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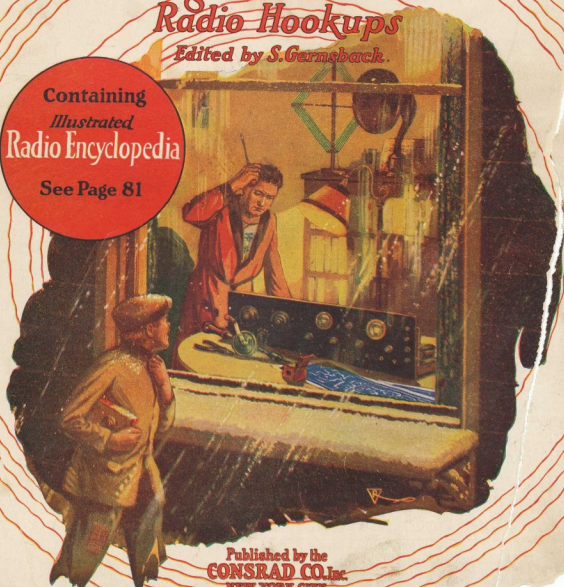
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*A Digest of the Latest
Radio Hookups*

Edited by S. Gernsback.

Containing
Illustrated
Radio Encyclopedia

See Page 81



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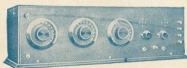
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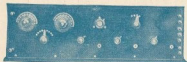
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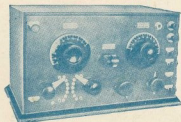
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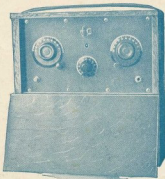
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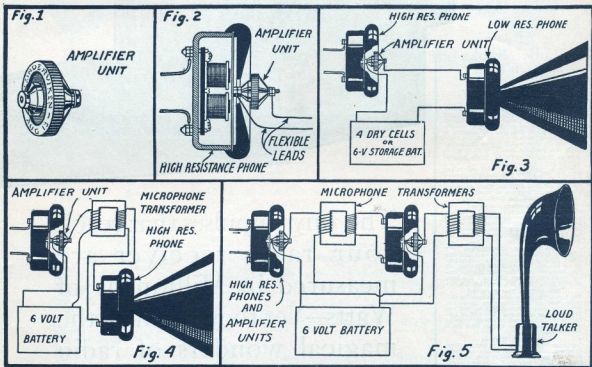


FIG. 1 shows the amplifier unit, actual size.

FIG. 2 shows how the unit is attached to a telephone receiver. The first procedure is to mount the unit on the diaphragm of a telephone receiver, which usually is a high resistance telephone, either 1,000 or 1,500 ohms.

Next we select the loud speaking telephone. If a low resistance telephone is available, it should have for maximum efficiency an impedance equal to the resistance of the amplifier unit, or about 10 ohms; it is connected up as shown in Figure 3. A 5 ohm telephone receiver is used in this circuit with a 6-volt storage battery.

Two telephones taken from a good double head-set of 2,000 to 3,000 ohms which do not rattle on strong currents, are employed in Fig. 4, one at the receiving end, the other as loud talker. In this hook-up there is one instrument which must absolutely be used with this combination, the transformer. As stated before in connection with Fig. 3, the impedance of the telephone, if used in direct connection, should equal the resistance of the unit. But as

the impedance of the telephone in Fig. 4 is much higher than the resistance of the unit, it may be 200 times as great, a transformer having a step-up ratio is used to match up the resistance of the unit with the impedance of the loud speaking telephone. In other words, the primary coil of the transformer should have an impedance (which is sometimes called "A. C. resistance") equal to the resistance of the unit, or about 10 ohms, and the secondary coil should have an impedance equal to the impedance of the high resistance telephone. This transformer may be purchased in any Radio Store and is called a microphone transformer or modulation transformer, designed primarily to use in radio transmitting sets. A 6-volt battery gives the best results. The current passing through the unit will vary from .1 to .25 ampere.

FIG. 5 shows a circuit for further increasing the volume of sound. This is simply two of the circuits, such as shown in Fig. 4, linked together. This arrangement is highly sensitive and the telephones on which the units are mounted should be packed in a box of cotton, so the slightest vibration or sound in the room will be picked up and heard in the loud talker. Any sensitive radio loud talker may be used in this particular circuit.

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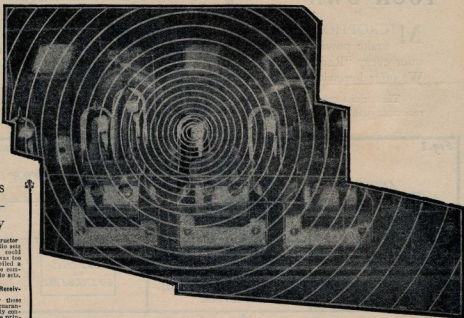
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RADIO REVIEW

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A Digest of the Latest Radio Hookups from the Radio Press of the World

In This Issue

S. GERNSBACK'S RADIO ENCYCLOPEDIA

Sixth Installment

APPRECIATIVE and encouraging letters concerning the Radio Encyclopedia, which forms a part of each issue of RADIO REVIEW, have been coming to us from considerable numbers of our readers.

¶ We should like, however, to get some closer comment as to the specific practical use that radio followers derive from this section of our publication. And we should be pleased also to receive such constructive criticisms as may occur to them in looking for, or applying given information in the Encyclopedia.

¶ Are the definitions clear enough to be thoroughly comprehended by a non-technical reader?

¶ Are the diagrams and illustrations as complete and detailed as desired?

¶ Are there any definitions omitted which the reader or amateur constructor might expect to find? Is there still further material he needs for his work, which should have a place there because it is also generally needed, but which still has not been covered?

¶ Should the definitions now included be elaborated further?

¶ We aim to make this department of RADIO REVIEW above all else thoroughly usable, to present data that will be adequate, inclusive, and readily available—in other words, to make it in arrangement and contents a *working* Encyclopedia.

¶ To do this at all points we need your suggestions and co-operation. On the points outlined above the experiences and expectations of our readers would be our most accurate guide. They represent questions which we should like very much to have answered by our readers themselves.

The Consrad Co., Inc.

233 Fulton Street

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RADIO REVIEW

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*A Digest of the Latest
Radio Hookups*

Volume I

Number 6

DECEMBER, 1925

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RADIO REVIEW

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Vol. I

DECEMBER, 1925

No. 6

How to Build the New Rasla "99" Reflex

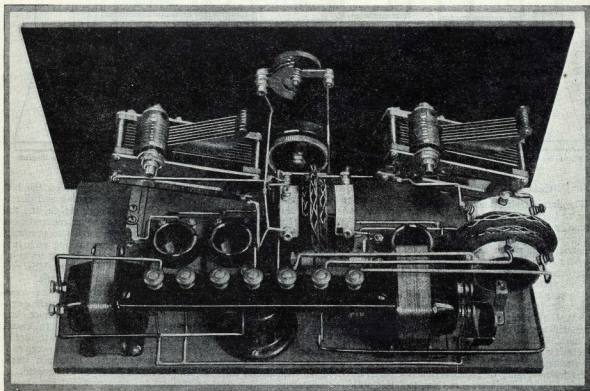
A Selective Three-Tube Reflex Receiver Employing UV199 Type Tubes

NOW that the reflex systems have been advanced to a relatively high state of perfection, and the number of tubes necessary for loudspeaker reception reduced to a comparative minimum, it is only fitting that these

similar tubes. Mr. Barbly tells the complete story as follows:

The unusual high standard of performance obtained with the circuit described has a number of contributing factors, the most important of which is,

tube. In fact, it is safe to say that in numerous instances where these tubes have been used in circuits designed for storage battery tubes, the results have not been up to expected standards, particularly in regard to volume. As a



Illustrations by courtesy of N. Y. Eve, Graphic
A rear panel view of the new Rasla "99" reflex showing the layout of the set. Carefully observe the relative position of the parts and wiring, because when the rotary plates of the straight line frequency condensers are turned they are apt to come in contact with a lead and cause a short circuit.

methods should be applied to the smaller tubes, capable of dry cell operation. L. R. Barbly, writing in the *New York Evening Graphic* radio section, has given circuit diagram and full details of an excellent three-tube reflex employing UV 199, C 299, UX 199 or

perhaps, the proper design and proper constants of the parts used. There are several requirements which must be met in order to get the most from the 199 type of tubes.

Very few of the popular circuits are designed exclusively for this type of

result there are many who feel that this type of tube is not capable of "delivering the goods."

This reflex circuit owes its high efficiency to a careful consideration of the constants and design necessary to make the 199 type of tube talk up. Conse-

quently, we have a powerful, compact set, capable of performance at least equal to, or superior, to many circuits employing a large number of tubes. It is easy to build, extremely selective, and because of its small size—7 by 14 inches—can readily be used as a portable set whenever desired.

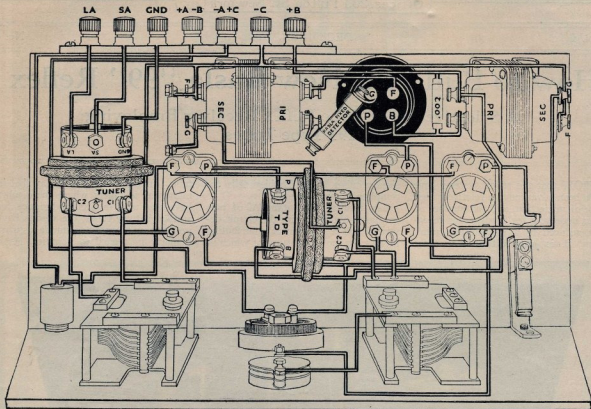
tivity is emphasized, the side bands are more or less cut off. Selectivity at the expense of clarity is not the case with this circuit.

Fixed Crystal Detector

A fixed crystal detector is used; and it is interesting to note this point—that

essary retuning. A fixed crystal with a predetermined contact eliminates these undesirable features.

It is understood that in many circuits of this type the first tube receives only a part of the load, so to speak, the reflexed tube receives more because it is doing double duty, and the output of



Picture wiring diagram of the Rasla set. While the new straight line frequency condensers are not shown in this drawing the rest of the diagram can be followed for layout and wiring.

Circuit Description

The circuit itself cannot be classed as new, or tricky, for it is a simple reflex circuit, with one stage of tuned radio frequency amplification preceding a reflexed tube, which serves a double purpose of radio and audio amplification, and is followed by one step of straight audio amplification. Yet, judging by results, which is the final and all important test in any circuit, a new standard of reception is established. This will appeal to many, because no technical skill is needed to build and wire this circuit and no expensive parts are necessary.

As far as quality of reproduction is concerned, this circuit has something to brag about. The cone type of speaker provides an excellent test for determining quality of reception or distortion, and tests conducted with this type of speaker clearly demonstrated its tonal quality to be far above average and, furthermore, it shows fairly equal amplification at all frequencies. This is more or less unusual, since it is well known that where exceptional selec-

a reflexed tube with a crystal detector is superior to a regenerative tube detector, which can be mathematically proved. This fact, together with the correct design of parts for the characteristics of the type of tube used accounts to a large degree for the sensitivity, selectivity and volume of this reflex circuit. Regarding the crystal itself, a fixed crystal is used for the simple reason that when other types are employed and adjustment is being made we invariably encounter an annoying squeal or howl.

Not only does a fixed crystal eliminate this noise, but it must be remembered that in a sensitive circuit such as this a different point of contact on the crystal changes values. For example, for a given setting of the detector, coupling and tuning is adjusted for a certain wave-length, and should contact be changed to a poorer point on the crystal, the volume will be less and the coupling too close. Vice versa, with a better contact point coupling will be too loose to absorb any additional energy, resulting in the tube oscillating or nec-

both tubes being forced on the last, with resultant overloading and distortion. Only by proper design, and this brings us back to proper constants, can the entire load be distributed as equally as possible, thereby making each tube carry its full share. It was an equal distribution of this load which presented a problem in this circuit.

Another problem which was successfully solved, and was absolutely essential for successful performance, was that the inductance of the grid circuit and the radio frequency transformer be so designed that oscillations occur over the entire range of broadcast wavelengths, with the type of tube used. A method has been provided for absorbing or neutralizing surplus energy, in order to control the oscillations at any wave-length. Maximum efficiency in any receiver lies just below the point where the circuit is ready to break into oscillation.

Circuit Efficiency

The theoretically perfect receiving set, giving 100 per cent efficiency, is

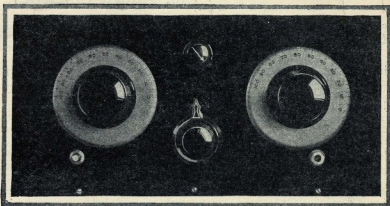
almost an impossibility; but this reflex circuit goes as far as is practically possible today. When tested, alongside of a standard three-tube regenerative set using an equal number of tubes, superiority was clearly indicated. One of the numerous tests for both sensitivity and selectivity, and also volume, was as follows: Station WFI, Philadelphia, 395 meters, was first tuned in on this reflex circuit with good volume on the loud speaker. It was impossible to pick this station up with the other receiver. So much for the sensitivity. Station WOR, 405 meters, was then tuned in and the volume on the set described was so far superior to the standard three-tube regenerative that comparisons were out of the question. Incidentally, it was a very simple matter to tune in WFI, only ten meters apart, to the total exclusion of WOR. The same test, with identical results, was repeated in another location. Different sets were tried, and the reflex proved its superiority every time.

Tapped Transformer

Referring to the schematic wiring diagram, you will notice that in the stage of straight radio frequency amplification a Rasla tuning unit is used, consisting of a conventional primary, untuned, or aperiodic, with a tap for use with a long aerial. The secondary is tuned with a .00035 condenser. This is somewhat different from the pre-

tuning are the result of using the secondary in this manner. Note that in the set shown in the photos, Rasla straight line frequency variable condensers are used in order to incorporate the feature of this type of condenser.

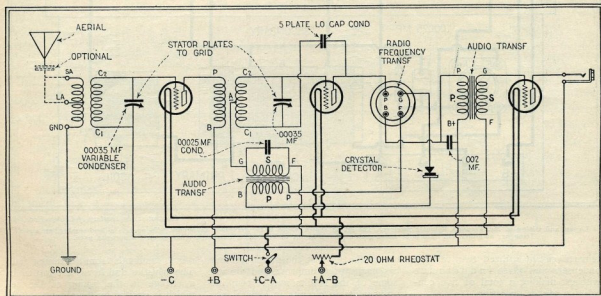
for the extraordinary volume which is characteristic of this circuit. It is essential that a .00025 bypass condenser be connected across the secondary of this transformer, since it provides a necessary bypass for the radio frequency current around the transformer.



The front panel layout. The completed set can be installed in a standard 7 x 14 inch cabinet.

The five plate balancing condenser, which is used in conjunction with the remainder of the secondary winding, and the plate of the reflexed tube act as a volume control and are essential for selectivity, because it enables us to bring the circuit into an oscillating, or near oscillating, state with excellent control. Of course, the second tube

A short outdoor aerial is essential for this set. When an outdoor aerial is used, about 60 feet, including the lead-in, will be found most satisfactory. Indoor aerials, telephone connections, or even a loop with one side grounded, will give excellent results. Even when a short outdoor aerial is used it is advisable to try a .00025 fixed



A schematic diagram of the new Rasla reflex with all the necessary data clearly given.

viously published Rasla Reflex circuits, in that the entire secondary coil is in the grid circuit. In the Rasla TD special 199 coil, used in the reflex step, the primary is connected in the usual manner and the secondary also tuned by a .00035 condenser, but only a part of the secondary winding is used in the grid circuit. Selectivity and sharp

being reflexed, it gives us both radio and audio frequency amplification.

The impedance of the fixed crystal is matched by the interstage Rasla r. f. transformer, allowing efficient coupling at this point. The audio transformer used in the reflex stage has a low primary impedance which also equals that of the crystal, and herein lies the reason

condenser in series with the antenna, and the antenna binding post. A long aerial of the outdoor type will keep the set from working at maximum, for it will not allow the circuit to operate near its oscillating point, which is particularly true on the higher wavelengths. The circuit diagram shows a

(Continued on page 13)

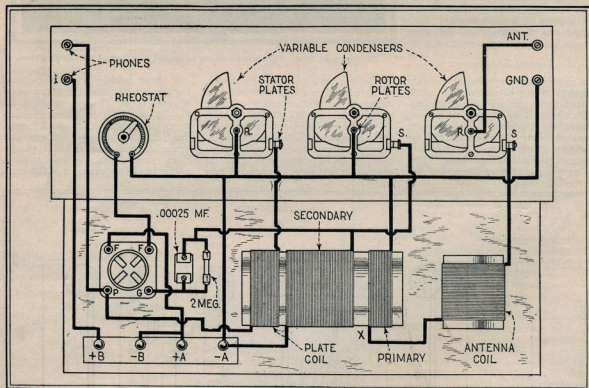
An Up-to-Date Reinartz Receiver

Improvements Offered on the Reinartz Circuit for Added Efficiency

THE circuit described herewith is a deviation from the old original Reinartz circuit. So many radio fans obtained satisfaction several years ago with the use of the Reinartz circuit and so many qualifications of merit are characteristic in the Reinartz scheme, that the attempts to improve it resulted in the circuit shown in this article. If the reader will remember the original

circuit. In place of improving the circuits that at that time were considered the best, radio authorities forgot them completely and gave their attention to newer discoveries in circuit design. Many of these were far inferior, considering the efficiency from a tube-for-tube standpoint. It is surprising to know that 70 per cent of the old Reinartz following are still making good

were used a few years ago, were bothered a great deal with what is commonly known as body capacity. For those who have recently become interested in radio and have never experienced body capacity, it might be stated that body capacity was a very bothersome effect noticed in tuning a receiving set. It causes the set to whistle or howl as the operator re-



Layout and wiring of Mr. Freund's Reinartz receiver. The set as shown above is for reception on phones. To operate a loud-speaker, an audio frequency amplifier will have to be added such as shown in the accompanying schematic diagram on the opposite page.

Reinartz circuit utilized two variable condensers and three inductance switches, making a total of five controls for proper operation.

Benjamin E. Freund, technical editor of the *Chicago Evening Post Radio Magazine Section* offered this new and improved form of Reinartz which is easy to build and fully efficient for broadcast reception. Mr. Freund recently described the set in the *Chicago Evening Post* as follows:

At the time of the Reinartz circuit's popularity, very little thought was given its development for simple opera-

tion of the set that the march of time has neglected to improve and discard. Some of the results noted from improvements in circuits in general was the discarding of switchpoints and conductance switches.

Proper design of coils has made it possible to cover the entire wave-length range of frequencies allotted for broadcast use by a single fixed inductance (not tapped) and a variable condenser.

Body Capacity Bothered

The old Reinartz circuit, and in fact all of the pet regenerative circuits that

moves his hands from the tuning dials. The whistles and howls are caused by a change in the tuning of the set, which is excited by the absence of the operator's presence from the immediate electro-static field of the receiver. The operator's body, electrically speaking, is at a ground potential. Any part of the body when brought near a sensitive part of the radio circuit would tune the circuit in a similar manner to a condenser when the rotor plates are enmeshed within the stator plates. When the set was tuned, the capacity of the operator's hands acted in the same

Illustrations by courtesy of Chicago Eve. Post

capacity as one member (rotor) of a condenser, and the operator's capacity was used partially in the tuning of the receiver. When the operator removed his hands from the dials the withdrawal of the hand effected a decrease in capacity and subsequently detuned the receiver. In those days, when a set was detuned slightly, whistles and howls occurred, and naturally the absence of the operator's hands after tuning a receiver caused a great deal of trouble in operating a set. In extremely sensitive receivers, when distant reception was desired, it was often difficult to maintain reception of a weak signal without keeping the body in deadlike stillness. Objects three and four feet from the receiver often affected the capacity of the receiver sufficiently to cause a detuning from the frequency of the signal received.

How It Was Conquered

The first advancements toward eliminating this nuisance was a shielding of the receiver with sheet metal and grounding it so that the sensitive sections of the receiver were on one side of the shield and the operator's body on the other. This did not prove very satisfactory because the shield absorbed a great quantity of energy and grounded it; the absorption of the shield being far in excess of that of the operator's body. Finally, through determined experimenting, or accident, somebody found that grounding the filament circuit and returning the rotor side of the variable condensers placed the parts of the circuit that were in contact with the operator's hand at a ground potential, and in this discovery complete elimination of body-capacity trouble resulted.

The improved Reinartz circuit described herewith is the result of all im-

provements found since the innovation of radio broadcasting, and which could be of advantage in the Reinartz scheme.

Coils May Be Made

This circuit requires only the manipulation of three dials, these controlling

the rotation of three variable condensers. The inductances, of which there are four, are easily constructed by an experimenter and are wound in two units. The antenna coil is separately wound on one coil form and the primary, secondary and plate coils are wound on a second coil form. This form may be anything in the way of a good dry insulating tube, such as Formica, Bakelite or dry cardboard. The antenna coil should not be in in-

ductive relation with the primary, secondary or plate coil and, consequently, it may be placed at any distance from the other inductances or in a position where the inductive field which might exist between it and the other windings would be at a minimum.

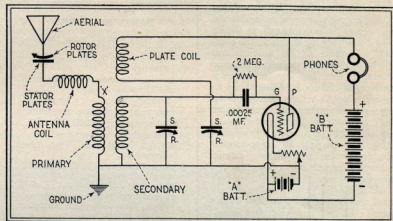
Experimenters, who have only two variable condensers available or, for other reasons, wish to have only two controls, may reduce the present circuit to one requiring only two controls by

connecting the antenna variable condenser and the antenna coil to the upper side of the primary coil at the point designated in the diagram as "X." The primary coil consists of only a very few number of turns, generally between six and fifteen, and consequently is of the

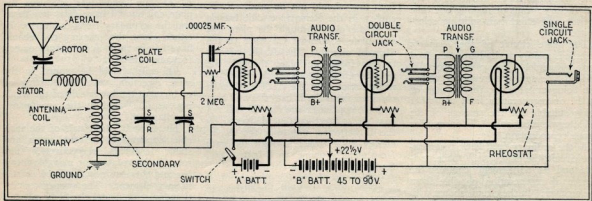
length if it happens to be passing through the primary circuit. For example, if ten signals of different wave-lengths are collected by the antenna, they will all pass through the primary coil. The secondary will select any of the ten signals, the exact selection depending upon which of the ten wave-

That Untuned Primary

A little explanation in regard to the theory of the untuned primary will enable the reader to appreciate the reason for annexing the antenna condenser and antenna coil in the improved Reinartz circuit. In a primary circuit, whether it be coupled to an



A schematic diagram of the one-tube set or tuner and detector.



Hookup of a two stage amplifier to the Reinartz set described herewith. If an amplifier is to be used in this way the set will of course require a larger size panel.

eliminating the antenna variable condenser and the antenna coil and connecting the antenna to the upper side of the primary coil at the point designated in the diagram as "X." The primary coil consists of only a very few number of turns, generally between six and fifteen, and consequently is of the

lengths the secondary circuit is adjusted to. In any circuit where untuned primary is used, the selection of the signal to be received and, consequently, the selectivity of the set, depend entirely upon adjustment of the secondary circuit.

At the present writing, and in a city such as Chicago, where broadcast congestion is bothersome and selectivity a most desirable factor, it is often difficult to obtain the necessary amount of selectivity in a one-tube set to effect satisfactory reception. By connecting a variable condenser and an additional coil, such as the antenna coil, as shown in the accompanying diagram, the combined inductance of the antenna coil and the primary coil possess a value of inductance that has its fundamental wave-length capable of being tuned to any wave-length within the broadcast range, providing the variable condenser used for tuning is of a correct value.

In place of the antenna circuit collecting and passing all wave-lengths being transmitted, the primary circuit becomes a tuned one and only the wave-length through the condenser and to which the inductance value is adjusted will be permitted to flow to the ground. If the primary circuit is adjusted to a wave-length of 300 meters, only a 300-meter wave signal will pass through it, and if the secondary circuit be likewise adjusted to 300 meters then, through induction, the signal will be induced in the secondary coil and subsequently delivered to the grid of the tube in the usual manner.

Aid to Selectivity

The addition of the antenna coil and antenna variable condenser double the selectivity of the circuit over the condition that would prevail if the antenna coil and condenser were not used. The writer has found this to be a very satisfactory means of making one tube operate and effect hair-splitting selectivity.

The plate circuit of the Reinartz scheme is mainly devised around a feed back principle. The plate circuit is divided into separate frequency paths; one being suitable for the passage of R. F. or regeneration, and the other being suitable for the passage of the B battery current and A. F. energy for phone reproduction.

In the ordinary feed-back regenerative circuit, the plate coil is made variable and its adjustment controls the degree of regeneration possible from the receiver. In the circuit shown with this story the plate coil is fixed and adjustment of control of the feed-back radio-frequency energy is made through the variable condenser C3.

Condenser Across Plates

As the B battery and phones have fundamentally a very high resistance, naturally their impedance would be high and offer a resistance to the flow of R. F. current. In the average re-

generative circuit, where radio and audio-frequencies traverse the same path, it is necessary often to shunt a by-pass condenser across the phones and B battery. As the by-pass condenser has a much lower impedance for high-frequency current than the B battery and phones, the condensers form an easier flowing path, and consequently the R. F. current travels through these condensers rather than through the phones and B batteries.

PARTS REQUIRED

The parts necessary for the construction of the set are:

- 1 formica panel, 7 inches wide and 14 inches long.
- 1 formica baseboard, 7 inches wide and 13 inches long.
- 1 rheostat. (See later reference.)
- 1 grid leak, two to five megohms.
- 1 grid condenser, .00025 mfd.
- 1 tube socket.
- 3 variable condensers. (See later reference.)
- 1 piece of formica or hard cardboard tubing, three inches in diameter and seven inches long.
- 1 piece of formica or hard cardboard tubing, three inches in diameter and four inches long.
- 8 binding posts.
- 3 dials.
- 3 yards connecting wire.
- 1 radio tube.
- 1 small spool, No. 22, double-cotton-covered copper wire.

To make the set function the necessary batteries, phones, aerial and ground will also be needed.

In the Reinartz circuit, separated radio and audio frequency paths are provided for and consequently the by-pass condensers are not necessary; in fact, they should not be used. R. F. energy in the Reinartz circuit travels from the plate through the plate coil and plate condenser C3 back to the filament circuit. The A. F. current travels from the plate through the phones and B batteries back to the filament circuit. As the A. F. current is obtained from the B batteries and as a variable condenser such as C3 will not pass the correct current delivered by the B batteries, naturally the A. F. energy must travel through the path from plate to phones to B battery and finally to the filament circuit. And on the other hand, as the phones in B batteries offer a high impedance to R. F. energy, the R. F. energy would traverse the path which offers the least resistance, which naturally would be the path from plate coil to plate condenser C3 and finally back to the filament circuit.

Because of the separate halves devised for the radio and audio frequency current, the Reinartz circuit is capable of maximum efficiency in the handling of both. The rotors of C2,

which is the secondary condenser, and C3, which is the plate condenser, are commonly connected and grounded with the filament circuit, which safeguards against body capacity difficulties. In the connection of condenser C1 for the same reason it is advisable to connect the rotor to the antenna, which is the low potential side of the antenna circuit. For further information relative to the construction of an improved Reinartz receiver, such as detailed in the foregoing the following data will be of value.

The accompanying schematic diagram showing the tuner and detector and a layout wiring diagram will give the home radio set constructor all the working information needed. It is advised to use standard parts and carefully wire them as shown. A separate diagram shows how to add a two-stage audio amplifier for volume.

The circuit is not critical to the type of tube used, as long as rheostat and grid leak of proper values are used. If a regular detector tube, such as the UV-200, C-200 or WD-12, is used, a six-ohm rheostat should be employed. If a tube of the "99" type is used, a rheostat having resistance within 25 or 40 ohms should be provided. With a tube of the "99" type a 5-megohm grid leak should be used and a 2-meg grid leak with any of the other tubes. Greater distance will be covered by the use of a 5-meg grid leak with any of the tubes at a slight sacrifice in signal strength of near stations.

The writer has found from experimentation that variable condensers of either 13 to 23 plates may be used, provided the coils are wound to suit them. If 13-plate condensers are used the plate coil should have thirty-five turns and the secondary eighty turns. If 23-plate condensers are used the plate coil should have forty-five turns and the secondary forty-two turns. In either event the primary coil should have fifteen turns and the antenna coil forty-five turns.

All coils should be wound in the same direction, with the starting of each coil at the lower side of the winding, as illustrated in the accompanying diagram.

The R and S terminals of the variable condensers are the rotor and stator terminals, respectively. The rotor is the rotating or movable member and the stator is the fixed or stationary element. The proper connections must be made, else body capacity effect will be introduced into the set.

Coil Spacings

The distance between the plate and the secondary windings should be about one-fourth inch, and the distance between the secondary and the primary windings about one and one-half inches. The antenna coil may be

(Continued on page 31)

A New Five-Tube Radio-Frequency Set

Radio-Frequency Transformers Completely Shielded
Offer Several Promising Qualities

THE circuit described in the following article is of the five-tube tuned radio-frequency type and employs special metallic enclosed radio-frequency transformers for the reduction of interstage coupling. McMurdo Silver, of the Silver-Marshall Co., Chicago, Ill., is responsible for the design and development of this set, which has found great popularity among Chicago radio fans. The structure of the circuit and scheme around which the receiver is formed differs very little from any of the tuned R. F. types which

metal case acting in the capacity of a shield, hence the reason for its name, "Metaloid." The shielding of transformers for use in tuned R. F. circuit is a rather new idea, and, from the results had in tests made by the writer, it appears to have many promising qualities. We have heard recently much about binocular, twin-cylinder and toroidal coils, all of which have peculiar design for the purpose of eliminating many factors that are disastrous to efficient reception of radio signals. The latter-mentioned designs

fields to other inductive parts of the circuit. The Harper metaloid has been designed with the same intentions and it is the belief of the designer that the degree of efficiency with which the metaloid serves its purpose is much higher than any other type of tuned R. F. transformer.

What Diagram Shows

The accompanying pictorial wiring diagram shows a five-tube R. F. circuit, using the Harper metaloid. From observance of the connections to the

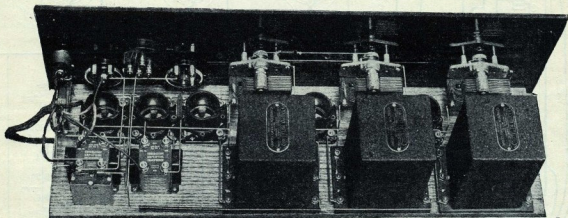


Photo showing a back view of the set. Carefully note the neat arrangement of parts and wiring.

have become quite popular within the last few years.

A description and details for the construction of this receiver were recently given by Benjamin E. Freund in *The Chicago Evening Post* as follows:

Two stages of tuned radio-frequency amplification, a detector stage and two stages of audio-frequency amplification comprise its circuit formation in the sequence in which the various functions take place in the routine of an incoming signal. The circuit offers some new developments in the design of radio apparatus, among the most prominent being a new type tuned R. F. transformer and straight-line frequency variable condenser. The transformer is the Harper metaloid, designed by a prominent consulting radio engineer of Chicago, and manufactured by the Gibbons Radio Corporation, also of this city.

To the writer's knowledge, the Harper metaloid is the first tuned R. F. transformer to be self-contained in a

are known mostly for their ability to reduce to a minimum inter-stage coupling.

Experiences gathered in the development and research of various tuned R. F. receivers have proven that energy in magnetic form often strays through various parts of the receiver, and, where the energy is absorbed in sections of the receiver that are not intended to absorb it, they induce energy from other parts. The result is a loss of energy which cannot be used for its intended purpose. A transformer is primarily a device for coupling the energy output of one tube to the input of a succeeding tube. To deliver a maximum amount of the output energy into the input of the desired tube it is necessary to have a coupling device that will dissipate a minimum amount of the energy to be transferred. The binocular and toroid type of coil have been designed to facilitate efficient transmission from one tube to another. Their self-contained magnetic field retards any tendency toward straying

Harper metaloids it may be seen that six binding posts have been furnished. The purpose of the six binding posts is to allow a variety of uses, where maximum efficiency may be had in any of them. The extreme right-hand metaloid is used as a coupling unit between the antenna circuit and the first R. F. tube. The remaining two metaloids are used for coupling the first and second R. F. tubes, and the second R. F. tube and detector tubes, respectively. Primary terminals of the metaloid are indicated by Nos. 4, 5 and 6. The secondaries are indicated by Nos. 1 and 3. Arrangement has been made in the design of the metaloid to enable obtaining the highest efficiency in circuits using both dry cells and storage battery tubes. When using storage battery tubes, terminals 5 and 6 are used for primary connections; terminal 5 connecting to the plate of the tuned R. F. If it is desired to construct this set for use with dry-cell tubes such as the UV-199 or C-299 tubes, a few minor changes from the plan shown in

connection with this article are required. The first metaloid, to the right, is used as an antenna coupler, and the other two are used as coupling transformers for the R. F. stages. It has been found advisable to use a higher inductance in the primary circuit when using UV-199 tubes, consequently to adapt the metaloid for use with the dry-cell tube, terminals 4 and 6 should be used instead of 5 and 6, as used with the storage-battery type tubes. The secondary terminals are in this case the same as in the storage-battery tube circuit. No. 1 is connected to the low potential side of the condenser and to the negative C battery, with the excep-

regulate this voltage with great care, otherwise the filament may be overloaded and the electronic supply exhausted. The plate, or B battery, voltage to be used in both the radio-frequency and A. F. amplifiers with either storage-battery or dry-cell tubes should be in the vicinity of 90 volts. A correct voltage to use in the detector tube can be found by a quick check on various values from $22\frac{1}{2}$ to 45 volts; this voltage also applying for both types of tubes.

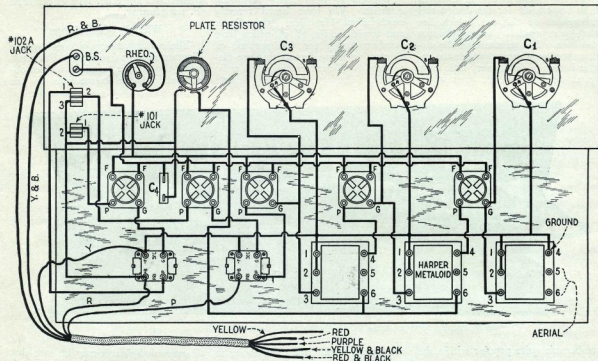
The use of a C battery in connection with both large and small tubes is very important. Large tubes require a grid bias between one and one-half to five

connected in series with terminal 5 or 6 may be tried, the correct terminal connection to be determined best by experiment.

Parts Needed for Set

The following is a list of parts necessary to construct the Harper metaloid receiver:

- Three S. L. F. condensers (.00025 mfd.).
- Three four-inch molded dials.
- Three conductances.
- Five shock-absorbing sockets.
- One six-ohm rheostat.
- One 200,000-ohm modulator resistor.
- Two $3\frac{1}{2}$ -1 audio transformers.



Layout and wiring diagram of the new five-tube tuned radio frequency set employing shielded transformers.

tion of condenser C, which is returned to the positive A battery. Terminals 1 and 2 are handled in the same manner as when used with storage-battery tubes.

Voltmeter Recommended

With storage battery tubes the rheostat should have a resistance of approximately 6 ohms, and with dry-cell tubes a resistance of about 10 ohms will be required. The writer has always deemed it advisable to use a voltmeter in conjunction with any circuit designed to use UV-199 or C-299 tubes. A meter reading from 0 to 5 volts is all right, and the filaments of the tubes should be adjusted to give a reading on the meter of about three volts. The voltmeter may be connected directly across the filament terminals of any one of the five sockets. The use of a voltmeter with dry-cell tubes is quite necessary because it is imperative to

volts. The use of a C battery tends to improve the selectivity and tone quality of the receiver, as well as reduce plate current consumption, thus assuring finer operation of the receiver and greater life in the B battery. With the dry-cell type of tubes the C battery voltage range will be found between four and six volts.

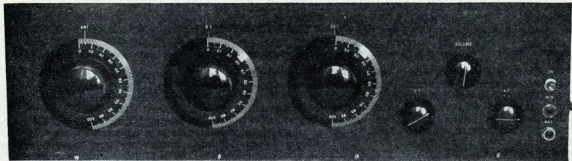
When using the metaloid as an antenna coupler various degrees of primary inductance may be had to suit different antenna conditions. If an indoor antenna is to be used, terminals 6 would probably give the best results, the entire primary inductance being used in this connection. A fairly short outside antenna of a total length of sixty or seventy feet would probably give the best operating conditions by connection to tap 5. Where extremely long antennas are to be used, a fixed condenser having a value of approximately .00025 mfd. or .0005 mfd. con-

- One 101 jack.
 - One 102 jack.
 - One on-off switch.
 - One .002 mfd. condenser.
 - One $7 \times 24 \times \frac{1}{4}$ -inch drilled grain and engraved panel.
 - One $7 \times 23 \times \frac{1}{2}$ -inch oak baseboard, bus bar, spaghetti, lugs, screws, etc.
 - One Belden five-lead colored cable.
- The total cost of the parts of this receiver should not amount to more than about \$65. In making the battery connections, a cable with five color wires are shown in place of the customary binding posts. The yellow and black lead to connect to the negative of the A battery. The red and black lead connects to the positive A battery. The purple wire is for the plate supply in the detector tube and should connect to some point on the B battery supplying a voltage between $22\frac{1}{2}$ and 45

volts. The red lead supplies the plate voltage to radio-frequency and audio-frequency tubes and should connect to the positive 90-volt end of the B bat-

tery. The negative of the B battery should connect to the negative side of the C battery. Condenser C-4 should have a value of about .5 mfd. and is used to

readers that no gridleak or condenser has been used in the circuit. By returning the low potential side of the grid circuit of the detector tube to the



Front panel layout of the new five-tube tuned radio frequency receiver.

tery. The negative of the B battery should be connected to the positive in the A battery directly and outside of the receiver. The positive terminal of the C battery should connect to the negative side of the A battery; the

bypass radio-frequency current across the high resistance of the plate resistor.

No Gridleak Needed

Upon careful study of the diagram it probably will be noticed by many

C battery lead, and supplying a negative bias about $4\frac{1}{2}$ volts to the grid circuit, the tube is made to operate under a condition for detection that is similar to any condition effected by the grid leak and condenser.

How to Build the New Rasla "99" Reflex

(Continued from page 7)

negative bias applied to the grid of the first tube, to the grid of the reflexed tube through the reflexed audio transformer, and to the grid of the last tube. The use of a "C" battery is not optional, but is absolutely necessary in this circuit for good results. The rheostat is placed in the positive A battery lead.

The picture diagram shows the correct layout of parts and no attempt should be made to alter it unless a larger panel is used. In this case the only alterations advisable are in the scope of further spacing, without changing the relationship of the parts to one another. It is important that the Rasla TD Special No. 99 coil be placed between the Rasla radio frequency transformer and the reflexed audio transformer, so that there is no coupling between coil and transformer.

Equipment List

Parts necessary are as follows:—

- One 7x14 panel.
- One baseboard.
- One Rasla C R transformer (new type).
- One Rasla tuner.
- One Rasla TD Special 99 tuner.
- One Rasla fixed crystal.
- One Rasla Special LoCap condenser.
- One high ratio audio transformer.
- One low ratio audio transformer.
- One 20-ohm rheostat.
- One open circuit jack.
- Three 199 sockets.
- Two .00035 mfd. Rasla S.L.F. condensers.

- One .00025 fixed condenser.
- One .002 fixed condenser.
- Two four inch dials, vernier.
- One battery switch.
- Seven binding posts.
- Binding post strip.

The parts should be placed as near as possible to the picture layout, and wired as follows: From the binding post marked plus A run a wire to one side of the rheostat, the other side of the rheostat is connected to the F plus markings on each socket. The F minus terminals of the three sockets are joined together and connected to one side of the filament switch, the other side of the switch being connected directly to the A minus binding post. The wiring of the two antenna and ground terminals is clearly indicated.

Wiring Instructions

To wire the first grid circuit from C1 on the first coil two wires are run, one to the variable plates of the first large tuning condenser and continuing to the F— side of the reflexed audio transformer, and from there to be continued to the C minus binding post. C2 is connected to the fixed plates of the first condenser, also to the first socket grid terminal. The second tuner, type TD special 99, is connected as follows: Join the P terminal to the first socket terminal marked P, then connect B terminal to the binding post marked B plus 90 volts. C1 is connected to the variable plates of the second condenser, and from this condenser terminal the wire is run to the

fixed plates of the LoCap condenser. C2 is connected to the fixed plates of the second condenser and to the second socket grid terminal. The terminal A minus on this tuner is connected to the G terminal of the high ratio audio transformer.

