RADIO'S LIVEST MAGAZINE

A GERNSBACK PUBLICATION

April
25 Cents

# Radio-Craft

FOR THE
SERVICE MAN - DEALER - RADIOTRICIAN

HUGO GERNSBACK Editor

The
Radio-Controlled
Tank
See page 600

Tone Control, by John F. Rider   New Tube Types   A Home-Practice Set
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# Radio-Craft

FOR THE SERVICE MAN · DEALER · RADIOTRICIAN

HUGO GERNSBACK, Editor-in-Chief

JOHN F. RIDER, Editor Service Dept.

C. P. MASON, Associate Editor

VOLUME II
NUMBER 10

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## In Forthcoming Issues

RADIO-FREQUENCY TRANSFORMER DESIGN, by Sylvan Harris. Some years ago Mr. Harris announced the result of exhaustive researches on R.F. transformers, in the most complete form then available to the constructor. There has been since that time no popular explanation of the general principles of coil design. Mr. Harris will discuss the subject in the light of the new tubes and new methods of construction which have since been introduced.

THE DIODE DETECTOR, by C. H. W. Nason. The cycle of radio has swept around again to the two-element rectifier, which Fleming introduced a generation ago. But modern radio circuits retain the theoretical advantages of this tube, while overcoming the difficulties which hindered its use back in the crystal days.

AN A.C. BEAT-FREQUENCY OSCILLATOR, by H. G. Cisin, M.E. This article, describing an apparatus which is so well built that it may be used for laboratory measurements and tests of the value of apparatus, will be valuable to Service Men, and of interest to every serious experimenter.

A FIFTY-WATT AUDIO AMPLIFIER. One of the most interesting features of this system, adapted to auditorium or open-air work, is the novel arrangement for correcting the frequency-characteristic, to give the proper balance of tones at great sound intensities.

And numerous articles for the Service Man, the constructor and the experimenter.

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Several friends want me to get VARI-TONES for them. They were sold on this wonderful device from the first time I let them hear my set. All in all, I think it is the most wonderful radio contribution to people who want to bring their sets up to date that I have seen offered. Wishing you the best of success, I am, respectfully yours,

J. Frank Westerkamp,
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Donald Taylor,
3638 So. Saginaw St.,
Flint, Mich.

LIST PRICE. $4.75

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**$2.95**

### Have the BIG NEW Feature of 1931 Nationally Advertised Radio Without Having to Buy a New Set

Tone Control is the big, new radio feature this season on expensive radios. It is a fine thing.

People's ear-drums differ. Some folks like emphasis on bass notes. Some prefer high notes. Some like it somewhere in between these extremes.

Then, too, acoustics differ in different rooms. The same radio "sounds" better in one room than in another.

Occasionally the air may be "noisy" with high frequency interference. Such noises usually are on high frequency wave lengths.

Again, the broadcasting of certain programs or of certain stations may be a little off—too much stress perhaps on low or high notes.

Outside of regulating the volume loud, medium or soft with your set, you couldn't do much to correct these annoying conditions.

### But Now! —

Now, merely by connecting in one minute the VARI-TONE Tone Control, with a slight turn of its knob, one way or the other, you can adjust the tone pitch to suit your ears.

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APRIL
1931
VOL. II—NO. 10

Radio-Craft
FOR THE
SERVICE MAN · DEALER · RADIOTRICIAN

HUGO GERNSBACK
*Editor*

"Takes the Resistance Out of Radio"

Editorial Offices, 96-98 Park Place, New York, N. Y.

# Radio Gadgets

## By Hugo Gernsback

IT would be most interesting, if someone of a philanthropic nature should erect a radio museum in which would be displayed all of the different radio appliances which, during the course of the years, have been put out by enterprising and hopeful manufacturers. For one thing, it would be most interesting from a historical standpoint; and, from many other standpoints, it would afford a good deal of amusement, aside from the instructive value.

Those who have had occasion to leaf through back-numbers of our radio publications, going back over a stretch of ten years or more, will be amazed at the tremendous amount of radio material that has been put out, and so much of which became obsolete very quickly. Of course, in an art that advances as rapidly as radio, this is a necessary evil; yet it is surprising how many radio accessories, that we could not do without at one time, are never heard of today. The new-comer, who is just starting in radio, often has not the slightest idea what the old gadgets were all about. A large catalog could be made of all of these obsolete items, many of which can no longer even be bought; while others, though obsolete so far as the experimenter is concerned, are built into a radio set as a regular thing. Very often it will be found that what once was an accessory, thought necessary to a radio set, is today no longer an accessory; for the manufacturer of the set builds it into the radio set as a matter of course.

Of the many gadgets that come to mind, only a few may be mentioned here.

For instance, there was the adjustable loud speaker. No one, some few years back, wanted to buy a loud speaker unless he could regulate it himself by means of an adjusting screw. Where can you buy an adjustable loud speaker today?

Then there was an epidemic of vernier dials. Fortunes were made and lost by a number of manufacturers, in just this one item alone. Yet a vernier dial today is almost obsolete, except in short-wave sets. Manufacturers of radio sets prefer to build their vernier arrangements, if they use any, right into the set.

Then we had the tube protectors, and there were a good many of these. Vacuum tubes were at that time fearfully expensive (costing as high as six and seven dollars apiece) and it was quite the thing to have a special fuse attached to every socket, to prevent the tube from blowing out, if the "B" battery should be actually shorted across the filament.

No radio set, six or seven years ago, could be sold unless it had anywhere from one to three jacks, into which you could plug in not only your loud speaker but your telephone receivers as well. We could plug into the detector circuit, if we wanted to, or into the first or second stage of the amplifier; and no set was considered complete without such gadgets. Where are the radio jacks today, and where do you plug in your telephone receiver, even if you want to, except perhaps in a few short-wave sets?

Then there was an outburst of adjustable grid leaks. A grid leak was considered so much junk unless you could adjust it to your heart's content. Dozens of manufacturers made grid leaks, from the simplest to the most complicated types, to take care of the demand. It is doubtful whether the new radio experimenter will be able to buy an adjustable grid leak today.

Then we had our tuned radio-frequency transformers. Some of the best tuned radio-frequency sets had to have tuned transformers, in order to get the last ounce of efficiency from the set. Today the tuned radio-frequency transformer is a museum attraction.

Then, for a while, we had a number of multiple tubes. The detector, radio-frequency and audio-frequency tubes were all incorporated into a single bulb. It was proposed to do away with all the other tubes in the set, and have just one. The idea did not go over, principally because of the great cost of such a tube; although it is inherently sound. I do believe that, in the future, we may have some of these multiple tubes again, provided they can be manufactured cheap enough.

At about the same time, we had a huge crop of tube rejuvenators. This was an interesting gadget; mainly for the reason that tubes were at that time very expensive and they could actually be somewhat rejuvenated by means of one of these appliances. Such electric tube rejuvenators sold from $5.00 upwards. Go into a radio store today and ask for a tube rejuvenator; and the clerk will, most likely, not have the slightest idea of what it is all about.

Then we had the tube-howl arrestor, which was also an interesting little gadget at which we laugh, or at least smile, these days. Tubes were not as efficient then as they are today, and they were mostly microphonic. In those days it would have been impossible to manufacture a midget set; for the simple reason that the feedback of the loud speaker would have made radio reception impossible. Even five feet away from the set, a loud speaker produced enough audio feedback to start the tubes to howl. The tubes in those days were almost universally microphonic; hence the howl-arrestor gadget. It is doubtful whether there are any in the market today.

For the same reason, we had an epidemic of cushioned sockets, for these tubes; these were supposed to cure the howl evil and, incidentally, prevent filament breakage. The cushioned socket today is also an anachronism, for the reason that the modern tube no longer requires it.

Then there was the fad of wavetraps. Hundreds of thousands of these gadgets were sold; the most interesting points about them being the advertising claims, most of which were unwarranted. There was hardly a wavetrap manufacturer who did not make claims that his contraption also reduced or eliminated static. In some cases, this contention might have been true; because some of these wavetraps eliminated the signal as well, so you could hear neither static nor radio program. While there is still a limited market for wavetraps, the modern set has practically eliminated the wavetrap entirely.

What is the moral of all this? Simply that no one knows, ahead of time, what will or will not be successful in the radio art; and there is no way to find out except by the hit-and-miss system. No art can progress without this experience; and it is to be doubted that the radio industry would have achieved its present position had it not been for the activities of our inventors, big and little. There is always a market for a good gadget, and we have them today as we had them years ago. The future alone will tell which of these accessories will prevail.

# Service Men's Department

***This department is about the Service Man, for the Service Man, and largely by the Service Man. Its contributors are practical men, and we invite every Service Man in the country to tell about his own experiences of all kinds.***

## Edited by JOHN F. RIDER

### TONE CONTROL?

**By John F. Rider**

THERE has been a great deal of agitation about tone control. The principle is being discussed pro and con. Some receiver manufacturers favor its application, and others are against it.

What is tone control? What does it do? Questions of this type are heard daily.

Tone control, in the fullest sense of the word, denotes a means whereby the tone of a sound may be changed. Since the tone is a matter of pitch and, therefore, involves frequency consideration, "control of a tone" would seem to signify some means of varying the frequency. Obviously, such a procedure is impossible; but it is possible to vary the comparative amplitudes of the frequencies present in a sound, and thus to change the timbre of the tone. By increasing the amplitude of some frequencies, or the intensity of the sound, it is possible to create in the mind of the listener the same impression as if he had heard frequencies which were absent in the sounds issuing from the speaker.

While it is true that certain physiological reactions can be produced by means of a system which is of such design that the amplitudes of the frequencies can be varied, this does not signify that such a result is possible with the present-day systems of "tone control" which are employed in radio receivers. There are many reasons which indicate the need for a tone-control system: among them are the peculiarities of the human ear; the fact that the reproduction of the broadcast music must usually take place in a room which is much smaller than studios where the original music is being produced; the fact that the intensity of the reproduced music is much less than that of the original; the fact that the reproducing mechanism is far from being perfect; and several other similar considerations. However, the reader should not imagine that the average capacity-type tone control system produces such a control of the frequencies which are being passed through the audio amplifier. In short, the capacity-type, and similar simple forms of tone control, introduce distortion. Of that, there is no doubt; but the question arises, whether such distortion is or is not desired by the listener? Judging from all signs, distortion of the nature caused by the simple forms of tone control is desired by the radio public. That such a condition has been existent for a long period of time has been shown by the oft-suggested methods of producing "mellow tones."

"Mellow tones," as interpreted by the radio public, and as produced by several popular methods, means the loss of the higher audio frequencies. Anyone interested in the characteristics of speech and music will readily appreciate the significance of the high frequencies in speech and music; they mean brilliance and color in music, intelligibility and articulation in speech. But, if I do not care for the presence of the high audio frequencies in music, and I am satisfied with the speech-sounds which do not contain the frequencies above 2,000 cycles, who is there to tell me that what I hear is not what I *should* hear? Perhaps it is poor music in the ears of a music lover; but I like it just the same.

**MR. JOHN F. RIDER, who passes upon all the material submitted for publication here, in the Service Men's Department, is a radio engineer of the first rank who has devoted much energy to the popularization of technical knowledge. None excel him in the art of making difficulties clear; he is a practical instructor, and the author of books known by all Service Men as useful guides. Letters, stories, requests and suggestions for this department may be addressed to him in care of RADIO-CRAFT.**

On the other hand, the introduction of the simple form of tone control defeats the efforts of that group of organizations who are true music lovers and are attempting to foster interest in musical appreciation. There is no doubt about the distortion introduced by the simple form of tone control, there is no doubt that it impairs the beauty of a symphonic orchestra — but one is tempted to ponder over the possibilities of satisfactorily reproducing a 125-piece symphonic orchestra in a living room (say, 14 x 17 feet), when the receiver is not equipped with tone control. Furthermore, one is tempted to ponder over the sensations of the average man or woman who is not a lover of symphonic music, and who would, when obliged to listen to perfect reproduction, express an unfavorable comment. Many such individuals find pleasure in symphonic music when they can change the timbre of the complete sound. Whether or not such a viewpoint is correct, is beyond the point. The fact remains and it is glaring that the simplest of tone-control systems affords a means of satisfying the desires of the listener.

Perhaps we should qualify the last statement. The true music lovers who can appreciate good music, and whose auditory organs are such that they can appreciate the absence of certain frequencies, find no advantage in the tone control. Unfortunately, however, this group is a minority, and the majority must rule. Condemnation of the tone control is not in order. What is necessary is the design of a tone-control system which can be applied when desired, and disconnected when not desired. Of course such a system must increase the cost of a radio receiver. The design of the radio receiver without the tone control should be based along the ideal, theoretical lines, tending to produce music and speech of the highest calibre.

No one on earth can control the musical or gastronomic tastes of any other individual or, for that matter, any of the human desires. Radio manufacturers have known for a long time that the receiver-buying public has not been satisfied with the musical reproduction. It would be wonderful if all of us were music lovers; it would then be unnecessary for some of the rich men in this country to endow and finance musical organizations. The ticket sellers at concert halls greet many of their customers by the first names, because the same people come again and again. They are music lovers, but their numbers are few. We might just as well look the truth in the face; the major portion of the population desire "hot jazz" and not symphonic concerts.

The beauty of a symphonic rendition can be appreciated only when the listener is in the concert hall, or if the reproduction is of the original intensity. Musical composers attempt to create a picture in the mind of the listener. How can one visualize the march of countless men, the rumble of thunder or of cannon, and countless other images, when the intensity of the reproduction is so low as to cause the loss of many notes; and the crash of bass drums or the thunder of bass chords upon a piano sound like the flapping of wings?

It is indeed unfortunate that the majority of the listening public desire depth of low notes, and not the brilliancy of the high notes. It is also unfortunate that the zone of frequencies representative of noise includes the upper audio register. Efforts to

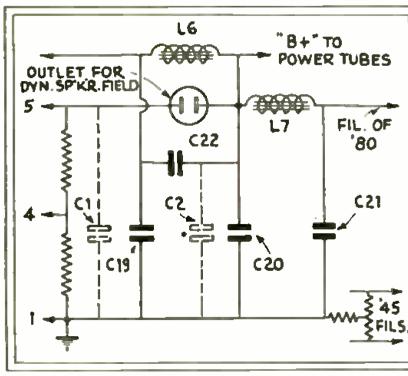
(*Continued on page 623*)

# Operating Notes for Service Men

*Hum, oscillation, irregular operation, and lack of selectivity or sensitivity have many causes; but a timely hint may save checking over a whole receiver in the shop*

By BERTRAM M. FREED

HUM, to an annoying extent, in the Bosch "48 A.C." chassis, may be due to one of the usual causes of such a complaint—bad tubes, an open section in a center-tapped resistor, or unmatched audio secondaries—but it has been sometimes found that the chassis has an inherent hum. At what time this condition developed does not matter; but it may be remedied by the addition of a 2-mf. filter condenser, with a working rating above 300 volts, connected from one side of the speaker field's outlet to the chassis (Fig. 1). Trial will show from which side this bypass is most effective. This chassis is used in several models; the "16," "17," "18," "Jr.", etc.



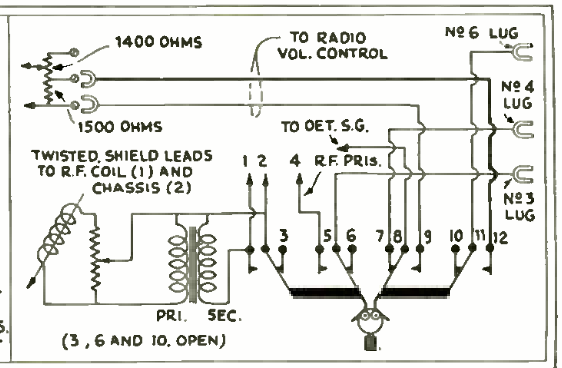




Fig. 1 Fig. 2

*Left, Bosch "48 A.C." filter; right, transfer-switch and cable connections of the Radiola "47."*

Many Service Men forget the existence of the antenna aligning condenser which is located directly above the antenna and ground binding posts in the Bosch "58" and "60" series; this has a black knob for manual adjustments. Lack of sensitivity and, often, cross talk, are caused by an incorrect setting of this condenser; it should be adjusted when the receiver is tuned to 1,000 kilocycles.

### Transformer Hum

An elusive hum, in the Kolster "K43," may be caused by any of a number of defects; it must be determined whether it is due to the "B" supply, a faulty component, or is purely of a mechanical nature. Most frequently, its cause will be found in the vibration of a power transformer shield; placing the hand firmly on this shield will show whether the hum is due to it. If so, and no objection is made, the shield may be discarded; it is removed by straightening the lugs which hold it and pulling it out. Otherwise, the space between the transformer and the shield may be packed firmly with soft paper and the shield fitted back in position. The air space, which formerly amplified the hum from the transformer, is now occupied by the stuffing, and the vibration is greatly dampened.

Electrical hum, in this model, may be caused by too much resistance in the hum control across the 2½-volt circuit of the heater-type tubes. This component may be removed, and one of about 15 ohms value substituted, to obtain more accurate and finer adjustment. Care should be taken to fasten this unit firmly to the chassis. An unbalanced condition of the secondary winding of the push-pull input transformer will result in hum which can be remedied only by replacement. All terminals of the power pack must be securely fastened down.

A cause of oscillation, in the Bosch "48," and certain Eveready models, is improper position of the variometer rotor, which should work with the condenser gang to provide equal sensitivity and stability over the whole tuning scale. When the latter is at 0, the rotor of the variometer should be at right angles to the stator. To align the rotor, loosen the two nuts which hold the variometer to the chassis, and adjust it. When replacing it in position, be certain that both sets of the insulating washers are in position between the frame of the variometer and the chassis. During the operation, and before the unit is fastened in place, it will not be amiss to bend the contact spring on the rotor to give better contact; for imperfect contact here may be a cause of much distress. Remove the gang shield, and bend the spring so that the tension on the shaft is increased.

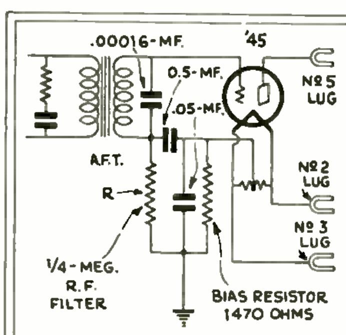
### Phono-Radio Switches

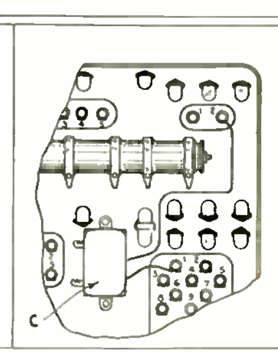
Much time was wasted recently on a Radiola "47," and an account of the reason may save another Service Man a similar experience. This set operated correctly on the phono. side, but spasmodically on the radio side; which led to the conclusion that the trouble was in the R.F. end. Testing the parts and circuits showed a lack of screen-grid voltage on the R.F. amplifiers. The cable is hard to trace, because red and green wires lead to different components. (See Fig. 2). Finally, however, the defect was found in a badly-corroded transfer-switch prong, which made, apparently, good contact with the other terminal. The switch was carefully cleaned of the corrosion, which had acted as an insulation, and the prongs were bent to increase their tension.

A complaint, on the other hand, of spasmodic record reproduction on a Philco combination, was traced to poor contacts on the transfer switch. Care must be taken, however, not to bend the blades too far; or the elasticity and tension may be lost in this component.

A loud hum in the Radiola "67," which was not caused by any defect in the "B" supply, or any other component, was cured by placing wads of felt on the speaker cone, to prevent undue response to the 60-cycle note. This did not interfere with reproduction, and the customer was satisfied. On this model, when the local-distance switch is placed on the "local" side, the aerial is disconnected. In some localities, even with a sensitive super, reception is poor without an aerial; and the receiver will in some cases oscillate violently. In this set, the power pack is somewhat different from the

(*Continued on page 623*)



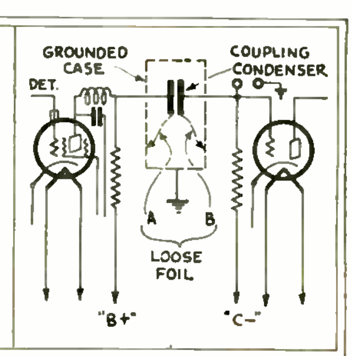




Fig. 3 Fig. 4 Fig. 5

*Left, output of the Radiola "66": center, an addition to early numbers of the Victor "RE-45" to reduce hum; right, a sensitive point in resistance-capacity coupling, as in the new Zenith "10," "11" and "12" (the latter not the old models similarly numbered.)*

# Leaves from Service Men's Note Books

*The "Meat" of what our professionals have learned by their own practical experiences of many years*

## By RADIO-CRAFT READERS

### NOISE IN A S.-M. SET

**By James H. Mills**

ONE of the Silver-Marshall sets was very noisy; this was traced, after several hours of testing, to the dial. By shaking the dial knob on the set, there was produced in the speaker noise which suggested a broken or loose connection somewhere in the set. I removed the chassis and found a filter condenser mounted and grounded to the base of the dial. In ninety-nine cases out of a hundred, this would be all right; but here was the hundredth, and it caused all the trouble. It is true that the dial was grounded; but only through a rolling contact, which was the noise producer. A wire direct from the filter can to the chassis cured the trouble.

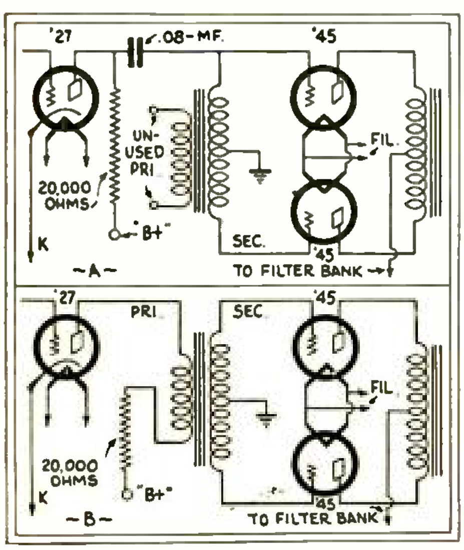
### KYLECTRON "K-70"

**By A. S. Cook**

ABOUT 75% of the Kylectron "K-70" sets, manufactured by the United Reproducers Corp., which I have been called upon to service, have been troubled with a short in the .08-mf. condenser coupling the first A.F. '27 with the grids of the '45 tubes. When a replacement condenser is lacking, a speedy and oftentimes permanent repair can be effected by utilizing the unused primary of the push-pull transformer, the secondary of which acts as a grid coupling choke.

To do this, remove the defective condenser from the circuit, and break the plate connection of the '27 tube at the 20,000-ohm resistor. Then, connect one end of the unused primary to the plate and the other end to this resistor.

Many of my customers have said that this method of coupling the circuits gives a better tone to the set. Personally, I cannot tell any difference; but who am I to disagree with the customer?




*The resistance-impedance coupling in the Kylectron uses a push-pull transformer's secondary as a choke. A repair restores the original purpose of the transformer's primary.*

### REVAMPING A.C. RADIOLAS

**By John J. Nothelfer**

FROM this method of improving the tone quality of Radiola "17," "18" and "33" receivers, I have had excellent results for many customers. Two changes in these receivers will result in greater tone quality and lessened hum.

The first is to install a 2,000-ohm resistor in series between the cathode of the detector tube and the ground or "B—" of the set; this resistance should be shunted by a 1-mf. condenser. The plate feed for the detector is taken off the 45-volt tap and put on the 100-volt connection of the voltage divider along with the plate supply of the R.F. tubes. This method will result in semi-power detection; although sensitivity is lowered, the tone quality will more than make up for this.

The second step is to take out the first audio-frequency socket and replace it with one of the UY type; the filament prongs of which are then wired to the detector filament connections. The cathode of this tube also should be wired with a resistor, say 2,000 ohms, and shunted in like manner to the detector.

This procedure may apply to any receivers designed along similar lines.

The advantage of changing the '26 to '27-type tube, in the first A.F. stage, is that the hum will be quite noticeably reduced.

### REPAIRING RADIOLA 25s

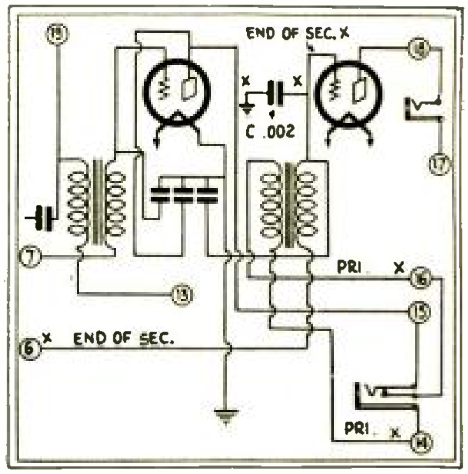
**By J. J. Stancil**

SINCE there are a number of the old R.C.A. "Model 25" supers scattered around, and since it has not been deemed practical for the average Service Man to open up the catacomb when any part of its interior goes wrong, I feel that some of my experiences with these might be worth noting.

I have found, quite often, that one of the A.F. transformers gives way—especially the primary of the last transformer. Some of the people who have lived with and enjoyed these old sets do not care to part with them; so I have replaced the audio transformers. The following applies, in this instance, to the last A.F. transformer but works equally well with the interstage one.

I took an R.C.A. audio transformer (ratio 3½-1) and, after cutting a hole through the front side of the catacomb can, directly in front of the last A.F. tube, I could readily solder the grid wire of the transformer to the grid terminal of this tube. I then connected the other secondary wire of the transformer to terminal No. 6 on the catswhisker back of the catacomb.

I then took a .002-mf. condenser; soldered one terminal of it to the catacomb can and connected the other terminal to the grid end of the secondary of the transformer, in place of the condenser connected in this circuit inside of the catacomb. I connected one of the primary wires of the transformer to terminal No. 14 of the terminal strip, back of the catacomb, and the other primary to No. 16 terminal. After making the above connections, I bolted the transformer in an external position on the oval metal frame holding the catacomb, in a position as near to the original one in the catacomb as I could. The set worked fine and there was no drop-off from volume or general efficiency that I could discern.




*The Radiola "Model 25" is still popular with many users; transformer replacements may be made externally. The connections of the "cat" are shown in Data Sheet 16 (April, 1930, RADIO-CRAFT).*

The points marked X are the ones to which I made connections as indicated. I have replaced both the A.F. transformers in like manner in different receivers. The first transformer would, of course, be connected to different terminals on the catacomb; but these are readily found by checking up on the terminal strip.

### THE OHMIC SERVICE MAN—AND ZENITH SETS

**By J. Rubenstein**

WE often wonder, after the explanation has occurred to us, why we failed to find the seemingly obvious solution of a problem for so long a time.

I was recently called to repair a Zenith "De Luxe A.C."— a big eleven-tube job—and found on the detector plate an intermittent voltage which indicated poor contact or a loose connection. The trouble was finally traced to the plate resistor of that tube. The value of that resistor is 100,000 ohms; so, setting my Weston "547" tester to the high-resistance reading, I placed the prods on the resistor and watched. A reading of approximately 100,000 ohms was noted; and a second reading confirmed the first.

I then traced the circuit, but everything tested O. K.; I came round to the resistor and tried it again, but this time the meter didn't budge. Rechecked; same result.

A glance at the test prods, and the solution came to my mind; I verified my suspicion. I had inadvertently placed my fingers on the metal portions of the prods, and the meter recorded *the resistance through my body!*

In the same set, what appears to be a resistor cartridge near the detector plate is a bypass condenser for the latter. Also, a lot of noise, similar to static, was traced to corroded contacts in the pilot-light socket. The latter, in this set, is of the automobile type, using a 6-volt, 3-cp. bulb.

In a Zenith "33X" a bad hum, when the volume control was turned down, was traced to excessive voltage on the plate of the detector. This should not be greater than 45; the former reading was 54.

## "LOW VOLUME"

**By Ruford W. Watson**

OF all the problems that face the radio Service Man, the problem of low volume is perhaps the most perplexing, that is after the tubes and antenna installation check okey. The lack of ability to get the stations "that we used to get every night" may be traceable to any one of a thousand things, ranging all the way from weak batteries to an audio transformer that is almost ready to kick off.

In one Crosley "Bandbox," the lack of wonted sensitivity was traced to the condition of the condenser gang. The set was several years old and had seen much service; the rotors are supported by only one bearing, and wear had thrown them out of alignment until the plates touched in spots as the dial was turned.

Corrosion in the condenser gang of an Atwater Kent electric caused the set to be weak, and extremely noisy when the tuning dial was rotated.

About the only thorough way, of correcting such troubles, is to completely dismantle the gang; while this work is being done it is well to make sure that the volume control is in quiet operating condition. The shaft of the volume control in a Crosley electric "Bandbox" was found so badly corroded that the set would not function properly. A little emery cloth corrected this difficulty.

Reducing the resistance of the grid suppressors in another set—a Zenith—that lacked "pep" solved another problem of low volume.

In certain Apex models the low-potential end of the grid-bias resistor is grounded to the "Gnd" post of the set. In one case of low volume and intermittent operation, my client informed me that pressing firmly against the "Gnd" post oftentimes restored the set to normal operating condition. He surmised that the ground connection within the set was bad; the tone quality of the set led me to an entirely different conclusion, which was that of improper grid bias for the 45's. My Jewell analyzer confirmed my suspicion, and within ten minutes the set was in normal condition.

Sometimes I come upon a job that has been badly bungled by someone who professes to be a radio technician, but doesn't seem to realize that radio practice will not tolerate the use of acid in soldering.

As an exaple of the possible great extent of the damage, and the unexpected nature of the effects, I was once called upon to check up on trouble in an Apex screen-grid set. The dealer who sold the set, and who was having the service work done, informed me that the indications were that it was power-pack trouble. I found the voltages all low and fluctuating. Continuity tests for shorted condensers in the power-pack and by-pass condensers acquitted these parts, which were in good condition. There

(*Continued on page 624*)

# The Service Man's Open Forum

***His Opinions on Conditions and Practices in the Radio Business***

## SERVICING FOR PROFIT

*Editor*, RADIO-CRAFT:

I look forward with pleasure to the coming of each new issue of your helpful magazine.

I have been connected with radio since days of the old spark sets and loose couplers. Let me say, that I have subscribed or bought from news stands, practically all of the leading radio publications and, up to date, I think I get more genuine help from this paper than all the others combined.

I am service manager for one of the largest music houses in Nebraska and, of course, have my ups and downs in the routine of service work. The shop is very complete, with all necessary equipment such as test panels, tube checkers, oscillators and analyzers. Radio servicing is a business with our firm, and was installed as a means of making money and keeping our customers satisfied, not as a necessary evil.

Our line of sets are the Majestic, Atwater-Kent, R.C.A. and Victor, and we service all new sets free for the first thirty days and guarantee the tubes for six months; but we do not believe in free service. The public know that they will not receive anything for nothing; so why kid them to believing that they might? The satisfied customer pays his hard-earned money for service and, if the machine is not satisfactory with him, he has room to complain and the business man can afford to make it right. He is being paid for it.

I notice a good many comments on the midget receivers. In our part of the country, the midget has not cut a very big figure. Only the people, who could not otherwise own a radio, buy them; and we use the midget radio as a football to roll our customer to higher-class merchandise. I think


*A typical example of the arresting advertisements which have caused so much comment in recent letters to the Open Forum. Obviously, the purpose is introductory; some Service Men have even advertised free first calls for the purpose.*

that the midget radio, used the proper way, will make the dealer money.

I have a suggestion to make for the boys who are installing the automobile type of radio. The majority of autos that are being equipped with radios, are the larger types; many have two wire wheels in fender wells on the side. By slipping insulating materials between the metal supports that hold the wheels in place, and drilling two small holes about one-eighth of an inch in diameter in the running board of a car, it is possible to connect the wheels in series and gives the automobile plenty of unshielded aerial; the wheel, being mounted on rubber, gives the aerial plenty of insulation.

On my own car it was only necessary to put one piece of inner tube under each of the tire-lock arms, to completely insulate the wheels from the rest of the metal body; and this system works very well, besides eliminating plates and excess wire. The valve-lock nuts can be used for a connecting link.

EVERETT A. SHERMAN,
*Gaston Music & Furniture Co.,*
*Hastings, Nebraska.*

## ESPRIT DE CORPS

*Editor*, RADIO-CRAFT:

In all probability, Mr. R. Douglas Clerk can handle that "Skeptical Bunch" in just as short order as he serviced (?) those receivers. I believe, however, that there are two sarcastic replies from Maine and Iowa that could just as well have been left unsaid. If some of these Service Men had other things to do except find fault with a brother Service Man and his methods, I frankly believe there would be more harmony and less friction among us.

'Tis well said, "United we stand, divided we fall," and so be it. Fellows, let's pull together and we will win!

I have been a Radio Service Man since the days when helping a fellow put that "Catwhisker" on "The Spot" was all in the day's work. With stacks and ungodly piles of magazines, and books now more or less obsolete, not to mention those unrecorded hours of circuit experimentations to

(*Continued on page 628*)

# ERLA MODEL 224 A.C. SCREEN-GRID RECEIVER

This receiver is manufactured by Electrical Research Laboratories, Inc., Chicago, Ill. The following values are used in this circuit:

Condensers C1, C2, C3, C4 are the tuning capacities; C5, C15, 0.5-mf.; C6, C7, C8, C12, C13, 0.25-mf.; C9, C10, .001-mf.; C11, C19, 1. mf.; C14, 0.1-mf.; C16, C17, 2 mf.; C18, 3 mf.

Resistors R1, R6, R7, 70,000 ohms; R2, 5,600 ohms; R3, R12, 6,000 ohms; R4, 80 ohms; R5, R8, 100,000 ohms; R9, 1,000 ohms; R10, R11, 10,000 ohms; R13, R14, 20 ohms.

Average current readings for this set are as follows: filament potentials; V1, V2, V3, V4, V5, 2.4 volts; V6, V7, 2.5 volts; V8, 5 volts. Plate potentials; V1, V2, V3, 175 volts; V4, 70 volts; V5, 95 volts; V6, V7, 245 volts; V8, 350 volts. Screen-grid potentials; V1, V2, V3, 80 volts. Ground-to-cathode; V1, V2, V3, 1.5 to 2 volts; V4, 6 to 7.5 volts; V5, 4.5 volts. Grid-to-filament, V6, V7, 50 volts.

This chassis is well shielded and normally does not oscillate. However, if a tube shield is left off, or if the aerial lead is allowed to dangle in around the tubes or control-grid leads, oscillation may occur. If the bottom shield of the chassis is removed, oscillation is generally encountered. It is likewise important that the ground and the aerial leads be connected as oscillation may occur if these are left unconnected. It is also important that all the shielding, particularly on the gang condenser, be in place and fastened securely. Changing the screen-grid tubes around may correct oscillation or tendency to motorboat.

Considerable heat and loud humming of the transformer should be investigated for short circuits across one of the windings of the transformer. A piece of wire or solder may have become loose, or the insulation of one of the leads may have been cut through, and short-circuited one or more of the transformer's windings. In any of these cases, if the transformer has not been allowed to remain in this short-circuited condition too long, correction of the short or separation of the shorted leads and the insertion of new leads will correct this and, usually, the transformer will again operate satisfactorily.

If the switch leads of the "high-low" voltage switch become shorted, considerable heating and danger to the power transformer will result. If one of the plates of the '80 should become quite red and its filament bright, whereas the other filament and plate are comparatively cool, the trouble is due to improper connection of the high-voltage winding to the plates of the '80 tube. Voltage tests will generally show a considerably higher reading on one plate than on the other. This is due to the connection of the tap on this winding to one plate, instead of the tap's being connected to its proper circuit connection. Filter chokes of this power-supply unit generally will give very little trouble; however, if either should be shorted, a considerable increase of hum, as well as abnormally high plate voltages, will result. An open circuit of either choke coil will result in absence of voltage across this coil, as well as the circuits to which it supplies. The filter condenser used in the power supply is considerably oversize, and there should be very few cases of breakdown of these units. Excessive hum may be due to an open resistor, which will require replacement.

The volume control-and-switch combination is a particularly rugged unit; the resistor being rated considerably above its operating value. The possible troubles from this unit are an open circuit, due to cutting of the resistor wire, or improper operation of the phono-radio switch. The cutting may be caused by hitting with a sharp tool or the like. Care should be exercised in working on this unit, in order not to injure the resistor element. If this resistor is open at one end, there will be no control of volume on weak or strong signals. This, of course, should not be confused with the somewhat abrupt variation of control when attempting to control strong local volume in the "distance" switch position. If this resistor is open at the other end, there will be no signals received, since no voltage is then impressed on the screens of the screen-grid tubes. A check for either of these conditions may be made by connecting a voltmeter from the screen to the cathode; and varying the volume control should show variation of the screen-grid voltage.

