The SUPERHETERODYNE BOOK

1932 1933

Issued by Wireless Weekly

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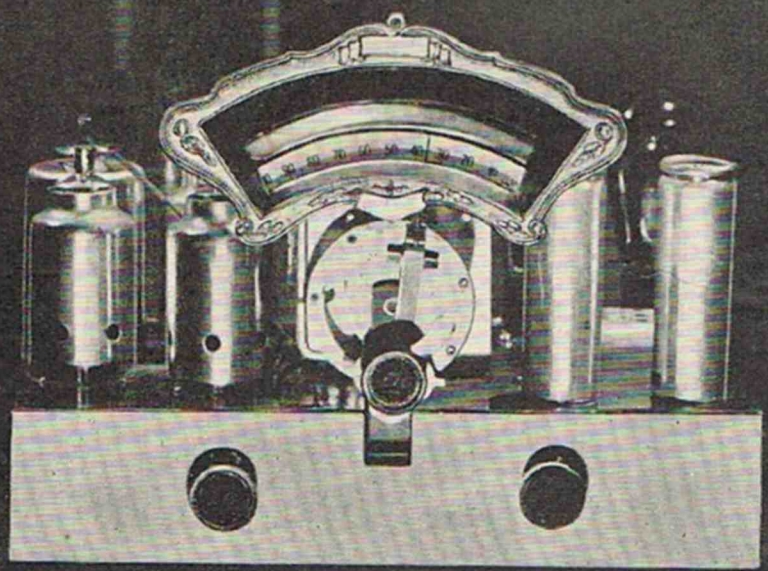

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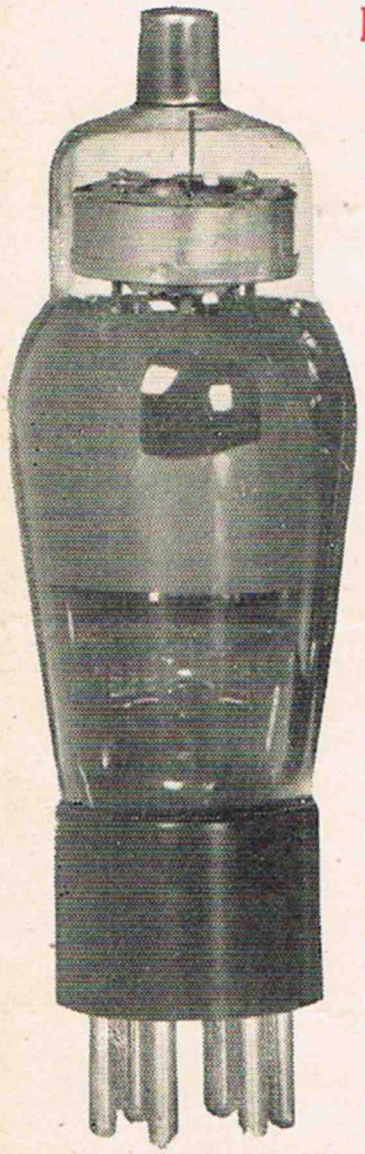

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The SUPERHETERODYNE BOOK

1932-1933

ISSUED BY "WIRELESS WEEKLY"

A Selection of Special Receivers Designed and Described

BY A. G. HULL

(Technical Editor of "Wireless Weekly")

INDEX TO ARTICLES

GENERAL ARTICLES

CONSTRUCTIONAL ARTICLES

OTHER ARTICLES

The SUPERHETERODYNE BOOM

THE manner in which the superheterodyne has jumped into popularity during the last twelve months is little short of amazing. A year ago there were probably not more than a thousand of these receivers in Australia. To-day we estimate from correspondence received and a careful survey of the market that there are no fewer than 50,000 in operation. Furthermore, you could not buy a commercially-built superheterodyne in Sydney a year ago, whereas to-day all Sydney manufacturers, with the exception of two, are making these sets.

What is the reason for this sudden focussing of attention upon a circuit not entirely new? The superheterodyne has been in existence for eight or nine years; basically the system is an old one; what then, has caused its sudden rise?

We do not believe that anyone in the radio trade or any listener-in will think we are overstating the position when we say that it is due mainly to "Wireless Weekly." More than any other contributing factor we have been held responsible for the boom of the superhet. Its rise and progress have coincided in every way with the development of special designs and their publication in "Wireless Weekly." No other periodical in Australia, until the last month or two, has so much as described a superheterodyne, and the radio trade was from the beginning chary of following the bold course set by our technical policy. Not until it was clear that the radio public was definitely following our lead did a few adventurous manufacturers enter the field.

No amount of publicity in "Wireless Weekly," however, could possibly have made the superhet. so popular had not a special set of circumstances combined with the vision and energy of our technical editor, Mr. A. G. Hull. When B stations began springing up on all sides a year or so ago, it was immediately evident from our correspondence that thousands of listeners were experiencing interference. Familiarity with the T.R.F. circuits, then mainly in vogue, made us doubt its capability to meet with the situation. A brush with the authorities showed that no assistance could be expected from that quarter. Mr. Hull then turned his attention to the superheterodyne which had a reputation for selectivity, and was being used to combat a similar problem in America. At about the same time there began to appear successive series of new valves, which made it possible by the application of considerable ingenuity and careful study to rid the superhet. circuit of much of its frightening complexities.

Mr. Hull has not let the matter rest since then. The superheterodyne set had been changed from a bulky complicated ten-valve circuit to a compact, simple and inexpensive set of from three to five valves with three times the range, sensitivity, and selectivity of the old job, and ten times its reproductive quality.

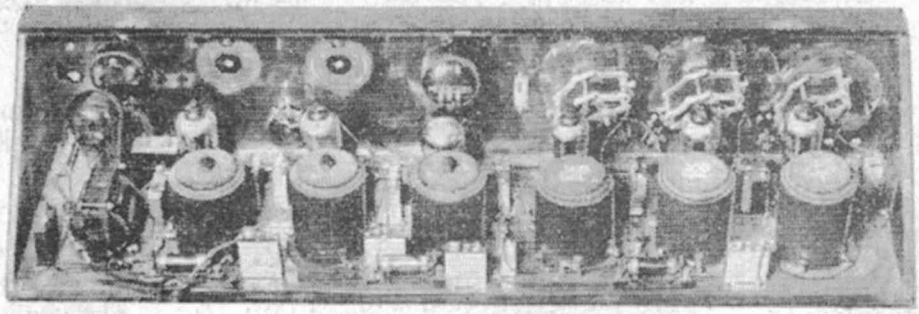
The circuits described in this book are the product of this effort to give Australian listeners receivers better than any previously available, and the success this effort has met with is testified by the huge number now in use. Some of these circuits have been described in "Wireless Weekly," but they have all been revised in the light of later experimentation, and several entirely new circuits have been added.

In this book, therefore, the radio enthusiast will find the latest and the most complete exposition of a type of receiver which looks like becoming the standard for use throughout Australia.

THE EDITOR OF "WIRELESS WEEKLY"

SUPERHETERODYNES

What They Are and Why They Operate



A view of an old type superhet.—showing complicated layout and the impossible intricacy of parts.

THE term "Superheterodyne" simply denotes a certain type of radio circuit. This circuit is very different from the ordinary radio circuit, and is also capable of giving greatly improved performance. It has become extremely popular in all parts of the world, and so the following outline of its theory should be of interest to radio enthusiasts:—

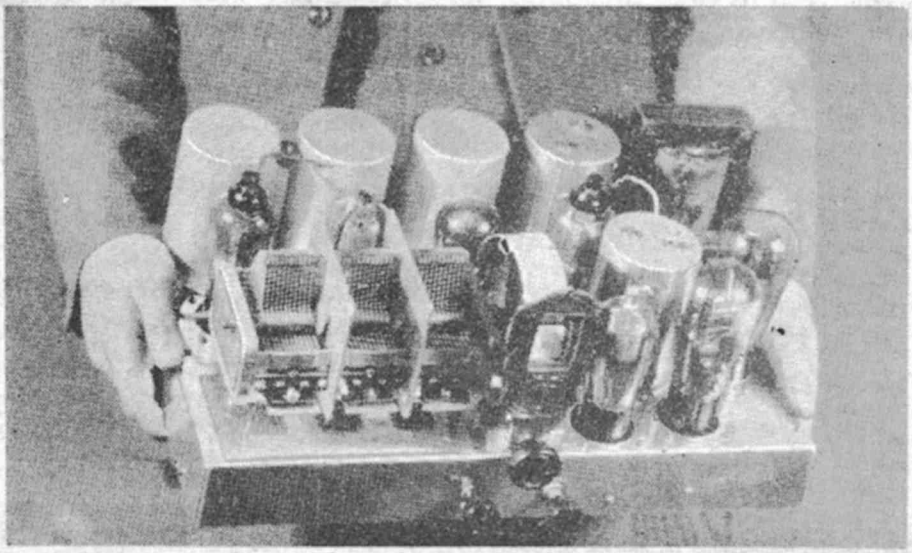
NOT NEW

The superheterodyne circuit is not by any means a new one, having been popular many years ago. In the old days the chief advantage of the superhet. was its stability. Even without screen-grid valves or neutralising it was possible to use several stages of amplification without oscillation troubles. To-day the chief advantage of the superhet. lies in its extreme selectivity. Readers who own ordinary sets will understand what we mean in this respect when we say that a good super will not only separate 2UW from 2KY, but also place other stations between them, without any overlapping whatever. Owing to the ever-increasing number of stations on the air this selectivity is of great value to those who wish to ensure consistent reception of interstate stations, such as 7HO, 3UZ, 5DN, 4GR, 2CA, 7LA, and 4BC, which are normally overshadowed by the locals. The reason for the stability and selectivity of the superhet. is explained later. In the old days on account of the comparatively low gain available from the valves then in use the usual superhet. was a very complicated and expensive instrument, difficult to build and difficult to operate. But during the past few years the performance of valves, particularly of screen-grids and pentodes, has improved to such an extent that the modern superheterodyne need be neither complicated nor expensive.

Re-Radiation

Originally superhets. were always used with small loop aerials in order that they would not cause interference with other receivers in the neighborhood. Even with such a small aerial the super was renowned for its long-range performance. To-day the re-radiation problem has been mastered by the introduction of a screen-grid r.f. amplifier ahead of the first detector. The r.f. amplifier also helps to further improve the selectivity and range of the job. Apart from these minor considerations the superhet. remains fundamentally the same. Those enthusiasts who wish to keep up to the minute in design will do well to brush up their knowledge of supers, and on this account we give a few of the fundamental points about them.

The superheterodyne circuit is entirely different from the ordinary receiver circuit in that we have an oscillating valve in our set, which produces oscillations of a certain frequency. The oscillator is adjusted so that its oscillations combine with the incoming signals to produce a beat note of a frequency of 175 kilocycles or other frequency which may be chosen. At this frequency we can amplify the signals in a most efficient manner with little probability of oscillation trouble or instability. After amplification at this intermediate frequency, as it is termed, we detect the signals and handle the resultant audio signals in the usual manner. The reason for the stability will be clearly understood when we point out that a frequency of 175 kc. is equivalent to a wavelength of about 1700 metres. Most readers are aware that their sets are more inclined to be unstable at the lower wavelengths. So it is with the superhet., and we find that even three electrode valves can be used for intermediate amplifiers without any oscillation trouble. In the modern circuits this feature is in itself not so important as before the advent

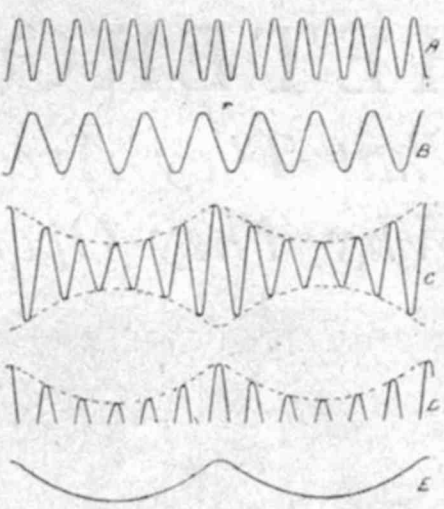


A modern superheterodyne showing neat, efficient and simplified layout

of screen-grid valves, but nevertheless we find we can use intermediate transformers to give greatly increased gain and still retain the stability which is inherent.

Why the Selectivity?

At first glance it may not be easy to understand why the superhet. gives such improved selectivity. It can be more clearly understood when we consider the requirements for tuning-in a desired station. If we heterodyne an incoming signal of say 400 metres with a frequency from our oscillator of say 385 metres or 780,000 cycles, we get a wavelength equal to the difference in the frequency of the fundamental signal and the oscillator, in this case 780,000 less 750,000, which equals (approximately) 30,000 cycles or 10,000 metres wavelength. However, if we have a signal of 10 metres above the fundamental and heterodyned it with the oscillator set as previously we find that we have 780,000 cycles less 730,000 cycles—a difference of 50,000 cycles or 6000 metres. We see that although the difference between the original signals is only 10 metres, the difference in the intermediate amplifier has been increased out of all proportion to almost



THE SUPERHETERODYNE PRINCIPLE

In diagram A we have the frequency of the current of the carrier wave of the incoming signal. In B we show the frequency of the current of the oscillations which are derived from the oscillator valve. When the two currents are combined we have a resultant frequency as shown in diagram C. Diagrams D and E show the same frequency after rectification. It will be seen that the new frequency formed by the beating of the two frequencies from the original signal and the oscillator has formed a frequency of a much longer wavelength.

4000 metres. Therefore without any ultra selectivity in the intermediate stages we find the set is in effect many times more selective than the ordinary set.

Analysing a Modern Superhet.

An inspection of a modern superheterodyne reveals a more or less normal stage of tuned radio frequency amplification. This is fololwed by another normal tuned stage feeding into the so-called "first detector," although it does not actually detect, but is merely a mixer in which the oscillations, which are fed into the cathode circuit from the oscillator valve, mix with the incoming signals to give the required frequency for the intermediate amplifiers. With modern screen-grid valves in the intermediate stages it is found that two stages of intermediate amplification will give more gain than can be handled comfortably, and consequently most superhets. use only one intermediate stage.

The Audio End

The second detector, the audio amplifier, and the output arrangements follow similar arrangements to those usually found in popular sets of the tuned radio frequency type.

What The Broadcast Listener Should Know

About The Operation of a Superheterodyne

AFTER struggling for months to get the maximum selectivity from their superheterodyne, one of our leading manufacturers recently received a complaint from one of their distributors to the effect that they had lost the sale of a set on account of the fine tuning necessary. They were beaten to the sale by a rival, whose set was so poor in selectivity that any station could be heard over a space of about six degrees on the dial. The sets being placed in the house for a demonstration without sufficient instructions to the operator, it was only natural that the intending buyer was misled by the apparent ease of control of the cheap job. We say misled, because actually the finer the tuning of the set the better it will be when it comes to trying to separate the many broadcasting stations which may cover the dial in a couple of years' time. At present there are nearly eighty stations in Australasia, and this number was reached only in the past twelve months, and there is every chance that it will be increased in the next year or two.

In another case, a superhet. was rejected by an intending purchaser because it was considered "noisy," meaning that it was actually sensitive enough to pick up small electrical disturbances or trace of static. This noisiness is quite essential if long range reception is to be expected, and, sad to say, the better the tonal quality of the set the more susceptible it will be to all forms of extraneous noise. But the intelligent use of the volume control should be sufficient to make the superhet. just as quiet as any ordinary set, and for the reception of local stations or the more powerful interstaters the superhet. should be no different from any ordinary set; in fact, the extreme selectivity of the super should mean that only a small amount of static should be heard.

SEASONAL EFFECTS

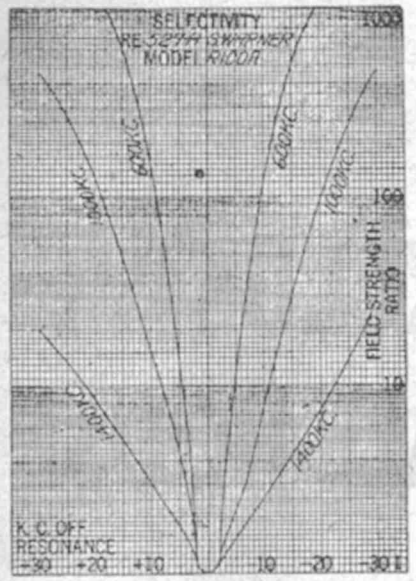
In summer-time static is usually rife and reception of far distant stations is likely to be anything but entertaining. However, in winter-time the static usually clears away for months on end, when a good superhet. will considerably broaden the listener's scope by providing from 30 to 40 stations from which programmes can be selected. Naturally, when so many stations have to be placed on a dial without interference, it is essential for the tuning to require careful adjustment, but this is not a difficult matter; in fact, after a few days' experience it becomes quite normal to handle the dial with ease.

TUNE ON TO THE STATION

It is most necessary to tune the superhet. right on to the station desired, as, if the tuning is a little off the station, and the volume control fully advanced to bring in the station at fair strength, it means that the set will be most sensitive to noise, and distortion will also be introduced through other causes. The volume control should always be set at the minimum position to give sufficient volume, and then the dial should be adjusted to exactly tune to the desired station.

DON'T MEDDLE WITH ADJUSTMENTS

If a ready-made superhet. is purchased it will be properly aligned, and on no account should any of the adjusting screws be altered. The slightest misadjustment will throw the set completely out of action, and to re-adjust it will call for the services of a competent mechanic and extensive measuring equipment. All readers should take this warning seriously, as it may save a lot of worry and perplexity.

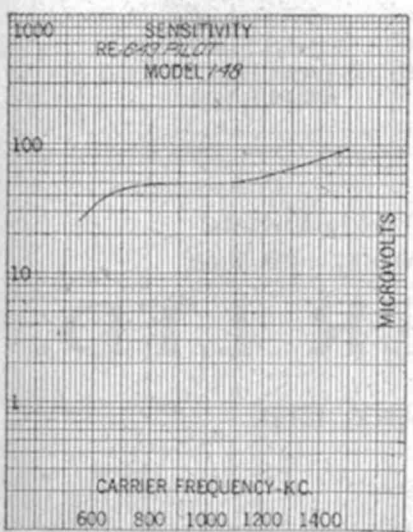


The selectivity curve of a good t.r.f. set.

SUPERHET. *Versus* TUNED R.F.

A Few Pointed Remarks For Those Who Doubt the Advantages of the Superhet.

THE superheterodyne has gained an immense following in the last twelve months, but there are still a few engineers and enthusiasts who appear to regard the superhet with awe. It is to these people that we wish to direct a few pointed remarks. They are really engendered by reason of the fact that we recently decided to give readers a rest from superhets and proceeded to build up a set having three r.f. amplifiers and power detector, resistance coupled to the pentode, following somewhat on the lines of some of the sets at present selling well around town. On completion oscillation trouble was in evidence in no uncertain manner, and although several different types and styles of coils were tried the oscillation trouble was not stopped until all plates, screens, and cathodes were decoupled with 10,000, 50,000, and 400 ohm resistors respectively with half microfarad by-pass condensers. After this was done the oscillation was stopped, but the next trouble was alignment of the tuning gang. For some reason we found that it was almost impossible to get anything like decent tracking, although all coils matched up on an oscillator. However, after much trouble the set was O.K., or as near to it as possible, and we then tested it out up against a five-valve superhet (five valves in all as against the other's six). As regards selectivity the difference in the two sets was amazing, the t.r.f. job would just separate the locals with difficulty, and the only interstate stations which could be heard below 2BL were 4BH (Brisbane) and a couple of others which overlapped, but could be separated by keen concentration on the part of the listener. With the superhet the list of interstate stations which could be heard on the same band were almost innumerable, 20 call signs being clearly logged in a couple of hours' test, each perfectly clear of interference.



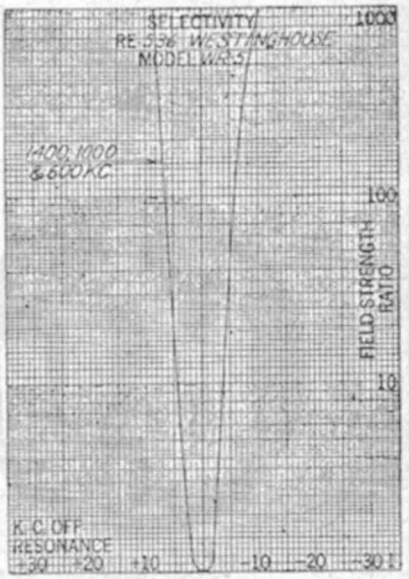
The sensitivity curve of a t.r.f. set.

SENSITIVITY

At its best the t.r.f. set was even more sensitive than the superhet, but unfortunately the sensitivity of the set varied according to the setting of the dial, whereas the superhet appeared to have constant sensitivity irrespective of the wavelength to which it was tuned. Perhaps the feature of the superhet which was so attractive was the fact that there was no tendency to oscillate, only about half the number of components were required, and not the slightest difficulty was experienced in lining up the gang.

TO BUY A SUPERHET.

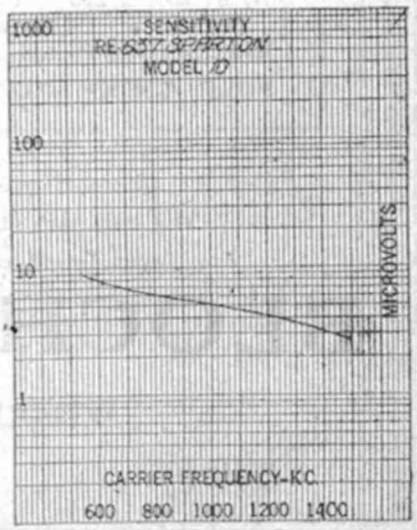
If you intend to buy a factory-built receiver you should watch "Wireless Weekly" carefully. From time to time sets are reviewed, and their performance curves are published. From these it is possible to determine the exact capabilities of the set as recorded on an accurate signal generator equipment. The safe way to buy a set is on performance curves, and these can only be seen in the columns of "Wireless Weekly."



The selectivity curve of a good superheterodyne.

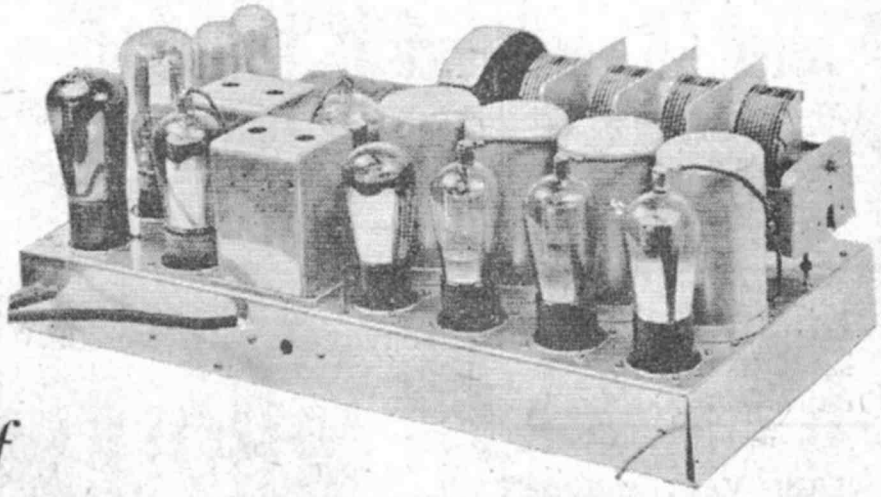
NOT WORTH WHILE

Naturally we immediately decided that it was not worth while wasting space on the t.r.f. set, although we know that some stick-in-the-muds would prefer it. We know how it must hurt some technicians to realise that they are slipping backwards and their knowledge going out of date. But it is no use dodging the fact that the t.r.f. set is fast becoming obsolete, and within the space of a few years the t.r.f. set which lists at more than £30 will be a thing of the past. At present some factories think that superhets are unsuitable for mass production, but surely the fact that the American factories produce five million superhets a year without difficulty is certain proof that they can be turned out in large quantities if handled properly.



The sensitivity curve of a superhet.

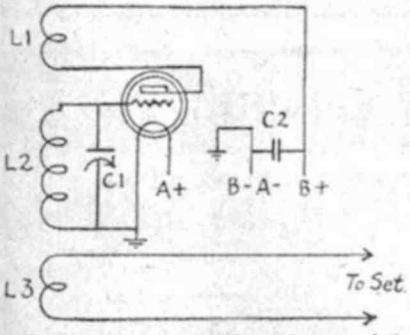
Single dial Superhets are critical receivers to put into operation, and require special knowledge.



The Tracking of SINGLE DIAL SUPERS

THE general theory of why and how a superhet. works is fairly easy to understand, but the manner in which the single dial control is arranged is a little more confusing.

It is quite easy to follow the way in which the incoming signal is "mixed" with a signal from an oscillator to form a heterodyne signal of 175 Kc. for amplification in the intermediate stages,



The circuit of an oscillator for superhet. testing.

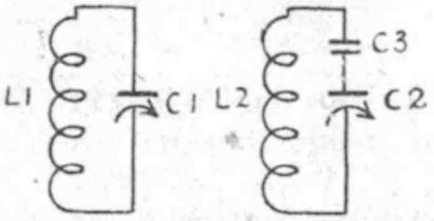
but the trouble is to understand how two sections of a ganged condenser, each of the same capacity, can work together to tune two circuits of different resonant frequency.

THE OSCILLATOR FREQUENCY

We all know that a tuned circuit comprises both capacity and inductance, and since the capacities are the same we have to arrange a method of varying either the capacity inductance, or both, of the oscillator circuit. First of all, let us consider what frequency the oscillator must tune. If the r.f. tuner is set for a station tuned to 1500 Kc, then the oscillator must be tuned to 1675 Kc. If we move the r.f. up to 1000 Kc, then the oscillator must move to 1175 Kc. If the r.f. tunes to 600 Kc, then the oscillator must tune to 775 Kc. Now before going further, we may recall to readers' memory the fact that in a tuned circuit the resonant frequency is a function of its inductance times its capacity, or LC, as it is known. If a circuit has a capacity of .0005 and a coil of 200 microhenries, then the LC is the product of these two values—.1, and the circuit will tune to 600 metres. If we halve the capacity and double the inductance, the frequency still remains the same. However, the LC product varies inversely as to the square of the frequency, so that for double the frequency we require one quarter the LC figure. This explains why a condenser to cover the entire wave band must have a maximum capacity nine times greater than its minimum, for we have to cover from 500 Kc to three times this frequency.

THE PURPOSE OF THE PADDER

Nine times the minimum is the required maximum for the r.f. tuner, but in the case of the oscillator we cover an entirely different band, i.e., from 675 Kc. to, not three times that frequency, but to only 2½ times as much, i.e., 1675 Kc. So for the oscillator tuning condenser the maximum capacity must be only the square of 2½ (6¼) times the minimum. So in order to arrive at such



The resonant circuit of the r.f. stage. The resonant circuit of the oscillator.

an arrangement we add the padding condenser, C3 in diagram 2, which means less capacity at the minimum setting and also less at the maximum setting, but since the padding capacity remains constant, the decrease is not in direct proportion to the setting of the dial, and so we find that the maximum capacity is 6¼ times the minimum as desired. However, we also have to consider that the oscillator resonant circuit is called upon to tune over a different wave band entirely, and we need an inductance which will fix up this difficulty. In actual practice it has been found advisable to have an inductance for the oscillator tuner or about 80 per cent. of that used for the r.f. tuners.

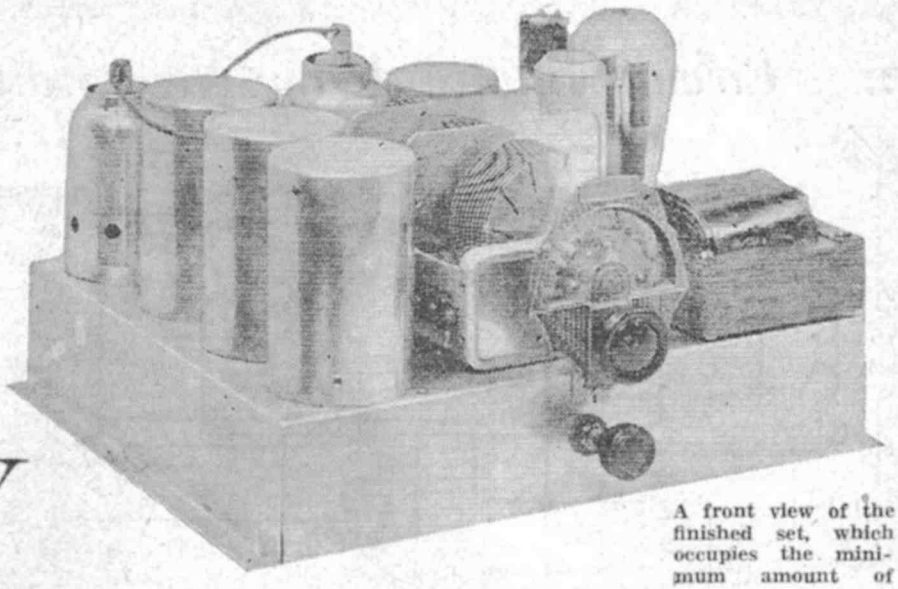
ALIGNMENT

Although it is fairly easy to get proper alignment of the supers by working on faint signals or on static alone, it is very much better to work with an oscillator which gives a constant output. A suitable circuit is shown. The grid coil of the oscillator and the tuning condenser for that circuit follow normal broadcast practice. However, the pick-up coil consists of just a turn or two wrapped around the secondary. The condenser across the B supply is a 1 mfd. fixed condenser, or something about that capacity.