To connect the C R transformer, join the P terminal to the second socket P terminal. The lead is also run from the P terminal of the second socket to the variable plates of the LoCap condenser. The B terminal is connected to the P terminal of the second audio transformer. Connect the G post to one end of the crystal detector; the F terminal is connected to the P terminal of the high ratio reflexed audio transformer. The F terminal on the primary side of this audio transformer is connected to the other end of the crystal detector.

A .00025 fixed condenser is connected across the secondary terminals of the high ratio audio transformer. The B terminal of the second audio frequency transformer is connected to one side of the open circuit jack, and to the B plus 90 volt binding post. A .002 fixed condenser is connected across the primary of this second audio frequency transformer. The grid terminal of the second audio transformer is connected to the G terminal of the third socket. The other end of the transformer, marked F, is also connected to the C minus binding post. The P terminal of the last socket is joined to the open side of the jack and the wiring is completed.

Protecting Your Loud-Speaker

An English Device for Safeguarding Your Loud-Speaker or Phones

L OUD-SPEAKERS and phones are rather expensive instruments and it is well worth while to consider protecting their delicate windings. John Underdown, an English radio author, describes the construction of a unit for this purpose in *The Wireless Constructor*, London, England, as follows:

The average amateur seldom realizes that the windings of phones and loud-

speakers are very delicate in nature, and time upon time these are inserted directly into the plate circuit of audio-frequency tubes, and often when power amplifiers are used. In this position

high value and will often cause a breakdown of the delicate windings to take place. To overcome this trouble, it is desirable that the windings of the loud-speaker should be isolated so as merely to carry the necessary signal current fluctuations, and not the heavy direct plate current of the last tube. To overcome this difficulty a simple type of filter circuit, such as that about to be described, may be used.

The Arrangement Used

Referring to the circuit diagram of Fig. 2, you will see a transformer coupled stage of audio-frequency amplification which may be taken to represent the last stage in any set. Even if resistance capacity or choke coupled, the essential part to which we wish to refer will remain unaltered, namely, the arrangement shown in the plate circuit of the tube V. Within the dotted lines on this diagram is what is known as a filter circuit. This consists essentially of the choke Z and the condenser C₁. The passage of direct current through the loud-speaker L.S. is completely stopped by this com-

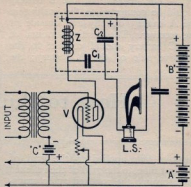


FIG. 2

The last stage of an audio-frequency amplifier with the filter circuit incorporated.

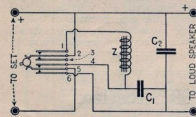


FIG. 1

A theoretical diagram of connections.

speakers are very delicate in nature, and time upon time these are inserted directly into the plate circuit of audio-frequency tubes, and often when power amplifiers are used. In this position

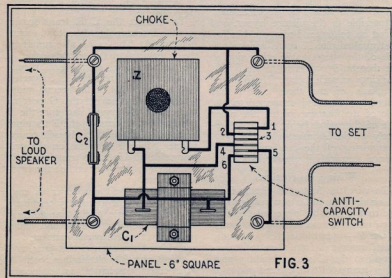


FIG. 3

Illustrations by Courtesy of *The Wireless Constructor* (London, England)
The practical wiring diagram. Follow the switch connections with care.

not only does the loud-speaker carry the necessary fluctuating current representing the signals received, but also the plate current of the last tube. Using some types of power tube this steady plate current is of considerably

denser, but the fluctuating currents representing signals are communicated through it and actuate the loud-speaker. The direct current supply to the plate of the tube is, however, carried by the choke Z, and does not pass through the

to them. In practice, a value of 1 to 2 μ F is used in this position, and in the unit to be described is actually of 2 μ F capacity. The value of C₂ will, of course, depend upon the type of loud-speaker used, and will generally vary from .001 to .01. If the value of this condenser is too low, the tone will tend to be shrill and somewhat tinny, whilst if too high the stage of "mellow-ness" can be passed and the resulting signals become "woolly" or "fluffy" in nature.

To allow interesting comparisons to be made as to the effect of using the loud-speaker with the choke in circuit and without, a two-pole double-throw switch has been incorporated, and the necessary connections are shown in the diagram of Fig. 1. In this diagram the components are given the same letters as in Fig. 2, but it will be seen that the connections allow, with the switch in the left-hand position, the loud-speaker to be tried without the filter circuit, whilst with the switch to the right the filter arrangement is brought into use. The direct current in the plate circuit of the last tube now goes through choke Z, and the loud-speaker is isolated as far as this current is concerned. In practice, when heavy output is to be

(Continued on page 19)

An Easily Made Regenerative Set

A Simple Two-Tube Regenerative Receiver Designed for Operation on a Loud Speaker

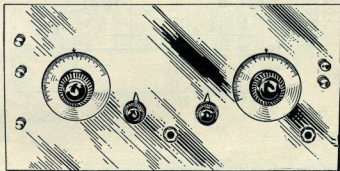
IN the following, *Joseph Calcaterra* gives complete details for constructing a regenerative receiver which not only appears most attractive, but should, under general principles, prove as efficient as any other similar regenerative type of set if properly constructed. Mr. Calcaterra's article as given herewith recently appeared in the *Radio Informer* of Canada, and we are presenting it to our readers herewith for their approval.

There is no doubt that for those who require a simple, inexpensive set; one that is easy to build and easy to operate, a two-tube regenerative set easily stands head and shoulders above all others. There has been considerable agitation against the regenerative types of receivers. Some of this criticism has been justified and a great deal more has been unjustified. A great deal of the trouble which has caused this feeling against the regenerative receiver has been the result of poorly designed and built sets operated by fans who had no idea of the trouble they were causing to their neighbors when they allowed their receivers to oscillate or who had found that it was comparatively simple to bring in a station by "tuning in growls." A properly operated regenerative receiver of the type that requires so few adjustments that it can be adjusted so quickly as to eliminate almost entirely any objectionable radiation, is one of the best receivers we have with us today. As far as cost is concerned, there is no set which can compare with it, dollar for dollar. On local stations, and in this classification I include stations up to 25 miles distant, I have no trouble in receiving on a loudspeaker with the detector tube alone. Of course, the volume is not very great, but it is sufficient to be heard clearly in every part of an average-sized room. With the two tubes the volume is all that is required to entertain a roomful of people with plenty of volume to be enjoyable. I have used this set within eight miles of the most powerful stations in New York City when every one of them, separated by not more than 40 meters, were going without any interference from the others. The set is one of the most inexpensive that can be built. Exclusive of batteries, phones, tubes and loud speaker, but including all the parts that are necessary to construct the set itself, the cost can be kept down to \$20.00.

The Circuit

The circuit of the receiver is shown in Fig. 2. The symbols on the wiring diagram have been numbered to correspond to the numbers of the individual parts shown on the panel and baseboard layout, Fig. 5, so that you can easily see the relation existing be-

rent in the filament circuit can be turned off by setting the blade of the rheostat on the off position, out of contact with the resistance element. In a one stage amplifier set of this type it is very seldom that trouble will be experienced because of a howling amplifier stage. If you should happen to have such trouble, a .00025 to .001



Illustrations by courtesy of *Radio Informer* (Toronto, Canada)
Panel view of the two-tube regenerative set.

tween the symbols; the parts and the connections between the various terminals. The letters used with each instrument correspond to the various terminals of each instrument. The numbers of the parts and the lettered terminals will be used later in the detailed step by step description of how to wire the receiver. There is nothing alarmingly new about the circuit used, but the proper arrangement of the parts and wiring, which will be described in detail later in the article, makes all the difference between a poor and good receiver. Many fans do not seem to realize the importance of proper layouts of parts and wiring as a means of obtaining the very best possible results from a given circuit. The facts that two fans can both build sets using the same hookup and parts and get entirely different results proves the importance of careful location of parts and wiring and painstaking efforts in the construction of the set. The conventional type of three-coil regenerative circuit with an aperiodic primary closely coupled to a secondary coil and with a tickler coil in the plate circuit of the detector placed in inductive relationship to the secondary coil is employed in the receiver. A stage of audio frequency amplification is used to bring the signal strength up to a point sufficient to give good volume on the loudspeaker. No filament battery switch is required since the cur-

rent in the filament circuit can be turned off by setting the blade of the rheostat on the off position, out of contact with the resistance element. In a one stage amplifier set of this type it is very seldom that trouble will be experienced because of a howling amplifier stage. If you should happen to have such trouble, a .00025 to .001

mfd. fixed condenser across the secondary winding of the audio frequency amplifying transformer will usually remedy the trouble. A C battery is not required in this circuit if not more than 45 volts B battery is used. If it is desired to use a higher B battery voltage on the amplifier for greater volume, provision must be made for a C battery as well as separate B battery terminals for detector and amplifier, as will be described later in the wiring directions. The tuning unit is made by taking a standard variocoupler, and winding seven to fifteen turns of No. 22 D.S.C. wire around a portion of the stator winding. The new coil is then used as the primary winding, the stator coil as the secondary winding and the rotor coil as the tickler coil to provide regeneration.

The Elements Used in the Receiver

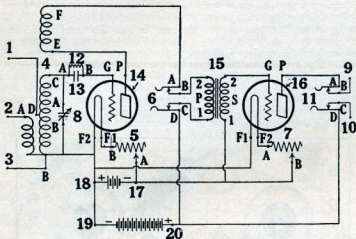
In the panel layout shown in Fig. 3 and in the wiring diagram shown in Fig. 2, number 1 is the terminal connected with the midpoint tap of the stator or secondary winding of the variocoupler. Number 2 is the terminal connected with the top end of the primary or aperiodic winding. Number 3 is the terminal connected with the bottom end of the primary winding, and the bottom end of the stator coil, which serves as the secondary coil of the tuning unit. The functions of these terminals and their uses

as aerial and ground terminal connections will be explained later in the section on how to operate the set. Number 4 is the special variocoupler tuning unit. A separate coil of from 7 to 15 turns should be wound on the lower half of the stator coil (I have found twelve turns to give best results

amplifying transformer of reliable manufacture.

Number 16 is the amplifier tube socket. This socket should also be of the type designed for UV 199 or C 299 tubes.

Number 17 is the negative A battery binding post terminal.



Circuit diagram of the set with letters and numbers as referred to in the text.

for the aperiodic primary coil). The top end of this new coil which serves as the aperiodic primary winding should be connected with an extra terminal A provided in the open space between the two halves of the stator winding of variocoupler 4. The other or lower end of the new coil should be attached to terminal B, that is, to the terminal with which the lower end of the original stator winding is connected, thus connecting the bottom end of the aperiodic primary coil with the bottom end of the stator or secondary coil and serving to ground the filament circuit. One half of the rotor winding should also be removed as shown in the panel and baseboard layout.

Number 5 is a 30-ohm rheostat.

Number 6 is a double-circuit jack.

Number 7 is another 30-ohm rheostat.

Number 8 is a .00025 mfd. variable condenser.

Number 9 is one of the output terminals of the receiver and number 10 is the other output terminal. These may be used for permanently connecting the loudspeaker into the plate circuit of the amplifier tube or they may be used later to add additional stages of audio frequency amplification to the receiver.

Number 11 is another double-circuit jack.

Number 12 is a 3 megohm grid leak.

Number 13 is a grid condenser having a capacity of .00025 mfd.

Number 14 is the detector tube socket. This should be of the type designed for UV 199 or C 299 tubes.

Number 15 is an audio frequency

Number 18 is the positive A battery binding post terminal.

Number 19 is the negative B battery binding post terminal and number 20 is the positive B battery binding post terminal.

Number 21 is the wood baseboard of the receiver.

Number 22 is the binding post panel.

Numbers 23 and 24 are the brass angle brackets used to mount the binding post panel on the baseboard.

How to Locate the Holes

After you have all your parts together, the next step in the construction of the receiver is the laying out of the holes for mounting the parts on the panel.

panel layout and spot the holes through the sheet by means of a centerpunch.

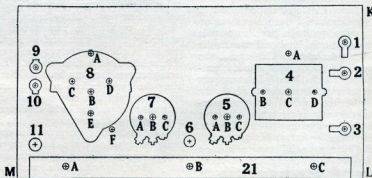
It must be understood, of course, that these mounting holes can be used only if the same instruments that I employed are used. If different instruments are used, the same centre or shaft holes can be used but the other mounting holes must be changed to correspond to those of the instrument you use.

Where only one hole is used to mount an instrument, the hole is designated by the number of the instrument. Where two or more holes are used, a number is used for the instrument and each hole is designated by a combination of the number of the instrument and a letter sub-division, as for instance 5A, 5B, 5C, etc.

The layout shows the rear of the panel, all holes being located and drilled from the rear of the panel.

If you would rather lay out the holes by making each measurement, the following will give you the exact measurements for the panel holes. The first measurement given is the distance of the hole from edge KL while the second measurement is the distance of the hole from edge LM.

- Hole 1— $\frac{3}{4}$ and $5\frac{1}{2}$.
- Hole 2— $\frac{3}{4}$ and $4\frac{1}{4}$.
- Hole 3— $\frac{3}{4}$ and 2.
- Hole 4A—3 and 5 1-16.
- Hole 4B—4 1-6 and $3\frac{1}{2}$.
- Hole 4C—3 and $3\frac{1}{2}$.
- Hole 4D—1 15-16 and $3\frac{1}{2}$.
- Hole 5A—6 and $2\frac{1}{2}$.
- Hole 5B— $5\frac{1}{2}$ and $2\frac{1}{2}$.
- Hole 5C—5 and $2\frac{1}{2}$.
- Hole 6—7 and $1\frac{1}{2}$.
- Hole 7A—9 and $2\frac{1}{2}$.
- Hole 7B— $8\frac{1}{2}$ and $2\frac{1}{2}$.
- Hole 7C—8 and $2\frac{1}{2}$.
- Hole 8A—11 and 5 1-16.
- Hole 8B—11 and $3\frac{1}{2}$.
- Hole 8C— $11\frac{1}{4}$ and 3 15-16.



Panel drilling layout for the set with outlines of parts to show the position of each unit.

Make a template the same as Fig. 3, the exact size of your panel, and mark on it all the holes required to mount your instruments. All that is necessary to locate the holes is to place the panel directly beneath the full-size

- Hole 8D— $10\frac{1}{4}$ and 3 15-16.
- Hole 8E—11 and $2\frac{1}{2}$.
- Hole 8F— $10\frac{1}{4}$ and 2.
- Hole 9— $13\frac{1}{4}$ and $4\frac{1}{2}$.
- Hole 10— $13\frac{1}{4}$ and $3\frac{1}{2}$.
- Hole 11— $13\frac{1}{4}$ and $1\frac{1}{2}$.

How to Drill the Holes

A simple hand drill that will take drills up to $\frac{1}{2}$ inch, a few drills and a countersink are all that are required to drill the panel. The drills required are No. 31, No. 28, No. 18, No. 10, $\frac{3}{8}$ -inch and 7-16-inch.

If you do not expect to use the drills again for building other sets and do not care to go to the expense of getting the large hand drill and large drills, you can get along with a hand drill that can hold drills up to $\frac{1}{4}$ inch in diameter and a drill assortment consisting of a No. 31, a No. 28, a No. 18, a No. 10 and a $\frac{1}{4}$ inch one. The larger holes can be made by first drilling with a $\frac{1}{4}$ inch drill and then enlarging the hole with a small round file.

Before drilling a hole, be sure that you have the proper hole and have not mistaken it for another. It is always a safe policy to drill the smallest holes first so that if you drill a hole with the wrong-sized drill by mistake, it is a simple matter to redrill it with a larger drill. If you drill a hole too large, it is almost impossible in some cases to remedy the error.

Holes 21A, 21B, 21C, 4A, 8A and 8F should be drilled with a No. 28 drill.

All the rest of the holes, with the exception of holes 1, 2, 3, 9 and 10 should be drilled with a No. 18 drill.

Holes 1, 2, 3, 9 and 10 should be drilled with a No. 10 drill.

Holes 4C, 5B, 7B and 8B should be redrilled with a $\frac{3}{8}$ -inch drill.

Holes 6 and 11 should be redrilled with a 7-16-inch drill.

Holes 4B, 4D, 8C, 8D and 8E should be countersunk on the front of the panel to fit the flat head mounting screws provided with the variocoupler and condenser.

The exact location of the parts which are mounted on the baseboard is not important. They can be mounted in approximately the positions shown in the layout, Fig. 4.

How to Mount the Parts and Wire the Receiver

Before the parts are mounted on the panel and baseboard a few slight changes will be necessary in order to get the maximum possible efficiency from the circuit.

Hold your variocoupler in a position such that you are looking at the rear bearing with the axis of the stator coil in a vertical position and the mid-point tap terminal of the stator winding to your right. In this position one-half of the stator winding is above the bearing and the other half is below it.

To use the variocoupler in this circuit it is necessary to remove about half the number of turns from the rotor winding.

These turns can be removed very easily by unsoldering one end (either end will do) of the rotor winding from

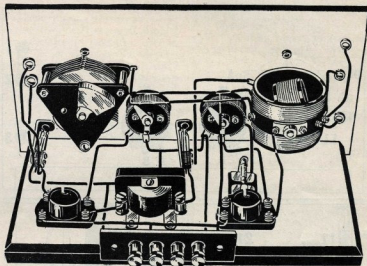
the terminal to which it is soldered, unwinding the turns on one half of the rotor, cutting the wire with sufficient left over to make a single turn around the emptied half of the rotor and soldering the new end to the terminal from which it was unsoldered.

An additional terminal A is provided on the stator in the space between the two halves of the stator winding at a point shown by terminal A of variocoupler 4 in the baseboard layout.

This terminal is for the top end of the aperiodic primary that is wound

surrounding good contact between rotor plates and rotor plates terminal on the condenser and between the shaft connections and the terminals of the variocoupler and bend the washers slightly, so that there is plenty of spring in them, thus making good contact doubly sure.

The soldering lugs which are used on the terminals should be tinned with solder before being fastened to the various terminals. If this is done you will have no trouble with loose connections later as a result of the loosen-



Rear view of the two-tube regenerative set described herein. This set is one which will give excellent results if properly built and operated.

on the bottom half of the stator winding. This aperiodic primary coil should consist of twelve turns wound over the bottom half of the stator winding.

The top end of the aperiodic antenna winding or primary coil is run through a small hole at the middle of the stator, near terminal A and soldered to terminal A on the inside of the stator tube. The other or bottom end of the coil is run through the same hole through which the bottom end of the stator winding goes and is soldered to the same terminal to which the bottom end of the stator coil is connected, namely terminal B.

Before mounting the parts it is good practice to check up each point where there is any possibility of trouble. Remove the top locknut of the sockets and tighten the nut and screw to make sure that there will be no chance of poor contacts later impairing the efficiency of the set.

Also go over the terminals on the variocoupler, the variable condenser, the rheostats and the transformer to be sure that all connections are well-made both mechanically and electrically.

Then take the shaft stop collars from both variocoupler and condenser, take off the spring washer which in-

ing of the connections, due to the application of too much heat in soldering. When the terminals have been tinned with solder, a mere touch of the soldering iron is sufficient to cause the solder to flow quickly and adhere firmly.

The mounting of the parts on the drilled panel is so simple that it is not necessary to take up considerable space here to describe the operations in detail.

The assembled battery binding post panel is mounted on the baseboard so that when a rectangular hole the size of the binding post panel is cut into the back of the cabinet, the outside face of the binding post panel will be flushed with the outside face of the back of the cabinet.

The wiring of the receiver is a very simple matter. The parts and terminals have been so arranged that all connections between them are as short and direct as it is possible to make them and all the parts can be wired together very easily by short lengths of bare, round, bus bar wire using right-angled bends wherever necessary.

A good general idea of the way in which the wires are placed to avoid close coupling between various circuits and eliminate capacity effects and howling can be gained by studying the

photograph of the wired receiver in Fig. 2. To avoid skipping connections, underline each instruction as you make each connection.

To avoid capacity effects and howling in tuning the set, the directions for connecting the stationary and rotary plates of the variable condenser into the circuit should be followed very carefully. The stationary plates terminal of the condenser is designated by the letter A and the rotary plates terminal by the letter B.

For soldering, use a rosin core

secondary winding of transformer 15 and the negative A battery lead.

Terminal 20 should then be used as the positive B battery terminal of the detector stage and should be connected only with spring D of jack 6.

Another binding post should then be provided to act as the positive B battery terminal for the amplifier stage and this terminal should be connected with the D spring of jack 11. In that case of course there should be no connection between the D spring of jack 6 and the D spring of jack 11, as is the

Next connect in turn, the negative A battery terminal 17; the A terminal of rheostat 5; the B terminal of rheostat 7 and the S1 (beginning of secondary winding) terminal of transformer 15.

Now connect together the D spring of jack 11 and the D spring of jack 6 and join this connecting wire with the positive B battery terminal 20.

Then connect the F terminal (front mounting bracket terminal) of the rotor coil of variocoupler 4 with the A spring of jack 6.

The C spring of jack 6 should be connected with the P1 (inside end or beginning of the primary winding) terminal of transformer 15.

The B spring of jack 6 should be connected with the P2 (outside end of the primary winding) terminal of transformer 15.

Next connect the A terminal of grid condenser 13 with the top end, terminal C of the stator winding of variocoupler 4.

The B terminal of grid condenser 13 should be connected with the G terminal of socket 14.

To avoid confusion in designating terminals, one filament terminal of each socket has been marked F1 and the other F2. In the sockets themselves both terminals are marked F.

Then connect the F1 terminal of socket 16 with the F2 terminal of socket 14. The connecting wire should then be connected with the negative B battery terminal 19 and the positive A battery terminal 18.

The rotary plates terminal B of variable condenser 8 should then be connected with terminal B of variocoupler 4, and with terminal 3.

A wire should then be used to connect the connecting wire just mentioned with the wire that connects the F1 terminal of socket 16 with the F2 terminal of socket 14.

Now connect the stationary plates terminal A of variable condenser 8 with terminal C of variocoupler 4.

The B terminal of rheostat 5 can then be connected with the F1 terminal of socket 14.

The A terminal of rheostat 7 should be connected with the F2 terminal of socket 16.

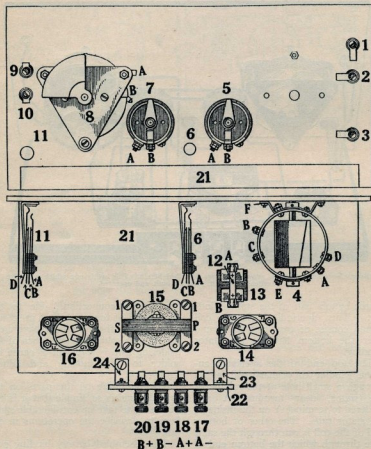
Then connect the P terminal of socket 14 with the rear bearing terminal E of the variocoupler 4. The rear bearing makes contact with the other end of the tickler or rotor coil winding.

Next connect the S2 (outside end of the secondary winding) terminal of transformer 15 with the G terminal of socket 16.

The P terminal of socket 16 should be connected with the A spring of jack 11.

The B spring of jack 11 should be connected with terminal 9.

The C spring of jack 11 should be connected with terminal 10.



Complete panel and baseboard layout of the receiver showing how the parts are mounted. At the top is a back view and below a top plan view.

solder such as Kester's Rosin-Core Solder, a good electric soldering iron if possible, and a liquid flux to make the soldering easier. I have found a flux made by dissolving $\frac{1}{4}$ oz. of powdered rosin in $\frac{1}{2}$ oz. of medicated alcohol very useful in soldering. A small brush can be used to apply the flux to the joint.

If more than 45 volts are to be used for the amplifier tube for greater volume it will be necessary to use a C battery and separate positive B battery terminals for detector and amplifier stages.

A C battery of the $4\frac{1}{2}$ -volt flash-light type may be inserted in the circuit between the S1, beginning of the

case when only one terminal is used for both. Another way of providing the additional connection without using another binding post is to disconnect binding post 18 from binding post 19 and use binding post 18 as the positive A and negative B battery terminal. Then binding post 19 can be used as the positive B battery terminal for the detector stage and binding post 20 as the positive B battery terminal for the amplifier stage.

To wire the receiver described in this article begin by connecting the A terminal or variocoupler 4 with terminal 2.

Next connect the D terminal of variocoupler 4 with terminal 1.

This completes the internal wiring of the set. The battery connections should be made as follows: The negative terminal of the A battery should be connected with terminal 17; the positive terminal of the A battery with terminal 18; the negative terminal of the B battery with terminal 19 and the positive terminal of the B battery with terminal 20.

How to Operate the Set

The actual operation of the set is very simple, but the aerial and ground connections to the set will call for some explanation. The set can be used as a single circuit receiver by connecting the aerial wire with binding post terminal 1 and the ground with binding post terminal 3. If you consult the wiring diagram you will see that what this does is to connect the aerial with the mid-point tap of the stator winding, with the aperiodic coil out of the circuit entirely. If you do not care to wind the coil on the standard coupler, this type of receiver will be a very simple one to construct. When used to listen to local stations this arrangement may be used only with a very short antenna, an inside wire about eight to ten feet long. If you connect the aerial with binding post 2 and the ground with binding post 3, you have a three-circuit hook-up with an aperiodic primary; a fixed secondary tunable with the variable condenser and a variable tickler coil in the form of the rotor of the coupler. This type of circuit is very selective, but is rather critical in tuning. In many cases local stations can

be tuned in without any aerial, using only a ground connection to binding post 3. In order to avoid causing squeals in your neighbors' sets all that you have to do is to exercise a little care in tuning your set or in changing from one station to another. Before you change to another station, decrease the tickler coil coupling by turning the rotor back slightly before you change the setting of your condenser. You can then change your condenser setting and bring in another station without causing the squeals. After you get the best setting with the condenser you can increase regeneration by adjusting the tickler coil carefully until you get maximum signal strength without causing the set to break into the disturbing squeal. When you change from the detector to the amplifier stage a slight adjustment of the tickler coil will usually be found necessary.

List of Parts Required for Construction of the Set.

- Radiation panel, 7 x 14 x 3-16 inches.
- Wood baseboard, $\frac{3}{8}$ inches thick, 13 inches long, and $6\frac{1}{4}$ inches wide. The width of the baseboard will depend largely on the depth of your cabinet and should be made to suit the cabinet.
- Cabinet for a 7 x 14 panel.
- General Radio type 268 variocoupler.
- 10 feet No. 22 D.S.C. wire for winding extra coil on variocoupler.
- General Radio, type 247-K, .00025 mfd., variable condenser.
- 2 General Radio, type 301, 30 ohm rheostats.
- 2 Carter, type 104, double-circuit jacks.

General Radio, type 302, Vernier dial for variocoupler.

General Radio, type 310, dial for variocoupler.

General Radio, type 299, tube sockets.

General Radio, type 231-A, audio frequency amplifying transformer.

1 Dubilier, .00025 mfd. grid condenser with grid leak mounting clips.

1 Dubilier, 3 megohm grid leak.

1 Radiation binding post panel, cut to $4\frac{3}{4}$ inches.

9 General Radio, type 138-Y, binding posts.

2 Brass angle brackets, made of 1/16 inch thick brass; $\frac{1}{2}$ inch wide, length of each leg 1 inch. One No. 28 hole should be drilled $\frac{3}{4}$ inch from bend on one leg and another No. 28 hole should be drilled $\frac{5}{8}$ inch from bend on the other leg.

7 1-inch No. 6 round-head brass wood screws for fastening panel and sockets to baseboard.

6 $\frac{3}{4}$ -inch No. 6 round-head brass wood screws for fastening transformer and binding post panel assembly to baseboard.

6 $\frac{3}{8}$ -inch 6/32 round-head brass wood screws for fastening soldering lugs to grid condenser terminals; to serve as terminals for the ends of the primary coil, and for fastening binding post panel to mounting angle brackets.

6 6/32 hexagon brass nuts for points where the $\frac{3}{8}$ -inch 6/32 screws are used.

2 dozen General Radio soldering lugs with 6/32 clearance hole.

5 lengths round bus bar wire.

6 inches Kester rosin-core solder.

Protecting Your Loud-Speaker

(Continued from page 14)

dealt with, the latter arrangement usually gives more satisfactory results than when no filter is used.

Parts Required

In the construction of the unit the following parts were used:

One panel 6 in. by 6 in. by $\frac{1}{4}$ in. thick.

One case to take above panel, 6 in. by 6 in. and any suitable depth to take the components on the panel.

One choke.

One 2 μ F fixed condenser.

One double-pole change-over switch.

One condenser. The value of this condenser will depend upon the type of loud-speaker to be used.

Four terminals.

Quantity of 16 gauge tinned copper wire for wiring.

Seven $\frac{1}{2}$ inch machine screws and nuts.

2 $\frac{3}{4}$ in. machine screws and nuts.

Drilling and Mounting

No difficulty will be experienced in mounting the parts on the panel, as these are all held in position simply by screws through the panel, and nuts. Ample room is left inside to carry out the wiring, and to permit of the condenser across the phones being readily changed. Wiring is carried out with 16 tinned copper wire, and from the diagram no trouble should be experienced in this part of the construction. The change-over switch is simply mounted by means of three screws, while a further two have been used as

stop-pins to allow the switch contact to make correctly.

Connections

To connect the unit to the set, the two terminals on the left-hand side of the panel are connected to the phone terminals of the set, that marked plus going to the plus terminal. This latter is always identified by the fact that it goes directly to the high-tension supply. The loud-speaker is connected to the two left-hand terminals on the panel marked "loud-speaker," the plus of this latter being connected to the terminal marked plus on the right-hand side.

With the switch in the position marked "out" the loud-speaker is correctly connected to the set, while with the switch in the "in" position the filter circuit is brought into operation.

The "Luludyne" Receiver

A Radio Set Designed In Honor of a Beautiful Girl Named Lulu

HERE'S a receiver that has romance connected with its coming and it surely appears to be worthy of consideration by the home radio constructor. *Simon Kahn*, the author, gives the story in *The Experimenter* as follows:

"Oh, for something more exciting!" mused Lulu, as she sighed, with restless ease. "This monotonous drone of rise early, dress quickly, swallow breakfast, and then race for the subway in a determined effort to get to work—on time or otherwise—is simply getting on my nerves!"

Versatile Lulu!

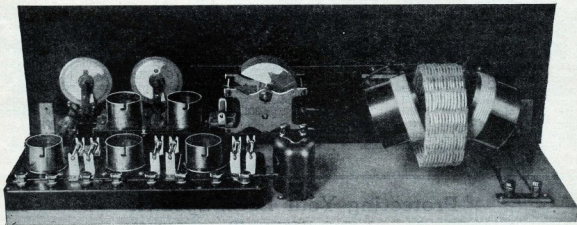
sing, and, if I may be allowed to use the familiar phraseology, she can "pound brass" as well as the regular he-man operator.

But with all these diversions, Lulu was restless. Life was becoming just one dull affair after another. Not that she lost interest, nor was bored, but because events seemed to follow in a fixed sequence. Her date book was usually filled for several weeks in advance, and if perchance something transpired to interfere with her plans, she still managed to fulfill all obligations.

Would she care to play tennis this

diversity of activities which fell to her lot, she was constantly yearning for something else, some new thrill.

It is rarely that one's wishes and desires are granted and fulfilled to such a large extent as were Lulu's. She usually got what she desired, although she had to work very hard for it. Her grit and determination, combined with an exceptional power of will, soon overcame seemingly impossible situations which might have caused consternation and bewilderment for a man. But in the face of all this she never lost her temper or became angry. To become provoked was not in her constitu-



Illustrations by Courtesy of *The Experimenter* (New York)

Rear view of the famous Luludyne. Note the exceptionally well balanced layout and arrangement of apparatus. Of especial interest are the relatively short leads connecting the various instruments and the separation of the tuning unit from the rest of the set so as to prevent losses by absorption and interaction. The grid leak and grid condenser are connected directly from the tuning condenser to the grid post of the detector tube. This is a vital consideration where efficiency of the highest order is to be maintained.

Besides the theatre, the art galleries, the chase, the various social functions with their innumerable dances, and a host of other things to take up her time, Lulu had nothing to do except spend an occasional hour in learning the intricacies of radio and practicing the code. In truth, what Lulu could do with two hands, few could do with four. Agile, alert, robust and strong, beaming with a radiance that fairly emanated the health of youth and vitality; her figure—divine even as that of Venus; her hair, a world of it, more lustrous by far than Diana's; her eyes—softer and more brilliant than Helen of Troy's; her lips—rubies that shone resplendently, more beautiful than Cupid's bow at its best. Such was Lulu—and more, yes, much more. For Lulu can cook, she can sew, she can

afternoon? No, that would hardly do. Horseback riding came first. Would she like to go swimming some time next day? Sorry, but an engagement to entertain at tea would prevent that. And so on and so on.

To say that Lulu was pampered would not do. She simply wasn't.

True, she had found the study of radio both timely and interesting. For had she not been tutored, in her spare time, by her friends who had followed the progress of the so-called wireless since the early days? Fascinated by the art, she became enthused to such a degree that she finally mastered the code, and it really is wonderful to see her copying at "30 per" with a nonchalant air about it.

But Lulu was quite disappointed. Enthralled though she was with the

tion. Yet, pity the one who wilfully violated her rights!

Frank is one of the sort that can stretch the rather vivid imagination beyond the limit of elasticity and then go a step further. Many a time and oft he repeats the episode of the "flying bull"—when he was able to receive such stations as Nauen, Moscow and Yokohama on a crystal set using a loop antenna during a severe thunderstorm. So he solemnly swears, but little does he dream that Fred, of whom we shall hear more shortly, "fixed" him that evening. (Please don't be too previous. It was nothing to drink.)

For Frank to sit down and work out a problem with pencil and paper was an impossibility, and he admitted it. Strange to relate, he could diagnose a cause and source of trouble in the most

perplexing complications, but when confronted with the simplest rudiment, he failed completely to account for anything, except for the fact that he knew he didn't know! Ordinarily, Frank is a high-strung individual who, being temperamental in the extreme, is a fine specimen of a handy man around the house. He is carpenter, plumber, artist and painter, electrician and hod carrier, all in one. But above all, he is an accomplished radio man, adept to a great degree in building, wiring and installing sets. His handiwork is most pleasing and he takes no small pride in his products. In the vernacular, he gets great enjoyment in telling the "cock-eyed world" about his achievements. However, one cannot blame him, because his work is really exquisite and he is continually trying to improve it. And he did try very hard at a special occasion, with most gratifying results. But wait, we shall see later.

Some say that Frank was too busy with his work to think of anything but radio. Others say that he was constantly dreaming of new worlds to conquer. Of these, the latter are correct in their assertion. Frank was a born dreamer. Not that he wasted his time in deep somnambulistic trance, but he strove in utmost fashion to create things worth while. He would start with a spurt, all elated over the prospects on the outcome of some certain project, and then invariably fail to complete it until after too long a time had elapsed. His inspiration seemed to fade out soon, distressing him sorely. How to relieve the situation was beyond his power.

With serious intent, Fred began a lengthy lecture on the benefits of recreation, its effect on stimulating the mind, the body—and the reaction on the pocketbook.

It did not take Frank long to see the point, a very literal transition indeed, for the next week-end saw them both down at Rockaway Point, enjoying themselves and glad to leave the turmoil of the city.

"I must introduce you to Lulu and the gang," was the opening remark made by Fred when they got there. For Fred and Lulu had been great chums for many years, and by putting two and two together, Fred figured that no small amount of fun was in prospect.

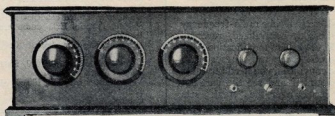
Did you ever meet a fellow who was good looking—a regular fellow in every way who was as "straight as a string"? Did you ever have need of a friend who could be depended upon, be thoroughly trusted and do more for you than justifiable expectation could demand? No less than such a friend was Fred. Muscular, powerful, well built, with a mind that could think quickly and clearly under the most adverse conditions, Fred was truly a super-man.

Fred was an old-timer in the radio game. He first became interested when announcement was made of Marconi's successful trans-oceanic experiments. The next day, and for several months after, he could be found listening-in, in his spare time. He admits that about all he heard for two months was the 60-cycle A.C. hum from the nearby transmission line. Yet, his persistence, adroitness and general enthusiasm kept him at it, and so after many a moon had passed he was rewarded for his patience by the strains of melodious open-gap spark signals from a ship that happened to be in the immediate neigh-

beat his efforts and thus made up his mind to do his very best.

Both set to work and prescribed a certain date upon which they were to compare their craftsmanship—on that date the virtues and outstanding qualities of their work would be revealed.

With a diligence and persistence that is part of his complex anatomy, Frank carefully rounded his receiver into shape, and then when he finally exhausted everybody's patience, appeared on the scene at the last moment and, with his well-pronounced ego, acclaimed himself conqueror of con-



A front view of the Luludyne as it appears when completed. Although this set has three tuning controls it is not difficult to tune.

borhood. From that time on he and radio have been inseparable. What has gone before is forgotten history, as it would take several volumes in order to put down all the escapades, trials and tribulations which were Fred's. You will recall that I mentioned that Fred listened-in in his spare time. Verily, but his teacher must have thought all his time was spare, as Fred had the happy faculty of forgetting to go to school, and often remained at his wireless contraption all day long. But men change with time, and although the proverb states that men are but grown-up children, Fred was the exception that proves the rule.

The meeting was pleasant, one which I shall not forget soon. I can remember Frank, with face beaming, Fred with flustered cheeks and Lulu with a twinkle in her eyes that fairly teemed with mischief.

A short time later found Frank raving to Fred about how charming Lulu was. After Frank winded himself—he must have been speaking for several hours—Fred quietly told him that he knew all about it and more. You can imagine Frank's consternation!

Noticing the conspicuous absence of a radio set in the bungalow, Frank suggested that he should bring one up the next week-end. On second thought, he didn't have one which would serve the purpose. Frank usually gets bright ideas, but Fred has the knack of getting brighter ones, so the "four-letter crossword puzzle" suggested that they each build one in Lulu's honor which would do her justice.

It was an excellent idea, thought Frank, and he was in rapturous ecstasy. He knew that Fred was determined to

quero. And he had SOME set with him! Knobs and dials galore; switches and meters and bezels; pilot lights, petite clock and panel lamp—all decorating the panel and giving it a resplendent air.

Fred had already surmised what Frank was going to create—a veritable bunch of *junk*—an expensive array of entirely and wholly unnecessary apparatus which, although improving the appearance of the radio set, did not in any way improve its operation, its simplicity of control, or its distance-getting ability and quality of reproduction. Frank's set was a five-tube tuned radio frequency affair, which, after a brief test, was no mettle to Fred's, for Fred had produced a set which was also *some* set!

With a unanimity that was spontaneous, the glory of the occasion went to Fred, who named his receiver "The Luludyne." Even Frank bowed in acquiescence. He had been beaten and Fred's masterpiece, *The Luludyne*, entered the Valhalla of Fame.

It certainly does "produce the goods," and if you could see Lulu twirl the dials in exuberant delight! She has finally found a diversion of which I am glad to say she will never tire. At least she told me so. And as for Fred, he is more than content to build Luludynes for his appreciative and thankful friends and neighbors. He'll build one for you, too.

Constructional Details of the Luludyne

The Luludyne, as can be seen in the accompanying photos and diagrams, consists of a low-loss regenerative tun-

ing arrangement to which audio-frequency amplification of the highest quality is added. One stage of transformer-coupled and three stages of resistance-coupled amplification comprise the faultless amplifier which gives such splendid reproduction.

It is surprising to note with what regularity and clarity distant stations can be brought in. And the other great features of the set are that, first, it is primarily a single-control set, in which the added optional controls of antenna coupling and tickler feed-back adjustment, for the reception of local stations, are incorporated. It thus becomes a simple matter to accurately "log" stations.

Alongside a five-tube radio-frequency circuit, straight, neutralized, reversed feed-back or other modification, the Luludyne can easily run rings around it. To be convinced, you need but build one for yourself and see the vast superiority it has over the "freak" sets now on the market.

It is the conviction of the author that the three-circuit tuner and the very excellent audio frequency amplifier as described, added to it, make it the very best radio receiver that has as yet ever been built.

The tuning unit will be described first. The primary and tickler coils are

into a purely single control, the .0005 tuning condenser providing ample accuracy and ease of tuning. Note from

PARTS NEEDED

- 1 7 x 24-inch panel.
- 1 6 x 22-inch baseboard.
- 1 Lopez low-loss coupler.
- 1 General Instrument low-loss .0005 mfd. condenser.
- 5 Standard sockets.
- 1 20-ohm Yaxley rheostat.
- 1 6-ohm Yaxley rheostat.
- 1 Federal double circuit jack.
- 1 Federal single circuit jack.
- 1 Cutler-Hammer key type filament switch.
- 3 4-inch dials.
- 1 .00025 mfd. grid condenser.
- 1 2-meg. grid leak.
- 3 Dubilier .006 fixed condensers.
- 1 $3\frac{1}{2}$ to 1 ratio Erla audio transformer.
- 2 Rasco binding post strips.
- 7 Binding posts.
- 3 Vebey grid leaks, 1,000,000, 500,000, 250,000 ohms.
- 3 Vebey resistor couplers, 100,000 ohms each.
- 1 Cabinet.

the photo that the tuning coupler is placed away from any other apparatus. This in itself prevents any undesirable feed-back and allows perfect control of regeneration.