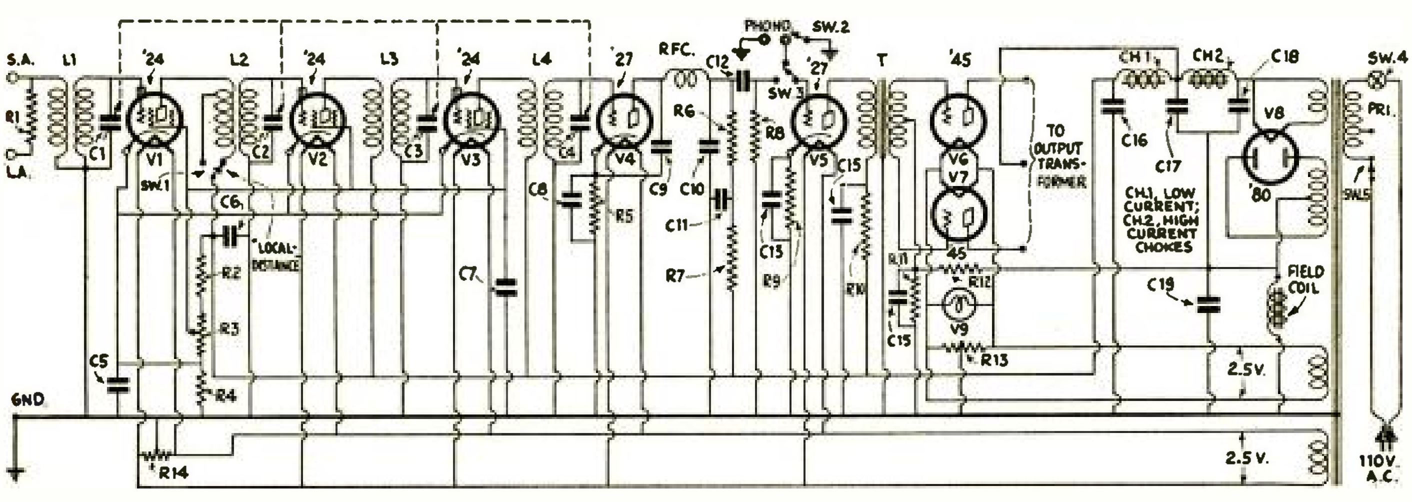
If the single-pole switch, governed by the shaft of this control does not operate, when the control is turned toward the extreme left in the "off radio and on phono" position, no phonograph operation will be had. An examination of this switch will generally reveal either condition, and the method of its correction by re-adjustment. A little roughness in the volume control will be overcome by applying a touch of light oil with the finger tips across the resistor element. It should be noted that the shaft and body of this control must be insulated from the chassis frame.

Distorted signals may be due to poor '27's or '45's, but there are a number of other possible causes of this trouble. Low "B" voltages resulting from a defective '80 will, of course, cause distortion. If the distortion is due to rattles in the speaker, this may be defined by substituting another speaker. Generally a speaker which rattles will have its moving coil rubbing on the center pole-piece. This can generally be felt, by slightly pressing the diaphragm in and out, and noting whether any rubbing exists. Another cause of distortion, which is generally very bad, is caused by either reversed connections in the speaker transformer or by an open or shorted connection at this point. Open grid-biasing resistors, or shorted bias condensers in the first audio or push-pull stage will result in distortion and increase in the hum level. An open field connection will also result in distortion and weak signals. Voltage readings across the field connections will be abnormal and, also, no magnetic pull will be felt on touching an iron or steel tool to the center pole-piece. An open winding on one side of the push-pull transformer will also result in some distortion, principally on strong signals; this latter condition will bring about some increase in the hum level.

The field coil of the reproducer in this receiver has a resistance of 1,000 ohms and is designed to carry 100 milliamperes.

Mounted on top of the condenser shield is the pilot lamp and receptacle. On looking at the front side of the condenser shield, the four aligning condenser adjusting nuts will be seen; these serve to align the tuned stages, and seldom require readjustment. To make adjustments in the alignment of the tuning condenser, the receiver must first be removed from the cabinet and connected up on a bench with antenna and ground as for receiving. By looking to the left of the tuning dial, four holes will be seen along the shield can of the tuning condensers. Through three holes can be seen four hexagonal nuts, which are to be adjusted for aligning the tuning condenser. Any wrench which will fit these nuts whether insulated or not may be used. Proceed as follows, to align the circuits: Tune in an oscillator signal between 220 and 240 meters; use an indicating meter. Set the "local-distance" switch on the "distance" position. Turn down the volume control until station can just be heard. With the No. 4 Spintite wrench turn the adjusting nut (nearest the tuning dial) first to the right and then to the left. If this section of the tuning condenser is properly aligned, the signal will get weaker whichever way the nut is turned; however, adjust for strongest signal. Follow this procedure with the remaining circuits.

It is important that the proper polarity in connecting the pick-up leads to the chassis be observed. One jack is marked "R," meaning red or grid side of cord; and the other is marked "B," for the ground side of cord. Connection to the incorrect terminals may result in hum, or lack of phonograph volume.




*Schematic circuit of the Earl "Model 224 A.C." screen-grid receiver. Note that the field coil of the reproducer is in series with the "B—" lead of the power pack; and the phonograph pick-up connects to the input of the first audio tube, V5. A novel "local-distance" switch, Sw1, is part of the design.*

# BOSCH MODEL 60 VOLUME-CONTROL RECEIVER

This receiver, the "Model 60" chassis with automatic volume control, is manufactured by the American Bosch Magneto Corp., Springfield, Mass.; the following parts values are used:

Condensers C1, C2, C3, C4, C5 are the usual tuning capacities; C6, an antenna trimmer; C7, C11, C14, .04-mf.; C8, C10, .25-mf.; C9, C12, C13, C17, 0.5-mf.; C15, C20, C26, .006-mf.; C16, 1.0 mf.; C18, C19, .0001-mf.; C21, C22, C27, 2 mf.; C23, C24, 4 mf.; C25, 0.75-mf. (exact).

Resistors R1, 500 ohms; R2, R4 R6, R8, R9, 1,000 ohms; R3, R11, R12, R13, R26, ½-meg.; R5, 20,000 ohms; R7, 10,000 ohms; R10, R28, 50,000 ohms; R16, 900 ohms; R17, R19, 5,000 ohms; R18, 25,000 ohms; R20, R21, 2,000 ohms; R22, 1,300 ohms; R23, 2,380 ohms; R24, 160 ohms; R25, 950 ohms.

The "Model 60" and the "Model 58" are very similar in general arrangement. The "60," however, is equipped with automatic volume control, a "mute" switch, and a larger reproducer. On the side of the cabinet is the tone control. In addition to the tubes required for the "58," the "60" requires a type '24 tube for the volume control, V8. An automatic "radio-phono." switch is operated by simply turning the tuning dial to zero. The "Model 61" corresponds to the "60," but is designed for use on 25-cycle, 100 to 130 volt A.C. supply. The chassis is the same, and the power pack differs only in the power transformer and filter condensers. Letters D and E refer only to the style of cabinet.

Lack of sensitivity may be due to incorrect connection of the three leads to the "local-distance" switch. It may be advisable, in some localities, to operate the set without a ground connection. Check the alignment of the tuning condensers.

Poor tone quality may be due to a defective '45 (which is ionized). Check also the remaining tubes in the receiver. If the plate currents of the type '45 tubes differ more than 5 ma., the output transformer will be overloaded and some distortion will result.

Operating voltages for this receiver follow: Filament potentials; V1, V2, V6, V7, 2.4 volts; V3, V4, V5, V8, 2.3 volts; V9, 5.0 volts. Plate potentials; V1, 170 volts; V2, 180 volts; V3, 185 volts; V4, 60 volts; V5, 150 volts; V6, V7, 250 volts; V8, 30 volts. Screen-grid potentials; V1, 70 volts; V2, 80 volts; V3, 85 volts; V4, 10 volts; V8, 20 volts. Control-grid potentials; V1, V2, 2.0 volts; V3, 1.5 volts; V4, 1.0 volt; V5, 0.1-volt; V6, V7, 50 volts; V8, 0.2-volt. Plate currents; V1, V2, 3 ma.; V3, 2 ma.; V4, 0.1-ma.; V5, 6 ma.; V6, V7, 30 ma.; V8, 0.2-ma.

The condenser drive-belt consists of a heavy stranded phosphor-bronze cable having a small loop at each end. Correct tension is maintained by means of a spring. After replacing the belt it is necessary to reset the dial; to do which, loosen the small gear on the knob shaft. Turn the shaft to the left as far as it will go. Set the dial against the stop at "100" position, and re-tighten the small gear. The procedure in replacing the belt is as follows: turn the condensers to the position of minimum capacity. Place the loop at one end of the drive-cable over the pin at the top right hand side of the large drive drum. Lead the belt along the groove and downward to the small grooved drum. Turn the condenser gear to the "100" position (condenser fully engaged). Start the belt at the center groove of the small drum and wind on 6½ turns in a clockwise direction (to the right), toward the front of the receiver. Bring the belt up and over the idler pulley. Follow down the groove of the large drum and hook the loop over the drum's tension spring. The spring can most easily be pulled into the correct position by looping a length of wire or strong cord around the spring hook.

The field coil of the dynamic reproducer has a resistance of 2,000 ohms; and the voice coil, one of 10 ohms. A copper shield ring over the core prevents feed back between voice and field coils and the "B" supply. The only adjustment consists in centering the moving coil in the air gap. Do this as follows: loosen the holding screw. Insert in the air gap, around the moving coil, four gauges made of paper strips 0.01-in. thick. The strips should be about 6 in. long and 3/16-in. wide. Re-tighten the screw and remove the gauges. The connections to the reproducer are made at the terminal strip located under the name plate. The red and brown leads run to the voice coil; and the black lead to a terminal.

On the "Model 60" is a meter M which may be used in aligning the tuned stages. The meter will swing to the right as alignment is reached.

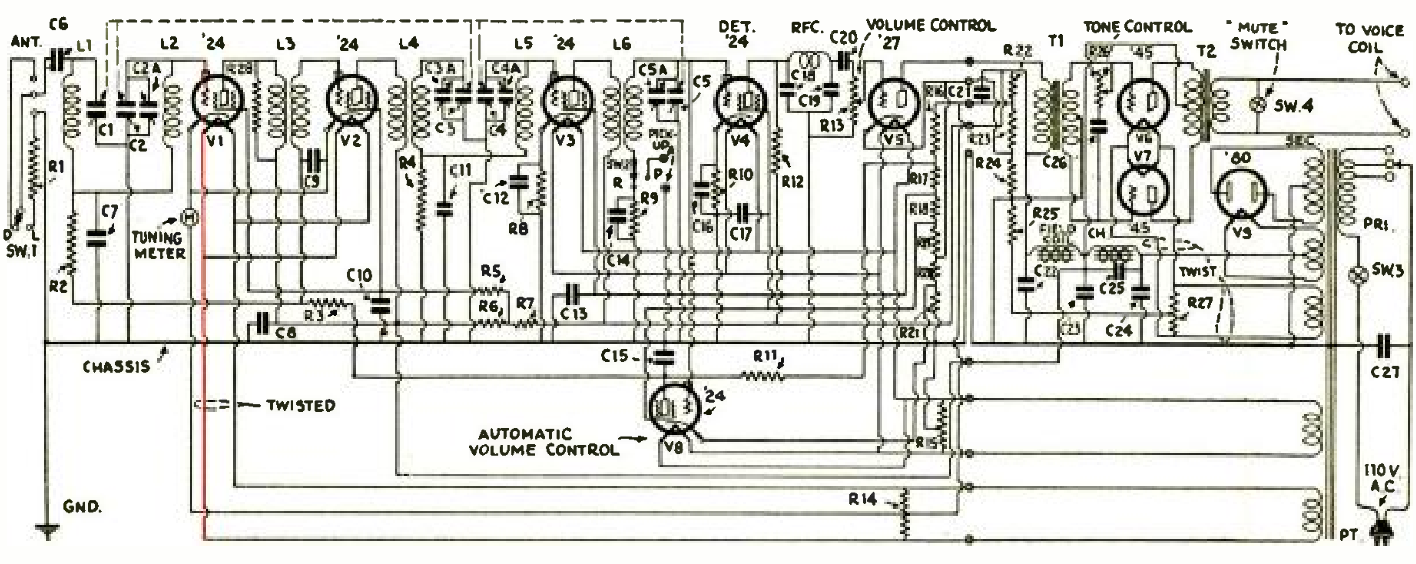
A grounding spring on one of the tuning condensers, in the third R.F. stage, grounds this condenser in the "phono" position, or dial zero setting, and in this position prevents circuit oscillation.

The operation of the automatic volume control circuit is as follows: When the signal being received increases in volume (as in tuning in a more powerful station) it results in a higher signal voltage on the detector tube. This higher voltage is applied to the grid of the automatic volume-control tube, by direct connection through one lead. A higher voltage on the grid of the automatic volume-control tube results in the tube drawing greater plate current through R3, which controls the grid bias on the first and second R.F. tubes. The increased plate current through R3 causes a greater increase in the voltage drop across this resistor. This change increases grid bias on the first and second R.F. tubes and thereby cuts down the signal. The tuning meter M is in the plate circuit of these two tubes; it also indicates, therefore, the action of the automatic volume control, swinging further to the right (low plate current) as the signal level rises on a powerful station. It will be noted that the filament, cathode, and grid circuits on the first two R.F. stages are separate from those of the rest of the receiver, and are at approximately the same voltage (above ground) as the plate of the automatic volume control tube.

It is necessary, for the proper functioning of the receiver, that there shall be no points in the coils or wiring where leakage to ground may occur. It is also important, for proper operation, that the automatic volume-control tube should have proper characteristics. Such a tube can easily be selected as follows: have all the tubes in place except the automatic volume control, and switch the receiver "on"; but do not tune in a station. If the tubes are all operative, the meter needle will swing to the left from 3¼ to 5 divisions. Insert the automatic volume-control tube, V8, and note the action of the needle. *The automatic volume-control tube tested is suitable if the needle remains in the same position.*

The various resistors in the receiver have the following color code: 250 ohms, white; 500 ohms, yellow; 900 ohms, black-brown; 1,000 ohms, white-red; 2,000 ohms, brown-yellow; 5,000 ohms, black-yellow; 10,000 ohms, blue-yellow; 20,000 ohms, green-yellow; 25,000 ohms, blue; 50,000 ohms, green-white; 0.1-meg., blue-white; 0.25-meg., brown; 1.0 megohm, black; 2 megohms, black-white.

R.F. transformer L3 is untuned, and signal amplification through this stage increases in the low-frequency region (100 on the dial). The antenna input system is so designed that one setting of the antenna trimmer condenser C6 will maintain the antenna in tune over the entire broadcast band. This condenser is provided with a small adjusting knob, and need be set only when it is installed or when subsequent changes are made in the aerial. It is recommended that this condenser be adjusted in the following manner: tune in a semi-distant station which comes in at some point between 40 and 60 on the dial. Reduce the volume until the station can barely be heard; then turn the adjustment knob until it is at the point of loudest reception.



# Favorite Testing Equipment of Service Men

*And methods for its use to the best advantage in and out of the shop*

## ANALYZER AND TOOL KIT

By H. Harrison and W. Green

THE test analyzer described embodies features which have always been desired in any instrument built for service work: (1) low cost: (2) simplicity of design; (3) accuracy of measurements; () ruggedness of the complete unit. It is needless to add that the kit is capable of testing anything from old battery models to the latest screen-grid receivers.

The total cost is extremely low; approximately \$25.00, including the carrying case, panel, two Jewell meters, and all other parts. The diagram is of very simple design, toggle switches being used to obtain the various meter readings instead of the usual push-button or bi-polar arrangements. Accuracy was found to be within 1% limits, after competitive tests with commercial instruments had been made.

The carrying case is ideally suited for service use. There are two large compartments for tubes and tools. A dozen tubes may be easily carried in the tube compartment. In the tool drawer may be placed the pliers, screwdrivers, soldering irons, replacement parts, and other usual service aids. The over-all height of the carrying case is 16.5 inches; the width and depth are 12 and 7 inches respectfully. The total weight with all accessories is 18 pounds; the analyzer itself is only 8 pounds.

### Finding Resistor Values

Two Jewell meters are used to obtain the necessary test readings. They are an O-1 milliammeter, and a O-3-15-150 triple-range A.C. voltmeter. Since a O-1 milliammeter is used for all direct-current measurements, it is a very simple matter to calculate the resistors necessary to convert the meter into a voltmeter of various readings. It is needful to multiply the full-scale voltage wanted by 1,000, to get the size of the resistor directly in ohms. For example—the resistance necessary for a O-100-volt scale is 100,000 ohms.

Be sure to use accurate resistors, since the accuracy of the meter readings depends upon the resistances. Such resistors are made by various manufacturers and are very easy to procure.

To find the resistance value of the shunts used for the 10- and 100-milliampere scales, it is necessary to know the internal resistance of the milliammeter. In this particular case a Jewell "Pattern 88" was used. The shunts for this meter are 3 1/3 ohms for the 10-mill. scale, and 0.3-ohm for the 100-mill. scale. The internal resistance of the meter is 30 ohms. If other types of milliammeter are used, it is necessary to divide the internal resistance of the meter by the full-current reading desired *less one*. For example: if a Weston No. 301 is used, and the 10-ma. range is wanted, divide the internal resistance of 27 ohms, by 10, (current range desired) less one or 9. The shunt in this case is 3 ohms.

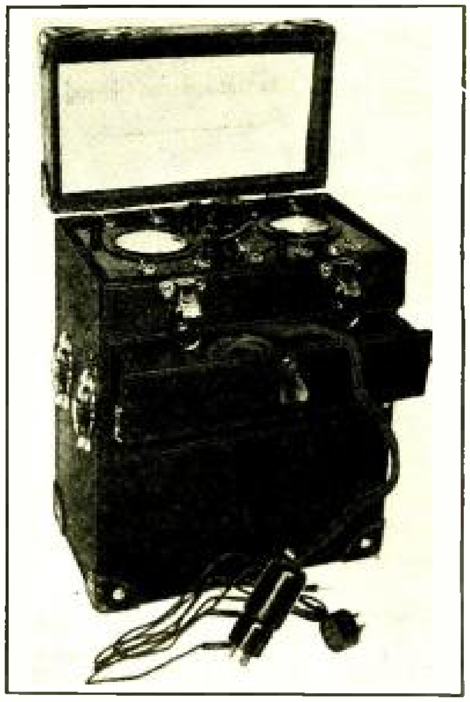
### Resistance and Capacity Tests

Resistance and capacity tests are now important features of every testing device. In this analyzer, a 4.5-volt battery, in series with a 1,500-ohm resistor and the milliammeter, is used to test unknown resistances. The same test can be used to test continuity and short circuits. For measuring resistances, the following formula is used:

$$Rx + R = E/I.$$

E is the battery voltage; I is the current reading obtained when testing; R is the resistance in circuit; and Rx the resistor under test.

Assume a current reading of 0.6 on the milliammeter; this equals .0006-ampere (all values must be expressed in terms of volts, amperes, and ohms). Substituting in the equation given above: we find that Rx plus 4,500 equals 4.5 divided by .0006, which is



*The finished tool kit, with analyzer above, and compartments for tubes and tools.*

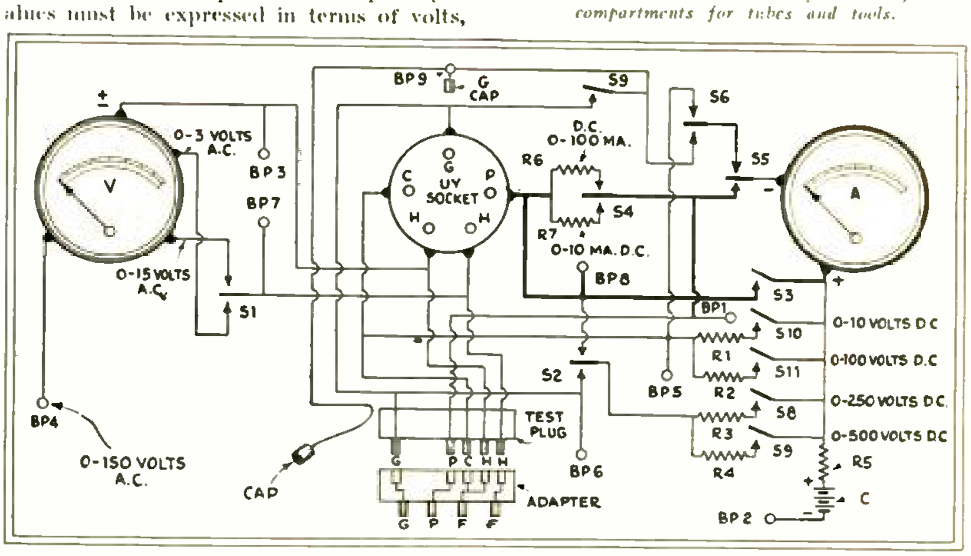




**Fig. 1 (above)**

*The schematic circuit of the analyzer, in which two good meters are used, together with shunts and series resistors which make possible a very wide range of tests on tubes and circuits.*

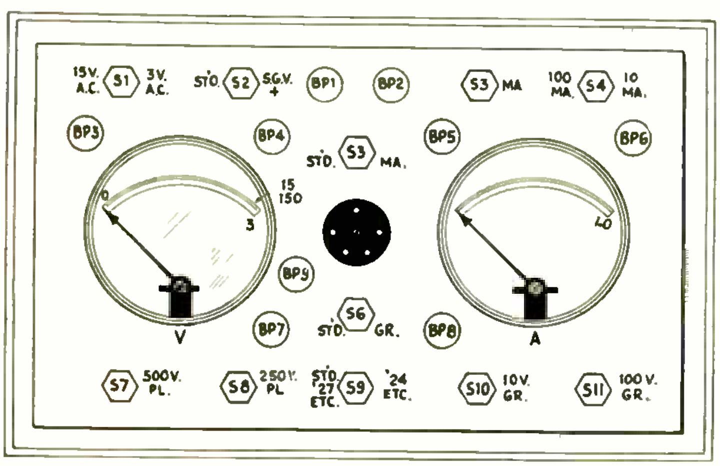




**Fig. 2 (left)**

*The appearance of the panel, showing the relative positions of the meters, socket, toggle switches and binding posts. With a little practice, readings can be taken very rapidly.*

7,500. Since Rx plus 4,500 equals 7,500, therefore Rx is 3,000 ohms. The capacity of condensers may be determined from previous calibration. The 120-volt A.C. line, in series with the 150-volt meter and the condenser under test, will give readings depending on the capacity under test. A graph or chart is drawn, after standard condensers have been tested to obtain the readings. Be sure that the line-voltage is always the same when testing; for the readings will vary if the line-voltage is different, and the graph will be of no use.

Having computed the resistances and shunts for the voltage and current scales, we can now proceed with the actual con-

(*Continued on page 625*)

# A Modern Single-Meter Tube Checker

*The circuit and arrangement of a new instrument, designed by a maker of precision testing equipment, for use of dealers and Service Men*

By H. G. CISIN

SOME men get along splendidly during boom periods but, at the first sign of a depression, they give up in despair and fade out of the business picture. Others refuse to accept defeat and, when times are bad, they expend extra effort, try out new ideas, and often make more money than they ever made before.

This point is strikingly illustrated by the experience of radio dealers and Service Men who have adopted the use of a tube checker to pep up their business. The explanation is found in the very nature of radio. The action of a radio receiver depends fundamentally upon the action of its vacuum tubes. Considered in this light, every radio receiver consists essentially of a collection of parts designed to connect a group of tubes in a certain predetermined manner, and to supply these tubes with definite voltages. When these functions are properly performed by the radio set, it will operate satisfactorily, *provided that the tubes themselves are normal.*

Modern tube checkers are highly refined instruments, and bear little resemblance to the earlier devices bearing the same name. A fitting instance of this trend in test equipment design is the "Supreme Model 19" tube checker; this test instrument, embodying many unique features, is illustrated in Fig. A, and its schematic circuit is shown in Fig. 1.

### Layout of the Instrument

It tests at the correct filament voltage every type of tube, including the new 2-volt, the 3-volt and the 7½-volt tubes. This matter of proper filament voltage, while testing, is of the utmost importance; if improper voltages are used, readings obtained are meaningless. The "Model 19" also tests *both* plates of full-wave rectifiers, and offers a positive test on screen-grid tubes. This last is another important feature, in view of the constantly-increasing use of screen-grid tubes in modern radio receivers. The "Model 19" is so advanced in its design that it will even test pentodes.

Six separate sockets, plainly marked, provide for every type of A.C. or D.C. (battery) tube in general use; since each tube has its own testing socket, no switches are required and hence maximum speed in testing tubes is attained. An ingenious arrangement is provided for testing 2½-volt power tubes in the 3.3-volt socket. The circuit characteristics are such that the current-resistance drop introduced by the 2½-volt tubes is exactly correct for reducing the applied potential to the 2½ volts required.

The various pin jacks used have insulated heads to prevent accidental short-circuits and shocks. In addition to the "control-grid" jack, mentioned in connection with the screen-grid test, there is a space-charge "Sp Ch" jack, which provides an effective potential of 10 volts for the space-charge connection of pentodes. There are also two other pin jacks, marked "H," which furnish a 3.3-volt filament potential for overhead- (top-)heater filament tubes. Suitable leads are included with the checker for making the various pin-jack connections.


**Fig. A**

*The appearance of the "Model 19."*

The meter employed is a large 3½-inch D'Arsonval-type G. E. direct-current milliammeter, in a full bakelite case. Both the 80- and the 8-mil. scales are fully calibrated. The 80-mil. scale is normally in the circuit, but, when the 8-mil. button is pressed, a shunt is taken out of the circuit (see schematic wiring diagram Fig. 1), making the 8-mil. scale effective. When the "Screen Grid—80" button is depressed, an effective positive screen-grid potential of 70 volts is applied to the screen-grid and pentode sockets. When the "Grid Test" button is depressed, the normal zero-bias control-grid potential is changed to an effective negative potential of 3 volts.

The difference between the two plate-current readings, with a fixed difference of 3 volts applied to the grid, constitutes the mutual conductance index of the tube. This method gives the readings a definite value unobtainable by the frequently-used methods of employing an uncontrolled variable voltage with free grid.

The Supreme checker utilizes a large-capacity transformer supplying secondary potentials of 125, 70, 10 and 3 volts and filament potentials of 7½, 5, 3.3, 2 and 1½ volts. The size and the quality of the transformer employed assure adequate filament current.

### Principle of Operation

To determine the condition of a tube under test, it is necessary merely to check the meter readings with the ideal limits, which are plainly marked on the instrument panel beside each socket. This eliminates waste of time in referring to charts, curves, or other-data sheets.

The "Model 19" can be used by anyone, since it is extremely easy to operate. In fact, written instructions are hardly necessary; observing a few simple precautions makes it impossible to injure this tester. In fact, positive protection is afforded to the meter against damage through the attempt to test short-circuited tubes.

The tube readings, used as reference indices, have been developed in co-operation with a number of the largest manufacturers of vacuum tubes. In compiling them, thousands of tubes were tested; comparisons were made on the most elaborate factory

(*Continued on page 626*)

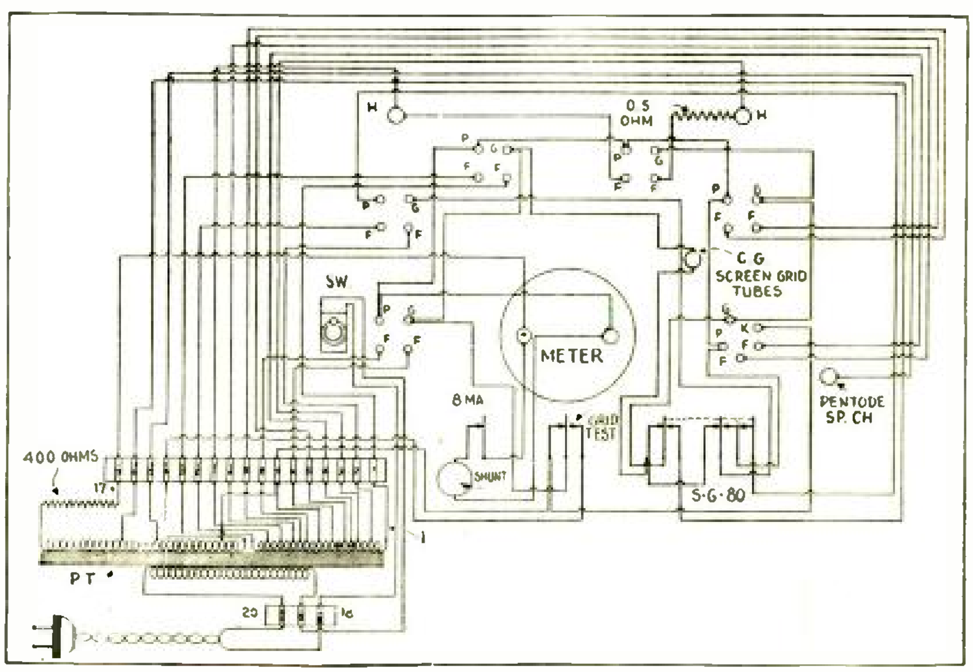



**Fig. 1**

*The internal connections of the checker, which is arranged to take any type of tube, with the minimum of switching. The central D.C. meter is automatically connected to any tube which is plugged into the appropriate socket.*

# Battery-Operated Sets--New 2-Volt Styles

*The introduction of the two-volt tubes marks another period in Receiver Design*

By R. D. WASHBURNE

MANY radio programs have winged their speedy way through the ambient ether since our radio manufacturers last gave any really serious thought to ameliorating the sad plight of the man without a standard light-line connection in his home.

"What is Radio's Greatest Need for 1930?" was the heading of a page, in the December, 1929, issue of RADIO-CRAFT, in which one radio dealer stated:

"There are approximately 7,000,000 farm homes in the United States. In this vicinity, (Minnesota), about 21% have battery-operated sets, and only about 2% A.C. sets.

"This year all-electric sets have had their boom in city and small-town sales. The great majority of farm homes are not equipped with electric-light current. About 90% of the farmers who have electric-light plants have radio sets already.

"Basing my assumption on the foregoing facts, there are between five-and-one-half and six million farm homes that are in the market for battery-operated radios and, in view of this, I consider the most urgent requirement of the radio industry today is the creation of a battery-operated radio working at peak efficiency with a minimum number of tubes and a minimum consumption of battery current."

Suddenly, there comes a loud knocking at the door, and lo, we find demanding entry a radio receiver completely self-powered; and combining every feature the heart could desire. Selectivity, sensitivity, volume and quality are there. So too are automatic volume control, tone control, superheterodyne circuits, combined long- and short-wave tuning, illuminated dial, dynamic reproducer (also, the "inductor dynamic" reproducer), single-dial control, chassis construction, screen-grid tubes, push-pull power amplification, dual volume control, complete shielding, frequency-calibrated dials, low current consumption, power detection, resistance-coupled audio, handsome console cabinet designs; and many other desirable qualities.

Figuratively and almost literally, there have been developed by many manufacturers of fine electric receivers, "over night," superlative radio sets designed to operate with self-contained current supplies.

### Freedom from Line Limitations

And the light of this bounty shines on the radio enthusiast who lives in the "D.C." districts; where only direct-current lighting lines have penetrated, and the pleasures of the "A.C." set owner seldom are found. Also graced by this visitation are the residents of districts where "25-cycle," or "32-volt" are the prevailing current supplies; and, to a much less extent, 220-volt circuits (as, for instance, in New York City where certain hotels are generating their own current).

Although it is only recently that factory wheels have started to turn out this new type of radio receiver, the laboratories of many radio companies have been working for a long time to perfect their design.

Foremost among the essentials is the 2-volt tube. Like the old UX-199 and the CX-399, the new standard, type '30 "general purpose" tubes consume only 60 milliamps. for operation of their filaments. Another tube of the 60-ma. type, not comparable with any of the '99s, is the '32 screen-grid tube. Next we consider the power tubes; and find that the new type '31 consumes 130 ma.—approximately the same amount as the old type '20 which drew 120 ma.). The main differences between the old tubes and the new may be summed as follows: filament potential for the '30, '31, and '32 is only 2 volts—whereas, the '99 and the '20 require 3 volts. Then, too, the new tubes are more uniform in characteristics; they have higher amplification factors, greater undistorted power output, and more rugged construction.

### The Air-Cell "A" Battery

Another and startling development of the laboratory is the "Air-Cell" battery illustrated in Figs. A and B.


**Fig. A**

*The panels on the top of this 2-volt battery protect the carbon electrodes from the air, until it is ready to use.*

Continuing our comparative analysis, we find that the new source of filament current has the outside dimensions of 13½ x 10 x 7 in. high; weighs, without electrolyte, 25 lbs.; and its current-capacity rating is 600 ampere hours at a normal current drain of a little over half an ampere.

At this point we may call attention to an interesting graph (Fig. 1) which shows the comparative lives of several banks of ordinary "No. 6" dry cells of the usual rating, working on the same receiver, in direct comparison with an air-cell battery. Intermittently discharging these batteries through a 7-tube set using three screen-grid '32's, two "general purpose" '30's, and two type '31 power tubes, it required 36 dry cells, used in a series-multiple connection of the correct type (to obtain maximum performance from the dry cells) to equal the operating life of 1,000 hours, at the rate of three hours per day, obtained with the single air-cell.

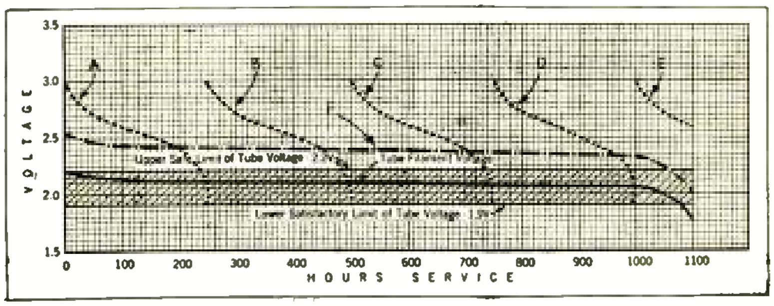



**Fig. 1**

*A-B-C-D-E, working lives of dry cells, compared with the air cell (horizontal broken line). Below, limits of tube voltage compared to the cell's effective supply.*

It will be noted from Fig. 1, that the maximum output potential of an air-cell battery is 2.5 volts; and the minimum, 2.0 volts.

The operating voltage of the air-cell battery, as shown in Fig. 1, is of great interest because of its constancy throughout the life of the battery; note the life-line of the air-cell plotted against the upper and lower working limits of the new 2-volt tubes. This graph is obtained by the use of a series resistor to drop the 2.5-volt potential of the air-cell battery to the operating voltage of the tubes.

Considering the new battery from the cost angle, we find that this unit, listing for a little less than nine dollars, is much less expensive, judged on the basis of its total operating life, than dry cells.

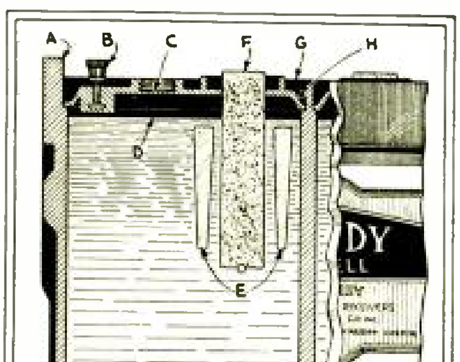



**Fig. B**

*Cross-section of an "air-cell": A, case; B, terminal; C, filling vent; D, level of electrolyte; E, zinc electrode; F, carbon electrode; G, seal; H, partition.*

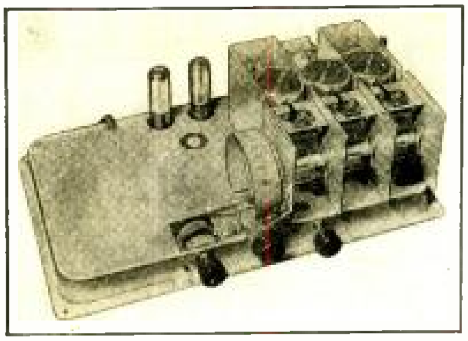


**Fig. C**

*The Lyric "B-94" chassis, showing dual volume control and compensating condensers; a 6-volt battery is used.*

It is difficult to draw a cost comparison between the air-cell battery and a 2- or 6-volt storage battery; since in each instance the factors involved have different values. However, sufficient information has been given above to enable the reader to make his own computations.

### Theory of Operation

Like the regular dry-cell, the air-cell uses zinc and carbon electrodes. Unlike the "dry" cell, which uses a depolarizer in the form of a paste to prevent hydrogen (an insulator) from forming on the carbon electrode and thus reducing the voltage of the cell, the new air-cell uses an electrolytic solution; in conjunction with a plate formed of a special grade of carbon which is highly porous to oxygen.