HOW TO USE THE OSCILLATOR

We take it for granted that the super has been built from a reliable coil kit, and that the intermediates are aligned to 175 Kc. Now turn the set to a station down below 2SM, for preference, and get the trimmers aligned roughly. By juggling with the oscillator section it should be possible to get the r.f. sections lined up with the trimmers about the middle of their movement. Now turn back to above 2FC and get on to another station. Then place a short piece of wire across from the fixed plates to the moving plates of the oscillator tuning gang. This will stop all reception, and the outside oscillator is fitted with the pick-up coil connected between the cap of the first detector and earth. Then rotate the dial of the special oscillator until the station is again heard. At the same time rocking the normal dial to make sure that the station is correctly tuned by the r.f. end of the set. Having the station tuned in to perfection, then stop the outside oscillator, and taking great care not to disturb the dial setting, remove the outside oscillator and the wire which is shorting the set oscillator. Now, still paying great attention to the matter of keeping the dial as set previously, proceed to adjust the padding condenser until the station comes in at full volume. The trimmers of the r.f. and oscillator sections should not need touching during this process. And when swung back to a low wavelength they should not need more than a fraction of a turn either way.

One of the new 3-valve Superheterodynes using the latest 6-prong valves—extremely selective—simple and inexpensive to build — and ideal for difficult locations. But read the article.



A front view of the finished set, which occupies the minimum amount of space.

The BABY *SUPERHETERODYNE*

So much has already been written about superhets that many readers may wonder that there is anything left to say or anything new to talk about. But here is something very different from the rest of the superhets—a baby superhet with some very interesting features. Only four valves are used in all, yet quite a number of interstate stations can be logged with it at fair strength. The outstanding feature of the job is the use of the 247 type pentode as a combined second detector and output valve. This scheme means that the speaker is connected directly into the plate circuit of the detector and no audio amplification takes place in the ordinary way. The result is that there is no hum trouble whatever, and if built as described this set should not have the slightest trace of hum.

For the same reason the fidelity of the receiver is excellent, as there is no chance of frequency displacement in any coupling condensers, audio transformers, or anything like that. The chief point is to obtain a decent matching of impedances with a special type of loud-speaker having an input transformer with an impedance of 55,000 ohms. But even with the ordinary type of speaker quite fine results can be obtained.

MAXIMUM UNDISTORTED OUTPUT

The only feature which may not meet with the entire approval of all types of listeners is in the matter of maximum undistorted output. This is limited to about 1½ watts of power. This is about equal to that obtainable from a 245 type power valve, but not as much as can be obtained form a 247 type pentode in the usual type of circuit. If you want fine reproduction with excellent selectivity, then this is the set, but if you want an amplifier to supply music for dancing and so on, then this is not the job. By the bye, we might mention that the set is entirely unsuitable for use as a gramophone amplifier for electric pick-up work.

SELECTIVITY—MAXIMUM PLUS

Speaking of performance, the outstanding feature is the selectivity. There are seven tuned circuits in all, and the actual selectivity falls only slightly below that of the most expensive nine-valve superhets. Local stations occupy only a degree or so on the dial, even if very close to the set. There must be dozens of listeners who live in the "difficult" areas, such as Mosman, Cremorne, Pennant Hills, Ryde, Parramatta, Coogee, Maroubra, and so on, to whom this job will have a particular appeal.

THE PARTS

The aluminium base should be of fairly heavy gauge aluminium or steel. Any flexing of the base is going to make the alignment of the trimmers a very difficult matter. With the gang in correct alignment, just a slight twist of the framework will mean that the station tuned will vanish into oblivion. So the first desirable feature is a heavy gauge base. The size of the base given is the smallest possible size that can be used with ease. Even so, it is not large enough for the "Universal" power transformer. So if a "Universal" power transformer is to be used, then the base will need to be a couple of inches wider and deeper.

THE COIL KIT

The coil kit used in the original set was a Lekmek kit, which is sold as a unit containing the three solenoid coils, their cans, the two intermediates (canned), a three-gang tuning condenser, a padding condenser, and its shunt condenser.

THE POWER TRANSFORMER

The power transformer shown in the photographs is rated at 385 volts at 75 m.a., with filament windings of 2½ volts 3 amps., 2½ volts 1½ amps., and 5 volts 2 amps. Should it be desired to use the "Universal" power transformer, which is suitable for use with the majority of our sets, then the 350/350 100 m.a. terminals will be used, and the resultant rectified d.c. supply will be just about right.

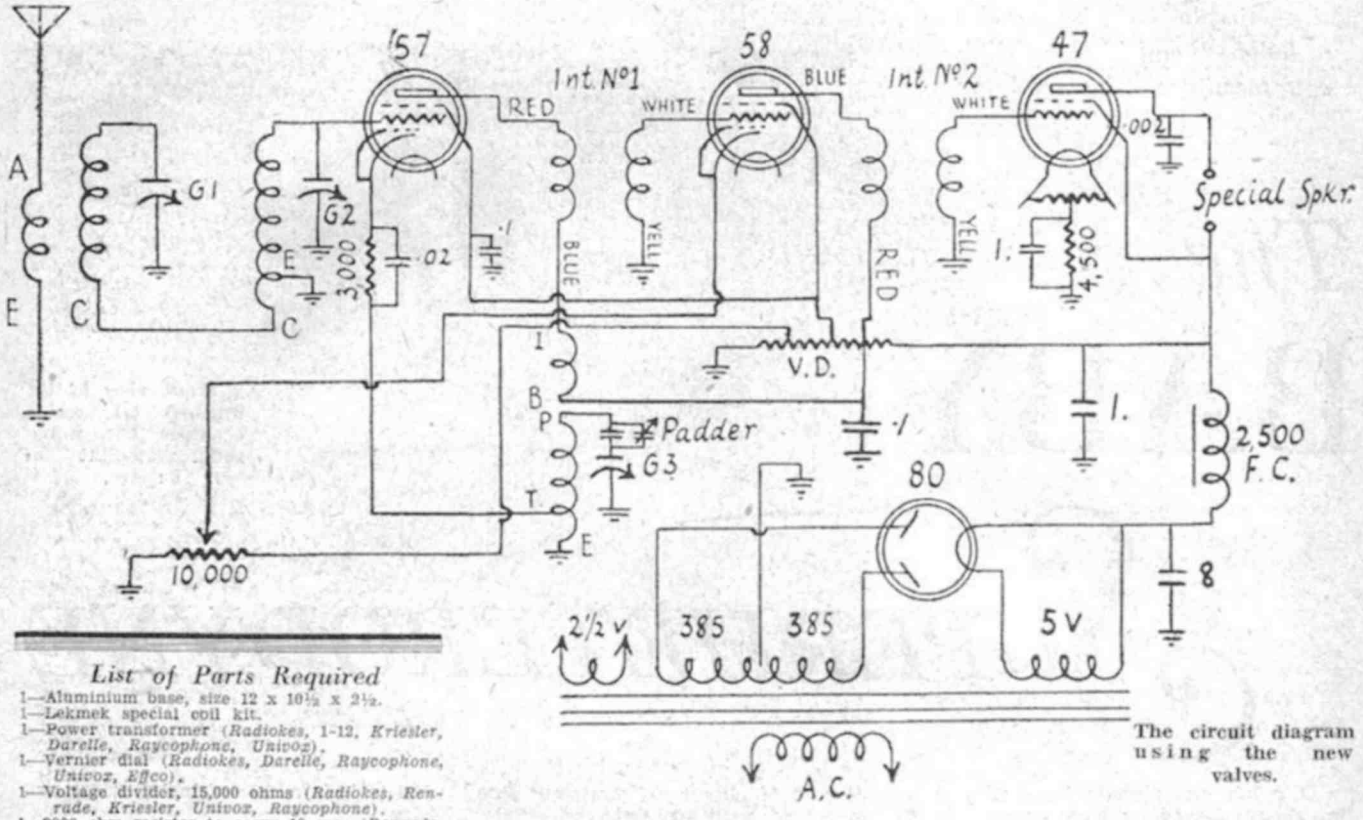
THE VOLTAGE DIVIDER

A voltage divider to draw a fairly heavy bleed current is very helpful in a circuit such as this one, where the total drain of the set is only about 10 m.a., apart from the bleed current in the divider. On this account we suggest a 15,000 ohm voltage divider, or one of even lower resistance. A voltage divider with adjustable clips is also helpful in order to get all voltages arranged as required.

THE RESISTORS

The 3000 ohm resistor is fairly critical, and a good wire-wound job is recommended. However, little current is carried, and on this account a good quality grid-leak will serve. Similarly, the 4500

:: Circuit Shows How New Valves Are Used ::



The circuit diagram using the new valves.

List of Parts Required

1—Aluminium base, size 12 x 10½ x 2½.
1—Lekmek special coil kit.
1—Power transformer (*Radiokes, 1-12, Kriesler, Darelle, Raycophone, Univox*).
1—Vernier dial (*Radiokes, Darelle, Raycophone, Univox, Effco*).
1—Voltage divider, 15,000 ohms (*Radiokes, Renrade, Kriesler, Univox, Raycophone*).
1—3000 ohm resistor to carry 10 ma. (*Renrade, Radiokes, I.R.C., Alpha, Kriesler, Raycophone*).
1—4500 ohm resistor to carry 10 m.a. (*Renrade, Radiokes, I.R.C., Alpha, Kriesler, Raycophone*).
2—1 mfd. fixed condensers (*Wetless, Polymet, Hydra, Chanex, T.C.C.*).
2—.1 mfd. fixed condensers. (*Wetless, Polymet, Hydra, Chanex, T.C.C.*).
1—8 mfd. electrolytic condenser (*Dulytic, Polymet, Sprague, T.C.C.*).
1—.02 mfd. fixed condenser (*Renrade, Wetless, Pilot, T.C.C., Alpha*).
1—.002 fixed condenser (*Renrade, Wetless, Pilot, T.C.C., Alpha*).
1—10,000 ohm potentiometer (*Radiokes, Univox, Pilot, Chancery, Raycophone*).
Valve sockets—2 6-pin, 1 5-pin, 2 4-pin (*Renrade, Raycophone*).
Necessary screws, wire, solder, terminals, &c.
Valves—1—57, 1—58, 1—47, 1—80 (*Mullard, Cossor, Radiotron, Ken-Rad, National, Union, Philips, &c.*).
Speaker—Special 55,000 ohm impedance, with 2500 ohm field (*Jensen, Amplion, Saxon, Jubilee*).

ohm resistor carries only about 6 to 10 m.a., and so grid-leak will serve the purpose. However, grid-leaks of this particular resistance are scarce. Fortunately, anything from 4500 to 6500 ohms will serve, and if the worst comes to the worst two 10,000 ohm grid-leaks can be fitted in parallel to give the desired result.

CONDENSERS

The two .1 condensers specified can be replaced with condensers of .5 or 1 mfd. if on hand. The 1 mfd. specified can also be replaced with 2 or 4 mfd. types if more convenient.

THE BY-PASS CONDENSER

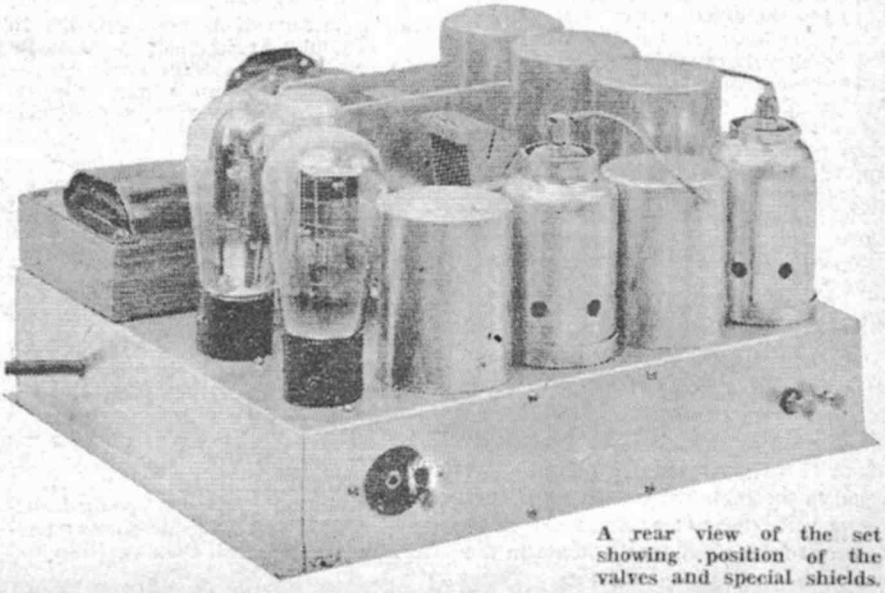
From the plate of the pentode to earth we have a by-pass condenser, and the choice of its capacity determines the final tone of the set. With a .002 as specified the tone remains brilliant and contains plenty of high notes. Many listeners do not like crisp reproduction, preferring a deeper or thicker tone. The impression of a better low note response is obtained if the high notes are eliminated by means of a larger by-pass condenser. If .01 mfd. is used the tone will be somewhat similar to that of many popular sets sold round town. A happy medium would be .004 or .006 mfds.

VOLUME CONTROL

The 10,000 ohm potentiometer specified for the volume control can be replaced with a 5000 ohm one without in any way affecting results.

THE VALVES

In the valve equipment it will be noticed that the new six-pin valves have been used for the first detector and intermediate sockets. These are recommended, but are not essential. Anyone desiring to use the 224 and 235 in these positions need only neglect the suppressor grid shown on the circuit diagram and use five-pin sockets. The resistance values remain the same, and there is not the extreme difference in performance that one might imagine from studying the amplification factors of the different valves.



A rear view of the set showing position of the valves and special shields.

Wiring Is Extremely Simple Task

THE SPEAKER

As mentioned elsewhere, it is very important to have the special high-impedance speaker if the very best tonal quality is desired. The set will operate quite well with an ordinary speaker, but the reproduction is inclined to be harsh, due to the presence of distortion caused by the fact that the impedances are not matched.

LAYOUT

The layout shown in the original set is strongly recommended, and it is very necessary for the leads to and from the padder to be as short as possible. Otherwise there is no reason why the layout could not be modified a little, but the general sequence of the coils will be found fairly difficult to change without introducing long leads.

WIRING

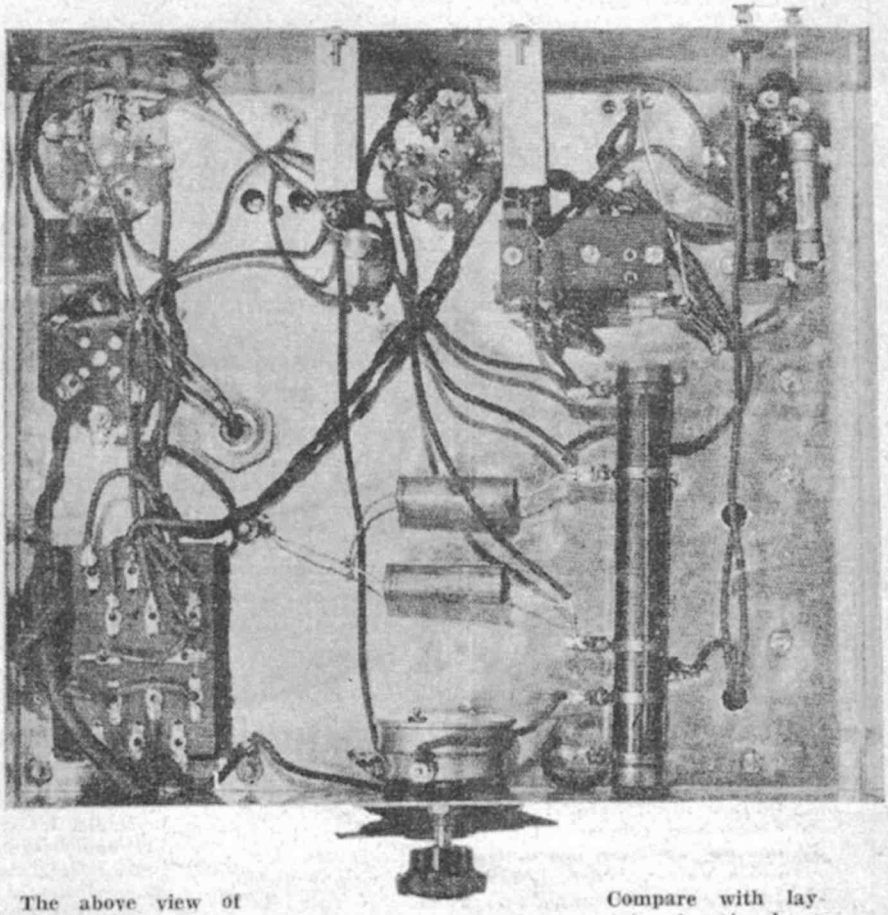
The wiring is very simple and straightforward. We give a picture diagram of the wiring, which shows the main leads, but for the sake of clearness all the filament wiring has been omitted. This wiring is carried out with twisted flex, and should present no difficulty.

"JOEYS"

A peculiar form of "joey" (whistle and squeak) can occur in a superhet if there is any exposed wiring attached to the oscillator tuning circuit. This is due to various high frequency signals getting into the oscillator circuit, beating with it and being amplified in the usual way. To stop this trouble it may be necessary to fit copper braid as a shielding over the leads to and from the padding condenser and from the grid of the combined detector and oscillator.

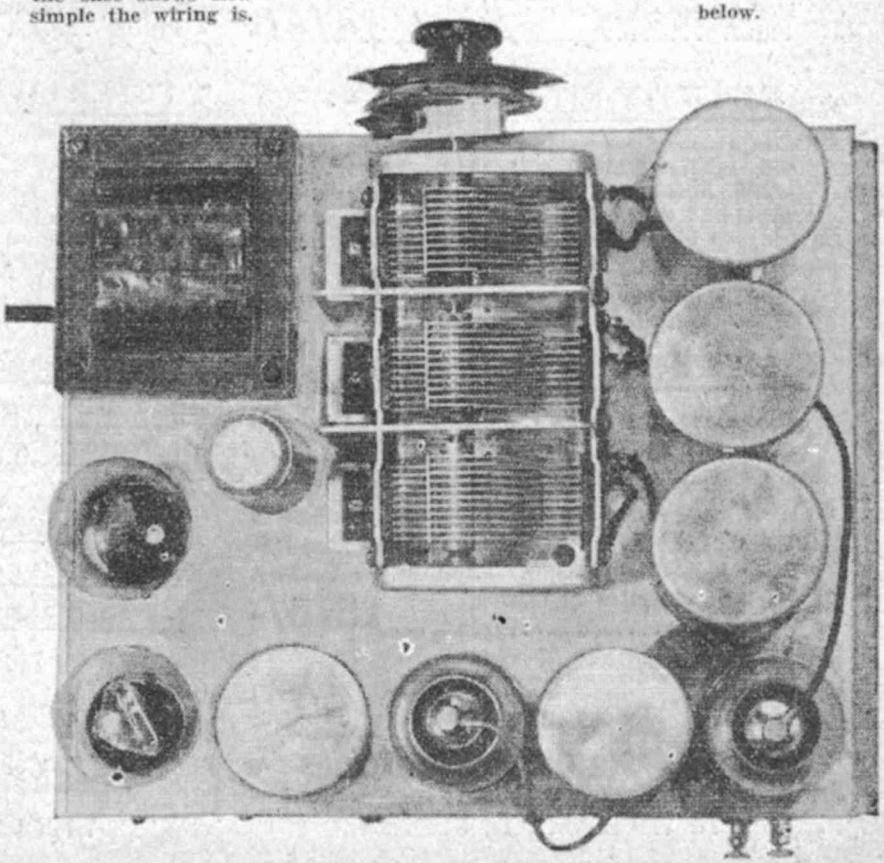
SETTING THE VOLTAGE DIVIDER CLIPS

In order to set the voltage divider clips a voltmeter is desirable, so that the correct voltages, i.e., 250 for the plate, 100 for the screen, and 30 for the volume control, can be obtained with the set in actual operation. Those who do not have access to a voltmeter can get the voltages roughly by setting the plate clip about one inch from the high potential end of the average voltage divider. The screen tapping will be about two-thirds of the way down to the low potential end, with the volume control clip about an inch from this end. A fair idea of the settings necessary in the original receiver can be obtained from the photographic view of the under-panel wiring.



The above view of the base shows how simple the wiring is.

Compare with layout of set shown below.



UNIVERSAL KIT 53-B (SUPERHET)

Comprising: 2 Shielded Coils (Aerial and Oscillator), 2 Inter. Freq. Transformers, 1 Padder Condenser and Trimmer, 1 2-Gang Condenser, 1 Coil of Hook-up Wire, Instructions and Diagrams. Utilises 4 Valves, 2/236, 1/239, 1/238. For operation from 6-Volt Accumulator, or from 6-Volt A.C. Transformer. Recommended for Motor Car Set or Home Battery use.

PRICE £4/4/-

SIMPLICITY KIT 52-E (SUPERHET)

Comprising: Same as 53-B but for A.C. operation, and utilises 5 Valves, 2/224A, 1/235, 1/247, 1/280. Represents the most simple Super to construct and very efficient, but not recommended for use near Broadcasting Stations owing to double spot tuning.

PRICE £4/4/-

SUPER-SIX KIT 60 (SUPERHET)

Comprising: 3 Shielded Coils (R.F. Aerial and Oscillator), 2 I.F. Transformers, 1 Padder Condenser and Trimmer, 1 3-gang Condenser, Coil of Hook-up Wire, Instructions and Diagram. Utilises 6 Valves, 2/224A, 2/235, 1/247, 1/280. Uses R.F. Stage instead of Selector. Excellent for Country. Daylight reception certain.

PRICE £5/5/-

SUPER-FOUR KIT 42-E (Superhet)

Comprising: 1 Aerial Coil in Shield, 1 Selector Coil in Shield, 1 Oscillator Coil in Shield, 2 Intermediate Frequency Transformers, 1 3-Gang Condenser, 1 Padder Condenser and Trimmer, 1 Coil of Hook-up Wire, 1 Set of Instructions. Utilises Four Valves, 1 type 57, 1 type 58, 1 type 47 and 1 type 280, as used in the Baby Super Het

PRICE £5/5/-

SUPER-FIVE KIT 51 (SUPERHET)

Comprising: 3 Shielded Coils (Aerial, Selector and Oscillator), 2 I.F. Transformers, 1 Padder Condenser and Trimmer, 1 3-gang Condenser, Instructions and Diagrams. Utilises 5 Valves, 2/224A, 1/235, 1/247, 1/280. Equipped with Selector Circuit. Excellent for Metropolitan work — good Interstate. Low Noise Level.

PRICE £5/5/-

POWER TRANSFORMER 51-TS. PRICE £1/10/-

POWER FILTER CHOKES. PRICE 8/6

INTERMEDIATE FREQUENCY TRANSFORMER PRICE 12/6

AUDIO TRANSFORMER (B.C.I.). PRICE £2/2/-

AUDIO CHOKE 53-B. PRICE 15/-

SHIELDED TUNING COILS. PRICE 4/6

PRODUCT OF

Lekmek Radio Laboratories

(N. S. GILMOUR)

75 WILLIAM ST., SYDNEY

SALES AGENTS

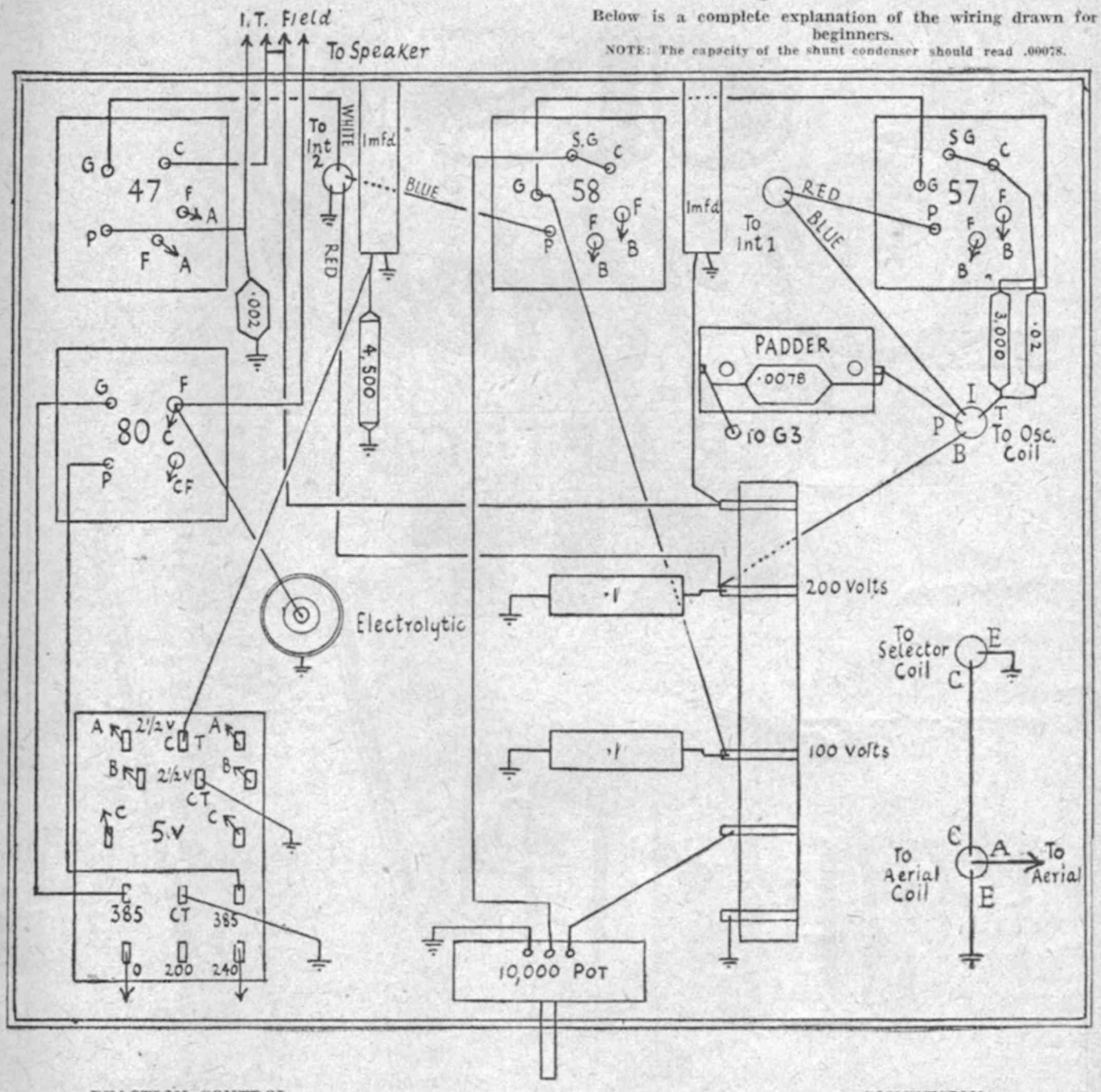
Speakers (A/sia) Limited

70 CLARENCE ST., SYDNEY

:: Beginners Will Find This Diagram Useful ::

Below is a complete explanation of the wiring drawn for beginners.

NOTE: The capacity of the shunt condenser should read .00078.



REACTION CONTROL

It should be noticed that, as described, the set is intended for operation by an intelligent person. The volume control is so arranged that when fully advanced the set will burst into oscillation. Just before the point of oscillation the set is extremely sensitive, and, what is more to the point, by this method it is possible to get practically constant sensitivity at all settings of the dial. Should it be desired to install the set permanently for use by all members of the family, and so on, a limiting bias resistor will be needed for the intermediate valve. A 400 ohm resistor, by-passed with a .5 or .1 mfd. fixed condenser, will be necessary between the cathode of the 58 and the moving arm of the potentiometer.