Proceeding from the detector tube, the next device is the audio transformer. This must necessarily be of a

cuit. It is, therefore, better to satisfy one's self with lesser volume and greater clarity will then ensue.

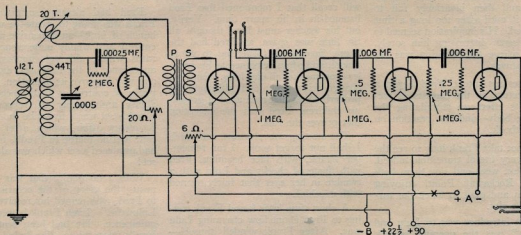
The resistance coupled amplifier has long been known for its superior reproducing qualities. The three stages incorporated into the Luludyne have proved no exception to the rule and do their work to perfection.

Nothing more need be said concerning the amplifier except that as little deviation as possible from the given values be allowed.

One 20-ohm rheostat is used for the detector tube and affords an extremely fine control of filament current. For the amplifier tubes, a 6-ohm rheostat furnishes sufficient degree of control.

Note the slight length of the wire leads from the grid leak and grid condenser to the grid terminal and tuning condenser, respectively. In fact, the word length cannot be properly used, for the connections are direct to the terminals themselves, no wire being used. This is a salient feature that goes a long way in keeping the efficiency of the set at its highest.

From all outside appearances the



The circuit employed by the Luludyne. It consists of a three-circuit regenerative detector, a single stage of transformer coupled and three stages of resistance coupled audio frequency amplification. It gives splendid results.

both wound on a rotor form, 3 inches in diameter. Twelve turns of No. 16 D.C.C. constitute the primary winding. The tickler coil has twenty turns of No. 22 D.C.C. For the secondary, which is wound in the well-known low-loss method, forty-four turns of No. 12 D.C.C. comprise the coil formed by thirteen pins placed in a $4\frac{1}{2}$ -inch diameter circle.

The coupling of both the primary and the tickler coils can be varied by means of a shaft attached to the rotor form of each. The tuning is resolved

low ratio, one in the order of 3 to 1 serving the purpose very nicely. If a higher ratio is used, slightly better amplification may result, but the control of regeneration becomes hampered and the quality of the music may be affected.

It will be found best to employ no more than twenty volts or so as plate voltage for the detector tube. Remember, a small overload or slight distortion in the detector tube circuit becomes greatly amplified in the amplifier cir-

Luludyne looks exactly like a neutrodyne, but as a matter of fact it is by far superior, both in performance, looks and all-around efficiency. It is one set which its owner can truthfully acclaim as the best.

All the parts of the very best materials can be procured for less than thirty-five dollars, and this incentive of low cost for such an exceptional receiver should prove a dominant factor in persuading you to duplicate it.

induced are as effective as one can accomplish, hence the Thordarson-Wax set will rank among the foremost DX-getters it is possible to construct at home.

The regeneration control is smooth and the settings on the C3 dial are spread out. This is due particularly to capacity means employed for varying the regeneration. Even with the semi-circular plate type of variable condenser, known as straight-line capacity, this spreadout on the lower waves is probably a little better than with a tickler used for inductive feedback. But to gain even a greater distribution a straight-line wave-length condenser was used. Normally this would not constitute much of an improvement over the semi-circular plate type, but the particular condenser employed has a 360-degree-rotation dial, hence the surface of the dial affords greater separation between low wave-length assignments even than would a straight-line frequency condenser, where the conventional 190-degree dial is used.

The approach to the oscillation point is very gradual. In fact, one can sense the excessive condition before it actually demonstrates its existence in the form of a squeal. Radiation is thus curtailed.

With the proper inductances the set will tune from about 180 meters to about 600 meters, provided condensers of low minimum capacity are used. This refers to the wave-length tuning capacities, C1 and C2. The regeneration control, C3, keeps apace with these to a marked degree. In other words, if the set will tune a given range the regeneration may be relied on for that belt, too. As the practical wave-length belt of broadcasting stations is from 209 to 545 meters it can be seen that the range of wave-lengths will be more than amply covered.

Coil Connections

The coils are connected as indicated in Fig. 1, the electrical diagram of the wiring shown schematically. Also the coils may occupy the relative positions as shown, L1L2 being horizontal and L3L4 vertical.

Tracing the coil connections, aerial goes to the beginning of L1, ground to the end. A minus connects to the beginning of L2 (which adjoins the end of L1), while the end of L2 goes to the grid. The stator plates of C1 connect to grid, too, while the rotor plates go to A minus. The other RF transformer, or interstage coupler, is connected with beginning of L3 to plate, end to B plus, beginning of L4 to rotor plates of both C2 and C3, tap to A plus and end of L4 to grid condenser and to the stator plates of C2.

The radio side of the circuit requires no special precautions, beyond connecting the coil terminals correctly and mounting the coils at minimum or zero stray inductive coupling. The up-

right position may be preferred by some for L3L4, but the horizontal position may be maintained for it, as well, provided right-angle mounting, in respect to L1L2, or other angle for preventing unwanted feedback, is followed. The photographs show both coils mounted horizontally, but with axes at right angles.

The AF Hookup

In the audio circuit are a few important factors. For best quality the blocking condensers should be large. No smaller capacity than 0.25 mfd. should be used. It is safe to use up to 4 mfd., but the larger capacities are rather bulky and expensive, and 0.25 mfd. was used as a compromise between price and size, while still maintaining good quality. Do not use .006 mfd. blocking condensers in this hookup.

In Fig. 1 you will notice that a leak is placed in the grid to filament circuit of each of the three audio tubes. One of them is variable and is in fact a potentiometer of 500,000 ohms maximum (0.5 meg.). The grid is connected to the pointer and the two remaining potentiometer terminals respectively to the 0.25 mfd. condenser and to C battery minus. By turning the arm the resistance is changed. The higher the resistance in the circuit, the lesser the leakage path from the grid, hence if any tendency toward excessive volume exists at the expense of quality, turn the potentiometer to a lower setting, to allow more of the excess charge to leak off the grid of the tubes.

The question arises as to why the variable control or volume regulator is placed in the second audio instead of in the first. One good reason is that independent volume adjusters exist in prior tubes—R1 for RF, R2, R4 and C3 for the detector. It is always the better practice to regulate volume ahead of the AF, where practical. But supposing that the control is not ample, i. e., some overloading of tubes takes place in the audio stages. The first AF tube has been regulated as well as possible by the rheostats, variable detector leak and the regeneration control, too. Hence it is logical to have the potentiometer in the second AF tube, the idea being to check the strain at the earliest practical stage where it occurs and where no compensator exists. Should the potentiometer fail to check choking effects, the final leak may be less than the prescribed 0.5 meg., 0.1 meg., being safe. Ordinarily the AF hookup will be very fine just as diagrammed, with the constants as given. But in this particular set the radio-frequency amplification is so strong that any tendency toward overloading that might exist in any other set is present here. However, as the solution is unailing there is nothing to worry about.

The manner of connecting the auto-transformers is identified in Fig. 1.

There is a single tapped winding. The beginning of the winding goes to the blocking condenser joined to the grid of the succeeding tube, the tap goes to plate of the preceding tube and the end of the winding to B plus. The posts are marked on commercial products. The primary part of the winding has a core, just as has the secondary, in fact, it is the same core.

The B battery voltages and also the C battery value can not be given as standard for all cases. For the detector plate connect the 45-volt tap of the B battery block, but this voltage may be even 67½ for greater volume and richer tone. Try both and even other voltages, higher and lower. Any tendency of the set toward over-oscillation may be checked by reducing the experimental B battery voltage here. The B posts of the two remaining auto-transformers are connected to B plus 135 volts, and this may be taken as standard, although the grid bias should be varied from 6 to 12 volts. It is assumed that the 201A type tube is used throughout. The bias that is theoretically correct for minimum B battery consumption and maximum grid response can not be always accepted as best from a quality viewpoint, and one may determine the C voltage on the basis of auditory effects alone.

The set is to be operated exclusively on a speaker, hence no provision is made for a detector tube listening post.

The overloading that takes place, and which is entirely curable, is not due to the form of coupling at all, but to the limitations of tubes. Of course, much of this strain can be more simply averted by using high-Mu tubes in the first and second audio stages (tubes 3 and 4). Instead of 6 to 8, the normal Mu of the 201A, etc., you would have about 20. Such a high-Mu tube must not be used in the final audio stage, but the 201A type or a special last-stage Mu tube being employed. The regulation high-Mu tube in the final audio stage cuts down the volume and injures tone quality.

The 1.0 mfd. fixed condenser that by-passes the RF current around the batteries is optional and if a small condenser is in mind for use here it certainly should be omitted, for only a large one serves the purpose.

The Adjustable Factor

Looking over the variable factors in the set we find the following:

- (1) The tuning condenser C1 regulating wave-length.
- (2) The tuning condenser C2 regulating wave-length.
- (3) The regeneration condenser C3 regulating feedback.
- (4) The rheostat controlling the RF tube.
- (5) The rheostat controlling the detector tube.
- (6) The grid leak controlling the dis-

Every one of these is a volume regulator. But not every one ranks as a control. Once the detector grid leaks, the potentiometer and the two rheostats are set they may be left that way. Hence remain only the three tuning controls or radio-frequency elements.

The Coils

The same number of turns on about the same diameters, using the same kind of wire, will give approximately the same inductance in all cases and will enable tuning to be satisfactorily accomplished with .0005 mfd. variable condensers across the secondaries and a .00025 mfd. variable condenser for feedback. The tuning condensers are C1 and C2, while the regeneration condenser, .00025 mfd., is C3. These are shown in the schematic diagram of the wiring, and also in the picture diagrams (Figs. 1 and 2).

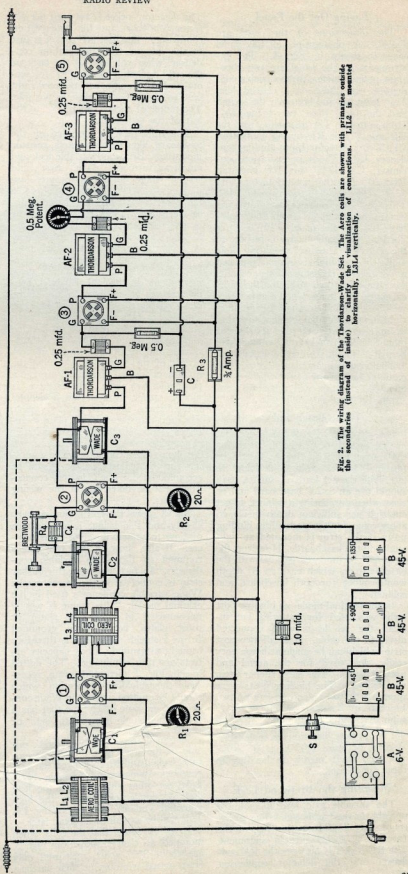


Fig. 2. The wiring diagram of the Theoderson-Wade Set. The Acro coils are shown with primaries outside the secondaries (instead of inside) to clarify the visualization of connections. L1L2 is mounted horizontally, L3L4 vertically.

Laying Out the Panel

The dimensions of the panel are 7x24". A photograph of the panel view is shown in Fig. 4. The instruments on the panel are two rheostats, potentiometer, three variable condensers (all these on a central line, $3\frac{1}{2}"$ from top and bottom), the switch and the jack, these two being $1\frac{1}{2}"$ from bottom. The distances from the left are 3", for RF tuning condenser, C1, 8" for detector input tuning condenser, C2; 13" for regeneration condenser, C3; $17\frac{1}{2}"$ for RF rheostat, R1; 20" for the potentiometer, and $22\frac{3}{8}"$ for the detector rheostat, R2. This leaves the center shaft of the detector rheostat $1\frac{1}{8}"$ from the right-hand side of the panel. The jack is lined up perpendicularly in respect to the detector rheostat mounting hole while the switch S is similarly placed under the RF rheostat. This accounts for everything that will be on the panel excepting two items. The dial pointers will be mounted so that the point is right next to the dial, but not touching it, in each case, and the screws for mounting the panel on the cabinet will be placed so six are evenly distributed.

The panel instruments should be mounted before any of the wiring is attempted, and this will therefore constitute the first assembly job.

The Baseboard

One may use a 7x23" baseboard, but in that case there will be no room for the conventional binding post strip or terminal block. Those desiring to terminate the set leads at such a strip should use an 8x23" baseboard and be sure, when purchasing a cabinet, to get one that has sufficient depth inside, to allow room for the protruding binding posts if the strip is mounted at right angles to the baseboard. However, the strip may be mounted parallel with the baseboard, in which case an 8" depth would suffice for both baseboard and cabinet.

In the original model, no binding post strip was used for batteries but instead the set leads were connected direct to the cable. A small two-post strip, which can be made at home very easily, was used for the aerial and ground leads. The hard rubber strip was $1\frac{1}{2} \times 2\frac{1}{2}"$. The binding posts were mounted thereon, also one end of two brackets or Z-angles, which were $\frac{3}{4}"$ high and had two end tips extending $\frac{1}{4}"$ angles to the $2\frac{1}{2}"$ legs, but in opposite directions to each other. A piece of brass $1\frac{1}{4}"$ long, $\frac{1}{2}"$ wide, will lend itself readily to bending to these dimensions.

Mounting the Bretwood Leak

The variable grid lead is mounted upright on the baseboard. The socket centers are $2\frac{1}{2}"$ from the back of the panel. All sockets are in alignment. The RF socket is between the RF condenser and the detector condenser.

The detector socket is between the detector condenser and the regeneration condenser. The first AF socket is just to the left of the regeneration condenser, when you look at the back of the set. Sockets (4) and (5), for second and third audio, are mounted right next to each other, as close as possible. The center of socket (4) is $2\frac{1}{2}"$ to the left of the switch shaft hole.

The coils may be mounted on the baseboard, likewise the sockets, resistor mountings, Bretwood variable leak and auto-transformers. The first and second stage auto-transformers are mounted parallel with the panel, while the third and last one is at right angles to the others. (Fig. 3.) One of the by-pass condensers (all large-capacity fixed condensers go by that name) may be mounted on top of the final auto-transformer, and it is perhaps preferable that this be the last .25 mfd. instrument, so that the 1.0 mfd. condenser may be mounted to left of the jack, looking at the set from the rear. This leaves two by-pass condensers to be accommodated, both .25 mfd. One is placed on top of the first auto-transformer and the other mounted upright at left of the second AT, so that the greater room will be taken up on a perpendicular plane, where there is plenty, rather than on the horizontal plane, where there is not too much. The auto-transformers will place themselves, so to speak, if the previously expounded precautions are taken and the photographs consulted. The mounting for the ballast resistor has to be accommodated. The C battery connections will be taken up in the wiring directions.

Fig. 3 shows the coil mounting very clearly and also brings home the idea of how to mount the auto-transformers. It also shows a lead that seems common to the three variable condensers. In fact, however, this busbar strip is connected to the frame of the Wade variable condensers used in the original model. This frame is wholly unconnected to either the stator or rotor plates, hence when grounded forms a shield. The lead is therefore brought to ground. Body capacity effects are thus eliminated. The dotted line in Fig. 2, picture diagram, represents this shielding connection, which should be omitted unless the Wade condensers, or some other type that has a frame insulated from both sets of plates, is used.

The grid condenser is soldered, one side to the grid post of the detector tube socket and to bottom of the perpendicularly-mounted variable grid leak, the other side of both the leak and the condenser going to the high potential end of the secondary L4. This will be explained in detail later.

It will be found that the coils, when mounted as clearly shown in Fig. 3, are about $8\frac{3}{4}"$ apart, measured only from actual winding, at their farthest

points, while the minimum distance between the two coils is about $2\frac{1}{2}"$ between actual windings. Notice that the coil forms are supported by mounting brackets. These are supplied with Aero coils and are nickel-plated.

Some persons may possess three .0005 mfd. condensers. They may use those three, but should make the tap at the 8th turn on L4, instead of at the 14th turn, due to the extra capacity in the condenser C3.

Wiring Directions

The wiring of the set is relatively easy. Those who can not read the schematic diagram (Fig. 1) quite so readily should consult the picture diagram (Fig. 2). They are the same. In Fig. 1 the ballast resistor seemed to read "R," instead of "R3," due to an imperfection in the engraving, so consider it R3. It is shown as R3 in the picture diagram. There is no R elsewhere in either diagram, so no confusion can result.

First wire the filament circuit. The A plus lead is brought from battery to one side of the switch, the other side of which is joined to the F plus posts of all five sockets. A minus is connected to only three points, so far as the filament wiring goes: (a), to one side of the ballast resistor R3; (b), to one side of the detector rheostat, R2; (c), to one side of the RF rheostat, R1. The open sides of those three instruments are connected as follows: R3 to the F minus posts of all three audio sockets, R2 to the F minus post of the detector socket and R1 to the F minus post of the RF socket. In Figs. 1 and 2 the sockets are enumerated: (1) RF; (2), detector; (3), first audio; (4), second audio; (5), third audio. When the connections are made up to this point the filament wiring is completed. You may try out the tubes and see whether they light and whether the two rheostats change the brilliancy of the two tubes they are supposed to control and the switch turns all five tubes on and off. In wiring the rheostats select that rheostat terminal which is joined to the movable arm as the one that goes to A minus, the other rheostat terminal going to F minus in both cases.

Coil Connections

In the commercial coils, considering L1L2, the terminals are identified, as P, B, F, G and T. As previously explained, no connection is made from the set to T in this case. P goes to aerial, B to ground, F to minus A and G to grid of tube (1). Expressed otherwise, the beginning of the primary L1 goes to aerial, the end to ground; the beginning of the secondary L2 goes to negative A and the end to the grid of the RF tube. Also connect the rotor plates of C1 to negative A battery and the stator plates to grid.

The interstage transformer, L3L4, is

connected, P to plate of tube (1), B to B plus 45 volts, F to the rotor plates of both C2 and C3, and G to grid. Told otherwise, the beginning of the primary L1 goes to plate, the end to B plus; the beginning of the secondary, L4, to the rotor plates of both C2 and C3. Note carefully that the usual grid return connection established at this point (commonly A positive in a detector circuit) is NOT made to battery or to anywhere other than to the rotor plates of the two condensers, C2 and

single mounting. The other side of the leak will be discussed later. The plate of the second audio tube (4) is connected as was the previous stage to P on an auto-transformer, B going however to another B plus lead, representing 135 volts. G goes to one side of the second 0.25 mfd. condenser, the other side of which connects one extreme terminal of the potentiometer, a Centralab 0.5 meg. instrument, rated commercially in the equivalent value, 500,000 ohms. The pointer or midpost

and the ear used as a guide when you tune in.

Three more set connections remain: (1) the by 1.0 mfd. condenser, located next to the jack, is connected, one side to B plus 135 volts, the other side to A minus. This is somewhat different from the accustomed connection but is correct.

One more left, but do not try that until you have done some preliminary testing. See that the rheostats work properly and that the ballast resistor

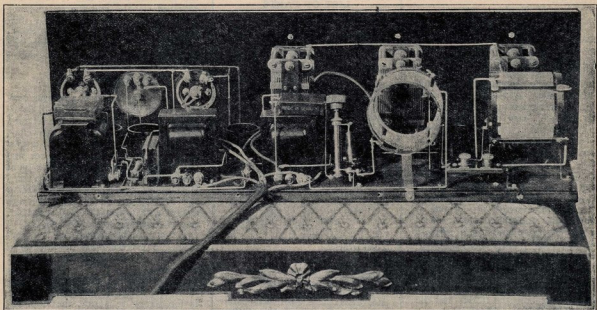


Fig. 3. Rear view showing up particularly the manner of mounting two of the 0.25 mfd. condensers atop the auto-transformers, and clarifying the rheostat and potentiometer wiring. The shield lead is shown running from center to right and connecting the frames of the variable condensers to ground. The flexible leads to the coils are made from the rotor plates of the condensers, because they have a back-and-forward motion. The top part of the leak should go to the coil L4 and the bottom part to the grid of the detector socket. Note the serial-ground connecting binding post strip. Instead of a strip for the battery connections the leads are established direct from instruments to cable cords. Identify each cord by some marking when you wire up.

C3. The tap (T on commercial transformers) goes to A positive. This is 14 turns from the rotor plate connection. The end of the secondary L4 goes to the stator plates of C2, to one side of the variable grid leak and to one side of the grid condenser C4. The other side of the grid condenser is joined to the grid post of socket (2). In connecting the leak, be sure that the lug near the knob (that is, the point nearest where your hand may be when adjusting the leak), goes to the coil and the lower lug to the grid condenser. This avoids body capacity effects even if the hand touches the metallic connecting point of the leak.

The plate of the detector tube (2) is soldered to the stator plates of C3 and to the P post of the first Thordarson auto-transformer. The G post of this instrument goes to one side of the 0.25 mfd. condenser. The B post goes to the B plus 45-volt lead. This is the detector voltage as well as the RF plate voltage. The free side of this fixed condenser goes to the grid of the first audio tube (3) and to one side of a 0.5 meg. grid leak. This leak takes a

of the potentiometer is connected to grid of tube (4). The plate of tube (4) goes to P on the third auto-transformer, B goes to B plus 135 volts, while G goes to one side of the remaining 0.25 mfd. condenser. The other side of that condenser goes to the grid of tube (5) and to one side of a 0.5 meg. fixed leak. The plate of that tube is joined to the hooked spring of the single circuit jack, J, while the right-angle of that jack goes to B plus 135 volts.

There still remain eight connections as a part of the wiring. The open ends of the three leaks (two fixed leaks and the potentiometer that is used as a variable leak) are joined together, and a flexible lead connected to this busbar strip. This flexible lead is for C minus. At some convenient point tap the A minus lead in the set and bring out another flexible lead. This is for C plus. When the C battery is installed, with C plus to A minus and C minus to the common lead for the leaks, the test will be made for the correct bias. Usually 6 volts will be about right, although up to 12 may be tried,

functions. Use the switch to turn the tubes on or off as a unit. Then try the rheostats additionally. Finally satisfied up to this point, disconnect the A battery negative. Connect B minus to A plus. Insert one tube in one socket only. If the tube lights, quickly remove the tube and find the short circuit, remedy it, and try again. If the tube does not light in the first socket place it in one socket after another, being sure that no glimmer results. This much attended to, restore A minus to its proper place and leave B minus and A plus connected to each other (but not to A minus). Again go through the single-tube-in-a-single-socket test, with the switch at an "off" position. If no light results, then attach aerial to its post, insert the speaker cords in a plug, insert the plug in the jack and tune in.

Getting Best Results

Do not be disappointed if first results are poor. It is surprising how bad they can be, just as surprising as how wonderfully fine they will be. Choking may result in dull, suppressed,

distorted signals. Adjust the potentiometer until the signals clear up considerably. Adjust the Bretwood leak to the same purpose. Once these two are adjusted, they may be left that way. Next, if choking is still in evidence, reduce the resistance in the grid of the final tube. Put in a 0.25 meg. fixed leak, or, if you have a 0.1 meg. leak, use that. Finally—if not at first—you will hear signals the like of which may never have greeted your ears before when they were attuned to a radio receiving set.

Tuning

The wave-length controls are the two variable condensers, C1 and C2, and they will read alike, or nearly so, all through the range of wave-lengths. The regeneration control will be approximately the same, but cannot be expected to keep in step. At first you may have to tune in a station by the whistle, but soon you will learn how easy it is to scent the signal before half enough regeneration is supplied, and you will cut down radiation considerably.

The method of obtaining regeneration in the Thordarson-Wade circuit is based on the Hartley oscillator, and this method is often used by amateurs in transmitting circuits on account of its simplicity and effectiveness. It is the Hartley oscillator with parallel feed, so-called because the plate voltage is supplied the tube through a circuit which is in parallel with the high frequency circuit. In the Hartley oscillator the tuning condenser is connected across both the tickler and the grid coil so that the tickler becomes a part of the tuned circuit. In the simplest form there is only one coil, one terminal of which is connected to the grid and the other to the plate. The filament is connected to a tap on this coil.

Location of the Tap

When the circuit is used primarily as an oscillator this tap should be somewhere between one-third and one-half the way up from the plate end of the coil, but when the circuit is used for a regenerative receiver it is best to put the tap just a few turns away from the plate end of the coil. If the tap is too close to the grid the effective input voltage will be low, the tuning and the control of regeneration will be very critical, and there will be a great deal of hand capacity effect. But if the tap is only a few turns from the plate end these disadvantages are minimized. The shielded condenser (C3) prevents hand capacity.

Regeneration is controlled by means of this .00025 mfd. variable condenser. This is the usual by-pass condenser which is ordinarily connected directly between the ground and the plate. In this case it is connected between the plate and one end of the tuning coil so that the current that is ordinarily bypassed is made to flow through a small portion of the tuning coil. The greater

this portion of the coil is, up to about one-half of the number of turns in the coil, the greater will regeneration be, but the number of turns included in the by-pass circuit should never be greater than required to obtain satisfactory operation.

Determining Factors

The number of turns required not only depends on the value of the variable by-pass condenser, but also on the

LIST OF PARTS

- 1 7 x 24-inch panel.
 - 1 8 x 23-inch baseboard.
 - 1 Radio-frequency tuning unit, L1L2 (Aero Wave Trap Unit).
 - 1 Interstage R.F. tuner, tapped, L2L3 (Aero Wave Trap Unit).
 - 2 .0005 mfd. variable condensers, C1, C2 (Wade, with dials).
 - 1 .00025 mfd. variable condenser, C3 (Wade, with dial).
 - 1 .00025 mfd. grid condenser, C4 (Dubilier).
 - 3 .025 mfd. "by-pass" condensers (Dubilier).
 - 1 1.0 mfd. "by-pass" condenser (Dubilier).
 - 2 20-ohm rheostats, R1, R2 (Bruno).
 - 1 34-ampere ballast resistor, R3 (Veby).
 - 3 auto-transformers (Thordarson).
 - 1 variable grid leak, R4 (Bretwood).
 - 1 0.5 meg. fixed leak (Veby).
 - 1 0.5 meg. potentiometer (Centralab).
 - 1 0.1 meg. leak (or 0.25 or 0.5 meg.) for last tube (Veby).
 - 3 dial pointers.
 - 5 sockets.
 - 1 A battery switch.
 - 1 single-circuit jack.
 - 1 battery cable with Glamzo markers (A-4, A-5, etc.).
- Accessories: One 2-post strip with two Z-angle brackets for aerial-ground; two 4½-volt C batteries; three 45-volt B batteries; one 6-volt A battery, 100 amp. hr. or more; five 6-volt tubes; flexible lead for C minus connection; another for A minus to C plus; aerial wire, 50 ft. No. 14 insulated lead-in wire, cabinet, speaker, lightning arrester, bus-bar, lugs, solder, hardware.

distributed capacity of the head set or transformer windings in the plate circuit of the detector, on the filament temperature, on the grid leak and condenser, on the quality of the tuned circuit, and on the frequency of the incoming signals. The adjustment should be made at normal filament current and for a signal which requires that the tuning condenser be set at maximum. Then the turns should be adjusted so that when the by-pass or regeneration control condenser is set at about 75% of its maximum the circuit will just oscillate.

Operating the Set

Some sets anybody can tune, without previous experience, and get fine results. Other sets require some special knowledge. One of these is the Thordarson-Wade.

While even total ignorance will result in some measure of reception, and indeed of a sort that will satisfy quite a large percentage of persons, only a

knowledge of the fundamental workings will enable one to achieve that rapturous goal—full, rich, thrilling tones, surpassed in quality by nothing that radio has to offer.

The sources of trouble, grouped in the order of their importance, are:

- (1) Choking effects.
- (2) Uncontrollable oscillations.
- (3) Tuning.

It is assumed that the wiring is done properly. All directions necessary for building the set are given in the previous pages, and if those are followed strictly, and the set will not work, or emits only a poor peep, then some part is defective, some coil short-circuited or other blemish present that should be located with earphone and a dry-cell.

The Choking Effect

The choking effect is a serious consideration, because it is quite likely to occur, and the builder of the set may wrongly assume that the marvelous quality that was promised was a case of over-enthusiasm. But the set was put under nightly operation for more than three weeks and it stood up manfully under all sorts of tests, including the hunting of distant stations, and always with a deep-throated resonance that is charming to ear and soul.

A set may be choked due to overloading anywhere along the line, from the radio-frequency input to the final audio-output. A tube can handle just so much, no more, under given conditions, and when the voltage at the grid is too strong to permit the amplified plate response to keep pace, then there is trouble. Hence, in order of position in the circuit, let us take up the various sources of possible choking.

The R.F. tube has only one safe volume control, the rheostat, which should be used for properly keying up this audion for best action. If the filament is heated too low there will be either faint signals or over-oscillation, and the adjustment of this rheostat is therefore very important. It cannot be considered as something independent, since unless the detector tube is also correctly heated there will not be uniform efficiency as governed by the filament heating. In other words, a compensating effect exists whereby the R.F. tube and the detector tube balance each other. If one is heated too much the other may have to be heated too much to gain any sort of passable reception, or if one is underheated, the other may have to be either underheated or overheated. There is, however, in any set only one point which represents maximum efficiency for any tube, although some slight variation may be necessary on account of some extremely different frequency when one passes on to another station.

Getting Started

A good way to start is to turn the R.F. rheostat a little less than halfway

up, provided it is a 20-ohm instrument, as prescribed. Then the detector rheostat setting is determined. Meanwhile it is assumed some local station is being heard, and perhaps trouble is being experienced, such as hissing. Now vary the detector rheostat. Some tubes will function best as detectors when they are lighted very low. Just barely turn on the rheostat and you will often get the best results. Determining the right position of the detector rheostat arm is important, since one is not to adjust this rheostat any more, unless a freshly charged "A" battery is being used, or one which is rather low, in which case corresponding adjustment is necessary so that the tube will be heated at the correct temperature, denied it by the battery condition unless the resistance is changed accordingly.

Beginning with the lowest possible heating of the detector tube, now adjust the R.F. rheostat to a lower temperature. If a local station is being received it is possible that the signal will get fainter and fainter, until finally it disappears. If the R.F. rheostat can be manipulated that way, and turned off completely, without causing over-oscillation in the set at any point, the detector tube may be assumed to be operating at the correct temperature. This is not a set where the R.F. rheostat is used as an oscillation control, or even to vary volume, as we have a variable condenser to take care of that as an R.F. function.

Naturally all tests like these will be made on local stations and if these are fairly loud they will be plainly audible no matter what may be the setting of the variable condenser C3 under the saturation point. Turn the condenser C3 to represent higher and higher capacity settings, and see whether oscillation is produced. Normally the oscillation point or climax should be registered at about 50 for the highest wavelength station you can receive. If it is 30 or 20, or even less, then pursue the following: First turn down the R.F. rheostat a little, then move up the condenser until the reading is about 50 or a little less. Second, if this fails, reduce the "B" battery voltage on the R.F. tube. Third, if this fails, too, reduce the plate voltage on the detector tube. Finally, you will be able to get the oscillation point at about 50. A final expedient would be to make the tap on L4 nearer the end of the coil, but that should not be necessary.

Do Not Detune

We have considered every possible means afforded by the set itself for the elimination of choking effects or other forms of distortion on the radio-frequency side, except detuning and grid leak. It is bad practice to detune to avoid too much volume, because the ideal radio receiver should be responsive to exactly the desired frequency. If it is a selective set it must be a sharp tuner on a quality basis to pass the

side bands that make rich tones and natural voice and music possible, and any detuning necessarily means the chopping off of side bands. One form of distortion—more volume than the tubes can handle—is simply replaced by another form—the cutting down of volume by adversely affecting the incoming wave. This is bad indeed. With only the best practice as our goal we shall decide on utter resonance as a prerequisite, and if the set cannot handle the product of this resonance we will shoot trouble until it does.

The other factor is the variable grid leak, in this case the Bretwood. This, it will be remembered, is mounted on

all else has failed. The resistor in the grid circuit of the second audio tube is a variable one (a 500,000-ohm potentiometer), and its setting is rather critical, although once this is determined it need be changed only slightly, if at all, when exceptionally weak or strong stations are being received. Thus, one will find that some passable sort of reception is heard and yet that energetic volume that one has been led to expect is missing. Adjust the potentiometer so that a slight hiss is heard, then gently turn it back until this hiss is gone. The setting determines both the leakage from the grid and to some extent the bias thereon. Strangely enough, it has

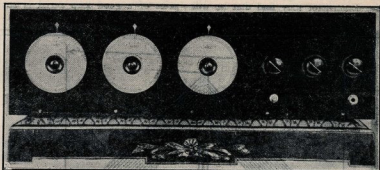


Fig. 4. Panel view of the set. The dials, left to right, are RF, detector and regeneration. The knobs are RF rheostat, potentiometer and detector rheostat. The switch is under the RF knob, the jack under the detector rheostat knob.

the baseboard. It should be set so as to conform with best requirements and left that way, the only exceptions being in the event another tube is used for detector, or a distant station's carrier wave refuses to yield to actual reception. The slight variation of the leak setting for extremely distant reception will not affect the reception of locals, and the setting as it was when distance was being enjoyed may well be left "as is."

The leak functions so that when the plunger is all the way in the resistance is all the way out; that is, the minimum resistance is used, hence the leakage path from grid to filament is greatest. By unscrewing, the resistance is increased, the leakage cut down. Assuming the leak plunger all the way in, about eight or ten turns in the only possible direction will give approximately the right setting for most tubes. But as tubes vary, one will start with this position, and if choking or oscillation exists, even after tests have been made as previously outlined, the leak knob will be turned outward (to the left).

All these tests are preliminary; that is, after we have taken up the audio pathology we may find that the R.F. and detector side that we thought were quite all right still need attention.

Analyzing the Audio

On the audio side the resistors are indeed important. The 0.5 meg. leak in the grid circuit of the first audio tube is about right for all conditions and no special attention need be paid to it, until

an effect upon oscillations in the radio side of the receiver, due no doubt to the common "A" and "B" batteries used. That is one reason for suggesting the inclusion of the 1.0 mfd. fixed by-pass condenser—to keep this effect at a minimum. However, once you adjust the potentiometer, which is exclusively a volume or purity control and not to be confused with the more usual radio purpose to which a potentiometer is put, that adjustment will remain the same for all local stations and most distant ones, with the exceptions already noted. The potentiometer correctly set, it may be necessary to change the settings of the R.F. and detector rheostats.

Now supposing that the quality has been improved, but still there seems to be failure to realize the ultimate. This will evidence itself by the seemingly suppressed nature of the signals. In other words, the volume is there, one must imagine, but a restricted passage-way, as if a tightening effect upon one's throat, is blocking the sound. Vary the condenser C3 until you come near the saturation point, then slightly retune the two other condensers. You will need two hands to do this, one on the R.F., the other on the detector dial. Perhaps you will just strike the solution—hear the enveloping volume, with the low notes reaching your ears with astounding fidelity of pitch, and the middle and high ones coming through in the same glorious fashion. It is

(Continued on page 38)

An Effective Loop Aerial

This Loop Aerial Can Easily Be Constructed for Tuning Over the Broadcast Wave-Lengths

THE need for a small and efficient loop aerial grows ever more cogent as time goes on and receivers become more sensitive, while the number of broadcast stations working on a limited band of wave-lengths increases daily, the constructor may find that he will

no difficulty in the actual building. The article as it appeared in the *Wireless World* is as follows:

In the case of a superheterodyne receiver a loop aerial becomes a *sine qua non*. Unfortunately, however, the price of a good loop aerial is some-

ing supports and air-spaced turns, rather than to the question of size, they would probably be surprised to note that they would obtain greater efficiency from a small "low loss" loop than from a larger and more unwieldy instrument using insulated wire wound slackly and haphazardly, as is the case with some instruments brought to one's notice. In any case, when using a correctly designed and constructed superheterodyne receiver, for which this loop aerial is primarily designed, it is quite unnecessary to use a large loop, and most excellent results will be obtainable with this instrument. A further advantage is that a small loop aerial is more easily portable, and is less conspicuous in an ordinary room. The loop which is described here is, as will be observed from the illustration, small and unobtrusive in appearance, but at the same time it is very easily and cheaply constructed with a few simple tools and materials.

Few Materials Required

In designing a loop aerial, provision must be made for rotating the loop in a convenient and rapid manner without having recourse to moving the main stand of the instrument, and this has, in the present instrument, been accomplished in a particularly neat and simple manner which will be described later.

The materials required consist of two 3-ft. lengths of 1-in. x $\frac{1}{4}$ -in. wood, two 9-in. lengths of 1-in. x $\frac{3}{8}$ -in. wood, 1 "scooter" wheel of 4-in. diameter, a 3-in. length of $\frac{1}{4}$ -in. brass rod, a piece of brass $2\frac{1}{4}$ -in. x $\frac{3}{8}$ -in. x 8-in., two terminals, 15 small brass wood screws, 70-ft. of bare No. 20 tinned copper wire, and a small quantity of scrap bakelite or hard rubber.

The scooter wheel may be obtained from any toyshop for a small sum. It is first necessary to saw up the 3-ft. lengths of wood into five portions having lengths of 25-in., 24-in., and three 6-in. lengths respectively. The $\frac{3}{4}$ -in. wood will not require further cutting.

Constructing the Cross-pieces

The 25-in. strip should now be taken, and a section $3\frac{1}{4}$ -in. long by $\frac{3}{8}$ -in. deep be cut away from the edge, commencing at a distance of $1\frac{1}{2}$ -in. from one end. This will be the bottom end of the upright of the frame. A $3\frac{1}{2}$ -in. section of $\frac{3}{8}$ -in. depth should now be cut away at the other end, but on the same edge, the cut-away portion com-

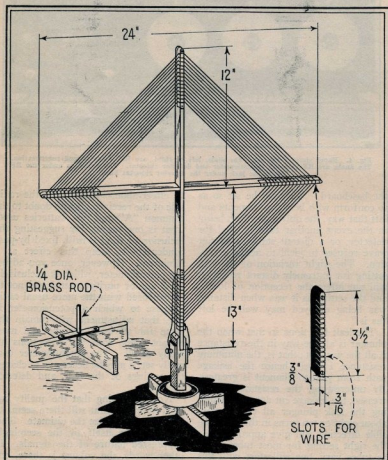


Illustration by courtesy of *Wireless World* (London, England)

Sketch of the loop described herewith with dimensions. The smaller drawings show the support for the frame and the insulating strips.

eventually be driven to use a loop aerial in order to obtain a high degree of selectivity.

An effective spiral type of loop has recently been described by H. Houghton in *Wireless World* of London, England. Mr. Houghton gives full details for making this loop, in a most comprehensive manner; and if the constructor follows the directions given herewith, we are sure that he will have

times prohibitive, and it becomes necessary to construct one at home. Happily, this is not a difficult matter, but it is noticeable that the average home-made loop aerial is sometimes unwieldy and untidy in appearance.

It cannot be denied that more energy is picked up by a large loop than by a small one, but if constructors would pay greater attention to eliminating losses in a loop by using good insulat-

mencing at the extremity. The 24-in. length requires to have a section $3\frac{1}{2}$ -in. x $\frac{3}{8}$ -in. cut away from the extremity of the same edge at either end. The 24-in. strip must now have a slot $\frac{1}{4}$ -in. in breadth by $\frac{1}{2}$ -in. in depth cut away at the centre point of the edge opposite to that having the cut-away portion at its extremities. The 25-in. strip has a similar slot which is 13-in. from the bottom end previously mentioned, and is on the same edge as the cut-away portions at either end. The purpose of these slots is to enable the upright and horizontal of the frame to be fitted together in the manner known to joiners as "half and half."

It is now necessary to obtain a piece of $\frac{1}{4}$ -in. bakelite or hard rubber and cut small sections of dimensions such that they will just fit in to the small cut-away portions at either end of the upright and horizontal portions of the loop. These pieces of bakelite or hard rubber are secured to the woodwork by passing two small wood screws through each piece and screwing into the woodwork of the upright. Fourteen slots spaced $\frac{1}{8}$ -in. apart are now cut into each of these four insulating strips with a hacksaw. These slots are $\frac{1}{4}$ -in. deep, and should be slightly enlarged at their bottom ends by boring them transversely with a fine drill. The purpose of these slots is, of course, to support the wires of the instrument.

An examination of the sketch will readily make clear the constructional points which we have been discussing.