The electrolyte-forming chemicals, in solid form, are placed in the battery at the time of manufacture. To prevent them from losing some of their strength by possible contact with moist air, while waiting to be placed in service, the battery is hermetically sealed at the time of manufacture by thin rubber membranes under the filler holes, and by a transparent sheet of Cellophane placed over the tops of the special "breather" carbon electrodes. Thus sealed, no change can take place in the chemicals; the battery can be placed in service at any time after manufacture, and still be as "fresh" as the day it was made.

To place the battery in service, all that need be done is to remove the covers from the electrodes so they can "breathe" oxygen, punch out the membranes in the bottoms of the filler holes, and fill the two compartments with cold drinking water; about six quarts, total, being required.

*This battery has a very definite overload point beyond which it is unsafe to go. This overload point is determined by the maximum rate at which the carbon electrodes can extract oxygen from the surrounding air, and amounts to approximately 0.75-ampere.*

At current drains below this figure, the porous carbon is able to replenish the oxygen as rapidly as it is consumed within the battery; and as long as the carbon contains oxygen it repels water and remains dry. As the chemist would say, there is a "meniscus" or capillary effect downward, instead of upward. Once the oxygen content is exhausted, however, the water in the electrolyte rushes into the pores of the carbon and produces a condition closely analogous to lung congestion. Under such conditions the battery dies of "suffocation." Any load on the battery, therefore, amounting to more than 0.75-ampere will bring about the premature death of the battery; *and, once it has been subjected to this treatment, it never recovers.* (Hence, the extreme care with which the radio sets, arranged for this battery, have been designed.)

**Fig. D**

*A Brunswick 2-volt set from the rear: A, air-cell battery; B and C, dry-cell batteries; D, inductor-dynamic reproducer; E, shields of '32 tubes.*

The most practical application of this condition is that, under no circumstances, should an air-cell operated receiver be equipped with a pilot light which draws its current from the air-cell "A" battery; except where lamp makers supply special bulbs. Standard panel lamps consume from 0.40 to 0.45-ampere; and this lamp load, in addition to the tube load of the receiver, is sufficient to overload the battery and ruin it.

The electrolyte used in the air-cell "A" battery is a solution of sodium hydroxide (caustic soda), the active ingredient is zinc. Now, as the zinc dissolves in the electrolyte, a reaction takes place which produces, as a waste product, sodium zincate which, being heavier than the electrolyte, sinks to the bottom of the battery, and thereafter plays no part in the production of current. It will be seen, from an examination of Fig. B, that there is almost as much room below the zinc electrodes, which is provided to make room for the sodium zincate, as there is above them.

The passage of current through the cell dissociates the water in the electrolyte into its principal constituents, oxygen and hydrogen. The hydrogen ions migrate toward the carbon electrode, where they discharge themselves against the oxygen which the electrodes draw in from the surrounding air and by this combination produce water. Inasmuch as the oxygen in the electrode is freely available all over the surface of the electrode, there can be no accumulation of the voltage-reducing hydrogen at current drains below the overload point; and, as a consequence, the working voltage of the air-cell "A" battery remains practically at its full initial strength throughout the life of the battery.

From consideration of the facts above stated, it may have dawned upon the technician that accurate meters will be a mighty necessary part of the equipment of the man who, for pleasure or profit, is building receivers to use 2-volt tubes and the air-cell battery; or any kind of current supply, for that matter. To the Service Man, of course, they are indispensable.

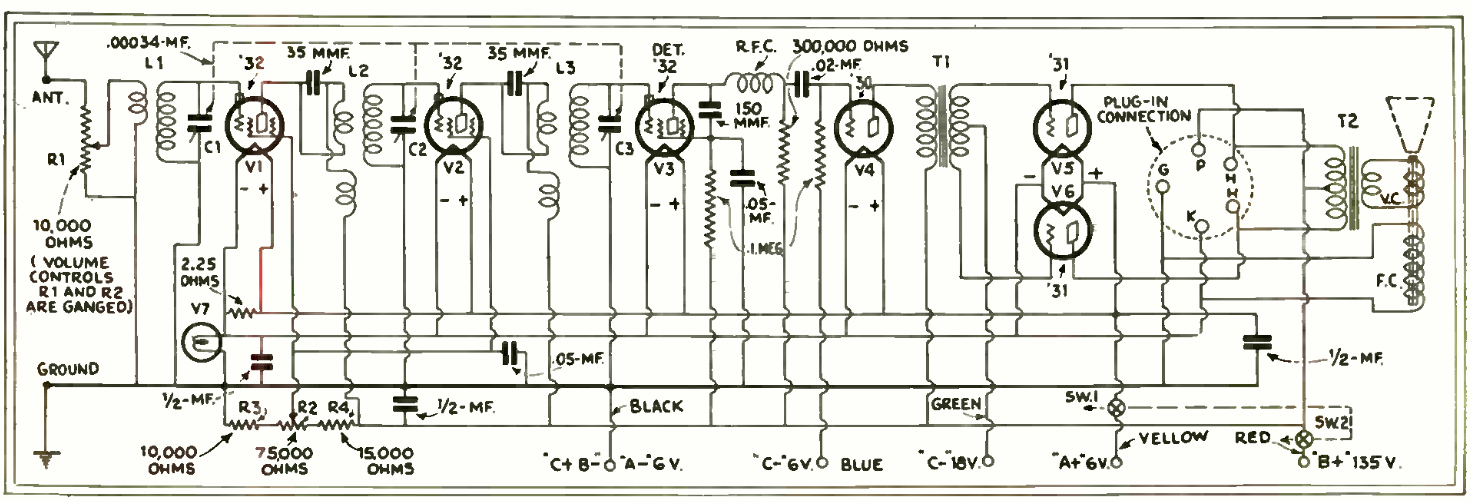



**Fig. 2**

*The schematic circuit of the All-American Mohawk "Model B-94" Lyric, the chassis of which is illustrated above; it comprises a screen-grid power detector. The field coil of a dynamic reproducer is also operated from the six-volt storage battery which operates this receiver.*

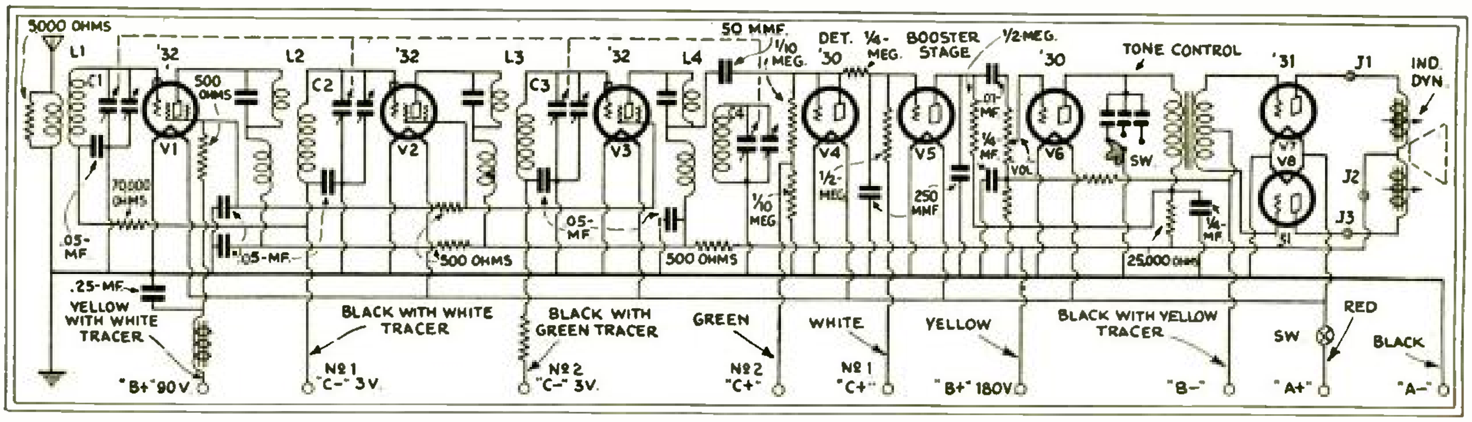



**Fig. 3**

*The circuit of the Philco "Model 30" receiver, illustrated at the lower left, which is designed for operation from a two-volt source. It incorporates automatic volume control and tone control; and operates an inductor dynamic which requires no field current*

### Practical Circuits

Now that we know something about the accessories to the "2-volt-receiver," let us find out what the laboratory of the manufacturer has produced for the man who wants a radio receiver having low up-keep cost; either because of a desire for economy in light-line operation, or lack of standard light-line facilities. (Our English cousins have a name for it, "mains supply.").

### Brunswick 2-Volt Models

One of the foremost receivers to incorporate advanced design in battery receivers is the "Model B-15" Brunswick radio set manufactured by Brunswick Radio Corporation. It is one of the models of their "Uni-Control" line of receivers.

By reference to the schematic circuit of this receiver, Data Sheet No. 38, in the March issue, it will be noted that a resistor R6 of 0.6-ohm is used to reduce the output voltage of the air-cell to the correct value for the filaments of the tubes.

Other points of interest are the *capacity* control of volume, condenser C5. Four tuned stages of screen-grid amplification, using a tuned-grid and choke-coupled plate circuit, assure high selectivity. Both sides of the filament circuit are grounded to the chassis; which is connected to the 3-volt "C—" potential. There are a screen-grid power detector, a resistance-capacity-coupled first audio stage, and push-pull second audio.

As indicated in the schematic circuit, and shown pictorially in Fig. D, three "B" battery units are required. In this figure is an excellent illustration of the relative size of the air-cell "A" battery and the remainder of the compact installation.

Another Brunswick design intended for 110-volt D.C. circuits (manufactured as the Models "DC-15," "DC-22," and radio-panatrope "DC-32") uses four '32's, a '30, and a power stage with four '71A's in double-push-pull, feeding a dynamic reproducer.)

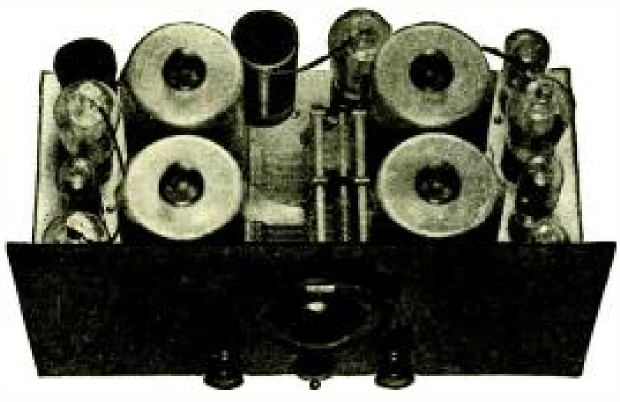


**Fig. F**

*The chassis of the Lincoln 2-volt superheterodyne, which has tuned intermediates, and covers several wavebands.*

### Philco 2-Volt Receiver

Automatic volume control is one of the features of the "Model 30" Philco radio set, a product of the Philadelphia Storage Battery Co., shown in Fig. E. A schematic circuit of the receiver is Fig. 3.

As in the all-electric "big brothers" of this set, the distinguishing characteristics of the "screen-grid plus" line are retained. Of these, the most novel is the "diode" or two-element detector, V4, with grid and plate connected together. This is the "linear" detector by which the "screen-grid plus" receivers are recognized. The "booster stage" V5 detects a bit of the R.F. not rectified already by V4 and, in addition, acts as an audio amplifier. These two detectors also are part of the automatic volume control in the "Model 30." By checking over the circuit an odd condition will be noted; "C" batteries Nos. 1 and 2 "float," so far as the "A" circuit and chassis are concerned; the positive returns of these batteries being to points in the circuits of the volume-control tubes.

In the "30," there are three screen-grid tubes and four tuned circuits; the last unconnected at the high-potential end. The total "B" voltage is 180, and a 2-volt Philco storage cell, type "Drynamic 92-R," supplies the "A" potential; no series resistor is used in the "A" circuit. The total plate current drain of this set is about 25 ma.

The current readings obtained on the "Model 30" Philco, using an average set checker, are as follows: Filament potential, all tubes, 2.0 volts (the readings of tubes V7 and V8 being reversed in polarity with respect to the others). Plate potentials, V1, V2, V3, V7, V8, 150 volts; V5, 15 volts; V6, 90 volts. Control-grid potentials, V6, 1 to 4 volts; V7, V8, 24 volts. Screen-grid potentials, V1, 60 volts; V2, V3, 58 volts. Plate currents, V1, V2, V3, 1.5 ma.; V6, 2 ma.; V7, V8, 8 ma.

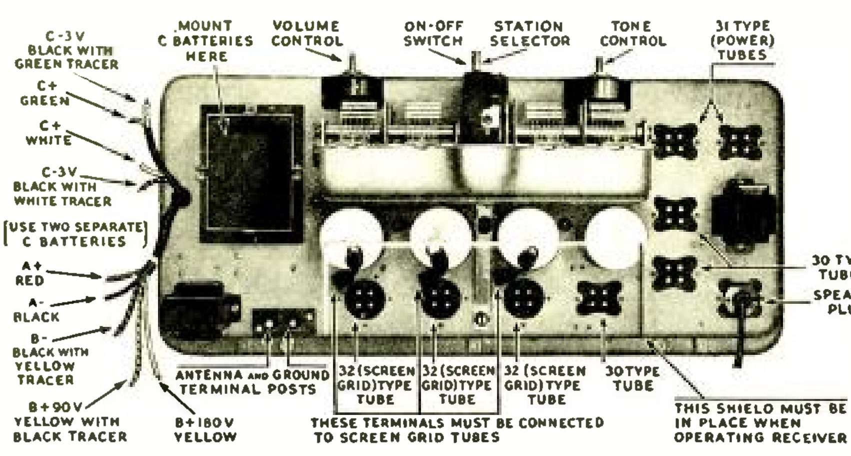



**Fig. E**

*The arrangement of the Philco "30," the circuit of which appears above. As in the "screen-grid plus" models described in last month's Data Sheet, it uses a two-element "linear" power detector, and a booster stage described in the manual as a detector-amplifier.*

### Lincoln 2-Volt Super

The latest in superheterodynes uses 2-volt tubes; and tunes in stations on the 80-meter band—in addition to the usual broadcast stations. This receiver, the Lincoln

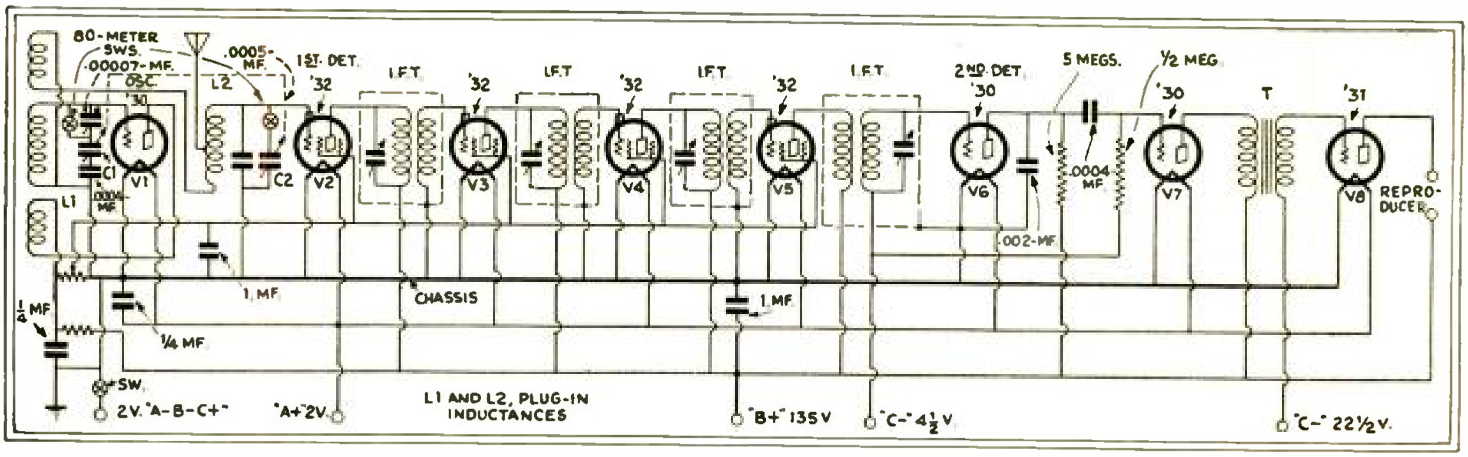



**Fig. 4**

*The Lincoln "DC-8" superheterodyne not only works on two volts, but gives a choice of two wavebands, which may be extended by the use of plug-in coils. This specially powerful set may be operated from an air-cell battery; or a storage battery may be used. The filament-voltage control is external to the circuit shown.*

"Model DC-8" made by the Lincoln Radio Corp., is shown in Fig. F; the diagram of connections is given in Fig. 4. It is recommended particularly to the experimenter.

This receiver also is designed to use the air-cell "A" battery; total plate potential required, 135 volts. Volume control is obtained by varying the bias on the screen-grids of the '32's. It is observed that there is no provision for reducing the output potential of the air-cell to match the filaments of the tubes. The plate circuit drain is only about 16 ma.

Special high-gain intermediate-frequency transformers are used; these are tunable by means of the knobs which may be seen in the picture, Fig. E. The oscillator and tuning condensers, C1 and C2, are under single-dial control.

Short-wave stations may be tuned in by turning the wave-change knob; this operates the dual switch, changing the circuit connections in the manner shown. Coils L1 and L2 are of the plug-in type and may be changed for others at the will of the experimenter.

### Pierce-Airo Midget

The inhabitant of a "D.C." district, where the supply is 120 or 240 volts direct current is not to be left out in the cold. Instead, we present for his consideration the circuit and details of the Pierce-Airo, "De Wald, Model D.C. 632" midget radio receiver, Fig. G and Fig. 5.

In this single-dial, mantel-type radio set we find two stages of tuned screen-grid R.F. amplification and a screen-grid detector

**Fig. G**

*A midget, operating its two-volt tubes from the D.C. house line, which is still found in many residential districts of cities.*

using type '32 tubes; a single stage of resistance-capacity coupled A.F. amplification, using the type '30 tube; and a stage of transformer-coupled push-pull amplification using two type '31 tubes. The filaments of all these tubes are wired in series; and the filaments of tubes V1 to V4 are shunted by individual resistors to pass the excess current from the 130 ma. required by the power tubes.

Lighting-circuit "strays," or "X's," are effectively choked by the 1:1-ratio transformer, which is functioning as a filter in the incoming line circuit. The Mazda lamp acts as both a panel light and a safety resistor; the specified type must be used.

A caution to be observed, when testing most D.C. lighting-circuit receivers, and particularly this "De Wald," is to refrain from removing tubes while the set is operating. Failure to follow this caution will probably result in burning out the filament shunt of the tube removed.

### All-American Mohawk "Lyric"

The owners of 6-volt batteries will be interested in the radio set illustrated in Fig. C; the "battery set" chassis of the Rudolph Wurlitzer Mfg. Co's. "Model B-94" 2-volt tube radio set. The schematic circuit is shown in Fig. 2.

Referring to this diagram, we find that the 6-volt "A" supply is reduced to the required two volts by the pilot light, V7, which passes just the required amount of current for the new tubes. Special R.F. transformers, designed to obtain even transfer of energy throughout the broadcast band, and similar in circuit arrangement to

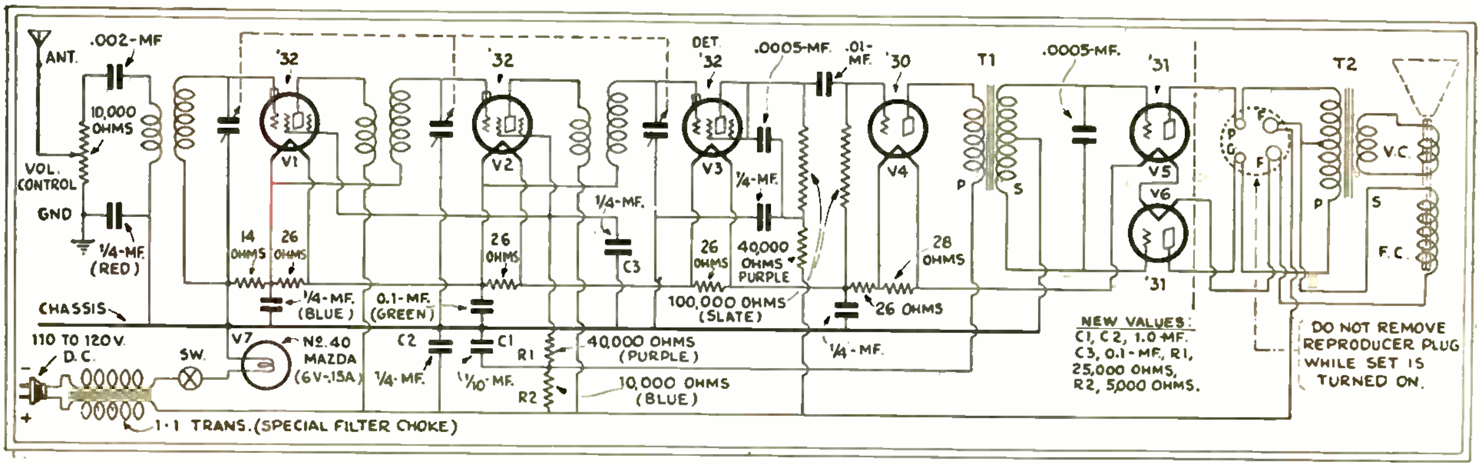



**Fig. 5**

*The schematic circuit of the Pierce-Airo "DeWald Model DC 632" midget illustrated above. It is designed for 110-volt D.C. operation; but may be connected to a 220-volt line through a series resistor; the Mazda lamp ballasts the circuit. Note the dynamic's field coil is in series with the filaments.*

those used in the Philco "Model 30," are part of the tuning system; and a single dial controls the three tuning condensers. Resistors R1 and R2 constitute a dual volume control. A special dynamic reproducer, deriving its field current from the "A" supply, is part of the equipment. To prevent exceptional drain from the "B" supply, the plate circuit, including resistors R2, R3, R4, is opened by switch Sw2 at the same time the filament switch Sw1 is operated.

Space for the batteries is evident in the illustration of the set chassis, Fig. C.

### The Home-Builder's "DeLuxe" Two-Volter

At this point we bid adieu to the manufacturer and the B.C.L. and, through the courtesy of Mr. H. G. Cisin, present to the radio experimenter wishing to construct his own 2-volt-tube receiver, the "DeLuxe Two-Volter." The diagram of connections is Fig. 7; the parts layout followed in the original receiver is Fig. 8; in Fig. 6, we see the arrangement of the completed chassis.

In addition to the three type-'32 screen-grid R.F. amplifiers, of the two-volt type, there are two general-purpose '30's and two type-'31 power amplifier tubes of the 2-volt filament type in push-pull. A "bass-treble" tone-control switch (48) shunts a fixed condenser across the primary of the first A.F. transformer for tone control.

Since the "A" supply may be a 6-volt storage battery, or an "A" eliminator, resistors are required to drop this potential to the required two volts for the new tubes. These are Amperites (9, 20, 32, 44, 55, 61 and 61A in Fig. 7.)

If an Eveready air-cell "A" battery is used, the wiring of the filament circuit will be somewhat different. First of all, the Amperites are omitted; the wiring then going direct from the switch (69) to the positive filament terminals of the various sockets. Instead of connecting the "A—" post (68) directly to the chassis, this post is insulated in the same way as the positive post; and a ½-ohm fixed resistor (Carter,

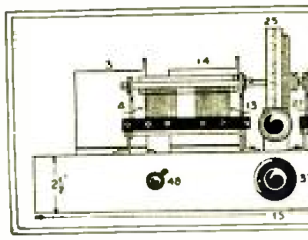


**Fig. 6**

*The front appearance of the chassis of the completed single-dial "DeLuxe Two-Volter," intended for the home constructor. This set was designed by Mr. H. G. Cisin, well known to our readers, to use standard parts generally available.*

Yaxley, or equivalent) is connected between the negative post and the chassis. This serves the purpose of lessening the voltage of the air-cell "A" output from 2.5 volts to 2.2 volts; which reduces the initial voltage applied to the tube to the maximum allowable. At the same time, it is necessary to 2.00 volts (as against 2.1 to 1.7 volts for a single lead-plate cell). This resistor must be variable; the filament supply is to be checked accurately with a voltmeter, or an ammeter.

Note the thorough by-passing of the circuits of this receiver. A list of recom-

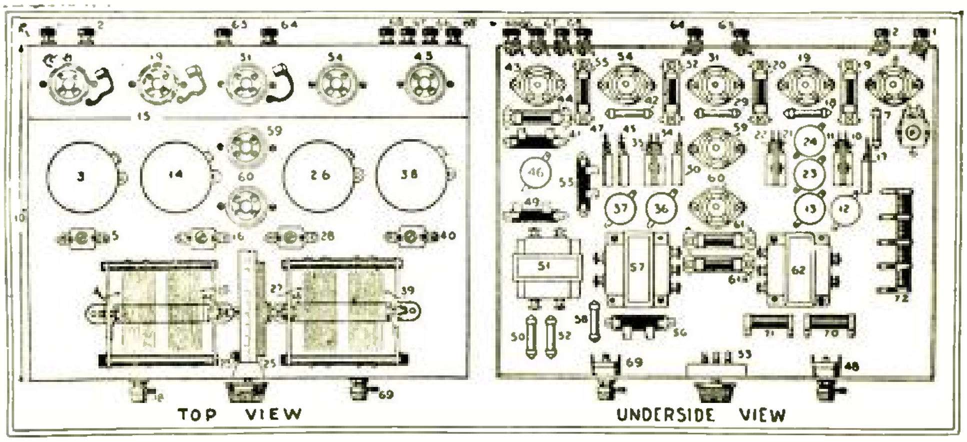



**Fig. 8**

*Left, the top view of the chassis, illustrated above; right, a view from beneath. The constructor may easily shield the screen-grid tubes, the positions of which are indicated by sockets 8, 19 and 31.*

to dispense with the pilot light; because the smallest 2.5-volt lamp consumes 0.3-amp.; which, added to the 0.6-amp. requirement of the remainder of the set, would overload the air-cell "A" battery by the amount of 0.15-amperes.

If a 2-volt storage cell is used, no resistor will be required. And, if two Edison cells are used, a ½-ohm resistor is needed; since the operating-potential range of two of these nickel-iron cells in series is from 2.40

mended parts, as used in the original model, is given below:

#### List of Parts

Two *Cardwell* "dual" variable condensers, type "217-CL" (4, 15), and type "217-CR" (27, 39); capacity, each section, .00035-mf.;

One *Silver-Marshall* R.F. shielded coil, type "124" (3);

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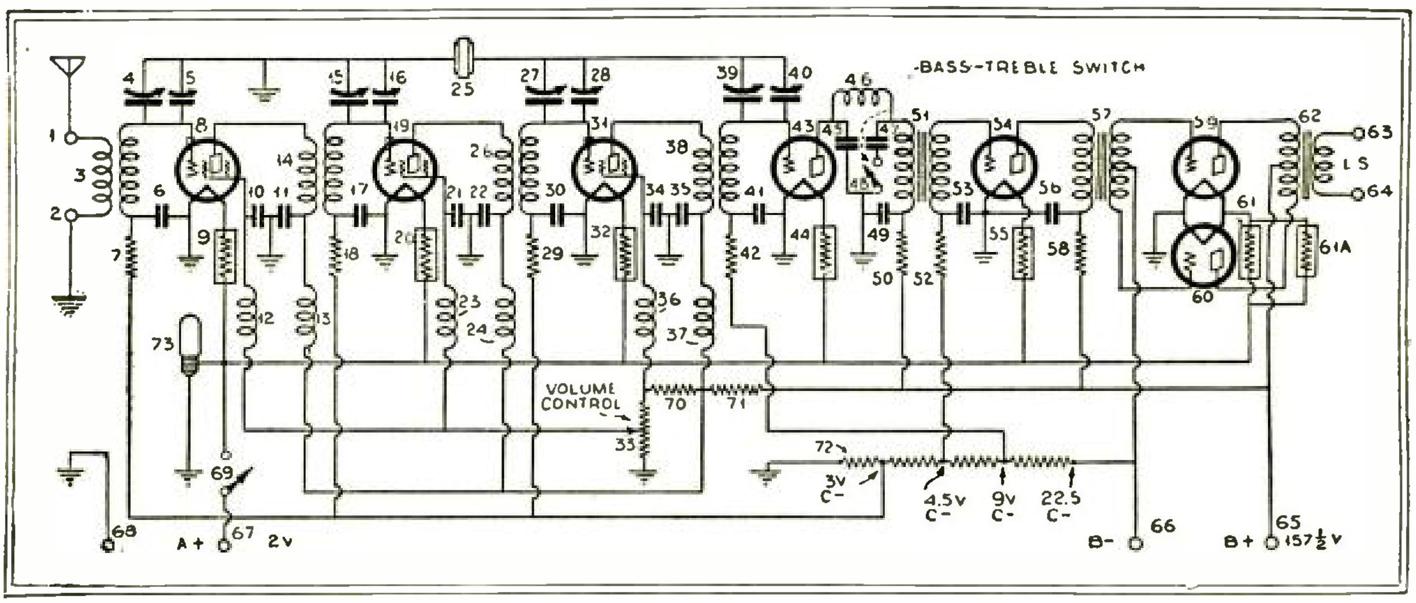


**Fig. 7**

*The schematic circuit of the "DeLuxe Two-Volter," a set of high selectivity and amplification, but very low current consumption. It may be operated from either an air-cell or a storage battery economically; the only changes in the design necessary would be in the Amperites or filament-ballast resistors used.*

# Recent Advances in Radio Tube Design

EVERY advancement in technical appliances brings with it additional and oftentimes unsuspected practical problems; and further experiments and inventions are at once required. This is one of the reasons why patents have continued to increase in number for a hundred years after the date when a commissioner of the Patent Office foresaw the end of its usefulness, for lack of anything further to invent.

So it has been in radio: every addition to the apparatus which has been available to radio workers has suggested something new. The vacuum tube was a revolutionary step forward, for the owner of a crystal; before the possibilities of a single tube could be exhausted, the multi-stage R.F. amplifier was indicated. The problems which it introduced were almost innumerable; then the four-element, or screen-grid, tube emerged from the laboratory in which it had been hiding for years. Before the newcomer could make its mark commercially, the growing demand for light-line current supply revolutionized the radio industry. Electric sets went rapidly through the process of refinement; and, when the A.C. screen-grid tube appeared, it might seem that the ultimate of which early radio experimenters talked had been reached. The modern electric receiver has practically unlimited R.F. amplification, sufficient to bring up to full volume any signal, however distant, which an aerial can catch out of the etheric turmoil; and it has audio amplification sufficient to fill any room with sound. At last the radio listener, it might seem, has all that he can hope for.

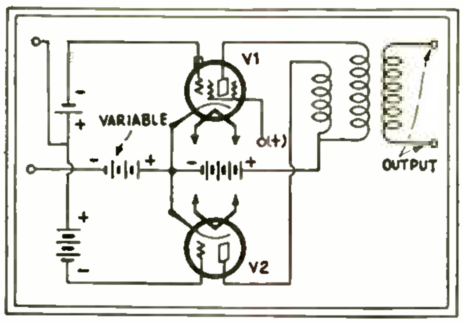


**Fig. 1**

*In parallel, two tubes (one high-mu and one low-mu) would change the amplification factor automatically with the grid bias applied.*

Nevertheless, even a millionfold amplification has its drawback. While the tuned circuits of a receiver, one after another, may create a ten-kilocycle separation at the detector, there is no such sharpness in the early stages. A signal, unwanted by the listener, may be ten thousand—perhaps a million—times as strong as that for which he is tuning. And it will come into the early stages of the receiver with power so terrific that it plays the very deuce with the tubes' characteristics. Therefore, we have overloading, distortion, cross-talk, etc.

The old advice to the annoyed listener, to move away from the interference, will hardly do. The majority of listeners, at least in the urban districts whose consolidated buying power dictates the design of commercial A.C. receivers, have nearby one or more stations from which one or at most two screen-grid R.F. stages would give overpowering volume. In a receiver with four such stages of amplification, something must be done to deal with the locals; their presence cannot be ignored, no matter what selectivity is provided.

We have been provided with, first, the manual volume control and, then, the automatic volume control which, by altering the biases on the R.F. amplifiers, reduce the amplification of the set. Yet even these are insufficient to solve the problem in the face of strong interference; for if the tube is, so to speak, throttled down too tightly, the goblin distortion pops up.

To meet the problem presented by multistage amplifiers, utilizing tubes of very high amplification factor (or "mu"), a new type has been devised. A very brief explanation of its action may be given here.

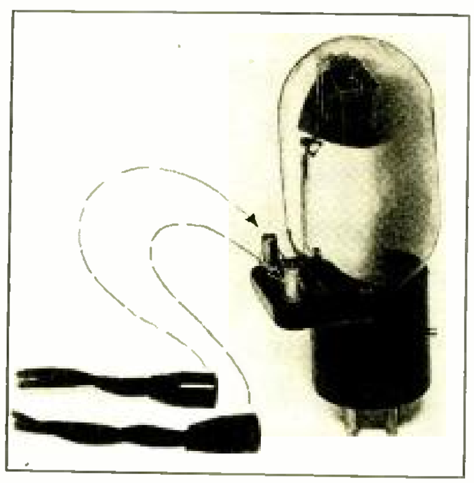

**Fig. A**

*A "Lestron" adapter tube, taking filament current direct from the light-line, without alteration in the wiring of the set.*

When the grid bias of a "high-mu" tube (of which class the screen-grid tubes are the extreme examples) is made too high, to prevent the output from overloading the following stage, the characteristic of the tube is altered; its shape, as shown on a graph, is curved, signifying that the output must be distorted. One of the results is that the percentage of modulation of the signal is increased, as the plate current falls; and this effect, carried through several tubes, may be serious when it reaches the detector.

In the old days, experimenters were fond of working with stages of R.F. amplification which could be switched in and out; and some distance fans would perhaps be still willing to welcome a gadget of this kind. Modern conditions call, however, for something automatic which only the Service Man need worry about.

The solution was reached through a process of reasoning something like this: suppose a circuit, as in Fig. 1, where a tube of high amplification factor and low grid bias (V1) is put in parallel with one of low amplication factor and high grid bias (V2). A small signal is put upon the two grids; the greater part of the voltage output comes from V1. As the signal increases in strength, we steadily increase the bias on both tubes. Because of the greater effect of grid voltage on plate current in the high-mu tube, the amplification of V1 is cut down much more rapidly than that of V2; and the latter assumes a more and more important part in the circuit. Finally we have increased the bias so much that V1 is blocked; no plate current flows; only the low-mu tube V2 is working, but on a strong signal it is giving ample output.

### The "Variable-Mu" Tubes

To construct a receiver on this plan, however, would double the number of tubes, as well as increase the number of parts and the possibility of trouble. The solution which has been found by the Radio Frequency Laboratories, under the direction of Stuart Ballantine, is the design of a "variable-mu" tube, which shall combine the characteristics of the two tubes shown in Fig. 1. After a great deal of research, the tube has reached the commercial stage, being made standard equipment in a new Majestic superheterodyne; and it is being produced by the Raytheon and Arcturus tube factories as well.

The principle of the variable-mu tube is that its elements are not arranged symmetrically, as in previous tubes; for instance, at certain places, the voltage on the grid exercises less control on the flow of plate current than at others. In Fig. 2, let us say, the control grid is more open in the center than at either end. A voltage may be put upon it such that at either end no electron can pass through the mesh; and the two ends of the grid present an impassible barrier to plate-current flow. In the center, however, the mesh is more open, and a considerable number of electrons can pass. The tube, therefore, still operates with a greatly-reduced amplification factor.

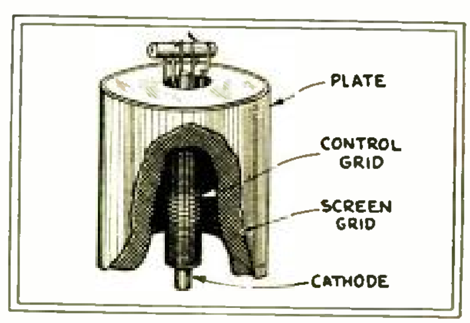


**Fig. 2**

*A control-grid, unevenly spaced, passes plate current at one point while it is cut off at others by the grid bias. This varies the amplification factor, or "mu."*

Two tube types, resembling greatly the '24 in normal characteristics, have been designed. The "550" is capable of handling an input voltage fifty times as great as that which can be applied to the '24 before the same degree of distortion is reached. However, since this entails the application of a

(*Continued on page 630*)

# Radio-Controlled Tanks of the Future

*Is it possible to make war with robot armies in moving forts operated by remote control?*

WRITERS of war stories, peering into the future, predict an approaching era when fighting will be done by machinery under remote control. Guns automatically operated will fire from deserted fortifications and from tanks which contain no living operators. Airplanes without human pilots will observe positions through televisors, and drop projectiles guided from a post at headquarters, many miles away. The casualties will be solely among robots of steel and copper, whose orders are conveyed to them by radio, or other subtle signalling methods. Such is the picture which is painted upon the drop curtain which conceals the next war—if it be true that war has not been abolished along with the dips in the business cycle.

