizes the new R.C.A. AC tubes which have made the operation of radio receivers direct from house current so simple, efficient and dependable. The first three tubes employed in the AC model are UX 226. These go into the radio frequency sockets. The detector tube is UY 227, with indirectly heated emitter. Another UX 226 is used in the first audio stage. Raw AC current heats the filament of all UX 226 tubes. Power tube UX 171 is in the last audio socket. This makes the "dog houses" rumble sonorously and the bass drums deeply boom.

The Power Converter

The power converter which smooths the alternating current is a marvel of engineering ingenuity. Only half the size of an ordinary "A" storage battery, it supplies the required A, B and C currents, without hum. Finished in brown frosted crystalline.

There are models for 25 and 60 cycle current. A snap switch shuts down the set and power converter completely.

Price of Power Converter--$60

You owe it to yourself to see the "Bandbox" and listen to its remarkable performance. If you cannot easily locate the nearest Crosley dealer, his name and address will be supplied on request. Write Dept. 16.

IMPROVED MUSICONES

Although Musicones improve the reception of any radio set, they are perfect affinities in finish, beauty and reproductive effectiveness for Crosley Radios. A new model built in the form of a Colonial Tilt-Table with brown mahogany finish, stands 3 feet high. Price $27.50.

16-Inch Super Musicone
(As pictured with Bandbox)
$12.75

12-Inch Ultra Musicone
$9.75

CROSLEY RADIO

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

NEUTRODYNE

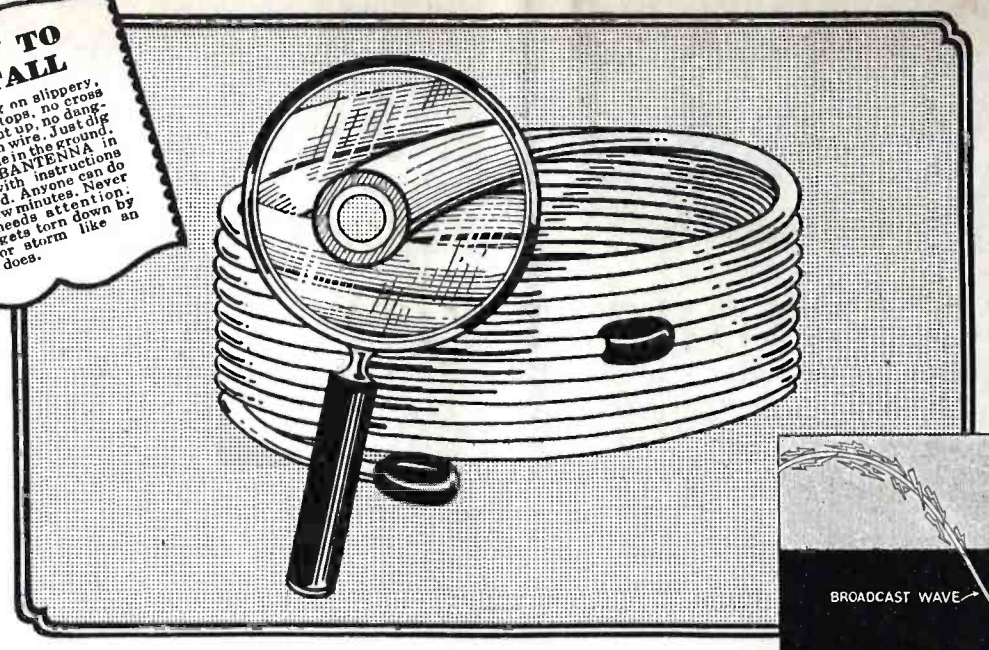
Crosley recommends the use of five 201-A Radiotrons and one UX-171 power tube, or Cunningham equivalents, which are furnished at standard tube prices, with each Bandbox. While Radiotron UX-171 is 180-volt tube, it gives a superior performance for 135-volt "B" batteries.