INTERSTATE RECEPTION

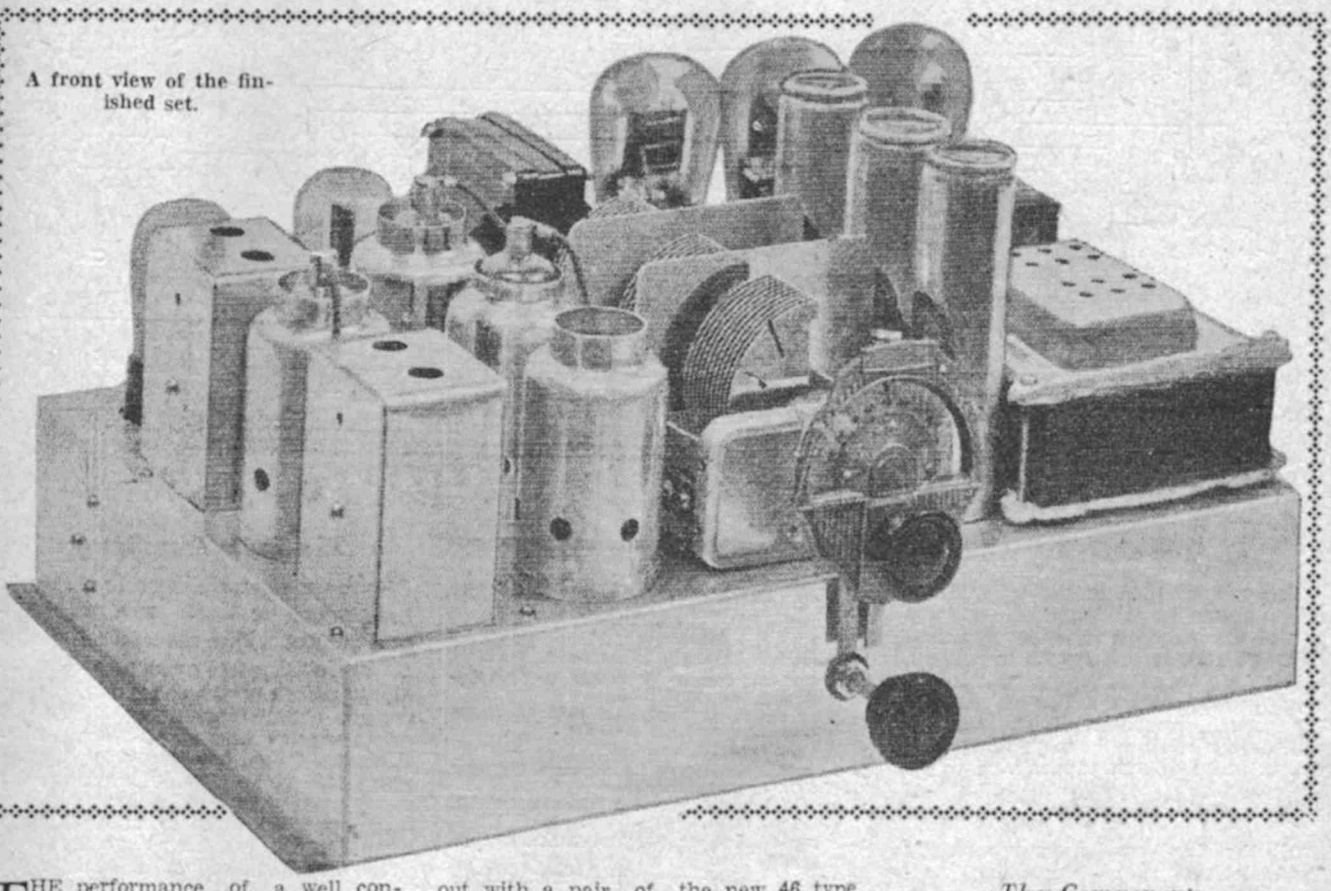
To make the most of the set for interstate reception it is very advantageous to have a large aerial, fairly high, and well clear of buildings, etc. An effective earth is also desirable. On account of the remarkable selectivity of the job it is possible to use a very large aerial without getting any interference trouble. In some cases it will be found that the set will operate better without an aerial, but with the earth wire on the aerial terminal.

CONCLUSION

In finishing off this article on the subject of a four-valve superhet we want to point out very clearly that a four-valve superhet only contains three valves and a rectifier, and must be considered as such. Notwithstanding the glamor which surrounds the name of superhet., actually there are superhets. and superhets., and we do not claim that this job will out-perform the big supers of seven, eight, nine, or a dozen valves. We do know that it can give greater range and infinitely greater selectivity than the average three-four receiver of the t.r.f. type, and we do know that it is cheap to build and easy to get into operation, but we leave it at that.

The 9-58 SUPER.

A 9 Valve Superheterodyne for 58 Type Valves



A front view of the finished set.

THE performance of a well constructed and adjusted superhet. of the normal seven-valve type can hardly be improved upon. It is usually quite impossible to use greater sensitivity than about 5 m/v. Even if there is no particular static or thunderstorm about, there is enough noise in the atmosphere to make it impossible to use a greater sensitivity than 4 or 5 microvolts except for perhaps two or three nights in the year. Similarly in the matter of selectivity, it is not desirable nor reasonable to have a greater selectivity than that readily obtainable with a more or less ordinary superhet. Therefore why should we describe a nine valve superhet.? The answer is quite an easy one—"Simply to get greater volume and better fidelity when receiving both interstate and local stations." The single pentode is O.K. in its way, but there comes a time in the life of nearly every radio enthusiast when he longs for greater volume, better bass note response, and a general improvement in fidelity. One of the most reliable methods for attaining these improvements is to use a push-pull audio system. Well, here is a superhet with all the charms of the ordinary superhets, but with the addition of a powerful push-pull stage. The new types of valves are used throughout with a pair of the new 46 type valves as Class A amplifiers in push-pull.

The Circuit

The r.f. and intermediate circuits are arranged after the style of about 90 per cent. of the popular commercial receivers, but when we come to the second detector we start the differences. First of all a 56 type triode is used instead of the more popular screen grid. The detector is then resistance coupled into another 56 used as an audio amplifier. This in turn feeds the primary of a high grade input push-pull transformer driving the pair of 46 valves. The 46 is used with the screen tied to the plate at the socket, and in this condition works after the style of the usual 45 type valve except that less plate current is drawn, yet the undistorted output is maintained.

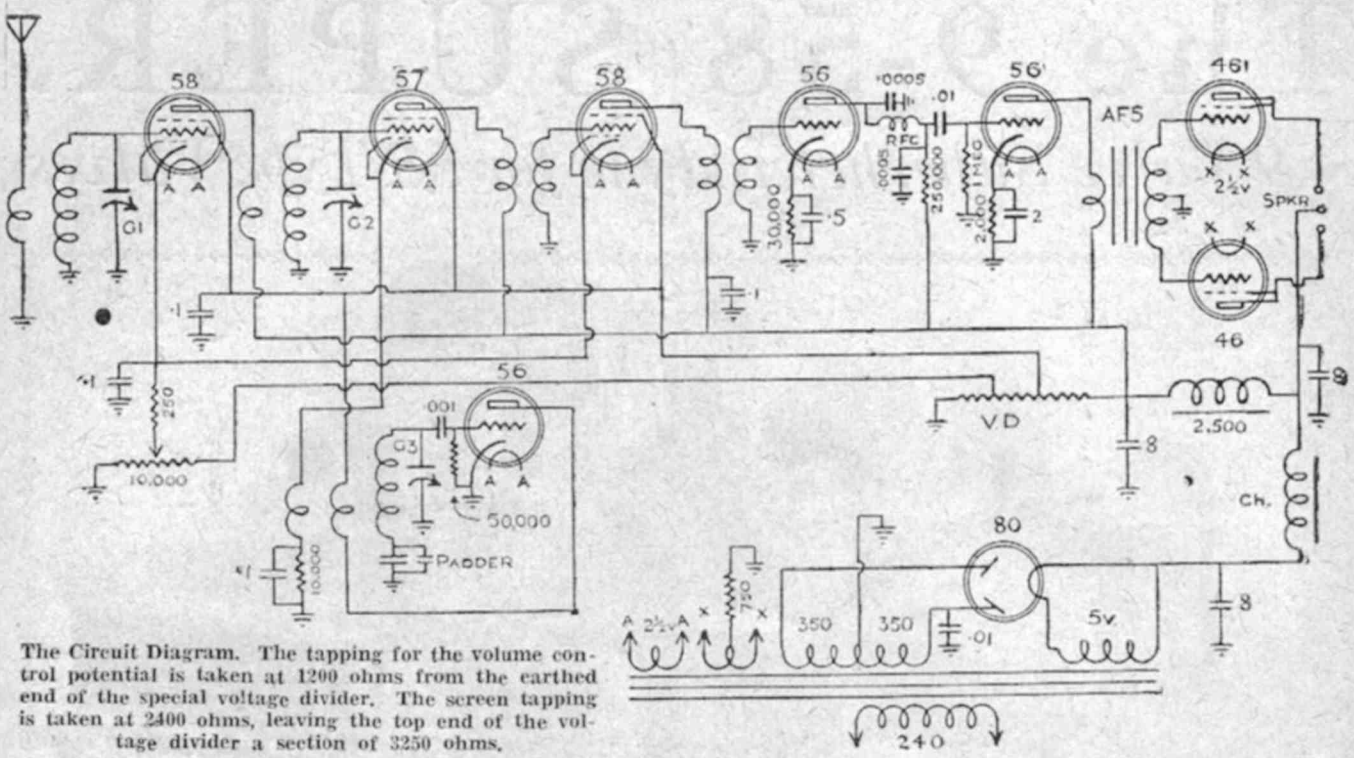
The advantages of cutting down the total current drain are considerable, as unless we are careful we will find that the total wattage of the power transformer will get up to about 100 watts, making it an expensive and cumbersome job. However, as described the total drain is not excessive, and the ordinary power transformer or the "Universal" will suit the purpose down to the ground.

The Components

Glancing through the parts list there are a few items which may be more fully detailed. The base is large, but even so, considerable juggling may be necessary to get all the parts stowed away without crowding. The depth of the base must be at least 3in.

The Power Transformer

The Universal power transformer is ideal for this set, and the full 400 volts can be used for the high tension. There is no objection to loading up the push-pull valves with about 400 volts. Another transformer entirely suitable is a type readily available with a high tension rating of 350/350 volts at 110 milliamps. At the slightly lower drain taken by this set the actually d.c. voltage after rectification, and filtration will be somewhere between 300 and 400 volts and O.K. for the purpose. The choke, of course, has merely to handle the total high tension current, and so a 100 ma. rating is O.K.



The Circuit Diagram. The tapping for the volume control potential is taken at 1200 ohms from the earthed end of the special voltage divider. The screen tapping is taken at 2400 ohms, leaving the top end of the voltage divider a section of 3250 ohms.

New Nine-Valve 58 Series Superhet.

1—Aluminium base, size 18 x 12 x 3.

1—Power transformer (*Radiokes* (1-12), *Univox, Raycophone, Kriesler*).

1—Filter choke, 30 henry, 100 m.a. (*Radiokes, Univox, Raycophone, Kriesler*).

1—Kriesler superhet. coil kit.

3—8 mfd. electrolytic condensers (*Sprague, T.C.C., Polymet, Dulytic*).

1—2 mfd. fixed condenser (*Wetless, T.C.C., Chanex, Hydra*).

1—.5 Fixed condenser (*Wetless, T.C.C., Chanex, Hydra*).

4—.1 Fixed condensers (*Wetless, T.C.C., Chanex, Hydra*).

2—.01 Fixed condensers (*Renrade, Wetless, T.C.C., Polymet, Pilot, Alpha*).

1—.001 Fixed condenser (*Renrade, Wetless, T.C.C., Polymet, Pilot, Alpha*).

2—.0005 Fixed condensers (*Renrade, Wetless, T.C.C., Polymet, Pilot, Alpha*).

1—"1930 Four" special tapped resistor (*Radiokes, Renrade*).

1—250 ohm wire-wound resistor (*Renrade, Radiokes, Raycophone, Alpha, Kriesler*).

1—750 ohm wire-wound resistor (75ma) (*Renrade, Radiokes, Raycophone, Alpha*).

1—2000 ohm wire-wound resistor (*Renrade, Radiokes, Raycophone, Alpha, Kriesler*).

1—10,000 ohm Potentiometer (*Chancery, Raycophone, Univox, Kriesler, Radiokes.*)

1—10,000 ohm grid leak (*Renrade I.R.C., Alpha, Pilot, Radiohm, International*).

1—30,000 ohm grid leak (*Renrade, I.R.C., Alpha, Pilot, International, Radiohm*).

1—50,000 ohm grid leak (*Renrade, I.R.C., Alpha, Pilot, Radiohm, International*).

1—250,000 ohm grid leak (*Renrade, I.R.C., Alpha, Pilot, International*).

1—1-meg. grid leak (*Renrade, I.R.C., Alpha, Pilot, International*).

1—Radio frequency choke (*Raycophone, Radiokes, Kriesler, Alpha*).

1—Push-pull input transformer (AF5C) (*Ferranti, Pilot, Ideal, Radiokes*).

Sockets—3 6-pin; 5 5-pin, 2 4-pin (*Raycophone, Renrade*).

Valves—3—58
3—56 (*Philips, Radiotron, Ken-Rad,*
2—46 (*National Union, Mullard, Cossor, etc.*).
1—80

Speaker—DC dynamic, with 2500 ohm field and push-pull input transformer (*Jensen, Amplion, Saxon, Jubilee*).

The Coil Kit

The coil kit used in the original receiver shown in the photographs was one of the standard Kriesler superhet. kits. This kit is well known to readers, and holds a very fine reputation with all types of set builders. The kit includes the ganged condenser, all the cans as well as the coils, and the padding condenser and its shunt capacity.

Condensers

All the fixed condensers are readily available, and there is nothing particularly critical about their capacities, although it is always safer to follow out our recommendations in this matter if it causes no inconvenience. Those who prefer deep reproduction (mellow) may prefer to replace the .0005 by-pass condenser in the plate circuit of the second detector with one of a larger capacity such as .001 or even .002, but this should not be necessary if the audio transformer used is a high-grade job.

The Resistors

The wire-wound resistors all need to be capable of carrying the current that will pass through them. The special resistor is one having tappings at 600, 600, 1200, and 3250 ohms. These were turned out for the "1930 Four" in the good old days, and are quite plentiful. The two 600 ohm sections have a gap between them which will have to be shorted out with a piece of wire to preserve the continuity of the resistance. The 750 ohm resistor has to carry the plate currents of both of the output valves, and so should be rated to carry 75 or 100 ma.

The rest of the resistors, and particularly the grid-leaks, are not very critical, and, apart from recommending the best that can be purchased, there is little else to be said about them.

The Audio Transformer

However, when we come to the audio transformer we touch on a very delicate subject. The whole tonal quality of the job depends more upon the audio transformer than any other component. Transformers are listed at prices varying from about 7/6 to £4/4/-. It sounds tough, but even so we recommend the £4/4/- line. Of course, in many cases such a price is right out of reach, and we want to make it quite clear that the job can and will operate in a fine manner, even with a 7/6 transformer.

The Loud Speaker

The loud-speaker needs to be of the d.c. dynamic type with a field coil having a resistance of 2500 ohms. However, the most important point is that its impedance for the input transformer must be low and its transformer centre-tapped. The speakers with input transformers intended for push-pull 245 type valves will serve the purpose nicely.

Layout

The coils are mounted on a bracket under the base, directly under the gang. In this position we get nice short leads for the grids of the valves, and also neat and compact layout. The leads to the plates are also short, giving us many advantages for this system of layout.

The Wiring

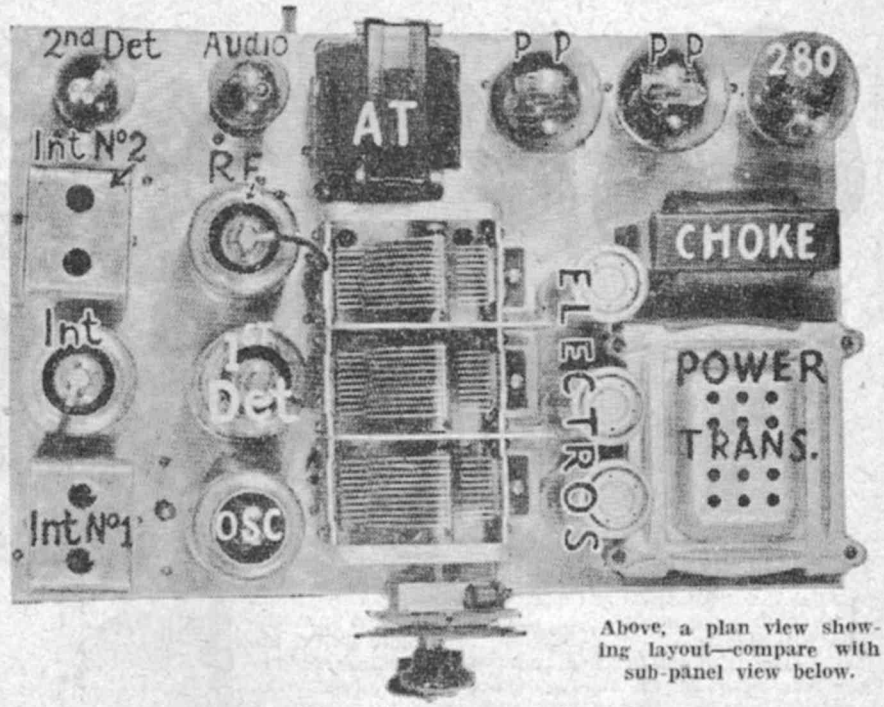
The wiring will be carried out in the normal way, and there is nothing troublesome about this. A shield of braided copper over the aerial lead into the primary of the aerial coil might be handy in case of oscillation troubles, but this is very unlikely to occur.

Adjustment

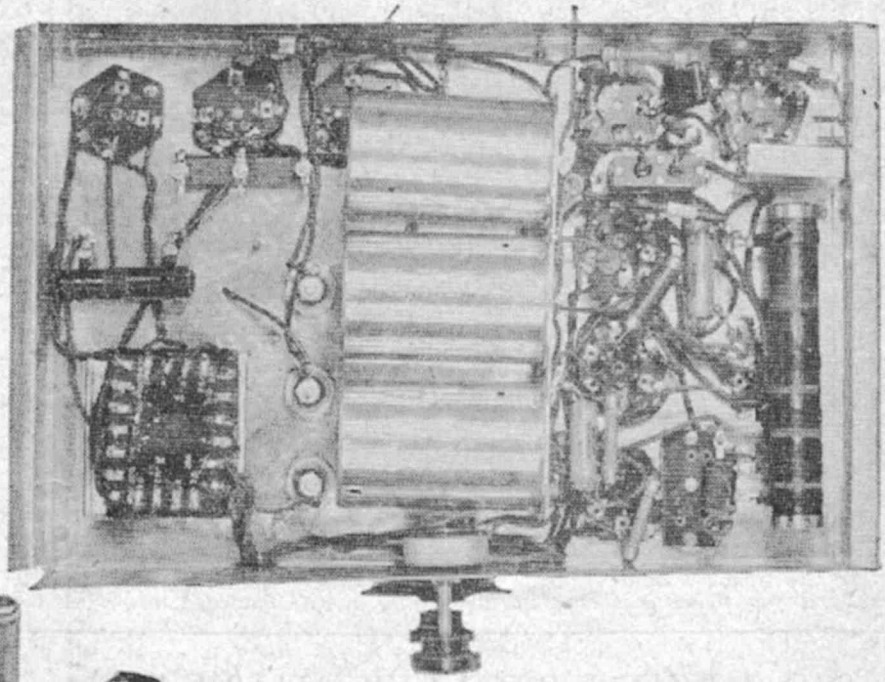
The adjustment of the coils is carried out in exactly the same way as for any other superhet. First of all, the trimmers are roughly adjusted on a powerful local station, and the padder is adjusted to about two-thirds of the way in. Then swinging to a station below 2UW the aerial and r.f. trimmers are adjusted whilst the dial is kept rocking. When best results are obtained the dial is swung over to a station above 2FC and the process repeated. However, this time it is the oscillator and padder that are adjusted, the aerial and r.f. trimmers being left as set. During the process the dial must be gently rocked, to and fro, and, of course, the correct setting is the one that gives the greatest volume.

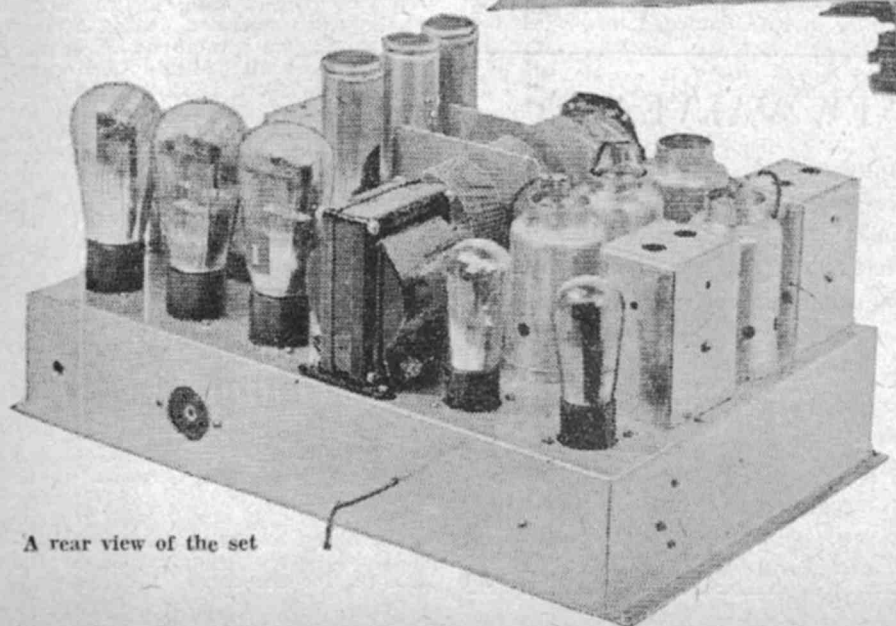
Troubles and Worries

Troubles with the job should be very few and far between. The Kriesler kit is exactly the same as used in the Kriesler production jobs, and so it should always be reliable. In the Kriesler factory they can run through anything up to 50 superhets a day without ever having a hold-up on any particular set, so it seems only natural that the home builder should be able to get them to go easily. However, in any case of trouble a special service has been arranged by the Kriesler Company. Anyone wanting any help can ring the special 'phone MA3377, and free advice will be given. The coils are all covered by a guarantee, and to ensure satisfaction by all builders the Kriesler people are also pleased to look over the sets after completion and carry out any final adjustment or alignments necessary. Doubtless this remarkable manner in which the coils are guaranteed and serviced is responsible for the popularity they enjoy.



Above, a plan view showing layout—compare with sub-panel view below.



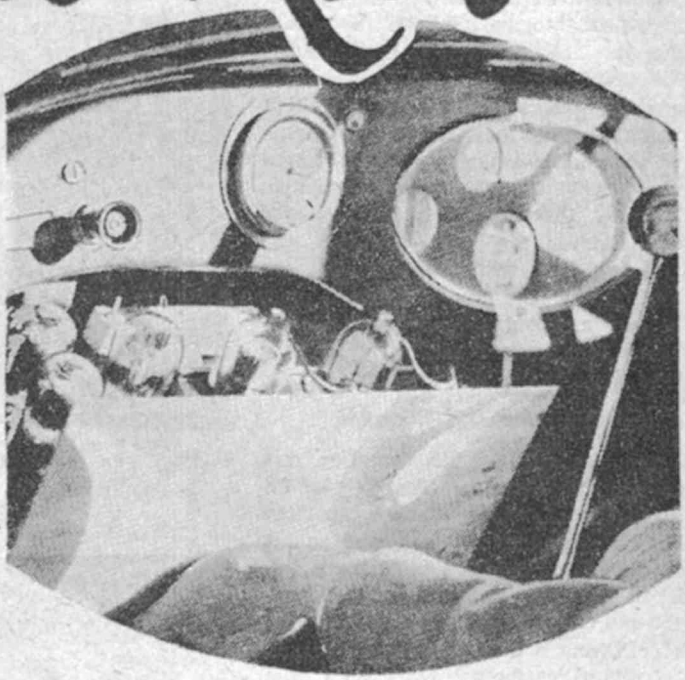


A rear view of the set

THE ALPHA SUPERHET KIT.

SINCE the sets described in this book were designed the Eclipse Radio Co., of Clarence Street, have introduced a new coil kit, under the name of "Alpha." This coil kit is designed for use in superhet circuits having a pre-selector stage ahead of the first r.f. valve. With slight modifications to the circuit it can be used in the following supers: "The 9-58," "1932 Series," "Outspering," and the "Battery 8." The coil kit is supplied as a unit, and contains the four solenoid coils (aerial, selector, r.f., and oscillator), two intermediate transformers, a four-gang condenser, all the necessary cans, the padding unit, shunt capacity, and so on. The "Alpha" coil kit is available from all radio dealers at £4/17/6.

Automobile Radio



What about a set for your car? Here are a few points to watch in the installation of radio receivers in automobiles. Special valves which do not pass interfering noises from the ignition system, and other devices for successful operation.

THE Universal superhet. is an ideal set for the purpose, as this article explains:—

The installation of a radio set in a car appeals to many. Unfortunately, however, there are several snags in the proposal. The idea is not new by any means—as a matter of fact, it is about three years since "Wireless Weekly" described a set for the car. That particular job was quite ahead of its time in many respects, notably the use of indirectly heated valves; but had for a "snag" a rather heavy filament current drain. No owner of a car likes to overload his battery, for most are acquainted with that hopeless and helpless feeling which confronts them when the battery refuses to budge the starter on a cold and frosty morning.

IN THE PAST

In the past few years many car sets have appeared only to vanish again. In most cases it was found that the interference noises from the ignition system came through and spoilt the reception. Suppressors fitted to the sparking plugs, shielding of the whole ignition system with sheets of copper, and many other efforts, proved fruitless in eliminating the trouble. However, quite recently it was found that most of the noise was being carried into the radio set via the car battery and the filaments of the valves. A ready cure for this trouble was to have the valves of the indirectly heated type, and so special valves for the purpose were produced by the leading American manufacturers some time ago. These valves are now readily available in Australia, and of course they help very considerably in the suppression of interference noises, but also have other special advantages.

FLUCTUATING VOLTAGES

For a start, the filament of the valve in a car set has to withstand two disruptive forces, the first being the fluctuating voltages applied. The car battery does not give a constant voltage, varying from about 4 or 5 volts when flat, up to 7 or 8 volts when being charged or overcharged. The ordinary valves designed to operate from accumulators in the home are rather susceptible to suffer in both gain and tone when the applied voltage varies, and the filament does not withstand such treatment for long without giving trouble. Many an enthusiast has built up a car set only to find that the valves expire every couple of months or less. Perhaps much of this trouble is also due to vibration. The fine, in fact hairlike, filament of the directly-heated type of battery valve will not stand very much vibration, but this trouble is also cured by the use of the indirectly-heated type battery valves with their rugged heaters.

SENSITIVITY NEEDED

Owing to the fact that it is not desirable to have an unsightly aerial erected on the car, the set needs to have plenty of gain in order to give ample volume when operated with a very small aerial and a counterpoise, or else no "earth" at all. At the same time, there is often not much space in the car for the set, so that a multiplicity of valves is also undesirable. Terrific gain with due selectivity and absence of instability can only be obtained with modern circuits, so naturally the ideal circuit for the car set embodies the superheterodyne principle.

EASE OF CONTROL

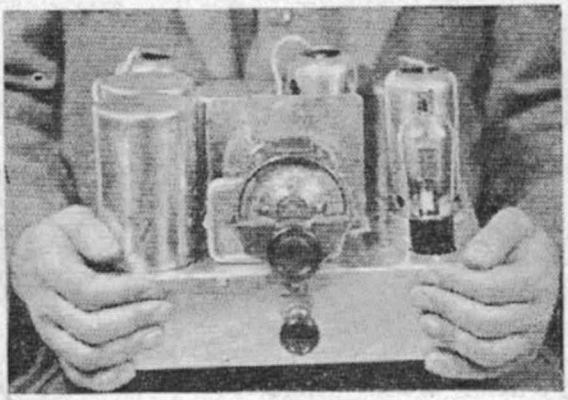
Another factor to be considered is ease of control. Since the driver of the car cannot afford to allow his attention to be distracted, it is essential that the set be very easy to manipulate, and that it have only a minimum number of controls. This definitely rules out the use of reaction, and further strengthens the claims of the superhet. circuit to be ideal for use in car sets.

Taking all the above considerations into account, it appears that the Universal superheterodyne represents the ideal set for the car.

USING THE NEW VALVES

IN practically all of the circuits shown in this book the new six-prong valves can be used to replace the screen-grids specified. To fit the 58 instead of a 235 it is only necessary to alter the valve socket and connect the extra terminal to the cathode at the socket. The new 57 will replace the 224 type valve similarly, but in the case of the 56 a slight alteration may be required. In oscillator circuits the 56 is likely to cause a continuous howl unless the value of the grid-leak is reduced to 50,000 ohms. The new 46 will replace the 245 type valve as a Class A amplifier if the sockets are changed in a push-pull circuit, but the total high tension current drain drops a little. Fortunately, this usually means merely a slight rise in voltage, and the circuit balances up satisfactorily.

Reducing the size of the Superhet—a circuit designed for a.c., batteries, or motor car.



Showing the comparative size of the set.

Introducing the 4 VALVE SUPERHETERODYNE

THE next article deals with the construction of a unique type of autodyne superheterodyne, but before going on to the constructional details it may be as well to detail some of its features and the circuit upon which its performance depends.

INTERCHANGEABLE

The first interesting feature is the way in which the set is interchangeable for operation from either batteries, a car, or the electric power supply. This has been made possible by the use of the latest indirectly-heated battery valves, known as types 236, 238 and 239. As described, the chassis will be suitable for operation from batteries, but there is also a description of a power unit to which the set can be plugged to convert it to all-electric operation at a moment's notice.

THE CIRCUIT

The circuit provides for the very latest type of superheterodyne using four valves in all. The first is a screen-grid, operating as a combined detector and oscillator. The next valve is a radio frequency pentode operating as an intermedfate amplifier, and, as many readers may know, this particular pentode has also the same exponential characteristics as the variable-mu valves. The second detector is a screen-grid valve operating as an "anode bend" detector (which is also rather unconventional in battery sets). The screen-grid detector is fed through a high-impedance choke, and drives an indirectly-heated pentode output valve.