Fitting the Framework

The three 6-in. lengths of wood should now be taken, and $1\frac{1}{4}$ -in. should be sawn off one strip. The three pieces should now be firmly glued together, the shorter one being in the

middle. All three strips have their ends flush at one end, thus leaving a gap $1\frac{1}{4}$ -in. deep between the two outer portions at the other end. Once the glue has set quite hard, a $\frac{1}{4}$ -in. diameter hole must be drilled into the "flush" end to a depth of three inches. Having done this, the centre of the scooter wheel should be cut away in the form of a rectangle having dimensions of 1-in. x $\frac{3}{4}$ -in., and it should then be fitted tightly over the "flush" end of the three pieces of wood which have been glued together, the position of the scooter wheel being such that $\frac{1}{8}$ -in. is left protruding through the scooter wheel. Here, again, an examination of the sketch will clear up any points upon which the constructor may be doubtful. The end of the upright of the frame may now be dropped into the slot between the two outer pieces of wood and firmly glued there. The reason for mounting the frame in this manner will now be apparent, since if the length of the upright of the frame were extended so that the two side pieces of wood could be glued on either side of it, it would be extremely awkward to drill the 3-in. hole in the butt end of it. Two small pieces of $\frac{1}{4}$ -in. bakelite or hard rubber having approximate dimensions of 1-in. x $\frac{1}{2}$ -in. should now be screwed in a convenient position to either side of the bottom end of the completed upright (see illustration). These are for the purpose of mounting terminals.

Constructing the Base

The construction of the base may now be proceeded with. It is necessary to take the length of $\frac{3}{8}$ -in. wood, saw it into two equal parts, and affix the two parts into the form of a cross by means of the method known as "half and half," which has been pre-

viously referred to. The ends of the cross may be chamfered, the same remarks applying to the actual cross-pieces of the frame. The whole of the woodwork of the instrument should, of course, be stained and polished before any of the fittings are attached to it. The $\frac{1}{4}$ -in. brass rod should be taken, and a thread cut at one end of it. The small piece of sheet brass must have a $\frac{1}{4}$ -in. tapping hole drilled in the centre, and a thread cut to receive the threaded end of the brass rod. The brass strip is mounted on the top of one of the crosspieces of the base by two small screws, as seen in the illustration. The actual loop may now be mounted on the base by inserting the brass rod into the hole in the bottom of the butt end of the upright. It will be seen that the loop can now be very freely and easily revolved on its base.

Winding the Loop

The instrument is now complete, except for winding on the turns of wire. This is quite simply carried out with No. 20 bare tinned copper wire, 13 turns in all being wound on to the frame. As seen from the illustration, it is necessary to mount two small pieces of insulating material with thin slots cut therein on the lower part of the upright, in order to "anchor down" the two ends of the winding at the point where the winding commenced and finishes.

Provided that this instrument is carefully constructed in accordance with the instructions given, it will be found to be very compact and neat in appearance, and at the same time is extremely efficient and productive of excellent results when used with a receiver sufficiently sensitive to operate without the intermediary of an outdoor aerial.

An Up-to-Date Reinartz Receiver

(Continued from page 10)

located in any space available, as its placement is not critical.

By closely following the diagram and carefully constructing the coils, the builder should be able to erect an excellent set. This receiver will give splendid results. It will be found to be selective, easy to operate and capable of reception from coast to coast in winter weather.

May Use but Two Condensers

In the event that a prospective builder has on hand but two condensers, the set may be constructed without the antenna coil and the right-hand condenser. The antenna should then be connected to the end of the primary coil, marked X. A slight sacrifice in selectivity, volume and dis-

tance will result from the elimination of the third condenser. In the writer's experiments the use of this third condenser was found to be equal to a stage of radio-frequency amplification, so if the ultimate in results is desired, it is suggested that all of the coils and condensers be used, just as shown in the accompanying diagram.

Connecting Phones to Amplifier

There is a right and a wrong way to connect phones to an amplifier. If they are incorrectly connected they become demagnetized and soon lose their sensitivity.

The simplest way to find which is the best connection, is to plug the

phones in at the last step of amplification and tune the receiver to the loudest possible signal; then remove the phone caps and lift one edge of the diaphragm with the finger until it clears the edge of the shell. When the phones are connected in one direction, you will observe a stronger pull than when the

connections are reversed. When the connections are so placed as to obtain the greatest pull on the diaphragm, put a mark on the phone terminal that was connected to the plate of the tube. Thereafter always connect the marked terminal to the plate.—*Popular Mechanics* (Chicago, Ill.).

How to Make Basket-Weave Coils

Method of Winding Inductances in Basket-Weave Form

THE basket-weave method of winding coils is becoming increasingly popular with the amateur who makes his own coils, especially for short-wave work where a coil should be practically

It should be mentioned here that the former described needs a 2 and a 4 B.A. tap and die and the appropriate drills for its construction, but for the benefit of those who do not possess these tools an alternative method will be given at the end of this article.

The base is made of $\frac{1}{2}$ -inch brass, a blank 4 inches in diameter being obtained from one of the large metal merchants, though it could probably have been only $\frac{3}{8}$ of an inch or $\frac{1}{4}$ of an inch thick without detriment to the finished former—which is shown in Fig. 1. The center of the blank was found and a 3-inch circle scribed on

lengths was rounded off with a file and a little over one-quarter of an inch of the other end was screwed with a 2B.A. die. It was now merely necessary to screw the rods into place in

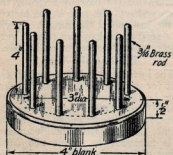


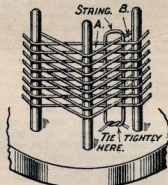
Fig. 1. Illustrating the base and arrangement of the spokes.

self-supporting so as to include a minimum of dielectric in its field.

In the following article from *Radio News* magazine some valuable data on the construction of basket-weave coils should be helpful to the home radio constructor and is presented as follows:

Construction

The writer, requiring a coil of this description for a Tropadyne adaptor



Illustrations by Courtesy of Radio News (New York)
Fig. 3. The coil is self-supporting and secured with string.

one surface. This circle was divided into nine equal parts and a center punch mark made at each division line. The division of the circumference into any number of equal parts is easily done by multiplying the diameter by 22/7 and dividing the resulting figure by the number of divisions required. This figure will not be quite accurate, but any slight inaccuracy can easily be corrected by "trial and error."

Brass Rods

A hole was drilled at each of the punch marks, a 2B.A. tapping drill being used. After this the holes were tapped out 2B.A. and the complete base was filed smooth and polished with sandpaper. The top edge had a groove cut in it on a friend's lathe just to finish it off and a coat of lacquer applied.

Next a length of 3/16 brass rod was obtained and nine 4-inch lengths cut from it. One end of each of these



Fig. 5. The "lifter," for raising the coil off the base before fastening.

order to be able to make basket-weave coils. The single-weave coil is the most usual and is shown in Fig. 2. But double- and triple-weave coils can be made if desired, and form interesting variations from an experimental point of view, as well as allowing more turns of wire to be accommodated on a winding of given length.

It was also intended to wind special chokes for 15-meter reception; these, of course, need to be much smaller than those generally used, and so another circle, one inch in diameter, was scribed inside the first one. This was divided into seven parts and 4B.A. tapping holes were drilled, the pegs were made, of course, from 4B.A. rod.

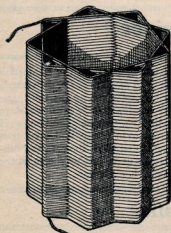


Fig. 2. The appearance of a single-weave coil wound on the former described.

that was described in *Wireless Weekly* for November 26, 1924, made up a special former for the job, which has since proved exceedingly useful whenever a coil has been wanted.

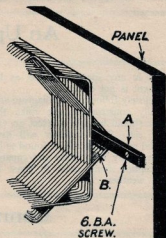


Fig. 4. A suggested method by which the coil may be mounted.

These pegs were made only two inches long, but the same amount was screwed at one end of each. The chokes made on this former consisted of thirty turns
(Continued on page 51)

An Efficient Four-Circuit Receiver

A Set Employing the Four-Circuit Principle with the Idea of Economical Operation

A PRESENT-DAY radio set must be economical to be popular. Any set which is sparing of its A and B batteries and tubes is bound to succeed. Yet this economy must not be carried too far; every fan wants to receive distant stations and desires to be able to operate a speaker on them.

A most interesting type of four-circuit receiver which is economical to build and operate, yet will give efficient results under general circumstances, was recently described by R. C. Hitchcock in the *New York Herald Tribune* radio magazine section as follows:

In the accompanying illustrations is shown a four-tube set which has proven very efficient, hearing stations several hundred miles away on the loud speaker during summer evenings. In winter its range would be easily three or four times as great. A few of the considerations in the design will be discussed before describing the set itself. There are nearly as many kinds of radio sets as there are different manufacturers making them, and those which operate a loud speaker range from two-tube sets up to any number under ten.

A really effective radio set should use its tubes economically. That is, each tube should have demanded from it all the work that it can do well. A two-tube reflex set which will operate a speaker is said to be economical in a certain sense. Let this be considered briefly. A reflex set makes a tube carry a double load at all times—audio and radio energy. When this is done often the audio load becomes so great that the tube cannot carry its two loads efficiently, and distortion results. The present five-tube neutrodyne is a fine example of engineering, and will give as good reception as is wanted by an average fan. But if the question should be asked, "Does each tube work up to its limit of capacity," the full answer would have to include an explanation that the first radio tube and even the second radio tube seldom work at their maximum possible output.

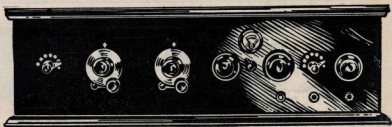
From this typical set a generalization can be made. Radio-frequency amplifiers seldom handle sufficient energy to make their tubes work anywhere near their maxima. Of course, the radio-frequency amplifier brings up a very weak signal to a strength sufficient to be detected successfully, and in so doing it no doubt brings in some signals that otherwise would not have been audible. This point, however, is becoming less

and less applicable to present-day broadcasting. Stations are increasing their power and radio-frequency amplifiers are becoming less necessary. And, from what has been said, it is almost a foregone conclusion that a radio amplifier is uneconomical; the tube simply does not have power enough to make it do its utmost. Having determined to make a set which demands the utmost from each tube, yet

connect the coil. A separate B battery for the detector makes for clearer operation; this is shown in the schematic wiring diagram.

Audio Amplifiers

Having chosen the detector circuit, the amplifier should be picked out. Our keynote is economy. A high rate transformer, say 6:1, would certainly give more output than one with an



Illustrations by courtesy of N. Y. Herald Tribune

Front view of the completed four-circuit receiver.

not going so far as to overload a tube, what set should be selected? Reflexes and neutrodynes will not be considered, neutrodynes because their radio-frequency tubes are underloaded and reflexes because their tubes are likely to be overloaded.

The Detector

Having found that radio-frequency amplifiers are apt to be uneconomical, the next step is to consider only sets that do not have this form of circuit. Let the detector be considered. Is there a form of detector which is efficient? The regenerative detector is considered good, although the circuit chosen should be one that makes the minimum interference. The very simplest regenerative set is a bother to its owner as well as to the neighbors. The neighbors will object to the tendency for radiation and the owner probably will find that stations will come in "two at a time," due to the poor selectivity afforded by most receivers of this type. A three-circuit tuner would prove satisfactory, but a four-circuit tuner, with its incorporated wave trap, was finally chosen as being more selective and being little, if any, harder to tune. Regular Cockaday units may be used for the coils, but in the set here described a home-made set of coils was used. A few changes were made in the mounting of the coils, which will be made clear by looking at the illustration of the layout. Details will be given later in this article on how to make and

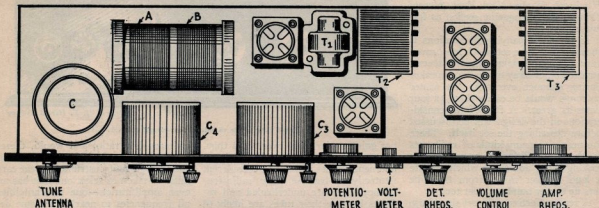
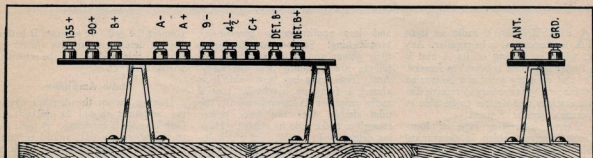
ordinary low ratio, and would, therefore, be economical, but in choosing such a high ratio instrument great care must be taken to select one that has an even amplification—one that amplifies all frequencies to nearly the same degree. There are a few high ratio transformers on the market which are guaranteed by their manufacturers to have even amplification. So far in the set there are two tubes working at maximum output, a regenerative detector and a high ratio audio amplifier. A set so equipped will furnish satisfactory volume on local stations, with no further additions. But distant stations will not be loud and distinct, and further amplification is necessary to hear them. A second high ratio audio amplifier would not prove satisfactory because it would overload a single tube. Another reason why two similar transformers should not be used is that they tend to bring out the worst points in each. For example, even though theoretically the amplification is even, there will be certain frequencies that are amplified slightly more than others. Suppose such a point to be at 2,000 cycles. Two similar transformers, used one after the other, would distort signals badly—making the 2,000 cycle notes stand out more than the original intensity would justify.

Still keeping in mind that the set has a fairly strong output from the first audio transformer, it will be seen that a push-pull amplifier is ideal for the second step. The power is easily han-

dled by two tubes, and with the connection used an even balance and faithful reproduction are secured. This completes the main units in the set—all four tubes are working at their peaks. Several features will now be described which have been incorporated to add to the ease of obtaining the desired vol-

this speed is too fast to be safe on the road, comparable to the current being too great for the speaker to handle. The auto could be slowed up by putting on the brakes, still leaving the engine in gear; this would correspond to the putting of a resistance in the speaker circuit, a very wasteful procedure. If,

keep his tubes at the voltage best suited for their economical operation—should he buy an expensive meter and conserve A battery current or buy a cheap meter which continually wastes a lot of current? The problem is somewhat simplified and a solution reached more easily when it is considered that once



A suggested layout for the receiver described in the article herewith. Above shows the binding post strips for aerial, ground, "A," "B" and "C" batteries.

ume and the device for making each tube work at its best voltage point.

Volume Control

In some sets resistances are put across the speaker connections to control the volume. This performs the desired result, but it wastes B battery energy. If a resistance could be inserted in some part of the circuit before the B battery has been reached, the loud speaker results would be the same, but the means would be more economical. For this set resistances are placed in the grid circuit of the first amplifier tube and a selector switch provided to give the adjustment desired. Energy arriving from the detector circuit, at the grid terminals of this transformer, is allowed to leak through the resistance, thereby making a weaker signal for the tubes to amplify. This arrangement affords a considerable saving of amplifier B batteries. An analogy may serve to make the arrangement clearer. Compare the current which flows through the speaker to an automobile being driven along a road at a speed of forty miles an hour. Suppose

however, the speed of the auto is decreased by reducing the engine speed, then the car would go slower with no power wasted; this corresponds to putting in resistances in the grid circuit before the amplifier B batteries are reached. In the wiring diagram the switch marked "volume control" is connected to these resistances. For use with the high ratio transformer T1, five grid leak type resistances are used and are put on a narrow hard rubber strip. The resistance values for each are the same, 50,000 ohms. This value is sometimes rated in megohms, and manufacturers mark them 1/20 megohm or .05 megohm, which is exactly the same as 50,000 ohms.

Voltage

The filament voltmeter included in this set is not an expensive one, and yet it is really economical. This is explained by remembering that the expensive meters that are designed for continuous service use very little current. Cheaper instruments use quite a lot of current, and the set builder has this situation to face—he wishes to

the tube voltage has been set at any particular time it will remain there, so a meter is really needed for just a short time. With this consideration, a switch may be included for connecting the meter while the rheostat is set, and then the meter can be cut out of the circuit. This saves the A battery, as only a small amount of power is wasted while the meter is being read, and allows a cheap meter to be used. In this particular set there are two rheostats, a separate one for the detector and amplifiers, so the voltmeter has two circuits to measure. It is, therefore, put on a double throw selector knife switch, S1 in the wiring diagram, in addition to the "off and on" one, the second switch changing the voltmeter from the detector to the amplifiers, these voltages being set separately by their respective rheostats. A small knife switch, S2, allows the cutting of the current from the push-pull amplifier tubes, so that the set can be used with two tubes, with the plug in the first jack. When using the full set of four tubes three of them are controlled by the amplifier rheostat, but when

using two tubes only one tube is on the amplifier rheostat, so that the amplifier rheostat should be reset whenever switch S2 is pulled, so that the one amplifier tube does not receive the battery energy through a rheostat set to serve three tubes. The voltmeter is used, of course, to set the rheostat correctly. The volume control obviates the necessity of using two tubes except in the case of powerful locals. But keeping strict economy in mind, the A battery is saved when two tubes are used; hence, the inclusion of this feature in the set.

The Coils

The coils may be the regular ones of a factory-made unit, and .0005 mfd. condensers used for C3 and C4. For the coils to be described, C3 and C4 were variable low loss condensers of .00035 mfd. capacity each.

The coils may be wound on coil forms having hard rubber end rings and glass rod supports. These are strictly low loss coils and proved effective. Seventy turns on the form (3-inch diameter) of green double silk

denser, C5, is wired behind the panel to increase the capacity of the condenser which tunes coil B—making the set easy to tune by spreading out the stations on the dial and permitting tuning to higher waves by increasing the capacity by throwing switch S3 and beginning on the first part of the dial again. An antenna series condenser, not shown, of .00025 mfd. capacity, or a variable condenser of greater capacity, may be used if extreme distance is wanted with a long antenna.

A one-turn coil, D, over coil B is made of bus wire covered with spaghetti. This one-turn coil is connected as shown in the schematic wiring diagram. Tinned copper bus wire is used throughout for wiring, connections being kept apart as much as possible, crossing at right angles when necessary, and junctions being soldered with rosin flux.

Outside Connections

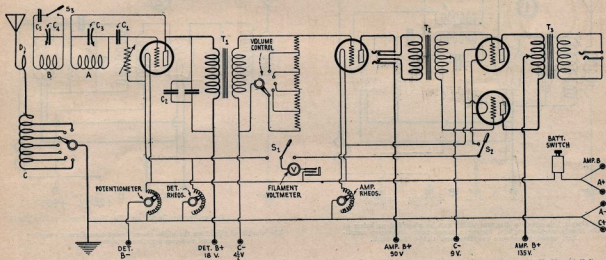
Horizontal narrow hard rubber panels are used for connections. These are shown clearly in the back view

the first amplifier jack is under the volume switch and the second amplifier jack is under the amplifier rheostat.

Operation

The potentiometer provides a fine adjustment of the regeneration, and is especially effective when a 200-type tube is used as a detector. When the arm is near the negative side of the potentiometer regeneration takes place with difficulty, and when near the positive post regeneration is easy to obtain. Try several B voltages to find the one which operates most easily on all wave lengths. A 201A tube used as a detector will use more voltage than a 200 tube. This type of circuit has no ground in the grid circuit, and will prove sensitive to body capacity. Long vernier handles will make the set do its best, but even without these aids to tuning the set will work well, and with this added feature sensitivity is marvelously increased.

The main tuning is with the condenser connected to coil A, but the wave trap, coil B, has to be kept along



Wiring diagram of the four-circuit receiver. Carefully note the way the resistances are tapped in order to control volume. All details of the circuit are clearly shown. Other data is given in the text.

Illustrations by courtesy of N. Y. Herald Tribune

No. 20 copper wire made up coil A and thirty-five turns of the same wire comprised coil B. Green silk thread is tied around the completed windings to keep them from sliding on the glass rods. Forty-five turns of either No. 20 or 22 wire is used on coil C, and taps are taken at the following turns: 1, 3, 7, 15, 45. Coil B in the original circuit is inductively coupled to coil C, so that these tune together for the longer wave lengths. In the set shown these coils are kept separate, allowing closer tuning. To allow coil B to tune to the longer waves a small mica grid con-

showing the binding post strips and supports. The cabinet is not shown, but a slot should be cut in the back to allow wires to run to these binding posts. If a keyhole saw is not available for cutting the slot separate holes may be bored for each binding post wire. The panel of the set as shown is 7 x 26 inches, but a 7 x 30 size could be used, and the wiring would be slightly less crowded. For simplicity, in layout illustration some instruments are not shown. The voltmeter selector switch S1 is under the voltmeter, the battery switch is under the detector rheostat,

with it to hear stations at all clearly. To tune stations having long wave lengths (above 400 meters) the auxiliary condenser, C5, should be connected by using the knife switch provided, S3.

Maximum volume is, of course, obtained when the volume switch is placed on the off tap, with no resistance in circuit, and if this should prove too strong for the speaker the control is easily set to the desired place. This is a neater and more satisfactory way of reducing volume than by detuning or reducing regeneration, with the accompanying retuning.

New Two-Tube Radio-Frequency Circuits

Amateur Tells of His Experiments with Them
and Gives Constructional Data

THE radio frequency vogue has produced some very interesting arrangements of new circuits and the radio enthusiast who dabbles around with new hookups will do well to look into the matter. Frank Frimmerman, who is amateur 2FZ, wrote this very fine article on the subject of two-tube radio frequency circuits, giving the results of his experiments. It appeared in *The Experimenter*, New York and is given here as it may likely prove of interest to our readers who decide to try out one of these circuits. The article reads as follows:

Diagram 1 shows a two-tube circuit using one stage of tuned radio frequency amplification, impedance coup-

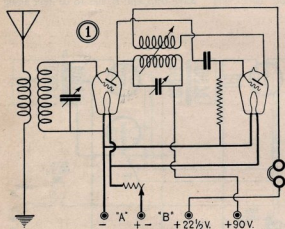
rheostat readily controls the filament current for both tubes.

The tuning of this receiver is slightly difficult in that three controls are necessary. The first step after turning on the filaments of the tubes is to tune the first variable condenser to resonance with the desired frequency. The plate tuning condenser is then adjusted in order to obtain maximum signal strength. It will be found necessary to adjust the coupling between the feedback coil of the detector tube and the tuned impedance transformer in the plate circuit of the first tube. The circuit may cause squealing to some extent, but radiation is effectively blocked by the first radio frequency tube.

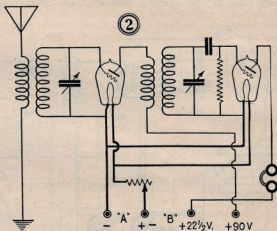
mary winding is at one end of the secondary coil, the low potential side or that side which connects to the filament circuit.

If the attempt is made to use more than six turns in the primary of the coupling transformer, the set will generally become regenerative and may burst into oscillations quite frequently. The neutroformer angle, 54.7 degrees, is not necessary when building this circuit but possible trouble can be avoided if the coils are mounted in this manner.

The variometer has long been known as an exceptionally fine tuning device, qualities are such that it surpasses the condenser for efficiency. Circuit 3



In circuit 1 is given a diagram which can be classified as being of the loosely coupled variety, having a tuned radio frequency amplifier, tuned impedance coupling and tickler feed-back.



Illustrations by Courtesy of *The Experimenter* (New York)

The circuit of Fig. 2 on the right shows tuned transformer coupling and non-regenerative detector.

ling to the detector tube and regeneration in the latter. This circuit gives excellent results when properly made and adjusted. The primary of the input radio frequency transformer can be wound with No. 18 D.C.C. and consists of 10 turns on a 3 1/4-inch diameter tube. The secondary winding should preferably be of No. 26 D.C.C. and contains 60 turns of wire. The coupling transformer consists of a primary winding containing 50 turns of No. 28 D.C.C. on a 3 1/2-inch diameter tube, while the tickler coil is one containing 40 turns of the same size wire on a 3-inch diameter rotor.

The variable condensers are both of .00035 mfd. capacity. A .00025 mfd. grid condenser and a two-megohm leak are requisite for the proper functioning of the detector tube. A six-ohm

Audio frequency amplification can readily be added.

Circuit 2 is a modification of circuit 1. It is of the non-regenerative variety and consists of one stage of tuned radio frequency amplification and tuned transformer coupler detector. Ordinary neutroformers find ready application for use in this circuit.

The average neutroformer, which term by the way applies only to a tuned radio frequency transformer of special design, has a primary winding consisting of six turns of No. 26 D.C.C. and a secondary winding of 65 turns of the same size wire. The primary is wound on a tube 3 1/8 inches in diameter while the secondary is wound on a tube of 3 1/4 inches diameter. The relation between the primary and secondary windings is such that the pri-

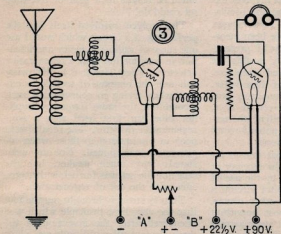
shows the use of two variometers in a circuit comprising one stage of tuned radio frequency amplification and impedance coupled non-regenerative detector. As a foreword, the circuit is very critical of adjustment. The input transformer to the first radio frequency tube has a 40-turn secondary instead of the usual one of 60 turns. The circuit does not give as much volume as circuit 1, but it reproduces very clearly, providing the condition for self-oscillation is avoided. It may be necessary to alter the plate voltage to 45 volts or lower, but generally 90 volts on the plate of the radio frequency amplifier tube is approximately the correct value.

Circuit 4 shows an experimental circuit which is extremely difficult to handle and which has many difficulties in getting it to work properly. As will

be noted, there are three controls. Analyzing the circuit we see that it is of the conductively coupled type, the antenna being directly connected to the grid inductance; that tuned trans-

formation and regenerative detector coupled by means of a tuned transformer. Here again neutroformers will find a special use to good advantage. A plate variometer in the detector circuit

former coupling is employed and that regeneration from the detector tube is introduced to the grid of the first tube by means of a feed-back arrangement. This latter consists of an ordinary variocoupler having a 40-turn secondary and 35-turn tickler coil. The coupling transformer can be made by mounting a 12-turn coil in close relation to the stator of the variocoupler. This circuit will be found difficult to



In Fig. 3 we see a different form of tuning arrangement, a variometer impedance coupling and non-regenerative detector.

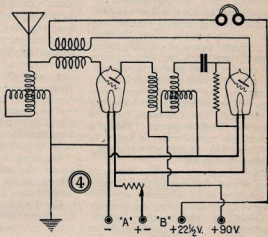


Fig. 4 shows a modification of circuit 3. Here, tuned transformer coupling and regeneration is successfully employed.

socket, one 6-ohm rheostat, 8 binding posts, a small panel and cabinet. Fig. 5 shows that the grid circuit of the detector tube is untuned. It should be shunted with a .00035 or .0005 mfd. condenser. Care should be taken so that the fields of the coupling coils do not interact and do not cause excessive feed-back. Both the antenna and ground connections to the primary coil of the detector input circuit should be

is commendable from the standpoint of ease in control of regeneration. A neutroformer angle of 54.7 degrees should be used for best results. This circuit is bound to give extremely good reception, and has proved its merits time and again. If so desired, although not necessary, a small neutralizing condenser can be employed. This can be connected from the grid of the first tube to a tap placed 15 turns from the fila-

ment side connection on the secondary of the coupling transformer.

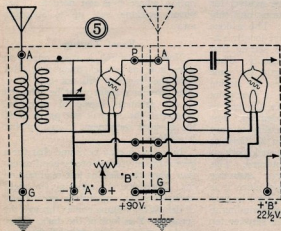
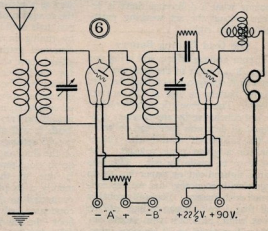


Fig. 5 is a diagram of one stage of radio frequency amplification to be added to a detector tube.



The circuit of Fig. 6 employs tuned transformer coupling and a regenerative detector.

handle unless loose coupling is employed at the beginning and only an experienced operator will find joy in working it.

In Fig. 5 we see an arrangement whereby a unit known as one stage of radio frequency amplification can be added to a receiving set comprising a detector and one or more stages of audio frequency amplification. The owner of the well-known three-circuit regenerative set will welcome the use

disconnected, and if the primary and secondary happen to be connected so that the filament is at ground potential, this connecting wire should be taken out. The above precaution is necessary so that the "B" battery current, which will flow through the primary winding, will not burn out the filaments of the tubes through short circuiting.

In Fig. 6 we find perhaps the best possible arrangement for using one stage of tuned radio frequency ampli-

ment side connection on the secondary of the coupling transformer.

In summarizing, tuned radio frequency amplification, even if applied through the use of but one tube, will greatly enhance the distance receptive qualities of any non-radio frequency amplifying set. This, of course, brings to the fore the old three-circuit regenerative receiver of which we have previously spoken.

It is obvious from the above that the

addition of more stages of radio frequency amplification leads to a condition where excessive feed-back is bound to take place. When this occurs, violent oscillations ensue which are hard to control. It is thus necessary to disregard what is known as low loss parts and discriminately employ the necessary high resistance wire, small diameter coils, widely separated coupling transformers, long leads and other absorption circuits. And all this for the reason that the radio frequency transformer has not been developed to a stage where maximum efficiency can be obtained. There is much more to be done in the development of the radio art and the experimenter is urged to bend his efforts to help solve the many problems before us.

Radio frequency amplifications can be of several different types. There is the straight radio frequency amplifier using as the input circuit a conductively or inductively coupled antenna system. The input unit can be of the tuned or untuned variety. To this arrangement can be coupled additional stages of either resistance, impedance or transformer coupling. The latter two types may be of the untuned or preferably of the tuned variety.

More than three stages of R. F. amplification has been found to result in unwanted and undesirable complica-

tions. Excessive feed-back due to interstage coupling, both of the inductive and capacitive types cause too much squealing. Self-oscillation is difficult to control and reception of signals becomes a tiresome task that involves expert manipulation, so that the oscillation can be avoided. Two stages, therefore, are all that have been incorporated into the majority of present-day receivers. Especially is this the case with the neutralized receivers. There are several types of these latter. Among them are the monophase, neutrodyne, neutralized receiver of Rice, that of Farrand, the superdyne, the tertiary bucking coil, the potentiometer or lossor and other adaptations.

Regeneration, either that due to inherent feed-back within the receiver or else that which is applied by the use of a tuned plate in the detector circuit, a tickler feed-back coil or other means, is without doubt the most important factor to consider when summarizing the causes which contribute towards the successful operation of any radio frequency amplifying receiver. Not due to the amplification constant of the tubes, nor due to the ratio of voltage step-up in transformation from successive stages of amplification, the volume possible to obtain from this type of set lies, mainly—and in a very large meas-

ure—in the amount of regeneration present. Bearing this in mind, the author has spent some time bending his efforts in a direction whereby the use of a two-tube receiver would bring as much in results as a four or five-tube set could do.

The problem resolved itself into the perfecting of a circuit which would use one stage of radio frequency amplification in conjunction with a regenerative detector. (See Circuit 6.) Knowing full well the amount of trouble to expect when trying to consummate such a condition, the radio frequency amplifier tube was first used with a non-regenerative detector. The results were poor in comparison to those when regeneration was applied. Not only were signals very much weaker, but the range of the set was far below that possible with the use of regeneration.

This is strongly brought out the fact that the very first principle which was uncovered after the invention of the three element tube still finds and plays the most important function in our receivers. The only decisive attempt to improve regenerative tendencies in a set was the introduction of the super-regenerative circuit. But this being an entirely different principle, leaves the field wide open for more experimental work to be done along this line.

The Thordarson-Wade Set

(Continued from page 29)

amazing what a difference there is between getting the set working pretty well and just right.

The Grid Biasing Battery

If your zealous efforts still bring you only a little nearer to the goal you may rest comfortably assured that the grid biasing battery is not at the correct voltage. The formulatic considerations are not conclusive by any means. Disregard all data you ever read or heard on the subject of what is the correct bias for a given plate voltage. The test is to be made by ear. The bias that is figured out on paper has to do largely with economy, and we are concerned with quality. You will probably find that 3 volts negative bias will be about right, although you should try $4\frac{1}{2}$, and up to 10 or 12, or some intermediate voltages. The biasing effect of the potentiometer has something to do with this, as it is compensatory, hence experiment independently and do not be afraid to go against the accepted biasing ratings. If you find that an utter absence of bias improves reception, then by all means leave out the "C" battery, although it is unlikely that any improvement will be noted by its utter omission.

Radio-frequency Features

The regeneration control is particularly handy, since the set may be oper-

ated as a non-regenerative receiver for the reception of local stations, and only two dials used for tuning. This is done by tuning in a low wave-length station and getting the C3 setting that affords best volume and clarity. Then for the higher wave-lengths the same setting may be used, unless the station is a notoriously weak one, at your point of reception, in which case C3 may be moved up two or three degrees. For locals it will not be necessary to vary the C3 settings more than 10 divisions of the dial, and, as suggested, perhaps no motion here will be needed. This is due to the condenser assuming merely a by-pass purpose, since it is connected as would be a fixed by-pass condenser, only with a small winding to boot (the few turns on L4 between tap and rotors).

The advantage of this form of regeneration control therefore is that you do not tune out the signal from a local station by any adjustment of C3, unless you introduce over-regeneration. I was assuming the omission of the regeneration feature.

As all forms of regeneration bring up the possibility of distortion arising from forced feed-back—an extreme amount of returned energy being used to compel reception that the set is un-

option where it is not needed. That means stations, say, up to 50 miles away.

Exact Tuning

Now, the tuning is easy, once you learn how, as is everything else. But here the learning will not take long. The resonance point must be achieved to the greatest degree of precision, otherwise the set will not prove itself the glorious monument to quality that it really is.

In tuning it may be found that for a given station you get pretty good reception when the dials at left read 60 and 62. Then you try retuning by slight variations, and suddenly a great burst of delightful volume comes through the speaker. You look at the dials. They read 61 and 61. You were off the resonant point.

Another possibility is that when not in exact resonance there will be better quality than when resonance is achieved. Usually in such a case resonance will be accompanied either by some slight distortion or by oscillations, great or small. Turn back the feed-back condenser a little and you will bring about that luscious volume mentioned before. Indeed, the same condition has been reached in either case—resonance accompanied by correct feed-back (if any).

A Low-Loss Crystal Set

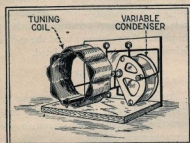
English Radio Publication Exploits Crystal Set Employing Low-Loss Parts

IT is a singular fact that in the present era of "low-loss," the elimination or rather attempted reduction of losses has been confined to that class of sets having less reasons for keeping down the losses. In other words, the receivers using vacuum tubes have been the recipient of the low-loss benefits, and the lowly crystal set—presumably the more needy by far—have been

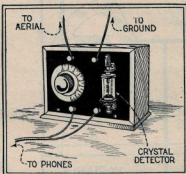
The question is answered and the application made, in a very interesting article appearing in *The Wireless*

of the set depends a great deal on the tuning arrangement, and if this is inefficient the maximum amount of signal energy will not be passed on to the detector, whether it be tube or crystal.

In the case of a tube set, losses that may occur in the aerial-tuning circuit can be overcome by the use of regeneration.

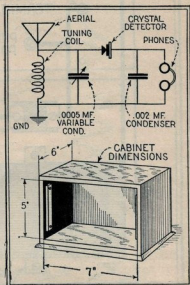


Back view showing how coil and condenser are mounted.

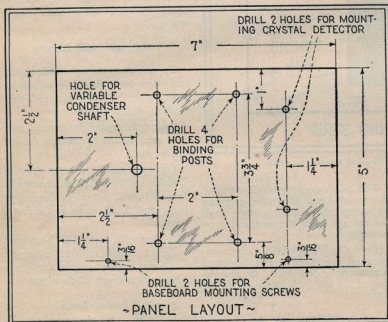


The completed low-loss crystal set.

Magazine, London, England. Here the author describes a crystal set arranged to take advantage of the latest theories regarding losses in coils and con-



At the top is the circuit diagram of the low-loss crystal set. Below shows details of cabinet for the set.



Illustrations by courtesy of *The Wireless Magazine* (London, England) shown. Location of mounting screw-holes will have to be determined according to the type of condenser used.

neglected. Any assumption that crystal sets have gone entirely out of vogue will be wide of the mark as a survey of the field readily shows. Therefore why not apply the various low-loss ideas to crystal sets?

Without going into an academic discussion of the merits of the low-loss idea, the set described should prove an unusually efficient crystal receiver. The complete article follows.

In all radio receivers the sensitivity

This, of course, is not possible on a crystal set, and the utmost care must be taken to ensure that there is the minimum of losses in each component part, the most important being the tuning section.

High Efficiency and Low Losses

A glance at the illustrations of the receiver about to be described will show the general construction and lay-out adopted, which make what is a highly-efficient low-loss crystal set.

An original feature is the design of the coil. This is of a self-supporting type wound with stranded enamelled aerial wire, and is tuned by means of a low-loss variable condenser.

The coil is conveniently mounted on a baseboard attached to the panel. This method of mounting is becoming very popular among home-constructors owing to the ease with which components can be mounted, leaving the panel free

for the controls. The appearance of the set is also improved, as no coil mounting screws are necessary on the panel.

marked out on the board and nine small holes drilled equidistantly round the circumference. The nails should then be driven in the holes.

and connected up. The wiring is started before the coil is mounted, so that easy access is possible to all connections.

The ends of the coil should be scraped clean (each strand separately) and then soldered. This must be carefully done, as one strand left out will result in the efficiency of the coil being lowered.

An insulating strip $3\frac{3}{4}$ by $\frac{1}{2}$ in. by $\frac{1}{8}$ in. is required for fixing the coil to the baseboard. The method of fixing is shown clearly in the drawing.

A $\frac{1}{8}$ -in. hole is drilled at each end of the strip to take the $\frac{3}{4}$ -in. brass screws which are used for mounting.

The coil is laid on the baseboard in its correct position and the insulating strip is screwed over one side of the coil with sufficient pressure to hold it in place. After being placed the coil is wired up and the set completed.

Cabinet

A cabinet for the receiver may be constructed from mahogany, the constructional details being given in the accompanying sketch.

The cabinet shown has no lid, any alterations to the set being made by sliding the panel and baseboard out of the case.

Operation and Results

To test the set the aerial, ground and phone leads should be attached to their respective cord tips and these pushed into the correct jacks.

Adjust the crystal detector and tune in a local station by moving the condenser dial.

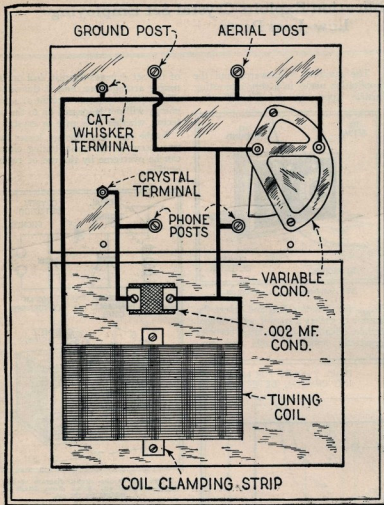
On a test aerial two miles from the London station 2 L O was received at fair loud speaker strength, dance music being audible 15 ft. from the instrument.

At five miles from 2 L O there was sufficient volume to work eight pairs of phones without appreciably diminishing the strength of the signals.

Indoor Aerial

On an indoor aerial at the same distance reception was all that could be desired.

The set was not tested over a greater distance, but it seems from the results obtained at short ranges that good reception should be obtainable up to 30 or 40 miles from a main broadcasting station.



Layout of the parts on the panel and baseboard including the wiring.

For constructing this low-loss set the following parts are required:

Bakelite or hard rubber panel 7 in. by 5 in.

Wooden baseboard, 7 in. by 5 in. This should preferably be of seasoned oak.

.0005-microfarad variable condenser.

.002-microfarad fixed condenser.

35 ft. stranded enamelled aerial wire.

4 cord tip jacks and cord tips.

Crystal detector and crystal.

The Coil

The coil is wound on a form consisting of a piece of wood 5 in. square and 1 in. thick into which are fixed nine headless nails.

A circle of 4-in. diameter should be

The coil, consisting of 32 turns of the stranded enamelled wire, may now be started, the winding going outside one nail and inside the next, and so on in sequence.

Before removing the coil, the cross-overs of the wires should be bound with string or thin wire. On completion of the coil, it is slipped from the form.

Building the Set

The panel should be drilled as shown in the drilling diagram and then fixed to the baseboard by means of two round-headed $\frac{1}{2}$ -in. brass screws, after which the parts can be assembled and wiring begun (see diagram and illustrations).

The fixed phone condenser is screwed down near the phone terminals

The Counterphase Circuit

A Two-Control Receiver Employing the Toroidal Form of Coils for Coupling the R. F. Stages

THE ideal receiver, under present conditions as viewed from the standpoint of the broadcast listener, should be capable of operation with extreme ease, selective enough to receive any desired station without interference from any other station, and sufficiently sensitive to insure coast-to-coast reception.