A picture which appeared recently in one of our English contemporaries is reproduced here; the original, it is said, was taken at a public demonstration in Tokio of a tank which was operated entirely by radio from the post in the foreground. The tank went through numerous maneuvers, under full command of its operators, to the enthusiasm of a great crowd of spectators. While the picture does not seem to be of an official type, it is evidently genuine; the tank itself seems rather small and not too warlike.

### Radio Remote Controls

The feasibility of remote control of a vehicle has been known for many years. John Hays Hammond, Jr., some years ago demonstrated wireless control of automotive torpedoes; and he exhibited, as an amusing toy, his "Wireless Dog," whose movements were guided without physical connection to the controls.

At the World's Radio Fair of last season, in New York City, the most spectacular exhibits were undoubtedly those of various "robots" and other examples of the use of photoelectric cells and electric relays. There were a knight in armor, and a winsome lady, and other mechanical devices which seemed almost human in intelligence and activity.

### A Photoelectric Control

One of the most interesting demonstrations of this kind was given under the auspices of the Museum of the Peaceful Arts, by the engineers of the Westinghouse company. The miniature automobile, shown in the photograph reproduced at the lower left, was operated by the spoken command, directed into a telephone receiver. The pitch and tempo of the words selected the proper relay at the other end of the telephone line, to light a lamp in one or the other eye of the grotesque face. This lamp was, in actual operation, turned toward the rear of the little car; where its rays were picked up by the photoelectric cell to which it corresponded. The photoelectric cell, in turn, operated one of the relays under the car; and this, according to the spoken word, made the car start forward, stop, back up, or sound its horn. There was no other connection between car and operating lamps than the beam of light.

*This picture, which appears to be a somewhat retouched enlargement of a snapshot, shows a radio-controlled tank going through its paces in Japan. (From Popular Wireless.)*

*The apparatus used in the control of an automobile by word of mouth, at the Radio World's Fair of 1930. The signals were in this case given by light at short-range, instead of radio, but the principle is similar. (Photo by Westinghouse Elect. & Mfg. Co.)*

In one sense, this might be classed with radio remote control. Light waves may be considered as radio waves, only about 1/2,000,000 of a meter long. The photoelectric cell forms a receiving system and detector of these waves; it is not, however, as sensitive as a tuned radio circuit at a considerable distance.

### War Conditions

The method illustrated, of the exhibits we have described, might readily be applied to the operation of a tank, however, which received signals by radio; to the extent that the movements of the tank could be electrically controlled. Tanks, however, are now driven by explosion engines, rather than batteries; and considerable energy is required in their guidance. We may picture the future tanks, however, as equipped with shock-proof batteries delivering great amperage to their motors; and thus being capable of starting, stopping, and steering under the control of radio-operated switches.

Other points, however, enter into the problem of operating a tank by radio under conditions of actual warfare; which would indicate that, while the technical feat is possible, under peace conditions, it would be difficult at the front under the conditions imposed.

For instance, the tank normally carries a crew, who are able to observe and direct its course to avoid, or overcome, local obstacles. The only substitute for them would be not one, but several televisors, of great efficiency. Each of these would require a

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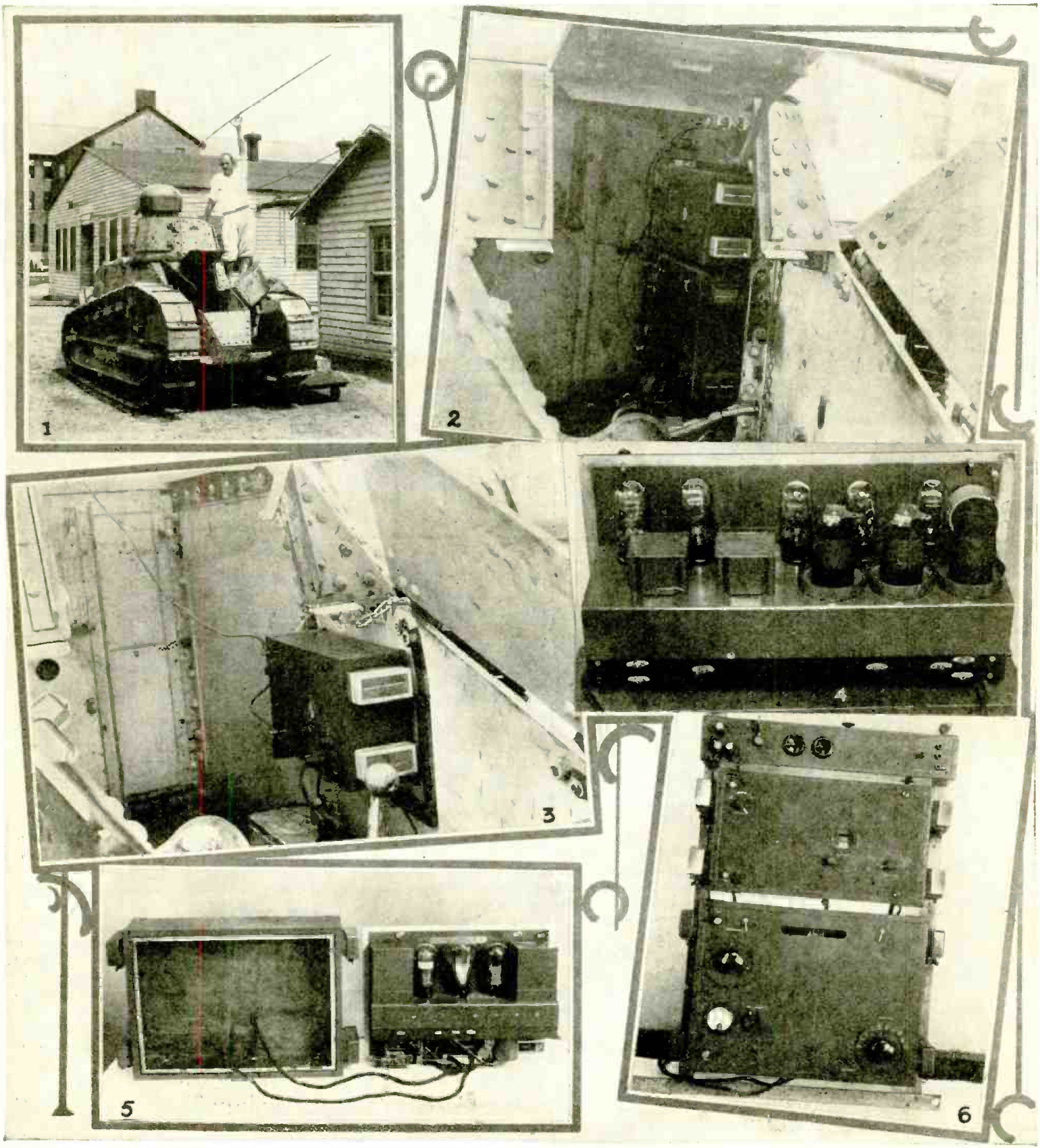


*Radio equipment of Uncle Sam's tanks is shown above: the tank in (1) is an old-timer, used for these experiments. Observe its flexible aerial. (2) Receiver and transmitter in position; (3) receiver alone with battery case below; the oblong end-pieces are buffers. (4) Chassis of the receiver which uses five UX-864 tubes; (5) transmitter removed from its case. (6) The assembly of Fig. 2 removed from its mountings. (Photos by Signal Corps; U.S.A.)*

# New Radio Devices for Shop and Home

**In this department are reviewed commercial products of most recent interest. Manufacturers are requested to submit descriptions of forthcoming developments.**

## THE SKYSCRAPER RECEIVER

WHAT is unquestionably a forerunner in radio cabinet set design is the pattern of the Westinghouse radio receiver bearing the trade name of "Columaire." Illustrations of this departure in cabinetry and equipment are Figs. A, B, and C.

The tendency toward forms slimmer and higher, as manifested in the architecture of the modern skyscraper, was found to be borne out in the entries submitted in the Westinghouse company's recent "$10,000 Radio Idea" contest, many of whose entrants stressed the desirability of the future radio sets taking up less room. It is here exemplified in a high degree by this receiver.

The "Columaire," occupying a very small floor area, 10 x 12 inches, will fit in a corner or flat against the wall of the home. Consequently, it is particularly adapted to small apartments. The design is of no particular period, but leans slightly toward the modernistic and, therefore, will fit well with existing furniture. Its height is 59 inches.

Among the unique features in this newest design in radio receivers is the design of the reproducer. Instead of appearing on the front of the cabinet, the grille is placed on the top; it has sufficient strength to hold light articles, such as a small vase. The full length of the cabinet is utilized to obtain a five-foot horn; the directional effect of the average horn has been overcome, in this reproducer, by introducing at the opening a plug of special shape. It is this plug, too, which eliminates distortion due to the proximity of the walls and ceiling.

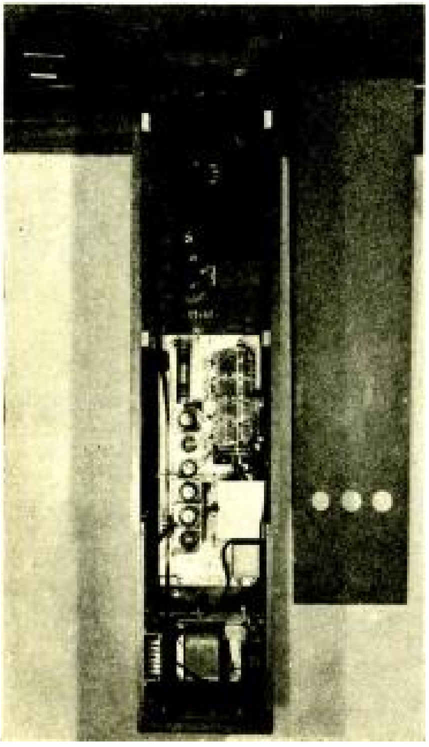


**Fig. C**

*The vertical receiver from the rear, showing ease of access. The horn opens on top.*

All controls and dials are flush-mounted on the sides of the instrument, as the illustration shows, and are readily operated from either a standing or a sitting position. The receiver chassis is that of a 9-tube screen-grid superheterodyne, in which is incorporated a tone control.

After this receiver has been in service for a sufficient length of time to require the customary special attention, the Service Man will find the necessary information available in a RADIO-CRAFT "Data Sheet." The service technician will be glad to learn that the requirement of servicing the set for tube replacement or adjustment has been given full consideration; the back of the cabinet is easily removed, and the horizontal arrangement of the tubes makes their replacement quite easy.

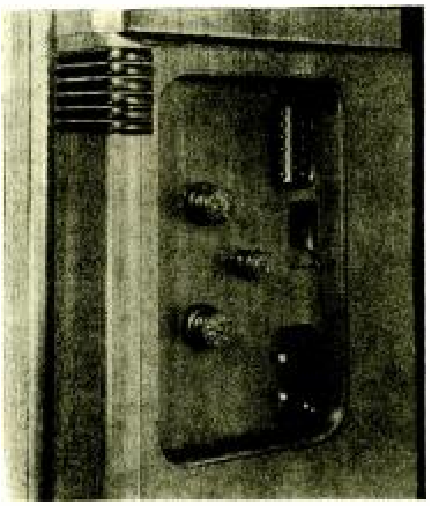


**Fig. B**

*The panel of this superheterodyne looks like an ordinary one, up-ended.*

The suggestion of "grandfather's clock" in the columnar appearance of the cabinet is heightened by the presence of an electric time piece. Into the construction of this clock, the Westinghouse engineers have worked an "automatic control" which will continue to operate the clock mechanism for a time should the main current supply cease; as when a house fuse blows. Further, this auxiliary drive, when its power is expended, will not permit the time movement to operate upon re-application of the line supply until the drive is re-set.

Since the bulk of the weight of the instrument is in the base, the set stands solidly; while its small girth permits it to be conveniently transported by automobile.

The design of the chassis permits incorporating, at a later date, the newly-developed Westinghouse remote-control equipment.

**Fig. A**

*This "grandfather's clock," 1931 edition, is a radio receiver for city apartments. A remote-control unit is on the table.*

## SMALL TUNING CONDENSERS

A SERIES of small-space tuning condensers ranging in maximum capacity from 19 mmf. to 322 mmf. have been developed in the laboratories of the Hammarlund Manufacturing Company. The smallest condenser is 2¾" long and the largest, 4" long. All "Midline" types are 2" wide, with plates fully extended. The "capacity" type is only 1½" wide.

No screws or nuts are used anywhere in the construction of these condensers, soldered eyelets being employed; thus all possibility of parts vibration is eliminated. This is an excellent feature for aeroplane and automobile sets.

The "Midline" type are known as the MC-(number of plates)-M type and the capacity as the MC-(number of plates)-S type. They are made in the following capacities: 19.2 mmf.; 34.2 mmf.; 49.2 mmf.; 78.6 mmf.; 93.6 mmf.; 100.2 mmf.; 138. mmf.; 198.6 mmf.; 242.4 mmf.; 294. mmf.; and 322 mmf. All are available in either clockwise or anti-clockwise types, and for base or single-hole panel mounting. The shaft is the standard ¼-inch size.

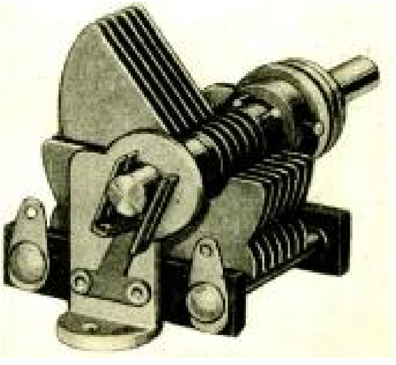


**Fig. D**

*The newest condenser types are much more compact and smaller than instruments of the same capacities in previous models. They are strongly and precisely built.*

**Fig. E**

*The smallest of modern screen-grid receivers is this Crosley "Wigit."*

### A SUB-MIDGET RECEIVER

PICTURED in Fig. E is the newest thing in small radio set design, the "Model 48" or "Wigit" midget radio receiver manufactured by the Crosley Radio Corp. Two interior views are Figs. F and G; the schematic circuit is Fig. 1. (*See page* 619.)

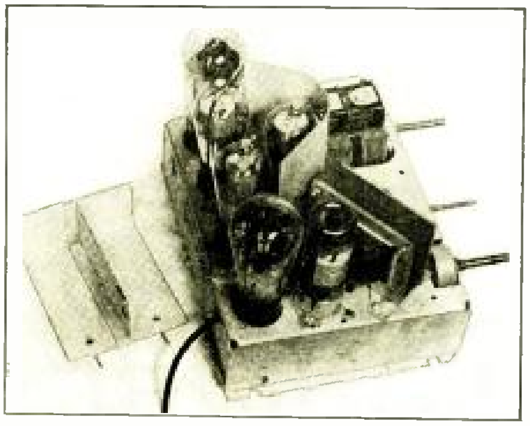
This selective receiver is probably the first screen-grid electric set, incorporating a sensitive reproducer, to list under forty dollars. It utilizes two screen-grid tubes as R.F. amplifiers, and a third as a power detector, which feeds into a type '45 power tube. An earlier model of similar appearance, the "Elf," which used only two screen-grid tubes and lacked the sensitivity of the later sets, has been superseded by it. The cabinet has the appearance of carved wood; its material, however, being "Repwood," a composition which may be modeled to present the appearance of carved wood.

A unique point in the design of the set is the manner of arranging the shielding. Because of the extreme compactness of the design, it was found necessary to devise some special means of reaching the tubes for replacement, without the necessity of removing all the shielding. The result was obtained by designing a "plug-in shield." It is difficult to arrive at a true conception of the size of this radio set by comparing the sizes of its components; since nearly every instrument is special and of proportions smaller than are found in previous radio sets; the exception being the tubes. The tuning gang, for instance, is extremely compact. Filter requirements have been met by a single 8-mf. Mershon electrolytic condenser. The power transformer has been designed to occupy little more space than is required for an audio transformer. The variable resistor for volume control is of "small space" type; and the fixed resistors establish new standards of minuteness. Each R.F. transformer, of small size, is totally shielded.

The complete receiver (cabinet, reproducer, power and receiving equipment), weighs only 22 lbs.; of which about one-half is the cabinet.

The (discontinued) "Elf" was designed only for local reception; whereas the "Wigit" is designed both for local and distant reception. That it fully lives up to the expectations of its design engineers, this department, after careful test in the heart of New York City, is glad to affirm.

(*Continued on page* 619)



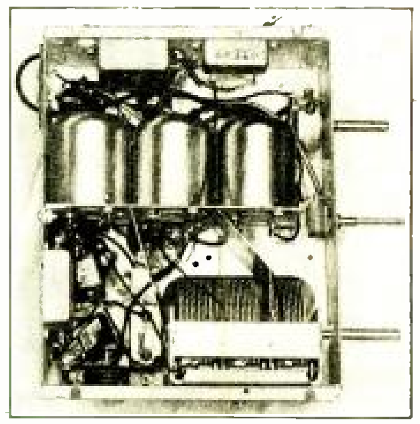


**Fig. F** (**left**)

*The tiny size of the "Model 48" (Wigit) chassis is indicated by the tubes, part of whose shielding is removed.*

**Fig. G** (**right**)

*Under view of the same chassis.*

# Practical Hints to Radio Manufacturers

## *By Radio Users and Service Men*

### ADJUSTABLE TUNING SCALE

OFTEN a customer complains that the tuning dial, calibrated to kilocycles, reads incorrectly either at one end, or in the center. If the dial were made in about five sections, and held by six screws, the readings could be made to correspond to the positions of the stations, over the whole dial.

K. R. TANTLINGER,
*508 Boyd Avenue,*
*Cumberland, Md.*

### REPLACEABLE CAPACITIES

PRESENT practice of many manufacturers is to assemble condenser blocks for filters in a large tin can "impregnated" with tar. Repairing one of these is the work of several hours. I am sure that these blocks could be assembled, without additional expense, and at a great saving of tar, to facilitate the work of servicing; to say nothing of saving to the customer and reduction of the time during which his set is laid up.

One concern in particular—and there are many more—makes a charge of $17.50 for replacing a filter block. If only one of the filters goes west—$17.50. I get lots of Majestic repair work, and I never get over the uneasy feeling that comes to me when I must tell a customer that the charges on his power pack are from $12.50 to $22.50; for sometimes an old '80 goes with the condensers. Power transformers are easier, and replacements are made with less expense in the majority of cases. My opinion is that the condenser-block assembly could be simplified so that one or more damaged sections could be replaced.

Educating people to realize that radios do not have the stamina of the old spring-operated phonograph looks hopeless, at times. Allow me, in closing, to say "Darn the tar!"

B. M. EILER,
*Ponca City, Oklahoma.*

**HINTS TO RADIO MANUFACTURERS**

**Until further notice, each "What the Public Wants" suggestion published here will be paid for at the rate of $1.00; and their practical value, rather than their ingenuity or curiosity, will determine the selection, since this feature is intended to be of educational value to the radio industry. This means that we ask ideas from our readers, not for new inventions, but for simple details, often very small ones, which they have observed.**

### COMPLETE LINE PLUGS

MANY manufacturers are sending out their sets with only the cap part of the attachment plugs. This is often embarrassing when the Service Man goes out to hook-up a new set and forgets to take with him a screw-in plug; and the prospect is always amazed to think that the manufacturer of (often) expensive sets does not equip them with both parts of the attachment plug. It is just the lack of such little inexpensive things as this that gives the manufacturer the name of being "cheap," from both the customer and the Service Man.

G. B. GERMAN,
*411 American Exchange Bldg.,*
*Duluth, Minn.*

### HANDIER CABINET TOPS

SERVICE MEN have often experienced difficulty in checking some of the receivers where the top of the cabinet is not hinged. The compartments are so small that it is necessary to grope in the dark to insert the analyzer plug or to change tubes. In some instances, time can be saved by taking out the chassis. It would seem that to provide a hinge for the cover, when

(*Continued on page* 629)

# The "Universal Super-Wasp" for All Bands

*A short-wave receiver with a frequency-range switch of novel character*

By ROBERT HERTZBERG

IN THE "Universal Super-Wasp" receiver, here presented in full detail to the readers of RADIO-CRAFT, a striking advance has been made in the technique of short-wave reception. Difficulties which have been experienced by the short-wave listener have been overcome, after a long period of experiment, by the final design of a waveband-control switch, whose operation will be explained below, as well as many novel circuit features which were evolved in the process of reducing the ingenious conception to practice. The completed receiver is one to which full justice cannot be done by mere illustrations; as the fine points of its construction can be appreciated only by thorough examination. It is, undoubtedly, the most advanced short-wave set yet presented for the public favor.

**SHORT-WAVE listeners have found, in the enormous breadth of this interesting field, one of their greatest problems in the past. In place of one tuning range, there were many. No single coil or tuning capacity, no matter what ingenious devices were used, could cover this whole vast radio field from 20,000 to 1,500 kilocycles—thirteen times the width of the upper broadcast band—at full efficiency. And the exchanging of coils, in sets with more than one tuned circuit, and with complete shielding, was a source of constant annoyance. Now, by a most ingenious mechanical and electrical arrangement, described here by one of the four collaborating radio authorities who are well known to our readers, this problem is so effectively solved that the receiver shown here covers, not only the short waves, but the broadcast band and beyond, into the region of long-wave signals. This receiver will be of interest to every prospective short-wave listener, and even more so to those veteran fans who have worked with its predecessors in turn; the "Wasp," the battery-operated "Super-Wasp" and its A.C. successor; which have become familiar throughout the world as successive steps making short-wave work easier and more satisfying.**

### Tunes from Long Waves to Short

The standard "Universal" now uses a total of six tubes, including the rectifier. Its big feature, its wavelength-changing switch, eliminates the plug-in coils that heretofore have been the greatest nuisance in short-wave work. The coils are fixed inside the set and are thrown in and out of the circuit by means of a very ingenious pair of rotary cam switches contained in molded bakelite housings. This switch, which is controlled by a small knob on the front panel, has seven positions, which cover seven wavelength ranges as follows: (1) 15 to 23 meters; (2) 22 to 41 meters; (3) 40 to 75; (4) 70 to 147; (5) 146 to 270; (6) 240 to 500; (7) 470 to 650.

This unusually wide wavelength range, probably the widest covered by any short-wave receiver, takes in not only all the short-wave channels, but also the entire broadcast band and even the calling waves used by commercial ship and shore telegraph stations. On the broadcast ranges it brings in stations that are not at all audible on many regular broadcast receivers, the minimum settings of which are sometimes as high as 240 or so meters.

The complete schematic wiring diagram of the Universal is Fig. 1. At first glance this may appear somewhat complicated, but a close study will reveal it to be quite understandable. The set uses one stage of screen-grid tuned-radio-frequency amplification, a regenerative screen-grid detector, one impedance-coupled audio stage, using a '27, and a push-pull output stage using two '45's. For the sake of simplicity, the four antenna couplers permanently mounted inside the set are represented as a single coil (L1), and the four detector coils also as one (L2). Each of these coils has two windings; L1 has a primary and a secondary, and L2 a combination primary and tickler, and a secondary. One end of each winding is permanently grounded; either directly to the chassis or through a non-inductive condenser, as in the case of the primary-tickler. The other ends of the respective coils are brought to contacts on the cam switches, and they are connected in the proper sequence as the switches are turned.

### Changing Wavebands by Switch

The antenna and detector tuning condensers (C1 and C2 in the diagram) are actually double units; one section of each has a maximum capacity of 130 mmf., and the other of 415 mmf. They have a common rotor connection but separate stators; the latter connections are also brought out to contacts on the cam switches, so that there are 15 contacts altogether on the switches. For the sake of convenience, I designate the small sections by A (as C1A and C2A) and the large sections by B (as C1B and C2B); there is also provided a fixed loading condenser of .0004-mf. capacity to shunt each variable instrument. The coils, in the upward order of their inductance value, may be numbered 1, 2, 3, and 4.

When the wavelength switch is set to the first range, coils No. 1 and condensers A are connected together in each tuned circuit;

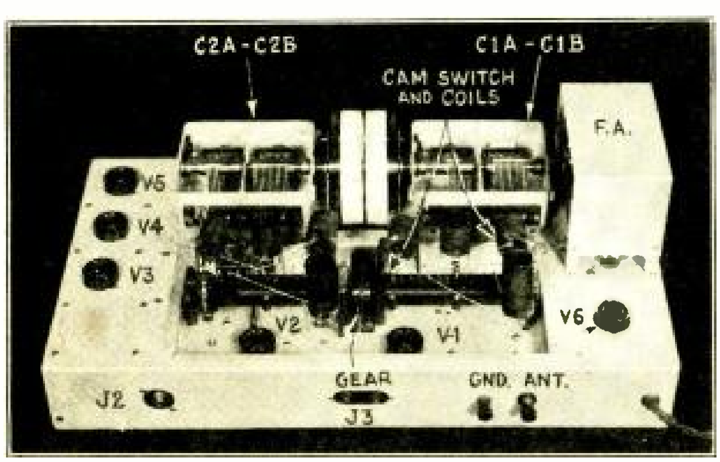



**Fig. B**

*The chassis of the "Universal," from the rear, showing how the "pan" carrying the radio-frequency mechanism drops into the frame. The two wave-changing switches run horizontally across the center of the picture; six short-wave coils, at right angles, are visible behind them.*

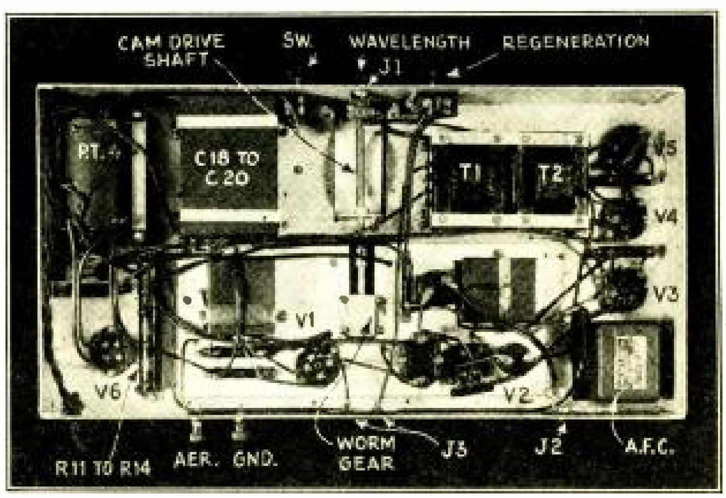



**Fig. C**

*The "Universal" chassis inverted: power units at the left and A.F. components at the right of the tray; while the worm-gear driving the waveband switch appears in the center.*

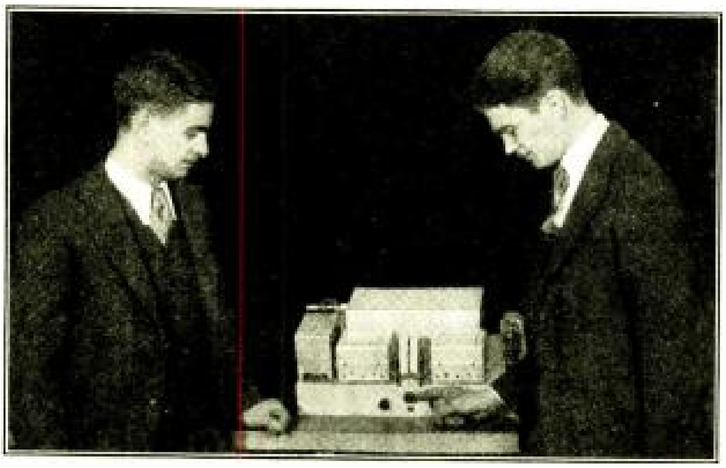


**Fig. A**

*The "Universal" chassis fully assembled, as it appears from the front. Mr. Geloso has his finger on the knob which drives, through a worm gear, the two rotary-cam switches which change the waveband covered by the tuning knob.*

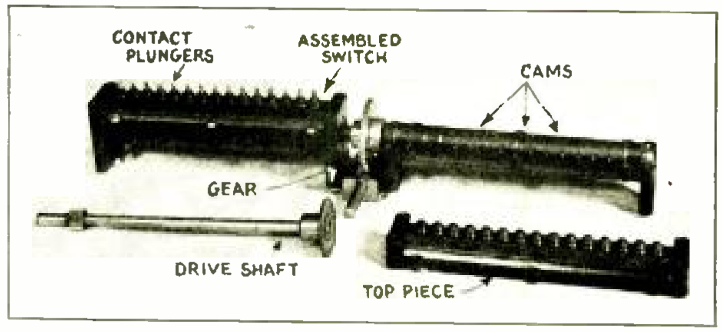



**Fig. D**

*The two rotary - cam switches; that at the right is separated to show the parts.*

in range two, coils 2 and condensers A; range three, coils 3 and condensers A; range four, coils 3 and condensers A and B; range five, coils 4 and condensers A; range six, coils 4 and condensers A and B; range seven, coils 4 and condensers A, B and C. The shift from one range to another is made in an instant; and it is not necessary to open the set or disturb anything in it.

The primary and tickler windings, of both antenna and detector coils No. 3, are each tapped in one place; part of each winding being used for waverange three and all of it for range four. The primaries and ticklers of the No. 4 coils are tapped in two places, for use on ranges five, six and seven.

### Novel Regeneration System

The method of coupling the R.F. stage to the detector and the system of regeneration through the combination primary and tickler was adopted after exhaustive investigations by David Grimes and Edgar Messing, radio engineers whose names are well known to readers of RADIO-CRAFT. It is the logical method of coupling for screen-grid operation on the short waves and provides very smooth regeneration, the control of which does not affect the tuning circuits. Thus it is possible to log stations very definitely and to duplicate the dial settings at any time.

If you will follow the circuit carefully, you will see that the radio-frequency current from the plates of both tubes and the screen-grid of the detector tube V2 is led back to the tickler winding T through C10, (the .00004-mf condenser between the screen-grid and the plate) and C4 (the .0005-mf condenser at the lower junction of this circuit). The R.F. choke coils in the plate and screen-grid leads prevent the R.F. current from taking any other path. The control of regeneration is provided by a 50,000-ohm potentiometer (R10), regulating the screen-grid voltage.

Incidentally, a phonograph pickup jack (J2) is connected directly in the screen lead as shown, and the regeneration potentiometer thus acts as a volume control on the phonograph music.

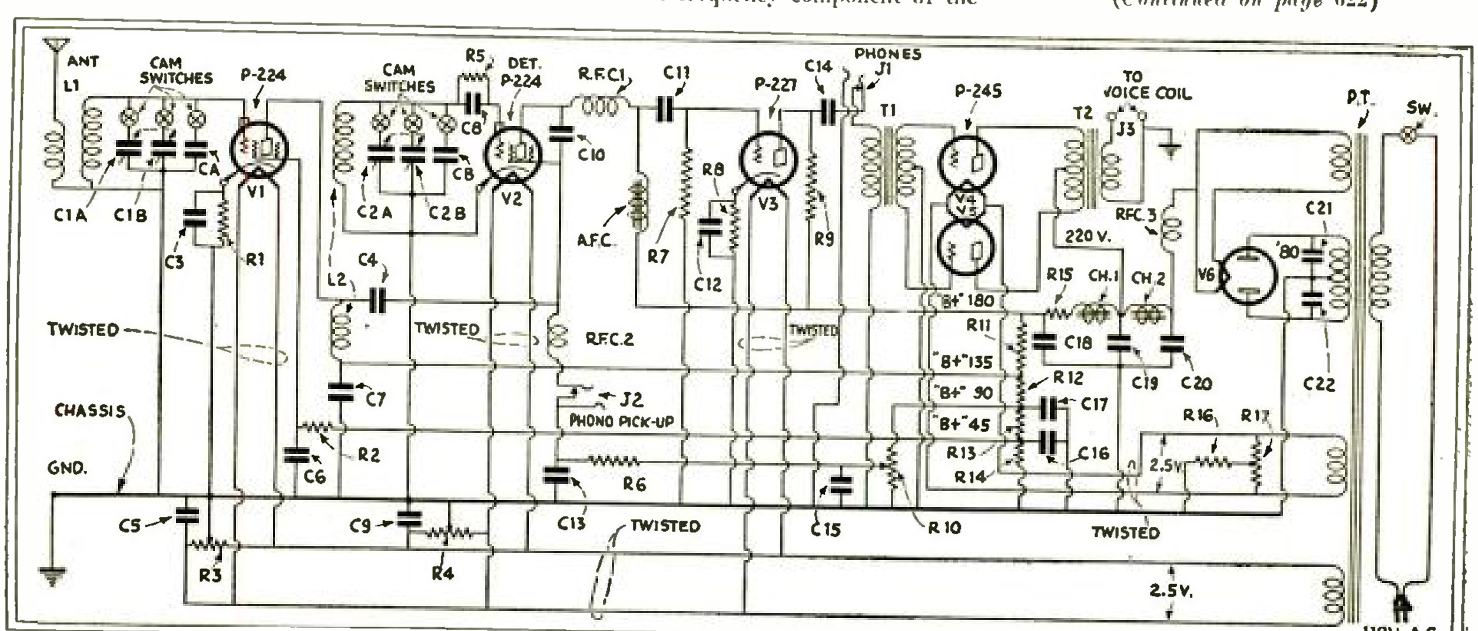
The plate voltage for the detector tube is fed through a high inductance choke coil (A.F.C.), rather than through a fixed resistor. The choke coil allows the plate voltage to assume the value necessary for efficient operation and, at the same time, prevents the audio-frequency component of the plate current from leaking off through the "B" circuit.

Because of the high amplification furnished by the screen-grid R.F. and detector tubes, headphone operation is comfortable only at the first audio stage, so the phone jack J1 is connected in the plate circuit of the '27. A shunt-feed arrangement is used for the plate voltage, in order to keep all direct current off the jack. If the jack were made "live," the wearer of the phones would invariably shock himself when he touches the aluminum chassis. The push-pull output stage is of standard design and will operate a regular dynamic speaker at full efficiency. The terrific "sock" of this set can be appreciated only by a person who has actually tuned one.

The "Universal" is exceedingly quiet in operation, the hum scarcely being noticeable. The designers of the set benefited by their previous experience with the well-known "A.C. Super-Wasp," which has developed an international reputation. The entire power pack is built directly on one end of the chassis, this proximity having absolutely no bad effects.

*It was discovered that the '80 rectifier tube is a prolific source of R.F. disturbance;* so this part of the circuit is protected by buffer condensers (C21, C22), across the high-voltage winding of the power transformer and also by means of an R.F. choke coil R.F.C3 in the "B+" lead.

(*Continued on page 622*)




*The circuit of the "Universal Super-Wasp," somewhat simplified by the representation of the four sets of R.F. transformers as one. The capacities CA and CB are fixed .0004-mf. condensers used only to tune the highest waveband, above 470 meters. Note the unusual regeneration method.*

# A Long-Wave Converter for the Broadcast Set

***A new application of an old principle which presents some interesting possibilities in the way of distant reception, for the experienced set builder***

By CLYDE J. FITCH and C. H. W. NASON

WE are all familiar with short-wave reception of foreign broadcast stations; but few of us realize the great amount of broadcasting of exceptionally good foreign programs which is done with high power on wavelengths longer than those used in this country for broadcasting.

Whether or not these long-wave stations can be clearly received on this side of the Atlantic must depend upon the location and sensitivity of the receiving antenna and the weather conditions. The average broadcast listener does not want to invest in a special long-wave receiver for tuning in these stations—especially if he has already a sensitive broadcast receiver at hand. But the method of receiving them about to be described makes use of any standard broadcast receiver, and avoids the use of a special long-wave set. This system, which was first suggested by Mr. C. P. Mason of the editorial staff of RADIO-CRAFT, comprises a simple two-tube adapter unit with a heterodyning oscillator, as in any superheterodyne receiver, for changing the frequency of the long-wave station to a higher value suitable for reception on the broadcast receiver.

In this adapter, the "sum-frequency" (as in the well-known Infradyne system), rather than the "difference-frequency" is employed, in the manner explained below. Under favorable conditions, with a good sensitive receiver and a long aerial, preferably directional toward the northeast, a set owner should have little difficulty in tuning in some of the more powerful of these long-wave stations when using this simple adapter.