SIMPLIFIED COIL KIT

The coil kit used is not the same as has been specified by us previously, but is a special job, having only two solenoid coils and a two-gang condenser. There is only a single tuning stage ahead of the first detector, yet the job does not re-radiate, and second spot trouble is reasonably well surmounted. Operated away from the broadcasting stations, or used in a car with a very small aerial, it is not possible to notice the second spot, but even if a large aerial is used in the midst of the powerful transmitters in Sydney the second spots are mere curiosities, and do not in any way affect the general performance of the job.

THE OLD BATTERY SUPERHET.

Some time ago "W.W." described a battery superhet., which proved an excellent performer, but unfortunately had two drawbacks. The first was the rather high cost of the components, and the second was the need for two-dial control. After considerable negotiations (a stronger word might express the idea better) with the various coil manufacturers we managed to get the coil kit we desire at a price which we consider quite reasonable under the circumstances, and in which we have every faith as regards quality, finish, and accuracy.

THE COST

We have not worked out the total cost of the components, but we fancy that readers will be quite satisfied on this point, as, besides the coil kit, there is little else except a few resistors and condensers. These are fitted to make the job entirely automatic as regards bias, so that no "C" battery is required, no matter from what source of power the set is operated. By saving the cost of the bias battery, and also making it possible to run the batteries to a very low figure without affecting results (because the applied bias varies proportionally to the voltages applied), these resistors will more than pay for themselves by the time the set has been in operation a few months.

SINGLE DIAL CONTROL

Single dial control is possible with the new job, and presents no difficulty at all. There are only two sections of the ganged condensers, and it is a very easy matter to make these align right over the dial by the use of a padding condenser. Since there is no r.f. stage to bring into alignment also, nor even a band-pass filter, the job is easier to align and keep in alignment than any superhet. previously described by us.

PERFORMANCE

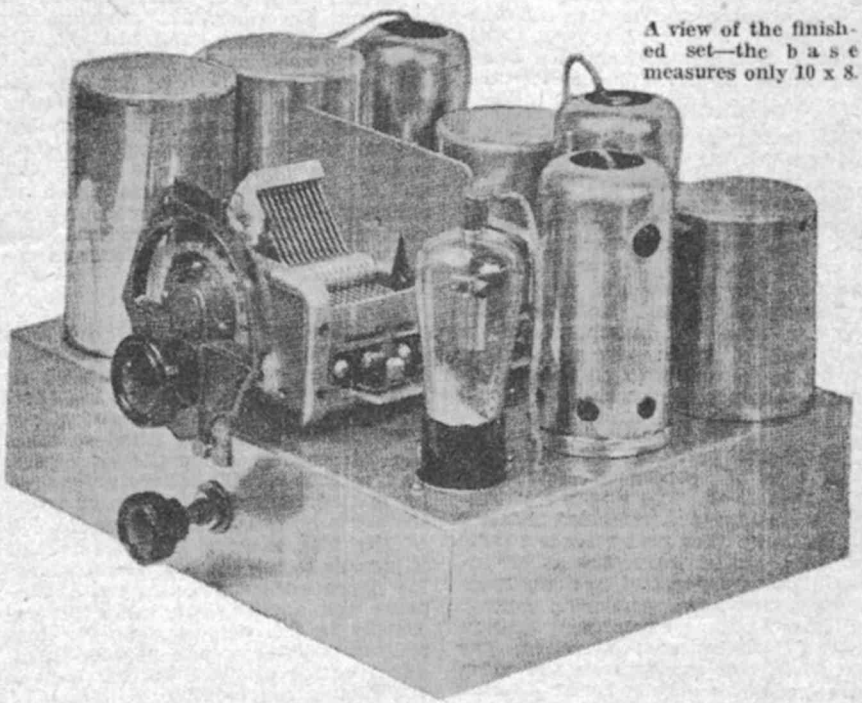
But after all, it is the performance of the job which makes us so enthusiastic. On the evening on which the job was first assembled, over 40 stations were logged cleanly and clearly. No trouble was experienced in separating 2KO from 3AW, and 3BA from 5AD, and other stations 10 kc. apart were readily separated. Of course, the very powerful locals spread over the dial a bit, but even so, 3BO and 3UZ came through quite clear of 2GB. As regards range, we did not get a chance to fully extend the job, but 6WF, 2YA, and other far-away stations came through with plenty of punch. Background noise, for which many superhets. are being reviled in scurrilous language by interested parties, is not at all in evidence. Probably this is on account of the use of the very latest types of valves, particularly the r.f. pentode, which strikes us as being a remarkably fine valve.

TONAL QUALITY WITH SUPERHETS.

CERTAIN radio enthusiasts have an idea that the superheterodyne cannot have the same tonal quality as an ordinary t.r.f. set. This is quite wrong. A superheterodyne with properly adjusted intermediate coils has a decided band-pass effect, meaning that a 10 k.c. band width is obtained with steep sides. In practice, this means extreme selectivity without cutting the side bands. With a t.r.f. set extreme selectivity is almost certain to mean that the high notes will be attenuated, but in a good superhet. high notes up to 8000 cycles frequently will come through without discrimination. Actually, few of the Australian stations attempt to transmit any musical frequencies above about 5000 cycles, so this response is ample.

The UNIVERSAL 4 valve

We give a name to most of our "Wireless Weekly" circuits, not to disguise revamped circuits familiar by other names, as is frequently the practice with some technical magazines, but for our readers' convenience, so that a short title provides an easy means of reference in conversation or correspondence. It is also an advantage if the name is in some way suggestive of the design and performance of the set. In calling this circuit the "Universal 4," we do not think we have overstepped the bounds of this policy. Not only is its range universal, but it is also universal in its application, being suited for use with batteries, a.c. mains, or in a motor car.



A view of the finished set—the base measures only 10 x 8.

THE tremendous strides marking the development of radio design during the past three or four years have previously been mainly evident in the improved results obtainable with all-electric receivers. The battery operated receivers have been sadly neglected, and more particularly few improvements in the battery valve characteristics have been noted until quite recently. Without improved valves, it is very hard for the set designer to improve results to any great extent. It is fairly safe to say that as regards ability to log stations the battery set of to-day is very little better than its forerunner of four or five years ago. Things in the all-electric line are entirely different, however, and the all-electric job of five years ago was a very woeful affair.

However, all that must now be considered as history, for we feel sure that the receiver here described is going to mark the opening of an entirely new conception of battery set performance. There is one nasty "snag," which we can only face bravely, but in every other respect we are sure that no battery set ever described in Australia, irrespective of the number of valves employed, can hope to compare with this new job. The "snag" is the filament current. For a modern battery set this current is rather high, and means that a fairly heavy duty six-volt accumulator will be required. Fortunately the high-tension current is very low, and "B" batteries should last well. Of course, the difficulty is not serious when the set is used as an automobile radio set, as an ampere or so is comparatively nothing to a car battery accustomed to a charging at 12 amperes and a similar drain.

PERFORMANCE

Performance is the one thing we cannot definitely claim about, because so much depends upon location, adjustment, and other factors. On the original set when tested at Northbridge, 41 stations were received cleanly and clearly, but in an up-country location there is no saying what stations may be received. As reported elsewhere, the original was also tested at Adaminaby, and even more stations were heard. Selectivity is a big feature of the set, but, again, actual separation of the stations depends upon the ratio between the strength of the signal to be received and the strength of the signal from the nearby station which is likely to cause interference. For example, at Northbridge there was no difficulty about separating 2KO from 3AW, although only 10 K.c. separates these stations. On the other hand, 2GB spread over a fair width on the band, and very nearly crept into 3UZ and 3BO, although these stations are a lot more than 10 K.c. away. However, there is this much that can be said—we've never seen or handled any t.r.f. set which had anything like the selectivity. Tonal quality and volume are also quite up to the standard of the best battery sets, although possibly not quite up to the "Class B" standard.

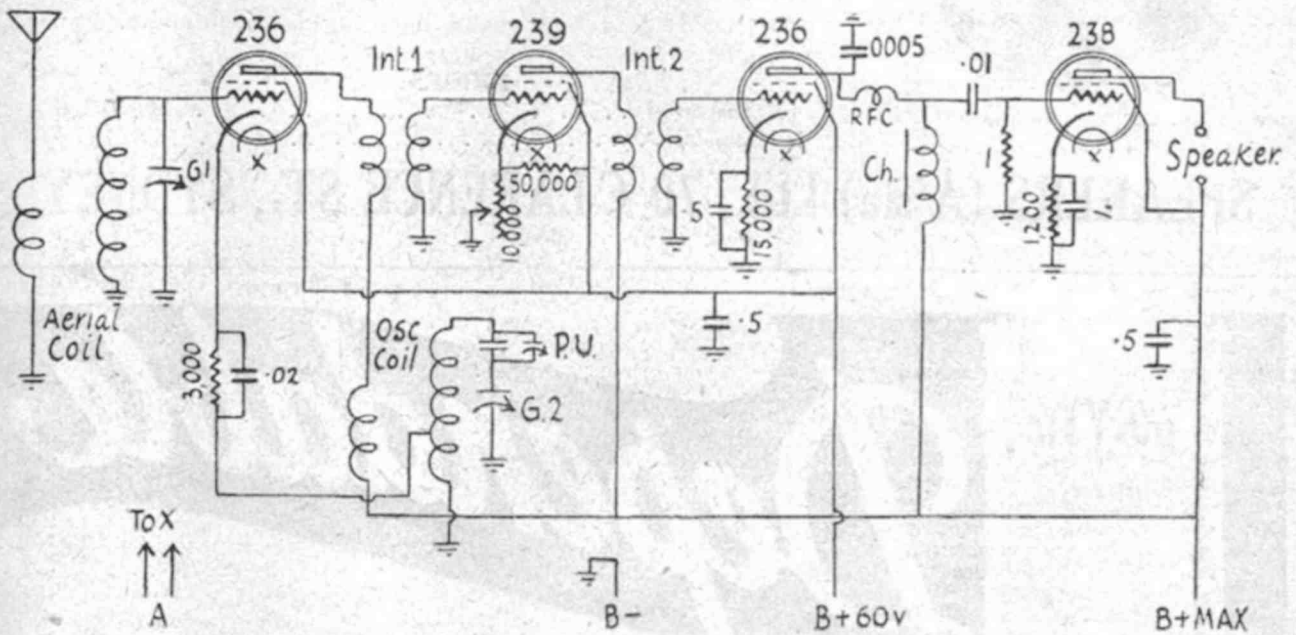
THE PARTS REQUIRED

For the set as a plain battery job there are not many parts needed, and quite a few of those specified are really extras, fitted in order to eliminate the

LIST OF PARTS REQUIRED

1—Aluminium base, size 10 x 8 x 2.
1—Lekmek Special Kit.
1—Dial to suit (*Efco, Radiokes, Raycophone*).
1—Special High-impedance choke (*Lekmek, Radiokes*).
1—.01 mfd. fixed condenser (*Wetless, Polymet, T.C.C., Renrade, Chanex, Alpha*).
1—.02 mfd. fixed condenser (*Wetless, Polymet, T.C.C., Renrade, Chanex, Alpha*).
1—3000 ohm resistor (10 ma) (*Renrade, Radiokes, Raycophone*).
1—1200 ohm resistor (20ma) (*Renrade, Radiokes, Raycophone*).
1—1 megohm grid leak (*I.R.C., Renrade, Pilot, International, Alpha*).
1—50,000 ohm grid leak (*I.R.C., Renrade, Radiohm, Pilot, International, Alpha*).
1—15,000 ohm grid leak (*I.R.C., Renrade, Radiohm, Pilot, International, Alpha*).
3—.5 mfd. fixed condensers (*Wetless, T.C.C., Hydra, Chanex*).
1—1 mfd. fixed condenser (*Wetless, T.C.C., Hydra, Chanex*).
1—.00025 fixed condenser (*Pilot, T.C.C., Renrade, Kriesler, Alpha*).
1—Radio frequency choke (*Raycophone, Kriesler, Radiokes, Alpha*).
1—10,000 ohm Potentiometer (*Raycophone, Chancery, Radiokes*).
3—Valve cans.
5—UY type sockets (*Renrade, Raycophone*).
Necessary wire, solder, cap clips, etc.
Valves—American types, 2—236, 1—238, 1—237 (*National Union, Ken-Rad, Philips, Mullard, Cossor, Radiotron*).
Speaker—Suitable *Jensen, Amplion* (Type L1), *Jubilee, Saxon*.
Batteries—135/180 volts "B" supply (*Impex, Diamond, Ever-Ready, Volta*), 6 Volt, "A" supply (*Exide*).

Superheterodyne



usual "C" bias battery. By using automatic bias, as in this set, it is possible to get greater service from the "B" batteries. As the applied voltage drops, the bias becomes proportionately reduced, so that the set will give good tonal quality and general performance down to the last dreg of current from the battery.

THE BASE

The base specified is of rather small dimensions, but the components fit quite comfortably. The finished receiver is very compact if built on to this base, and will fit quite readily into any spare space in a car.

THE COIL KIT

It is quite beyond the scope of the average home builder, or even the most advanced home builder, to attempt to construct the coil kit. The Lekmek kit specified lists at £4/4/, and includes the ganged condenser, two solenoid coils, two intermediate coils, four cans, a padding condenser (adjustable), fixed condenser for shunting across the adjustable padder, and a coil of special hook-up wire.

THE HIGH IMPEDANCE CHOKE.

A special choke having a very high impedance is necessary to feed the screen grid detector. If this is not readily available it may be substituted by a secondary of an audio transformer of high quality, such as a Philips, Ferranti, or similar brand. If an audio transformer is used it can be connected with the primary and secondary in series to further increase the inductance.

THE FIXED CONDENSERS

Although we would not go so far as to say that the set is critical, we might add that it is the type of set which needs the right compcnents if it is to give best results. The condenser and resistor values should be adhered to strictly, as a few microfarads or a few thousand ohms variation may make a lot of difference.

WIRE-WOUND RESISTORS

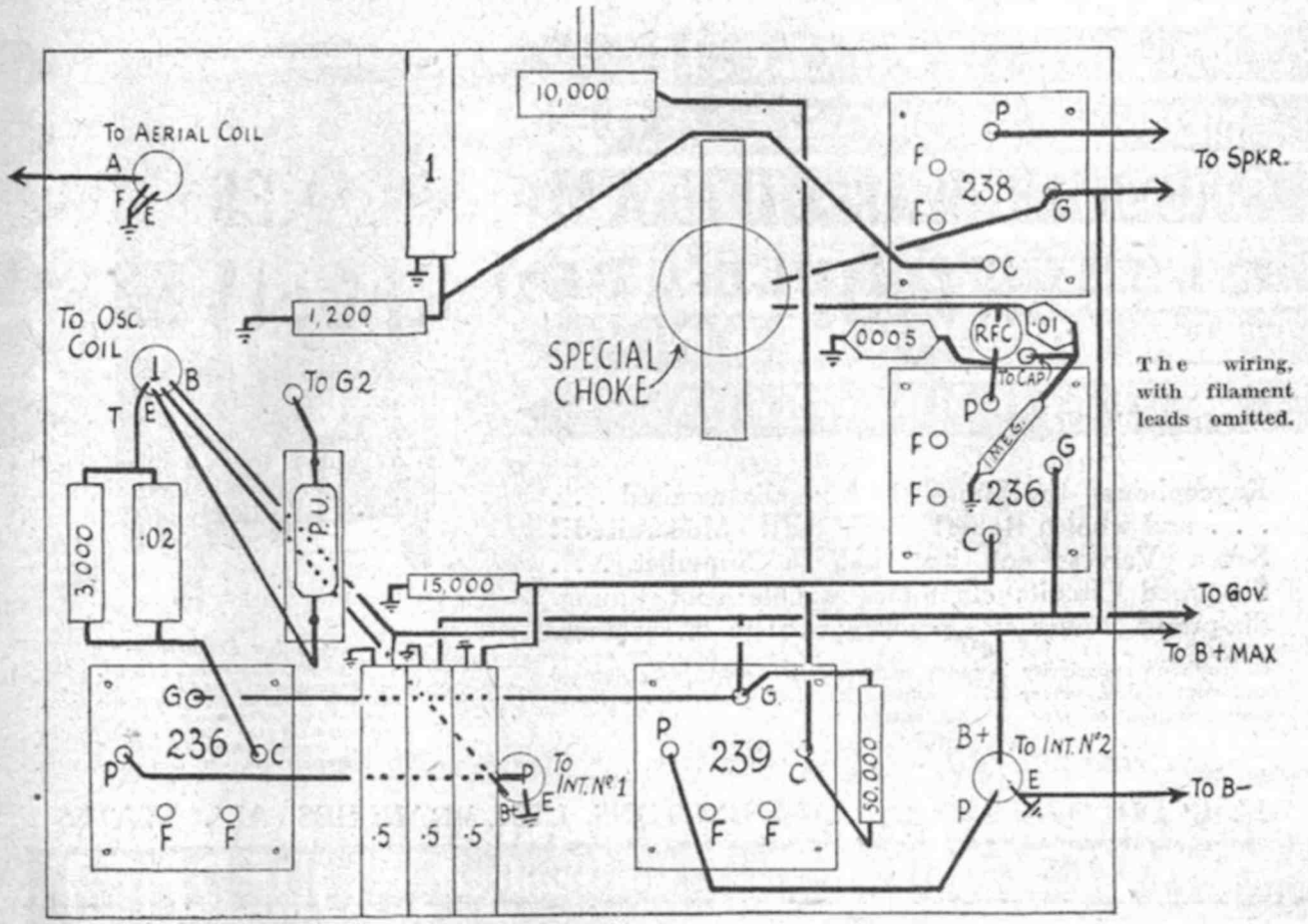
The wire-wound resistors should be fairly accurate, particularly the 3000 ohm bias resistor for the combined detector and oscillator. Although this resistor does not carry much current, it should be very close to the 3000 ohms.

THE GRID-LEAKS

The grid-leaks are not so important. In the case of the bias resistor for the second detector this value can be anything from 10,000 to 100,000 ohms. The only grid-leak to carry any considerable current is the 50,000 ohm job, but even so a one-watt resistor will serve the purpose.

THE RADIO FREQUENCY CHOKE

The radio frequency choke is more correctly an intermediate frequency choke, and needs to be very effective if the set is to be entirely stable. Personally, we have taken quite a fancy to the new type of honeycomb r.f. chokes, which can be obtained quite cheaply.



The wiring, with filament leads omitted.

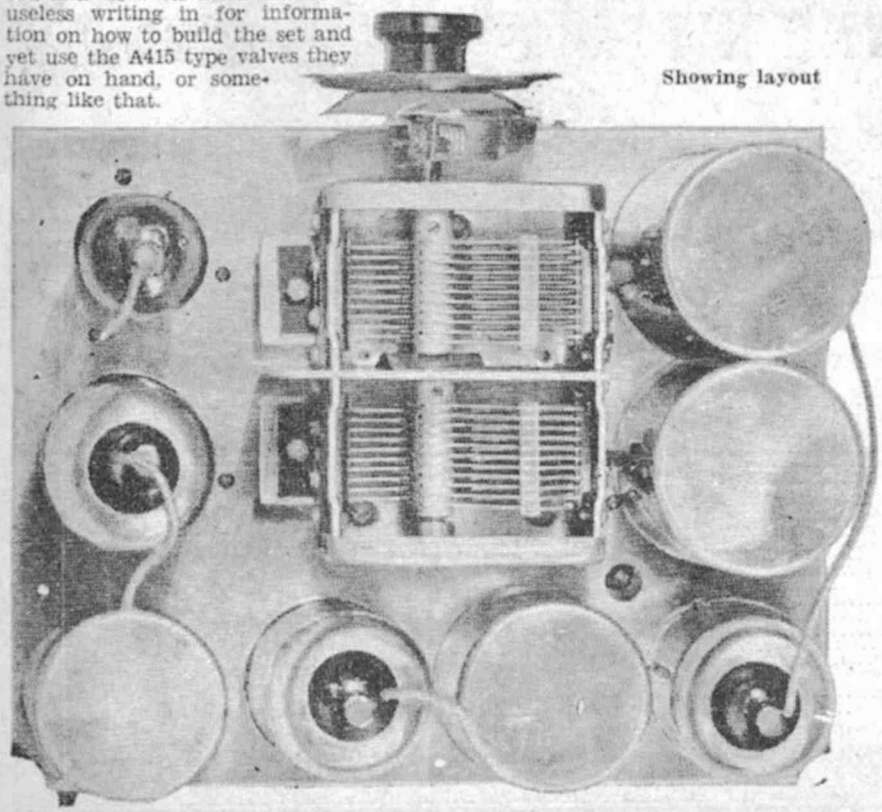
THE VALVES

It is very necessary that the valves fitted be exactly as specified. We cannot hope to show readers how to use ordinary types of battery valves in this set, and we warn them that it is useless writing in for information on how to build the set and yet use the A415 type valves they have on hand, or something like that.

LAYOUT

The arrangement of the components can be readily followed from the photographs. First the parts should be mounted on top of the base and then the other components stowed away underneath in the neatest possible way and without using any longer leads than necessary.

Showing layout



THE WIRING

There is nothing troublesome about the wiring, except that if the set is to be used as a universal job it is desirable to have the filaments wired up with twisted flex, so that hum trouble will not be experienced if the filaments are operated by alternating current from a power transformer.

ABOVE PANEL WIRING

On top of the base there is a little wiring which is not covered by the picture diagram, which shows only the underside of the base. There are the leads to the caps (grids) of the valves, of course, and also the leads from the coils to the sections of the tuning condensers. These should not provide any difficulty. As a finer point of interest, it is considered good practice to run the earth wire from the coil units direct to the terminal provided on the section of the gang tuning that coil. This means that the aluminium base is not actually used as part of the tuned circuit, and may cut out some slight difference in r.f. potentials, due to using the base as the return. However, the point is not at all important.

BATTERY CONNECTIONS

As will be noticed from the photographs in the original receiver, a valve socket was fitted into the base and the battery leads were taken to the pins of an old valve base. By this means the switch is eliminated, and to put the set in operation the plug is simply inserted in the socket. For convenience sake, in the original the filaments were used for

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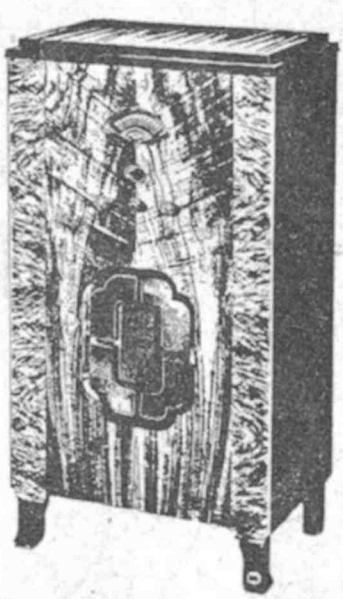

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SIMPLICITY OF CONSTRUCTION
EASE OF OPERATION

All Intermediate Frequency Transformers are balanced on a signal generator and tested on the air in a standard set.
The LEK-MEK Universal Kit £4/4/-

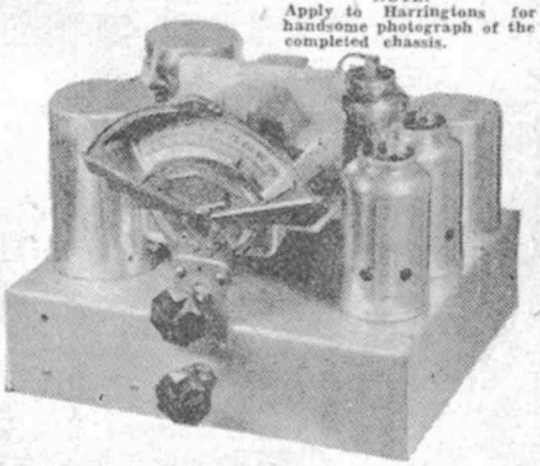
OTHER PARTS REQUIRED

Aluminium Chassis—10in. x 8in. x 2in.	6/6
Raycophone F.V. Dial	13/6
1 High Impedance Choke	15/-
1 .01 Fixed Condenser, T.C.C.	3/6
1 .02 Fixed Condenser, T.C.C.	3/9
1 3000 ohm W.W. Resistor	1/6
1 2000 ohm W.W. Resistor (Raycophone)	1/6
1 Grid Leak, .1 Meg.	2/6
1 Grid Leak, 50,000	3/-
1 Grid Leak, 15,000	3/-
3 Fixed Condensers, .05, at per condenser	4/8
1 Fixed Condenser, 1 mfd.	5/-
1 Fixed Condenser, .00025	2/6
1 Raycophone R.F. Choke	2/6
1 Potentiometer, Chancery	9/6
3 Raycophone Valve Cans at	1/6
5 Raycophone UY Sockets at	1/-
4 Raycophone Valve Clips at	3d
Wire, Hardware, Screws, etc.	4/-
VALVES: 2 x UY235	25/ each
1 x UY238	25/ each
1 x UY239	27/ each

Batteries, Loud Speaker, at prices current.

Send for illustrated pamphlet describing the Universal Superhet.

NOTE:
Apply to Harringtons for handsome photograph of the completed chassis.



This Kit places a Superhet. within the reach of all.

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the filament leads, with the maximum high tension running to the plate, sixty volts to what would be the screen pin of the valve base and the earth lead to the cathode terminal. A pair of separate flex leads are taken out through a hole in the back of the base for the speaker.

THE SECOND DETECTOR BIAS

Bias for the second detector is obtained by a 15,000 ohm bias resistor fitted between the cathode terminal of the valve socket and earth with a half-mfd by-pass condenser. It may seem strange, but this value can be varied to suit individual tastes. According to the engineer in charge at the Lekmek laboratories, the chassis they built up worked best with a 50,000-ohm resistor, but in our case 15,000 appeared better in every respect. Values of from 10,000 to 100,000 ohms can be used without greatly affecting results.

IMPROVING THE TONE

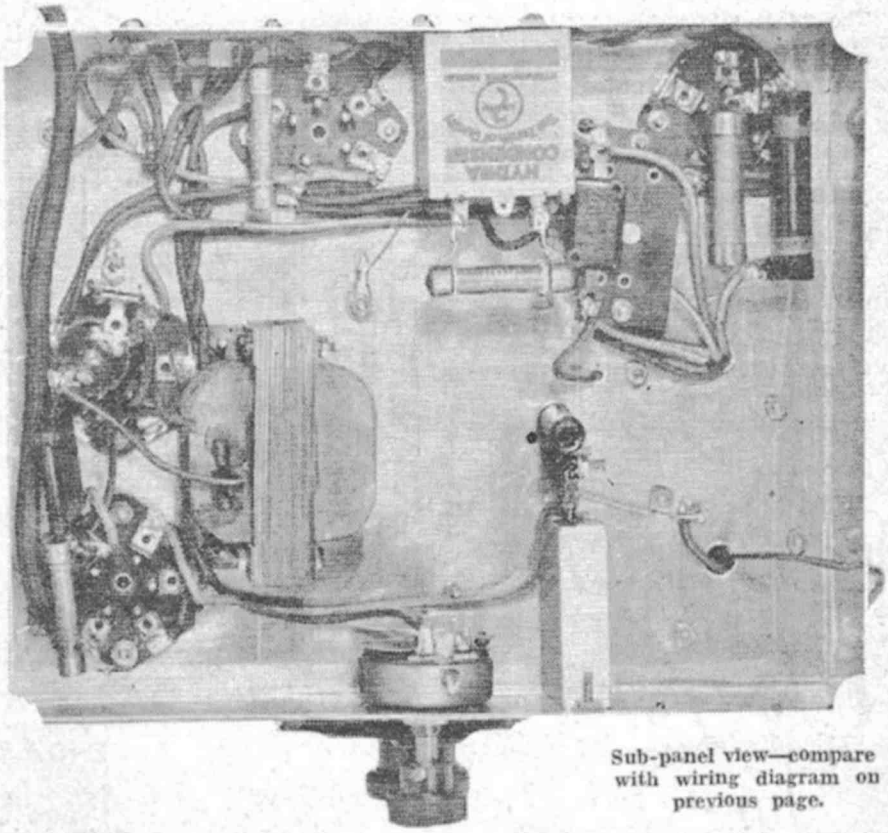
To get the very finest tonal quality it is desirable to place a quarter-megohm grid leak across the high impedance choke. This shunt resistor will limit the impedance of the choke and remove certain resonances which may be troublesome, but will also, unfortunately, cut down the gain a trifle. However, the average person accustomed to hearing the average battery set will be more than pleased with the reproduction from the set as it stands.

THE AERIAL

For use in the city areas or in any location close to a transmitter it is desirable to use a short aerial of about ten feet in length strung up around the room. If the set is to be operated in an up-country location, the length of the aerial can be increased to fifty or a hundred feet, and can be as high as possible, out-of-doors. An effective earth is most desirable, and if a water pipe is not handy a lead should be soldered to a kerosene tin buried several feet in damp soil.