Such a receiver, moreover, must also function without impairment of the natural qualities of the program to be received; in other words, faithful reproduction of tone quality is absolutely essential.

A receiver said to possess such qualities has recently been described by J. T. Carlton in *Radio News* magazine. Mr. Carlton explains the principles of the circuit as follows:

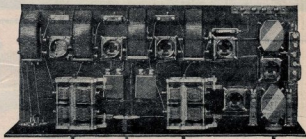
To appreciate the basis on which the circuit described herewith is founded it is necessary to turn back for a moment to the point in the development of radio frequency amplification where "adding a stage of radio" to a regenera-

Adding more and more stages became the immediate aspiration of the multitudes. Commercial refinements were rapidly introduced, resulting in more efficient apparatus, and a consequent in-

crease in receiver efficiency and selectivity.

Photograph showing the arrangement of the apparatus in the Counterphase receiver. Note the position of the tandem condensers and the toroidal coils.

Photo courtesy of Radio News (New York)



crease in receiver efficiency and selectivity.

Why "Feed-Back" Circuits Oscillate

But, unfortunately, as increased efficiency became manifest, the difficulty

was in resonance or exact tune with a signal.

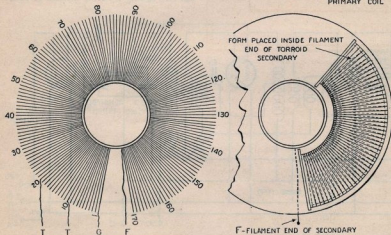
When in resonance with an incoming signal, the grid circuit of the tube offers but very small resistance to the flow of current set up by the signal to which it is tuned; this condition, of course, prevails where the essential components of the receiver are designed for high efficiency. When only a small resistance is offered to the passage of a current a large flow will result. As the energy fed into the grid circuit is amplified through the tube, a much stronger signal current results in the plate or output circuit of the tube. When the set is tuned to resonance with the incoming signal the feed-back may become excessive, and swamp the signal current. The circuit is then in an oscillatory condition—the undesirability of which is manifest through the whistles and howls that ensue.

To maintain the maximum signal current in the grid circuit we must maintain a condition of resonance in the tuned circuit, but to allow the use of the low resistance grid circuit we must have means of limiting their energy feed-back from plate to grid so that the signal will not be swamped by whistles and howls.

If the tendency to oscillate were uniform at all frequencies the problem could be solved by any of several methods that are well known. But this is not the case. Oscillations are much more difficult to control on the lower wave-lengths, and with the confusion caused by crowding 90 per cent of the stations on the lower half of the broadcast scale, the futility of any method of fixed control becomes immediately ap-



PRIMARY P TO B 25 TURNS
N° 36 WIRE WOUND CLOCKWISE.
COUNTER PHASE COIL R TO M
25 DOUBLE TURNS N° 36 WIRE
WOUND COUNTERWISE
50 TURNS IN ALL



Specifications for the toroidal coils which are used for coupling the R.F. stages.

tive set was considered an accomplishment. Greater range became possible because of the fact that signals primarily too weak to register an effect on the detector tube were strengthened sufficiently for detection.

that is commonly known as "oscillation" also increased in importance. It was found that within the tube of each stage of an efficient low loss set such amplification would occur that excessive plate energy would flow to the grid

parent—whether the system employed be neutralization at some mid-frequency or the introduction of enough

on the high frequencies, usually leaves the upper end dead.

With such considerations in mind,

free from howls and whistles, is always secured at this point.

The Counterphase Circuit

The desire was to provide an adjustable compensation for this tendency to oscillate that would allow maximum results at all frequencies rather than at only one. The "Counterphase" circuit now described provides a practical method of controlling three stages of radio frequency amplification with the same ease and efficiency as if only one or two were used.

In this circuit on which patents are pending, semi-variable capacities are employed; that is, the $\frac{1}{2}$ to 30 mmf. condensers are once adjusted and remain fixed thereafter.

The means employed to secure the necessary variations to provide for controlling the oscillation tendency is at once new, simple and ingenious. In a condenser when the capacity is decreased the tendency to oscillate is increased. If we introduce a resistance in series with the condenser we will counteract this tendency. Each stage of amplification except the first, which is not difficult to stabilize, has its grid and plate circuits with like and reverse phase windings respectively coupled by fixed capacities in series.

Each stage is easily adjusted so as to prevent oscillation at any frequency by varying the series resistance. Decreasing the series resistance increases the tendency to oscillate, thus governing the amount of reverse phase energy necessary to suppress oscillations at the high frequencies.

An outstanding advantage of this method lies in the fact that there is no detuning effect noticeable, as a result of which it is possible to tune three radio stages as well as the detector with but two tuning controls instead of four.

SPECIFICATIONS FOR TOROIDAL TRANSFORMERS

Secondary, or outside coil, cross section $1\frac{1}{2}$ inches square, or $1\frac{1}{4}$ inches in diameter, if round; 170 turns No. 24 double-covered wire. Core $1\frac{1}{2}$ -inch tube.

Primary wound on celluloid form made to fit 120 degree inside filament end of secondary consists of 25 turns No. 36 enamelled wire, space wound.

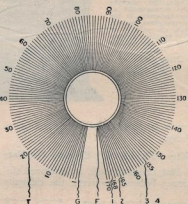
Counterphase winding, 25 turns No. 36 enamelled wire, space wound on same form between primary turns.

Counterphase condenser 1mmf. to 30 mmf., variable.

Tuning condensers, double units, 350 mmf., with trimmers of 25 mmf.

1 mfd. fixed capacities across "B" battery and across "C" battery.

.001 mfd. across detector plate to filament.



NOTE: COIL TO HAVE 170 TURNS OF NO. 24 D.S.C. WIRE TO BE TAPPED AT 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, AND 170 TURNS FROM GRID END. NO BRIDGE COIL TAPS 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170.

Specifications of the toroid connected to the antenna.

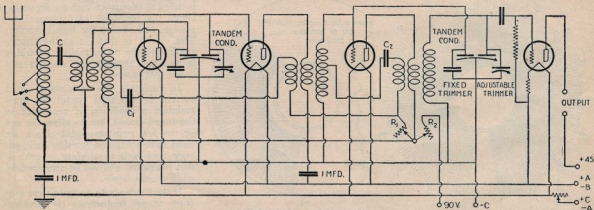


Diagram of the Counterphase circuit, showing how the tandem condensers and the toroidal coils are arranged.

losses to stop the trouble even on the lower waves. The former method usually results in whistles and screeches at the lower end and weak amplification at the upper, while the latter plan, although it may give favorable results

Harry A. Bremer evolved a method of control whereby the circuit might be kept at a point just below that of oscillation at all frequencies or wavelengths. It will be remembered that the greatest amount of amplification,

Indeed, it is possible to go on adding more stages of radio frequency, if there were any practical reason for desiring to do so.

It is possible that a single control (Continued on page 46)

An A. C. Storage Battery Charger

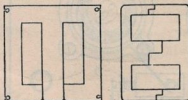
Complete Directions for the Building of a Vibrating Rectifier for Charging a Storage Battery

IN the early days of radio communication, when some few hundreds of pioneer amateurs were building crystal sets to hear radio spark messages from ships and the time signals from the government stations, there wasn't very much in the way of apparatus available on the market. We were forced to make the majority of our instruments. To the writer at least, there was another factor to be considered—that of conserving cash. In these days of high quality parts and low prices it is nearly always cheaper to buy the parts ready-made. There is, however, a definite satisfaction in "rolling your own." Many amateurs and broadcast listeners prefer to make as much of the radio receiver and accessory apparatus as possible. If the set works well they can point to it with much pride as a "home-grown" product. Direct current charges are one of the easiest accessories to build, and probably the majority of fans have made their own. The alternating current charger for storage batteries is another thing, however. Seldom are these necessary units described in radio journals. This article by *Keith La Bar*, which appeared in *Radio*, San Francisco, California, gives all the essential details for the construction of an efficient charger for rectifying alternating current. Mr. La Bar's valuable article follows.

Every once in a while someone gets ambitious and writes an article on how to make a homemade battery charger. But usually we are prevented from making a charger because we do not know how to substitute things we have for the parts called for in the article. Materials for a charger cannot be bought at the corner radio store. They must be dug up out of nothing. We will tell of the places pay dirt is most likely to be struck.

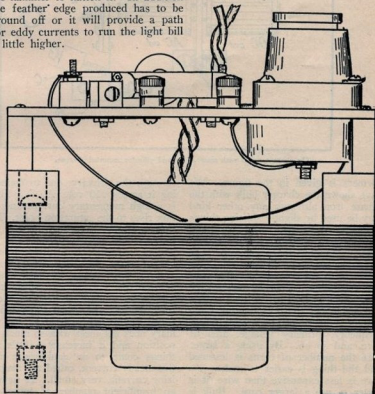
The chief, and most important ingredient of a charger is the transformer, and the character of any transformer rests upon the quality of iron used. We are usually told by writers that if silicon steel (really very soft iron of the best quality) necessary to the happiness of the transformer is not to be obtained we may substitute with stove pipe iron. This means we must cut about a hundred or more pieces by hand to make a success of the thing. Now the stove pipe iron of fiction is not what it is cracked up to be. The iron that has been sold to

us as stove pipe iron was most treacherous stuff. Using the family snips on this iron will temporarily ruin the strongest hand. If it will cut, it twists up into most unfriendly shapes where it defies the most coaxing efforts of



Forms of iron used for core of transformer.

the hammer to flatten it. In addition the feather edge produced has to be ground off or it will provide a path for eddy currents to run the light bill a little higher.



Illustrations by courtesy of *Radio* (San Francisco, Cal.)
Sketch showing vertical section through charger. The method of mounting parts is clearly shown. Compare this view with that of the charger panel on the next page.

So you see why some of us go to great lengths to get good iron. Well, one man's junk is another man's riches. The light and power company of your town is troubled now and then with burnt out pole transformers. A few turns short and the whole thing has to be scrapped. They usually burn

off the insulation, reclaim the copper, and throw away the core. Four of us peered inquiringly into the murky depths of the Missouri River one lazy Saturday afternoon looking for a barrel of this core that was rumored to have been dumped in a short time before.

The core is thrown away because it does not pay to ship it. So it may be purchased at an exceedingly low rate, and if the man in charge of the department likes your looks he may give it to you. Even if they charge you for it enough to make your transformer ought not to cost more than four bits. (Economy note—Doll your sis-

ter up in overalls and get her to ask for it).

If a complete transformer may be purchased with windings intact by all means buy it. What is wanted is the smallest of the pole transformers, about the size of a man's head. We have usually paid about \$2.10 or less,

mostly less, although friends have reported paying as much as \$3.75. However, these were not burnt out, but merely old style, and were carefully kept intact and used for 1,100 volt plate supply for C. W. transmission. The wire to be obtained from them is very useful, both for the building of our transformer, and just to have around.

The two forms of iron used to the greatest extent in these small trans-

formers. The softer the iron the more it will hold. Even the best iron can be magnetized only to a certain point and can go no further. With a certain value of magnetism the voltage produced by a transformer varies as the number of turns. Now this applies to voltage produced in the primary by lines of force cutting the turns as well as the voltage produced in the secondary.

Let us imagine a current flowing

secondary circuit, the action of the current flowing in this circuit is to decrease the density of magnetism which in turn decreases the back E. M. F. in the primary, which then allows more current to flow, this current being in proportion to the power used. In making some transformers where power is cheap and copper is high, they are made deliberately inefficient with a smaller number of primary turns than they ought to have. Transformers for intermittent work also fall in this class. As it is probably as easy for us to make an efficient transformer as a poor one, we will be generous with the iron and wire. Here is a table of primary turns to use with a certain area of core of good iron and a frequency of 60 cycles. For 50 cycles use 6/5 these figures. Values as low as 2/3 or less of this can be used with a large drop of efficiency. You pay the light bill, not I.

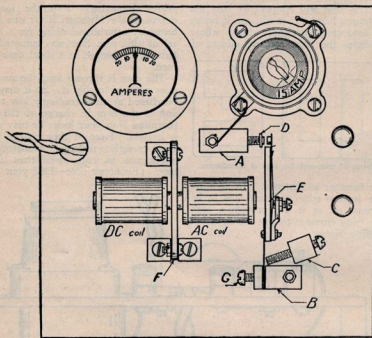
Section	Area	Primary turns	Practical figure
$1\frac{1}{2} \times 1\frac{1}{2}$	$2\frac{3}{4}$ sq. in.	525	525
$1\frac{1}{2} \times 2$, etc.	3 sq. in.	392	400
$1\frac{1}{2} \times 2\frac{1}{2}$	$3\frac{3}{4}$ sq. in.	348	350
2×2 , $1\frac{1}{2} \times 2\frac{1}{2}$	4 sq. in.	296	300

Doubling the core halves the turns.

The larger the wire used, the better the transformer, as there is a smaller heat loss and smaller voltage drop. We wish to limit any probable damage done by this heat rather than save power here. For our primary current of about 1 ampere it is the height of conservativeness to use nothing smaller than No. 20. Personally, we have got by using No. 24.

For the heavy current side we must use heavy enough wire to carry a current of at least 5 ammeter amperes, which means in a battery charger a current of double this value for half the time, due to the habit of chargers of using only half the cycle. The heat loss caused by a current of 10 amperes half the time is not that caused by a current of 5 amperes all the time. With a 5-ampere current and a resistance, say to make things easily seen, 1 ohm, the losses would be $5^2 \times 1$ or 25 watts. With a 10-ampere current the losses are $10^2 \times 1$ or 100 watts for half time or an average of 50 watts. This shows we must use wire heavy enough to carry double the current indicated by the ammeter. A wire of 10 amp. carrying capacity is then needed. Still again, if we use too large a wire we can never hope to get it in the space in the iron. It is an eternal compromise between what is theoretically efficient and what is practically impossible. About the lowest limit is No. 14 S. C. C.

Two or three smaller wires may be wound simultaneously and connected in parallel to equal one large wire. In this case one should be careful to wind them side by side and use the same length of wire for each. Two strands of a wire is equal to a wire three sizes



The charger panel with meter, fuse and vibrator mounted thereon.

formers is given in the figure. We have shown the charger built with the square iron although any other kind may be used by slightly shifting things around. With such iron we build transformers known as the "shell type." Winding the primary over or under the secondary and not on a separate leg of the core gives better voltage regulation. That is, the voltage drop from no load to full load is less.

The number of turns on the transformer is determined by several things, frequency, primary voltage, area of core, and so on. By using a larger core the number of turns is lessened and the thing is easier to make. As core is less expensive than wire, it is better to use a larger core. Bulk is nothing to us. There is a certain theoretical minimum limit of turns for any particular value of these things, and we will show why this is so.

The action of a transformer depends upon two things. Magnetic lines of force are produced in the iron by current flowing in the coils. These lines of force react in turn upon any surrounding turns and produce an electromotive force in the windings. Iron will hold only a certain density of

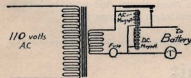
through the primary, due to connecting it across 110 volts A. C. There is a high momentary current and the flux rises to the saturation point. This flux produces a voltage across the primary bucking or opposing the line voltage. If there is a sufficient number of turns this back electromotive force is nearly equal to the line voltage and the current then drops to a low value. This lowering of the current reduces the back electromotive force so that the current in the primary does not meet with so much opposition and it increases a little and things come to an equilibrium with this steady current, called the magnetizing current, very small. If there is an insufficient number of turns, the flux goes up to the saturation point, and tends to produce the opposing E. M. F. But this E. M. F. does not approach the line voltage by a great deal, and the power runs away in the form of heat. If magnetism could go up to a higher value the current would cut itself down, but it can't. So we use enough turns to keep the magnetic flux below the saturation point, where everything is jake.

When power is absorbed from the

larger, as 2 of No. 18 equals 1 of No. 15.

The number of secondary turns is to the number of primary turns as the ratio of the voltages between them. A good value for the secondary is 10 volts with 1/11 of the number of primary turns used. If relatively small wire is used for the secondary a few extra turns may have to be wound on to compensate for voltage drop. A few turns may even be wound on over the whole thing if the charger does not charge fast enough to suit requirements.

Delivering a constant potential, these chargers give a tapering charge. The current is at a high value at first, and, as the battery comes up the current drops off, until as full charge is reached the current may be a fourth of the initial current. Nothing is the matter with the charger if it does this. It is the best way to charge a battery.



Wiring diagram for the charger.

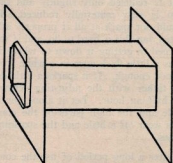
The windings are wound by hand on a cardboard spool, the low voltage side being wound first if you are short on heavy wire. A layer of tape or empire cloth goes over this and then the primary winding goes on. Do not use enameled wire for the primary unless it is wound smoothly and each layer is covered with insulation. If you have lots of wire and lots of room to wind it in, the primary does not even have to be wound in layers. Merely wind it to about 3/4 in. in depth all along the tube, then put a layer of insulation and continue with winding. In winding it is necessary to count the turns, of course. Keep a pencil and a piece of paper handy and at every 50 turns put down how many turns have been wound on. If you interrupt the winding even for a minute put down the number. It is no joke to lose count. A pound of No. 20 ought to be enough for the primary.

The transformer is held at two sides by strips of wood over and under, which serve as a base and a place to fasten the top panel. These two wooden strips are fastened together with countersunk bolts which, if the laminations are punched, may run through the iron, or if they are not punched, may extend on each side of the iron. On top of these strips is fastened a bakelite panel to carry the vibrator coils and the vibrator. For our charger a 7x7 panel was used. An old panel should be used, one that has served its time and that is ready to retire. It isn't worth the money to buy a new panel. Bakelite is really necessary only for the vibrator and coils.

Wood may be used to mount the rest of the stuff, the fuse plug and ammeter on.

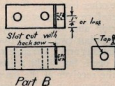
The ammeter is a product of the auto wrecking yards. Four bits. The dime store has fuse plugs. The binding posts should be good and heavy. The battery is connected to these.

The vibrator and magnets are inter-



Cardboard spool for winding. While winding it is suggested to keep the core filled with lead pencils to prevent collapse.

esting. Good mounted contacts are hard to prepare, so we use the replacement unit of the Homecharger. For a buck you get a whole part that wiggles back and forth and the contact it hits against. Some parts must be constructed to hold these Homecharger parts. A brass block (A in the figure) is made to hold the contact D. It may be made any size within reason. Two holes are drilled to fasten it to the panel. They may either go all the way through and bolted to the panel or drilled part way and tapped. In the end of the block a hole is drilled and tapped 8/32 to hold the contact. The threads of the contact are of odd size



Part B

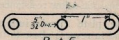


Part A

Details of parts for the vibrator of the charger.



Part C



Part F

and so will make it impossible to screw it in very far. This does not matter particularly. This hole must be drilled at least 3/8 in. up from the panel to allow the vibrator to clear the panel.

Part B clamps tight upon the vibrator. It is also composed of a piece of square brass rod, about 1/2 x 1/4 x 1 1/2 in. The most important dimension here is to get the set screw G over as close as possible to the edge of the block toward the vibrator. This is because the spring is very short. The slot the spring fits in is made with a hacksaw. The set screw is an ordinary 8-32 screw with the end filed flat. Tightening the screw too tight is sure to strip the threads in the brass block. Here as in the other block two vertical holes are drilled to fasten it to the panel.

Part C is a small block with but two holes. The horizontal one serves to carry the screw that adjusts the distance between the contacts and serves somewhat to vary the charging rate. It is drilled and tapped for a short distance at the bottom for fastening to the panel. A lock nut should be used with the long adjusting screw.

The electromagnets may be obtained from an old telephone ringer or telegraph sounder or may even be built out of an iron rod with pieces of composition for the ends. They are about 1 in. in diameter and 1 1/4 in. long. Larger ones may be used as long as they are the same size. They are wound with No. 28 or 30. They are tapped 8-32 at one end so we cut the head off a machine screw and fasten the magnets end to end, putting in iron strips in between so we can fasten the magnets to the panel. This long strip is drilled at the end and is fastened to the panel with L pieces.

It is very important to have the vibrator and the contact blocks fixed solidly to the panel. If this is not done it is impossible to "tune" the vibrator and the charger, instead of giving out a steady hum, will go "ooo ah ooo ah ooo ah, etc." This shows that there is a slow movement back and forth of the parts in addition to the steady vibration due to the A.C.

There is a certain ritual to be observed for best results when mounting the junk on the panel. The part holding the vibrator is mounted first. Then the block with the contact in place is laid on the panel and mounted so that the distance between the contacts is about 3/32 in. The A.C. coil is connected to the transformer and the D.C.

coil to a storage battery, and we see if the vibrator vibrates when the magnets are brought near to the vibrator. If possible we wish to fasten the magnets in such a position that the vibrator vibrates smoothly when both D.C. and A.C. magnets are on but does not vibrate at all and the contacts do not touch when the A.C. magnet is off but the D.C. is still on. If this happy condition is not attained the fuse must be slightly unscrewed when starting and stopping the charger, for if the contacts touch when the A.C. is off another fuse is gone. Remember that the A.C. magnet is nearest the vibrator.

If now we have the vibrator and

magnets fixed in position we may try a sample of charging to see if it really works. The transformer is connected to the battery in series with the vibrator contacts and the ever present fuse plug. The fuse is left out. Take a piece of wire and bridge the fuse plug. If the charger changes its note and takes on a steady buzz and the ammeter flops over to one side and there is very little sparking at the contacts it is charging O. K. But if the contacts splutter and flash fire and the ammeter spasmodically hiccups, pause a moment: The wrong half of the cycle is being used. Either reverse the A.C. magnet or the D.C. magnet; not both.

When everything is finally wired up and put in shape the charger will give a little more current than when temporarily wired. This is because a change in resistance in the secondary windings, due to shortening leads, affects

the charging current slightly. So use heavy wire for wiring the charger up. The battery may be connected to the binding posts in either direction. Flexible cords with clips may be substituted for the binding posts on the panel.

If the vibrator does not vibrate through a wide arc the charging current is reduced only slightly and the hum is very materially reduced. It should not spark at all if properly adjusted, but this is hard to do, and if we succeed in getting it down to where it gives a little flash once in a while that is good enough. If it sparks a little do not tinker with the adjusting screws for half an hour. Let it alone for a while and the high parts of the contacts wear off a little and the sparking ceases.

After a long period of use the contacts may have to be filed smooth. If they are not kept reasonably smooth the current is cut down materially.

With a very thin file they may be filed without removing them.

If tire tape was used in the transformer do not become alarmed if a thin wisp of smoky vapor is seen rising from the transformer. The tar is good for your sore throat. It soon all evaporates off, anyway.

A 15-amp. fuse is a good size. A discharged battery may be shorted through some of the 20's and nothing happens, which is poor business.

We have tried to give all the little things here that you would wish to know. One may have many big mistakes in a battery charger and nothing happens, but the little mistakes cannot be detected and eradicated so easily and cause more trouble.

Even if you never build a charger yourself and merely buy one, it is interesting to know how one is made and the many things that must be kept in mind when designing it.

The Counterphase Circuit

(Continued from page 42)

might be used if one were satisfied to accept the approximations which must always follow when an attempt is made to combine too many functions in one unit. In the writer's opinion, no normal, two-handed person wants a radio set with only one dial to turn, and if such desire should exist it is before he has operated either kind of set rather than *afterward*.

Considered as a whole, the efficiency of the Counterphase circuit is no doubt increased because it is unnecessary to introduce any kind of losses into the grid circuit, which is thereby allowed to remain in a low resistance condition.

The plate circuit inductances are wound in reverse phase to the primary windings of the same circuit. This reverse winding is coupled to an inductance which is in like phase with the grid winding, resulting in a reverse current opposing the plate current sufficiently to retard the flow of current from plate to grid. The values of the two auxiliary inductances are sufficient to feed enough reverse phase energy for the suppression of oscillations at any frequency within the broadcasting range.

A New Improvement

The variable resistance, by the way, incorporates a further new idea. It contains two separate resistance elements on the same shaft. Since sensi-

tivity is not required on nearby stations where volume must be reduced, the balancing arm is turned to zero on resistance R-1 before resistance is cut in on R-2 to decrease volume. On the other hand, when sensitivity is required we also want volume, so that the slider arm on R-2 turns back to zero resistance before the other becomes effective. We have, therefore, three stages of radio, a detector and the customary audio stages with but two tuning dials for selecting stations and a variable resistance which needs but slight adjustment to keep the receiver at the maximum point of efficiency on all broadcast frequencies.

The use of a hard detector tube allows all six tubes to be controlled by one rheostat, and if it is desired this may be placed inside the set, as its particular adjustment may be determined without difficulty, after which it need not be disturbed.

In the schematic circuit R-1 is the resistance that controls the feed-back, and R-2 is a resistance in series with the "B" battery, the effect of which is simply to decrease potential in the same manner in which a rheostat is used in a filament circuit.

Where it is necessary in tuning to cut out resistance in order to suppress oscillations it will be readily seen that turning the knob still further results in cutting down volume, and *vice versa*.

In other words, one resistance arm is always at zero when the other is in effect, and as each rotates about 270 there is a total of one and a half turns available between maximum sensitivity and minimum volume.

This newly designed dual resistance serves a double purpose in that it eliminates one extra control from the panel and simplifies tuning. After the station has been selected by the two tuning dials it is only necessary to remember that the resistance knob is turned in one direction to increase sensitivity and volume and in the other direction to decrease them.

Since maximum efficiency at all wave-lengths is the prime object in this circuit a further refinement is added in the tandem condensers. A small "trimming" condenser is added to each section of each tandem. One of these is adjusted and fixed so as to make its combined capacity with the main section a trifle greater than the other main unit, and then left permanently in that position.

By regulation of the second, or panel unit in parallel with the second section it is possible to adjust the capacity to secure exact resonance between the two. It is necessary to use the panel "trimmer," however, only when tuning extremely weak signals. For all ordinary tuning it is not used.

Construction of a Low-Loss R. F. Amplifier

Regeneration Employed for Further Increase in Signal Strength and Selectivity

THE demand of the radio fan now is—efficiency. By that is meant the most from the tubes used, which in turn means good distance reception, selectivity and volume. This is in a way a hard bill to fill, but for all those who do not expect the impossible, the receiver described in the following by L. G. Ingram in *The New York Herald Tribune* will be found highly efficient.

This receiver employs two tubes; a third may be added for additional volume on long distance stations if desired. The third tube is wired to the two tube unit in the conventional manner for adding a stage of audio-frequency amplification to any type of set.

Regeneration in the detector tube is used to further increase the signal strength and to increase the selectivity of the receiver. The addition of the

home from the instructions that follow; the condensers can be bought in any large radio store. Be sure that they are electrically and mechanically efficient, though, before buying them.

For the antenna and secondary coils two pieces of composition tubing three and a half inches in diameter by one-half inch long will be needed. Also four strips of composition paneling one-half inch wide by five inches long by one-sixteenth of an inch thick.

In the two pieces of composition tubing drill four holes. These holes are one-quarter inch from the edge and the holes are equi-distant from each other; in other words they are one-quarter of the circumference of the tube from each other. The composition strips have two holes drilled in them, one at each end, one-quarter of an inch from the ends.

The strips are bolted on the tubing so that the completed form looks like that shown in Figure 1 without the wire on it. This type of former offers mechanical strength and places no great amount of insulating material in the electrical field to increase the resistance of the coil to be wound on it.

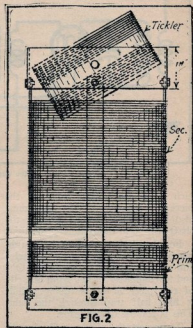
The primary and secondary coils are to be wound with No. 18 single cotton covered wire. The primary coil consists of five turns and the secondary of forty turns. The separation between primary and secondary will depend upon the location of the receiver.

For use in localities having one or more broadcasting stations within thirty miles a one-half inch separation is advised. The further away the stations are from the receiving set the closer the coils can be placed; however, do not place them next to one another. Very congested localities may call for greater separation, but this is generally not necessary if proper care is taken in the wiring of the set.

For the radio-frequency transformer the same general constructional details hold true except that one end piece of the former is one inch long instead of one-half inch. The other end is one-half inch long. The strips are the same length as for the first former.

The primary of the radio frequency transformer is wound with No. 18 single cotton covered wire and has five turns. The secondary is wound with the same wire and has forty turns. The separation between the coils here is also one-half inch. The

primary coil must be started at the end of the former having the smaller end piece. This is necessary so that the tickler coil will be at the filament end of the secondary.

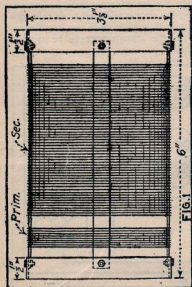


Illustrations by courtesy of
The N. Y. Herald Tribune
Radio frequency transformer should be made
as shown above.

For both coils the following constructional details should be followed. To start the winding and to bind the ends so that they will not slip two holes should be drilled in one of the strips near the end piece. Then where the wire ends another set of two holes for tying the wire. Do not use dope on the coils; if the ends are secured as directed the wire will not loosen. Wind the wire tight and the turns close together.

The tickler coil is wound on a composition tube two and one-quarter inches in diameter and one and three-quarter inches long. In the center of this tube drill a quarter inch hole and on the opposite side of the tube, also in the center, drill another quarter inch hole. These holes must be in line with one another and exactly in the center of the tube so that the tube will center on the shaft.

Forty turns of No. 26 single cotton covered wire are wound on this tube for the tickler coil. Twenty turns are



Showing construction of antenna and secondary coil.

tickler coil does not make the tuning more difficult and is therefore incorporated in the receiver.

The radio-frequency amplifier tube can be reflexed. This may or may not be done; it is up to the constructor to do as he sees fit. The reflexing of this tube will increase the volume of the signal to a great extent and will dispense with an extra tube for loud speaker work on local stations.

To construct a receiver of this type it is advisable to use low-loss coils and condensers. The coils can be made at

placed on either side of the shaft hole. Make this one continuous winding by carrying the twentieth turn of the coil around the tube so that it starts the first turn of the second half of the coil on the other side of the shaft hole.

In the large end piece of the radio frequency transformer two holes are drilled with a quarter inch drill for the shaft of the tickler coil. These holes are placed three-eighths of an

swinging in the air or may be secured to binding posts that can be placed on the end of the radio frequency transformer former. The latter method is to be preferred, as then immovable leads to the tickler coil may be made.

To keep the tickler coil shaft from moving back and forth a hole should be drilled in the shaft where it comes out of the end piece of the radio-frequency transformer. These holes

should be mounted at the left-hand side of the panel, then the radio-frequency transformer, and, last, the second tuning condenser. Both these condensers have a capacity of .0005 mfd. The rheostats controlling the tubes may be mounted at the bottom of the panel and each one directly in front of the tube it is to control.

The radio-frequency transformer may be mounted on brass angles, which are screwed to the baseboard, or may be fastened to the panel by means of brass brackets. Whichever method appeals to the constructor may be used, with no change in the efficiency.

The primary and secondary coil former must be mounted at right angles to the radio-frequency transformer and at least six inches away from the transformer. If this is not done the radio-frequency tube will oscillate to such an extent as to make the reception of radio signals impossible.

When all the parts have been mounted on the panel and baseboard then wire up the circuit according to the diagram given in Fig. 3. Use this circuit first whether the reflex diagram is to be used finally or not. If the circuit is operating according to Hoyle when wired up as per diagram Fig. 3 then the transformer may be inserted and the circuit adjusted to fit this addition with a great deal less trouble than were the transformer to be used at first.

inch from the outside edge of the piece. The holes in this tube must also be exactly centered so that the shaft will be in the center of the tube.

For the shaft a piece of brass tubing one-quarter inch outside diameter and six inches long is employed. One and three-quarter inches from one end of this piece of brass tubing a hole is filed half way through the tube. This is for the tickler leads.

To mount the tickler coil place it inside the radio frequency transformer with the shaft holes lined up with the holes in the end piece of the transformer, then force the brass tubing through the four holes. If it is found that the rotor coil turns on the shaft, that is when the shaft is turned the coil remains stationary, then it may be fastened in the following manner:

Drill a small hole in the center of the rotor tube and force a piece of No. 14 wire through it to the brass tube. Solder the wire to the shaft and bend the end of the wire over the rotor tube. This will prevent the coil from shifting back and forth on the shaft at the same time that it is holding it from turning on the shaft.

The flexible leads for the tickler coil are made from a ten-inch length of flexible insulated wire. This wire is doubled in half and the doubled end forced through the end of the shaft and pulled out inside the rotor coil through the hole filed for this purpose. The flexible wire is then cut at the bend and the two ends are soldered to the two ends of the tickler coil.

These flexible leads may be left

should be drilled as close to the edge of the composition tubing as is possible. A small piece of No. 14 wire can then be forced through the holes and bent around the shaft. Be sure

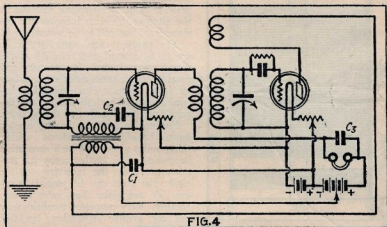


FIG. 4
This receiver may be converted into a two tube reflex by employing the above diagram.

in drilling that the drill does not cut the flexible leads from the tickler coil or break the insulation.

Panel Layout

The panel size for the two-tube set, whether reflexed or not, is 7x12. A 7x10-inch panel may be used, but, as this would require a crowding of parts, it is not advised. The binding posts had best be mounted on small pieces of composition fastened to the baseboard by brass angles.

The secondary tuning condenser

In wiring the set be careful to avoid parallelism between any two wires, keep the filament leads close together and far from the grid and plate leads. The end of the radio-frequency transformer nearest the tickler coil is connected to the filament of the detector tube. The end of the primary of the radio-frequency transformer nearest the secondary is connected to the positive "B" battery.

For those who desire to make the reflex set after the straight two-tube

(Continued on page 51)

How to Eliminate a Control

Details of a Set Designed to Eliminate a Tuning Control

ELMINATION of one or more controls has resulted in much simplification in tuning of the multi-tube receivers, in many cases, however, at the expense of efficiency. In an article in *Radio World*, New York, Percy Warren shows a method of arranging a four-tube set—one radio-frequency stage, the standard detector and audio

brought farther from or nearer to the stator. The variable plates of the other condenser are not affected. In this way the plates of this condenser may be put ahead or behind the other variable condenser so that both condensers tune exactly in step.

Let us suppose that the secondary winding, L₂, of the radio-frequency

cally place the panel parts and save a great deal of trouble. The panel is 7 x 24". The variable condenser is placed in the exact center. That is, the center hole is 3½" from the top and bottom and 12" from each end. The holding holes are given in a special template provided with each condenser. Place this template over this 5/16"

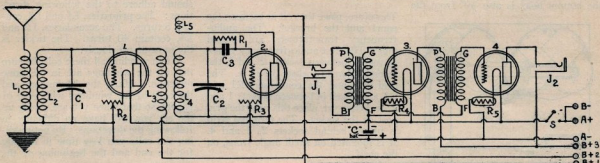


Fig. 1. The 2-control 4-tube set described by Percy Warren. One dial tunes C1 and C2. This is accomplished by the Hanscom S-C Capacity Element.

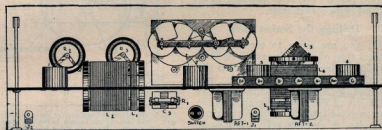
stages—in such manner as to eliminate one of the controls. Furthermore, he does it in such a way that efficiency is not impaired. This set should prove to be popular with the radio fan who does not like to fiddle with numerous dials. Mr. Warren describes the set as follows:

Where one stage of R.F. and a detector tube are used, with regeneration in either stage, the usual three controls may be reduced to two, thus simplifying the tuning. An excellent way of accomplishing this is to use a gear system. Thus the rotors, as well as the stators, are mechanically and electrically separate and if a positive grid return is desired for detector tube this can be done simply by connecting the terminal of the interstage coupler's secondary to A+, which could not be done if the rotor were common to both condensers, for then the R.F. tube would have a positive grid return, which is inefficient.

There is also another feature of this special attachment. If you will look at the diagram you will note that there is a special compensating device, attached to the condenser on the left. Here a piece of bakelite strip is attached to the variable plates. The bottom of this strip goes to a small cam. This cam is attached to a small arm. By moving this cam the movable plates of this condenser are moved. They are

transformer contains 40 turns, and the secondary winding, L₄, of the 3-circuit tuner has 45 turns. This means the

hole, and drill the others. This takes up 4" of the space in a square area. The center hole for rheostat R3 is



Illustrations by courtesy of Radio World (New York)
Fig. 2. Showing the back view of the set, with the Hanscom capacity unit in sight.

variable condenser which shunts the R.F.T. will be about 8 degrees ahead of dial that controls the second R.F.T. However, we only have one dial here and we therefore adjust the plates of the condenser that has this device on it so that the same dial reading represents resonance for both. In other words, the secondaries of both circuits are equalized. Of course, any discrepancy of tuning, such as due to tube plate capacity, etc., is made up in the same way.

Drilling the Panel

The first thing that ought to be done when building this receiver is to drill the panel. By doing this you automati-

placed 3½" from the left-hand edge, and 2½" from the top. The rheostat will not be in line with the condenser dial, which, by the way, is 3½" in diameter. The center hole of the other rheostat, R2, is 3" from the hole drilled for R3 and 2½" from the bottom, or on the same plate as R3. The diameters of the center holes are 5 1/16". The holding holes are placed ½" from the center of the center hole, one on the left and one on the right. These are ⅝" in diameter. The single circuit jack, J2, is 1 1/12" from the left-hand edge, and 2" from the bottom. The diameter of this hole is ⅞". The filament switch is 12" from the left and the right-hand edge of the panel is 2"

from the bottom. The diameter of this hole is about $\frac{1}{2}$ ". The double-circuit jack, J1, is placed 9" from the right-hand edge, and 2" from the bottom. The diameter of this hole is also $\frac{1}{2}$ ".

The hole for the shaft controlling the tickler coil is $3\frac{1}{2}$ " from the top and the bottom, and 3" from the right-hand edge of the panel. A small knob, rheostat size, is used. The only holes that remain to be drilled are the bracket holes. The bottom hole of the bracket on the left is $19\frac{1}{32}$ " from the bottom. This is a $\frac{1}{8}$ " hole. The top hole is $5\frac{1}{32}$ " from the bottom hole. They are both $\frac{7}{8}$ " from the left-hand edge. The diameter of this hole is $\frac{1}{8}$ ". Now on the right-hand side the other bracket holes are placed. The bottom hole of this bracket is $19\frac{1}{32}$ " from the bottom, $\frac{7}{8}$ " from the edge, and has a diameter of $\frac{1}{8}$ ". The top hole is $5\frac{1}{32}$ " from the bottom hole, is also $\frac{7}{8}$ " from the

center of the coil is $3\frac{1}{2}$ ". This means that the socket would hit the coil.

LIST OF PARTS

- 1 antenna coupler, L1L2.
 - 1 3-circuit tuner, L3L4L5.
 - 1 Hanscom condenser unit. (This contains the variable condensers C1 and C2 of .0005 mfd. each.)
 - 2 20-ohm rheostats (R2, R3).
 - 1 2-megohm grid leak (R1).
 - 1 .00025 mfd. condenser (C3).
 - 2 AFT.
 - 1 double-circuit jack (J1).
 - 1 single-circuit jack (J2).
 - 1 7 x 24-inch panel.
 - 2 dials.
 - 2 $\frac{1}{4}$ -amp. ballast resistors (R4, R5).
- Accessories: One pair of brackets, one terminal strip, A, B and C batteries, four tubes, phones, speaker, antenna and ground wire, connecting wire, screws, nuts, etc.

Therefore, place the coil in between the panel and the bracket. The audio-frequency transformers are placed thus: The first audio-frequency transformer is between sockets 2 and 3, the second between sockets 3 and 4. The grid leak and the condenser, R1 and C3, are placed in between sockets 1 and 2, or, better yet, place this near the grid post of the socket. The terminal strip is placed behind sockets 2, 3 and 4. It is mounted on small angle irons, on the shelf.

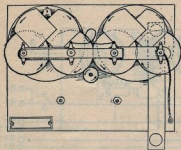


Fig. 3. Showing how the condenser mechanism works. Remove the looped pigtail to construct the set shown in Fig. 1, as the two tuned circuits have different grid returns.

edge, and has a diameter of $\frac{1}{8}$ ". This is all the drilling there is to be executed on the panel. The next substance to be drilled is the socket shelf.