Back in 1924, one of the writers used to confuse his friends with the direct reception of programs from FL, in Paris, France, on the long waves. This was long before the advent of short-wave broadcasting.

The rather formidable list of stations accompanying this article is assigned to frequencies *below*—or waves *above*—*the broadcast band*, as it is known on this side of the Atlantic Ocean. The power used in some of these transmitters raises the question, just how many of the programs would be receivable over here with a sensitive receiver? Of course these same long waves are in use over here for ship traffic and for aircraft, radio beacons, weather services, etc.

A super-converter for receiving stations on the higher waves, incorporating advanced design data, is shown schematically in Fig. 1. The method of changing the frequency is quite the same as in any superheterodyne; except that the carrier frequency is beat or heterodyned "upwards" to meet the range of a broadcast receiver. In normal super practice, the signal is beat "downward," to a lower frequency, rather than to a higher one as in the present case. (See Fig. 2.)

When voltages of differing frequencies are superposed, one upon the other, the resultant wave is of a complex nature; it comprises, not only the original oscillations, but "beats" having frequencies representing the sum and the difference of the original components. Our problem is to take signals within the range from 600 to 2000 meters, and convert them into signals within the range of the ordinary broadcast tuner. Let us say that our apparatus must be capable of accepting any frequency, within the range from 150 to 500 k.c., and "beating it up" (no pun intended) to produce a resultant oscillation which lies between 550 and 1500 kc. and therefore can be amplified by the R.F. system of any broadcast receiver.

If we generate an oscillation just below the broadcast band (let us say at 535 k.c.),

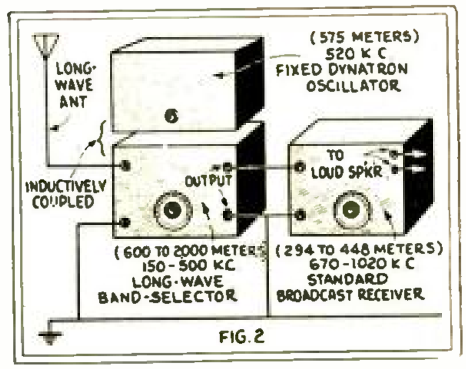


FIG. 2

*A substantial set-up like the above may be made where experiments have shown that receiving conditions are favorable. "B" voltage is supplied by batteries or a small power unit.*

and superpose upon it a signal from a station at the low-frequency limit (150 k.c.) of our desired band, the sum of the two frequencies will be 685 k.c., which is within the broadcast band. At the high-frequency limit (500 kc.) of the desired band, the resultant will be 535 plus 500 or 1035 k.c., and still within the range of our broadcast receiver. We have disregarded as unimportant the fact that other frequencies result from the beating together of the signal and the local oscillation.

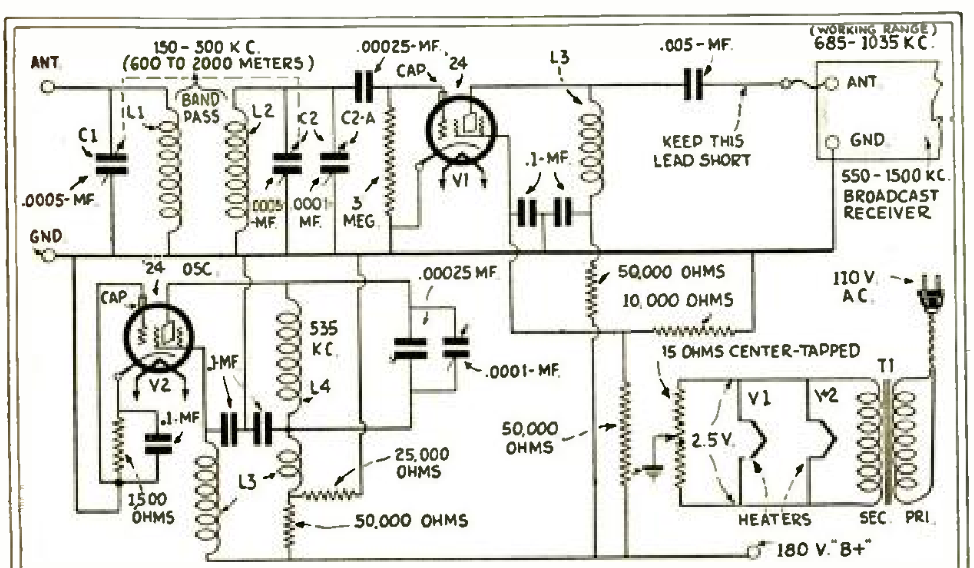


**Fig. 1**

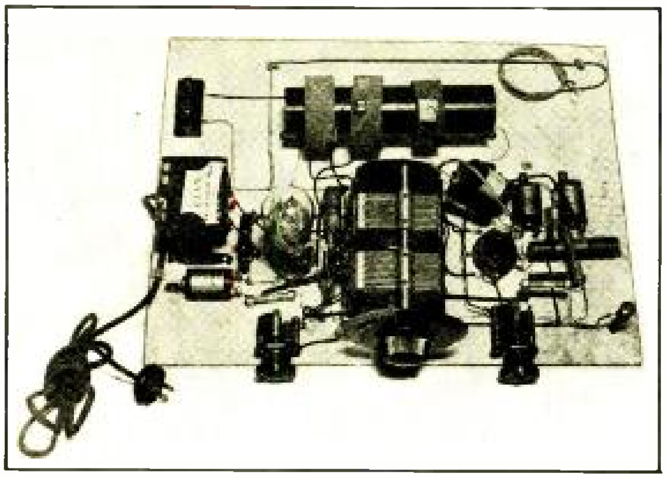
*A long-wave converter, arranged as above, creates a "sum-frequency" heterodyne between the R.F. signal and the oscillations of the dynatron tube V2: the modulator V1 passes this on, amplified, to the input of the broadcast receiver. A small filament transformer (lower right) lights the tubes.*

### Design of the Long-Wave Converter

For simplicity in operation, the converter device illustrated here has been made with a single tuning control, which tunes both windings of a coupled circuit or "band-pass" system. *The oscillator adjustment is left fixed* throughout the operation of the device; the tuning control of the broadcast receiver being varied to tune in the resultant oscillation, instead of using a fixed setting of the receiver and making the converter a two-control device.

Because of the natural capacity of the antenna, which is impressed across the first coil, a rather large equalizing condenser (C2A) is employed across the second tuning condenser. The tuning and ganging of these two circuits can be readily accomplished with the assistance of one of the long-wave American signals available in the band; as can the logging of the relative dial readings of the converter and broadcast receiver.

The tuning of the oscillator, so long as it is not disturbed after once being set, need



*A breadboard layout of the circuit shown on the opposite page, for experimental purposes. The type of oscillator is not essential, but only its frequency; which need not be of the exact value given; since the receiver's range covers three times the frequency range of the upper broadcast band, its tuning arrangement should be a sufficient control, after the converter has been adjusted with due regard to local reception conditions and interference, both on the broadcast band and above it.*

not be exactly to the frequency specified, so long as it is kept outside the broadcast band. In order to accomplish this, set the converter in operation but do not connect it to the antenna of the broadcast receiver. Then tune in some station near the long-wave limit of the broadcast receiver—WMCA at 570 k.c. is convenient for those located in New York City—and run a piece of wire from the antenna over to the converter. Place this bit of wire quite close to the oscillator winding, but do not connect it directly to the latter. Adjust the oscillator tuning until it interferes with the received signal. It will now be tuned to the approximate long-wave limit of broadcast assignments, and a slight further increase in the tuning capacity will place the oscillator frequency beyond the broadcast band. Aside from other considerations, it is necessary to keep the oscillator frequency outside the broadcast band, in order to avoid any possibility of causing interference in neighboring receivers.

Now, to turn to the physical characteristics of the unit we note one marked difference between this oscillator—a "Dynatron" circuit—and that employed in the usual superheterodyne receiver or converter. In the dynatron mode of operation, the screen-grid tube V1 is supplied with a screen-grid potential *greater* than its plate potential. In this voltage relationship, the tube becomes a "negative-resistance" device; that is to say, the plate current decreases with an increase in plate voltage. The natural negative resistance of the tube counteracts the resistance of the tuned circuit, and sustained oscillation results without the necessity for feedback by means of separate windings in the grid and plate circuits. This gives a remarkably stable oscillator which retains its adjusted frequency over long periods. (See Data Sheet No. 36 [Kennedy, Model 826B], in the February, 1931, issue of RADIO-CRAFT; wherein this type of oscillator—though working on a different principle—is used.)

The various voltages for the two '24 tubes employed are obtained by means of separate voltage dividers in each circuit as shown in Fig. 1. Since it is not advisable to take the "B" supply from the broadcast receiver, the experimenter may use "B" batteries or a small eliminator. Alternating current for the heaters is obtained from a small transformer T1 with a single 2.5-volt secondary.

In operation the coupling between the various windings should be as loose as possible—particularly between the oscillator and the tuning inductances. After alignment the tuning condensers (C1, C2) on some local station, such as a radio compass or airport, the search for the foreign broadcasters may begin. This is done by moving the C1-C2 dial of the converter very slowly across its range with one hand, while the other hand searches the range of the broadcast receiver. Needless to say, the antenna lead from the broadcast receiver to the converter should be as short as possible, t avoid pick-up from strong local stations within the broadcast band.

Values are given in Fig. 1; the coils used are Pacent duo-lateral (honeycomb) L1 and L2 having each 200 turns, and L4 75 turns. Each L3 is a Hammarlund 85-millihenry R.F. choke.

C1 and C2 are a Blan two-gang .0005-mf. bathtub condenser; a large capacity is needed for the long waves: C2A and the shunt across the oscillator fixed capacity are two Pilot 100-mmf. midgets. T1 is a Silver-Marshall "247" transformer, of which only the 2.5-volt secondary is used. V1 and V2 were UY-224 Radiotrons, in Pilot five-prong sockets.

(*Continued on page 635*)

## LONG-WAVE EUROPEAN BROADCAST STATIONS

| *Kilocycles Frequency* | *Meters Wavelength* | *Location* | *Watts Rating* |
|---|---|---|---|
| 153 | 1961 | Angora (Ankara) Turkey | 2,000 |
| 155 | 1935 | Kovno (Kaunas) Lithuania | 7,000 |
| 160 | 1875 | Huizen (sometimes announces "Hilversum"), Holland | *8,500 |
| 167 | 1796 | Lahti (relays Helsinki [Helsingfors]) Finland | *54,000 |
| 174 | 1725 | Paris ("Radio Paris") France | *17,000 |
| 183.5 | 1635 | Konigswusterhausen (Zeesen or Berlin) Germany | *35,000 |
| 193 | 1554 | Daventry ("5XX"—"National"—programs from London) England | *35,000 |
| 202.5 | 1481 | Moscow (RA1—"Komintern") U.S.S.R. (Russia) | 40,000 |
| 207.5 | 1446 | Paris ("FL" Eiffel Tower) France | *15,000 |
| 212.5 | 1411 | Warsaw, Poland | 160,000 |
| 222.2 | 1350 | Tunis ("Kasbah") Tunisia, French No. Africa | 500 |
| 222.5 | 1348 | Motala (relays Stockholm) Sweden | *40,000 |
| 230.6 | 1304 | Moscow ("Trades Unions"), U.S.S.R. (Russia) | 75,000 |
| 250 | 1200 | Kharkov ("RV4"), U.S.S.R. (Russia) | 25,000 |
| 250 | 1200 | Istanbul (Constantinople) Turkey | 5,000 |
| 250 | 1200 | Boden, Sweden | *750 |
| 260 | 1153 | Kalundborg (relays Kobnhavn—Copenhagen), Denmark | *10,000 |
| 268.6 | 1116 | Novosibirsk, U.S.S.R. (Siberia) | [illegible],000 |
| 272 | 1103 | Moscow ("Popoff") U.S.S.R. (Russia) | 40,000 |
| 279.6 | 1073 | Rostov-on-Don, U.S.S.R. (Russia) | 4,000 |
| 283 | 1060 | Oslo, Norway | *75,000 |
| 300 | 1000 | Leningrad, U.S.S.R. (Russia) | 20,000 |
| 320 | 938 | Kharkov, U.S.S.R. (Russia) | |
| 344.8 | 870 | Tiflis, U.S.S.R. (Georgia) | 4,000 |
| 357 | 840 | Nijni Novgorod, U.S.S.R. (Russia) | 1,800 |
| 375 | 800 | Kiev, U.S.S.R. (Russia) | 20,000 |
| 385 | 778 | Petrozavodsk, U.S.S.R. (Russia) | 2,000 |
| 389 | 770 | Ostersund, (relays Sundsvall) Sweden | *750 |
| 395 | 760 | Geneva ("Radio-Geneve") Switzerland | *1,500 |
| 416.6 | 720 | Moscow ("Experimental"), U.S.S.R. (Russia) | 20,000 |
| 428 | 700 | Minsk, U.S.S.R. (Russia) | 4,000 |
| 442 | 680 | Lausanne ("Radio-Lausanne"), Switzerland | 600 |
| 511 | 587 | Hamar (relays Oslo), Norway | 700 |
| 522 | 575 | Ljubljana (Laibach) Jugoslavia | *2,800 |
| 527 | 570 | Freiburg-im-Breisgau (relays Stuttgart), Germany | *300 |
| 530 | 566 | Hannover (relays Hamburg), Germany | *300 |
| 531 | 565 | Smolensk, U.S.S.R. (Russia) | 2,000 |
| 536 | 560 | Augsburg (relays Munich), Germany | 300 |
| 545 | 550 | Budapest, Hungary | *23,000 |

* *Input to Aerial*

NOTE: Few of these stations announce by call letters. England and France are 5 hours ahead of New York; Central Europe, 6 hours; and Russia and Turkey, 7 hours—so that it is useless to listen in the late evening.

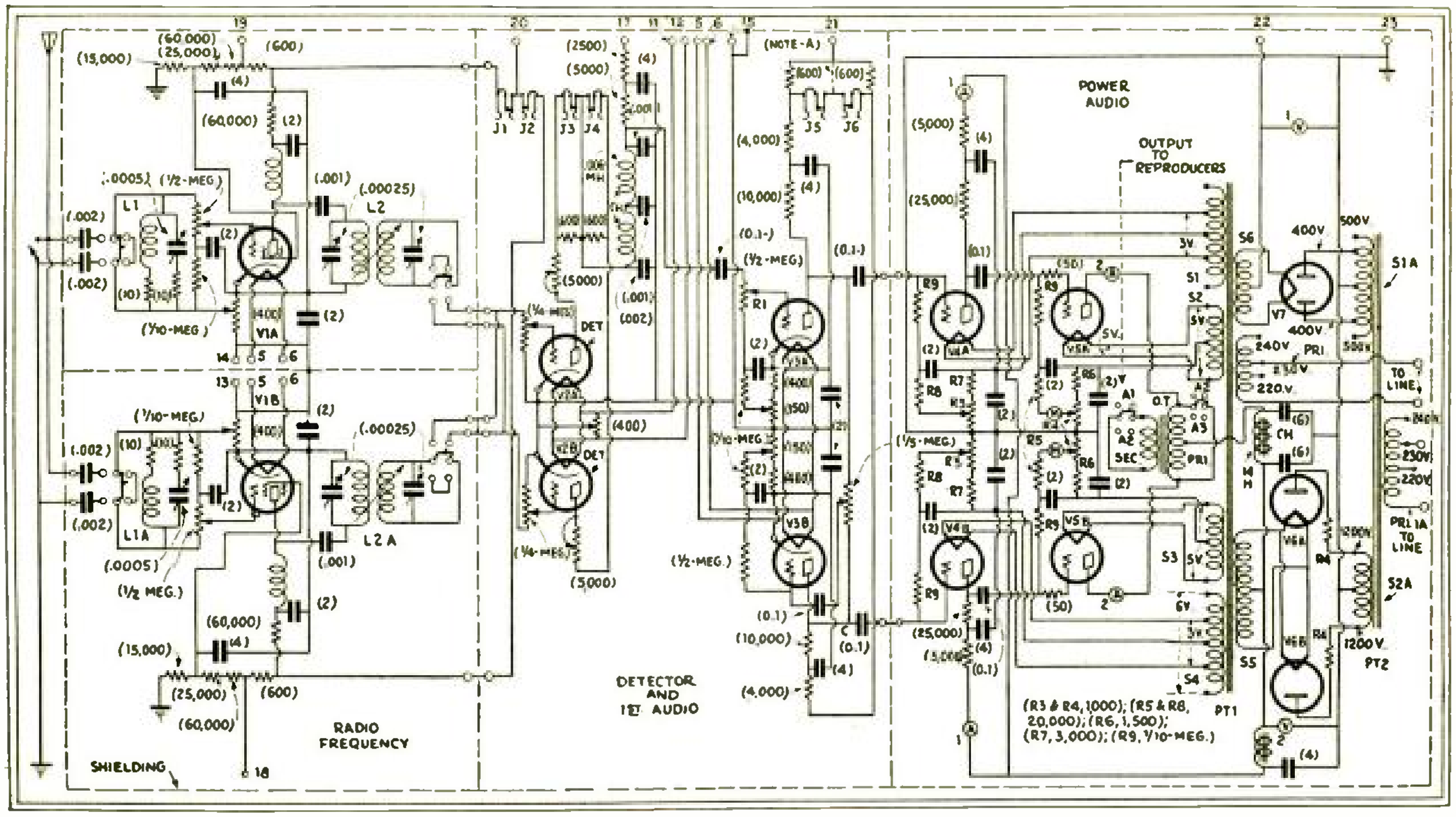



Fig. 1

*This extraordinary arrangement is not as complex as it looks, though the degree of filtering used is very high: a portion of the power connections appears below. "Paraphasing" takes place in the first audio stage, to avoid introducing transformers. The whole is a working exhibit in the Science Museum of South Kensington (London) England; and was designed with the technical advice of the British Broadcasting Co.; tubes are of British types and the design is not fitted for American conditions.*

# A Perfect Quality Demonstration Receiver

IF YOU had a free hand to design, without regard to cost, a receiver that would give perfect reproduction—so far as any human ear could determine—with tremendous output, what would you build? It is probable that the very interesting design which is reproduced above would not occur to you; in fact, under American conditions, it almost certainly would not. But this is the actual circuit which was designed, after consultation with the engineering staff of the British Broadcasting Company, and which was installed in the Science Museum of South Kensington (London), England.

For the purpose of filling the museum's auditorium with reproduced programs, the receiver is arranged to work into a dynamic unit, connected to a straight exponential horn, 27 feet long, the bell of which is built into the wall of the room, from the outside. The horn itself was made of lead-covered sheet iron, covered with pitch and felt, to prevent any resonance of its own.

Since the primary purpose of the receiver is to reproduce the local transmissions of the two Brookman's Park stations, which afford a Londoner his choice of "national" and "regional" programs, two tuned circuits were provided, and a pair of switches choose between them. The transmissions are well separated—842 and 1,148 kilocycles; and the ten-kilocycle band selectors coupling the R. F. stage are (or should be) sufficient to keep out foreigners and other British stations which, after all, are on the same programs. While the amplification of the receiver is doubtless enough to pick up many of the more powerful continental stations, this is not its purpose.

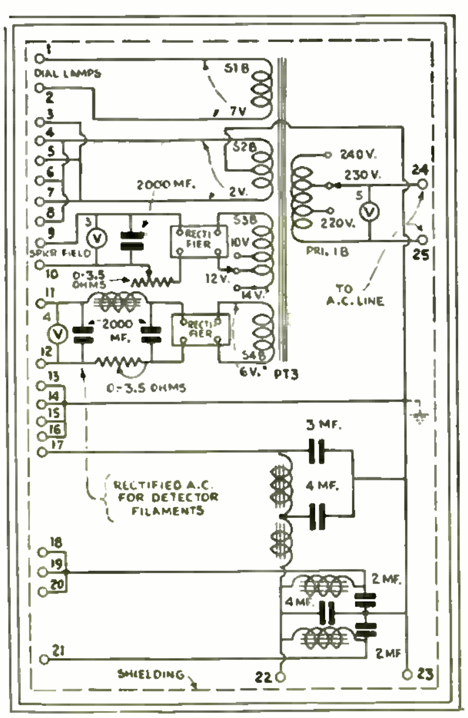



Fig. 2

*The terminals connect to those correspondingly numbered in the large schematic diagram.*

### Extraordinary Fidelity

While the R.F. amplification, therefore, is much less than that of an ordinary American commercial set of late design, this receiver is designed for fidelity to the highest degree. The characteristic curve of its performance shows an amplification which is constant, from 9,000 to 300 cycles, within a single decibel; and which falls off from the 1,000-cycle standard less than two db. at the lowest point—around 60 cycles. However, it is necessary to use an output filter to compensate for the characteristics of the horn itself. The receiver, operated considerably below the ratings of its last tubes, therefore gives reproduction of perfect fidelity, with 40 watts undistorted output.

While the set is operated from alternating-current mains, the most elaborate filter systems are employed to isolate different circuits and prevent hum. An automatic switch is arranged to put the receiver on and off at predetermined times; it has a relay which turns on the filaments of the tubes, and permits them to heat, before plate voltage is applied.

It will be seen that every stage is double; though only one R.F. amplifier is used at a time, since one is tuned to longer waves, and the other to shorter. But the push-pull detector, with its highly-filtered plate leads, is novel for broadcast reception, at least (see page 476 of February, 1931, RADIO-CRAFT); and the "paraphase" system of

(Continued on page 633)

# Home-Made Intermediates for Supers

***A method of neutralizing these important components which will be of interest to all constructors who can match their circuits***

**By JOHN OSTLUND**

SOME years ago, when I first started to work with superheterodynes, I supposed that the intermediate-frequency transformers had to be made to peak at about 10,000 meters (30 kilocycles) in order to get good amplification and stable performance.

It did not take long, however, to find that the closeness of the two settings on the oscillator dial made this undesirable. Everyone, who is familiar with these low-frequency intermediates, knows how marked that effect is.

It was, however, easy to remedy this by using an intermediate frequency so high that the two settings are sufficiently separated to enable the R. F. tuning to eliminate the undesired signal.

Other shortcomings of the superheterodyne, however, were not so easy to remedy; at least, they seemed difficult at the time. One was that, although the set may be selective on a loop, it is exceedingly broad when ordinary aerial and ground are used.

However, I have been working for a long time on the development of a receiver which will use any antenna system. Instead of the potentiometer, I use a fixed "C" bias, with a control in the plate lead for regulation of voltage and volume. Squeal and radiation are quite eliminated.

My system is to use intermediates with both primaries and secondaries tuned, but with neutralization to prevent oscillation. I also neutralize the first tuned R.F. stage. The result is a receiver which is easy to handle, and gives distance, volume and good tone with a proper audio amplifier. For ordinary room volume, one stage of audio is sufficient.

It is possible to construct the I.F. transformers in any of several ways; that I employ is to use three discs, 2 inches in diameter, the inner 1/16-inch thick, and the outer ones 1/8-inch thick, for convenience in counter-sinking the screws; with two others 1 inch in diameter and 1/4-inch thick.

These are then assembled on a 1/4-inch rod or bolt, as shown (Fig. 1) so that there is a form with two slots for windings. Two smaller holes, bored on either side of the center, serve to fasten the whole more tightly.

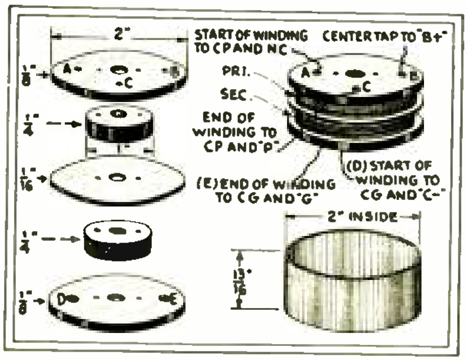



**Fig. 1**

*The very compact construction of these I.F. transformers is explained in the text.*

It is easy to make a coil winder by bending a 1/4-inch rod for a crank. Thread the longer end of the rod so that a nut may be run over it to hold the transformer; a couple of uprights on a piece of board hold the rod while it is turned.

I countersink the two outer discs for small screws, to which soldering lugs for securing the wire are attached by the nuts on the outer side. Then I wind on 84 feet of No. 32 D.C.C. wire in each groove, tapping one winding in the center. Since it is hard to wind the wire in regular layers, I measure it instead of counting the turns; and I like to take all the wire from the same spool, to be sure that it is of the same size.

The center tap (on the primary) will lead to "B+"; the inside or start to the tuning and the neutralizing condensers CP and NC; and the outside lead to the tuning condensers CP and the tube plates. On the secondary, the inside lead will run to the grid tuning condenser CG and the 4½-volt "C" battery lead; the outside lead to the tuning condenser CG and the tube grid. Two-inch bakelite tubing, cut to the right size, will fit nicely over the transformer.

I used Hammarlund 35-mmf. midgets for neutralizing at NC, because they fit nicely to the grid posts of the tube sockets. For tuning, Pilot "Micrograds," with a range from .0001- to .0005-mf., are suitable at CP and CG, as they will compensate readily for differences in the coils. If it were not for the differences of inductance and capacity in the coils, smaller condensers, even as low as 70 mmf., might be used; however, this might necessitate lengthening the wire.

The tuning condensers are fastened to the shields; though smaller components might be attached to the transformers. Individual S.-M. shields are used for these stages. It may not be necessary to shield each stage of the receiver separately, if proper spacing and position is employed; but the whole chassis must be well spaced.

It is very easy to neutralize the intermediate amplifier. Just tune in a strong signal (or use a modulated oscillator); take

(*Continued on page 634*)

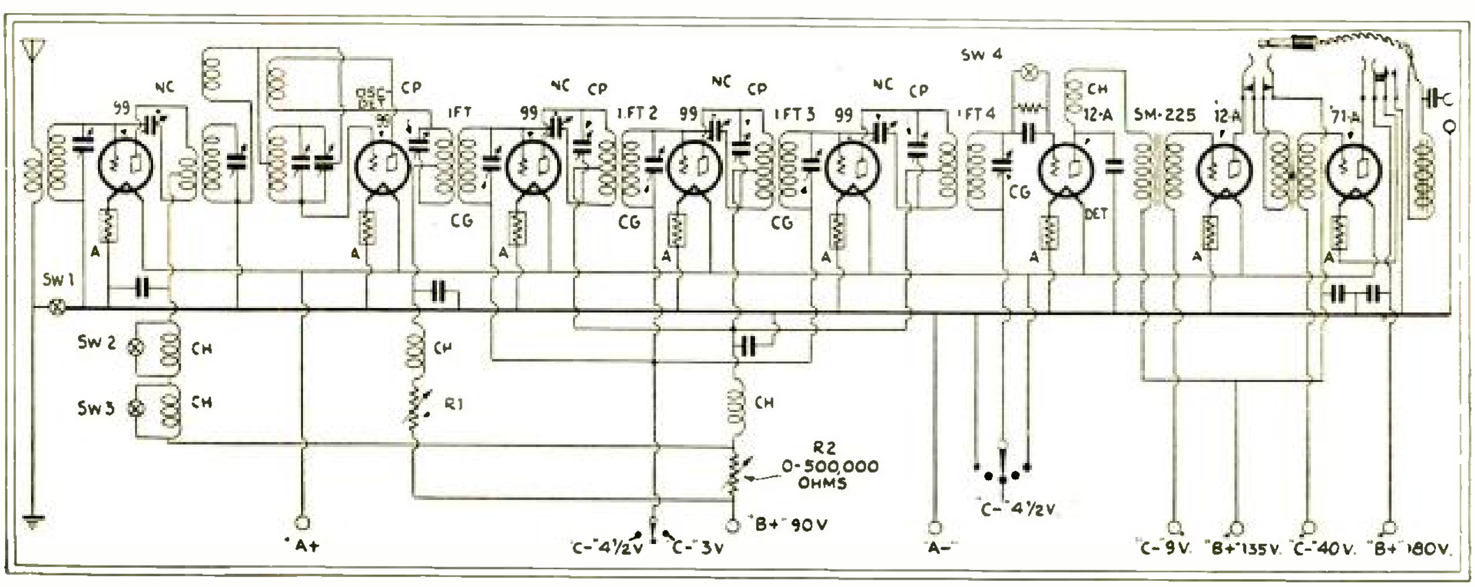
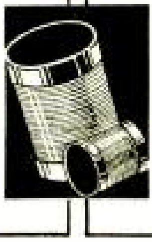
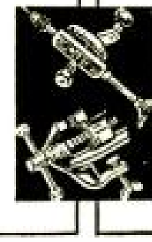



**Fig. 2**

*One of Mr. Ostlund's experimental models, designed for plug-in coils; the switches Sw2 and Sw3 select the proper R.F. choke for the waveband used. The frequency-changer is a strobodyne; a receiver of this kind should be attempted only by a set-builder with much experience.*



# RADIO CRAFT KINKS



## TEST PANELS AND PRODS

**By Luther C. Welden**

NOT long ago, battery kit-sets were put on the market with drilled front and sub-panels, some 30 inches long. These are now out of date, and the panels can be bought of some salvage stock houses very cheap. By using one of these panels, an efficient test panel can be built without a great outlay of money, especially if a few meters are on hand.

That the panels are drilled does not matter since, with a little care in arranging the meters and switches, etc., these holes may be used or hidden. A tube tester may be included; also an inexpensive ohmmeter for continuity testing. By using Fahnestock clips at the bottom for antenna, ground, and battery connections, a receiver may be quickly "hooked up" for test.

The panel may be set away from the "back board" of the workbench by using 2-inch pieces of bakelite or fibre tubing and long screws. Phone-tip jacks may be used at the meters and elsewhere for outside use through flexible leads and test prods.

Good test prods may be made by taking No. 8 insulated wire, (used on light and power lines) and cutting it into the desired lengths; leaving the insulation on except for about ½-inch at each end. One end is filed to a point, to the other are soldered the flexible leads and then taped.

Another way is to use hollow bakelite rods of proper length, through which you may pass a No. 12 or 14 insulated light wire. File the tips and connect as the above.

## TUBE-BASE TICKLER COIL

**By Louis E. Fay**

IN winding tube-base coils for 80 meters or above, it is impossible to wind both secondary and tickler on the outside. A method that I use is to wind the tickler on an old V 199 base instead of the usual jumble wound coil.

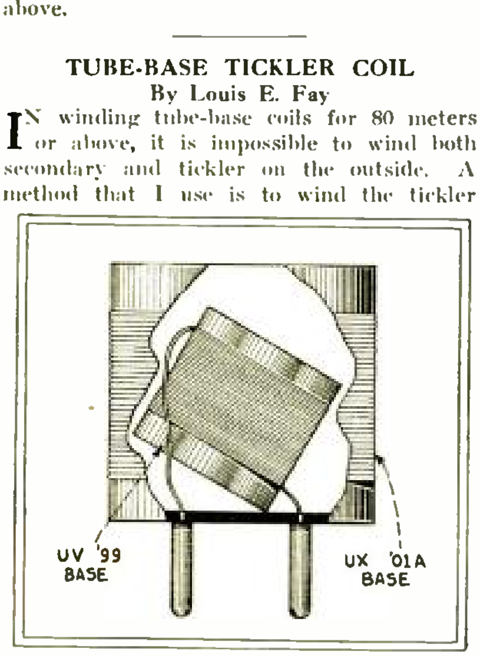



**Fig. 1**

*A tickler for a UX tube-base coil, with fixed coupling, is obtained with a smaller (UV) base.*

Wind the secondary on the X base as usual. Then take an old V 199 and remove the tube, contacts, and pin. This base will fit inside the large X base nicely. Wind the approximate number of turns on the V 199 base and solder leads to X base contacts. Then vary either number of turns or coupling until proper regeneration is obtained. Then pour in melted wax or paraffin to hold tickler in place.

## A MOVIE ADDRESS SYSTEM

**By Russell L. Woolley**

A "TALKIE" operator uses the method shown herewith, to make short announcements over his Western Electric sound equipment without cutting into, or breaking the seals of the theatre apparatus. The only equipment needed to do this is a

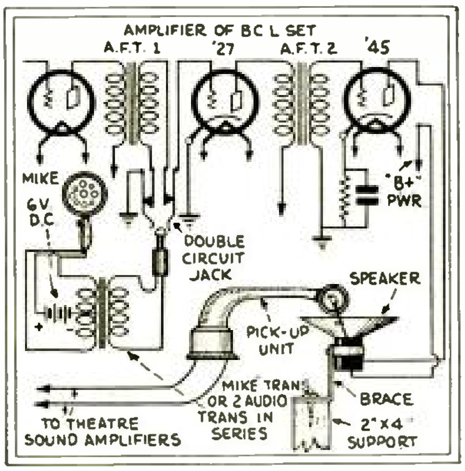



**Fig. 2**

*The mechanical coupling of a pickup to a magnetic speaker gives an input for an audio amplifier.*

portable broadcast set, with a double-circuit jack connected across the grid-circuit of the first audio stage of the receiver; a good "mike," a center-tapped transformer; and four dry-cell batteries. Two old audio transformers, with their windings connected in series, may be used in place of the microphone transformer. The broadcast receiver acts as a speech amplifier; the speaker—a magnetic one—is mounted near the pick-up unit of the "talkie" system. *When it is desired to make an announcement, the needle of the pick-up is centered on the diaphragm of the speaker unit.*

## ADAPTER FOR POLICE BROADCASTS

**By P. L. Pennock**

MANY set owners have asked me, time again, if it were possible to get the short wave broadcasts of the local police stations on their present broadcast receivers. This may be done sometimes, when the receiver is very close to the transmitter,

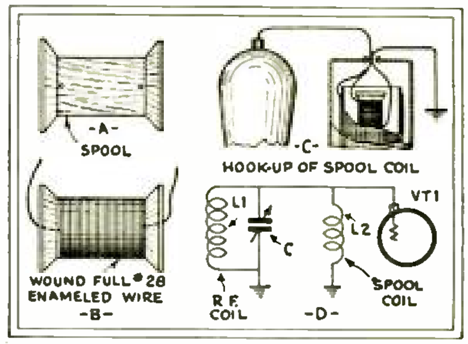



**Fig. 3**

*An additional inductance in shunt across a coil lowers the wavelength, if there is not too much self-capacity.*

which works only a little ways below the broadcast band; but, as a rule, a short-wave converter or adapter will be required. However, the method described here involves practically no cost and very little time; though it is true that the arrangement is not very efficient.

Procure some empty thread spools (of the ordinary type) and, at each end, drill a small hole to the center, just inside the flange. (Fig. 3A). Then insert one end of a No. 28 enamelled wire through this hole, leaving at least three inches for a lead; and wind a layer completely to the other end, passing the lead through the other hole (as at Fig. 3B). One of these inductors will be needed for each tuned R.F. circuit in the broadcast receiver, whether R.F. or detector; but none for the antenna coupler, if it is untuned.

If the receiver has screen-grid stages, lift the cap of the connecting lead from each tube until you can slip a terminal lead, from one of these chokes, under the cap and make an electrical contact with both tube and grid lead. Connect the other lead to some grounded point on the chassis or tube shields (See Fig. 3C) and set the spool on top of the regular coil; do this with each tuned stage. In any stage which does not use a screen-grid tube, the spool is connected between the grid prong of the tube socket and the filament side of the tuned circuit. These terminal wires should be polished with very fine sandpaper, until they will make good metallic contacts.

It will be found, when this has been done, that broadcast stations will tune much higher on the dial; and the short-wave stations on police, amateur, television and experimental waves will have come up among the lower readings of the scale. On a Crosley "42S" located here (*Canton, Ohio*), Louisville, Cincinnati, Akron, Cleveland, Richmond, Youngstown, Detroit and Buffalo have been heard. I would suggest that the local station be expected, but the distant ones merely hoped for.

(*Continued on page 616*)

# The Radio Craftsman's Own Page

*What our experimental readers have found out for themselves*

**Letters concerning hookups asking further details, etc., should be addressed to the writers of these letters, directly**

## A RESISTANCE-COUPLED SET

*Editor,* RADIO-CRAFT:

I have been a reader of this magazine since its birth, and have found no other with so much value to the Service Man and to the experimenter. (I speak in both capacities). I am sending a diagram of the short-wave receiver I have built, because I think it will be useful to some experimenter. I think that it is performing in A1 shape, considering that I use no R.F. or screen-grid tubes. As you see, the amplifier has three resistance-coupled stages; after experimenting with two stages of transformer coupling, one transformer and one resistance stage, etc., I have found that the set works more smoothly, clearly and strongly as shown. With a stage of resistance coupling following the detector, I can control regeneration more easily. The stations slide in smoothly, instead of banging in with a squall, as they did with transformer coupling. I think that, if other short-wave fans will try this, they will find their sets working smoother, and will tune in more stations.