ADJUSTING THE TRIMMERS

As soon as the set is finished, it should be possible to get a local station fairly well, and then starts the tricky but actually quite easy matter of lining up the trimmers. With all the trimmers set about the middle of their movement, including the padder adjuster, turn the dial to a station such as 2UW, 2CH, or 2SM, and with a screwdriver adjust the two trimmers on the side of the ganged condenser. Rocking the dial slightly, and at the same time adjusting the aerial trimmer of the gang, it should be possible to get maximum volume from this station. Then swing over the dial until 2FC or some station up that end of the dial is heard. Still rocking the dial to and fro over this station, put the screwdriver to the padder adjuster and adjust this until the station comes in best. The set should then be correctly aligned, but an eighth of a turn one way or another may be necessary to get best results from the very far-distant stations. The idea to keep in mind is to adjust only the aerial trimmer on the gang condenser when dealing with stations of low wave-length (high frequency) and only the padding condenser adjuster when handling the long wavelength stations (lower frequency).



Sub-panel view—compare with wiring diagram on previous page.

SECOND SPOT TUNING

When the set is operated in a city location or close to a powerful station, and a long aerial is used, there is a chance that the powerful station will appear on the dial at its usual setting, and also appear a second time at a spot on the dial at which stations 350 Kc. away would be expected. This is due to the fact that an intermediate frequency of 175 Kc. can be obtained by beating the incoming signal with an oscillator frequency either above or below it. If the selectivity lead of the first detector is insufficient to exclude all trace of the station when the aerial tuning circuit is 350 Kc. off resonance, then the second spot occurs. Since the cost of obtaining sufficient selectivity to exclude the second spot would be considerable, and the matter complicated, and since the second spot is more a curiosity than a defect, we have not worried about it in this case. The set is primarily designed for use in a car, with a very small aerial, or else as a battery set in a location far remote from powerful transmitters. However, readers should be warned that at Newcastle there is a chance that the second spot of 2NC will interfere with the reception of a Sydney station, and in Melbourne the second spot of 3UZ may mean that 7ZL (Hobart) will not be received clearly.

OSCILLATION

The volume control is so arranged that it may operate in a similar manner to reaction. If the volume control is fully advanced, the set may burst into oscillation. This is quite normal, and perfect stability can be obtained by retarding the volume control. By this method it is possible to get practically constant sensitivity over the whole band, and merely requires a little intelligent handling for best results. Needless to add, the set should be just on the verge of oscillation to give the very best range.

AS A CAR SET

The set is ideal for use in a car. The "B" batteries can be mounted under the set or in a special box mounted under the floor boards. The filaments are supplied from the car accumulator. The most convenient method of getting at the battery is to arrange a plug on the filament wires which can be plugged into the dash light adaptor. For an aerial a few lengths of insulated wire strung under the chassis or under the hood will serve, and the framework of the car may be used as the earth. In some cases, considerable experimenting can be done, such as trying the framework of the car as an aerial, and operating the set without an earth. Or, in some cases, a wire across the hood will serve for an aerial, and similar wires strung under the chassis will serve for a counterpoise, as a substitute for an earth.

ELIMINATING INTERFERENCE

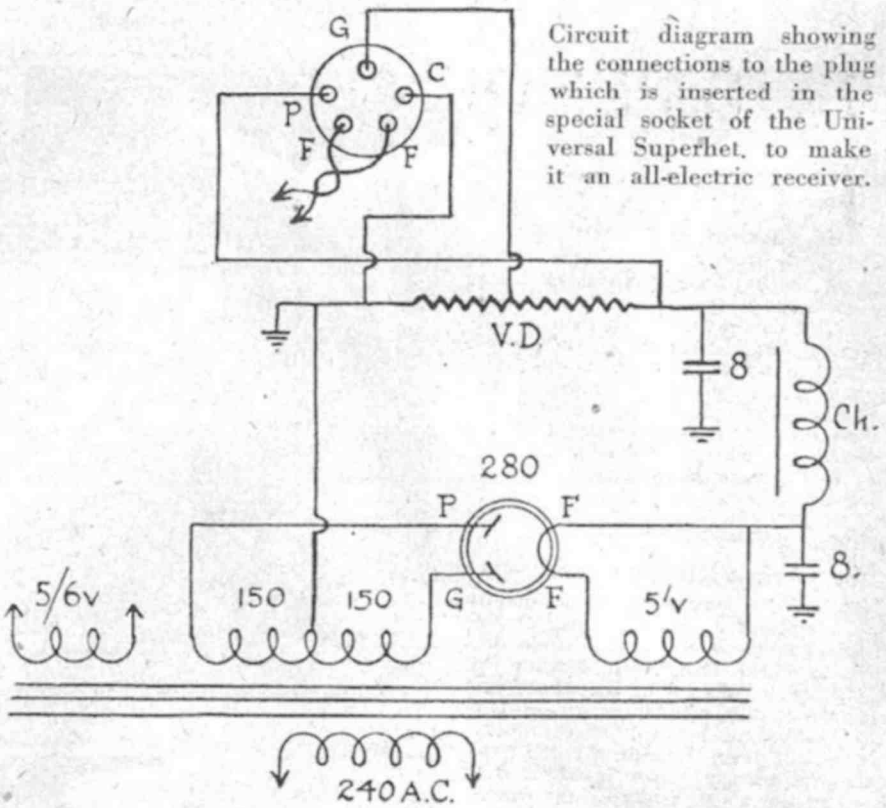
Interference from the spark plugs can be minimised by fitting 10,000 ohm wire-wound resistors in series with the plug leads. An earthed copper shield right round the distributor or magneto may help. In stubborn cases, a small fixed condenser of .01 mfd. capacity may be fitted across the breaker points of either a magneto or a distributor.

MIND THE BATTERY VOLTAGE OF YOUR CAR

If the set is to be used in a car, the first thing to do is to make sure that your car battery is not a twelve-volt type. Certain cars, such as the Morris and the old Dodge, use 12-volt accumulators. Needless to add, if the 6-volt valves are fitted to a 12-volt accumulator, they will not give satisfactory service; in fact, they will probably expire in a few moments.

ALL-ELECTRIC OPERATION

The set is also ideal for all-electric operation, and in the article below we detail the construction of a power unit to which the set can be plugged to make it all-electric. It is also very suitable for operation from an eliminator, as the current drain is very low. In this case, a filament transformer can be supplied by all dealers to supply the necessary 6 volts for the filaments, so that, with the aid of the eliminator and a transformer, costing a few shillings, it is possible to have an all-electric version of the job. Those who intend to use the set as an all-electric can follow out this article exactly, and then build the power unit as an entirely separate unit.



Circuit diagram showing the connections to the plug which is inserted in the special socket of the Universal Superhet, to make it an all-electric receiver.

a POWER UNIT for the Universal 4 Valve Superhet.

AS mentioned in the article on the "Universal" superheterodyne, it is suitable for use as an all-electric set if plugged into a special power unit. Here are the necessary details for those who wish to build such a unit.

It must be clearly understood that this unit can only be used with alternating current as found in the suburbs of Sydney and other places, and not the direct current as found in the heart of the city.

THE COMPONENTS

A power transformer is needed, a filter choke, two electrolytic condensers, and a voltage divider. Some wire, a suitable base, the plug for the leads and other minor odds and ends, will also be needed.

THE POWER TRANSFORMER

The power transformer for the job can be a special one, having a secondary winding of 150/150 volts at 30 m.a., with a 5 volt 2 ampere filament winding, and another winding of 6 volts 2 amps. But what we particularly recommend for the job is the Universal power transformer, of the type fully detailed on another page. This can be made up by an enthusiastic home-builder, or can be bought ready-made in a variety of brands. If a "Universal" transformer is built or procured it should be suitable for this set, and also for nearly every set to be described for a couple of years to come.

THE FILTER CHOKE

Similarly in the matter of the filter choke, a 30 henry 50 milliamp choke will serve, but we recommend the builder to use a 30 henry 100 m.a. choke, so that it will be more efficient for this job, and also likely to be suitable for all types of sets to come for quite a time.

THE FILTER CONDENSERS

For the filter condensers a couple of 8 microfarad electrolytics are desirable, but at a pinch satisfactory results can be obtained with a pair of 4 mfd. paper condensers. Needless to add, they must be capable of withstanding the voltage applied, which will be only 150 volts a.c. Practically any paper condensers should stand that voltage.

THE VOLTAGE DIVIDER

The voltage divider can be either a 15,000 ohm or 25,000 ohm type. The tapping for the screen voltage can be fixed by means of a ruler. It is near enough to place it about one-third of the way up from the earthed end of the divider. After the unit is in operation, it may be advisable to test the effect of moving this tapping a quarter of an inch one way or the other. Results will show whether a higher or lower voltage is desirable.

LAYOUT

Individual ideas can be exercised in the construction of the power unit, and we fancy that most of our readers will prefer to build up the unit on an aluminium base, of the same dimensions as the original set. The power transformer will be mounted with the terminal board showing underneath the base, and the electrolytics will mount so that their terminals are also underneath. By using an aluminium base in this way there will be no exposed wiring at all, making a very neat and safe job.

CONNECTIONS TO THE PLUG

In the diagram we show the connections to the plug, looking at it from the unit end of the plug (not the pin end). A suitable plug can be bought at any dealers, or if the builder is short of cash the base of an old valve of the 4/5 type will serve the purpose. To insert the leads in the pins of the plug it is necessary to get the ends of the leads skinned and tinned, and then pushed into position whilst the pin is kept hot by the application of a soldering iron.

VOLTAGES FROM THE "UNIVERSAL"

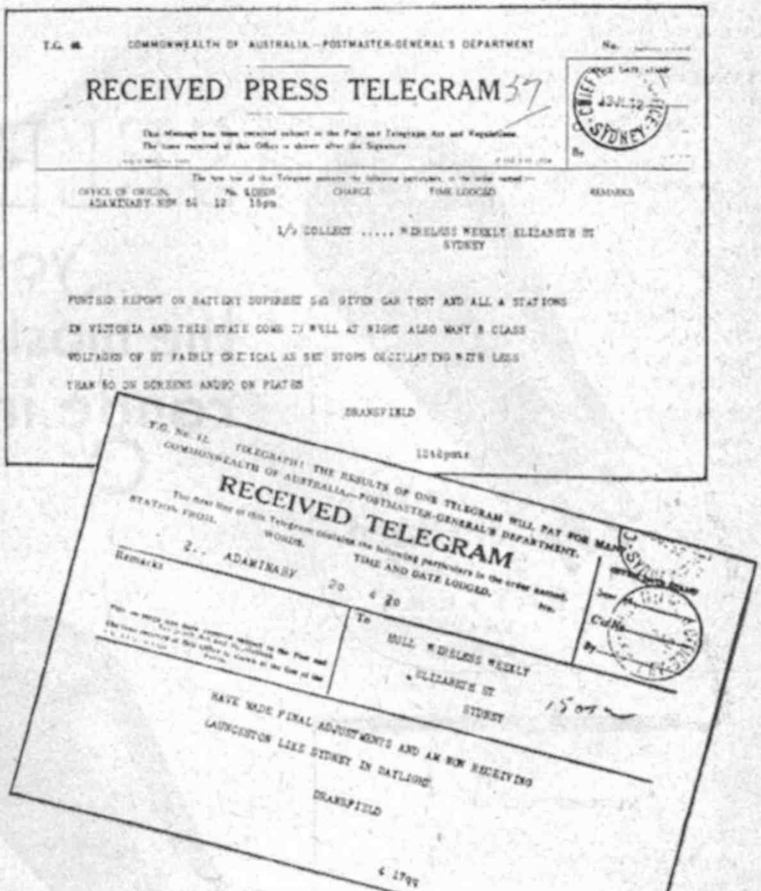
At first sight it may appear difficult to get the desired voltages from the "Universal" power transformer. This is the solution—for the secondary use that portion of the original secondary between 0 and 300, making the 150 tapping the centre tap of the winding. In other words, 0 will go to one plate of the rectifier, 150 will be earthed, and 300 will go to the other plate of the rectifier valve. For the filament of the rectifier, the 0-5 tapping of the 2 ampere winding will serve. For the filaments of the valves used in the superhet use 5 volts a.c., by taking one lead from the 2.5 tap of the 3 amp. winding, and the other from the 7.5 tap. The valves are rated 6.3 volts for the filaments, but are specially designed for automotive use where fluctuating voltages are encountered. Perfectly satisfactory operation can be obtained with only 5 volts a.c. on the heaters. All voltage tappings unused must be left vacant.

TAKE PRECAUTIONS

No one should attempt the construction of this unit unless he has an idea of the danger of mishandling the power supply. The 240 volts alternating current which is drawn from the power mains is capable of supplying enough current to seriously injure anyone holding one lead in one hand and standing on damp ground. It is far safer to build the unit, and then only touch it after entirely disconnecting the power supply lead from the power plug.

INDEPENDENT REPORT *On The Universal 4 Valve Battery Superhet.*

By the Rev. R. B. DRANSFIELD, Th.L., Adaminaby.



T.G. 48. COMMONWEALTH OF AUSTRALIA.—POSTMASTER-GENERAL'S DEPARTMENT

RECEIVED PRESS TELEGRAM 57

OFFICE OF ORIGIN. ADAMINABY NSW 56 12 15pm

1/5 COLLECT ..... WIRELESS WEEKLY ELIZABETH ST SYDNEY

FURTHER REPORT ON BATTERY SUPERHET SET GIVEN CAR TEST AND ALL A STATIONS IN VICTORIA AND THIS STATE COME IN WELL AT NIGHT ALSO MANY B CLASS VOLTAGES OF ST FAIRLY CRITICAL AS SET STOPS OSCILLATING WITH LESS THAN 80 ON SCREENS AND 80 ON PLATES

DRANSFIELD

1242pm

T.G. No. 11. TELEGRAPH! THE RESULTS OF ONE TELEGRAM WILL PAY FOR MANY. COMMONWEALTH OF AUSTRALIA.—POSTMASTER-GENERAL'S DEPARTMENT.

RECEIVED TELEGRAM

2.. ADAMINABY 20 4 20

To NULL WIRELESS WEEKLY ELIZABETH ST SYDNEY

HAVE MADE FINAL ADJUSTMENTS AND AM NOW RECEIVING LAUNCESTON LIKE SYDNEY IN DAYLIGHT

DRANSFIELD

4 17pm

WIRELESS WEEKLY

51 AUSTRALIAN BROADCASTERS

A complete official list of the A and B class broadcasting stations in Australia. A further list with complete programme schedules will be published shortly.

2CO, 7ZL, 3AR, 5CK, 2FC, 6WF, 5CL, 4QG, 3LO, 2BL, 6PR, 7HO, 4RK, 3UZ, 2GB, 5DN, 3BO, 4GR, 3HA, 2UE, 5PI, 2CA, 2KY, 3SH, 7LA, 2HD, 2UW, 6ML

4BC, 3YB, 2WG, 4TO, 3DB, 4MK, 5KA, 2CH, 6KG, 2NC, 3WR, 2SM, 3TR, 4BK, 3BA, 5AD, 2MO, 4RO, 2XN, 3KZ, 4BH, 2GN, 3GL, 2KO, 3AW, 2WL, 2AY, 3AK

Also 2YA KZRM 2 JAPS. and INDO CHINA

LOCATION.—Adaminaby, N.S.W., 326 miles from Sydney.

QUALITY OF LOCATION.—Poor for reception, but improves about 10 miles out of town. Sets giving fair results here give excellent results when taken out a few miles.

AERIAL.—66 feet long, 35 feet high at one end, 12 feet above set at low end.

EARTH.—Three feet of rusty water pipe driven into moist ground. Lead just wound around pipe.

RECEPTION.—The sensitivity of the set was abnormal, 51 stations were logged as follows, at night, between 7 o'clock and 11.30 o'clock:—2CO, 7ZL, 3AR, 5CK, 2FC, 6WF, 5CL, 4QG, 3LO, 2BL, 7HO, 4RK, 3UZ, 2GB, 5DN, 3BO, 4GR, 3HA, 2UE, 2KY, 3SH, 7LA, 2HD, 2UW, 4BC, 3YB (?), 2WG, 3DB, 5KA, 2CH, 2NC, 3WR, 2SM, 4BK, 3BK, 3BA, 5AD, 2MO, 4RO, 2XN, 3KZ, 4BH, 3GL, 2KO, 3AW, 2WL, 2AY, KZRM Manila, 2YA (N. Zealand), 1 French station, 2 Japs.

DAYLIGHT RECEPTION.—The daylight reception should make this set a wonderful godsend for the man on the land. Here are the results:—Morning reception between 7 a.m. and 1 p.m.:—

2CO, 7ZL (faintly), 3AR, 5CK, 2FC, 3LO, 2BL, 2GB, 3UZ, 2UW, 2NC, 2SM.

All the A class stations provide quite good entertainment but the B class are quite audible all over the room, except for 2GB and 3UZ; the quality is below normal from these latter stations.

SENSITIVITY.—The little set contains all the punch for night reception that anyone could require, while on several of the A stations the volume control has to be operated in the daytime. At night time, except for very long distances, a short aerial of 12 feet across the room was found sufficient, and the selectivity was improved at night. For comfortable reception of all the Eastern A stations a wire mattress made an excellent aerial. Both A stations in both N.S.W. and Victoria were quite audible on the speaker using a length of hook-up wire about 1 foot long as an aerial. Considering the distance, this is wonderful.

SELECTIVITY.—With a long aerial good selectivity is obtained, but too much volume for comfort.

The reception from one or two small stations was spoilt by second spot tuning. This was overcome in the present location by using an indoor aerial. Some trouble was experienced here with U.S.A. stations working on the same, or almost the same, wavelengths. These were too weak to work the detector, but were strong enough to form a third frequency beat which made itself apparent in a slight whistle or distortion. This happens only in three places on the dial, and only with a long outdoor aerial. For a country location, using an average aerial, say, 30 feet by 30 feet, the selectivity is all that can be desired.

> *A FAITHFUL AND ACCURATE REPORT.*
>
> *I, REGINALD DRANSFIELD, of Adaminaby, do declare that the foregoing report is a true, faithful, and accurate one of tests carried out with the new battery superheterodyne, using only four valves. Given under my hand this 16th day of July, 1932.*
>
> SIGNED. R B Dransfield
>
> WITNESS. G. K. Davis J.P.
>
> J.P.

and situated far away a longer aerial can be used.

VOLUME.—As already stated, there is more volume than is required. In Adaminaby, 326 miles by rail from Sydney, with an outdoor aerial, the daylight reception from 2FC is sufficient to overload the speaker!

TONE.—The tone leaves nothing to be desired, and working into a good permagnetic speaker, is not far off the tone of a direct-coupled set. The tone much resembles that of the High-Power Two, with a very good transformer.

GENERAL REMARKS.—Up to this point nothing but genuine facts have been given for the benefit of the readers of "W.W." but a few remarks in general review would be useful.

The beauty of the set lies in the fact that it can be used for D.C., A.C., or battery operation. In towns like Cooma with only a D.C. supply, it could be converted to an all-electric set, as many readers of "W.W." are now doing; but the Technical Editor had better advise in this direction, as it is no job for novices.

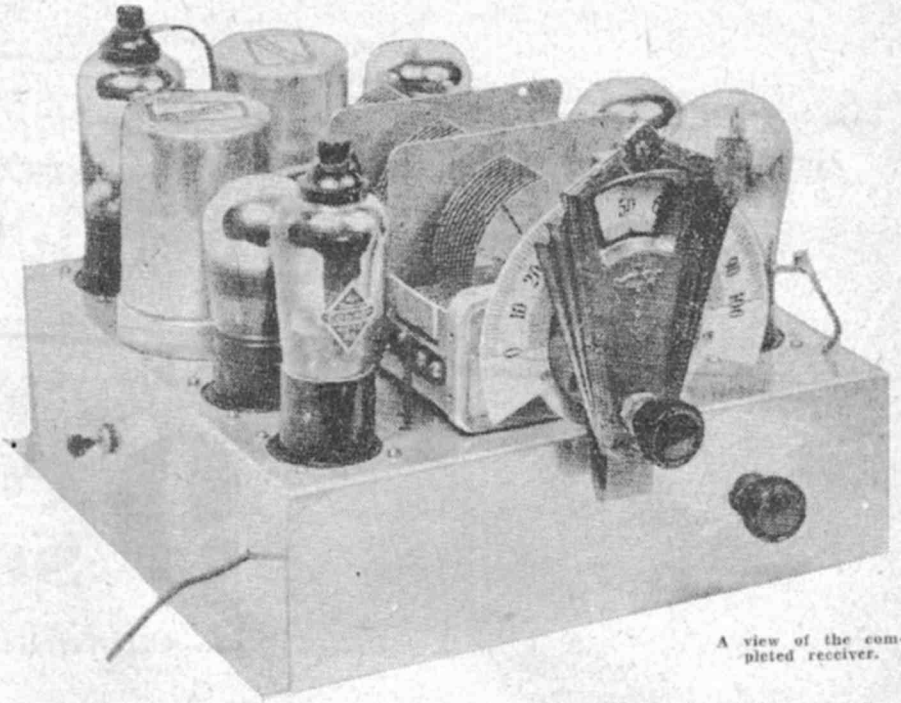
The second great advantage of the set is that it can be used with an indoor aerial. In country centres, where the static is sometimes very bad, this is a godsend, as the noise level falls 50 per cent. with an indoor aerial.

As the set has been sent to me to report on, I feel that a word of criticism is necessary. It concerns the volume control. When used with a normal aerial here the volume control fails to cut the volume enough for comfort even when right in, and I was forced to use an indoor aerial to get anyhting like reasonable action out of it. The Editor may be able to suggest a way out of it for us.

I would conclude this report with a suggestion. I do not think that the selectivity would be sufficient for country towns like Camden, which are about 50 to 60 miles from the city. It might be an advantage to add a band pass filter in front of the first valve for the use of close country listeners, say, within 80 miles of Sydney. It would also prevent any chance of double spot tuning.

At the conclusion of the test, for a joke, I hooked the set on to an ordinary wire fire screen in front of the fire and continued to receive all the Eastern A class stations and about six of the B! I regard this as the most outstanding achievement in the history of "Wireless Weekly." It puts every other set, including the Infinite Six, into the background.

The 6 Valve BATTERY SUPER-HET.

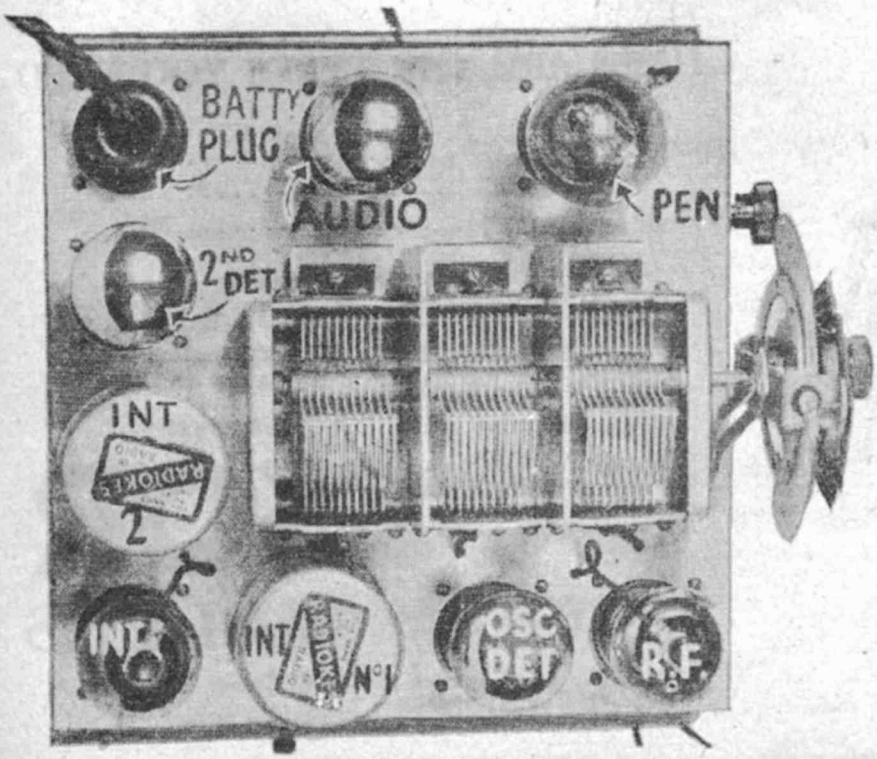


A view of the completed receiver.

IN order to put the country cousin on the same footing as the more fortunate (?) city dweller, the Radiokes factory has turned out a special superheterodyne coil kit for battery sets. This job is somewhat similar to the new types of superhet kit, as used in the "Ultra" a.c. receiver, but has an intermediate frequency of 175 KC. Using this kit, it has been possible for us to design a battery set with many attractive features. By using the double-grid special combined first detector and oscillator we manage to keep the total number of valves down to six, yet have the practical limit of gain in every part of the set. There is an r.f. stage ahead of the first detector, which entirely eliminates second spot tuning, an intermediate amplifier using a screen grid valve with very high gain. The second detector is a very sensitive valve, and then follow two stages of audio, using resistance coupled with high-gain valves, and finally ending in a power pentode capable of giving really solid punch. Throughout we have selected for the job only certain specific types of valves, which have the desirable characteristics to give us extreme gain. Of course, other types of valves can be used, but we cannot guarantee that the performance will be anywhere near the same standard with low-gain valves.

THE CIRCUIT DETAILS.

We trust that the matter of the combined detector and oscillator does not call for any great explanation. The same system was used in the battery superhet described in "Wireless Weekly" last May, and proved itself very effectively. The valve works as both a sensitive detector and reliable oscillator, and of course, saves quite a considerable amount of both A and B current. When taking into consideration the amount of current taken by a separate oscillator, it seems only logical to use this system for battery sets. The combination oscillator and detector also has a further advantage in that background noise is a lot lower when the separate oscillator is dispensed with.



A plan view of the set, showing layout of parts.

PERFORMANCE

If this job is in perfect adjustment and operating exactly in accordance with the design it will give the most excellent results; in fact, nothing in the way of battery sets should be able to beat it. On the other hand, on account of the high-gain valves used and the high-gain audio system, there may be a little tendency to instability, particularly when the volume control is turned "flat out." However, this should merely call for a little tinkering on the part of the builder. In other words, we do not recommend this set for the "greenest" novice, but more to those who will be in a position to get the maximum performance from the job, and then appreciate the performance.

THE PARTS.

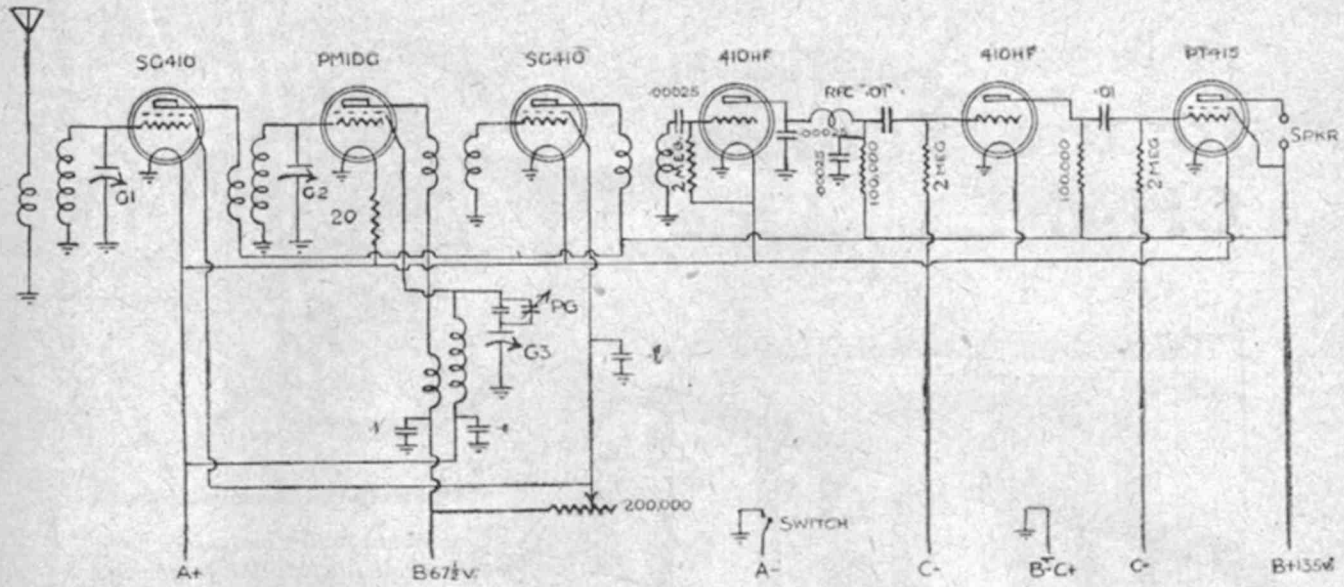
The aluminium base is quite a small affair, measuring only 12 x 12 x 3. However, this size is ample for the components if they are arranged exactly as shown in our photographs.

THE COIL KIT.

The coil kit is a special job, made for the purpose by the Radiokes people, and on no account must the old types of coil kit be used. In the first place, the old kit will not fit under the base; and, secondly, the whole affair is of entirely different design.

THE RESISTORS.

The 20-ohm wire-wound resistor is necessary to drop the filament voltage for the double-grid valve. This valve



Parts Required for 6 VALVE BATTERY SUPER.