Drilling the Socket Shelf

If you are going to use the gang socket type of shelf there will be little drilling to be done. You can tell the socket terminals, though they are not marked, by the fact that the grid is at rear left of the slot in the shell where the tube pin catches. The slot at rear, the plate is at right rear, the F— at left front, F+ right front. Suppose you are going to use individual sockets. The shelf is 23" long and 3" wide. Socket No. 1 is placed 3 $\frac{2}{5}$ " from left-hand edge. The outer circumferences are $\frac{1}{2}$ " from the edges. This socket will take up $1\frac{1}{2}$ " space. The next socket, No. 2, is placed 3 $\frac{2}{5}$ " from No. 1, moving from left to right. This will also take up $1\frac{1}{2}$ ". The outer circumferences are placed $\frac{1}{2}$ " from the edge. Socket No. 3 is placed 3 $\frac{2}{5}$ " from socket No. 2. The outer circumferences are placed $\frac{1}{2}$ " from the edges. This socket will also take up $1\frac{1}{2}$ ". The last socket, No. 4, is 3 $\frac{2}{5}$ " from No. 3. All these dimensions are taken from the outer circumference of the socket and not from the center. The antenna coil, L1L2, is placed in between socket 1 and the left-hand edge. The diam-

eter of the coil is $3\frac{1}{2}$ ". This means that the socket would hit the coil.

The secondaries of these coils are shunted by a .0005 mfd. variable condenser. If you desire to use a condenser with a capacity of .00035, normally 17 plates, the following wiring directions are given: The primaries, L1 and L3, contain 12 turns; the secondaries, L2 and L4, contain 55 turns. The tickler is the same. The diameters and the heights of the tubings are the same. Those desiring to use a .00025 mfd. condenser, which is normally an 11-plate condenser, should follow these directions: The primary, L1 and L3, contain 15 turns. The secondaries, L2 and L4, contain 63 turns. The tickler, L5, contains 53 turns. Those desiring to use the .001 mfd. variable condenser should adhere to the following directions: The primaries, L1 and L3, contain 8 turns. The secondaries, L2 and L4, contain 40 turns. The tickler is the same as previously.

When winding all these coils be sure that all the windings are in the same direction. Mark the beginnings and the ends of the windings with slips of papers, so that when you are wiring up the set you will have no difficulty in following the directions. By not marking the coils you lose time in looking for the end and the beginning of the windings.

Wiring the Set

The beginning of the antenna primary winding, L1, goes to the antenna binding post on the terminal strip. The end of this same winding goes to the ground binding post on the terminal strip. The beginning of the winding of the secondary portion, L2, goes to the ground and to A—. This lead also goes to the rotor plates of C1 and to the arm of the rheostat, R2. The end of the secondary winding goes to the grid of the R.F. tube and to the C1 stator.

Here is where you should pay close attention if you are going to use this special geared unit. In Fig. 2 you will note that the two rotor plates are connected together by a looped pigtail. This is done in the case that you desire a common rotor to go to the negative post of the "A" battery. But we are using two individual leads and therefore disconnect this flexible lead. Do not forget to do this, as you will short your "A" battery otherwise, using the Fig. 1 hook-up. The stationary plates of the variable condenser go to the grid post of socket 1. The arm of the rheostat goes to the A— post on the terminal strip. The other rheostat terminal goes to the F— post on socket 1. The F+ post on the socket goes to one terminal of the switch. The other terminal of the switch goes to the A+ post on the terminal strip. The beginning of the primary winding, L3, goes to the plate of socket No. 1. The end of this same coil goes to the B+2 post on the

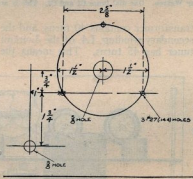


Fig. 4. Showing the template for the condenser unit. The hole at the bottom is for the compensating strip. There are three holes for the mounting of the condenser unit. This template is pasted on the panel.

Winding the Coils

The primary L1 is wound on a tubing $3\frac{1}{2}$ " in diameter and $3\frac{1}{2}$ " or 4" high. There are 10 turns placed here. A small space of about $\frac{1}{4}$ " is then left. The secondary winding L2 has 45 turns, begun right near the primary, as described. The wire is No. 22 double cotton covered.

The primary winding L3 of the 3-circuit tuner contains 10 turns, wound on a tubing $3\frac{1}{2}$ " in diameter, $3\frac{1}{2}$ " or 4" high. The secondary, L4, is wound on the same form with a $\frac{1}{4}$ " space left as in the previous case. There are 45 turns put on. The wire used is No. 22 double cotton covered. The tickler, L5, is placed near the secondary winding of

terminal strip, normally 67½ volts. The beginning of the secondary winding, L4, goes to the rotor plates of the variable condenser, C2. It also goes to A+. The other terminal of L4 goes to one side of C3, grid condenser, and to C2 rotor plates. The other side of C3 goes to the grid post on socket No. 2. The arm of the rheostat, R3, goes to the A— post on the terminal strip. The resistance wire goes to the F+ post on socket 2. The tickler remains to be wired up. The beginning of this winding goes to the plate post on socket 2. The end of this winding goes to the top terminal of the double circuit jack J1. The bottom terminal goes to the B+1 post on the terminal strip, normally 45 volts.

The inner terminal touching the upper terminal or plate connection, when the jack is out of the circuit, goes to the P post of the first A.F.T. The only other remaining jack post goes to the B+ post on the A.F.T. The grid post of socket 3 goes to the G post on the A.F.T. The F— post of this A.F.T. goes to the C— post. This same connection goes to the F— post

on the other A.F.T. The P post on A.F.T.2 goes to the P post of socket 3. The B+ post goes to the B+3 post on the terminal strip. The G post on A.F.T.2 goes to the grid post on socket 4. The F— post of both sockets go to the same connection that F— post of the other sockets. The plate post of socket 4 goes to the top terminal of J2. The bottom terminal of this same jack goes to B+3 post on the socket strip, usually 90 to 135 volts. Ballast resistors, R4 and R5, are placed in the negative A lead.

Put the grid leak R1 across the grid condenser.

Tuning the Set

This set is easy to tune. But suppose you have just finished the set and you get absolutely no signals, except the usual "B" battery click. First turn your tickler coil. See that if by turning this you hear a loud click when a certain point is reached. If you don't, then you have no regeneration. To cure this first reverse the leads of the tickler coil. If this doesn't help, add on more turns to the coil. Add on

about five turns for a starter. You may easily get too much regeneration. In that case reduce the number of tickler turns. The next thing to do is to put more voltage on the plate of the detector tube. Then try placing a .001 mfd. fixed condenser across the outside J1 terminals. Instead of adding turns to the coil you may place a .0005 mfd. fixed condenser across the tickler leads themselves. This will automatically increase the fundamental frequency that this coil will respond to. In other words, it will be the same as adding on turns of wire.

Now suppose you get broad tuning. This can easily be cured, provided you don't live within a quarter-mile of the stations.

A short antenna should be used. By a short antenna is meant one no longer (including lead-in) than 100 feet.

When wiring up the set, use No. 14 or No. 18 rubber covered or No. 18 double cotton covered wire or bell wire. Try not to use bus bars.

The 201A type tubes were used here throughout.

How to Make Basket-Weave Coils

(Continued from page 32)

of No. 24 S.W.G. D.C.C. copper wire.

The method of making these basket-weave coils self-supporting is shown in Fig. 3. First lift the coil so as to leave a space of ½ inch to 1 inch between the bottom of the coil and the base of the former. This can be done with a strip of metal beveled off at one end and inserted between the base and the bottom turn, or by means of a special lifting plate shown in Fig. 5. Next a piece of thin string or twine is slipped down the space, as shown at A, on one side of the crossing of the wires between the pegs and the other end slipped down the space B on the other side. The ends of the twine are now tightly tied to pull the winding together, and then knotted. After the crossings have thus been tied, it will be found that the coil can be slipped

off the former as a unit and will be quite self-supporting.

Mounting

There are various methods of mounting these coils, but what is probably the simplest is shown in Fig. 4. A is a piece of wood or ebonite cut down to slip into one of the spaces of the coil, as at B. About ½ inch is allowed at either end, by which the piece of wood or ebonite can be fixed to either the panel, some instrument, or the baseboard of the receiver.

Coils made on this former will be found to be very efficient and give a good tuning range on account of their low self-capacity, while for low-loss tuners they are undoubtedly one of the best types to use on short-wave work.

If the constructor does not happen to have the necessary tools for drilling and tapping the base and threading the ends of the brass pegs, another means of making the former is as follows: Drill the nine holes required in an inch-thick hardwood base with a drill which is a trifle smaller than the brass rod used for the pegs, and having cut these, drive them into the holes with a hammer until they are quite firm. As long as fairly light gauge wire is used in winding the coils, and undue tension is not put on the wire while winding, this will prove quite a satisfactory alternative. If too great a tension is applied to the wire the tops of the pegs will be pulled out of the vertical, and not only will the coils be conical, but after several turns have been wound the pegs will tend to become loose in their holes.

Construction of a Low-Loss R. F. Amplifier

(Continued from page 48)

set has been operating, insert the audio-frequency transformer, preferably one having a low ratio, in the circuit according to the diagram given

in Fig. 4. The condensers across the primary and secondary of the transformer will have different capacities for each different transformer used.

For a start use .00025 mfd. across the secondary and .0005 mfd. across the primary, or rather from the plate side of the primary to the negative filament.

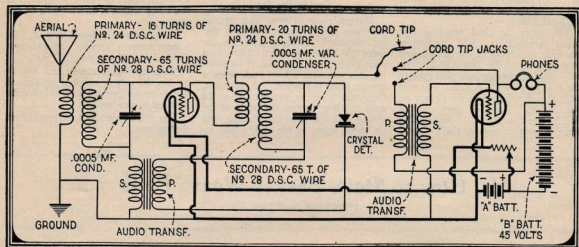
A Compact Two-Tube Reflex

Small Reflex Set Occupies Little Space
and is Easy to Build

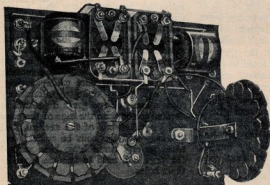
HERE is a two-tube reflex set which will give satisfactory loud-speaker reception on local stations and can be conveniently installed in places where space is limited. *Howard Schop-*

nary array of apparatus. Particularly are reflex circuits adaptable to use in portable receivers. Many experimenters have turned toward these efficient circuits for sets that they can take with

really workable two-tube set in such a small space is a novelty. The one big space-saver that the writer came across and that makes this set possible is the use of a special variable condenser that

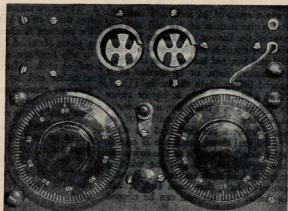


The circuit diagram of this highly efficient reflex circuit which, without any fixed by-pass condensers, gives excellent results, is shown directly above. The two radio frequency amplifying transformers are wound on spider-web forms, that can easily be made by anyone. Note the plug and jack system.



Illustrations by Courtesy of Science and Invention (New York)

Note the very compact arrangement of the instruments used in this two-tube portable receiver. The writer has had wonderful success with this set and you can duplicate it by following instructions.



The front panel view of this set shows the plug and jack arrangement enabling the last tube to be cut out when not desired. Note the socket mounting and the position of the crystal detector.

fer describes this receiver in *Science and Invention* as follows:

Undoubtedly the reflex circuit has found its own place in the field of radio and is with us to stay. It offers a most interesting field for experimental work and frequently unusual results are obtained from even an ordi-

nary array of apparatus. Particularly are reflex circuits adaptable to use in portable receivers. Many experimenters have turned toward these efficient circuits for sets that they can take with them on trips, but which can be used in the home also under practically all conditions. The set that the writer has designed has given some very good results. The entire unit is even more interesting when it is learned that it can be assembled on a panel only eight inches long by six inches wide. A

takes up no more room than an ordinary dial. It does not project back of the panel at all. These condensers can be plainly seen in the photograph below and to the right.

When using this receiver as a portable set, two ordinary "C" batteries in
(Continued on page 59)

A Chemical "B" Battery Eliminator

A Chemical Plate Supply Unit That Can Be Depended On At All Times

THE problem of eliminating expensive and short-lived dry batteries for the plate supply has held the attention of many engineers and amateur investigators for several years. A great number of devices have appeared on the market—some good, many indifferent or practically useless. The problem is very apt to reach solution through a chemical rectifier rather than the tube type, but the general run of chemical units are messy affairs and require frequent attention. If you are interested in a practical device for supplying smooth plate supply from the ordinary house-lighting system using alternating current, read what James Millen says in *Radio Broadcast*, New York, as follows:

There have been many articles published on B eliminators employing thermionic tubes, mean free path gas tubes, and even miniature dynamotors and motor generators. Very little has as yet appeared about a system which is in many ways superior to any of the others. No doubt this evasion of the chemical rectifier is due to a considerable extent to the existing opinion in the minds of many that this type of rectifier is sloppy, inefficient, and requires considerable attention. This, unfortunately, is true of the majority

of borax rectifiers used in many amateur transmitting stations. Several years ago when chemical rectifiers were first used for that purpose someone suggested a solution of borax as an electrolyte and as a result borax has been almost exclusively used for this

when properly made is most strongly emphasized by its use by one of the largest public utility corporations in the world.

As the chemical rectifier unit is very much cheaper than a tube rectifier, it is possible, without greatly increasing the

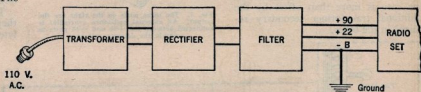
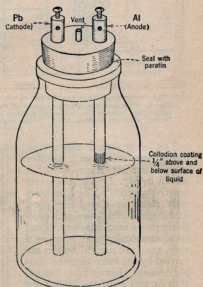


Fig. 1. From lamp socket to radio receiver. The illustration shows the entire system as used to change the 110 volt alternating current to a variable D.C. voltage for supplying plate potential to any radio set.

purpose ever since. Of all the different solutions available, borax is in my opinion by far the poorest. In fact one is almost justified in condemning the chemical rectifier if his experience has been restricted to the use of borax as an electrolyte.

Fortunately, however, there are several exceedingly fine solutions for use



Illustrations by courtesy of *Radio Broadcast* (New York)

Fig. 2. The rectifying jar. Several of these cells go to make up the complete rectifying unit. The anode, cathode and vent are supported in a cork top.

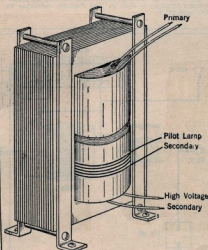


Fig. 3. A sketch of the transformer which steps up the voltage to compensate for the drop in voltage through the rectifier. This transformer is easily reconstructed from a toy transformer. An additional winding of a few turns provides for the pilot light current supply.

in lead-aluminum rectifiers, and a properly made cell, such as is described in this paper, is compact, clean, inexpensive, and efficient. Furthermore, it will seldom require any attention. The reliability of the chemical rectifier

cost of the complete B supply unit, to rectify both halves of the alternating current cycle. This complete rectification makes possible the use of a much smaller filter system. Still another reason for the much greater ease with which the output of a chemical rectifier may be filtered is the high inherent electrostatic capacity of the unit. The capacity of the single unit described in this paper is approximately 1 mfd. as compared with the negligible capacity of thermionic tubes.

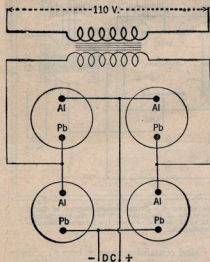


Fig. 4. The circuit of the chemical rectifier. Four jars are arranged in series-parallel to obtain the double-wave rectification which is properly smoothed out in the filter resulting in a direct current.

Each cell (when used with the solution mentioned below) will stand well over 100 volts, which makes it possible to obtain between 80 and 120 volts at the set, depending upon the transformer voltage. This is ample when used with the average broadcast receiver. Where it is necessary to rectify higher voltages, then several cells must be used in series.

Connections of Chemical Rectifiers

There are two methods of connecting chemical rectifiers. In the first or bridge method, Fig. 4, four small cells are required. In the second method, Fig. 8, only one cell (slightly larger) is required, but a double transformer secondary is needed to feed it. Thus the saving in rectifier cells in the one case is more than offset by the additional transformer secondary required in the other.

appearing at the impurity. This type of sparking should not be confused with the general scintillating sparking

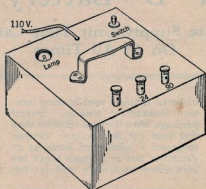


Fig. 7. The three posts on the right are the output. An external resistance (variable) is connected between the +90 and +24 posts to obtain the detector voltage.

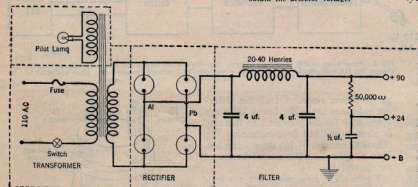


Fig. 5. The complete circuit diagram of the chemical plate supply from input to output. The dotted lines indicate the various subdivisions of the device, as follows: pilot filament, step-up transformer, chemical rectifier, filter. Usual engineering practice is used in this diagram referring to condenser capacities.

The jar is a three ounce "salt mouth" bottle fitted with a rubber stopper having three holes, as shown in Fig. 2. The electrodes are $\frac{1}{8}$ -inch rods. The aluminum rods must be chemically pure. Commercial aluminum will positively prove unsatisfactory. Lead rods, chemically pure aluminum rods, and "salt mouth" bottles are carried by the large chemical supply houses. Eimer and Amend, 18th St. and 2nd Ave., New York City, can furnish these supplies. In drilling, tapping, and cutting the aluminum, extreme care should be exercised not to lay the rod in any metal filings which may be on the work bench, or to fasten it in the metal jaws of a vise unless protected by wood, cloth, or paper. If any small metallic filings become imbedded in the surface of the aluminum, then the film of aluminum oxide which forms and breaks down again with every reversal of the current when the rectifier is in operation, will not be complete at that point. In operation, this failure of the oxide film completely to insulate the aluminum electrode from the electrolyte will be indicated by tiny sparks

pressed a. c. voltage is over 160 volts. The aluminum electrode in a properly operating cell will glow with a pale yellowish-green light and there will be no sparking. A slight sparking does not, of course, make a cell inoperative. In order to prevent sparking and consequent consumption of aluminum at the surface of the electrolyte where a protective film is not formed, the upper part of the electrode is coated with collodion, as shown in the illustrations. A short length of glass tubing is inserted in the vent hole in order to prevent its closing when the stopper is squeezed into the bottle.

Although there are several good solutions, I have found the two given below to be considerably superior to any others that I have tried.

Though not very generally known, they were among the original electrolytes used by Professor Nodon in developing his "Nodon" Valve. (See list of references at the end of this article.)

What Solution to Use

Though not the better of the two, the solution most easily obtainable is a saturated solution of ammonium borate. It is most easily prepared by the layman by adding several tablespoonfuls of ordinary boracic (or boric) acid, such as is to be found in the medicine chest of every home, to a half quart of distilled water in a glass or china container. Add four tablespoonfuls of ordinary household ammonia (the clear kind—not the

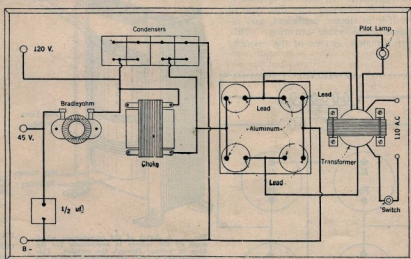


Fig. 6. The wiring layout. This drawing should be compared with the circuit diagram in Fig. 5 to identify the several parts and also the internal circuits of the choke coil and the transformer. The voltage regulation will be from 120 to 90 and 45 to 24, depending upon the internal characteristics of the transformer.

caused by using too high a voltage across the rectifiers. Such sparking is due to the electrical breakdown of the insulating film of aluminum oxide and will begin to take place when the im-

kind containing soap or borax). Shake well and let stand for several hours. The excess salt will precipitate on the bottom and the clear solution is to be used in the rectifiers.

The other, and better, electrolyte is a saturated solution of primary ammonium phosphate. ($\text{NH}_4\text{H}_2\text{PO}_4$). It is prepared by adding enough crystals of primary ammonium phosphate to one-half quart of distilled water so that no more will dissolve and then using the clear solution after the excess crystals have settled to the bottom.

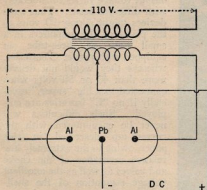


Fig. 8. The single cell method of rectifying. A double transformer secondary is not necessary as this circuit shows.

The practice of adding sodium or potassium salts to the electrolyte in order to reduce its resistivity is not to be recommended, for it will pit and corrode the anode (A1). The presence of sodium salts in any quantity will also cause the rectifier to give off an unpleasant odor after it has been in use for some time.

Never add anything but distilled water to take care of the loss of electrolyte due to electrolysis and evaporation. Addition of distilled water for every 400 hours of use will generally be sufficient unless an unusually large vent is incorporated in the cell.

In order to prevent a short circuit when the negative B terminal of the set is grounded, which is generally essential in order to entirely eliminate all a. c. hum, and also to raise the a. c. voltage, it is necessary to provide a transformer in the 110 volt a. c. line. The standard 75 watt amateur c. w. type transformer may be used for this purpose by running it with a resistance in the primary circuit or by feeding the 110 volt winding with a lower voltage obtained from a toy step-down transformer, in order to reduce the output voltage to a usable value. Such an arrangement is, however, both needlessly expensive and inefficient. A bell-ringing transformer may be worked backwards from a toy step-down transformer. Another bell transformer can not, however, be substituted for the toy transformer. Very satisfactory results were obtained by using an Acme 1½-henry double choke as a transformer. One winding serves as a primary and the other as a secondary. The air gap must be tightly closed. (Some choke coils have no air-gap.) This will, of course, be merely a "one-to-

one" transformer, and, due to the design, the voltage regulation is poor.

How To Make the Transformer

For best results, a transformer should be made which will meet the exact requirements. As the cutting and rolling of silicon steel for transformer core is a task which the average person will not care to tackle, the use of the core from toy a step-down transformer is recommended. These cores are well made of the shell type, and of the right size. The only thing to be discarded is the low voltage secondary. Moreover, they may be purchased at very reasonable prices, the list for the one best suited for this purpose being but \$3.75. A transformer should be selected which has a no-load power consumption of not more than ten watts. The transformer referred to above and used in the current tap shown in the photographs meets all these requirements. It is the new model 40 watt Lionel toy transformer. The task of removing the core will be greatly simplified if some alcohol is first applied in order to dissolve the shellac which binds the core together.

Remove the low voltage winding and in its place substitute a secondary wound with No. 28 or No. 30 enameled copper wire. Insulate each layer with thin tough paper. Protect the new winding from the core and

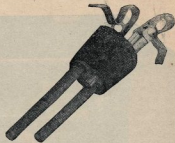


Fig. 12. A dummy jar element unit showing how Fahnestock clip binding posts of a special type can be used to connect to the elements. The support stopper is of rubber. The clips are so designed that they will slip easily over the anode and cathode tops.

case with Empire cloth or other suitable insulation. The proper number of turns will be 1125 for use with ammonium borate electrolyte and 1030 for use with the primary ammonium phosphate electrolyte. In either case, the final filtered d. c. voltage will be

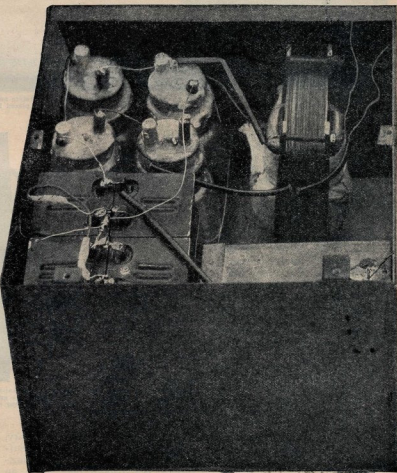


Fig. 9. The top is removed from the unit to show the construction. Either the transformer or choke coil should be shielded. In this model, the choke coil is shielded. This shield is grounded to the metal box which in turn is connected to the negative side of the output supply.

approximately 110 volts. For lower voltages use fewer turns.

The fact that turning off the A battery switch on the set does not shut off the input to the power unit, makes it desirable to employ a pilot lamp in

while exceedingly effective, are needlessly expensive and cumbersome, so that the use of a filter of the "smoothing" type is recommended for use with this B supply unit. (See General References.) (When an S tube is em-

ployed the voltage drop across the choke will be negligible. The use of audio frequency transformer secondaries as chokes is not to be recommended, because of their extremely high D.C. resistance. (About 2500 ohms for the average transformer secondary.)

There have been many complaints about B substitutes whose output voltage varies considerably with different loads. Thus such devices might supply 90 volts to the plates of the amplifiers in a small two- or three-tube set equipped with proper C batteries, whereas they would not deliver more than 40 or 50 volts when connected to a big "super," especially if no "C" batteries are employed. Such difficulties will never be encountered with the current-tap described in this paper, owing to the extremely low relative resistance of the choke and valves as well as the excellent voltage regulation of the shell-core transformer employed.

Details of Construction

The next and almost equally important step to be taken in the hum elimination is the grounding of the negative B lead from the B eliminator. This is very important! Before doing it, however, examine the regular ground connection to your set and see whether or not it is on the opposite side of the "A" battery from the negative B. If it is, then a large fixed condenser must be connected in series with the

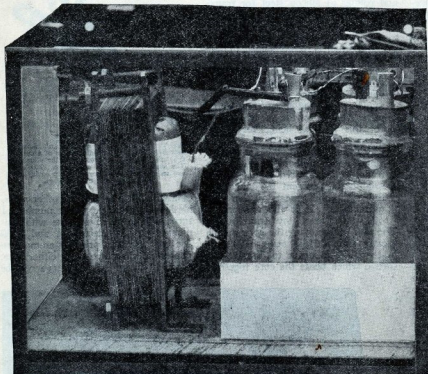


Fig. 10. A metal pan for the jars keeps them in place and prevents spilling of the electrolyte and breaking of the jars. A wooden sub-base allows the unit to be assembled first and then placed in the metal cabinet.

order to remind one of the second switch. This lamp should be so connected as to burn whenever the power unit is turned on. A small flash-light bulb, or even an automobile type bulb may be used for this purpose. In order that its life may be long, it should be burned at less than rated voltage. It is to be fed from a separate transformer winding of a few turns of No. 20, No. 22, or No. 24 wire. The winding must be well insulated from the other windings. Ten turns will be right for a 3-volt flashlight bulb.

If the output of the rectifier were to be fed directly into the radio set, a disagreeable hum would be heard in the loud speaker. The first step to be taken in the elimination of this hum is to pass the current through a filter before it reaches the set. The purpose of the filter is to "smooth out" the pulsations in the rectified current in much the same manner as the air dome on a reciprocating water pump "smooths out" the flow of the water. Where very large capacity condensers are employed in the filter circuit a more nearly correct hydraulic analog would be a pump feeding a reservoir from which a steady stream of water might be drawn. Filters of the reservoir type,

employed as the rectifying device, then it becomes imperative to use the larger filter.) The filter details are given in Fig. 5. The choke coil should have an inductance of above twenty henries and must be of fairly low resistance. (See General References.)

Making the Choke Coil

An exceedingly fine choke for use with this outfit consists of one pound of No. 30 enameled copper wire wound on the same type of core as recommended for the transformer. If No. 30 wire is used for the transformer secondary, then one pound of wire will be sufficient for both purposes, as the transformer will require only about an ounce of wire. The D.C. resistance of such a choke is but 320 ohms. Thus

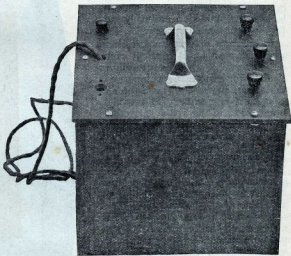


Fig. 11. The finished product. It is neat in appearance and very convenient. The unit may be placed on a lower compartment of the same table as the radio receiver, unlike many unsightly home made plate current supply devices.

regular ground lead or else it must be removed altogether. (We mean the ground to the set, not the ground to the power supply.) If both sides of the A battery were to be directly

(Continued on page 59)

How to Build a Simple One-Tube Set

Constructional Details of a Three-Circuit Regenerative Set for the Beginner

OUT of the myriad different receiving sets that have been tried and tested by radio constructors everywhere have come two or three well standardized circuit designs which are growing daily in popularity by reason of their superior constructional and operating statistics. In the one tube class, the improved three-circuit arrangement, with its two controls, its unequalled simplicity, dependability and its ease of assembly, is unquestionably the most satisfactory outfit for the home builder. Details for building such a receiver is given in a booklet issued by the *American Hard Rubber Company* and given herewith.

The set to be described in the following may be laid out with an eye to the future, so that the builder may later on tackle the job of putting together an amplifier for the operation of a loud speaker. Then the completed receiving set will be a three-tube outfit of the best type.

The total expense involved, including batteries, aerial, etc., should not exceed \$30, and may sometimes be less than \$25. While complete equipment for a one-tube set is often advertised for prices under \$25, it is well to remember that this either means inferior apparatus or does not include extras such as tube and batteries.

If a Radion Mahoganite panel is selected, the dials and knobs should also be of Mahoganite, to match. It is well to choose a variable condenser having some sort of vernier adjustment, because the tuning of the receiver will be so sharp that a very accurate setting of the condenser is essential to the reception of distant stations. The better grade of condensers now employ narrow strips of Radion as insulating supports for the fixed set of plates or have end pieces of Radion. Location of binding posts at the rear simplifies the wiring and avoids unsightly leads on the table in front of the set. The Radion binding post panel has provision for "C" and "B" batteries for an amplifier, but these places are not used for this set.

The WD-12 or C-12 tube is suggested as the detector since but a single dry cell is used for the "A" battery. A 6-ohm rheostat is required. The UV-200 or C-300 is slightly more sensitive, but calls for a storage battery. A 6-ohm rheostat is used. Where one intends to build an amplifier later on, it is best to use a storage bat-

tery tube in the first place inasmuch as such tubes are best for the amplifier. However, it is perfectly feasible to use

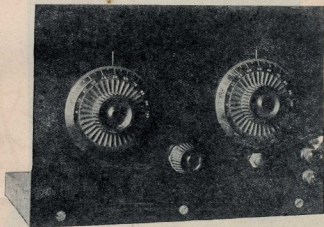
PARTS NEEDED

Radion panel, 7 x 10 x 3-16 inches.
Variable condenser, .0005 mfd.
2 Radion dials, 3-inch diameter.
1 Radion rheostat knob.
Rheostat to suit tube selected.
1/2 lb. magnet wire, No. 20 double covered.
Wooden base about 7 x 10 inches.
7 binding posts.
Radion binding post panel.
Radion tubing, 4 x 4 inches.
Mica grid condenser, .0001 or .00025 mfd.
One 2-megohm grid leak.
Mica phone condenser, .001 mfd.
3 inches of brass rod, 1/4 inch diameter.
Radion rotor ball, 3-inch diameter, for 1/4 inch shaft.
Radion tube socket.
5 feet bus bar.
Detector tube.
22 1/2-volt "B" battery.
Aerial equipment.
1/2 lb. bell wire for connection.
"A" battery.

dry cell tubes for the amplifier, results being clear, but slightly less in volume.

secured in two more small holes, and the ends pushed inside. The inner ends are bared, twisted together and soldered. About 1-16 inch from one end of the secondary, another small hole is drilled and from that point the primary coil of 15 turns is put in place. All of these windings must be put on in the same direction.

At points directly opposite on the tubing, and between the two halves of the secondary, 1/4 inch holes are drilled to pass the rotor shaft. With a rat-tail file, the holes are slightly enlarged so as to pass the shaft with a snug fit that does not bind. The shaft is cut into two 1 1/2 inch lengths. Next the rotor is wound full, small holes at the edges of the winding spaces holding the ends of the two halves of the coil—the tickler winding. These coils are started at the outside edges and wound towards the middle—in the same direction—so as to form a continuous coil when the inner ends are soldered together. After two 6-inch lengths of flexible wire have been soldered to the ends of the tickler coil, it is ready for insertion inside the tubing. To hold it at the centre, two short lengths of fiber tubing or a number of fiber washers



Illustrations by Courtesy of American Hard Rubber Co. (New York)
Panel view of the simple one tube set.

The Coupler

A lengthwise scratch is made on the Radion tubing, and a mark made at the exact centre. 1/4 inch either side a small hole is drilled. The secondary coil is wound in two sections, each half having 23 turns, which are tightly wound in place, starting at the center. The outer ends of the secondary are

are slipped over the shafts between tubing and rotor. The shafts are pushed firmly into the holes in the Radion rotor to make a "forced fit."

The holes in the panel for the shafts of coupler and condenser are made with a 5-16 inch drill, 2 1/4 inches in from either end of the panel and on the center line. Two right angle

brackets, bent from brass strips, support the coupler through two wood screws in the base. Holes for the condenser and rheostat are located with drilling templates furnished with the

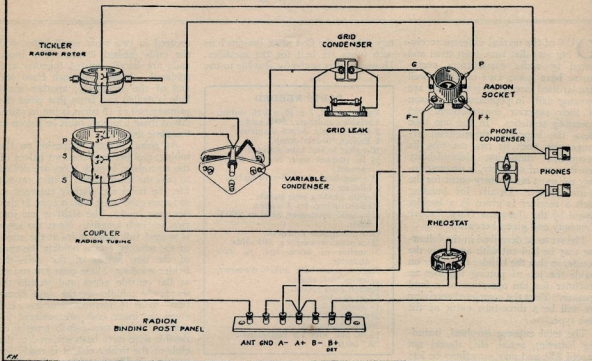
of phone connections and of connection to the amplifier should one be constructed.

Wiring

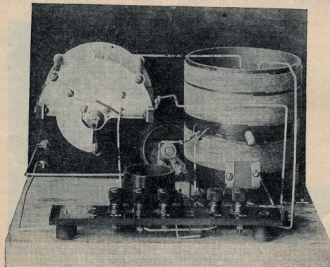
Rosin-core solder (without flux) is

minating at the actual contact points that should be used in wiring. To clarify the connections for the coupler, the tickler, is shown as though located outside, and the front portion of the

THREE CIRCUIT TUNER



Complete wiring diagram shown in picture form. Carefully trace every connection and compare with your set.



Back view of the set showing the location of parts and wiring.

instruments. Three or four wood screws fasten the lower edge of the panel to the base. The Radion binding post panel is mounted by two long screws and two pillars cut from metal or composition tubing. Binding posts at the right end of the panel take care

used for all joints where solder is necessary. Where good binding posts are available, the end of the bus bar lead is bent into a loop and a tight contact obtained beneath screw or nut. Connections are shown in the diagram, each lead being drawn with its ends ter-

coupler shown cut away so that the inner connections are visible. Connections No. 1 and No. 2 are the terminals of the primary winding, No. 3 and No. 6 the terminals of the secondary, and No. 4 and No. 5 the inner ends of the two portions of the secondary which are connected together. Note that No. 2 and No. 3 are soldered. Connections to the small condensers may be easily made by using two brass nuts and bolts for each.

A single wire, well elevated and insulated from contact with other objects, and about 100 feet long counting its lead-in, forms an ideal aerial. The ground is made to a cold water pipe or a radiator. If the set is placed on a small table having a shelf underneath, "A" and "B" batteries may be placed on the shelf and wires to them run in back of the table, out of sight.

When all wires have been properly connected and the tube found to light as it should, increase its brilliancy gradually until a sharp click is heard as the tickler is rotated. Then turn the condenser dial with one hand and the tickler with the other until a clear whistle is heard. The tickler is then moved until the whistle ceases and voice or music comes through clearly. Inasmuch as the receiver becomes a

miniature transmitting station when it is tuned so that whistles are heard, interference with other listeners may be caused. Hence the tickler should be maintained at a point near that at which

the whistles are audible, but not past that point. This yields the best in sensitivity without spoiling one's own or other nearby listeners' enjoyment. The dial numbers for all stations

picked up should be noted down and kept on record for future reference and to aid in the recognition of a station the second time it is heard.

A Chemical "B" Battery Eliminator

(Continued from page 56)

grounded, the A battery would be short-circuited.

The third step is to insert C batteries in your set so as to reduce the tube space current to a minimum consistent with good quality.

The fourth step is to shield the choke coil from the power transformer. If they are both in the same metal box, then merely placing their cores at right angles to each other may be all that will be required, although quite frequently it is necessary to place a grounded iron or steel partition between them, or even to place one of them in a separate metal box. The entire unit should be located at least three feet from the set. This is not always essential, especially where the unit is thoroughly shielded, but nevertheless it is a good rule to follow.

The fifth and last of the precautions to be taken is to remove as far as practicable from the set any lamp cords carrying house current. Occasionally when one fails completely to eliminate all the A.C. hum in a receiver using this B supply it may be due to ungrounded BX cables and conduits which are used in the house wiring.

It might also be well to add that in regenerative sets a large fixed condenser ($\frac{1}{2}$ to 1 mfd.) must be connected directly from the plus detector B binding post on the set to the negative B binding post. This condenser must be located at the set and not several feet away at the unit itself. The small condenser connected across the primary of the first audio transformer in many such sets will not act as a

substitute for the larger condenser connected as explained above. All regular neotrodes have a small condenser connected directly from the detector plate to the negative B which is sufficient in such cases. Don't, however, try such an arrangement on a re-

PARTS REQUIRED

2 Lionel transformers, 40 watts.....	\$7.50
4 W. E. 2 mfd. condensers.....	3.60
1 pound No. 30 enameled copper wire.....	.88
1 Bradleymon No. 10.....	2.00
1 Flashlight bulb and socket.....	.20
Steel box, panel, binding posts, etc.....	
4 3-oz. "salt-mouth" bottles.....	.20
4 No. 6 rubber stoppers.....	.20
1 2-ft. length chemically pure aluminum rod $\frac{1}{8}$ -inch diam.....	.20
1 2-ft. length lead rod $\frac{1}{8}$ -inch diam.....	.20
1 6-inch length $\frac{3}{32}$ -inch outside diameter glass tubing.....	.05
1 oz. $\text{NH}_4\text{H}_2\text{PO}_4$ at 60c 8 oz.....	.15

Total between \$15.00 and \$16.00
The lead and aluminum rods come in 2-foot lengths. This is more than required, but fractional parts of a bar are not sold.

generative set or it will cease regenerating.

The small pocket voltmeters sold for testing B batteries are worthless for determining the voltage supplied to the set by a B substitute. If a milliammeter and some B batteries are available, then a fair method is to read the plate current when the power supply is being used, and then switch over

to the B batteries and by varying the number in use, obtain the same plate current as with the power supply. The voltage of the B substitute is then roughly that of the B batteries, producing the same plate current.

The cost of operating a power unit drawing approximately ten watts from the house current is \$0.0009 per hour. Thus it costs but about ninety cents for one thousand hours of B supply and there is no shelf life deterioration when the set is not in use.

General References

For the benefit of those who may desire to obtain further information on the interesting subject of electrolytic rectifiers, the following references are given:

Radio Broadcast: December, 1924, Filter of the "smoothing" type described by R. F. Beers. Low Resistance Choke Coil also referred to in this issue.

Vol. 1: *Transactions of the International Electric Congress of 1904:* "The Nodon Valve," by Prof. Nodon.

Vol. 1: *Transactions of the American Electro-chemical Society, 1902:* "Electrolytic Rectifiers," by Prof. Burgess.

QST: June, 1922, "Electrolytic Rectifiers for Amateur Transmitting Work," by S. Kruse.

These references are mainly of a scientific nature and contain little constructional information which would help the builder of a plate supply unit such as described in this paper.

A Compact Two-Tube Reflex

(Continued from page 52)

parallel furnish the "A" supply for two UV199 tubes. In this way much weight and space are saved. Despite their small size, these batteries will give quite long life because of the small current consumption of the tubes.

The constructional details are, in essence, as follows:

Two standard type sockets are mounted on round-head machine screws three inches long. These support the sockets away from the panel as shown in the photograph. Small audio-frequency transformers of the type shown help further to economize space. A

semi-fixed crystal detector is mounted in the center of the panel. Select a good one so that you will not have trouble on this score. Variable condensers of the type illustrated are recommended if the set is to be made very compact. The radio-frequency transformers are wound on spider-web forms three inches in diameter and the details for the number of turns are given on the circuit diagram above. Two forms are used for each transformer, separated about $\frac{1}{4}$ inch. Note that the units are mounted at right angles to each other. They should also

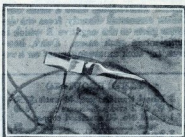
be placed as far apart as the size of the panel will permit. Oscillation should take place when the crystal circuit is open. If it does not do this, try reversing the leads to the primary coil of the second radio-frequency transformer. Connections to the crystal should also be reversed to determine the best operating connections.

Forty-five volts of "B" battery will usually be found sufficient for operating UV199's. Local stations can usually be received with loud speaker volume. Be sure to connect the "A" battery terminals as shown in the diagram.

Removing Insulation from Wire

HERE is one thing that often receives all too little attention from the amateur radio set builder. The writer has seen different people working on radio sets who will take a pair of scissors, a pocket-knife, or even a table knife to remove an inch or so of the insulation from a wire. This is all wrong, for no one of these ways should be followed if you would avoid trouble. If, for instance, you are to try to strip the insulation from a wire using a

it mechanically so that at some future time it may break just when it is most needed. Any sharp edge of this nature must always be avoided when you want to strip a wire.