I use a "B" eliminator to supply plate current to the amplifier, and two 45-volt batteries, for the detector supply. The set does not work so smoothly when using the power unit for detector plate voltage. With a '71A in the last stage, very good tone is obtained on a Temple dynamic speaker; on which I receive W2XAF, W8XK, W9XF and VE9CL very loud.

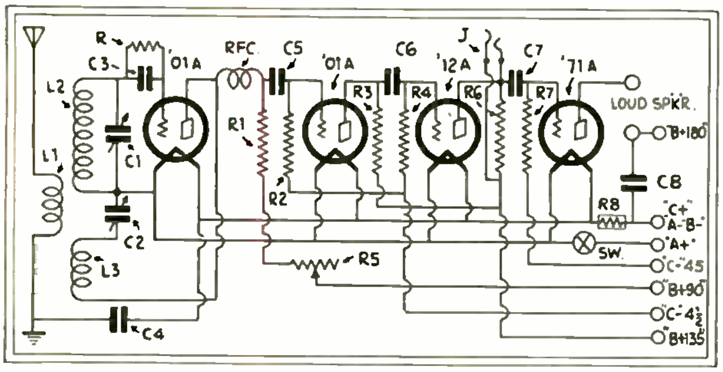
I have 83 short-wave stations logged, in addition to some television stations; letters of verification from PCJ, G5SW, LSX, HRB and XDA; have received GBW, WNC, GBS, WND, CMA, FTF, and some other stations whose calls seem foreign (DFT, LQA, RXC, etc.) but which I have no way of locating. Yours for better short waves.

WAYNE STORCH,
*Beecher, Ill.*

(The values of Mr. Storch's receiver are as follows: coils are wound on three-inch forms with No. 18 wire, spaced its own thickness; the primary L1 has 9 turns in each case. For 25 to 40 meters, L2 has 5 turns, L3 has 3; 40-80 meters, L2, 10, L3, 5; 70-100 meters, L2, 23 turns, L3 6. Secondary and tickler are separated 1/8-inch in each case.

C1 is a 7-plate, C2 an 11-plate instrument (capacities not specified); C3, .00025-mf.; C4, .002-mf.; C5, C6, C7, each .006-mf.; C8, 1 mf. R is 5 megohms; R1, R3, R6, 100,000 ohms; R2, 1 meg.; R4, 1/2-meg.; R7, 1/4-meg., R5 is a 100,000-ohm volume control and R8 is a 1-ohm filament ballast. The jack J is used for tuning in with phones. An aerial of about 50-foot length is used.

While the use of screen-grid R.F. amplifying stages before a short-wave detector may not add as high an amplification factor as in the case of long-wave broadcast receivers, it not only gives greater freedom from troubles due to antenna harmonics, but prevents radiation from the oscillator. As short-wave receivers become more common, the detector coupled into the aerial will doubtless go, as it has done from broadcast-receiver practice.—*Editor.*)




*Here is a standard regenerative short-wave detector, to which is coupled an audio channel giving a very good characteristic. However, in short-wave work, just as in broadcasting, advantages of R.F. amplification are appreciable; especially from screen-grid tubes, working into and out of tuned circuits.*

## AMONG THE "PROS"

*Editor,* RADIO-CRAFT:

It is of interest to read the arguments for and against the "Stenode" which you recently described. It has, in my mind, surpassed the best superheterodyne of today, because of its sharpness of tuning and control, for distance getting and picking up noises. As far as its construction is concerned, it is not, nor can it be, more complicated than some of today's manufactured receivers. The whole is yet in the experimental stage; but I am sure that in three years the whole radio system of today must be rebuilt around it; as the only solution to the crowded conditions of today.

M. J. REEFF,
*Alton, Iowa.*

## A LARGE CONTRACT

*Editor,* RADIO-CRAFT:

I built the "Roll-Your-Own" with a few changes; used Amperites instead of rheostats, .0005-mf. single condensers, and push-pull. The three tuned circuits are in aluminum boxes, the screen-grid tube and coil in a smaller can. For an aerial, I use a five-wire cage, fifty feet long, which I first erected in 1924. For reproducer, I have a large one which I made a couple of years ago from plain airplane cloth; it is 24 inches square and 7 inches deep, mounting a very heavy unit. The tone from this combination is very beautiful and without noises.

I will be glad to try and help out anyone who wants to know more about this super, and also on a good loud speaker.

GUSTAVE SIMMONS,
*228 Wyoming Ave., Billings, Montana.*

(Mr. Simmons, like a good many other open-hearted craftsmen, has an idea that he will receive about three letters. He will probably be rather surprised at the number who are willing to enter into unlimited correspondence with him, and perhaps lose interest at the fiftieth. Incidentally, we may say, the least that any inquirer can do is to enclose a stamped and self-addressed envelope; and to make his questions short, so that they can be quickly answered.—*Editor.*)

## MEASURING SMALL RESISTANCES

*Editor,* RADIO-CRAFT:

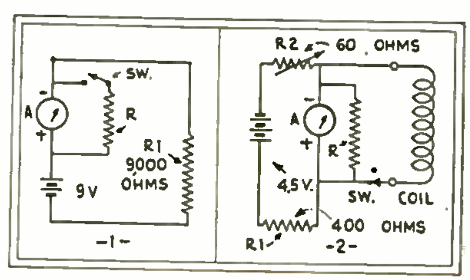
I see some complaints about Mr. Watson Brown's converter from those who could not get it to work well. Well, I was in the same boat; I tried it on a 110-volt A.C. set with a '26 input. No results; I then tried a "B" eliminator and got no results. I then took some "talking tape" aerial ribbon and wound it around every wire; filament leads, "B" leads, aerial and ground. I then mounted the converter and eliminator right alongside of a Crosley "Gembox." Then the fun began; and I must say it has beaten any short-wave set I have yet built.

I am waiting for an article on a super that will give 10-kc. separation in the congested district here; I think there are many other fans who would like to hear more from Mr. Hatry.

Another thing which would come in handy is an ohmmeter with a range from 1 to 5 ohms, to measure shunts for meters and also for dynamic voice coils. RADIO-CRAFT is getting better all the time, and I hope it keeps on till it has all the others put together beat.

CHARLES PRINCE,
*329 Seventh Ave., Astoria, L. I.*

(Ohmmeters and the recalibration of meters have frequently been discussed in RADIO-CRAFT. See page 564, May 1930 issue; page




*Left, a circuit which shows the ratio of the meter's internal resistance to the shunt resistor R. Right, method of measuring a low D.C. resistance.*

177, Sept. 1930; page 266, Nov. 1930; page 482, February, 1931 for a resistance bridge; etc.

In the determination of a shunt for a meter, the meter itself is the calibrating instrument. In the illustration (at 1) the reading of the meter A when the switch Sw is open, divided by its reading when the switch is closed, is the ratio between the two scales. [This assumes that R1 has a resistance so much greater than that of the meter itself that the latter may be neglected, in considering the whole circuit.] From this ratio subtract 1, to determine the ratio between R and the meter's resistance.

For instance, suppose the meter has a resistance of 30 ohms, and a scale of 0-to-1 milliampere; a shunt R is put across it, and the reading drops to 0.25-ma. The ratio of readings is four to one; and it will take four milliamperes through the parallel circuit of A and R to produce a reading of one milliampere on the meter. The ratio of 4, minus 1, gives 3; the meter A has exactly three times the resistance of R, and R is therefore ten ohms.

To prove the calculation, we add the *conductance* of the meter (1 divided by the resistance, as explained in the preceding

(*Continued on page* 616)

# A Home Telegraph and Phone Set

By MILTON E. SAUNDERS

THE hardest part about communication by code is the receiving it; learning to send is comparatively easy, but to understand a message when someone else is sending is another matter. To get the necessary practice, a simple arrangement like that diagrammed here is a valuable assistant. Two circuits, such as are shown in Fig. 1, are connected by a pair of wires. It should be easy to find a neighbor who will be interested in the idea and cooperate.

The features of this system are that a bell on one set can be rung from the other, by means of the double switch; and then, by turning on the set, conversation by phone as well as telegraphic communication is made possible. Voice and code may be transmitted and received, alternately, without changing any controls. The sound of the code messages is just like that of those received out of "the air."

The set-up illustrated herewith was built on the panel of a discarded radio hookup; and covered with black table oilcloth, after new holes had been drilled and the transformer and socket mounted. The panel carries all the parts; it is set into a shallow case, which supports it at the corners.

The "B" supply used is a 12-volt homemade storage battery; but six or eight dry cells would serve as well. This furnishes power for ringing the bell; a heavy-duty battery is not needed, as very little current is required, and for but a short time.

A single earphone is used for the "mike"; being arranged on a suitable support and

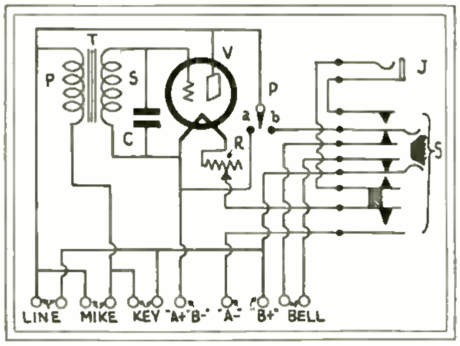



**Fig. 1**

*Circuit of the home practice set, one of which is required at each end of the line; it is simple and easy to operate.*

connected to two nickel-plated binding posts which are designed to receive phone tips.

The switch S was obtained from a second-hand dealer, having come from an old telephone box; however, any D.P.D.T. switch, with an added- make-and-break contact, will serve the purpose. Any suitable junk-box parts may be used for the rest of the outfit.

To operate the set, plug the headphones into the jack J, and connect in the batteries, the bell and the key. Before connecting the "Line" wires, joining this set with its companion at the other end, set the switch-blade P in position *b;* turn the set on, by the switch S and the rheostat R; and see if a buzz results when the key is pressed down. If not, reverse the terminals leading to one winding (either the primary or the secondary) of the transformer T. Connect the single earphone at "Mike" in the diagram, and adjust the pitch of the set's note by varying the rheostat R.

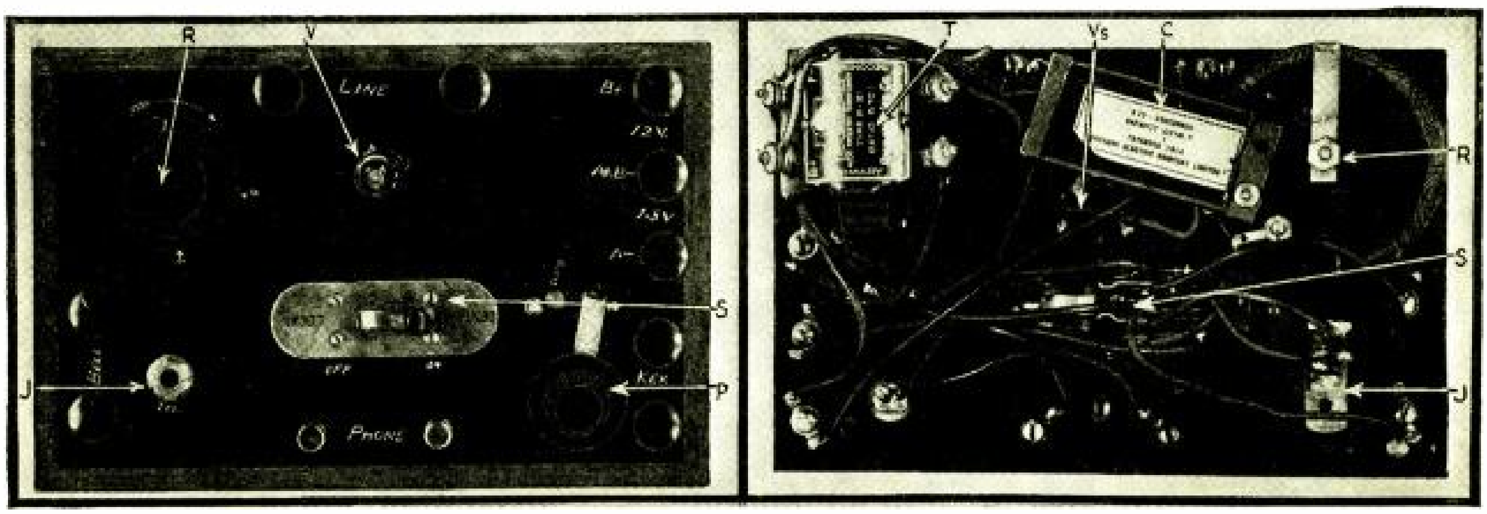
Then, with the "Line" wires connected, and both sets turned off, the bell of either set may be rung from the other by moving the switch-blade P to position *a* for an instant; then return it to *b*. No buzz will result from pressing the key until both sets are turned on.

When leaving the set, turn off the tubes at S; this switch also takes the phones off the line and puts the bell on.

The parts used in the set illustrated are: one A.F. transformer (T), an All-American type "R-21"; a "peanut" tube and socket (V); a rheostat R of suitable value; a fixed condenser (C) of .001-mf. capacity; a switch-blade and two contacts (P); a D.P.D.T. jack switch, with make-and-break (S); phone jack J; and eleven binding posts.

The accessories are, for each set, a bell or buzzer; a microphone (for which a single earphone may be used, as explained above); a pair of headphones; a telegraph key; a $1\frac{1}{2}$-volt dry cell for the "A" supply; and about 12 volts of "B" supply.

(The "peanut" tube is not readily available in the United States; but constructors on this side of the line, who have no Canadian correspondent, may use '99s or, if they are available, '30s, for the purpose. The batteries and the rheostat value required must be determined by the tube used.—*Editor.*)

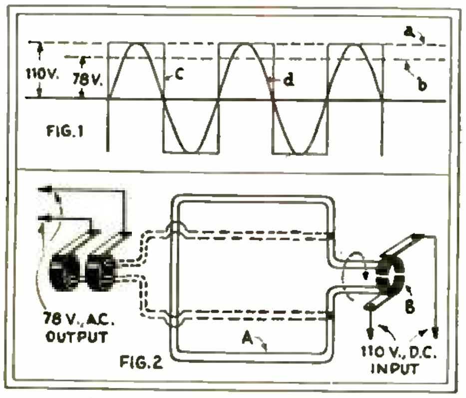



*Left, front view; and, right, the back of the panel salvaged from an old receiver, which mounts the home practice set. The key is mounted on the front, which is normally horizontal, and set into a shallow case; any junk-box parts will serve the purpose. The phone communication will prove an added convenience for students.*

# An Inexpensive D. C.-to-A. C. Converter

By R. W. OSLAND

FOR the last twenty years, it has been the lot of the writer to build special machinery for special purposes. One of the most pleasurable assignments was a recent one which necessitated harking back to almost-forgotten lore on the design of electrical motors, generators, and transformers. Briefly, it was necessary to build a device which would make it possible to operate an A.C. radio set from a D.C. line supply; but the prime requisite was *low construction cost*. The solution to the problem was interesting, simple, effective, and inexpensive.




*Above, "shapes" of currents; below, how an A.C. potential of 78 volts R.M.S. is derived from 110-volt direct current.*

### Selecting the System

The most common method of obtaining alternating current from a direct-current source is to gear an A.C. generator to a D.C. motor.

Although the output of the generator has a *sine-wave* (that is, smoothly variable in amplitude, D, Fig. 1) its output must have a filter in addition to that which follows the rectifier in the radio set. The cost of the three units, motor, generator, filter, was considered to be too great.

The next idea to present itself was an adaptation of the system described in the article, "Obtaining 'B' Power from a Storage Battery," in the July, 1930, issue of RADIO-CRAFT. However, a "square-topped" waveform (C, Fig. 1), is obtained by this means and, with such a high-voltage D.C. source (110 volts), it would require a very expensive filter system. Something else had to be thought of.

The next idea, and the one finally adopted, is made clear by reference to Fig. 2. We find that alternating current may be obtained by revolving a coil of wire placed in a magnetic field; this coil, the armature, is shown in the figure as a single turn of wire A. The action of this construction is reversible; that is, we may turn the armature A and generate alternating current, (the current being drawn off by means of "collector rings"), or apply alternating current to the armature and cause it to turn. In the latter instance, we have produced an A.C. motor.

However, we are interested in a D.C. motor operable from a light line of 110 volts. And, by reversing the connections at the proper instant it is possible to make our single-turn armature rotate as a D.C. motor; or, by rotating this loop (in a magnetic field) with the aid of a separate motor, direct current may be drawn from the circuit-reverser, or "commutator," B.

Having progressed so far the question arose: "Why not make, to work on D.C. a motor provided with connections to the armature terminating in collector rings, so that the A.C. generated as the D.C. motor armature rotates can be drawn off?"; somewhat in the manner illustrated, by means of our single-turn example. In the answer lie the constructional data to follow. For we have found within the direct-current motor a source of alternating current which, having sine-wave form, is easily filtered.

### The Converter's Components

Our equipment, then, would seem to consist of a D.C. motor specially equipped with collector rings and, perhaps, a small filter system. An insect in the ointment, however, is discovered upon recollection that it is not possible to take a direct current of, say, 110 volts, change it into an alternating current of sine-wave form, and still have 110 volts. This is made clear by reference to Fig. 1, which shows the "peak" voltage available at A and the "root-mean-square," or average value obtainable after alternating the polarity of the current, at B. For a peak value of 110 volts, an "R.M.S." potential of 78 volts is obtained. Therefore, we find that either a transformer or an auto-transformer will be needed to step the 78 volts up to 110 (or, 115) volts. The completed set-up is shown in Fig. 3.

The D.C. motor must have a removable shaft; and now comes the dirty work—the shaft must be drilled for nearly its entire length to make a conduit large enough to accommodate two No. 18 cotton-enamelled wires. (See your local machinist.) Refer again to Fig. 3, note that there are two brushes, B; the armature, A (shown, for clarity, as a single turn); field coils, F; and armature segments, S. The two new

(*Continued on page 621*)

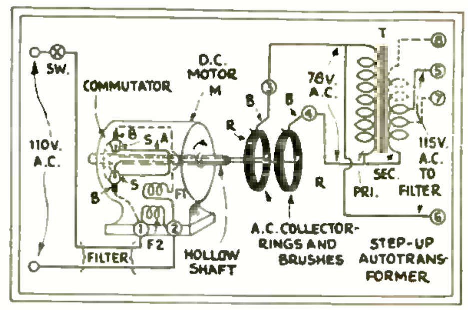



**Fig. 3**

*Interior and exterior connections of a converter. A 15-watt lamp is placed in series with the shunt field of the motor specified, to raise its speed from 1725 to 3600 r.p.m.*

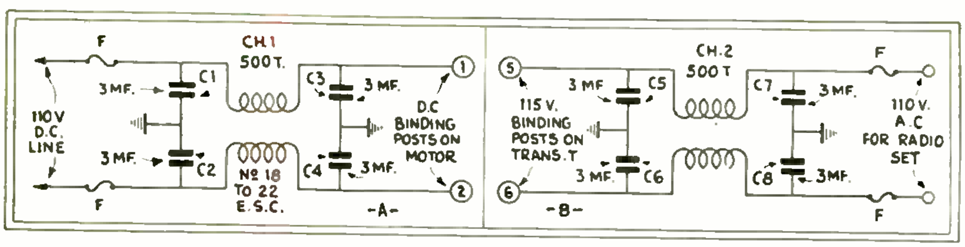
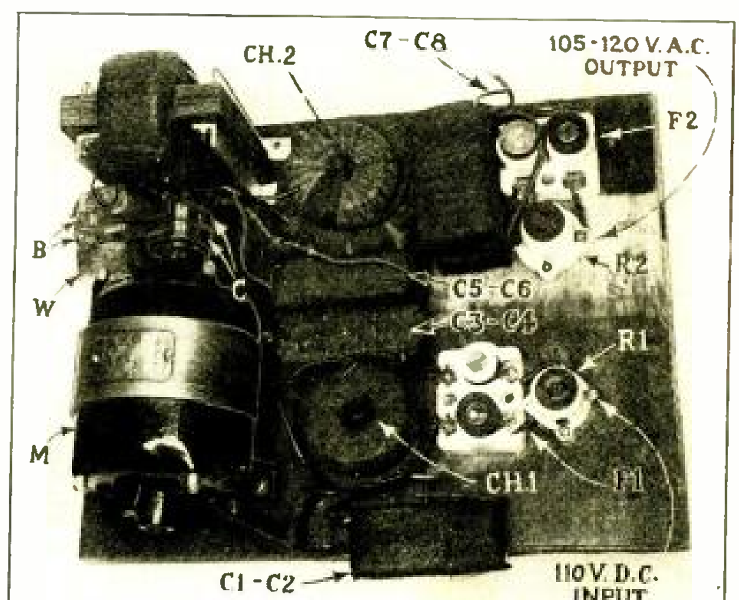



**Fig. 5 (above)**

*Input (A) and output (B) filters: the former may not be needed. The chokes are wound in the same direction, one winding over the other, on an air-core, 1 inch in diameter, 1 inch long; and taped.*

**Fig. A (right)**

*A breadboard model of the converter; a lamp receptacle, not shown, is required for a "Type SD" motor, as explained above. The apparatus need not be shielded, but should be placed at a distance from the receiver, and its leads twisted.*




***SPECIAL NOTICE TO CORRESPONDENTS: Ask as many questions as you like, but please observe these rules:***

*Furnish sufficient information, and draw a careful diagram when needed, to explain your meaning;* use only one side of the paper. *List each question.*

*Those questions which are found to represent the greatest general interest will be published here, to the extent that space permits. At least five weeks must elapse between the receipt of a question and the appearance of its answer here.*

*Replies, magazines, etc., cannot be sent C. O. D.*

*Inquiries can be answered by mail only when accompanied by 25 cents (stamps) for each separate question. Other inquiries should be marked "For Publication," to avoid misunderstanding.*

## HOME-RECORDING "STROBOSCOPE"

(113) Mr. Newton B. Parks, So. Norwalk, Conn.

(Q.) In the article, "Home Recording of Radio Programs and Speech," in the December, 1930 issue of RADIO-CRAFT, the statement is made (page 341), that the "stroboscope" makes possible a satisfactory solution of the problem of maintaining the correct speed of disc rotation for recording and reproduction. How does such a device work; and how can it be made?

(Q.) The stroboscope is a mechanical device which depends for its effectiveness upon the "inertia" of the optic nerve, or, more familiarly, the "persistence of vision." By courtesy of the Marconi Radio Co. of Canada, we are able to reproduce two stroboscope discs; one for use where the lighting circuit alternates at 25 cycles per second; and one for use on 60-cycle installations. These are shown in Fig. Q 113, on page 636.

When discs of this type are rotated at the correct speed by a phonograph turntable, the lines appear to stand still when the disc is illuminated by an electric bulb which is lighted by an A.C. supply of the stated frequency.

## ATTACHING AERIAL TO TREE

(114) Mr. Nelson G. Haas, No. Plainfield, N. J.

(Q.1) Is there a "correct" way of "hanging" an antenna between a house and a tree? It seems those installed without due regard for the swaying of the tree do not stay up very long.

(A.1) A propos of this subject we are privileged to quote some interesting information gleaned from the Davey Tree Expert Co., as follows:

"Where radio antennas are attached to trees, the manner in which the attachment is made may determine whether the tree or part of it will be killed. Too often the antenna is fastened by means of a wire that encircles a branch or perhaps the main trunk. In those cases where the encircling wire is used, no immediate harm will result aside from a certain amount of chafing which may or may not damage the living bark tissue. But, as the trunk or branch grows in diameter, the wire begins to press against the bark. In a relatively short time it becomes deeply imbedded and strangulation results, for the sap that flows in the inner bark is cut off by the wire barrier. The death of the branch or trunk quickly follows.

"To avoid the possibility of injury, the safe method is to use either a lag hook or a pulley with a screw end. These should be attached in the manner shown in the illustration." (Reproduced here as Fig. Q. 114), "using first a bit to make the holes in which threaded attachments are to be turned. The hole bored by the bit should, of course, be a little smaller than the diameter of the lag or screw, in order that the threads will hold firmly.

"The system suggested will not interfere with the life functions or normal growth of trees. It will prevent much of the needless injury that has often been done to fine shade trees in the past."

Certainly this is valuable data for the Service Man who wants his installation to be as good as possible. We might add that it is well to keep the aerial itself about ten feet from the leaves of the tree; this may necessitate the use of an insulator at this distance from the tree end of the antenna. Of the two methods illustrated above, the weight seems preferable; as most springs, through the action of strong winds, gradually lose their elasticity and are then no longer effective.

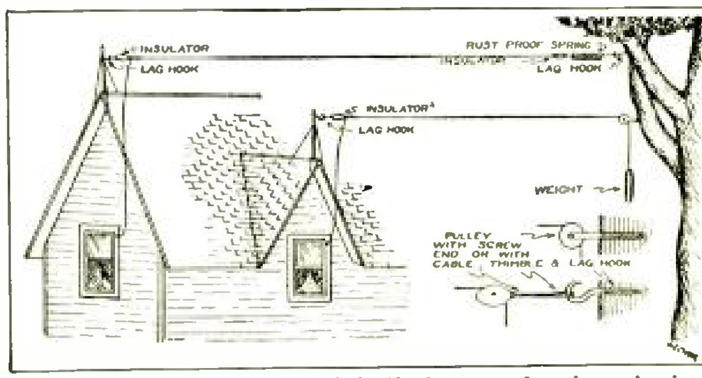



**Fig. Q.114**
*It is much more satisfactory to attach an aerial to a tree by a pulley, as shown, than by winding the wire around the trunk or a limb. Either a spring or a weight may be used to keep the aerial at its proper tension.*

## DAYRAD SERVICE OSCILLATOR

(115) Mr. Manual Smith, Bennington, Okla.

(Q.) Are there any data available on the use of the Dayrad "Type 180" test oscillator; and its circuit connections? What type of tube is used in the 4-prong socket?

(A.) The Dayrad "Type 180" portable test oscillator is a relatively new instrument and there are few service data available in this connection. As shown in the diagram of connections, Fig. Q. 115, a type '30 tube is used as the oscillator.

The procedure to be followed in using this modern service oscillator may be of interest:

First, the black lead of the shielded dummy antenna is connected to the sliding rod just below the unit marked "output control"; the red wire being connected to "ground." (The jack switch marked "550-1,500 kc." and "175-180 kc." should be turned till its pointer is in the former position.) The other end of the dummy antenna is to be connected to the set; the black wire attached to the antenna post and the red wire to the ground. Turning the line switch on now will put the oscillator in operation.

The output meter (Weston "Model 30" type 653) is removable for observation in the most convenient position. The "output meter connector," with its adapter, serves as the connection between the set and the meter. The latter is connected to the receiver by removing the output tube and placing this in the adapter's tube socket; the plug of the adapter is then inserted into the power-tube socket of the set. The two leads from the adapter are connected to posts C and 3 on the output meter; posts 1 and 2 are used if connection is made, where necessary, directly to the voice coil of a dynamic reproducer or a magnetic, respectively.

*(Continued on page 635)*

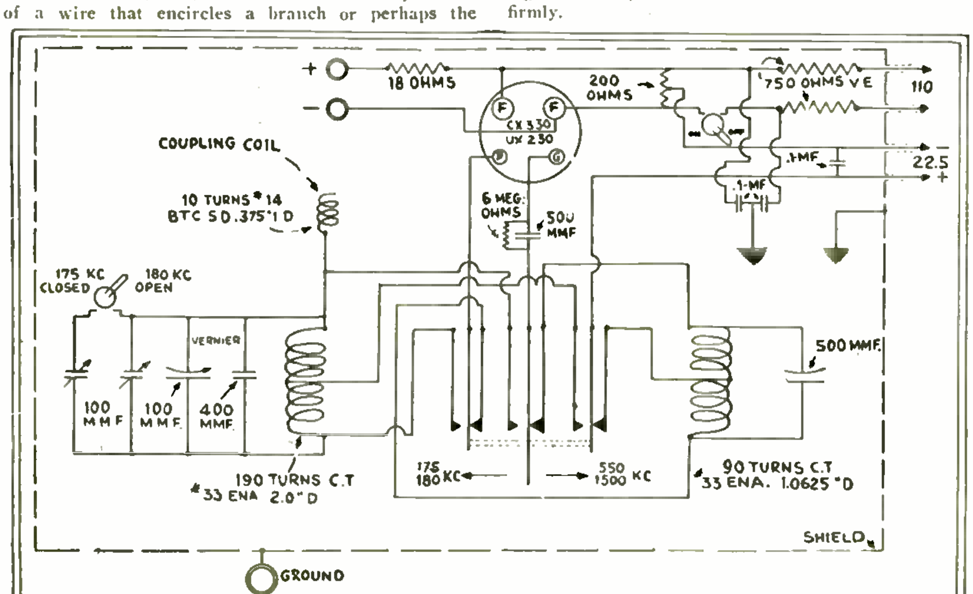



**Fig. Q.115**
*The schematic circuit, with values, of the test oscillator illustrated on page 620, which may be operated from either the light line or batteries. A sliding rod is used to adjust the output until the set receives the proper signal.*

## The Radio Craftsmen

(*Continued from page 612*)

issue) to the conductance of the shunt, to obtain the conductance of the parallel circuit:

$$\frac{1}{30} + \frac{1}{10} = \frac{4}{30}$$

The total conductance of the parallel circuit is four times that of the meter alone; so, while 1.0 milliampere flows through R1, 0.75-ma. is carried by R and 0.25-ma. by the meter A.

However, while we can adjust shunts to any meter in this manner, we do not learn the resistance of the shunt unless we know that of the meter. To find this out by measurement, we must have some precision standards: a source of voltage of known value, a resistor of known value, or another milliammeter of similar precision. With any two factors known, Ohm's law permits us to calculate the third.

Given, however, a meter the resistance of which is known, we may use it as an ohmmeter [as shown at 2] by the rule which has been given above. It may be necessary, however, to use a shunt on our meter to bring up its scale to a point which permits accurate determination of a low resistance, such as that of a voice-coil.

Let us say that we have put across our original meter a shunt (as at 2) of the value of 3 1/3 ohms; the scale of the 30-ohm movement is multiplied by ten. The effective resistance of the parallel circuit of the meter A and its multiplier R is 3 ohms. Putting a $4\frac{1}{2}$-volt battery in series, by means of the 400-ohm resistor R1 and the rheostat R2, we bring up the current through the entire circuit to 10 ma.; we read 1 ma. on the meter's scale. We then close the switch Sw and put the coil in shunt across the milliammeter; the needle of the latter falls back to 0.4 ma.

By our previous rule, the shunted coil has acted as a multiplier to raise the conductivity of the circuit $2\frac{1}{2}$ times (1 divided by 0.4 equals 2.5). Subtracting 1, again, the resistance of the meter and multiplier is 1.5 times that of the coil. The shunted meter had a total resistance of 3 ohms, we know; consequently, that of the coil is 2 ohms.

It will be observed that we have used a resistance (R1-R2) to lessen errors which would be caused by the internal resistance of the battery, and by the internal resistance of the meter. Out of 450 ohms in the series circuit, only 3 are due to the shunted meter, and the error is less than one per cent. No calculation of this kind, of course, is more reliable than the readings of the meter over its scale; and only with a precision instrument can certainty of any such degree be obtained.

We trust that this will be of help to some of our readers. The little table following may be useful. It shows the ratios of the value of the external resistance R to that of the meter [in circuit 1] as the needle drops from full scale [1 ma.] to the given readings, on R being shunted across the meter.

| When Needle of Meter Drops from 1.0 to | Obtain Value of R1 Multiplying Meter's Resistance by |
|---|---|
| 0.95 | 19.00 |
| 0.90 | 9.00 |
| 0.85 | 5.67 |
| 0.80 | 4.00 |
| 0.75 | 3.00 |
| 0.70 | 2.33 |
| 0.65 | 1.86 |
| 0.60 | 1.50 |
| 0.55 | 1.22 |
| 0.50 | 1.00 |
| 0.45 | 0.82 |
| 0.40 | 0.67 |
| 0.35 | 0.54 |
| 0.30 | 0.43 |
| 0.25 | 0.33 |
| 0.20 | 0.25 |
| 0.15 | 0.18 |
| 0.10 | 0.11 |
| 0.05 | 0.05 |
| 0.00 | Short |

For the value of the meter's resistance in the last column, of course, it is necessary with the arrangement of [2] to take the effective value of the parallel circuit A-R which includes both the meter's movement and the last shunt previously used for resistance calibration—that is, in Fig. 1, R is determined by multiplying A alone by the ratio above; but, in Fig. 2, the coil's resistance is found by figuring from the combination of A and R—a resistance less than that of either alone. It will be seen above that a measurement of this kind is most accurate when the value of the external resistance is nearly equal to that of the meter in combination with its multipliers.—*Editor.*)

## Radio-Craft Kinks

(*Continued from page 610*)

(The principle of this kink, shown schematically in Fig. 3D, is that two inductances in parallel with each other have an effective value lower than that of either. Our readers may find other ingenious adaptations of the same principle.—*Editor.*)

### ABSENT TREATMENT

BODY-CAPACITY has been dealt a telling blow by an English experimenter who writes *Popular Wireless*: "If there is trouble about"—his short-wave regenerative detector, obviously—"I tune it, right up, even to squealing point; then, at suitable distance, I set an absorption wavemeter, tune it to cut out the transmission, recline at ease, leave the set alone and then revolve the wavemeter alone."

Another form of "losser" which may interest the short-wave fan who likes to recline at ease while tuning in Hajji Hassan's Hennaed Houris, broadcasting from the Hedjaz.

### BLOW-OUT INSURANCE

IN England, the radio dealer who sells a set on the installment plan, with a year's guarantee, must keep the tubes in working order or replace them, say the courts.

Evidently the law agrees that "the tube is the heart of the set."

## DeLuxe Two-Volter

(*Continued from page 598*)

Three *Silver-Marshall* R.F. shielded coils, type "121" (14, 26, 38);
Seven *Silver-Marshall* R.F. chokes, type "275" (12, 13, 23, 24, 36, 37, 46);
One *Silver-Marshall* illuminated drum dial, type "810-R" (25), with pilot light (73);
One *Electrad* "No. 3 Super-Tonatrol," 50,000-ohm potentiometer type (33);
One *Electrad* "Truvolt" resistor, type "B-250" (70);
One *Electrad* "Truvolt" resistor, type "B-30" (71);
One *Electrad* "Truvolt" resistor, type "C-8," with three extra adjustable taps (72);
Two *Electrad* filament switches (48, 69);
One *Flechtheim* midget condenser, .001-mf., type "M-E" (45);
One *Flechtheim* midget condenser, .006-mf., type "M-J" (47);
Nine *Flechtheim* midget condensers, .01-mf., type "M-K" (6, 10, 11, 17, 21, 22, 30, 34, 35);
Three *Flechtheim* by-pass condensers, 1.0-mf., type "B100" (41, 53, 56);
One *Flechtheim* by-pass condenser, 2-mf., type "B200" (49);
Five *Durham* "Powerohm" metallized resistors, 50,000 ohms, type "M.F.4" with pigtail terminals (7, 18, 29, 42, 52);
One *Durham* "Powerohm" metallized resistor, 40,000 ohms, type "M.F.4" (58);
One *Durham* "Powerohm" metallized resistor, 60,000 ohms, type "M.F.4" (50);
Seven sockets, "UX-type" (8, 19, 31, 43, 59, 54, 60);
Five *Amperites*, "No. 631," with mountings (9, 20, 32, 44, 55);
Two *Amperites*, "No. 630," with mountings (61, 61A);
Four *Muter* or *X-L* midget variable condensers, 3 mmf. to 50 mmf. (5, 16, 28, 40);
One *Thordarson* A.F. transformer, type "R-260" (51);
One *Thordarson* A.F. transformer, push-pull input, type "T-2922" (57);
One *Thordarson* A.F. transformer, push-pull output, type "T-2903" for dynamic reproducer; or type "T-2880" for magnetic reproducers (62);
One *Eveready* "Air-Cell" "A" battery;
Four *Eveready* 45-volt, large size "Layerbilt" "B" batteries, "type 486";
One roll of *Corwico* solid-core hook-up wire;
Eight binding posts (1, 2, 63, 64, 65, 66, 67, 68);
One aluminum sheet, 14- to 16-gauge, size 15 x 20 in.; cut and bent to form the chassis, which measures 10 x 15 x 2½ in. high.
Two *DeForest* "Type 430" tubes (43, 54);
Two *DeForest* "Type 431" tubes (59, 60);
Three *DeForest* "Type 432" tubes (8, 19, 31).

Diagrams of the "DeLuxe 2-Volter" may be obtained by writing to Mr. Cisin, in care of RADIO-CRAFT, and enclosing a 2c stamp.