1—Aluminium base, 12 x 12 x 3.
1—Vernier dial.
1—Radiokes superhet. kit. Type 5-5.
1—20 ohm wire-wound resistor (*Radiokes, Raycophone, Kriesler*).
1—200,000 ohm Potentiometer (*Chancery, Pilot*).
2—100,000 ohm Grid leaks (*Renrade, I.R.C., Pilot, Alpha, International*).
3—2 meg. Grid leaks (*Renrade, I.R.C., Pilot, Alpha, International*).
3—.00025 Fixed condensers (*Renrade, T.C.C., Pilot, Alpha, Wetless*).
3—.1 mfd. Fixed condensers (*Wetless, Polymet, Chanex, T.C.C., Hydra*).
2—.01 mfd. Fixed condensers (*Wetless, Polymet, Chanex, T.C.C., Hydra.*)
1—1 mfd. Fixed condenser (*Hydra, T.C.C., Wetless, Chanex*).
1—Radio frequency choke (*Radiokes, Raycophone, Alpha, Kriesler*).
4—UX sockets, 3 UY (*Raycophone, Renrade*).
Valves—2—Cossor 41OSG.
2—Cossor 41OHF.
1—Cossor 415PT.
1—Mullard PM1DG.
Speaker—(*Amplion, Jensen, Saxon, Jubilee, etc.*)

takes a filament current of .1 ampere, but only two volts. Since the rest of the valves in the set are of the four-volt type, we have to drop 2 volts at a current of .1 amps. From this it will be calculated by Ohm's law that the necessary resistance is 20 ohms. The most convenient way of getting a resistor of 20 ohms capable of carrying the filament current is to buy a centre-tapped filament resistor of this value, of course neglecting the centre-tap.

THE POTENTIOMETER.

The potentiometer which is used for the volume control is wired as a rheostat, one of the outside terminals being left unattached. The potentiometer is called upon to carry only a small current, but most of the potentiometers available are not intended to carry any considerable current when they have such a high resistance. So it will be wise to get the best potentiometer available, to make sure that it does not burn out in service.

GRID-LEAKS.

The grid-leaks are small but important features, and again we strongly recommend the use of the very best obtainable. The actual values are not particularly critical.

CONDENSERS.

Since the voltages available from the batteries are comparatively low, the breakdown voltage ratings of the fixed condensers are not important.

THE WIRING.

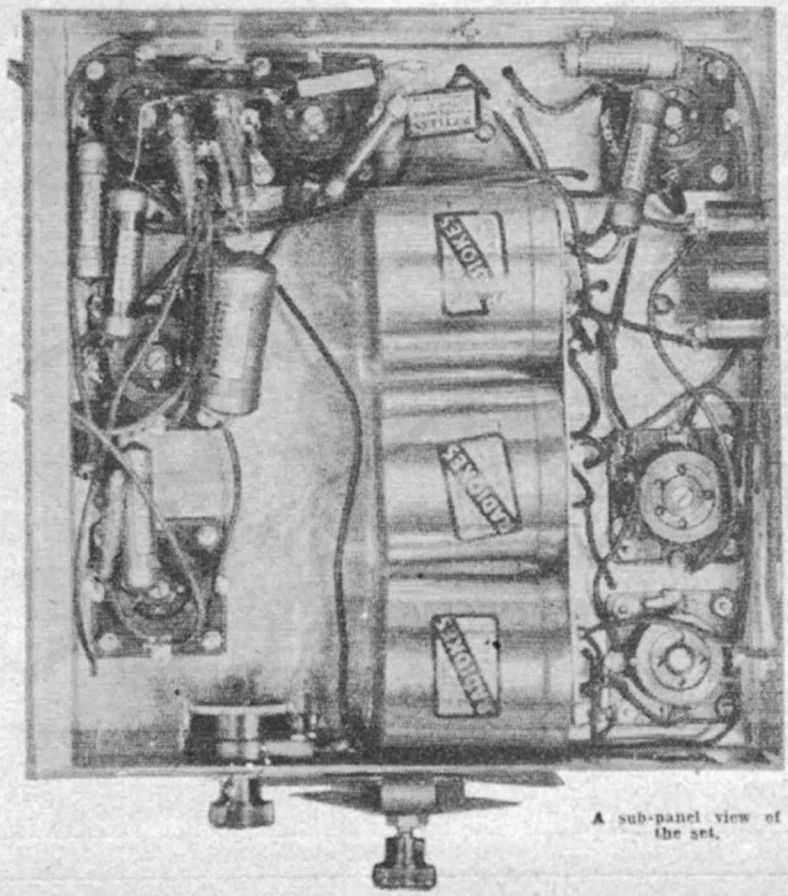
The wiring of the job is very simple on account of the way in which the coils are mounted beneath the base. For convenience sake a UY socket is mounted on the top of the base to take the battery leads.

OPERATION.

The alignment and operation of the job follows closely on the lines already mentioned time and again in the other articles in this book, and so should present no difficulty.

SERVICE AND ATTENTION.

All Radiokes products are covered by a comprehensive guarantee, and of course the coil kit specified for this receiver comes under this guarantee. Anyone requiring further information about it would be well advised to write direct to the Radiokes people—The Metropolitan Electric Co., Cleveland Street, Redfern.



A sub-panel view of the set.

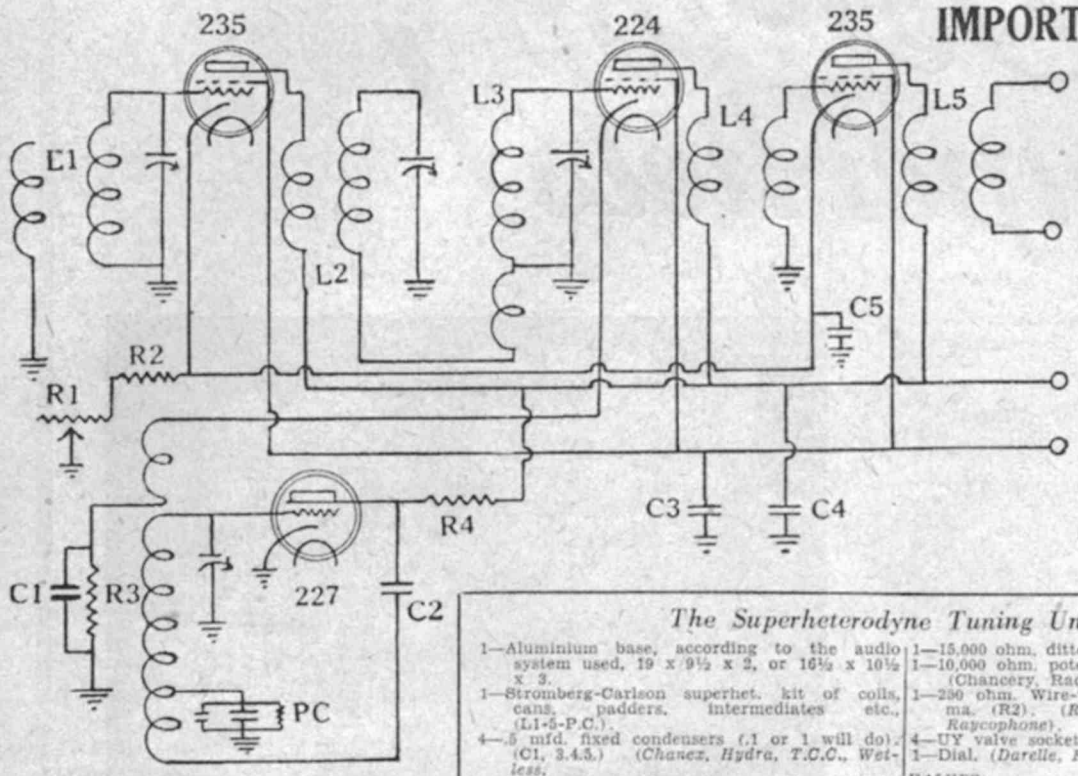
AUSTRALIAN BROADCASTERS

A complete official list of the A and B class broadcasting stations in Australia.

*Denotes power in the aerial. Stations 2MV and 2XL, previously in this list, are now off the air.

CALL SIGN	DIAL No.	W'LENGTH POWER, Etc.	NAME AND LOCATION	CALL SIGN	DIAL No.	W'LENGTH POWER, Etc.	NAME AND LOCATION
2CO		535.7 metres 560 k'cycles. 7500 watts.*	National Broadcasting Station, Relaying 3LO and 3AR, COROWA.	6ML		264 metres, 1135 k'cycles. 300 watts.	Musgroves, Ltd., Studio: Lyric House, Murray St., PERTH.
7ZL		517 metres. 580 k'cycles. 3000 watts.	National Broadcasting Station, Studio: Elizabeth Street, HOBART.	4BC		262 metres. 1145 k'cycles. 600 watts.*	J. B. Chandler and Co., Studio: 43 Adelaide Street, BRISBANE.
3AR		492 metres. 610 k'cycles. 5000 watts.	National Broadcasting Station, Studio: 120A Russell Street, MELBOURNE.	3YB		262 metres. 1145 k'cycles. 25 watts.*	Mobile Broadcasting Service, 430 Little Collins Street, MELBOURNE.
5CK		472 metres. 635 k'cycles. 7500 watts.*	National Broadcasting Station, Relaying 5CL, CRYSTAL BROOK, S.A.	2WG		260 metres. 1155 k'cycles. 50 watts.*	Riverina Broadcasting Co., 16 Fitzmaurice Street, WAGGA.
2FC		451 metres. 665 k'cycles. 5000 watts.	National Broadcasting Station, Studio: 96-98 Market Street, SYDNEY.	4TO		256.4 metres. 1170 k'cycles. 100 watts.	Amalgamated Wireless, (A'sia), Ltd., TOWNSVILLE.
6WF		435 metres. 690 k'cycles. 5000 watts.	National Broadcasting Station, Studio: Hay Street, PERTH.	3DB		254 metres. 1180 k'cycles. 500 watts.	3DB Broadcasting Stn. Pty., Ltd., Studio: 36 Flinders Street, MELBOURNE.
2YA		416.7 metres. 720 k'cycles. 5000 watts.	N.Z. Broadcasting Board, Wellington, NEW ZEALAND.	4MK		252 metres. 1190 k'cycles. 100 watts.*	Williams' Agencies, Ltd., Address : P.O. Box 165, MACKAY.
5CL		411 metres. 730 k'cycles. 5000 watts.	National Broadcasting Station, Studio: Hindhmarsh Square, ADELAIDE.	5KA		250 metres. 1200 k'cycles. 300 watts.*	Sport Radio B'easting Co., Ltd., Studio: 81 Flinders Street, ADELAIDE.
4QG		395 metres. 760 k'cycles. 5000 watts.	National Broadcasting Station, Studio: c/o State Insur. Bldgs., BRISBANE.	2CH		248 metres. 1210 k'cycles. 1000 watts.*	Council of Churches, 77 York Street, SYDNEY.
3LO		375 metres. 800 k'cycles. 500 watts.	National Broadcasting Station, Studio: 120A Russell Street, MELBOURNE.	6KG		246 metres. 1220 k'cycles. 100 watts.*	Goldfields Broadcasters, Ltd., Bourke Street, KALGOORLIE.
2BL		351 metres. 855 k'cycles. 5000 watts.	National Broadcasting Station, Studio: 96-98 Market Street, SYDNEY.	2NC		241 metres. 1245 k'cycles. 2000 watts.*	National Broadcasting Station, Relaying 2FC and 2BL, NEWCASTLE.
6PR		341 metres. 880 k'cycles. 200 watts.	Studio: Nicholsons, Ltd., Barrack Street, PERTH.	3WR		238 metres. 1260 k'cycles. 50 watts.	Wangaratta B'easting Pty., Ltd., Studio: Reid Street, WANGARATTA.
7HO		337 metres. 890 k'cycles. 50 watts.*	Commercial Broadcasters, Ltd., Studio: 82 Elizabeth Street, HOBART.	2SM		236.1 metres. 1270 k'cycles. 1000 watts.*	Catholic Broadcasting Co., Australia House, Carrington St., SYDNEY.
4RK		330 metres. 910 k'cycles. 2000 watts.*	National Broadcasting Station, Relaying 4QG, ROCKHAMPTON.	3TR		234 metres. 1280 k'cycles. 50 watts.*	Gippsland B'easting Service, Address: Raymond Street, SALE.
3UZ		326 metres. 930 k'cycles. 500 watts.	Oliver J. Nilsen and Co., Studio: 45 Bourke Street, MELBOURNE.	4BK		233 metres. 1290 k'cycles. 200 watts.*	Brisbane Broadcasting Co., Studio: King House, Queen St., BRISBANE.
2GB		316 metres. 950 k'cycles. 3000 watts.	Theosophical Broadcasting St., Studio: 29 Bligh Street, SYDNEY.	3BA		230.8 metres. 1300 k'cycles. 50 watts.*	Ballarat Broadcasters Pty., Ltd., C'wealth Bank Bldgs., Sturt St., BALLARAT.
5DN		312 metres. 960 k'cycles. 1000 watts.	Hume Broadcasters, Ltd., Studio: 29 Rundle Street, ADELAIDE.	5AD		229 metres. 1310 k'cycles. 300 watts.*	Advertiser Newspapers Ltd., Studio: Weymouth Street, ADELAIDE.
3BO		309 metres. 970 k'cycles. 200 watts.	Amalgamated Wireless (A'sia), Ltd. Studio: Kangaroo Flat, BENDIGO.	2MO		227 metres. 1320 k'cycles. 50 watts.*	M. J. Oliver, Address: P.O. Box 78, GUNNEDAH.
4GR		300 metres. 1000 k'cycles. 50 watts.*	Gold Radio Service, Studio: Ruthven Street, TOOWOOMBA.	4RO		225.56 metres. 1330 k'cycles. 250 watts.	Rockhampton Broadcasting Co., Studios in ROCKHAMPTON.
3HA		297 metres. 1010 k'cycles. 200 watts.*	Western Province Radio Co., 37 Gray Street, HAMILTON.	2XN		224 metres. 1340 k'cycles. 50 watts.*	G. W. Exton, Address: P.O. Box 138B, LISMORE.
2UE		293 metres. 1025 k'cycles. 1000 watts.	Radio House, Studio: 617 George Street, SYDNEY.	3KZ		222 metres. 1350 k'cycles. 200 watts.*	3KZ Broadcasting Station, Studio: 40 Victoria Street, MELBOURNE.
5PI		288 metres. 1041 k'cycles. 50 watts.*	Midlands Broadcasting Services, Studio: Ellen Street, PORT PIRIE.	4BH		217.3 metres. 1380 k'cycles. 600 watts.*	Broadcasters (Aust.), Ltd., Studio: 90-92 Queen Street, BRISBANE.
2CA		286 metres. 1050 k'cycles. 50 watts.*	A. J. Ryan, Kingston, CANBERRA.	2GN		216 metres. 1390 k'cycles. 50 watts.*	Goulburn Broadcasting Co., Studio: Auburn Street, GOULBURN.
4MB		283 metres. 1060 k'cycles. 50 watts.*	Maryborough Broadcasting Co., Wynne's Station, MARYBOROUGH, Q.	3GL		214 metres. 1400 k'cycles. 50 watts.*	Geelong Broadcasting Pty., Ltd., Studio: National Mutual Bldgs., GEELONG.
2KY		280 metres. 1070 k'cycles. 1500 watts.	Trades and Labour Council, Studio: Goulburn Street, SYDNEY.	2KO		212 metres. 1415 k'cycles. 200 watts.	Newcastle Broadcasting Co., Studio: 57 Hunter Street, NEWCASTLE.
3SH		277.8 metres. 1080 k'cycles. 50 watts.	Swan Hill Broadcasting Co., SWAN HILL.	3AW		210.5 metres. 1425 k'cycles. 300 watts.*	Vogue Broadcasting Co., Ltd., His Majesty's Theatre, MELBOURNE.
7LA		273 metres. 1100 k'cycles. 200 watts.*	Findlay and Wills Broadcasters, 67 Brisbane Street, LAUNCESTON.	2WL		209.06 metres. 1435 k'cycles. 50 watts.*	Wollongong Broadcasting Co., Address: 149 Crown Street, WOLLONGONG.
2HD		270 metres. 1110 k'cycles. 200 watts.*	Airsales Broadcasting Co., Studio: Civic Centre, NEWCASTLE.	2AY		203 metres. 1480 k'cycles. 50 watts.*	Charles Rice, Studio: 610 Dean Street, ALBURY.
2UW		267 metres. 1125 k'cycles. 1500 watts.	Radio Broadcasting Ltd., Studio: Paling's Bldgs., Ash St., SYDNEY.	3AK		200 metres. 1500 k'cycles. 50 watts.*	Akron Broadcasting Service, Ltd., 490 Elizabeth Street, MELBOURNE.

The 1932 SUPER-



IMPORTANT NOTICE

ON no account must the trimmers of the intermediate units receive any adjustment or tampering. The intermediates are definitely tuned before delivery, and must not be tampered with in any way. Once the adjustment of these trimmers is upset it can only be re-set by a competent mechanic with extensive equipment. So don't attempt to alter it. Similarly the coils should not be removed from their cans, and particularly in the case of the r.f. coils they must be handled very carefully. If the windings are scraped or damaged in any way their performance will be irreparably impaired.

The Superheterodyne Tuning Unit

1—Aluminium base, according to the audio system used, 19 x 9½ x 2, or 16½ x 10½ x 3.
1—Stromberg-Carlson superhet. kit of coils, cans, padders, intermediates etc., (L1-5-P.C.).
4—.5 mfd. fixed condensers (.1 or 1 will do). (C1, 3.4.5.) (*Chanex, Hydra, T.C.C., Wetless.*
1—.0005 mfd. fixed condenser (C2). (*T.C.C., Wetless, Alpha, Pilot, Renrade*).
1—10,000 ohm. grid-leak (R3) (*I.R.C., Renrade, Radiohm, International*).
1—15,000 ohm. ditto, 2 watt type (R4.) (Ditto.)
1—10,000 ohm. potentiometer wire-wound (R1) (Chancery, Radiokes, Raycophone).
1—200 ohm. Wire-wound resistor to carrry 25 ma. (R2). (*Renrade, Kriesler, Radiokes, Raycophone*).
4—UY valve sockets. (*Renrade, Raycophone*).
1—Dial. (*Darelle, Radiokes, Raycophone*).

VALVES

1—227 type valve | *Philips, Radiotron, Ken-*
1—224 type valve | *Rad, Mullard, National*
2—235 type valves | *Union, Cossor, etc.*

HERE is a reprint of the original article published in our issue of January 15, 1932, which really started the superhet. boom. The various versions of the sets described here have been built by hundreds, even thousands, of readers, and in 99½ per cent. of cases remarkably fine results were reported. Although published some time ago, and using the 235 and 224 type valves, these sets are by no means out of date; in fact, their general performance should come right up to the most modern standards. To anyone wanting a really reliable and trustworthy job we have no hesitation in giving them our fullest recommendation.

HOW IT'S DONE

THE idea in our minds when starting out to describe the three sets at once was that many readers have sets perhaps with excellent audio systems, but lacking in selectivity and sensitivity. These readers can now follow out the description of the superheterodyne tuner and add it to their existing set. Others will want to build the set as a complete job, and so we are adding the descriptions of three excellent audio amplifiers. In each case it might be also kept in mind that any one of these amplifiers will be particularly suitable for gramophone amplification or demonstration work. We fancy that all types of enthusiasts will be able to glean their shilling's worth of information out of this book even if they can't afford to build a superhet. for the moment.

Many readers may be sceptical about supers, but we want to say here and now that the old supers were not the same as the new ones. Personally we have just completed the eleventh modern super. These have been built during the past three months, and each one has been better than the last. To go back to building and getting enthusiastic about three and four valve sets is going to be our hardest task in the future. We assure all enthusiastic experimenters that once they get on to superhets their enthusiasm is going to take a new lease of life. In the first place, the natural selectivity of the superhet. is astounding. Interference troubles are immediately a thing of the past. Sensitivity can be obtained without any tendency to oscillation, and there are definitely no snags. The coil kit specified has now been used by us in building four superhets, and in each case the adjustment of the trimmers has been accomplished in less than ten minutes, and then one setting was perfectly O.K. for every setting of the dial. Two spot tuning, image interference, and all other troubles we often read about in books have entirely failed to materialise, and in every way the superhet can now be considered an entirely satisfactory and serviceable job, easy to build, simple to adjust, and capable of giving the most excellent results.

TONAL QUALITY

FROM time to time we have also heard tales about the tonal quality of superhets being poor on account of side band cutting or some such theory. In actual practice this is absolute piffle, and if anyone can fault the tonal quality of any of the supers described in this book he will be extremely hard to please.

NO HUM

IN each case attention has been paid to hum, and special steps taken in the design to ensure entire absence of this trouble. The resistance-coupled job is particularly free from hum, the direct-coupled job is also quite hum free if the resistance and condenser values are correct, and the push-pull job is particularly silent on account of the extensive filtering obtained by the use of the speaker field as a filter choke for all current feeding to the audio or detector valves.

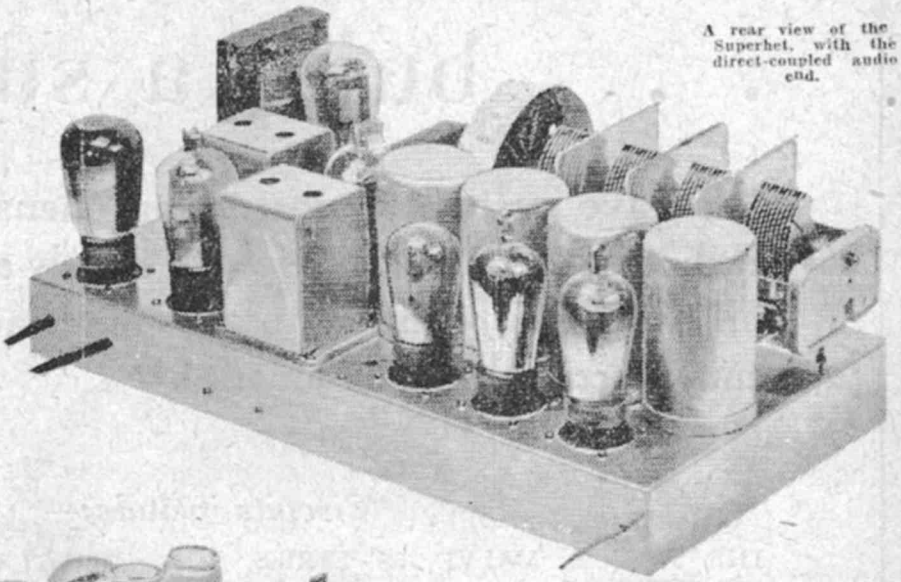
WHICH TO SELECT

"WHICH audio system shall I use?" is going to be the first question asked unless we go fully into the advantages of each circuit. Personally, we strongly advise readers to use the resistance-coupled audio stage. This eliminates any of the harshness of the pentode, calls for a low voltage power transformer, and is simple and easy to get into perfect operation. For those who wish to boast to their neighbors that they have a superhet with nine valves

HETERODYNE

Three Modern Audio Systems

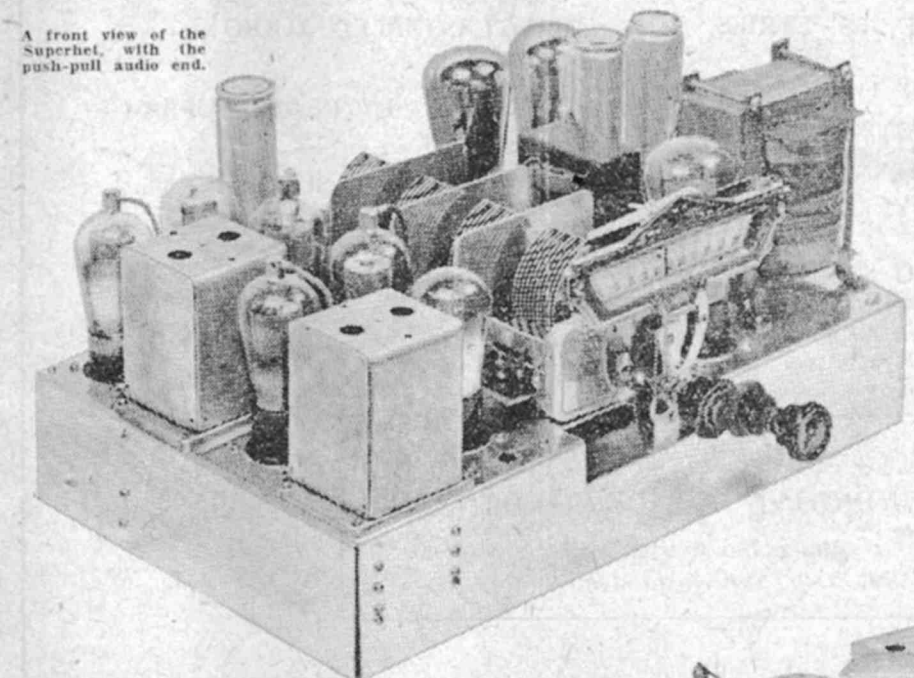
in it, then the push-pull job gives the most valves for a given cost. Results, however, are not necessarily in exact proportion to the number of valves employed. The push-pull job is very fine, and particularly so when a Ferranti AF5C is found lying about under the bench. For the direct-coupled cranks a version employing this audio system is included.



A rear view of the Superhet, with the direct-coupled audio end.

THE COST

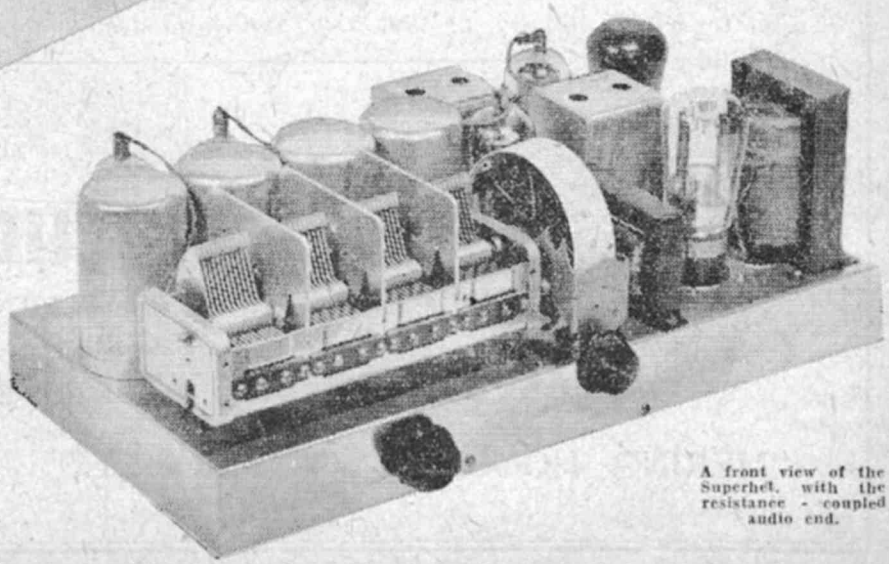
AT the moment of writing we are not able to tell exactly what the cost of the kits is going to be, but we fancy that there is not going to be any great difference between them. If the push-pull job is going to be listed at about the same price as the other jobs, then our first preference is going to swing to the push-pull job. As it has much greater audio gain than the others, it should give terrinc range, whether the coils are correctly lined up or not.



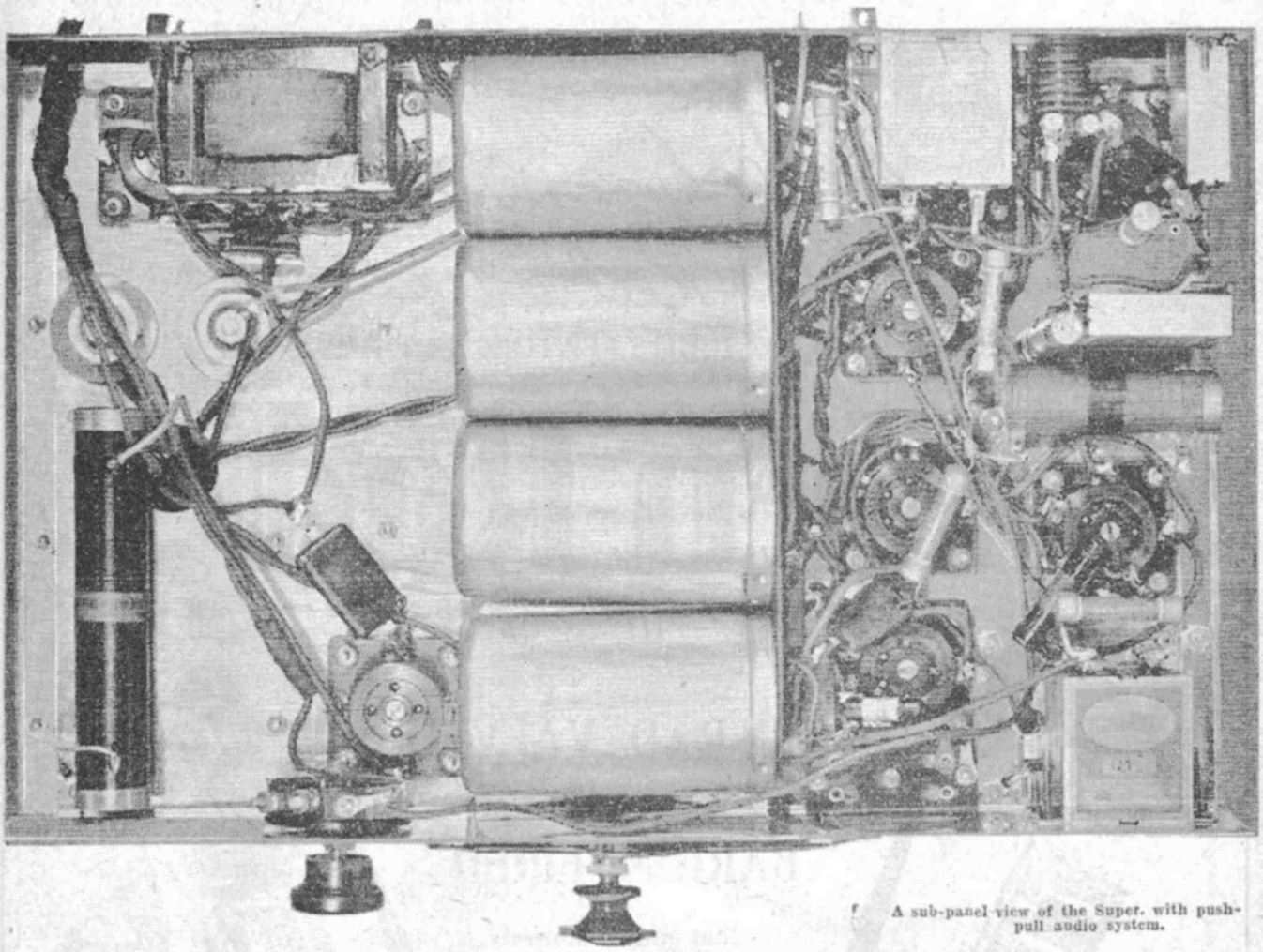
A front view of the Superhet, with the push-pull audio end.