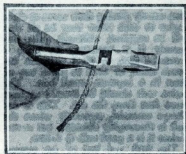
Illustrations by Courtesy of Science and Invention (New York)

After the insulation is broken, it can be quickly removed from the wire with a pair of pliers held as shown above.

One good kink in connection with this work is to grind or file a small semi-circle in the edge of the knife near the handle. This will not affect its cutting properties, but by placing a wire in the notch the insulation can be cut and stripped without any fear of harming the wire. Even with this method, however, there is a chance that if the tool is incorrectly manipulated, the wire may be nicked slightly with the possible result mentioned above.

The best method that the writer has found for the operations under discussion is to use that little portion of the pliers directly back of the joint or, in other words, on the opposite side of the joint from the cutting edge. This

space is found to be particularly well adapted to stripping insulation in a pair of pliers of the type illustrated. Open the pliers slightly and place the wire between the two flat surfaces found at the point mentioned. Then squeeze and it will be found that the insulation will be cut on both sides but that the wire will be undamaged. Remove the wire from this position and strip the insulation from it with the other part of the



The insulation can be broken preparatory to removal from the wire with that part of the pliers illustrated in use above.

pliers as shown in the photograph. Perfect results will be obtained.

In passing, we might also mention the fact that there are certain types of what are known as long-nose pliers that will perform the same operation as that described above if the wire is placed between the jaws close to the joint. Press and then release slightly and you can strip the insulation off the wire with the jaws.—*Science and Invention, New York.*

Storage Battery Lasts Years

JUST because a storage battery looks like a piece of unbreakable equipment is no reason why you should abuse it and then afterwards demand a new battery for the one you aided on its way to the scrap heap. Storage batteries require care.

They will last for years if given the proper attention. Charge them regularly; don't let them run down to the last ampere before recharging. Make it a practice to have a hydrometer handy at all times. When your battery drops below normal gravity, put

it on charge. Voltmeter readings will not give the true internal conditions of the battery. The hydrometer reading is the only satisfactory method to use. When fully charged the gravity of the average battery is between 1.275 and 1.300.

When the gravity falls below 1.200 it is time to charge the cells. Don't overcharge the battery. Let it gas freely for a few hours. Overcharging may cause the plates to buckle. Cover the positive and negative connection posts with a light film of vasoline.

This will prevent corrosion of the terminals and result in better electrical contact between the terminal and connecting wires to the set. Place the battery on a rubber mat if you want to preserve your flooring. Clean top and sides of container when you have completed charging process. This will remove the battery "sweat." Consult your battery service dealer when serious trouble arises. Most good batteries are covered by a liberal manufacturer's guarantee.—*Los Angeles Evening Express.*

INTERNATIONAL RADIO DIGEST

by A.P. Peck and Leon L. Adelman

MODERN WIRELESS

England, October, 1925.—Three tubes is about the usual number that the average person wants to use in an experimental radio receiving set and just that number is employed in the unique receiver described under the heading "The Coastal Three." The set is of typical English design, using honeycomb coils for tuning and it incorporates one stage of radio frequency amplification, a vacuum tube detector and one stage of audio frequency amplification. An absorption wave-trap is used to sharpen tuning in the antenna circuit. The radio frequency amplification stage is of the tuned impedance type but is not of the usual American design. It employs regeneration in the detector circuit in a rather unique manner. Included in the article are all of the instructions that anybody could want for constructing a set of this nature. A complete panel layout and a schematic as well as picture diagram gives all the necessary details. Several photographs make this article a most complete one.

* * *

A discussion of microphonic noises in vacuum tubes is something that very seldom is brought to the attention of the reading radio public. However, the author of the article entitled, "Microphonic Noises" has done considerable laboratory work along this line and the facts that he has noted are given in this article. Illustrations and descriptive text show why microphonic noises are present in vacuum tubes. The connections drawn from the various experiments that the writer conducted are interesting in the extreme and every student of radio apparatus should be interested in this article.

* * *

"The 'DX' Four" is the title of an article describing a rather unique four-tube receiver, employing both radio and audio frequency amplification. The detector arrangement is rather novel as it combines something on the order of a Reinartz receiver with radio frequency amplification of the tuned transformer coupled type. The circuit diagram of this set is quite interesting and furnishes many hints to the radio constructor. In line with the usual policy of the magazine under consideration, the article is most completely illus-

trated. The usual picture diagram showing the arrangement of the parts on both the panel and the baseboard also shows the various connections between the instruments. Another small sketch shows all of the details of the unique inductance used in the detector circuit. Several photographs complete the illustration of this subject and aid in showing the exact placement of every part.

From experience gained with receivers of the Reinartz type, the reviewer is of the opinion that this set should give most excellent results. Its design is such that it should be most selective and at the same time should give loud reproduction of signals.

* * *

The radio frequency amplifying transformer is a subject about which little is known but which should be given much more attention than is the usual practice. Under the title of "The High Frequency Transformer," several different types are discussed and suggestions are given for the best method of obtaining radio frequency amplification with transformers.

* * *

"An Accept or Wave-Trap" is the title of an article that discusses a radio instrument which most BCLs believe can be thrown together from any junk parts that happen to be available. This however, is not true and a wave-trap to really fulfill its purpose in life must be as well designed as any other one of the radio receiving instruments. The author of this article has evolved a very efficient instrument of this nature and has given in this article every possible detail on its construction. This trap is of the type that is placed in shunt with the antenna inductance and in it, its inductance and condenser are connected in series. A novel method of controlling the condenser so as to facilitate fine adjustment is described and illustrated in detail and the entire unit is so built that it can be placed within a small cabinet. A circuit diagram shows the connection of the wave-trap to a standard simplified Neutrodyne circuit. The details in this article are so explicit and so well outlined in both pictures and words that even the veriest tyro should have no trouble whatsoever in constructing a wave-trap that will meet all his expectations.

* * *

Do you know how a vacuum tube operates when it is working as a rectifier in a radio receiving circuit? If

not, you will undoubtedly be interested in the discussion entitled, "The Valve as a Rectifier." Here the author starts with a simple two element valve or vacuum tube, showing the action of it when operating under certain conditions. He then shows one of these valves connected in a radio receiving circuit and illustrates diagrammatically just what action takes place within the tube. Then, the grid is added to the tube, whereupon it is found that a different action takes place and this too is very plainly and definitely explained. The article is rather long, but there is so much good material in it that it is to be heartily recommended to the attention of all radio fans. Do not let the numerous current characteristic curves scare you as they are all extremely simple to understand if you will refer to them constantly when reading over the text of the article. This particular article on the subject is a veritable education in the line of vacuum tube operation.

* * *

We are all more or less interested in crystal detector receiving sets, particularly if we can achieve the construction of one that will really be selective enough to separate a few of the local stations from each other and not bring everything in in the form of a veritable radio hash. If you would do this, refer to the article entitled, "A Sharp Tuning Crystal Set." It contains much information regarding the construction of a low-loss crystal receiver that is very selective. It is quite an accepted fact today that certain types of low-loss windings will reduce the effective resistance of a radio circuit. Therefore it will also increase the selectivity. If the coils in a receiving set are space wound solenoids, the resistance is greatly reduced and this is the type of inductance used in the receiver under discussion. The particular set described is made for English broadcast reception and, therefore, is capable of tuning to quite a high wave-length. However, there is no reason why the same system could not be adapted to use in the United States and we are sure that the many hints for construction given in the article will be of value to all. Do not despise the crystal receiver because of the fact that it does not give as much volume as a tube, but rather look up to it for its low cost and reliable operation.

* * *

Those who have direct current house lighting supply will be interested

in the article entitled, "Working Your Set from the D. C. Mains." A filter system for smoothing out the ripples in the current supplied from this source is completely described and shown in connection with a standard three-tube receiving set.

Under the title of "Are Neutrodyne Circuits Worth While" a complete discourse of various methods of accomplishing complete neutralization in radio receiving sets is included. In the opinion of the author of this article, neutralization of radio frequency amplifying circuits is a well worth while procedure and should be followed.

Probably one of the most neglected points in the construction of standard regenerative receivers is that of the control of regeneration. We all know that the flopping tickler coils are awkward to operate under most conditions and are seldom completely satisfactory. Therefore, the article entitled, "Improving Reaction Control," which, translated into American radio language, means improving regeneration control, should be of unusual interest. In the set described in this article, the tickler coil is fixed in its inductive relationship to the secondary inductance and variations in regeneration do not affect the tuning of the secondary inductance. Regeneration control is accomplished by a variable condenser shunted across a coil placed in series with the tickler and the high voltage battery. This is a method that is to be recommended because with it, the detector tube can usually be worked at its most efficient point and at a place where the greatest amplification due to regeneration is obtained. The coils used in this set are completely described and illustrated in detail not only in sketches but in photographs of the completed receiver.

It is quite true that a good many of our standard receiving circuits in use today are outgrowths or modifications of transmitting circuits that are also in favor. Particularly is this true of the so-called Hartley transmitter. This type of circuit has been adapted to receiving in many ways, and is particularly used in the reception of C. W. or continuous wave signals. An article entitled, "A Two Valve Hartley—Reinartz Receiver," describes a set that might be said to combine the best features of both of these receivers into one that is not only novel in construction and in details, but that also will give most excellent results. Only two tubes are used in this set, one of them as detector and the other as an audio frequency amplifier; but, of course, a second amplifier could be added if desired. The set is well designed and if constructed according to directions should give excellent results, both as

to selectivity, volume and ease of control. No detail is overlooked in the illustration of the set.

One tube operating a loud speaker is something quite unusual, but this can be done if an efficient type of reflex circuit is employed. An article entitled, "A Low Loss Loud Speaker Reflex Circuit," describes just such a set, wherein a vacuum tube is used as both radio and audio frequency amplifier and a crystal detector is employed for rectification purposes. The set is somewhat of a departure from usual reflex designs and therefore is quite worthy of consideration. All of the necessary details for constructing the inductances and for hooking up the receiver are to be found in the article. Nothing is omitted and the average constructor should be able to obtain the same results and should find it possible to operate the loud speaker when receiving from local stations if the circuit described is employed.

Wireless Weekly

England, September 16, 1925.—The first item of general interest in this issue is a list of short-wave transmitting stations, both in this country, Canada and England. The list is one that everybody interested in short-wave work should have at his command.

"Inventions and Developments" heads a short article in which two interesting new circuits are shown. One is a method of providing both "A" and "B" voltages from an A.C. line and the other shows a uni-lateral type of filter tuner that should result in increased selectivity.

Jacks in a radio receiving set often cause a lot of trouble due to poor contacts or open circuits where closed circuits are desired. Under the heading of "Pitfalls With Jacks" these troubles are discussed and the writer shows how jacks should be used in order to obtain the best of results.

One of the questions that is foremost in the minds of radio students today is "Is There Heavieside Layer?" The author of this article takes up a short discussion of the various theories which today attempt to show certain phases of radio wave propagation. While somewhat technical in aspect, the discussion given is one that should not be missed.

The British seem to be having an awful lot of trouble in their own ranks

over their vacuum tubes and the public seems to be divided in two factions, one in favor of tubes using bright filaments and the other leaning toward those employing dull glowing filaments. A comparison between the two types is given in the article entitled, "Are Dull Emitters As Good As Bright?" Even though this subject is not under great discussion in this country, still the arguments put forth are quite interesting.

Foreign apparatus is so radically different in appearance in most cases to that used in this country that various parts catch the eye quickly and afford many interesting moments of study. In the article entitled, "Some Features At The Wireless Exhibition," unique apparatus is described and illustrated. Particularly novel is a three-tube receiving set of most unusual construction and design. Then we find some notes on vernier dials which are very interesting as well as on loud speakers, transformers, tubes, variable condensers and other radio accessories.

The English do not seem to be far behind us in the use of rectified A. C. for the plates of vacuum tubes, as one very complete unit is to be found described in this issue. It does not differ very much from those that we employ today and, therefore, it will probably give good results.

September 23, 1925.—"Signal Strength and Tapping Points" is the unusual title of an article dealing with the construction of inductance coils. Various types of coupling between the antenna and the secondary coils of a radio receiving set are discussed and the advantages of untuned antenna circuits, close inductive coupling and auto coupling are all dealt with. Due to the fact that variable condensers are in almost universal use in the United States today for tuning purposes, this article should be interesting because facts will be found in it that would never be found in any magazine published here. Several complete circuit diagrams are given and where statements are made the reasons for them are given.

Variable condensers have undergone radical changes in the past few years, having progressed from the old cylindrical type, using a sliding cylinder for varying the capacity, to the present-day interleaved plate type. Even this instrument can be refined considerably and under the head of "Some New Designs of Variable Condensers," some new types of improved variable condensers using interleaved plates are shown.

Did you ever look at a standard type of vacuum tube and wonder why the glass has a silvered appearance? This is something that probably the majority of BCLs know little about. The article entitled, "Why Dull Emitter Valves Are Silvered" clears up this point and shows how the material used for producing quite a complete vacuum inside of the tube gives this silver appearance to the glass.

* * *

Are low-loss coils necessary in every part of a radio receiving circuit? This is a question that needs a little consideration before answering. Several points that may not be entirely clear to the experimenter in regard to this subject are cleared up under the heading "When To Use a Low-Loss Coil." It is pointed out that only the circuits involving oscillation at radio frequency need be of the low-loss type. The resistance of an aerial and ground circuit is so great that the few extra ohms introduced by the coupling coil will make little or no difference in the final analysis. Therefore, the antenna coil need not be of the low-loss type. Other interesting facts regarding this newest type of inductance coil are brought out in the article.

* * *

Absorption and fading in radio transmission are two factors that are being given great consideration today. "The Problems of Absorption and Fading" is the title of an article which discusses these two phenomena from a practical standpoint.

* * *

October 7, 1925.—The increased use of short waves below 20 meters has opened a wide field for experimental work, but so little is known about these wave-lengths that many experimenters are groping in the dark for further enlightenment on various phases of the subject. Particularly are wave-meters capable of working on these low waves at a premium. Therefore, the article entitled, "Calibrating a Short-Wave Absorption Wave-Meter" should be of great interest to all transmitting amateurs. In this work, Lecher wires are used for the calibration and the article contains a complete description of an oscillator to be used and the wave-meter to be calibrated. Photographs show all of the constructional details that are necessary.

* * *

How tests for the insulating value of different materials are conducted is fully explained under the heading of "Some Practical Insulation Tests." The author shows the instruments used for these tests and describes how they are employed. The results that can be obtained in this way are very often most valuable, particularly to the experimenter.

Cheap high voltage meters for testing "B" batteries are instruments that should always be avoided unless you can absolutely ascertain that they are of the high resistance type which do not draw too much current. In the article entitled, "High Tension Battery Volt-Meters," the writer gives an example of how one person bought a cheap volt-meter that would read up to 120 volts and which drew in the neighborhood of $\frac{1}{4}$ of an ampere. Obviously, the use of an instrument of this nature on low amperage "B" batteries is something that is to be avoided. The remainder of this article also makes good reading.

* * *

It seems that the subject of short-wave receivers of various types will never be exhausted and in this issue we find an article describing such an outfit under the heading of "A Simple Short-Wave Receiver." A rather unique circuit is used here, feedback being accomplished through the primary of the antenna coupling coil and being controlled by a variable condenser connected from the plate to the primary. Complete details for the constructional work necessary are given and photographs show the completed set, plainly delineating the placement of all parts. Data is given on all of the coils used in the receiver and a novel system of plugging in coils is completely described. The coils are of the space wound solenoid type and should be most efficient if properly made. The entire article is worth looking into as there are several novel points incorporated in it that the average transmitting amateur can learn with profit.

* * *

POPULAR RADIO WEEKLY

Australia, August 12, 1925.—In one of the preceding paragraphs an article was reviewed in which the action of a vacuum tube as a detector was discussed. Here also we find another article that could very well go hand in hand with the first mentioned one inasmuch as it details the workings of an audio frequency amplifier. It is all very well to operate a receiving set and listen to the various good broadcasting programs, but still the average person will find more enjoyment if he knows just what is going on inside the set. This and many other articles will aid your study of radio reception.

* * *

Some people living in certain districts where one or more local stations come in with great strength, may desire to have some kind of a radio receiving set at hand which has practically no upkeep and which will bring in these local stations loud enough to be comfortably heard with the head-

phones. A short article describes a set using only a variometer, a crystal detector and a pair of phones. Such a set can be operated even by a child and comparatively good results can be obtained.

* * *

When tuning for "DX," often great trouble is experienced with interference from nearby stations. Under the heading of "Practical Pointers for Eliminating Interference in Long Distance Reception" some good hints that will aid the average BCL will be found. The article covers the subject completely and thoroughly.

* * *

Both low-loss and selectivity are claimed for the radio receiving set called "The Economy Three." This is a three-tube set of rather conventional design, although it uses choke coil coupled audio amplification. This system gives excellent reproduction and volume that compares favorably with transformer coupling.

* * *

August 19, 1925.—A type of winding that is not in very wide use today but which is very efficient is described in the article entitled, "How To Make a Novel Variocoupler." The forms and method of winding the so-called "D" coils are fully described and explained both in words and pictures. A variocoupler using "D" coils is rather hard to mount correctly, but a novel system is employed by the author of this article and is fully detailed.

* * *

Operating your radio receiving set at its greatest efficiency is the goal that you should strive to attain. Some information that will help you to do this is contained in the article entitled, "What Selectivity Accomplishes." The difference between broad and sharp tuning is graphically shown in an illustration accompanying this article and the hints given should be of value to all.

* * *

"Reducing the Super-Het" is the title of an article that outlines the process through which the author went in designing a Super-Heterodyne with a small number of tubes but which will still give most excellent results. Not only were the number of tubes and the consequent cost of the receiver reduced, but the space which it took up in its finished form was brought down to a minimum. The writer shows how to construct the one intermediate frequency transformer that is used and also gives all the details for winding the tuning and oscillation coupler. In the circuit employed, the first tube acts not only as detector but also as an oscillator. Considering the proposition from all angles, it would seem to us that the Super-Heterodyne as designed by the author of this article should give excellent results.

Should we get along with only one aerial or should we find the one that works best with the particular receiver that we are testing? The last mentioned procedure is by far the best and the reason for it is brought forth clearly under the title of "Why One Aerial Only?" The writer shows how several different types of aerials can be connected up to a selector switch so that the operator can use any one of the various aerials at will.

* * *

August 26, 1925.—After having become used to considering Super-Heterodynes employing at least half a dozen tubes if not three or four more than this number, the sight of the heading "A Super-Heterodyne Using Only Four Tubes" seems quite startling. However, the designer of this set has worked out a very simple scheme for greatly reducing the number of tubes in a Super-Heterodyne receiver. Using his system he only really gets one stage of audio frequency amplification and thus we do not believe that the volume obtained will be very great. However, the method of constructing this set is quite novel and is worthy of attention. Honeycomb coils are used for constructing the special intermediate frequency transformer. All of the details are given and an explanation of the operation is included.

* * *

One of a series of articles that are published in this periodical weekly appears in this issue and is entitled, "From the Scrap Heap." Although the original set described by the writer was made from scrap parts, this must not be taken to indicate that the set is not well made. On the contrary, it is and very good results can be obtained from it. It is a three-tube receiver of an unusual reflex type, employing regeneration, radio frequency amplification and two stages of audio frequency amplification. Both schematic and pictorial diagrams are included in the article.

* * *

Storage batteries are usually the parts of radio receiving sets that do not get very much care. They are charged, placed under the table or in a cabinet out of sight and never looked at again until the set fails to function properly. This is not the proper way to treat these batteries and an article entitled, "The Use and Care of a Storage Battery" points out these facts. If you will care for your storage battery, you will get longer life from it and the results obtained will be more satisfactory in every way.

* * *

September 2, 1925.—The average experimenter who has not had a very broad education in mathematics usually becomes discouraged when encountering the complicated formulas that are

usually necessary for determining the constants of various inductances and capacities to be used in a radio circuit in order to get the correct and desired results. However, late developments of radio engineers have made it quite possible for anyone to determine accurately the constants of a circuit without recourse to mathematics. This method makes use of prepared charts from which the desired constants can be immediately determined. Two of them are published in the article entitled, "How To Determine Constants of Radio Circuits." Full directions for their use are also included and the result is an article well worth while reading. Clip the charts given and paste them in your note book. They will always be handy for reference.

* * *

Small sets for local reception have been given so much space in various radio publications that the ones described in this issue can be passed over with little comment. Single and two-tube sets, some of them employing crystal detectors, are described.

* * *

A good many people think that they can buy almost any type of radio receiving set and then proceed to listen in on every and all stations in the whole country. This is indeed not true and you must not expect too much from your set. The item entitled, "What to Expect from Your Receiver" is a resumé of average results from different types of sets and makes interesting reading.

* * *



England, September 16, 1925.—"Four Valve Quality Receiver" is the title of an article describing a rather unique radio receiving set, employing one stage of radio frequency amplification, a vacuum tube detector and two stages of choke coil coupled audio frequency amplification. The author of this article built the set under discussion and, therefore, has furnished all of the details that anyone may desire. A complete panel layout, the disposition of the baseboard, the tube socket, sub-panel and the binding post strips and various other views of the receiver show everything necessary. Photographs are included, making the article extremely complete. The circuit is rather a departure from the type used in receiving sets in the United States and, therefore, should be interesting.

* * *

Under the head, "Novelties from Our Readers" some unusual hints to radio constructors and operators are included.

We all like to look at photographs of unusual radio receiving sets and in the section entitled, "Around the Stands at the Wireless Exhibition" many such illustrations are published. These show the general trend of British radio set construction and also that the foreigners seem to be coming around toward the American standards of radio set construction. Few sets of British manufacture today have the tubes projecting out through the tops of the cabinets. This type of construction seems to have been abandoned for the more practical and certainly more symmetrical American type, in which the tubes are all inclosed within the cabinet.

* * *

A single vacuum tube control panel that lends itself very well to all kinds of work will be found described under the head of "Experimental Valve Unit." The tube socket and all the necessary controls are mounted in a small compact cabinet and the resulting instrument can be put to many uses in the experimenter's laboratory.

* * *

A very neat and compact honeycomb coil set is described in the article entitled, "Compact Detector and Note Magnifier Set." Two vacuum tubes are used, one as detector and the other as an audio frequency amplifier. Aside from its novel construction, this set offers nothing of interest as it is merely an ordinary single circuit tuner.

* * *

The English seem to be doing a lot of work in the line of radio frequency amplifiers. Certainly more information is published in the English journals regarding this phase of radio reception than can be found in the papers published in the United States. Furthermore, these periodicals provide the reader with much interesting constructional data. Particularly is this true of the article entitled, "H. F. Amplifier Design." Circuits and constructional details are given that will be of great value to all of those interested in radio frequency amplifier construction.

* * *

September 23, 1925.—"Push-Pull Receiver—Amplifier" describes a four-tube receiving set using one stage of straight audio frequency amplification and one stage of push-pull amplification using two-tubes and two push-pull transformers. The set is neatly designed and quite well arranged on the baseboard, although the British parts do not seem to lend themselves as well to symmetrical construction as those in the United States. However, the article mentioned is well worth reading.

* * *

A more or less historical discussion of short waves is given under the head "The Short Wave." The development of radio from the time of Clerk-Max-

well up to the present day is reviewed in brief and several arrangements for directive radio transmission are illustrated and described. It is interesting to note the similarity of some of the old time beam methods of transmission to those in practical use today. The facts given in this article are well worth storing away in your memory.

"The Resistance Coupled Amplifier" is the title of an article dealing with that form of increasing the volume of reproduced radio signals. This type of amplification is coming more and more into use and the practical data given in this article should be well worth while. Several circuits are given showing various methods of coupling tubes together by means of combinations of resistances and condensers.

The Reinartz receiver is always favored among those who want a good all around set. A complete set using this circuit is described under the head "Three Valve Reinartz Receiver." Schematic and pictorial circuit diagrams of all of the connections and photographs indicate the layout of apparatus. The article is most complete in all details, including a list of the various parts employed in the set.

September 30, 1925.—An article containing much of interest in the way of history is that called "The Thermionic Valve, Its Origin and Development." Many interesting photographs show some of the very earliest types of rectifying vacuum tubes and carry the readers through the various stages up to the present day high grade vacuum tubes.

"Unsolved Valve Problems" describes some curious effects obtained when vacuum tubes are connected in certain ways. The information given in this article is very valuable and should not be slighted. It shows one many things about vacuum tubes that are not often encountered in standard textbooks on the subject.

A department entitled, "Practical Hints and Tips" gives the reader many little items that are of wide-spread interest.

October 7, 1925.—Operating radio receiving sets from a point removed from the actual installation is something that seems a little bit far fetched. Nevertheless, a system has been developed whereby this can be accomplished and all that it is necessary to do to tune your set using this method is to push one or the other of two buttons. The proposition is completely explained under the title "Remote Receiver Control" and full constructional details for applying this novel system to your own receiving set are given.

The article is interesting because of its novelty and because of the fact that the new system is worked out in quite minute detail.

A rather technical discourse on crystal detectors is presented in this issue. This particular item caught the reviewer's eye because of the fact that it went into the subject quite deeply. The article is a continuation of one that has been running in several issues of this magazine. To those interested in the theory underlying the operation of crystal detectors, a series of articles of this nature should be most welcome. Facts are brought forth that would be hard to find in any standard text book.

WIRELESS WEEKLY

Australia, August 21, 1925.—A short-wave tuner employing radio frequency amplification is something rather novel inasmuch as sets of this type are not in general use in the United States. The article entitled, "Radio Frequency Tuner for 30 Meter Work" presents all the details on a set of this nature. One stage of radio frequency amplification and a vacuum tube detector are employed for this work. Tuned impedance is used for coupling the two tubes together.

August 28, 1925.—Getting rid of the "B" batteries in radio receiving sets is something that we all want to do and a very practical "B" battery eliminator is described in this issue. It is of somewhat conventional type, but the details given are very complete and the article is well worth reading over.

September 4, 1925.—"More Power Per Valve" is a discussion of a system of radio frequency amplification which the author claims has a factor of 10. The details are quite well worked out and sufficient information is given to guide the reader correctly in the design of a similar amplifier.

Certain factors governing insulation values are rather obscure unless one has an engineering education. However, these propositions are quite simply dealt with in the article entitled, "Some Insulation 'Stickers' Explained." Dielectric values and phase angle difference are dealt with in a way that even one with little education in radio can understand.

September 11, 1925.—A continuation of the article on tuned radio frequency amplification appearing in the above reviewed issue of this magazine

describes the Browning-Drake circuit in complete detail. This circuit is both novel and sensitive as well as very selective. The article is well worth reading for the information contained therein.

A low-loss receiver for use on the very short waves is described under the head of "The Hilliard Low-Loss Set." The receiver described was very carefully constructed and made up in a form that would reduce all losses to the very lowest possible minimum. The set is designed for amateur waves.

Popular Wireless and Wireless Review

England, September 12, 1925.—Radio station G2NM is one of England's foremost amateur outfits. The operators work with phone on short waves is nothing less than remarkable. In this issue an interview with the owner of this station, Gerald Marcuse is published. An insight into the operation of a British radio station can be had by perusing this article.

A set incorporating both a crystal detector and a vacuum tube with some sort of a switching arrangement for selecting either one or the other is greatly to be desired. With it, local stations can be received on the crystal detector without the necessity of using the current from the "A" and "B" batteries. For "DX" reception, the vacuum tube can be resorted to. Under the heading "A Straight Crystal or Valve Receiver," a set of this nature is completely described. This is one of the constructor series running in this magazine and as such is dealt with in most minute detail. Everything from the panel layout to two pictorial circuits is given.

What constitutes low-loss and what real value are low-loss instruments? Many questions of a similar nature will be found answered in the article entitled, "Low-Loss." The details given are the results of many extensive experimental tests.

"Aerials and Aerial Equipment" is the title of an article dealing with the construction of aerial masts of various types. The method of erecting them and of placing aerials in position and bringing in the lead-in is described in detail.

When your radio set suddenly stops working and you cannot hear anything in the phones or loud speaker, what do you do? The author of an article entitled, "Silence" tells you what you should do in such an event. This is

the most exasperating trouble to trace inasmuch as there are no clues to lead us toward a correct solution. Therefore, a perusal of this article will be of great benefit the next time that this happens to you.

* * *

A very flexible receiving set of the reflex type is described in the article entitled, "The P. W. Three-Valve Reflex." This set is so arranged that with two double-pole double-throw switches, six different arrangements are possible. Either one radio frequency and the detector, one stage of R. F., detector alone, or any of these three combinations, plus an audio frequency amplifier can be used. The circuit is novel and quite interesting and is presented to the reader in both schematic and pictorial form.

* * *

October 3, 1925.—When and where to use vacuum tubes having high amplification constants and using comparatively large amounts of power is something that should be understood by all and if the article entitled, "Power Valves and How to Use Them" is studied and followed, no trouble should be encountered.

* * *

A two-tube receiver of unusual design and flexibility is completely described under the title, "The P. W. Two-Valve Ultra." The receiver is laid out in an exceedingly compact manner and the article gives complete directions for covering various wavelengths and for connecting different circuits.

* * *

Some notes on short-wave work are given in an article by that title by Gerald Marcuse, G2NM. The information given is most interesting.

* * *

Here we find another single tube reflex set of the usual type, employing a crystal detector for rectification. Full details are included.

* * *

RADIO INFORMER

Canada, September, 1925.—The first two articles which appear in this issue have to do with Radio and the Canadian National Exhibition and relate the progress of radio since the storm swept the country in 1922. The Canadians have been following right on our heels and are far ahead of their English cousins.

* * *

Our friend Jenkins of Washington and of television fame is again in the

fore with a story on the operation and theory of his prismatic disc type of transmitter of photos. Analogies are given and the style is such that even the most obstinate reader can understand the process. Other methods are briefly reviewed and an attempt made to show the superiority of the Jenkins' system. Thus there is the Belin system, the A. T. & T. Co.'s, the R. C. A., Bartlane, Leishman and others. Although the transmission of photos by wire or by radio is already a successful venture, the transmission of moving pictures by either method holds a far greater problem to be solved and it may be many years before it will come about, if at all.

* * *

Many times we are asked "What is the very best receiver it is possible to obtain?" Aside from looking askance and more or less foolish, we are unable to say much except that the super-heterodyne gives excellent results, that the neutrodyne does the work splendidly, that the three-circuit regenerative receiver cannot be surpassed and that finally, the reflex on account of its simplicity, low cost of operation and splendid reproduction, is as good as any!

In this connection, we find an article entitled "An Eight-Tube Long Distance Receiver." Eight tubes at once remind us that the set can be no other—to a reasonable degree at least—than the super-heterodyne with the embellishing dressing of various meters, switches, knobs, dials, etc., etc. Supplementing the drawings, is a rather lengthy discourse on the merits and outstanding characteristics of the super-heterodyne.

* * *

In a fitting glorification of the American broadcasting station we find station WOAW given a truly interesting and highly descriptive account. Vividly portraying the use and accomplishment of station WOAW, we can only realize the wonderful work being done by our broadcast stations by reading about them. In our everyday lives we are in constant touch with them, through their programs of entertainment. Little do we realize the many important functions which they play and to the great amount of trouble they put themselves to, in order to give us the best available material—and then free from all cost!

* * *

Heralded as "The Four-Tube 'Knock-Out' Receiver," a circuit showing one stage of neutralized radio frequency amplification to which the antenna is conductively coupled, tickler feedback regenerative detector and two steps of transformer coupled audio frequency amplification, is proclaimed as being the ideal set from the standpoint of selectivity, volume and sensitivity. Following a logical discus-

sion, the author explains in clear style the underlying reasons why such a circuit is to be recommended for all practical purposes.

* * *

In our course through the book, we come upon the eighth of a series of articles under the name of "The Home Study Radio Course." Here we find a very valuable resumé of the more important terms and a concise treatise on the various devices used in electricity and radio. Such a series of articles would go well in an American magazine, and we are going to be on the look out for it. As far as we know, the section in this magazine known as The Radio Encyclopedia, is the only one published along the same lines. For the beginner, one cannot begin to realize the wealth of information articles of this type carry with them.

* * *

A humorous parody on the trials and tribulations of station WALL to keep its scheduled program by the famous singer Brignoli will meet with the favor of everyone who reads it. The escapades and situations are pleasingly exasperating. Especially will it appeal to those who can realize what it means to have an operator go up a 100-foot tower and keep the antenna from coming down in a heavy storm!

* * *

"Static." What can be done about it? There have been a number of systems which have been developed and for which many claims have been made. In this particular article the writer does not confine himself to a mere dissenting attitude in regard to one so-called system for eliminating static. He goes further and in part:

Upon first inspection of his data it looked as though Dr. McCaa "had something," then a closer reading failed to reveal in his arguments a logical sequence. He would explain his apparatus and theory very thoroughly up to a certain point where his argument trailed off and became dismally vague and unconvincing, and then like the sun coming out from under a heavy cloud and bursting forth upon a weary world, would be the climatic assertion that—"well anyway, it worked!"

It would thus appear that the writer has been a student of the subject, and has spent considerable time in studying the problem. He fails, however, to give us a suggested remedy and leaves to our imagination the solution of this great bane in radio communication.

* * *

There is no better way in which to explain the mysteries and underlying principles of a subject than in a conversational manner and in "Jimmie and Dad Radio Stories," the ground is very nicely covered. The son and dad have a tete-a-tete and the language used is so simple that the beginner can

readily grasp the meaning of the various terms. Of course, all the information comes from Jimmie and it is his dad who asks all the questions.

* * *

"A Simple Two-Tube Reflex" is the title of the following item. It is written by an American author who is well versed in the intricacies of radio and who knows what the radio builder is on the lookout for. The one who is looking for a receiver which will be easy to operate, be economical of "A" and "B" battery consumption and give volume and tone quality which is hard to surpass, will do well in duplicating these specifications for a two-tube reflex.

* * *

Among the numerous news items in the issue, we cannot help but feel justified in reprinting this one. It is characteristic of the unselfish and valuable work of the American Radio Amateur. "Flint, Michigan.—Chief of Police James P. Cole of this city has the distinction of being perhaps the first police head in this country to care for the daily routine of his position by means of radio during a long period of absence from the city. While Chief Cole attended the recent Indianapolis gathering of the international organization of police chiefs, he maintained steady touch with his department at home, directing all of its activities and passing on all of its problems.

"Co-operation of amateur radio stations in this city and Indianapolis was secured through the efforts of members of the American Radio Relay League in both cities. F. D. Fallain of this city, owner and operator of 8ZH—located in the police headquarters building—and R. Stark and J. T. Hood of Indianapolis did the relay work during the convention sessions. The tests, aside from their practical value to Chief Cole and his department, served as a remarkable demonstration of the usefulness of amateur radio in the co-ordination of police work. It was pointed out that broadcast messages from amateur stations would furnish a faster means than is now available of getting out warnings and important police news. Voice broadcasting of such messages is available now in only those communities possessing broadcasting stations, whereas the presence of amateur telegraphic stations in almost every community gives the police departments a closer tie-up with each other.

"So well does the Flint Police Department like the radio communication that it now has four distinct stations. 8ZH and 8AND are the amateur stations, while WFDF and WGF are the other two in the group."

This is only another chapter in the long and far-famed history of the American amateur. The government has forseen the value of the amateur and his work and has accorded him the

rights and privileges which no other country has given to their amateurs.

On going further through the magazine, we note that it is very much filled with amateur notes. This is a commendable thing and we hope that other contemporaries will follow suit. On short wave experiences, overhauling the set, testing, causes of interference, etc., we find that the subjects have been handled in a credible manner. Too much emphasis cannot be stressed on overdoing a thing, and the refreshingly timely articles written in brief make the book more interesting than otherwise.

* * *

One of the concluding articles is a lengthy discourse on the power vacuum tube. It stands out in contrast to the other short articles. Design, construction, efficiency and important notes are discussed with a view in mind to enlighten all those interested in the subject. And indeed the subject is well worth reading about, for it directly reverts our attention to present day broadcasting and its limitations and possibilities.

* * *



Ireland, October 1, 1925.—As might be expected in a foreign publication, the first article that we find in it is a reflex type using tuned impedance R. F. coupling and a crystal detector for rectification.

* * *

More foreign products are illustrated under the title of "Successful London Wireless Exhibition." These photographs show a tendency toward stabilization in the design of radio apparatus in Europe.

* * *



New York, December, 1925.—Radio News, the world's largest and greatest radio publication always contains material of an interesting and valuable nature. Particularly so is the December issue which we have perused with care and thoroughness.

Conveying more than a passing thought and furnishing food for the perceptive and imaginative mind, we find the editorial on "Power by Radio" to be more than a mere fancied idea

on how power will be transmitted in the future. In it, Hugo Gernsback, the editor of Radio News stresses the importance of a better and cheaper means of transmission of power and summing up the researches of scientists on the subject of heat, light and radio waves, comes to the inevitable conclusion that it is now only a matter of time before the great discovery will be made. The possibilities of the ultra short waves which are lying dormant due to the large amount of experimental work to be done along those lines and so little having been done up to the present, causes us to sit up and take notice. Skeptics who are always pessimistic about such futuristic ideas, are urged to carefully read the editorial.

* * *

Many new things were brought out for the first time at the radio show in New York City. Among them were elaborate receiving sets of exceptionally fine workmanship. Others were in the style of the more modern versions of radio-craft—resembling a large clock, a gigantic radio receiver and complete self-contained sets.

We can attribute the splendid progress in the design of sets, to the unwaning interest of the public. They have always and are still, asking for a better, simpler, and more efficient radio receiver. It is due to this reason that our engineers and manufacturers are busily engaged in bringing out new and better products. The pages given over to the new apparatus indicate that we are going along at a relatively fast pace in our attempt to achieve perfection.

* * *

Under the auspicious title of the "Kiro-Vox—Alias Neurophonometer," we find a most interesting description of a fraud radio—"invention" for which it is claimed that all ills and other body troubles can be cured. Yes, we may add, for toothache, sore feet and as a hair tonic—or remover. As a result of the exposé by Radio News, the "inventor" is now suing the publisher for the mere sum of \$1,000,000 for damages, etc. This gives us a hearty laugh and we must commend the magazine for the stand that it takes in the interest of the unwary public. If you want to enjoy a good laugh and see what has been classified as a complete fake, read the article. You will agree with us that Barnum was right.

Upon examination of the device, there appears to be only a simple radio receiver disguised with a few embellishments to fool the public.

* * *

Beginning in this issue we find the first of a series of articles, or rather biography of the "Experiments of Dr. D. McFarlan Moore." Those of you who have been following the progress of electricity and radio will at once

connect Mr. Moore as the inventor of the electric sign and numerous other electrical and radio appliances. Contemporaneous with the life of Moore, great men, such as Edison, Tesla, De Forest, Fessenden and Westinghouse are closely associated with the progress of the electrical and radio arts.

There are now running several biographies, many of which contain very valuable information of an important nature. Our advice to the radio enthusiast who is anxious to learn more about the evolution of the art, is to read these stories of famous American inventors and their work.

* * *

A story of the new powerful radio station at Davenport, England, G5XX, proves to be of interest. It shows the trend of progress toward the use of greater power in transmitting radio programs. In our country, we have the super-power station at WGY which transmits with 50 kilowatts of energy, twice as much as the English station.

The photographs which accompany the article show the vast difference between American and English design. At any rate, we on this side must pride ourselves on the fact that America has the best programs, the best radio broadcasting and is far ahead of any other country in this respect.

* * *

Writing on the subject "The Nature, Cause and Reduction of Fading," Dr. Greenleaf Whittier Pickard, the eminent radio engineer goes into a full and concise explanation of the phenomenon of fading. Graphs, curves and oscillograms are in abundance and the one who likes to delve into the mysticisms of radio is given ample opportunity to exercise his powers of reasoning. Dr. Pickard cites several instances in which various causes for the fading are given and we are inclined to believe his logical discussion of this most perplexing problem.

* * *

The Radio Controlled Automobile is the title of a descriptive article having to do with the control of an automobile by radio. While we admit that such a device as a man-less auto might cause bewilderment to the uninitiated traffic cop, we believe that much more has to be done in that direction before the law will allow them to run around. For war-time, such a contraption would prove invaluable. A glance at the number of relays that are necessary will be sufficient to cause one to think it over before attempting to build one himself.

* * *

In the discussion entitled "Is Lightning A.C. or D.C.?" we find evidence that it is undoubtedly a D.C. character. Proof by means of oscillographic records of lightning discharge currents show that all the energy is on one side of the zero line, thus showing

no reversal of the current. An interesting high light in the argument is that the average single flash of lightning lasts .0002 of a second.