### WAVELENGTHS FOR THE MOVIES

JUST below the broadcast band, in the region of experiments, the movies have been granted two wave channels, of 1552 and 1556 kilocycles, for use in facilitating the communications necessary during filming expeditions.

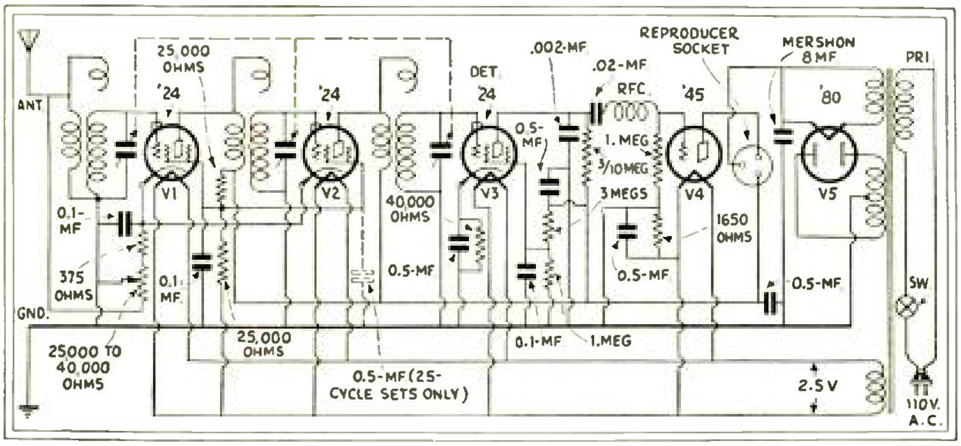



**Fig. 1**
*Circuit of the Crosley "Model 48" or "Wigit" illustrated on page 603; the small coils attached to the primaries are single turns around the grid ends of the secondaries*

# New Radio Devices

*(Continued from page 603)*

## LINE-VOLTAGE CONTROL UNIT

SO far as we are aware, the "Compensator" illustrated in Fig. II is the first device put on the market in such shape as to be adaptable to existing receivers by simple plug connections, while actually adding voltage to the radio set when the line voltage drops. It is manufactured by the Sola Corporation and is manufactured along sound engineering lines.

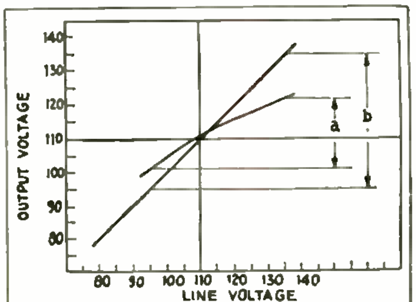



**Fig. 3**
*Input, horizontal; output, vertical.*

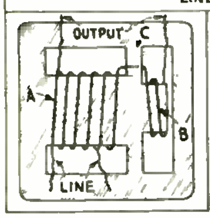



**Fig. 2**
*The "Compensator's" winding is arranged thus on the core.*

The principle of its operation may be comprehended by reference to Fig. 2; the unit operates as a special type of auto-transformer shunted across the A.C. light line (it will not work on D.C. circuits). Referring to Fig. 2, winding A functions as a standard step-up auto-transformer when the line-voltage drops below predetermined limits; this action builds till normal voltage is reached at this point.

Now, the section C of the core functions slightly under the "saturation knee" of the iron's permeability and, when the line-voltage rises, the increase of saturation in the core section C forces a great portion of the flux through the higher-reluctance path B. This causes an auxiliary coil of opposite polarity to counteract the excess voltage; and the unit thereby functions to deliver a smoothly corrected and steady flow of current. Its characteristic is shown in the graph of Fig. 3.

With an input potential of 95 to 135 volts, the Sola "Compensator" has a capacity of 100 watts. Its installation consists of simply inserting the radio set's plug into the "Compensator," and the plug of the latter into the power-supply receptacle. The unit weighs 7¼ lbs. and its dimensions are 3¼ x 4 x 3½ in. deep.

## DUPLEX RADIO OUTLET

THE unit shown in Fig. I is the "No. 2145" radio outlet manufactured by the Arrow-Hart & Hegeman Electric Co. One-half the receptacle is for the power connection of the radio set; the other the antenna and ground connections for the input circuit of the radio receiver.

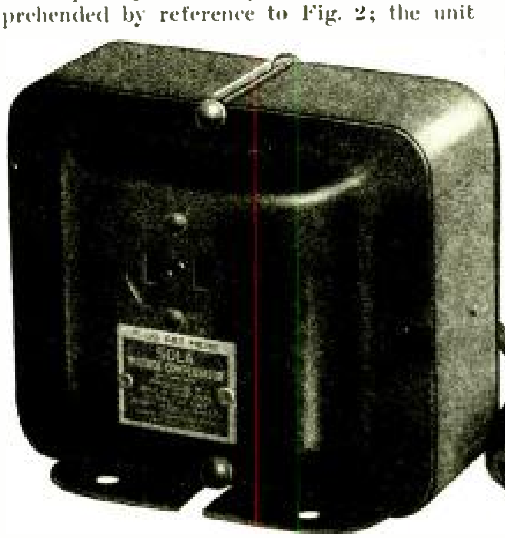



**Fig. I** (above)
*The duplex convenience outlet.*

**Fig. II** (left)
*Appearance of the "Compensator," an automatic line-voltage regulator.*

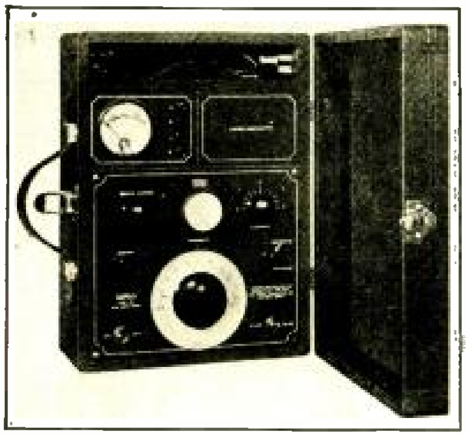


**Fig. J**
*A complete oscillator-meter combination for receiver adjustments and tests.*

It presents a neat appearance, due to the use of moulded bakelite. A scored metal dividing plate renders it quite impossible for one-half the unit to short to the other; the scorings make the plate fit properly in the outlet box. Its mechanical proportions are such as to enable it to be mounted in standard outlet boxes, like other electrical fittings; its design has received the approval of the Underwriters' Laboratories.

This two-gang outlet is clearly lettered "power," "aerial," and "ground." However, nothing is left to human error; a "polarized" plug is furnished as part of the equipment.

## COMPACT SERVICE OSCILLATOR

IN Fig. J is shown the "Dayrad Type 180" test oscillator, developed by the engineers of The Radio Products Co; its design is particularly flexible and compact. Among its attributes may be mentioned its use as, (a) self-modulated broadcast-frequency oscillator; (b) self-modulated intermediate-frequency oscillator; (c) output indicator; comparator; sensitivity-indicator.

It is a portable unit, using the type '30 2-volt-filament tube. The lighting current may be obtained from either two dry cells in series, or a 110-volt light-line. A 17-ohm limiting resistor is required when the "A" supply is a 4-volt storage battery. A Burgess "B" battery, which completes the current supply, connects to two leads in the battery compartment.

Included in the case are a dummy antenna, an output meter connector with adapter, an I.F. amplifier connector, and warranty and registration cards.

## A "TALKING PILLOW"

ALTHOUGH not a new idea, the headphone-equipped pillow recently put on the market by RCA Victor Co., Inc., and shown in Fig. K, has aroused considerable interest by its novel appearance. It is of regulation hospital size, and made of specially selected sponge rubber in which a sensitive radio reproducing unit is concealed. It is so constructed that, although the sound permeates the pillow, it cannot be heard except by resting the head on the pillow.

**Fig. K**
*There is a radio reproducer in this pillow.*

The new pillow may be sterilized like an ordinary pillow, and the pillowcases changed at will. A long cord is supplied to connect the "singing" pillow to the radio output connections.

It was especially designed for use in hospitals, to replace ordinary headphones which become irksome and chafe when worn for any length of time. The use of a loud speaker is not a solution to the problem; since its operation may be disturbing to patients in various stages of illness. It is useful for insomniacs, or to relieve the tedium of long journeys.

## D. C.--A. C. Converter

(*Continued from page 613*)

leads through the shaft connect at one end to collector rings; at the other they connect to armature segments.

If the motor is of the "bi-polar" type, the leads are to be *carefully* soldered to two armature segments diametrically opposite each other, as shown at A, Fig. 4; but, if it is of the "4-pole" type, to four equidistantly-spaced armature segments, as at B. This will result in obtaining approximately 60-cycle A.C., at 78 volts, if the motor has 24 to 28 segments and is a bi-polar unit rotating at about 3,600 r.p.m.; or a 4-pole one rotating at 1,700 to 1,800 r.p.m. The available power output will depend upon the size of the motor; that shown in Fig. A, as M, is rated at 240 watts and delivers sufficient current to operate average 8-and 10-tube electric sets.

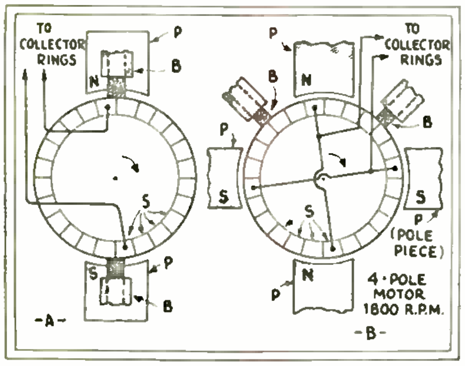



**Fig. 4**

*Collector-ring connections of a bipole motor (3600 r.p.m.) at A; for a 4-pole motor at B.*

The autotransformer used in this installation (T, Fig 3) was made by winding a primary of 400 turns of No. 21 cotton-enamelled copper wire over a form 1⅛ inches square and two inches long. About 72 silicon-steel laminations, 1/65-in. thick, will fit into this space. Over the primary are wound three layers of Empire cloth, and then, in the same direction, the secondary. (The inside end of this secondary is to be connected to the outside of the primary.) The secondary consists of 225 turns of No. 18 cotton-enamelled wire, tapped at the 150th, 175th, 200th, and 225th (outside end) turns; the latter lead bringing the available output potential to 120 volts (or the same value as the lighting service in most sections of New York City). Lengths of "angle-aluminum," drilled and bent into shape, bolt the core laminations together.

### The Filter System

Adequate filtering was obtained by following the construction and wiring details for the input circuit A of the motor, and the output circuit B of the autotransformer as shown in Fig. 5.

Note that four fuses, F, guard the input and output of the D.C.-A.C. converter. The exact values of the filter condensers will vary in every installation. They depend upon the motor used and the efficiency of the construction, and are to be determined by trial. The writer used individual 1-mf. units of the "replacement" type designed for radio service; building up each bank by paralleling the condensers until the correct degree of filtering was obtained. Each bank is to be taped. Whether it is desirable to ground the core of the autotransformer and, perhaps, the motor frame, to reduce hum, is to be determined by trial. The motor must be carefully balanced on a heavy baseboard supported on sponge rubber (such as four bath sponges); since any unbalance may cause hum!

### The Collector Rings and Brushes

The details of the collector rings R are shown in Fig. 6. The exact specifications will vary in each instance. The particular construction followed is shown. The flanges F are screwed to the wood pulleys on which the copper rings R are fastened; and set screws hold the flanges in place on the hollow motor shaft (through which run the two No. 18 leads from the motor segments S to these two collector rings.

The brushes are graphite blocks, having the dimensions shown; they are to be curved slightly on the inside surface to fit closely the curvature of the collector rings. The phosphor-bronze springs holding them in place do so only by friction—they are not otherwise fastened to the graphite brushes. These springs, seven in number for each brush, are 3½ inches long, and are soldered at one end. At this end they are to be drilled for two wood-screws; and then are they to be mounted on top of a wood post W, of the correct height for the particular set-up.

The author will be glad to answer inquiries regarding this inexpensive and effective D.C.-A.C. converter, *provided* return postage is enclosed. Good Luck!

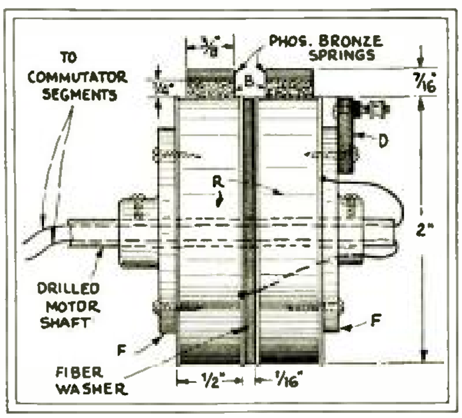



**Fig. 6**

*Details of collector ring and brushes, connection strip D is optional. The dimensions, of course, may be altered to suit the apparatus used*

### Equipment Required

One *General Electric* 115-volt Type SD, compound wound motor, 1,725 r.p.m., (28 segments) 1/6-h.p., 2 amps.;

Twenty-four *Radio Trading Company*, No. 1703 replacement condensers, 1 mf. each;

Two *General Electric* porcelain fuse blocks, F1, F2; and two 2-amp. fuses;

Two *General Electric* porcelain screw-type plug receptacles. R1, R;

Four pounds No. 21 cotton-enamelled copper wire (for filter chokes and autotransformer primary);

One pound No. 18 cotton-enamelled copper, wire (secondary of autotransformer T);

One roll, friction tape, ½-lb. size.

See text for descriptions of the following material; collector rings, core-iron; collector brushes; baseboard.

# The "Universal Super-Wasp"

*(Continued from page 605)*

### Assembly on Rugged Chassis

The "Universal" is a marvelous piece of mechanical engineering, being an exceedingly simple set to assemble in spite of its apparent complexity. The chassis is made of one piece of heavy aluminum, so formed that all the radio-frequency units are on top and the incidental power and audio units underneath.

The general appearance of the completed set, without its cabinet, may be observed in Fig. A, showing John Geloso, (chief engineer of the Pilot Radio and Tube Corporation, to whom the perfection of this versatile switching arrangement is due) and the writer. Mr. Geloso is pointing to the wave-changing knob, the indicating scale of which is mounted on a small disc directly above it. The two tuning condensers are controlled by individual vernier dials of the drum type. On the left side of the chassis is the choke-coil assembly, and just behind it the rectifier tube. On the right side are the three audio tubes.

Behind the tuning condensers is the complete R.F. and detector unit; this is mounted on a tray which slips into a large rectangular opening, cut out in the top of the chassis itself. The construction of this tray, which holds the coil and switch assembly, is made plain in Fig. B, which shows the set with the covers of both the condensers and the coils removed. The entire tray unit is supplied with the coils and switches already assembled in place and wired; since these parts are the heart of the set and the wiring must be done properly.

Fig. C shows the under side of the chassis of a completely-wired set. The arrangement of the parts has been worked out very carefully, all the connections being as short and as direct as possible. All the power units are on the left side, and the audio amplifier units on the right, with the R.F. tray between. The entire tray assembly slips very nicely into place, where it is held by machine screws passing into threaded holes. The worm-gear driving the cam switches is coupled to the control knob on the front of the set by a universal joint; the connecting shaft being plainly visible between the white indicating scales of the variable condensers.

### Ingenuity of Switch Design

A close up of the interesting cam switches is Fig. D. The split bakelite housing, a beautiful example of the die-makers' art, is shaped out in the center to accommodate a bakelite rod on which are mounted thin cams or washers, which are slightly eccentric in shape; only small sections of their periphery protruding beyond the surface of the insulating material. These cams make contact with a series of fifteen tiny plungers which are set in the top half of the housing, like the cylinders of an automobile. As the switch is turned by the worm gears, operated from the front panel, the cams make contact with the plungers; the combinations having been laboriously worked out to connect the double tuning condensers to the four fixed coils in the proper order to give the seven wavelength ranges mentioned. This switch idea is the result of more than a year's experimentation with every imaginable kind of switching device, and is the simplest, most reliable and most efficient scheme yet conceived for the purpose. The capacity between contacts has been reduced to a minimum, and the losses are so slight as to be negligible.

The effectiveness of this switching stunt is simply great. You sit down to the "Universal" and snap on the switch; then you can sweep back and forth from low waves to high waves quickly and comfortably, without wrestling with recalcitrant coils and loose shield cans. If one waveband seems dead, you turn in a second to another; there is always something to be heard, at any time.

The eight coils used in the "Universal" are wound in the factory, assembled in place on the edges of the switch housings, and wired properly to the contacts. The rest of the wiring, to be done by the individual purchaser, is no more complicated than that of an ordinary plug-in coil outfit. The set is a sure-fire outfit, and will work the first time it is turned on. So long as the cams are not disturbed, no trouble will develop, for the sequence of the connections is worked out very thoroughly and exactly.

The following parts values are used in this chassis: C3, C5, C6, C7, C9, 0.2-mf.; C4, .0005-mf.; C8, .00025-mf.; C10, .00004-mf.; C11, .01-mf.; C12, C13, 0.6-mf.; C14, .06-mf.; C15, C16, C17, 1.0-mf.; C18, C19, 3 mf.; C20, 2 mf.; C21, C22, 0-1-mf., buffer condensers. The resistors measure: R1, R2, 450 ohms; R3, R4, R17, 20 ohms; R5, 2 megs.; R6, R8, 2,000 ohms; R7, ½-meg.; R9, R10, 50,000 ohms; R11, R12, R13, R14 comprise the regular voltage divider; R15, output losser; R16, 1,000 ohms. Resistor R10 is the regeneration control.

The "Universal" is available with or without a cabinet. The cabinet that is regularly supplied is a plain, handsome walnut affair, and will not detract from the appearance of any home. It might be said that the advent of this receiver marks the graduation of the short-wave set from the cellar or attic to the respectability of a living-room accessory. It is a really fine broadcast receiver and, though it does not have the sensitivity or knife-like selectivity of regular broadcast sets using multi-stage screen-grid R.F. amplification, it is satisfactory for average home entertainment. It has an excellent audio system, which may be used with a phonograph pick-up, as explained before. It is a set that will produce endless hours of diversion, for the possibilities of the short waves are unlimited. There are many hundreds of stations of different kinds to be listened to, and a new thrill awaits the owner every time he tunes in.

Initially, the "Universal Super-Wasp" will be an all-A.C. job, for various line-voltages between 110 and 240 and for 50-60 cycles only. A battery model is definitely scheduled for production, however, and will be designed to use either '01A type tubes lighted from a storage battery or '30 type tubes on dry cells. The battery set will have all the distinctive features of the A.C. model.

## Tone Control?

(*Continued from page 586*)

remove noise have resulted in the elimination of some of the high frequencies. The sideband limitation has also resulted in the minimization of the upper audio frequencies. The musical instruments within the knowledge of the average individual are those which produce fundamental tones below the upper limits of the normal audio range. The popular type of music, listened to by most people for many years, has been that in which the low tones predominate. The telephone has caused people to comprehend speech despite the absence of the very high audio frequencies, and to appreciate the presence of the low tones. In fact, everything has favored the low tones and the majority of the people are not conscious of the highs.

Whether or not the present form of tone control can be classed as an improvement, is a subject open to discussion. The tone-control system, wherein the amplitude of the upper or lower audio register can be increased or decreased at will, constitutes an improvement. The present-day form of tone control by capacity or capacity-resistance units, was used back in 1925 and 1926, and is therefore not new. It introduces distortion, but it offers the advantage of permitting a change in reproduction to satisfy the desires of that tremendous number of people who prefer low tones and dislike high tones. Certain types of cheese may seem too odoriferous to many people and offend their fine sensibilities while hundreds of thousands find such cheese pleasing to their palates.

(And the moral is, we presume, that the successful cheese merchant makes his profit by furnishing his customers with the flavors and odors which they prefer, without regard to the brands which he puts on his own table. Or, as the old Roman said, *De gustibus non est disputandum*; that is, tastes are not to be disputed about, but satisfied. —*Editor.*)

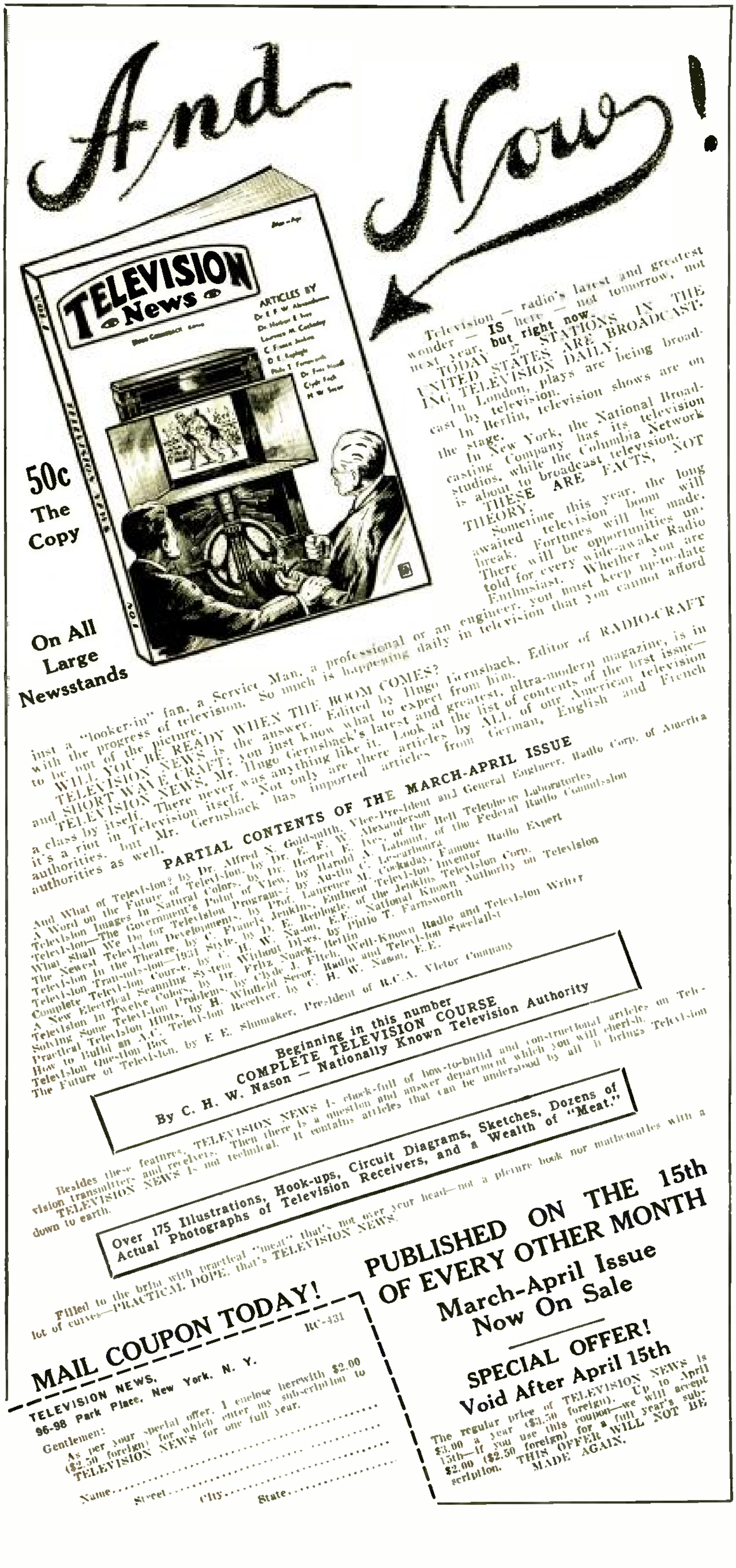
## Operating Notes

(*Continued from page 587*)

usual arrangement; a filter choke is used in each side of the line, in addition to the speaker field, which is in the negative line.

An open 250,000-ohm leak resistor, between the secondary of the last audio transformer and "B—" in the Radiola "66" super, has been found the cause of irregular reproduction; its position is indicated by R in Fig. 3.

In the Victor "RE-45" phono combination model, a hum which is exceedingly difficult to contend with may be encountered. The fact that '26-type tubes are used may furnish the average Service Man with an alibi; however, the hum due to these tubes should be hardly noticeable, and may be considered negligible. The first step is to be sure that every tube is perfect; the '45s or the '27, if of low emission or gassy, will cause a loud hum. The hum balancer should be regulated in the usual manner. Some receivers of this model were released without the by-pass condenser connected across the first filter choke, which appears in the later




product; if this is lacking, it should be supplied (Fig. 4). A capacity of one-half to one microfarad will do. If the hum still persists, examine the phono-radio switch; the two screws holding the fiber washers and the contact springs together may have loosened under vibration. If so, tighten these screws firmly.

Intermittent reception, in Zenith "Models 10, 11 and 12," was formerly very perplexing to some Service Men. One set would work well for some hours and then, seemingly without cause, it would start and stop spasmodically. As soon as it was touched, reception became normal again. For this reason, it seemed impossible to locate the trouble. Every component tested correct; tubes were changed to no avail, condenser plates were checked for alignment, and all bypass condensers were tested for leaks. Bouncing and striking the set would not cause the trouble to reappear; and the trouble continued to be mysterious. Then the chassis was placed on the floor and all wires were pulled, in an effort to locate the loose contact. At last, when a hold was taken on the set to turn it to another position, a Service Man unintentionally laid hold of the blocking condenser of the resistance-coupled stage; and the set began to act spasmodically again.

This condenser is riveted to the chassis; when it was removed, it was found that part of the foil was not completely covered with pitch, and vibration of the chassis would short the condenser. On some sets, while this took place, the reception was only impaired by the shorting of the grid side of the condenser. With the plate side shorted, reception was entirely cut out. The remedy is replacement with an 0.1-mf. condenser, or taping and insulating the original component so that a short cannot occur again. (See Fig. 5).

## Service Men's Notebooks

(*Continued from page 589*)

was, however, a short between high potential and ground, which was traced to the socket of the power tube—one of the subpanel type, universally used by manufacturers. And someone had used acid-solder when replacing a socket which he had deemed defective.

### UNUSUAL INTERFERENCE

**By R. W. Watson**

"INTERFERENCE" noises can be traced to unexpected places. Such was the case with a new Victor which I was called in to service; a terrific noise had suddenly developed in what was usually a very quiet location. A quick preliminary check of the set revealed that the trouble was not in the instrument itself, while a portable superhet very quickly determined that the interference was extremely local. Following the routine indicated by my findings, I began a check of the light bulbs which were burning at the time. The trouble was in almost the first one turned out; it was on the point of burning out and was arcing. A new bulb—and everything was okey.

In an Audiola screen-grid set, which the owner said might operate properly for an indefinite period, but would cut out; the peculiar fact was that it would come on loud and normal when the electric refrigerator in his home switched on. Meter readings of all voltages were taken in my laboratory and tubes were carefully checked; no abnormal condition could be detected. After a minute inspection of each and every piece of apparatus had systematically proceeded to the third R.F. coil, the low-potential end of the secondary winding was found to be entirely severed; the ends of the broken wire were held in place, and in partial contact, by the collodion with which the coil was coated.

The owner of a Zenith set reported that it faded badly, but snapping electric switches in the room might bring it back to normal volume. The fault was found in a defective grid suppressor.

## POLICE SIGNAL INTERFERENCE

By J. R. Steen

I WAS told by a member of the police force, on electrical maintenance duty, that he had a blinker, on a certain corner, which kept a woman awake at night by flashing through her window. I did not see any way to remedy this, if she did not wish to pull down her shade; but he went on to say that other families complained the blinker interfered with their radios.

I tested the motor, with a receiver in the same room: connected a ½-mf. condenser across the make-and-break contacts; connected two 1-mf. condensers across the line in series, with the common terminal to ground; shielded the motor's input leads and the motor. All this decreased the interference only slightly.

A little more experiment showed that a single 1-mf. condenser across the line, *if the condenser leads were not more than about an inch long,* would completely cut out interference from the blinker motor. It was also found that ½-mf. was just as good as the larger capacity across the make-and-break contacts.

## Testing Equipment

(*Continued from page 592*)

struction of the tester. A complete schematic drawing (Fig. 1) and panel layout (Fig. 2) are given. Of particular importance are the exact locations of the toggle switches, which will be described at greater length. The following parts are needed to construct the analyzer: carrying case; panel; 0-1 D.C. milliammeter A; 0-3-15-150 A.C. triple-range voltmeter V; six toggle switches; five S.P. D.T. three-contact toggle switches; necessary resistors (see diagram); a UY socket; UX and UY adapters; ten feet of 6-wire cable; a test plug composed of holder and UY tube base; nine binding posts, test leads, hardware, hookup wire, etc.

As stated before, the toggle switches are the heart of the circuit. Close observance must be given to the panel layout and the schematic diagram, in order to wire the switches in their proper terminals and positions. When all toggle switches are thrown to the left, all the meters are in the "off" or standard position; this is indicated in the diagram as the top position. Throwing the toggles to the right, and in certain combinations with each other, produces the proper circuit connections. When they are thrown in the proper sequence, it is possible to obtain the desired readings.

For example, we wish to test a socket using a '27 tube; for filament voltage, we throw S-1 to the right (that is, the 3-volt meter tap). For plate current indication, we throw S-5 to the right, and then S-4 to the left for the 100-mill. scale, and close S-3. If the tube draws less than 10 mills., then S-4 may be thrown to the right side.

For all plate-current readings, be certain that S-5 is thrown first; for otherwise the full plate voltage will be impressed on the milliammeter and the meter may be seriously damaged. Before making other grid or plate voltage tests, return switches S-3 and S-5 to the left or standard positions; being careful that S-3 is returned first.

To obtain grid-voltage readings, move S-6 to the right; then use S-10 for the 10-volt range or S-11 for 100-volt scale. As cautioned before, return all switches to the "off" position before proceeding with further tests.

For plate- voltage readings, throw either S-8 or S-7; choice depending on whether the 250- or the 500-volt scale, respectively, is required.

For screen-grid voltage tests, throw S-2 to the right and use the plate-voltage switch S-8 for indication. Before inserting a screen-grid tube, open S-9, so that the control grid will not be shorted to the screen-grid.

For continuity and resistance tests, test leads are connected to BP-2 and BP-5. For external milliammeter connections, use BP-1 and BP-8, throwing the milliammeter switches as previously described. In fact, for all external measurements the proper toggles must be put in the correct positions before tests can be made.

External voltage measurements can be made by using BP-5 and BP-6, with grid switch thrown, for 10 and 100 volts. For 250 and 500 volts, throw plate switches, and connect to BP-5 and BP-8. The binding posts for 3 or 15 volts A.C. are BP-3 and BP-7. The A.C. line voltage can be tested by terminals BP-3 and BP-4 which are connected to the 150 A.C. volt range. A flexible wire, with a control-grid cap connector is attached at BP-9, when testing with 224 or 222 tubes.

Remember to throw all switches back to the "off" position before making other tests; and you need not fear burning out the meter. The switch arrangements are only a matter of practice and are soon performed automatically.

The authors have constructed several of these instruments which are now in service, and performing in a very satisfactory manner. Service Men who construct this analyzer will be well pleased with the results.

The values of the parts indicated in Fig. 1 are: R1, 10,000 ohms; R2, 100,000 ohms; R3, 250,000 ohms; R4, 500,000 ohms; R5, 4,500 ohms; R6, shunt for 100-ma. scale (see text) 0.3-ohm; R7, shunt for 10-ma. 3 1/3 ohms; the arrangement of the switches listed is obvious.

The leads represented by the bold black lines in the diagram, which carry heavier current, should be of No. 14, or larger wire.

# Supreme "Model 19" Tube Checker

(*Continued from page* 593)

testing equipment available, and the tubes were tested under actual operation. Through this procedure, fairly definite limits for operative tubes have been made available.

The table reproduced here gives the panel markings for all tubes on which three readings are employed. The first column gives plate current, which is read on the 80-mil. scale of the meter unless the value is less than 8 mils.; in which case the 8-mil. scale button is depressed for a closer reading. If the plate current reading (at zero grid) is not greatly in excess of the first figure shown in the readings on the panel (Col. I), the tube may be classed as operable, if it will conform to the other test reading limits. The plate current with negative bias (about 3V.) is read on the meter when the "Grid Bias" push-button is depressed. If this reading is not *less* than the second figure shown in the markings on the panel (Col. II), the tube under test is operable, provided it conforms to the other two limits.

The third figure shown in the panel readings, opposite the type of tube (Col. III) is the "Change," representing the difference between the "Plate Current" and the "Plate Current with Negative Bias." If this change is not less than the limiting figure given, the tube under test may be classed as operable, provided it conforms to the other two limits.

### A Typical Test

To make the above still clearer, an actual test will be given as an illustration. Suppose that it is desired to test a '24-type screen-grid tube; this is placed in the 5-prong socket, designated for '24, '27, and 481 tubes. The tube checker is connected to any ordinary 50-60 cycle 100-120-volt A.C. power supply, by means of a detachable rubber-covered cable furnished for this purpose. A short connector, with pin plug on one end and control-grid clip on the other, is then plugged into the jack on the panel marked "Cont. Grid," and the clip is fastened to the cap of the tube.

The "On-Off" toggle switch is thrown to the operating position, and the tube is allowed to attain its full working temperature. In order to read the plate current of the screen-grid tube, it is necessary to press the red push-button marked "Screen-Grid—'80." Since the reading obtained is less than 8 mils., the "8-mil. Scale" button is also depressed.

In the case of the tube under test, a reading of 2.6 is obtained. Comparing this with the ideal "Plate Current" reading of 3, it is seen that the obtained reading does not exceed the ideal; and hence the next test is made. This is obtained by holding down both "Screen Grid-'80" and "8-mil. Scale" buttons while depressing the "Grid Test" button. The reading obtained on the tube being checked is 1.3; since this is greater than the second ideal reading, the tube again conforms to requirements.

By subtracting the second reading from the first, we obtain 1.3 as the "Change." Since this is greater than the ideal limiting figure, the tube has conformed to all requirements and is accepted as a satisfactory tube.

| Tube Type | (I) Plate Current | (II) Current with "—" Bias | (III) Change in Current |
|---|---|---|---|
| '01-A | 8.0 | 2.0 | 0.4 |
| '10 | 10.0 | 5.0 | 1.6 |
| '12-A | 14.0 | 4.0 | 1.5 |
| '20 | 6.0 | 3.0 | 0.1 |
| '22 | 3.2 | 1.0 | 0.3 |
| '24 | 3.0 | 0.8 | 1.0 |
| '26 | 8.0 | 3.6 | 1.0 |
| '27 | 8.0 | 3.0 | 1.4 |
| '30 | 6.5 | 2.4 | 0.3 |
| '31 | 13.0 | 5.0 | 0.2 |
| '32 | 3.0 | 1.0 | 0.8 |
| '40 | 1.0 | 0.5 | 0.1 |
| '45 | 24.0 | 12.0 | 1.4 |
| '50 | 26.0 | 12.0 | 1.0 |
| '71-A | 30.0 | 12.0 | 1.0 |
| '99 | 3.0 | 1.0 | 0.1 |
| 182-B | 25.0 | 12.0 | 1.5 |
| 183 | 30.0 | 22.0 | 2.0 |
| 484 | 7.0 | 2.5 | 1.0 |
| | | Second Plate | |
| '80 | 40.0 | 40.0 | |
| '81 | 35.0 | | |

While the foregoing description may seem somewhat involved, the actual performance of the test is simplicity itself and, ordinarily, takes less than a minute to complete. The current is snapped on, the two required readings are taken as soon as the tube is warmed up, comparison is made with the readings stamped on the panel—and the test is finished.

In the case of a '71A or a similar tube, having a comparatively high plate-current reading, the only push-button used is the "Grid Test" button. In testing an '80 type tube, the reading on the meter after the tube reaches operating temperature is the plate current of one plate. The other plate reading is obtained by pressing the "Screen Grid—80" button. The readings of both plates of full-wave rectifiers should not be less than the panel markings "40." This represents a minimum; and higher readings indicate proportionately better - quality tubes. A marked difference between the readings on the two plates may account for hum or distortion; and such tubes should be carefully observed in actual operation.

### The Checker as a Salesman

A number of methods have been suggested and are being used for increasing sales with the tube checker. Among these are free testing of tubes for customers, prominent display of the tester on the counter to create interest and inspire confidence, combination sales-service calls to check up the condition of tubes in use in the customers' home, etc. Many other sales-producing plans are constantly being evolved.

One dealer has adopted the plan of using his "Model 19" to educate his clientele to the fine points of tube purchasing; he displays above his counter a large chart showing the ideal limiting readings contained in the table. When a tube is purchased, the readings obtained on the tube checker are plainly marked on a dated label, which is

pasted on the tube. The customer is then able to check these readings with those on the chart. As a result of this frank method of doing business, this dealer's average weekly tube sales have increased 100 per cent. since the installation of the tube checker. In fact, tube sales in one chain of stores have been so stimulated that the owner is rapidly clearing out his stock of radio sets and specializing on tubes only; and the most prominent display is a tube checker!