PERFORMANCE

DURING the building of this set there were only two nights on which the full sensitivity of the supers could be used. On every other occasion the noise level was so high that we were unable to turn the volume control up beyond about half-way. However, on Christmas Eve and Christmas night the static cleared away for an hour or two, and, using the direct-coupled job, we had no trouble in logging exactly 36 different stations between 8 and 9.15 p.m. During this test we were using a short indoor aerial of about 10 feet length, and no earth connection whatever. The addition of an earth wire brought up the signal strength considerably, but also made the set sensitive to general interference noises from local electric fans, etc. Although located at Potts Point, where 2GB comes through at solid strength, there was no difficulty in keeping 2GB quite clear from 3UZ on the one side and 3BO on the other. The performance of the resistance-coupled job was very much the same, but the push-puller was far more sensitive; this sensitivity could not be used on account of the increase in the noise picked up along with the signals. However, conditions permitting, a better idea of the capabilities of this Super. should be evident in a better location.



A front view of the Superhet, with the resistance - coupled audio end.



A sub-panel view of the Super. with push-pull audio system.

be obtained, and a comparatively constant sensitivity for the whole of the wave-band can be obtained by this method. Obviously, if the set is to be installed for some dear old lady to operate, it is imperative that the resistor should be fitted so that oscillation cannot occur, no matter how the controls are handled.

THE VALVES

THE valves specified must be used. And deviation in this respect is carried out at the builder's risk. The use of any high-gain valves in place of the variable-mu valves will cause, possibly, cross-talk, two-spot tuning, and a host of other evils, and the effective gain will be considerably lowered. Don't be misled by high amplification factors, they mean little in actual practice. Readers who studied a previous superhet constructional article may be a trifle tickled on reading this paragraph, but it just can't be helped. We live and learn. On no account should ordinary 224 type screen grids be used to replace the variable-mu types specified. When first introduced a lot of people imagined that the 235 type valves were simply 224 types with different labels. They are not.

THE LAYOUT

THE best plan will be to follow the layout shown in the photographs as near as possible. If the coils are mounted on a bracket suitable for fitting under the base, but it is desired to use them on top of it, the eyelets which rivet the cans to the bracket must be removed. This can be done readily by using a quarter-inch drill and cutting a few turns into the rivets. They will then fall out, and the coils can be removed by unscrewing the central screw. Great care must then be exercised to ensure that the coil windings are not scratched or otherwise damaged when the cans are being removed or after they have been taken off. The lid of the can can be used to mark the necessary holes which will be required to take the leads through the base, and the coils can then be mounted directly on to the base, with the lids of the cans held rigidly under the coil brackets.

THE FILAMENT WINDING

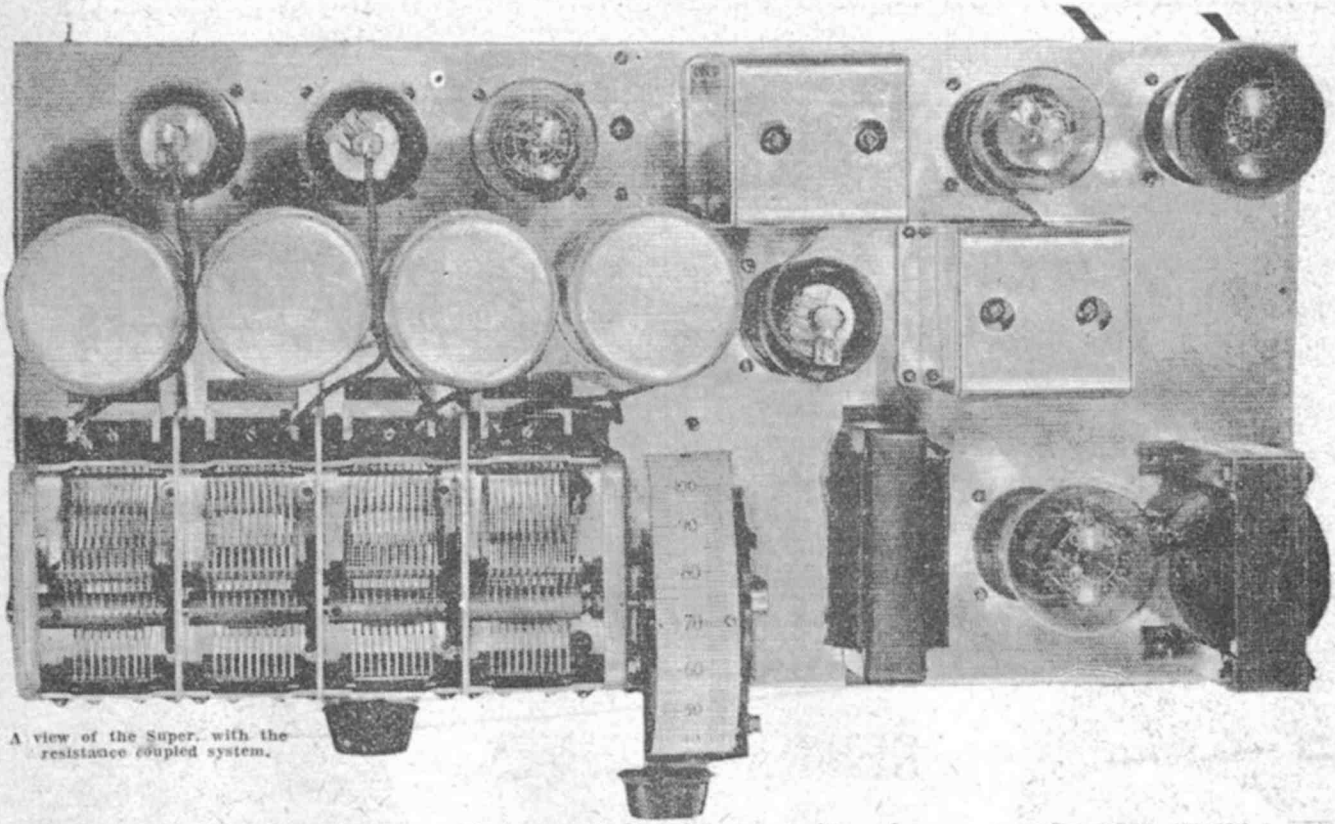
IN the case of the wiring of the filaments care must be paid to the current carried by the various wiring. It should be remembered that the 224 and 235 types take 1½ amperes each. If six of these are wired in parallel the total drain through the supply wires to the first valve will be 10½ amperes, a very heavy current. Fine gauge wire will not carry this current without burning out, and even fairly heavy wire will give a voltage drop of up to a volt if the leads are about twelve inches long. To overcome the difficulty two pairs of fairly heavy wire, such as rubber-covered power flex, should be run up, with only three valves pulling current from each of the pairs.

ASSEMBLING THE PUSH-PULL JOB

IF the coils are mounted under the base as shown for the push-pull job, a certain amount of ingenuity is required to get the parts assembled in their proper order so as to avoid awkward situations which may arise; for example, if the coils are mounted before the tuning gang. Personally, when assembling this set we placed all the components on top of the base, marking out the necessary holes, and then completed the drilling of these holes. The components on top of the base were then all mounted permanently and the wiring of the rectifier and the filaments of the valves was completed before the coils were mounted. The necessary holes to take the red leads through to the terminals of the stators of the tuning gang must be drilled before the coils are mounted, so that the leads can be pushed through as the coils are slipped into position.

MOUNTING THE PADDING UNIT

THE padding unit should be mounted so that the adjusting screw is accessible from the top of the base. It will be noticed that in the push-pull job we have a hole drilled in front of the oscillator valve. The padding unit is mounted so that the adjuster can be reached with a screwdriver through this



A view of the Super, with the resistance coupled system.

NOT FOR THE "MUG"

ALTHOUGH perfectly satisfactory in every way, the superhet is a little too advanced for the average novice, and we commend it more to the enthusiast who has at least built one set previously. Considering the number of valves employed, the sets are fairly simple, but hardly simple enough for the beginner.

THE TUNER

THE first item is the tuner, and this will be needed for all audio systems. It could also be used to add on to an existing audio amplifier. For example, anyone owning a good "1930 "Four" will simply alter his existing set and fit the tuner. If insufficient filament current is available, an extra transformer can be obtained cheaply, and can then be built into the tuner. The ordinary tappings of the special tapped resistor will supply sufficient current for the plates and screens. Similarly a "1930 Three" can be used in the same way. The r.f. end of the set being scrapped, the parts can then be used wherever possible in the r.f. tuner. The by-pass condensers should be available, so that the actual cost of the conversion will be small in comparison to the increase in selectivity and sensitivity. Tonal quality, of course, will not be affected in any way.

SELECTING THE PARTS FOR THE TUNING UNIT

GLANCING through the list of parts for the tuning unit, we find that two sizes of bases are specified. The first question, then, is to decide on the type of audio system to be used. If push-pull, then it may be found a good plan *to mount the coils under the base, in* which case the 16½ x 10½ x 3 base will just serve nicely. If, however, either of the other audio systems is to be employed, then we would suggest the longer base, with the coils all mounted on top. In this case the wiring is somewhat simpler and the general construction a little easier. The coils under the base, however, have one advantage in so far as the lengths of the grid leads are kept at an absolute minimum.

THE KIT

THE next item is the whole heart of the job, the Stromberg kit. This comprises not only the four coil units with their cans, but also the intermediate coils and cans, together with the four-gang tuning condenser and the padding unit. The latter consists of a small fixed condenser, shunted by another condenser of the adjustable type, together with a shunt resistor of 30,000 ohms. This is supplied in a unit with mounting screws ready for fitting in the set. It is shown in the circuit diagram as PC. The adjustment of this padding unit is responsible for the tracking of the oscillator tuning section of the gang, and is most important.

THE BY-PASS CONDENSERS

THE values of the by-pass condensers are not critical, and practically any capacity of small paper-dialectric condensers will serve.

THE MICA CONDENSER

THE small mica condenser of .0005 is an important item, and we strongly advise readers to use this capacity only or a .0006 mfd. if this size is available. This condenser acts as a sort of fixed reaction condenser for the oscillator to make it oscillate, in a similar way to *that by which the old one-valve set* gets reaction with a variable condenser.

THE GRID-LEAKS

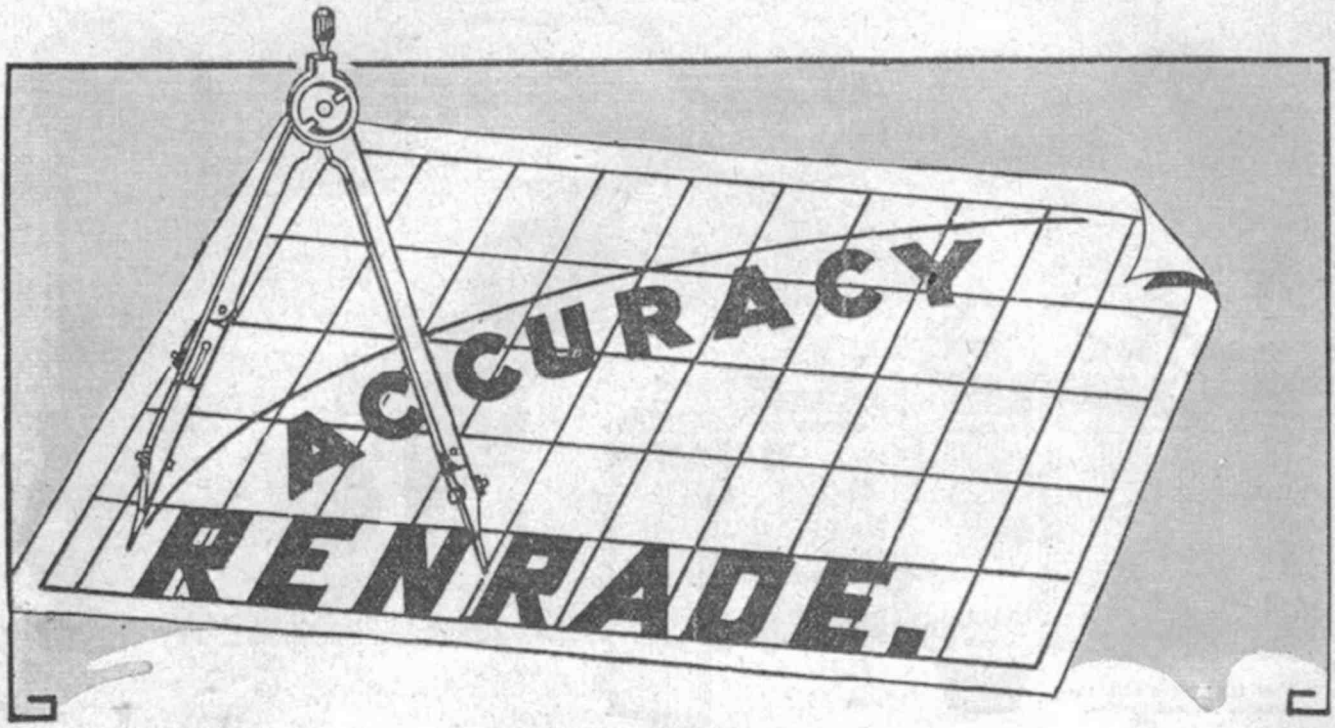
THE 10,000 ohm grid-leak is also a rather critical value, although smaller resistances down to 5000 ohms are O.K. It is also called upon to carry fairly heavy current, and should be of at least a 1 watt rating. The 15,000 ohm resistor can be from 10,000 ohms to 15,000, and is also carrying heavy current. A 2-watt resistor is desirable.

THE VOLUME CONTROL

VOLUME is controlled by the potentiometer R1. This potentiometer is carrying up to about 15 ma. current when volume is at maximum, so it must be of the wire-wound variety. If any trouble is experienced in getting a suitable potentiometer a Pilot resistograd or Emmco "Emmcostad" will serve the purpose quite well. If potentiometers of lower value are on hand, or if the potentiometer specified fails to give sufficient control, a little more current should be fed through the potentiometer. This can be arranged in the case of the push-pull job by taking the earthed end of the resistor R6 and running it to cathode end of the pot. instead. Similarly with the resistance-coupled job the earthed end of R6 can be treated in a similar manner.

REACTION!

THE resistor R2 can be omitted by experienced radio enthusiasts who know how to handle a set in an intelligent manner. In this case the set will burst into violent oscillation just before the volume control reaches the position where there would be no bias on the r.f. and intermediate valves. At the *point one degree before the oscillation* takes place, maximum sensitivity can



RENRADE RESISTORS

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WHEN building up your new Superheterodyne Set, remember one of the most important components is the Resistor. In order to cope with the demand for an accurate Resistor that remains constant under load, Renrade have produced a new Carbon Type Resistor finished in a very attractive Duco and calibrated by means of a spiral, which gives much closer calibration and a longer element. The longer element eliminates to a great extent the excessive variation in temperature, and therefore provides for greater accuracy in operation. They are also specially treated with duco which does not crack or chip, and being fitted with long tinned pigtails are easily mounted in a set. Do not risk the ultimate success of your Radio by using faulty resistors—

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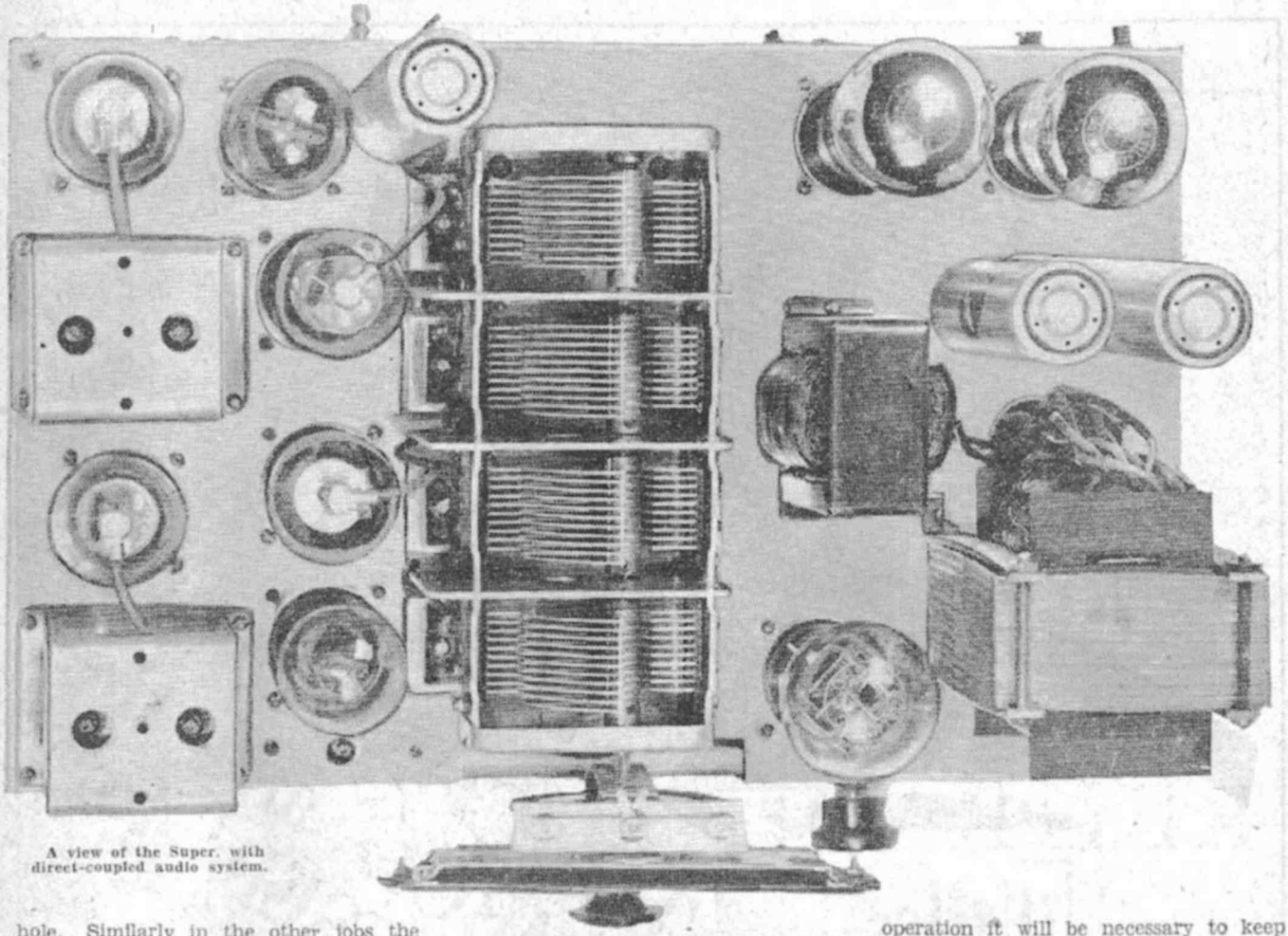


A view of the Super, with direct-coupled audio system.

hole. Similarly in the other jobs the padder can be mounted in any position adjacent to the oscillator valve or coil unit, but we think it a good plan to keep the actual condenser at least half an inch away from the aluminium of the base to ensure that there will be no stray capacity between the condenser and earth.

THE FIRST TESTS

THE job being now assembled and ready for testing, the first thing to be done is to get the audio end of the set in going condition. If a pick-up is available, so much the better. On switching on the set as usual the first item to watch will be the rectifier valve. The filaments should light up to a dull red, but on no account should a blue glow be present. If the blue glow appears switch off the set and search for a short circuit in the high tension. Otherwise the set should have a "live" sound for a few moments, and then settle down to a quiet hum. In the case of the direct-coupled job, a loud hum is heard until the valves warm up. After the set has warmed up it is most probable that a swing of the dial will bring in the local stations at any rate. Once a station has been picked up the most important part of the whole job has to be performed.

ALIGNING THE TRIMMERS

THIS is how we suggest that readers go about the alignment job. First set all trimmers at about half-way up, and screw the padder adjuster right out. Now set the condensers so that the rotors are exactly half-way out, that is, they stand vertically when the stators are horizontal, measuring along the straight edge of the plates. Now adjust the trimmer of the oscillator section of the gang until 2BL is tuned in at this setting of the dial at maximum strength. Then run back with the screwdriver to sections 3, 2, and 1 of the gang, trimming each section until 2BL is coming in at full blast. Doubtless during this operation it will be necessary to keep retarding the volume control to keep the signals from 2BL at a reasonable level, so that it is easy to tell when the trimmers are correctly adjusted for best results. Having lined up the sections so that 2BL is at full strength when the dial setting is such that the straight edges of the plates are at right angles to each other, the set should now be swung over so that the plates are just about out of mesh. Somewhere here it should be possible to pick up 2SM, 2UW, or 2NC. For preference an even farther distant station, such as 2AY, should be heard. Having picked up a station, the trimmers of the section 1, 2, and 3 can be again adjusted for maximum, but leave the setting of the oscillator section at exactly the same setting as originally found necessary to bring in 2BL at the given setting of the dial. Having lined the trimmers of the other sections for 2AY, now swing up to 2FC, 3AR, or 2CO. Do not adjust any other trimmers except the adjuster of the padding unit. A few half turns of this adjuster should now bring these stations up to full strength, and a swing back to 2AY should reveal that that station still comes in with its original strength. Running along the sections with the screwdriver again not more than a quarter of a turn should be needed for each section.

Stromberg-Carlson Superheterodyne Coil Kit

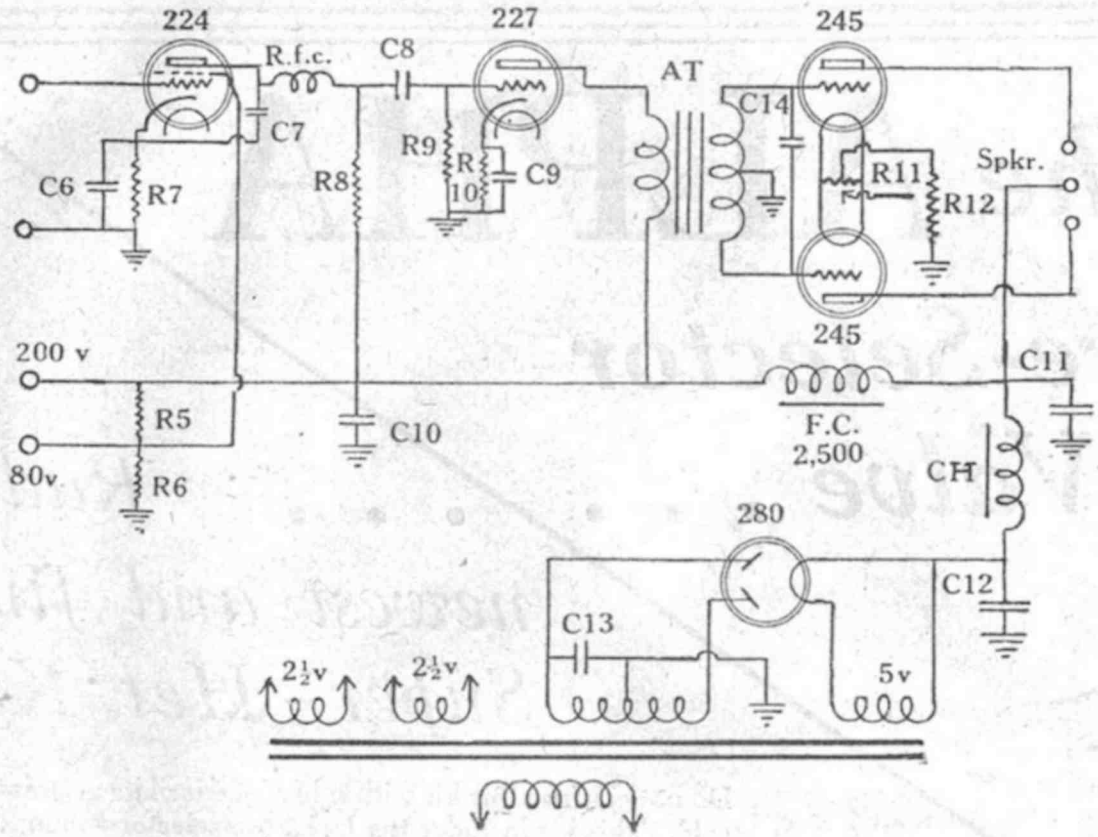
COLOR CODE

Intermediate Coils—
B plus—Red.
Plate—Green.
Earth—Yellow.
Grid—Blue.

Aerial Coil (No. 1)—
Aerial—Blue.
Earth—Green.
Grid—Red.

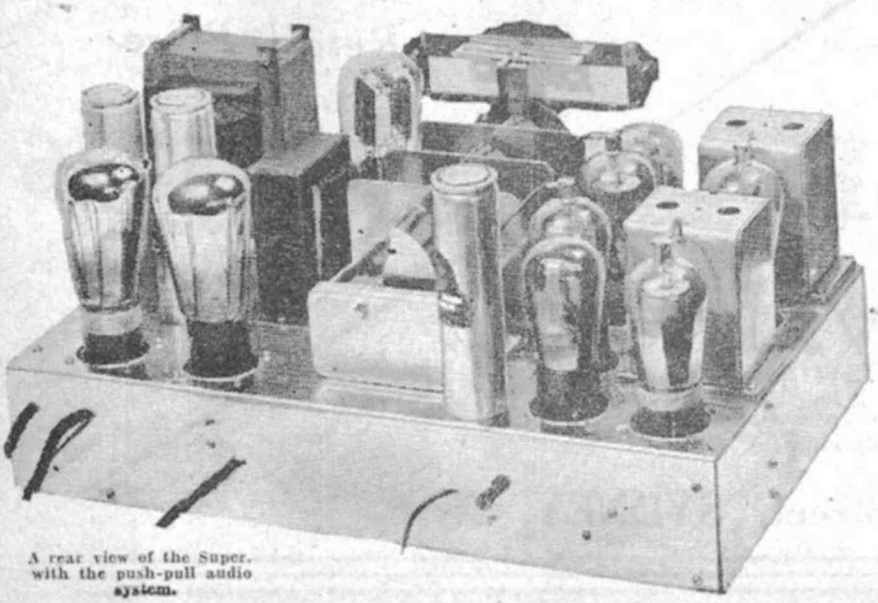
Other Coil Units—
Plate—Blue.
Earth—Green.
B plus—Black.
Grid—Red.

Oscillator Unit—
Cathode—Yellow.
Bias Resistor—Orange.
Reaction—Blue.
Padder—Green.