THE CROSLEY RADIO CORPORATION
POWEL CROSLEY, JR., *Pres.* **CINCINNATI, OHIO**

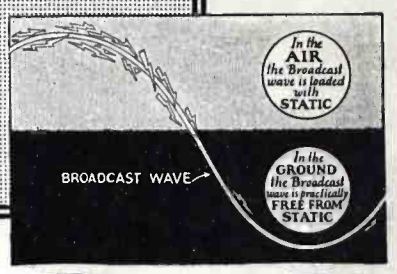
Prices slightly higher West of the Rocky Mountains

EASY TO INSTALL

No climbing on slippery, dizzy roof tops, no crossticks to put up, no dangling lead-in wire. Just dig a small hole in the ground. Bury SUBANTENNA in accord with instructions furnished. Anyone can do it in a few minutes. Never again needs attention. Never gets torn down by wind or storm like an aerial does.



This graph-picture tells the greatest radio story ever told. *Send coupon* for the complete explanation of the difference between noisy air waves and static-free ground waves.



Oh=the joy of Radio!

with a SUBANTENNA

"I get plenty of stations with my Subantenna, on the loud speaker, that I have never been able to reach with my outside aerial. It absolutely cuts down interference to the minimum,

cuts static out, too —not just partly out—but ALL out"

H. S. M., North Carolina

And besides that he gets stations with his Subantenna that he never could coax out of the air with an aerial! Read what Mr. H. S. M. of North Carolina thinks of Subantenna, in his letter which we have reprinted in brackets at the top of this column. He is just one of many thousands of fans who are enjoying clearer, louder, better long distance radio reception since discarding the unsightly, static-collecting, up-in-the-air type of aerial, and using in its stead, Subantenna, the new *underground* antenna.

Every Night a Good Radio Night —Now an Actuality

Gone is the time when the first warm day is the signal for pushing the radio back in the corner until cold weather comes again. A thing of the past is the disappointment of having an evening's radio fun spoiled by an unexpected storm or attack of static. Install a Subantenna and your radio will be as dependable as the sunrise. On any night, in any season, in any weather you can get real "distance," enjoyable clarity and bigger usable volume than you ever could before —all you need is a Subantenna.

What Scientists Found Out

For years the heads of great laboratories have been trying to perfect a means of tuning static out of radio impulses received from the air. And all this time they knew not only that the same radio wave which travelled thru the air also travelled thru the ground, but that the ground is practically free from static! Knowing this, a group of inventors set out to develop a device by which the radio wave could be satisfactorily picked up from the ground. Result! Subantenna — already tested and proved by thousands of users—and offered to YOU to test on an unconditional, unqualified guarantee basis. Read herewith, a few more of the voluntary letters of praise which Subantenna users have sent in. Then get the whole explanation of Subantenna—why the ground is almost static-free — why Subantenna increases the distance-getting capabilities of practically any set — why it increases volume and improves selectivity. Get this information from your dealer, or mail the coupon from this announcement for booklet and our *free trial* offer. Now, read:

Says its WONDERFUL!

"After 4 years of testing aerials I at last found the master in the Subantenna. The first night I used it was a very hot summer night. Static was very bad on my outdoor aerial. I connected my Subantenna and one could hardly believe the results. It was wonderful."—F. L. C., Mass.

Works Fine with "B" Eliminator

"We have the Subantenna installed and it is all you claim it to be. It works fine and we enjoy it very much. We also have a B Battery Eliminator and the two together work fine. We would not want to go back on the high-in-the-air aerial again as we get so much better reception on Subantenna."—A. J. L., Maine.

SURPRISED!

"I received the Subantenna and installed it the same night and believe me I was surprised with the result for I was quite suspicious about it. I am well satisfied."—R. E. G., Canada.

FREE TRIAL

Make This Convincing Test

Install SUBANTENNA. Leave your old aerial up. Select a bad night when DX is almost impossible with the ordinary aerial. Make a comparison station for station connecting first your aerial, then SUBANTENNA. If, from stations that are just a mess of jumbled noise with the old aerial, you don't get reception that rivals local in sweetness and clarity the instant you switch to SUBANTENNA, this test won't cost you even a single penny. Obtain a SUBANTENNA from your dealer or send coupon at once for scientific explanation of SUBANTENNA and for particulars of GUARANTEE and FREE TRIAL OFFER. SEND COUPON NOW!

SUBANTENNA

The New Underground Antenna

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