The "Model 19" is available in two types: a counter model and a portable model; the latter comes equipped with a lid, carrying handle and detachable cable. The lid is mounted on slip hinges, so that it can be readily removed; hence the portable model can also be used as a counter instrument. The mechanical construction of both types is identical. The "Model 19" checker weighs only 6 pounds; its dimensions are 3¼" x9 7/8" x 6 1/16". It is housed in a selected hardwood walnut-finished case, which is practically indestructible. In the event of accident, this rugged housing offers maximum protection to the instrument assembly.

## Service Man's Forum

(*Continued from page 589*)

find the One, I believe I can prove what seems to be lacking in some of our self-adopted brethren.

I certainly believe in every word Mr. Poli said under "Good Business Methods." Mr. Poli, let's hear more from you.

RADIO-CRAFT is certainly covering a much needed field and I, for one, appreciate its services. May it continue on and on.

NEWBURN C. KEY,
*Rockdaie, Texas.*

### HARD TO SWALLOW

*Editor*, RADIO-CRAFT:

I have just read the February issue, and I would like to say a few words in regards to the letter shown, from The General Motors Corp. First of all, isn't it funny how some of these large corporations try to "hog" everything they can? As soon as I had read the letter and their way of looking at the situation, I came to the conclusion that they were all wet.

Suppose that you wanted a G.M. Radio and nothing else would do. You purchase the set from your local dealer, have it installed, use it for a period of about six or eight months, then trouble develops. You send for the dealer's Service Man. He may do the job, because he had been instructed by the G.M. service book; but, this man may do other things that are to the dislike of the customer (things that I have run across, such as rough handling, and letting tools scratch the cabinet, or the soldering iron may accidently fall upon a nice new rug, all through careless working). No matter how well a man may know his work, I have seen them get careless. Then, right off the "bat," the customer turns "sour" and usually another independent Service Man of good reputation is the next one called. The first thing he will say, if he wants to be truthful, is: "I have no notes on your particular set, as the G.M. Corp. holds on to them." He may say that he will try to locate the trouble, but at a greater expense to the customer than if he were able to go to work on the set with notes for each model and circuit.

Now I do not know whether or not I have taken the right attitude or not; but it is my way of looking at the situation. I started in radio when crystal sets were the "rage," and have always tried to keep up with the newer things in Radio. I am a proud owner of the Official Radio Service Manual; and also a subscriber to the supplements, and a regular reader of RADIO-CRAFT. This magazine certainly has the Service Men at heart, and I know that many of them benefit by your wide variety of articles. This is the first letter that I have written to you because as a rule I try to slam writing letters; but this just stuck in my "Craw," and I thought you might like to hear someone's opinion on the matter.

PAUL W. MEYERS,
*407 Walnut Street*
*Philadelphia, Penna.*

## Hints to Manufacturers

(*Continued from page 603*)

the chassis fits the compartment so tightly, would add very little expense.

DONALD MAXWELL,
*112 Fayette Street,*
*Charleston, W. Va.*

### DESIGNATED SOCKETS

WITH the advent of the multi-stage superheterodyne, additional problems are presented to the Service Man and trouble-shooter in sub-panel endeavors. My hint is for the indication of the tube numbers at the bottom of the socket, as an aid toward rapid work. Moreover, additional help would be given by marking the stages (1RF, Mod., Osc. 2IF, etc.) at the top as well as the bottom of the socket.

FRANK DE MARCO,
*63 Oak Street,*
*Yonkers, N. Y.*

### EASIER CONNECTIONS

MANUFACTURERS of radio parts could make bigger holes in the lugs of rheostats, potentiometers, condensers, etc., so that a nut and bolt can be used, if desired, instead of soldering. If the hole be 11/64", a No. 6 dry-cell terminal can be used as a binding post. I have found this handy in experimental hookups and also of use when servicing. In a "battery-operated" district, facilities for soldering are not always available.

J. E. KITCHIN,
*Alert Bay, B. C., Canada.*

### BATTERY SETS—EXTERNAL AUTOMATIC CONTROL

I SUGGEST that all radio manufacturers tin the ends of the hook-up cables used on battery sets; also that they fasten the instructions, for connecting the batteries inside the set, so that they will not be lost.

That some radio manufacturer put out an automatic volume control which can be connected to any of the sets now in use.

PALMER STADUM,
*Baker, No. Dakota.*

**O**N Page 627 you will find an interesting announcement of the RADIO SERVICE MAN'S HANDY-BOOK *with addenda data sheets.* It takes but a few minutes to read of the full particulars about this new book.

# Recent Tube Design

(*Continued from page 599*)

grid bias higher than is convenient in most receivers, a compromise was effected by the design of the "551," which may be used as a replacement for the '24, with a higher grid bias (15 to 30 volts), obtained as before by the use of a proper resistor value in the cathode return lead. It is estimated that, in a receiver employing automatic or remote volume control, the range of control over the amplification of the received signal will be multiplied by a factor of 25. With such equipment, the use of a "local-distance" switch should be superfluous.

The "551," with a plate voltage of 180 and screen-grid voltage of 90, has normally the same plate resistance and mutual conductance as the '24. Its plate current is about a third higher (5.3 milliamps). It will, however, endure twenty-five times as much signal voltage, before 20% distortion is reached, as the '24; and its "cross-talk" factor, at the maximum, is but 3% of that of the latter tube. The fear that this action, permitting limited emission from the heated cathode, might shorten the life of that element, has been negatived so far in the endurance tests of the tube.

**Direct-From-Line Heating**

In the light-socket type of receiving sets, which has been standard for the past few years, the principal effort has been devoted to obtaining maximum results from the 110-volt, 60-cycle A.C. mains, which serve the majority of customers in the United States. The step-up transformer, supplying plate current through a rectifier, and the step-down transformer, furnishing low-voltage, high-current filaments with unrectified current for heating, have been practically universal. Tubes have been designed for raw A.C. operation on 15, 7½, 5, 3, 2½ and 1½ volts, with different types of connection. However, a large number of prospective electric set owners, whose house-lighting facilities are not always in accordance with the above standard, have profited comparatively little by the advance in receiver design.

For some years, however, one laboratory has been prosecuting researches in the idea of producing tubes for operation from the house current without the intervention of a transformer; and it is now announced by the makers, the Lestein Corporation of America, that three such types are ready for the market, with others to follow. These may be operated from either A.C. or D.C. mains, as the heating effects are practically equivalent.

As in the 2½-volt tubes now so extensively used, the cathode is heated indirectly by a tungsten filament, which is electrically isolated from an oxide-coated cathode. The arrangement of the electrode is, of course, standard—heater, cathode, grid and plate. The filament is wound upon an insulating core in non-inductive fashion to lessen hum. The parts are substantial in formation, and somewhat larger than in the usual tube design (Fig. 3.). While this increases inter-element capacity, it also reduces the plate impedance and increases the mutual conductance; this may be seen by comparing the average values below with those of the standard '12A and 45 tubes:

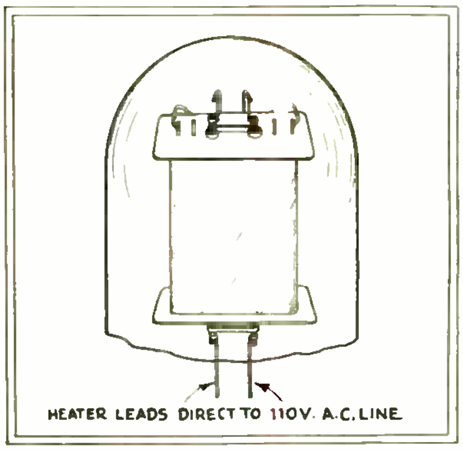



**Fig. 3**

*Appearance of the assembly in a 110-volt tube; there are two heater elements in the center.*

"Type 1012" (general purpose): amplification factor 8.5; plate impedance, 4,000 ohms; mutual conductance 2,000. Undistorted output in milliwatts, at 90 volts, 80; 135 volts, 190; 180 volts, 500.

"Type 1048" (power tube): amplification factor 3.5; mutual conductance from 2,600 to 3,000. The output at 180 volts plate, with a 34.5-volt grid bias, is 1,250 milliwatts; at 250 volts plate, with 50 volts on the grid, it is 2,900.

A full-wave rectifier, also employing an indirectly-heated cathode, is being put in production, and it is stated that a screen-grid tube with a "mu" of 500 (theoretical) and a mutual conductance from 1,500 to 1,800 micromhos, is undergoing laboratory tests. Since the only value to be changed for operation from higher or lower voltages is that of the heater filament, 32- and 220-volt tubes will also be available.

One of the most interesting possibilities, for city dwellers, is that of the development of a receiver operable equally well on D.C. or A.C. light lines supplying 110 volts. With the latter, it would be necessary, of course, to employ a rectifier and filter in the plate voltage lead; but tubes of such high mutual conductance, particularly in the power stage, will readily furnish good output volume. A high line-voltage, in this case, would be an asset.

The tubes described are regularly manufactured with standard UY bases. For the purpose of electrifying battery-model sets, however, the adapter type illustrated in Fig. A is also made, with a four-prong base, and the heater connections at one side. The harness, the insulating sleeves of which appear at one side, affords the necessary connections from the tube to the light socket without disturbing the set's wiring; only one filament prong is connected into the receiver's circuit. Thus any of the tubes (especially the power stage) may be wired for socket operation without disturbing the others.

## A SELENIUM DRY RECTIFIER

THE copper-oxide type introduced by Westinghouse ("Rectox," etc.) is the best known of the dry-metallic rectifiers, used in radio work to obtain direct current from an alternating source. Another, however, which has just been introduced by a German inventor, employs the non-metallic element selenium for the purpose.

As in other dry rectifiers, a stack of compound discs is built up on a central bolt, and compressed by a nut (Fig. 1). Each unit contains two metallic layers between which is deposited a layer of selenium, which has been specially treated until it acquires a crystalline structure; in which state it has high unilateral conductivity.

The units, shown in cross-section in Fig. 1, are flared for greater strength, and to aid in cooling; washers separate them and help to give more uniform tension. The selenium is protected from the air by the metallic covering on each side; and the action of the rectifier will not be weakened by exposure for a considerable time to temperatures up to 212° F. As the temperature rises, so does the resistance, furnishing automatic protection against overload.

Each element will support readily a voltage of 20 without breaking down; but in practice the rectifier is designed for 5 volts on each disc. The discs may be large or small; and the assembly may be wired, like other rectifiers, for half- or full wave rectification. Fig. 2 shows two elements connected to a transformer secondary, for charging a small storage battery. For plate supply and grid bias, it is necessary only to use a sufficient number of elements with the proper filter system.

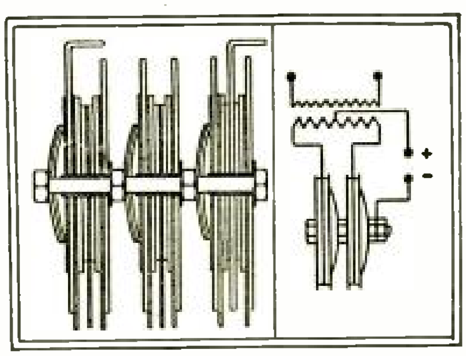


**Fig. 1** **Fig. 2**

*The selenium rectifier is a foreign novelty.*

# Radio Tanks

(*Continued from page 601*)

transmitting channel of far greater width than that needed for the actual relay signals. The complexity of the controls would be greatly increased if it were necessary to train and sight guns by television.

However, for the purposes, say, of tearing down obstacles such as wire, the positions of which were known, or of serving as land torpedoes to convey explosives to designated spots, we may suppose that such machines might readily be made; and that they might be operated over comparatively short ranges, by observers who were able to follow their courses directly. The whole resolves itself, from the military standpoint, into a question of values; in which men are considered as supplies to be expended, and in which their cost may be less than that of complicated machinery, while their ability to function under the most trying conditions is less delicate. At present prices of robots, the soldier is somewhat less expensive, as well as more rugged and versatile.

Certain other problems arise, in the multiplication of radio transmitters which would be required. Modern radio equipment for armies comprises an enormous number of units. A field army concentrates, into a limited area, more transmitters than there are broadcasters in the whole United States. To increase the number, even by the use of ultra-short waves, creates additional problems of interference.

It is true that the ultra-short waves—below five meters—have myriads of channels, and that their interference area is limited. Nevertheless, these waves are so sharply reflected, by the surface of the ground and other obstacles, that they can hardly be received out of the direct line of vision. We may, of course, assume, for each radio tank so controlled, an airplane which would keep it in the focus of a directional guiding beam; but the airplane, so tied down, would be limited in its movements and a target for high-angle artillery fire as well as for speedy combat planes.

### Design of Tank Radio Sets

Nevertheless, radio work is being carried on with tanks and motorized artillery and special services in all armies, including our own. We are enabled to present, by courtesy of the Signal Corps of the U. S. Army, pictures of the equipment which it has designed for work in tanks.

As to the apparatus itself, technical details of the circuits have not been released, though the radio man may quickly guess a few of the more evident points. The equipment shown is subjected to what is, perhaps, the severest test which any radio material will undergo in actual service. We may compare conditions to those of a transmitter and receiver which are being operated while being rolled from the top of a staircase to the bottom and back. The containers are heavily cushioned with rubber on the outside to take up the successive shocks, which are violent even where a tank has smooth going.

The wavelength range covered is not stated; but it is probable that more than one short-wave band may be used. It is not customary to equip every tank with a transmitter, since they usually move in fleets or squadrons under united command, when employed in maneuvers or action.

The shortness of the flexible aerial, protruding from the turret's cap in the first picture, indicates a wave possibly around ten meters (it is stated that the British army uses approximately an eight-meter wavelength in recent equipment).

The tank is, by its nature, completely shielded; so that an external aerial is needed, while the body of the machine serves as a counterpoise or ground. The aerial is made flexible, so that it will not be broken or swept away by obstacles overhead. Long-range reception is not necessary, or even desirable, since most of the signalling is intended only for the unit under one command.

An interesting feature of the apparatus shown is that it serves also for phone communication between different compartments of the tank where, it may be imagined, a high volume of sound is necessary to make itself heard above the continual banging, jarring and crashing attendant on operation under even the most favorable circumstances.

## Perfect Quality

(*Continued from page* 608)

amplification, used in the audio channel, produces an effect similar to push-pull in each stage.

The receiver itself presents little similarity to the ordinary home radio apparatus in appearance; though it is not unlike the installations used with the power-amplifier public-address systems here. The entire apparatus is mounted in a large, high metal rack, fitted with shields, which serves also for protection against the high voltages developed; and it is fitted with automatic safety switches. Any unit may be removed for adjustment. A separate rectifier is provided for the power stages, which take the high-voltage output of two half-wave mercury-vapor tubes. The set is fused, in about twenty leads; and flexible metal tubing shields the wiring thoroughly.

### The Circuit Itself

The receiver and the power supply themselves are shown in Fig. 1; for convenience, and to avoid a maze of lines, the intermediate connections are shown in Fig. 2. Though the whole is far from simple, it is not so complicated, after all, as the reader's first impression. Let us analyze it:

At first glance, this circuit will seem to consist of nothing but tubes, resistors, and condensers. Some of these components are coupling units; but most of them are used for filtering. Each filter resistor is by-passed by a fixed condenser of the correct value to meet engineers' specifications.

If the reader will carefully examine the diagram, it will soon be found that the circuit resolves itself into no more than a receiver incorporating a single stage of screen-grid R.F. amplification (tubes V1A and V1B) and a detector circuit (tubes V2A and V2B), followed by three stages of resistance-capacity coupled A.F. amplification. The first of these uses tubes with a "mu" of 10 (V3A, V3B), followed by a stage of low-gain amplification using 10-watt tubes (V4A, V4B), and a power stage comprising two high-power (75-watt) tubes. The last have a "mu" of 5, and require a plate potential of 1,000 volts (tubes V5A and V5B).

### Methods of Checking

The plate current to V1A may be checked by plugging a milliammeter into the jack J1, and noting the reading as the 400-ohm cathode bias potentiometer is adjusted; the performance is repeated for tube V1B, jack J2 then being called into service. The two grid-circuit potentiometers control the inputs of these tubes, to prevent overload due to the great strength of the locals.

A similar balancing procedure may be followed for the detector tubes V2A and V2B. Jacks J3 and J4 indicate currents, as determined by the settings of the plate circuit's variable resistors (since the grid leak return is directly to the cathodes of the heater-type tubes, there is no cathode resistor available to control the plate current; hence the use of these plate-circuit series resistors). The cathodes of these tubes are returned to a center-tapped potentiometer in shunt across their filaments.

The A.F. outputs of the detectors are

combined in the output circuit, filtered by a couple of R.F. chokes, by-passed; and then this A.F. energy is fed through a coupling condenser to the A.F. amplifier V3A; potentiometer R1 preventing tube overload.

The plate currents to these tubes determined by the settings of two grid-bias potentiometers are indicated on milliammeters plugged into the jacks J5 and J6. (Note A: the dotted lead is not shown in the official diagram of the circuit, but seems desirable.—*Technical Editor.*)

(*To be continued in May* RADIO-CRAFT.)

## Home-Made Intermediates

(*Continued from page* 609)

out the Amperite, or in some other way keep the tube from lighting in that stage. Adjust the condenser until you cannot hear the station, or, if it is a very strong one, till the signal is weakest. This must be done right; since the setting for best results is very critical.

If the owner of a superheterodyne wishes to try my method, after making the transformers, let him take out the potentiometer, and replace this control with a 500,000-ohm variable resistor (R2) in the plate lead. The grid lead which formerly ran to the potentiometer now connects to "C—1½."

If the intermediate frequency is changed greatly, however, it may be necessary to alter the number of turns on the oscillator coil.

I say nothing about the frequency-changing system; so much has been written about the superheterodyne, the Strobodyne, the Ultradyne, etc., that it seems unnecessary to go into a discussion of that. The receiver which I use has three Remler condensers with separate dials and plug-in coils for experimental purposes; though it would be easy to make one with but two dials, and it can even be reduced to one station selector. I would not have a receiver of this nature without a stage of tuned radio frequency ahead of the first detector. When reception conditions were good, I could tune in stations almost anywhere in the country on ground alone; this is better than using the aerial alone without a ground. The set, however, is so thoroughly shielded that even static cannot be received without antenna connections.

Even with 125 feet of aerial, it is possible to separate the strongest stations one receives here, on their 10-kc. channels, without distortion. (*The writer is located in central Minnesota*). I can tune out WCCO for either WLAS or WBAP.

Since I am working on low wavelengths, I employ two R.F. chokes in the plate lead of the tuned R.F. stage, and a variable plate resistor R1 in the frequency-changing stage. The switch Sw1 shorting the grid condenser and leak, and the top switch giving a choice of positive or negative bias are convenient, for use with different tubes. In all but the detector and audio stages, '99 tubes may be used for economy of batteries; I employ '12As for detector and first audio. (*The article was written before 2-volt tubes became available: these might advantageously be used instead.*) While the volume might not be so strong, with the '99s, I do not use the second stage of audio for my house, as it gives too much volume.

## Long-Wave Converter

(*Continued from page 607*)

The fixed condensers, the values of which appear in the text, are Aerovox cartridge-type by-pass condensers, for the larger capacities, and "Micamold" for the smaller; the fixed resistors are "Service" units, which are equipped with convenient pigtails for soldering them into circuit.

### An Optional Arrangement

For the experimenter with only two screen-grid tubes on hand, there is given, as an alternative another circuit, Fig. 3; this is offered by Mr. R. D. Washburne in consideration of the fact that not all screen-grid tubes exhibit the dynatron characteristic to an extent sufficient to drive the long-wave tuned oscillatory circuit. Without recourse to the connections shown in Fig. 3, the experimenter in many cases may be compelled to try a number of screen-grid tubes in the oscillator position. The remainder of the circuit remains the same.

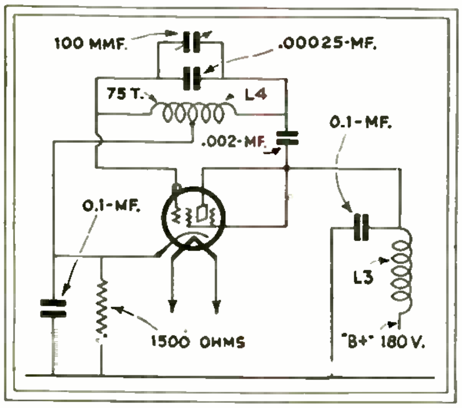



**Fig. 3**

*A rearrangement of the circuit of the oscillator V2; L3 and L4 are the same as in Fig. 1.*

A Hartley oscillator connection has been selected here for the circuit of V2. There is no need to change the socket, if it is desired to use the '24 in this position; it is necessary only to "strap" the screen-grid to the plate, as shown, with a jumper. It is equally easy to use a type '27 tube at V2; in this case, the "G" post of the tube socket replaces the "cap" connection; the strap from socket post "G" to post "P" will not be employed. The honeycomb L4 is shown center-tapped; there will be little difficulty in approximating the position of this connection, and making the tap. (The only essential to observe is to scrap the insulation off only one turn, to tap. If soldering paste, or insulation char, is permitted to extend to two or three turns, the resulting losses may prevent circuit oscillation.)

If batteries are used as the "B" supply, it will be unnecessary to supply over 100 volts to the screen-grid of the dynatron oscillator.

### INFORMATION BUREAU

(*Continued from page 614*)

The intermediate frequencies calibrated on the oscillator are 170, 172.5, 177.5 and 180 kilocycles. The I.F. output of the oscillator may be smoothly varied; the vernier must be set at 50 to obtain the exact fundamental frequencies. This variation feature permits "flat-topping" tunable I.F. transformers.

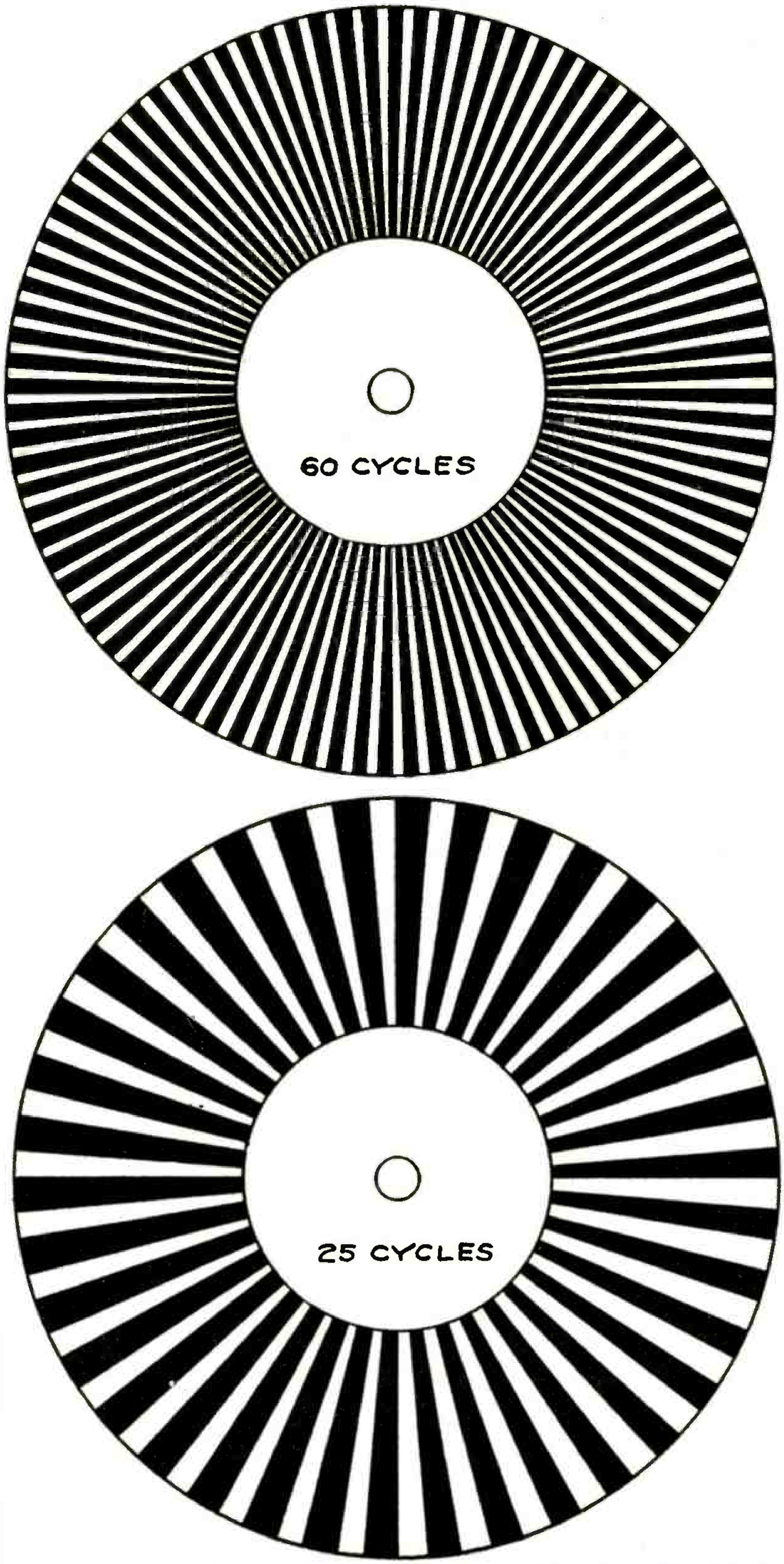



*Fig. Q113. Discs of this pattern, rotated on a phonograph turntable at the standard speed of 78 r.p.m. under a lamp varied by A.C. impulses of the stated frequency, seem to stand still. This "stroboscopic" effect would be strongest with a neon lamp.* (Marconi Radio Co. of Canada.

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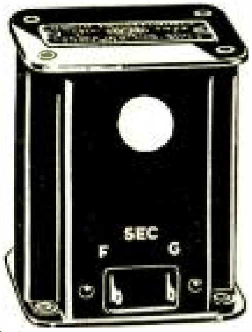


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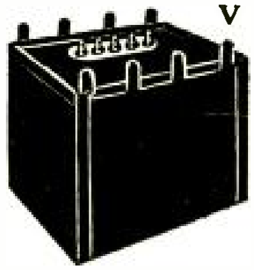

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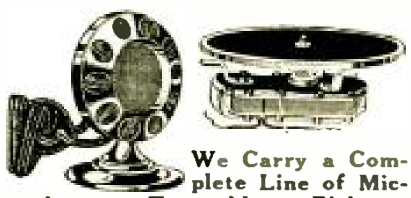

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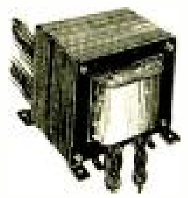

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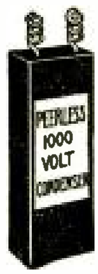


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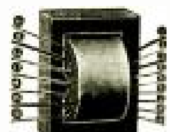
## Earl Power Transformer

70 WATTS



Make money revamping the old battery set. This power transformer used in Earl Model 22 receiver supplies "A," "B" and "C" potentials for: two '27's (or screen - grid '24's), three '26's, two '71A's and one '80 rectifier; total current output of high-voltage winding at maximum output (about 200 volts) is 80 ma. High-voltage secondary, filament winding for '27's, and for '71A's are center-tapped. May be used in any number of combinations. Suitable resistors, a couple of 4-mf. filter condensers, two 30-henry chokes and by-pass condensers complete fine power pack. Size 3¾ x 3 x 2¾ inches. 16 long leads and full wiring directions. Shipping weight 5 lbs. List Price $7.50.

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## "250" A.C. Power Transformer


This power transformer supplies current for five 1.5 - volt Arcturus tubes drawing 5 Ma. and ½ amp. on filaments; one 2.5 V. tube; two '50's, and two '81's. Two 227 or 224 (if suitable resistance is used) and 750 volts. Full wave "B" and "C." A line ballast resistor, such as the Amperite, in conjunction with the special 85-volt primary, will maintain even voltage over 105 to 125 volts. Entirely shielded in metal. 4¾ x 4¾ x 6½ inches high. Weight 15 lbs. For 110-120 volts, 50-60 cycles. List Price, $20.00.

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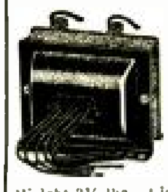

Modernize storage battery receivers by replacing '01A's with '26's and '27's heated by this filament transformer. Supplies 1.5, 2.5, and 5 volts; 2.5-volt winding center-tapped. Heats three '26's, two '27's, and two '12A's or '71A's. 3x3x4 inches. For 110-120 volts, 50-60 cycles.

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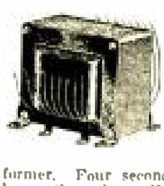
## Kolster Power Transformer

85 WATTS



Will supply sufficient current and voltage for push-pull '10's, in conjunction with type '81 half-wave rectifiers. The 2.25-volt secondary output is just below the rated maximum for type '24 and '27 tubes; tubes will last much longer than when heated from a higher-voltage transformer. Four secondaries are rated as follows: Secondary S1, 7.5 V., 1.25 A.; S2, center-tapped, 7.5 V., 1.25 A.; S3, 1.5 V., 4.25 A.; S1, 2.25 V., 1.65 A.; S5, 725 V., 90 Ma. Primary is tapped for low line voltage. Has eight feet drilled for mounting to base of pack. Generous iron core assures cool performance under heavy load. For 110-120 Volts, 50-60 Cycles. Dimensions: 4½ x 4½ x 4½ inches. Shipping weight, 12 lbs. List Price, $19.50

No. 4336—YOUR PRICE........ **$5.75**

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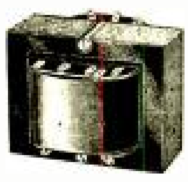
70 WATTS



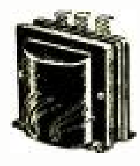
This transformer may be used in building up inexpensive chassis; or for replacement in such standard combinations as three '24's, two '27's, two '71A's or two '45's, and an '80 rectifier. Suitable for the home - built rack-and-panel public address amplifier, or cabinet-type phonograph power amplifier. Just the foundation unit for an audio amplifier to be used as a standard of comparison. Well designed. Connections are made to soldering lugs on the two end plates. Dimensions: 3¼ x 3½ x 4 inches. For 110-120 volts, 50-60 cycles. Shipping weight 5¼ lbs.

List Price. $12.50.

No. 1405—YOUR PRICE........ **$2.55**

## 2.5 Volt Filament Transformer

60 WATTS



Has 2 center-tapped windings. Both deliver 2.5 volts. One winding gives 3 amperes; the other, 11 amperes. Pigtail leads. Heavy iron case, beautifully finished in brown crackle. 110 to 120 volts, 50 to 60 cycles. Dimensions: 3¼ x 5 x 4½ inches. Shipping weight 9 lbs. List Price. $6.00.

No. 1414—YOUR PRICE........ **$3.45**

## A.K. 37 Filter Choke Condenser

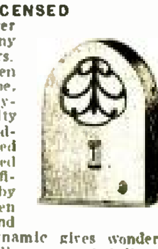

Contains two filter chokes, a speaker output choke, two high-voltage filter condensers, a detector by-pass condenser, and an R.F.-A.F. by-pass condenser, each connecting lead being identified by colors. To make up efficient power pack for a receiver using a type '71A output tube you need only a rectifier tube socket, a voltage divider, a power transformer, and this filter block. 3¼x4½x5 inches. Shipping weight 6 lbs.

List Price. $7.50.

No. 1800-283—YOUR PRICE.... **$4.95**

## The SONOLA 1931 A.C. Model Midget Receiver

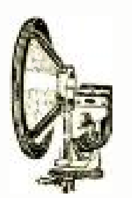
RCA LICENSED



This Midget Receiver will outperform many of its larger brothers. Uses 5 tubes: 3 screen grid, 245 power tube, 280 rectifier. Rola dynamic. Large capacity filter. Perfectly shielded. Selectivity obtained by use of three tuned stages. High amplification is assured by screen grid RF, screen grid power detector and '45 output. Rola Dynamic gives wonderful reproduction. So small you can put it anywhere yet it will fit. **There may be cheaper midgets on the market. We are fully aware of this. That's exactly why you should have a SONOLA. There is NO GRIEF with this high grade set.** For 50 to 60 cycle, 110 volts. Dimensions: 14 x 9 x 18 inches high. Shipping weight 30 lbs. List Price, $59.50.

No. 2500—Your Price (less tubes) **$29.85**

## Kolster Speaker Chassis

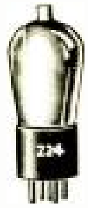


May be connected directly in the plate circuit of type '12A tubes; or to higher-power tubes through an output device. In push-pull circuits, speaker may be connected from plate to plate. "9 inch cone" type. Paper-rattle is prevented by a flannel damper; bass notes are well reproduced due to the "free-edge" effect. Its small dimensions make it eligible for use in home-constructed midget sets. Comes with 6 ft. cord. Dimensions: 10 x 5½ x 9½ inches. Shipping weight 6½ lbs.

List Price. $18.00.

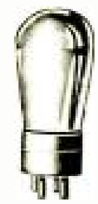
No. 1500—YOUR PRICE....... **$2.85**

## 6 MONTHS GUARANTEED NEONTRON TUBES




Sold on a **6 MONTHS** FREE REPLACEMENT GUARANTEE BASIS, PROVIDING TUBE LIGHTS! All tubes are carefully meter-tested before shipment, and carefully packed. Do not confuse these HIGH QUALITY tubes with any other "low priced" tubes—our low prices are possible because we do a VOLUME business!

| Choice of | Choice of | Choice of | Choice of |
|---|---|---|---|
| 226 | 112A | 245 | 222 |
| 227 | 200-A-199UX | 280 | 210 |
| 171A | 199UV-120 | 171 | 250 |
| 201A | 224 | | 281 |
| **63c each** | **70c each** | **80c each** | **$1.60 each** |



## Genuine Magnavox Microphone

**Do Your Own Home Phonograph Recording**

Made by the world-famous Magnavox Co. While originally made to strap on the head, it is easy to screw a handle onto one of the side brackets. The side brackets are covered with soft rubber and place the microphone at the best speaking distance from the mouth. Comes with 6 feet of cord. **The biggest mike bargain in America!** Complete with straps and buckle to fit around head. Brand new, in original factory packing. Shipping weight 1 lb.

List Price. $10.75.

No. 1610—YOUR SPECIAL PRICE **$1.55**

## Short-Wave Converter

Build a short-wave converter at lowest price on record, but with which excellent results are obtainable nevertheless. The voltage for the three 227 tubes used may be obtained from an external filament transformer or from a secondary winding of 2½ volts in a power pack. Wavelength from 30 to 110 meters. No plug-in coils; coil switch is used to cover wave band. Single dial tuning, no grunting, no body capacity, no squeals. Leak condenser modulation. Converter consisting of all parts (less filament transformer) including cabinet, panel, diagram and 4-page instruction sheet (less tubes).

No. 1619—YOUR PRICE ...... **$4.85**

No. 1615—6-Volt Battery Model, same price.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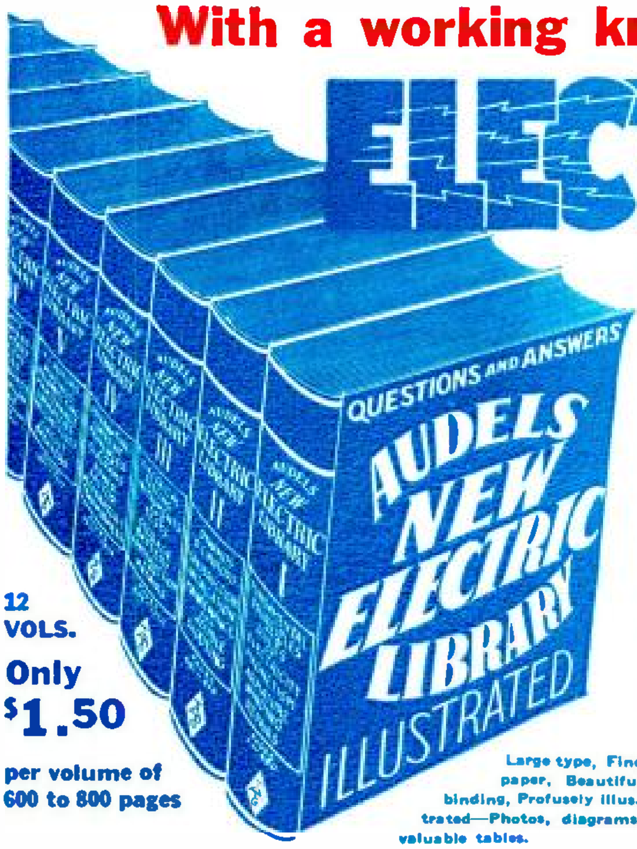


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