* * *

The use of radio is being extended to aid the surgeon in performing delicate operations. Just how radio is being applied has been made clear in an article entitled "Radio Aids the Surgeon." Accurate check on the heartbeats and blood pressure can readily be made and positive proof established whether a patient is alive or dead. There seems to be a great possibility for the use of radio in the science of medicine and it is only a matter of time for the two to become more closely allied.

* * *

In a continuation article of a series dealing with vacuum tubes, Dr. C. B. Bazzoni, professor of experimental physics at the University of Pennsylvania, deals with cold cathode gas filled discharge tubes. In this respect, the Crookes tube, the Geissler tube, and some forms of rectifier tubes are carefully studied and detailed. Facts about atoms, ions and ionization are given in clear and concise language. It is a real treat to read an article of such nature, because it contains authentic and valuable information.

* * *

A timely article on the so-called "Straight-line Craze" which is supplemented with a fitting sketch, brings to our mind forcibly the course of progress in radio receiver design. Hearing nothing but straight-line frequency condensers, straight-line frequency dials, etc., we find the reason to lie solely in the fact that something new and stimulating must be engendered into the public mind in order to incite further sales and promote business.

* * *

On the subject of "Trans-Atlantic Radio Telephone" we find that according to as yet unofficial announcement from responsible sources, the American Telephone and Telegraph Company will open an international telephone service linking the United States and England by means of radio across the Atlantic. It is proposed to use the single side band carrier wave as the medium of transmission.

Of late much experimental work has been done along these lines and it is certain from the results of recent experiments that such a system on a practical basis is not far from being realized.

* * *

Following closely upon the announcement and description of the new Interflex circuit by Hugo Gernsback, Editor of *Radio News*, we find a detailed account of the new regenerative interflux circuit, a purely single controlled receiver. This marks a decisive advance in receiver design and we are sure that the outstanding features of

this set which are all to be desired, will more than appeal to and repay the one contemplating its construction.

The crystal, which has lost nearly all its reputation because of the encroachments made upon it by the three element tube, is once more revived and its use stressed as greatly enhancing the tonal quality and operation of this new receiver. The new regenerative coupler which the author terms a *flexo-coupler* is a specially designed piece of apparatus, particularly constructed to perform the requisite duty of remaining in fixed position to cover the entire broadcast wave range. Complete details for the construction of the receiver are given. Even the one who is about to build his first radio set will be able to follow the clear diagrams and drawings which lend clarity to the description.

* * *

"The Reactodyne Circuit" is a new receiver which combines inductive and capacity feed-back which is preceded by a single stage of tuned impedance coupled R.F. amplification, the detector tube itself being tuned transformer-coupled. Excellent means are thus provided for controlling regeneration and eliminating oscillations. The circuit requires three tuning controls and is capable of getting good distance.

* * *

"The Isofarad Receiver" is another five-tube set to which various refinements have been added and for which great sensitivity and selectivity are claimed.

We view with apprehension the fact that the design of radio frequency receivers has been limited to the use of transformer-coupling, impedance-coupling, and resistance-coupling. Why does not some wide-awake manufacturer get busy and design a set using high MU tubes as coupling devices? Surely, the use of such tubes should greatly enhance the clarity and sensitivity of the set and lend greater overall efficiency in its operation. While we do not take objection to the use of shielded radio frequency transformers, we do believe that steps have not been taken in the right direction. Everyone will agree that a shielded radio frequency transformer is capable of delivering as much energy to the succeeding tube as is an unshielded transformer. The great advantage is, however, in the former case to prevent stray coupling and in the latter case to increase volume by means of added inherent regeneration. In this respect, greatest stability can be had with the shield transformer such as used in the Isofarad set.

* * *

On the highly technical subject of coupling, we find a real fine article dealing with exceptional simplicity on the complex mathematical phases. The topic is handled in a way in which even the man knowing little of algebra, can

understand. The subject is an important one and should be clear in the radioman's mind. Here is an excellent opportunity to learn about the subject in an easy manner.

* * *

"How to Make the Radio Dancer." This is a rather catchy title, but nevertheless the story included under it is one which will appeal to those who have small kiddies in the home. A description of a small unit which when attached to the radio set will set a doll placed upon it into ecstatic vibration will be found to be simplicity itself and to furnish very much amusement.

* * *

The multiple grid tube and its advantages are fully discussed in an article by the eminent scientist Theodore H. Nakken, inventor of the photoelectric cell using the actinic properties of the alkaline metals. It seems to us that greater possibilities lie in the use of such types of tubes, but so far, experimentation with them has been limited. Just why, we do not know, but it is hoped that more work will be done along these lines. Certainly, according to what the author has to say, it appears as though engineers on this side of the "pond" are more or less unacquainted with such types of tubes.

* * *

The amateur is given a chance to defend himself in the article "Traffic or Experiment?" The question is raised: "Who is the better class of amateur, the one who pounds brass or the one who is continually experimenting with new circuits, etc.?" We will let the reader find out for himself if he is interested sufficiently. At any rate, logic is to be demanded for a reasonable answer.

* * *

Five meter transmission is a very difficult task and there are countless experimenters who have failed completely to get a set working at that high frequency. Yet, by following concrete advice and adhering to the instructions of one who has had good success with such a system, duplication can readily be effected. 8CAU gives the "dope" and vouches for the results. If you are in doubt, ask an amateur, he KNOWS.

* * *

On the subject of electrolytic condensers will be found data never before described in popular fashion. It will be of especial interest to the one who likes to experiment or transmit. Complete constructional information is given and simple oscillograph charts supply ample information in the way of clarifying, not only the current, but the subject!

* * *

What type of audio frequency amplifier do you use? Is it the transformer-coupled type, resistance, push pull, or

impedance type? If you are satisfied with its quality and volume, read no further, but if you are looking for the best, listen.

Entitled "A New Impedance Coupled Audio Frequency Transformer," the article by Sidney E. Finkelstein, well-known radio writer, will be found to contain some excellent advice and details concerning good audio amplifier practice. It also gives constructional details on a new type of impedance amplifier for which undisputable claims of volume, clarity and fidelity of reproduction and even amplification over the entire broadcast range are substantiated. With three tubes, the amplifier is the acme of perfection.

* * *

The usual radio wrinkles page will be found to be replete with hints, kinks and helpful suggestions. Likewise, the standard circuits, information department and international radio pages contain good information. There are numerous other news items of interest, and as a whole the issue is to be commended for its valuable contents.

* * *

The EXPERIMENTER

New York, December, 1925.—"The Evolution of the Vacuum Tube" is the heading of an unusually interesting and highly illustrative article concerned with the development of the three element vacuum tube. Its inception by De Forest, based upon the pioneer experiments of the famous world's greatest inventor, Thomas Alva Edison, is fully clarified. It points out clearly that Edison and not Fleming was responsible for the discovery of the so-called Edison Effect—that the emission of electrons from an incandescent filament is conductive in one direction only. It is an article you will be happy to read as it contains historical data covering a period of many years.

The average man will be surprised to learn that Edison was far ahead of his time and had at such an early date as 1883 come upon a most wonderful principle, application of which was destined to revolutionize the world of intercommunication. Another development which has given the world a great service is the carbon type microphone used extensively both in the telephone and in broadcasting. This also was due to Edison's persevering efforts. Again it is stressed that you read the article.

* * *

The second article is a short one concerning the use and application of the lever principle in amplifying sound. Through the ingenious arrangement of the loud speaker unit and the phonograph reproducer, utilization of the tone arm and sound chamber is had,

with the result that exceptional volume and clarity of reproduction ensues. It is just the thing for the man who is looking for quality rather than distortion and non-uniform amplification.

* * *

Dealing with the subject of radio analogies, the author of an article on that interesting method of visualizing radio circuits goes into a discussion of the possibilities of analogies and their application to the design and originating of radio circuits. We find that he gives mechanical analogies which are in every respect in conformity with the given radio circuit and it is our sincere wish that we see more articles of this kind.

* * *

Notes on transmitters fulfill a want for the transmitting amateur who is on the lookout for advice and helps. It will be found particularly interesting from the standpoint of conveying information which is of actual value, the helpful suggestions being ones which have proved themselves as being of utility. U3MO writes on the subject.

* * *

At last we have found what we were looking for! For the first time in the annals of radio journalism, we have come across an article dealing with clearing up trouble in a radio set, no matter what kind of a set it may be. A simple three-range voltmeter and a small tube and tube base are the only materials which accomplish this large order and do it correctly. When testing for faults, the set is placed in actual operation and the meter at once points out where the trouble lies. This is a real experimenter's device which will come in handy at all times.

* * *

The Radio Data Sheets, a regular feature in *The Experimenter* every month, contain data of intrinsic value to all. The step by step process of evolution in the arts of electricity and radio are given in a clear manner.

* * *

The second of a series of articles entitled "QRM—I Am Being Interfered With" deals in completeness with the causes of trouble and noise as originate in the receiving set itself. The first article covers all other sources of interference.

Since the author is the assistant radio inspector of the Ninth District, he is well fitted for the task of writing on the subject. And his complete article proves it to satisfaction.

* * *

A hasty resumé of the stories in *The Experimenter* for December leads us to believe that the progress of radio is still a rapid one and that the magazine is devoting its efforts to record this progress in a way which will appeal to all readers.

* * *

Science and Invention

New York City, November, 1925.—The first article in the Radio Department of this magazine is that entitled, "A Continuous News and Time Broadcast Service." Suggested by an English correspondent, the idea presents many possibilities to the owners and operators of broadcasting stations. If sufficient agitation on the part of broadcast listeners could be brought to bear upon such persons, a service of this type would undoubtedly be incorporated in the programs of more than one station. Read the article and draw your own conclusions. Then, if you think well of the idea, why not write a little about the subject to one or more broadcasting stations, mentioning the idea and telling them that you would like to see such a service brought into action. If enough people do this, results should be obtained.

* * *

The next two pages are devoted to a description of station WRNY. On the first one of these pages, the program director outlines the plan that they are going to follow in connection with that station for the next six months. It is interesting in the extreme and as outlined, much entertaining material is in store for the listener-in on WRNY. The next page is devoted to a description of the station, accompanied by four photographs of the studio and the operating room.

* * *

Even though radio is one of the safest hobbies and pastimes that a person can indulge in, still there are certain things that must be watched when installing a radio receiving set or when putting up an aerial. The most important ones are outlined under the head of "Radio Hazards" and it is well worth while to read this article and profit by it.

* * *

The removal of insulation from wires in a radio set seems to be a most simple proposition, but still there are correct and incorrect ways of accomplishing the desired results. They are both described and illustrated in detail under the head of "Removing Insulation From Wire."

* * *

Here is one of the finest constructional articles that has come to our attention in quite a while. It describes in detail a receiving set in which any number of tubes from one to five can be employed and which at the same time can be made to cover a band of from 200 to 600 meters. The set is

neutralized and the coils are so wound that the neutralization is complete from one end of the band to the other. This is unusual for a Neutrodyne receiver as the capacity of the neutralizing condenser is such that it will usually only be active over a portion of the range of the receiver. However, a novel switching arrangement makes it possible to cover the above mentioned band with no trouble whatsoever. A plug and jack arrangement allows the selection of the number of tubes that it is desired to use.

* * *

Reflex receivers of standard design are not to be passed over lightly and, therefore, our attention is attracted by the set published under the title of "An Efficient Two Tube Reflex Circuit." Here a crystal detector is employed and the connections are made so that one stage of R. F. and two stages of A. F. amplification are obtained. A unique yet extremely simple plug arrangement allows the operator to cut out the second stage of audio frequency amplification when it is not desired to use it. The details for making the four spiderweb inductance coils used in this set are given in the article and an extremely clear circuit diagram shows all of the connections.

* * *

"Hints For Radio Builders" is the title of an article including six hints that should help the radio constructor towards obtaining better results from his receiving set. Several of these hints are quite novel and should be interesting to all. Particularly to the crystal detector fan is the first item of interest. Here two crystal detectors are shown hooked up in a most unusual circuit and the author claims interesting and exceptional results can be obtained with this arrangement, if properly handled. The rest of the article is valuable, particularly that part dealing with the placement of fixed condensers in radio receiving circuits in order to obtain the best possible results.

* * *

A manufactured set having only one tuning control is described under the title of "Five Tubes With Simple Tuning Control." Photographs illustrate the set and a circuit diagram shows how the connections in it are made.

* * *

Under the department head of "Radio Wrinkles" many small items of particular interest to the radio constructor will be found.

* * *

The Telegram-MAIL Radio Section

New York City, October 3, 1925.—A receiver of rather unusual construc-

tion and known as the RX1 type is described in this issue. Four tubes are used and the audio amplifier consists of one stage of resistance coupled and one stage of transformer coupled. A Sodium detector tube is used. All of the necessary details for constructing the set are given.

* * *

A description of the Jenkins' system of radio motion pictures is given in a rather simplified manner. Photographs illustrate the apparatus used.

* * *

Electrical apparatus in which circuits are made and broken or in which high frequency currents are set up often interfere with radio reception. How some of this trouble can be avoided is detailed under the title "Electrical Interference with Radio Sets."

* * *

Usually not much attention is paid to the actual position of a radio receiving set in a room. The contrary, however, should be true as correct placement will aid reception considerably. How to obtain this is detailed under the head "If You Are Installing Your New Receiver."

* * *

A reflex receiver that is really selective and that gives excellent results with only two-tubes and a crystal detector is described in the article entitled, "Proves Reflex Can Be Made Selective."

* * *

A weekly feature of this periodical is a page for the hams in which various notes and news of interest to all transmitting amateurs is given.

* * *

October 17, 1925.—The method of controlling oscillation by means of a quartz crystal is receiving considerable consideration on the part of radio engineers. The article entitled, "Quartz Method of Wave-length Control" gives some interesting information on this subject.

* * *

"R. F. Coupling In One Stage Receivers" gives some very valuable information on simple receiving sets.

* * *

Trouble shooting is dealt with in the article entitled, "Causes and Cures for Reception Troubles." A system has been worked out by means of which trouble can be quickly and easily located without resorting to the old hit and miss method.

(Continued on page 78)

Readers' Problems

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

1. This Department cannot answer more than three questions for each correspondent. Please make these questions brief.
2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.
3. Sketches, diagrams, etc., must be on separate sheets.
4. Please do not ask for construction data on manufactured parts, such as transformers, kits, etc., as such data cannot in all cases be obtained from the manufacturers.
5. We are unable to request that every inquiry which the reader wants to be answered by mail be accompanied by a remittance of one dollar to defray a part of the cost of the work involved.

(23) Mr. John H. Christie, 4141 W. Pine Boulevard, St. Louis, Mo.

Q. 1. Your July issue describes the Harkness Counterflex Receiver. I have a Harkness two-tube reflex and can you advise me where I can secure details to convert my two-tube reflex into a three-tube counterflex?

A. 1. Kindly be advised that full details for the conversion of the two-tube Harkness Reflex into a Counterflex set can be obtained by communicating with the Harkness Radio Corporation, 727 Frelinghuysen Avenue, Newark, N. J.

(24) Mr. F. J. Robinson, Wilmington, N. C.

Q. 1. Will you kindly furnish me with a picture wiring diagram of the radio set described on page 15 of the September number of RADIO REVIEW? This set is described as "A Powerful Six-Tube Super-Heterodyne." Complete blueprints would be better.

A. 1. Any further information regarding this set can be had by communicating with the *Radio World*, 1493 Broadway, New York, N. Y.

(25) Mr. N. R. Earhart, 917 Franklin Avenue, Columbus, Ohio.

Q. 1. In the September issue of RADIO REVIEW an article of instruction for building a home-made "B" Battery Eliminator specifies a "Marle" transformer, type 200. May I trouble you to kindly advise me where or of whom this particular type of instrument may be purchased?

A. 1. The Marle type 200 transformer used in this unit can be obtained from the Marle Engineering Co., 309 Main Street, Orange, N. J. We believe that the price of this transformer is approximately \$9.00.

(26) Mr. J. D. Skond, Sidney, Iowa.

Q. 1. In reading the September RADIO REVIEW I ran across the Super-Regeno-Dyne hookup. Now I am very much interested in that hookup and would like to construct it. However, I am inexperienced and can't seem to follow the meagre directions. Would it be possible for me to secure blueprints of this set, directions of how the R.F. coils are made, and other information? Where can I get these coils for this circuit?

A. 1. We do not publish blueprints of this particular circuit. However, the radio-frequency coils used in this set are manufactured by the Bremer-Tully Mfg. Co., Harrison and Canal streets, Chicago, Ill. If you will get in communication with that concern we are sure that they will furnish you with the desired data on the construction of these coils. Other information concerning this receiver can be had through communication with Earle W. Scrogum, 202 E. 56th Street, Chicago, Ill.

(27) Mr. Wilbur Day, Evansville, Ind.

In connection with the hookup of the short-wave set on page 26 of the September issue of RADIO REVIEW, I would like to know where I can get the following:

- Q. 1. General Radio Coil Forms.
- Q. 2. General Radio Coil Mounts.
- Q. 3. How many plates does a .000125 condenser contain?

The information you desire follows:

A. 1. General Radio Corporation, Cambridge, Mass.

A. 2. General Radio Corporation, Cambridge, Mass.

A. 3. A .000125 variable condenser is one of the so-called vernier types and has 3 plates.

(28) Mr. L. B. Powell, Akron, Ohio.

Q. 1. Described in RADIO REVIEW, July issue, on page 61, is a "Baby Super Set" which at present I am constructing. I find that the author of this article has omitted what is, in my mind, an important item, i.e., he does not show which half of the small "filter coil" is used for the primary or which for the secondary, not stating which is used as top or bottom half. The same is true about the connections on the large coil, and not all of us can follow a schematic wiring plan. If a Conrad pattern can be had of this set, or a picture hookup, I would be pleased to be able to purchase the same. The author of the article is very concise in his explanations, but please have him tell us about these coils. Also placing of the audio transformers—5 to 1 and 3 to 1.

A. 1. If you will turn to page 61 of the July issue of RADIO REVIEW and refer to the photo at the bottom of the

page it will aid you to follow the instructions given below. The top winding of the coil on the right is the one which is connected to the aerial and ground, the lower winding connects to the grid and filament of the radio-frequency tube and is shunted with a 23-plate variable condenser. These two windings have respectively 25 and 40 turns. The top winding of the coil on the left is the tickler coil and is shunted with a 13-plate variable condenser. These windings have respectively 40 and 60 turns. There is no diagram or blueprint available other than those which appeared in the article in question, but we believe with the above explanation you will have no difficulty in connecting up the set. The first audio transformer should have a ratio of 5 to 1, and the second stage should be 3 or 3½ to 1.

(29) Mr. Chas. Hauser, Yorkville, N. Y.

Q. 1. As a reader of your RADIO REVIEW magazine I would like to know if I can get a blueprint of the "D" Kofl Acme Reflex set that you have a diagram of in the September issue.

A. 1. We very much regret to advise that we do not publish a blueprint of this circuit, but would suggest that you communicate with the Acme Ap-

QUESTIONS AND ANSWERS

It is impossible for the editors to answer individually the thousands of letters reaching the offices of this magazine.

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

paratus Company, 186 Massachusetts Avenue, Cambridge, Mass., as they may be in a position to accommodate you.

(30) Mr. V. S. Rutherford, 328 London Street, Peterboro, Ont.

Q. 1. I should like to know if the new straight-line frequency condenser would be suitable to use in the Cotton Super-Heterodyne described in the July issue of RADIO REVIEW.

A. 1. The straight-line frequency condenser would be quite suitable for this purpose and would be found far superior in operation to the older type of variable condenser.

(31) Mr. F. H. Fox, Detroit, Mich.

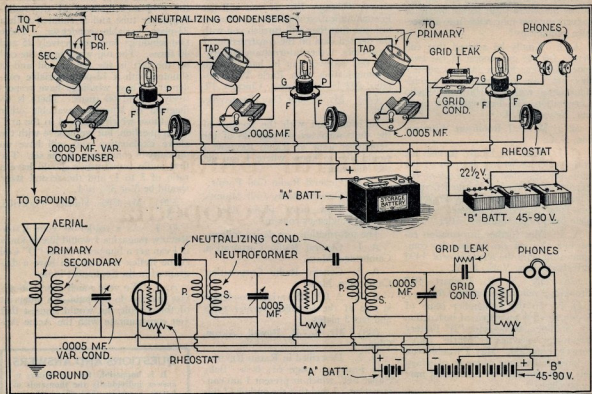
Q. 1. Will you kindly give me a diagram of a three-tube neutrodyne receiver, also constructional data for winding the neutroformers?

A. 1. The diagram is given here in both schematic and perspective form. The neutroformers are constructed as follows: Procure some cardboard or bakelite tubing 3 inches in diameter and cut it in lengths so each will be 3 inches long. Also procure some of the same kind of tubing but of a slightly smaller diameter so it will telescope into the larger tube after the wiring is in place on the smaller tube. The primary is the coil which fits inside the larger or secondary coil. Upon each of the small tubes wind 15 turns of No. 24 B. & S. D.C.C. wire. The

without the secondary tapped is the one shown in the diagram connected to the aerial and ground, and the other two neutroformers with tapped secondaries are shown in the diagram to the right of the untapped neutroformer. The neutroformers are tuned by .0005 variable condensers. The resistance of the rheostats will, of course, depend upon the type of tube used. The grid condenser should have a capacity of .00025 mfd., and the grid leak about 2 megohms.

(33) Mr. Robt. Vondrasek, 2741 S. Millard Avenue, Chicago, Ill.

Q. 1. In your issue of July, 1925, RADIO REVIEW, you have a circuit for a 60 to 600 Meter Tuner (page 37) which I have built. I have run into a



Q. 32. Circuit for a 3-tube Neutrodyne, the upper diagram being in perspective and the lower in schematic form.

Q. 1. Referring to your October issue of RADIO REVIEW, in which is described how to make a "B" Battery Eliminator. In checking the print it appears to the writer that the output designations of the negative and positive 135-volt and 22 1/2 detector are transposed.

A. 1. We thank you for calling this to our attention. The diagram on page 54 of the September issue is correct, but the schematic diagram of connections on page 60 is incorrect. The "B—" and "B+ Det" captions should be reversed.

(32) Mr. M. A. Turney, Brownsville, Texas.

three tubes which form the secondary coils are each wound with 60 turns of the same size wire and a tap is taken off on two of them at the 15th turn from the starting point. After the coils are wound the primaries should be fitted into their respective secondaries and so placed that the primary windings will be underneath the portion of the secondary winding that connects with the filament of the vacuum tubes, and so that the windings on both coils are in the same direction. If they fail to fit snugly, some sort of a small brass bolt should be run through the tubes so as to fasten them securely together. The neutroformer

little trouble which I don't seem to be able to overcome—awful howling and whistling. I wonder if you could give me some idea what the cause may be. There also is shown in your circuit a R.F. choke for which there is no data in your description. Will you kindly give me the details?

A. 1. The radio-frequency choke shown in the diagram on page 38 of the issue in question can be constructed as follows: 250 turns of No. 32 or 34 D.C.C. wire wound on a tube two inches in diameter. This coil uses an air core. If you still are troubled with an audio-frequency howl after inserting this choke, we would suggest that

you solder a wire to the frames of your audio-frequency transformers and run these wires to the ground binding post of your set. This may eliminate the howl. It may be that you have the two transformers too close together; they should be separated by about 6 inches if you have the space available. Also place the transformers so that they are at right angles to each other. The lead from the grid of the detector tube to the grid condenser should be very short, not over an inch long, as a long grid leak has a tendency to make a set howl.

(34) Raymond Falk, Mobile, Ill.

Being a reader of RADIO REVIEW, I became interested in a three-circuit tuner described on page 50 of the September issue. I am planning to build this set. I should like to get a little further information as to the parts as follows:

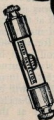
1. Could a straight-line condenser be used instead of the one shown?
2. What ratio transformers are used?

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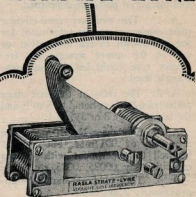
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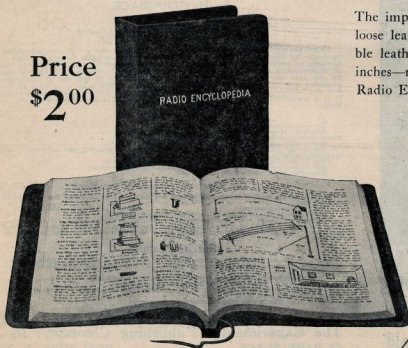
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3. How many microfarads is the fixed condenser marked No. 10?

4. What resistance is the grid leak?

This is one of the most complete drawings I have seen as far as wiring and placing of parts are concerned.

A. 1. The ordinary semi-circular plate condenser can be substituted for the one shown in the illustration, or one of the newer straight-line frequency type could be very advantageously used.

A. 2. The ratio of the first stage audio transformer should be 5 to 1, and the second stage 3 or 3½ to 1.

A. 3. Condenser No. 10 may have a capacity of .001 mfd., but it might be well to experiment with various capacities, say .00025, .0005, etc.

A. 4. The grid leak should be approximately 2 megohms.

(35) Mr. Robt. H. Norman, New Orleans, La.

Q. 1. In the September issue of RADIO REVIEW there appears the drawing of a Short Wave Set of Unusual Merit, on pages 26 and 27. My intention is to build this set and have read same over and understand drawing well except the short-wave coil No. 1, which comprises 20, 40, 80 and 200 meters.

From a reading of the construction of this coil it does not compare with the drawing of 1-2-3-4 taps as shown. If one follows the reading on page 27, the coil will have 6 taps instead of 4 as per drawing on page 26. However, any information you can give me on the subject, and tell me how I get 6 taps instead of 4 as drawing shown on page 26, will be appreciated.

A. 1. We believe you have misread the text on page 27 of the September issue, as there is not one coil used for the entire range, but four separate coils must be wound. We are quoting from the last column of page 27: "For the 20-meter coil, wind five turns of No. 16 D.S.C. and take a tap off at the first and third turns. A total of nine turns of wire will be required for the 40-meter inductance. This coil must be tapped at the third and sixth turns. For the 80-meter coil eighteen turns tapped at the sixth and twelfth will be necessary. Finally, for the 200-meter coil, thirty-five turns tapped at the twentieth turn, thus giving twenty turns for the grid coil and fifteen turns for the plate inductance. The coil form is 2¼ inches in diameter." You will note from the above that, with the exception of the 200-meter coil, each coil required has two taps, and these

two taps and the two ends will, of course, give the four taps shown at the bottom of the coil on page 26. The 200-meter coil has three taps all told, one at each end and one at the 20th turn. Tap No. 2 shown in the diagram on page 26 is omitted and for 200-meter stations the condenser is connected at the end of the coil, or, in other words, from tap 3 to tap 1, as the numbers appear in the schematic wiring diagram on page 26.

(36) Mr. K. E. Yoakam, Stronghurst, Ill.

Q. 1. I wish to substitute two 13-plate straight-line frequency condensers for the ordinary capacity type now being used in my Browning-Drake receiver. I have installed the new condensers and the one on the radio-frequency coil with the 70 turns of No. 22 on the secondary tunes the 200 to 600 band perfectly, but the one in the antenna circuit with the same number of turns tunes only from 250 to 600. How can I make the readings synchronize?

A. 1. We note you state that after substituting these straight-line frequency condensers one tunes from 200 to 600 meters but the other only from 250 to 600 meters. There is just one method of making these condensers

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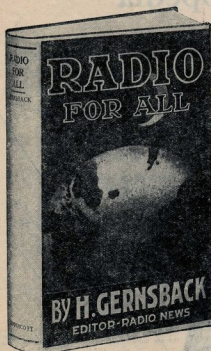
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synchronize, and it is rather a tedious one. Take the antenna coil (the one across which is shunted the condenser which you say tunes from 250 to 600 meters) and remove one turn from it, preferably from the grid end. After removing this turn tune the set and note the dial settings. Repeat this operation until both condenser settings are identical. However, care must be exercised or else it may not reach the higher wave-lengths. Synchronizing a condenser downward is always a delicate undertaking, as care must be taken in attempting to lower the range that the stations at the upper end of the wave-length band are not cut off the scale. It is for this reason that we suggest tuning the set after each turn is taken away. If you find that you have removed all the wire possible without cutting off the higher wave-length stations, and the condenser settings are still not identical, the only alternative then is to use a condenser with a smaller capacity and repeat the entire performance.

(37) Mr. F. E. Doren, Lima, Ohio.

Q. 1. In your September issue of RADIO REVIEW, on pages 32, 33 and 34, you described a one-tube impedance set from an article of John R. Meagher in *The New York Herald Tribune*. I have used all the necessary equipment, followed the specifications thoroughly, and as yet cannot get any results. In fact, cannot even get a sound, only when fingering the crystal detector. I have tested this set in connection with a tried ground and antenna wire. Can you give me any information about this or can I get in connection with John R. Meagher?

A. 1. You will, of course, realize that it is a difficult matter to diagnose the trouble at this distance. However, we would suggest that you again check over your wiring and as you trace out each wire check it off on the diagram shown on page 33 of the September issue of RADIO REVIEW. In this way you may find you have omitted some important connection. It is, of course, possible that there is a defect in some of the apparatus you are using, even though it is new and of standard make. We would suggest that you carefully examine the tube socket and make sure that the springs in the bottom of the socket are making connection with the grid and plate prongs of the tube. Bend them up slightly to insure a good contact with the tube. Often these do not make contact and, while the filament may light up, either the grid or plate may not be making contact. Also make sure that the sliding contact on the potentiometer is O. K. Sometimes these make poor connections. Mr. John R. Meagher can be reached care of the Radio Editor, *New York Herald Tribune*, Tribune Building, Park Row, New York, N. Y.

(38) Mr. A. H. Lee, Richmond Hill, L. I., N. Y.

Q. 1. In your September issue of RADIO REVIEW you described a long-wave set which was only a single-circuit set. I have tried out this set and it works all right, but it is very noisy. I would like to have a three-circuit set using honeycomb coils. Would you be so kind as to give me a list of right size coils for the different wave-length bands, using a .001 variable condenser?

A. 1. We are giving you below a table showing the approximate range of the various coils when shunted with a .001 mfd. variable condenser:

No. of turns in honeycomb coils	Wave-length in Meters	
	Minimum	Maximum
25.....	120	355
35.....	160	480
50.....	220	690
75.....	340	1020
100.....	430	1330
150.....	680	2060
200.....	900	2700
250.....	1100	3410
300.....	1400	4120
400.....	1800	5500
500.....	2300	7000
600.....	2800	8200
750.....	3500	10400
1000.....	4700	13800
1250.....	6000	18000
1500.....	7500	22100

For the broadcast band the best combination of coils would be 50 turns for the primary, 50 for the secondary, and 35 for the tickler. The best adjustment is had when the primary and secondary coils are separated about one-half of an inch. For the long-wave stations you can readily make up your own combinations of coils, bearing in mind that it is always better to have the tickler one or two sizes smaller than the secondary coil. The primary coil can also be one or two sizes smaller than the secondary coil. You will notice that the condenser across the secondary tunes very sharply while the one across the primary tunes coarsely. A triple honeycomb set with its two variable condensers and two movable coils is rather a difficult set to handle, but once you have mastered it you find it is one of the most selective and flexible sets that can be desired.

(39) Mr. Geo. H. Leavitt, Rochester, N. Y.

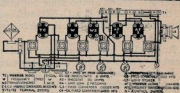
Q. 1. In the September issue of RADIO REVIEW, page 32, you give instructions how to build a one-tube tuned impedance set. I have built this set, following the instructions in every detail, except that I used a fixed crystal instead of an adjustable one. The set does not function, cannot hear a thing. Am using same aerial and ground I had been using on another set. Have checked over everything and find it cor-

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STATEMENT

Of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912, of RADIO REVIEW, published monthly at New York, N. Y., for October, 1925.

State of New York, ss.
County of New York,

Before me, a notary public in and for the State and county aforesaid, personally appeared S. Gernsback, who, having been duly sworn according to law, depose and says that he is the editor of the RADIO REVIEW, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and, if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, The Conrad Company, Inc., 233 Fulton Street; Editor, Sidney Gernsback, 233 Fulton Street; Managing Editor, W. G. Mott, 233 Fulton Street; Business Manager, R. W. DeMott, 233 Fulton Street.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each owner, should be given; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.) The Conrad Company, Inc., 233 Fulton Street; Hugo Gernsback, President, 233 Fulton Street; Sidney Gernsback, Vice-President, 233 Fulton Street; R. W. DeMott, Business Manager and Sec'y, 233 Fulton Street.

3. That the names and addresses of the bondholders, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the full names of stockholders and security holders as they appear upon the books of the company but also, in cases where the stock is held in or under the name of a corporation, the name of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, by paid subscription during the six months preceding the date shown above is (This information is required from daily publications only.)

S. GERNSBACK, Editor.
Sworn to and subscribed before me this 14th day of October, 1925.

(SEAL) JOSEPH H. KRAUS,
Notary Public, Queens County Register's No. 4522, N. Y. Co. County Register's No. 7164, New York County Clerk's No. 481. (My commission expires March 30, 1927.)

rect. You do not say in the article what "C" battery should be used, and how much "B" battery. Do you think the fixed crystal is at fault? The "C" battery I used was 2 Eveready dry cells in series. Three of the same batteries on the tube, which is a C-299, and one 22½-volt "B" battery in the plate circuit.

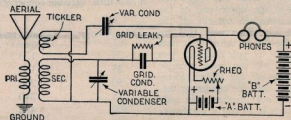
A. J. We note you have used a fixed crystal instead of a variable one. It is not advisable to use a fixed crystal, as they often have a bad habit of going dead due to the "B" voltage which goes through them. Sometimes they do not average much more than two weeks in a reflex or tuned impedance circuit. It may be possible that your fixed crystal has gone dead from this reason.

You have hardly enough "B" battery on your 199 tube. When this tube is used as a radio frequency amplifier as it is in this circuit, the "B" battery should range from 45 to 90 volts with from 4 to 7 volts of "C" battery.

Also carefully examine your tube socket to see that the springs in the base are making good contact with the plate and grid prongs on the bottom of the tube. It is possible that the filament

prongs are making contact with the tube socket but that the grid or plate is not. Bend these contact springs in the tube socket up slightly to insure a good contact. Also make sure that you have wound both coils in the same direction and that the wiring on one is not opposing that on the other. Be sure that your negative "A" binding post is connected to the ground and that the ground connection is a good one.

(40) Mr. J. J. Kelleher, Rochester, N. Y.



Q. 10. Schematic diagram of a regenerative set with fixed tickler. Wave-length and regeneration are both controlled by variable condensers. This set can be accurately logged.

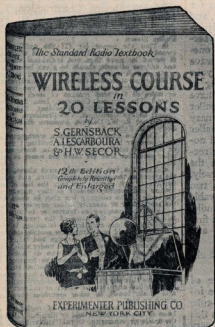
Q. 1. In your "Radio Listeners' Guide and Call Book," Late Fall Edition, on Page 20, Fig. 6, is a one tube set that I would like to try out; can

you give me the values of the different instruments? I have one 23 plate variable condenser and one with 11 plates. If I can use same in this circuit please show position of each.

A. 1. The circuit in question is reproduced herewith for ready reference. This tuner is all wound on one tube 3 inches in diameter and about 6 inches long. For the primary wind 21 turns of No. 22 DCC wire, leave a space of ¼ inch and wind on 50 turns of No. 22 DCC wire, then leave another ¼ inch space and wind on 50

turns for the tickler. The variable condenser across the secondary should have 23 plates. We suggest that you try your 11 plate condenser in series

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with the tickler coil and plate of the detector. It is rather small but may work satisfactorily. If it does not control regeneration over the entire broadcast band it will be necessary for you to replace it with a 23 plate condenser. However, try out the 11 plate condenser first. The grid condenser should be .00025 mfd., and the grid leak 2 megohms.

(41) Mr. Leland Smith, Nova Scotia, Canada.

Q. 1. I have a paragon regenerative receiving set but it won't work on the third tube. It is all right on two but as soon as you turn the third tube on it makes a noise and will drown out all music. If you hold your finger on the two posts marked "Loud Speaker" it will stop. Would you please tell what you think the trouble is and how to correct it?

A. 1. There are several things we suggest you try out. First change the tubes around in the sockets and see if this has any effect on the noise. Then if this has no effect try connecting a .001 mfd. fixed condenser across the two posts marked "Loud Speaker." This often reduces noises in the second stage. Also try soldering a wire to the frame work of the first and second audio transformers and then connect this wire to the ground binding post of your set.

(42) Mr. S. Marks, Ft. Morgan, Colo.

Q. 1. Can you please tell me whether or not dry cells can be used on the four-tube loop set described in the November issue of RADIO REVIEW? I can't very well use storage batteries.

A. 1. If you do not care to use a storage battery with this set we would suggest that you use 199 tubes instead of the 201-A tubes specified. Using 199 tubes this would make an economical set, but to attempt to use 201-A tubes with a dry cell filament supply would be extremely expensive and this method is not at all recommended.

(43) Mr. E. L. Roggy, Waco, Nebraska.

Q. 1. In your September number of RADIO REVIEW you have a description of a Super-regeno-dyne. I have built this set both according to the printed description and according to the diagram. That is, two ways. I find that it seems to work better according to the printed way. I believe you have made an error in the diagram. In it you have the F of the detector coil connected to the filament circuit, but the printed part says to connect it to the grid. Which is correct? Have had trouble controlling my oscillation, but as I do not know which way of connection is the correct way, I am at a loss just how to go about trying to control it.

A. 1. The printed text is the correct way. Through an artist's error the detector coil was not shown reversed in the diagrams as it should have been. As to the difficulty you are having with oscillation control: Possibly you are using too much "B" battery on the detector tube. As you no doubt know, this would have a tendency to make the set go into oscillation too freely. Try reducing the detector plate voltage somewhat. Some tubes seem to work far better with a plate voltage as low as 16½. We would also suggest that you try changing the tubes around in the sockets, as it occasionally happens that a tube oscillates too freely for smooth control of regeneration, and while such a tube is then unsatisfactory as a detector it would be satisfactory as an amplifier.

(44) Mr. E. H. Waltz, Palisades Park, N. J.

Q. 1. In your October issue of RADIO REVIEW you published an article concerning Mr. Frank D. Pearnes' four-tube set. In the diagram it showed two 11-plate condensers. As I have already purchased two 23-plate condensers, do you think if I put these in it would affect the set?

A. 1. The 23-plate condensers are too large and would make it difficult, if not impossible, to reach the lower wave broadcasting stations, some of which are now operating as low as 200 meters. We would suggest that you procure two fixed condensers either of .0005 or .00025 mfd. capacity (the correct capacity to be determined by experiment) and place one in series with the rotary plates of each of your condensers and then wire up the condensers in the usual way in the circuit. This would enable you to reach lower waves with the 23-plate condensers. If you find that you still cannot reach the very low wave broadcasting stations after inserting these fixed condensers, you can reach lower waves by taking turns off the coils, one of which has 60 turns and the other 56 turns. Take about five turns off each coil at a time and after each set of five turns is removed test the set to see what range is covered, but be careful not to remove too many turns, as you will then find that you cannot reach the higher broadcasting waves. Of course, these coils could be tapped and the taps led out to two switches, but this would add two more controls, which is not recommended.

(45) Mr. Frank Feger, Detroit, Mich.

Q. 1. In your September issue of RADIO REVIEW you have a "B" battery eliminator hook-up. I would like to know where the Marle Transformer is manufactured, or where I can get one.

A. 1. See answer to question 25 on page 71 of this issue.



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International Radio Digest

(Continued from page 70)

The Sun RADIO SECTION

New York, October 3, 1925.—A radio receiving set having a range of from 100 to 600 meters is described under the head of "A Double Zone Receiver." Specially designed inductances are used and all of the necessary information for their construction is given in the article.

Another resumé of resistance coupled amplification will be found in the article entitled, "Ins and Outs of Resistance Coupling."

October 10, 1925.—An interesting fiction story built around two radio inventors leads this issue.

Squealing in five-tube sets is something that often takes place and that is hard to eliminate. However, many hints towards accomplishing this are given in the article entitled, "How To Clear Up Squealing in Five-Tube Sets."

The necessity of operating the filament of a vacuum tube in the correct point is emphasized in the article entitled, "Filament Is Important Factor."

October 17, 1925.—The truth about straight line tuning is dealt with in an article by that title. Just when and where straight line frequency condensers will aid a radio receiving set is discussed in detail and many false claims that are made for this type of variable condenser are refuted. The article is most timely and of widespread interest.

A receiving set employing a novel method of regeneration control is completely and thoroughly described under the head "A Throttle Control Three-Circuit Set."

A single control six-tube receiver that has recently appeared on the market is described in the article entitled, "The Story of the Six-Seventy-One." This set is interesting because of the oscillation control in the R. F. amplifier and because of the three-stage audio frequency amplifier employed.

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