PARTS REQUIRED FOR THE PUSH-PULL AUDIO END

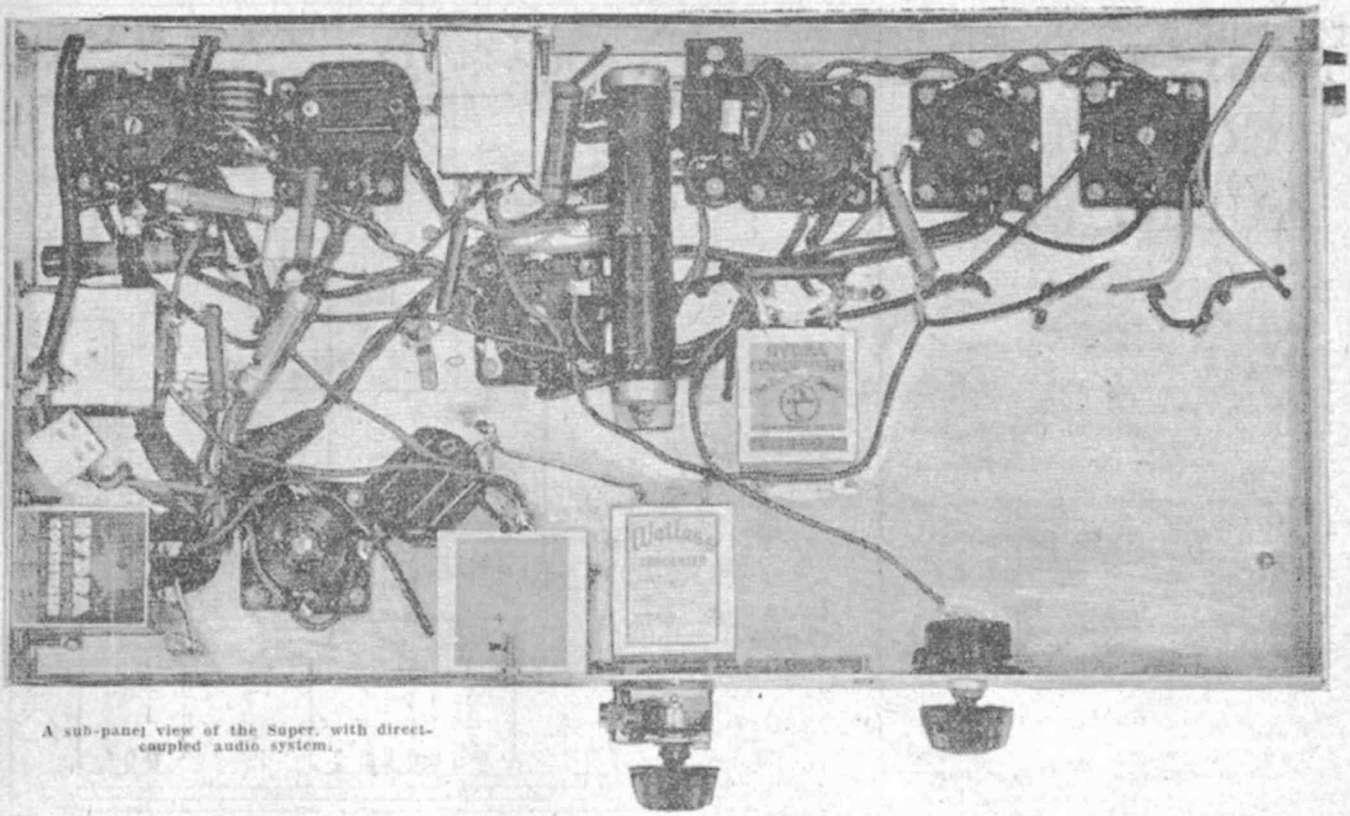
1—Power transformer, 350/350 v. at 100 m., 5 v. 2a., 2½ v. 3a., 2½ v. 10a. (*Radiokes, Kriesler, Univox, Raycophone*).
1—30 Henry, 100 mill. choke (C.H.) (*Radiokes, 1-12, Kriesler, Univox, Raycophone*).
1—Push-pull audio transformer (A.T.) (*Ideal, Ferranti, Pilot, Univox*).
1—Radio frequency choke (R.F.C.) (*Radiokes, Raycophone, Kriesler, Univox*).
1—3000 ohm wire-wound resistor, to carry 50 mills. (R5) (*Renrade, Radiokes, Raycophone, Kriesler, Univox*).
2—2000 ohm wire-wound resistors to carry 50 mills. (R6, R10) (*Renrade, Radiokes, Kriesler, Raycophone, Univox*).
1—750 ohm 10-watt wire-wound resistor (R.12) (*Renrade, Radiokes, Raycophone, Kriesler, Univox*).
1—20 ohm centre-tapped resistor (R11) (*Renrade, Radiokes, Raycophone, Kriesler, Univox*).
1—.01 fixed mica condenser (C8) (*T.C.C., Wetless, Renrade, Alpha.*)
1—.002 fixed mica condenser (C13) (*T.C.C., Wetless, Renrade, Alpha.*)
1—.001 fixed mica condenser (C14) (Optional) (*T.C.C., Wetless, Renrade, Alpha*).
1—.0005 fixed mica condenser (C7) (*T.C.C., Wetless, Renrade, Alpha.*)
3—8 mfd. electrolytic condensers (C10, 11, 12) (*Polymet, Sprague, Dulytic, T.C.C.*).
1—1 mfd. fixed condenser (C9 (*Hydra, T.C.C., Chanex, Wetless*).
1—.5 fixed condenser (C6) (*Hydra, T.C.C., Chanex, Wetless*).
1—50,000 ohm grid-leak (R7) (*Renrade, I.R.C., Alpha, International, Radiokes*).
1—250,000 ohm grid-leak (R8) (*Renrade, I.R.C., Alpha, International*).
1—1 megohm grid-leak (R9) (*Renrade, I.R.C., Alpha, International*).
2—UY, 3 UX sockets (*Renrade, Raycophone*).
Valves—1 224 type valve; 1 227 type valve; 2 245 type valves; 1 280 type valve (*National Union, Philips, Mullard, Ken-Rad, Cossor, Radiotron*).
Speaker—2500 ohm d.c. type (P.C. (*Jensen, Amplion, Sazon, Jubilee*).



A rear view of the Super. with the push-pull audio system.

FINAL JUGGLING

IT should be now quite an easy matter to tune in any station possible with due regard to static, but a little finer adjustment may be needed to get the necessary separation between stations such as 3BO and 2GB, particularly in certain locations. This can be carried out by bending the sections of the plates of the tuning condensers, which are slotted for the purpose. Using the knitting needle mentioned in another article it should be fairly easy to prod the plates to find just which ones need bending. It should be remembered that bending the plates outwards is exactly the same in effect as screwing out the trimmer adjuster. For example, if we find that the second section is O.K. at the bottom of the dial, but when we reach the top the adjuster needs a quarter of a turn outwards, then the outside plates of the section must be bent outwards so that the trimmer can be left at its original



A sub-panel view of the Super, with direct-coupled audio system.

position. Naturally, only the section of the plates which is now enmeshed, but which would be out of mesh when the set is tuned to the bottom of the dial, will be bent. Actually this somewhat lengthy description of the adjustments is likely to give readers a wrong impression. The job is quite simple, and probably without the slightest adjustment at all it will be found that the set will pull in all the static which can be tolerated.

THE PUSH-PULL AUDIO SYSTEM

THE audio system suggested for those who want the greatest number of valves for a given cost is the push-pull. The circuit follows along the lines of the "Super-six for A.C." ("W. W"., 16/10/'31) and there is nothing about it which is likely to give any trouble. The value of the resistor R7 may stand a certain amount of variation, 30,000 or even 25,000 ohms may give better results with certain valves, but a definite value cannot be decided without actual testing. Either way, the difference will be most minute. The condenser C14 is optional, and many who like brilliant reproduction will prefer to leave it out of the circuit. Its purpose is merely to tone down the high notes a trifle to give the impression of "mellow" tone so much sought after by certain types of listeners. It is not a bad idea to fit the condenser with a switch in one lead. This switch can then be brought through to the front of the panel as a "tone control switch."

THE RESISTANCE-COUPLED SYSTEM

THIS system is somewhat similar to that employed in the "Advance 1932" receiver ("W. W.", 8/1/32). It represents the only truly satisfactory method of employing the 247 type pentode. With this system of feeding the bias on to the grid of the pentode, instead of the more conventional automatic biassing system, it is possible to obtain the most excellent reproduction of the low notes, so that with the circuit as shown the tonal quality is particularly fine. It is also simple and easy to get into operation, and carries our strongest recommendation. As regards the selection of the parts for this circuit, it might be worth while to read the remarks published in a previous article in regard to this matter. There are no snags about the system, and we cannot find anything about it really worth while elaborating.

THE DIRECT-COUPLED SYSTEM

FOR a direct-coupled system any of the previously described amplifiers will suit, using either the 245 type power valve, F443 high-voltage pentode, or the 247 pentode. We do not particularly recommend the 247 pentode for direct-coupling, however, as it is very critical to faulty resistances, etc., and is too readily overloaded. It is fine for the resistance coupling system, but not so good, in our opinion, for direct-coupling. However, as an alternative, we suggest the use of the C443 type pentode, and this is shown in the circuit diagram published here. Actually the pentode is running at full load, and it might be more advisable to use an E443N in this socket without otherwise altering the resistance. This would mean that the E443N would be running at light load with about 250 volts on the plate and drawing 22 mills. plate current. At this light load the pentode is still capable of giving solid volume, and should last a lifetime, as it would keep so cool. It will be noticed that we have not troubled about a hum bucker with this amplifier, a 400-ohm resistor being substituted for the potentiometers originally specified in these circuits. Students of design may be a little surprised to notice that the special tapped resistor is the same as used with a 245 type output valve. This is possible on account of the total drain of the plain and auxiliary grid of the pentode being approximately the same as for the plate of the 245 alone.

SPEAKERS

IT will be noticed that we have catered for all the normal types of dynamic speakers at present available. The push-pull job needs a d.c. type with a field of 2500 ohms. For the resistance-coupled amplifier a similar speaker, but having 8000 ohms resistance, is required, whereas the direct-coupled job is suitable for use with an a.c. speaker. The various speakers can be interchanged with a little ingenuity, but that is another tale.

Parts Required for the

RESISTANCE-COUPLED AUDIO END

1—Power Transformer 350/350 at 100 m.a., 5v2a, 2½v9a, 2½v1½a. (*Darelle, Radiokes* 1-12, *Univox, Kriesler, Raycophone*).

1—30 Henry 100 mill. choke (C.H.) (*Radiokes, Kriesler, Univox*).

1—Radio frequency choke (R.F.C.) (*Radiokes, Kriesler, Univox, Raycophone*).

1—.0005 mica condenser (C2) (*Renrade, Wetless, T.C.C., Alpha*).

1—.001 mica condenser (C8) (*Renrade, Wetless, T.C.C., Alpha.*)

1—.01 mica condenser (C3) (*Renrade, Wetless, T.C.C., Alpha*).

2—8mfd. electrolytic (C5, C7) (*Sprague, T.C.C., Polymet, Dulytic*).

2—.5 mfd. condensers (C1, C6) (*T.C.C., Hydra, Wetless, Chanez*).

1—1 mfd. fixed condenser (C4). (*T.C.C. Hydra, Wetless, Chanez.*)

1—Centre-tapped resistor, 20 ohms (R11) (*Radiokes, Renrade, Raycophone*).

1—250 ohm wire-wound resistor (R12) (*Radiokes, Renrade, Kriesler.*)

3—50,000 ohm grid-leaks (R5, 6, 7) (*Renrade, I.R.C., International, Alpha, Radiohm*).

2—100,000 ohm grid-leaks (R10, R13) (*Renrade, I.R.C., International, Alpha, Radiohm*).

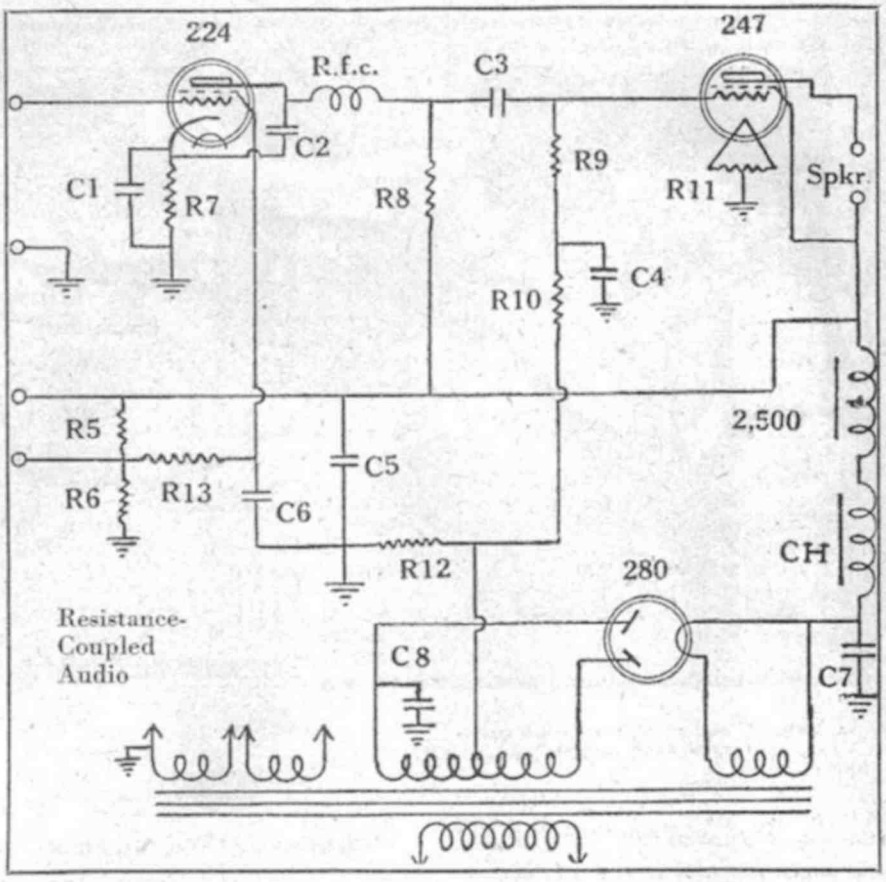
1—250,000 ohm grid-leak (R8) (*Renrade, I.R.C., Alpha, International.*)

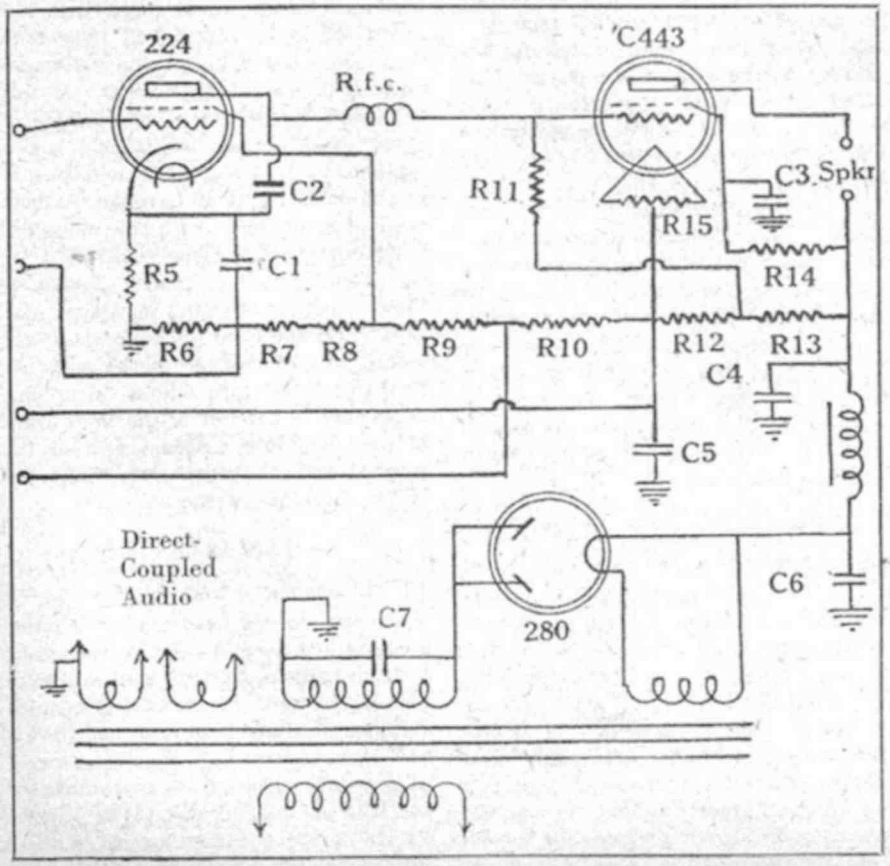
1—0.5 meg. grid-leak. (R9) (*Renrade, I.R.C., Alpha, International*).

2—UY 1 UX sockets (*Raycophone, Renrade.*)

Valves—1 224 type valve; 1 247 type valve; 1 280 type valve (*Ken-Rad, Philips, Radiotron, Cossor, Mullard, National Union*).

Speaker—2500 ohm D.C. type (F.C.) (*Jensen, Saxon, Amplion, Jubilee.*)





Parts Required for the

DIRECT-COUPLED AUDIO END

1—Power Transformer, 475 volts at 40 m.a., 2½v.8a., 4v.1a., 5v.2a (*Radiokes, Univox, Kreisler, Raycophone*).

1—30 Henry 50 mill. choke (*Radiokes, Raycophone, Kreisler, Univox*) (C.H.)

2—4 mfd. fixed condensers, to work at 500 v. (*Chanex, Wetless, T.C.C., Hydra*). (C4. 6.).

2—2 mfd. fixed condensers, to work at 500 v. (*Chanex, Wetless, T.C.C., Hydra*) (C3. 5).

1—1 mfd. fixed condensers, to work at 500 v. (*Chanex, Wetless, T.C.C., Hydra*) (C1).

1—0005 mfd. fixed condenser, to work at 500 v. (*Chanex, Wetless, T.C.C., Hydra*) (C2).

1—002 mfd. fixed condenser, to work at 500 v. (*Chanex, Wetless, T.C.C., Hydra*) (C7).

1—Special tapped resistor 490, 910, 2350, 3540 ohms (*Radiokes, Renrade*), (R6, 8, 9, 10).

1—Radio frequency choke (*Radiokes, Raycophone, Kreisler, Univox*). (R.F.C.).

2—25,000 ohm grid leaks (*Renrade, Radiohm, International, Alpha, I.R.C.*) (R12, 14)

2—100,000 ohm grid leaks (*Renrade, Radiohm, I.R.C., International, Alpha*) (R5, 13)

1—500,000 ohm grid-leak (*Renrade, Radiohm, I.R.C., International, Alpha*) (R11).

1—20 ohm centre-tapped resistor (*Renrade, Radiohm, I.R.C., International, Alpha*) (R15).

1—400 ohm wire-wound resistor (*Renrade, Radiohm, I.R.C., International, Alpha*) (R7).

2—UY. 1 UX sockets (*Renrade, Raycophone*).

Valves—1 224, 1 280 (*National Union, Philips, Mullard, Radiotron, Cossor, Ken-Rad*).

1—Philips C443 or Mullard PM24A pentode.

WHAT THEY WANTED TO KNOW

Compiled from Correspondence Received.

AFTER the publication of the constructional article on the "1932 Superheterodyne" we invited queries from readers. After these were answered we were able to get a very good idea of the type of questions asked by readers about superhets. Here is a selection of the points raised by querists, together with an idea of the way in which they were answered.

Q.—You speak of separating 3BO from 2GB as though it were a task, but I can do that already on my present set, so it appears that the superhet. is not much better?

A.—When speaking that way, we were talking about the operation of the set in a location where, on the average commercial set, 2GB spreads over half the dial. In your location you should be able to put another two or three stations between 2GB and 3BO.

Q.—Where will I mount the electrolytics in the resistance-coupled version?

A.—In the square on top of the base bounded by the second intermediate coil can, the power transformer, the output pentode, and the edge of the base.

Q.—In the resistance-coupled jobs the r.f. valves get about 250 volts on their plates. Is this harmful in any way?

A.—No, the valves are O.K. at this voltage when biassed as shown in the circuits published.

Q.—Can I tune in 6WF (Perth) on your superhet. with the same purity of tonal quality as a VERY local station when 2FC is still on the air?

A.—No. We make no ridiculous claims for the sets we describe. Any fool knows that reception of stations over a distance of over 2000 miles is inclined to be slightly marred by atmospheric noises, or noises caused by electrical devices and appliances in the neighborhood of the receiver. We would point out, however, that sets built to the circuits published have recorded sensitivity figures on accurate testing equipment to prove them more sensitive than any set previously described in "Wireless Weekly" or any other Australian technical journal.

Q.—Can I use the "————" ganged condenser with the coils?

A.—No, the capacity is unsuitable. As it happens, the coils are accurately matched to a certain ganged condenser and are not supplied except in the complete kit form with this particular condenser unit.

Q.—Can I add two more r.f. stages and three more intermediate stages to the set so that it will be really sensitive?

A.—The time and money would be far better spent in getting the set into perfect adjustment. Correctly built and aligned as per our diagrams, it is quite possible to get a sensitivity of under 2 microvolts absolute. This is quite beyond the limit which can be handled, and any signals not picked up under these circumstances would be useless, as they would be below the noise level, and no matter how much amplification is used they will still be amplified only in direct proportion to the noise level so that they will not be worth hearing.

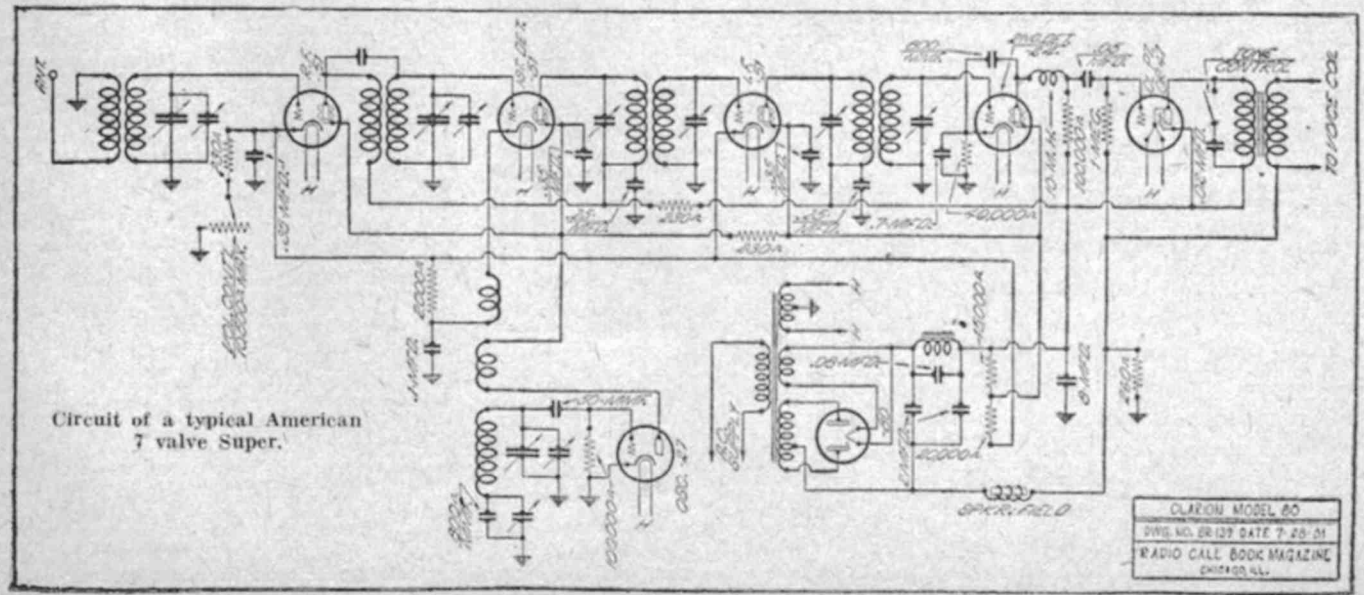
Q.—Will you please post me back a full explanation of why the superheterodyne works, why it needs so many valves, together with full picture diagrams for the layout of each of the three types when built on bases size 12 x 9 x 2?

A.—No.

HOW TO MAKE SUPERHET. COILS

TO many it may appear that it would be cheaper and simpler for the superhet. coils to be wound at home. Unfortunately this cannot be done, and we have therefore followed the usual manner of describing superhet construction only when dealing with a complete ready-wound coil kit. In this respect we follow the practice of all the leading English and American technical journals. Without complicated testing gear it is not possible for a home builder to tune the intermediate transformers to an exact 175 or 465 kilocycles as the case may be. It is not possible for us to even specify any particular number of turns for the intermediates, as so much depends on the way in which the coils are wound.

Even the larger factories find it necessary to use honeycomb or duolateral windings for the intermediates in order to get a certain degree of uniform distributed capacity, etc., and for the home builder to attempt to wind ordinary bunch windings would be a doubtful matter. In order to assure ourselves that 99 per cent. of those who work from these instructions will immediately obtain entire satisfaction we are not publishing any details of the coils, and only recommend that the sets be built with the particular coil kit specified for the purpose.



Circuit of a typical American 7 valve Super.

"NEVER HAD OR HEARD A SET LIKE IT"

How Radio Enthusiasts Have Responded to the "W.W." Superhets. Builders Loud in Their Praises.

PROOF of the popularity of the superheterodyne is shown by the remarkable reception accorded our own "1932 Superhet." It is reported by the manufacturers that several hundreds of kits of parts have been supplied, and so far as we know there is not a single case in which major trouble has been encountered. A little hum here and maybe a power pack warming up elsewhere, but, generally speaking, 99 per cent. of the builders appear to have obtained immediate results. Here are a few extracts from letters received:—

6WF AND THE JAPS.

MR. A. E. MOUNSEY, of 48 Pope Road, Blackburn, Victoria, says: "Five minutes after switching it on for the first time I tuned in 6WF, 4BC, and one of the Japs. I was using an outdoor aerial of about 40ft. It is a wonderful set, and more than fulfils my expectations. You are to be congratulated on your work in preparing such a wonderful combination. I am quite certain that there is nothing in Australia to beat it." Mr. Mounsey used the original resistance-coupled audio end.

23 EUROPEANS!

MR. K. L. WILLIAMS, of 8 Clifton Street, Prospect, South Australia, writes: "—— got all the necessary parts for the resistance-coupled job. I completed this set about ten days ago, and there is no doubt about it whatsoever. So good are the results that I think a detailed report may be of interest. In the first place, I had no difficulty in getting the set into operation—in fact, it proved to be the easiest set that I have ever built in this respect, nor did I experience any difficulty in lining up the condenser gang. The hum level was very low, indeed. The selectivity is excellent and the range phenomenal—on a short indoor aerial practically every station in Australia comes in at strong speaker volume, as also do many stations outside Australia, such as KZRM (Manila) and VUC (Calcutta); 2CO, 3AR, and 3LO come in at full speaker volume here in Adelaide at midday, a notoriously bad locality for reception. On Saturday morning I was up early, and was able to log 23 European stations at strong speaker volume, although it was then quite light. Some of the stronger stations, mostly Germans, were held until 6.15 a.m. This was on an indoor aerial, and most of these stations could be heard quite plainly using a 6ft. length of wire held in the hand. This performance is almost incredible, but I can assure you that I woke the others in the house up to hear these stations —the quietest a.c. set I have ever heard. I have never enthused over any set as I do over this superhet."

SELECTIVITY UNCANNY

ANOTHER builder to give us a report is Mr. R. Stewart, of 20 Hillard Street, East Malvern, Victoria. His letter runs: "I have built a push-pull job exactly as described, and can faithfully say that it is all you claim it to be. The selectivity is uncanny, and the range is, well, 30 stations were logged in one hour on 3 feet of aerial. The tone leaves nothing to be desired. I have built various sets to 'Wireless Weekly' instructions, including the 1930 Four and 1930 Three, but I have never had or heard a set to equal this super."

APPROACHING THE ULTIMATE

STILL another report worth comment is one received from Mr. Gilbert H. Hay, of Gilbert H. Hay, Ltd., Perry House, Brisbane. According to Mr. Hay:—

"Your super. is the best all-round set I have heard, and reflects great credit on your technical department. From a selectivity point of view it is quite outstanding. For instance, there is not the slightest difficulty in separating 2UW from 4BC, or 5CL from 4QG. We picked up the Siamese station, but static has prevented us from really testing the set on distance. The tone is excellent. To sum the thing up, you have produced a set having splendid tone, excellent range, extreme selectivity, with ease of control and all the sensitivity that can be used. What more could anyone want? You seem to have achieved something approaching the ultimate in receivers, as far as present equipment allows. In conclusion, I would like to express my appreciation of your kindness and consideration in replying to my former queries. I have been a close follower of radio development, and I can say without fear of contradiction that 'Wireless Weekly' has done more towards radio development in Australia than all other factors combined (that is, excluding such scientific achievements as the 235 variable-mu valve.)"

DID THE IMPOSSIBLE

G. A. ROBERTS (Warrnambool, Vic., 26/4/'32):—

"I constructed a 1932 Superhet, resistance-coupled job. Just went ahead and built it as described by you, and it was as simple to get going as a Meccano model. Went first pop, and within an hour got everything worth getting in Australia and about it.

"I turned it over to its owner, and he and it have been my best advertisement ever since. Previously I have had a soft spot in my system for 'high gain' stuff, a la 'Wireless World,' but this set did the impossible, and converted me back to normal again."

LOGGED 34 STATIONS

JOHN L. HARRIS, 5 Everton St., Hamilton, N.S.W.:—

"Having built the 1932 Push-pull Superhet . . . at the present moment have the set in operation, using a borrowed speaker, and as for sensitivity and selectivity, it would be hard to beat. Last night, in spite of interference, I logged 34 stations, three of which were only separated by 10 k'cycles from each other, the stations being 2KO, 3AW, and 2WL."

TRULY PHENOMENAL

FRANCIS G. MILLER, A. Inst. R.E., VK5BF, Murray Bridge, S.A. (16/9/'32):—

"Accept a word of thanks for the excellent circuit published in 'W.W.' of July 29, Superhet. Four. Have constructed this job both as battery and D.C. all-electric, and cannot fault it. Sensitivity is truly phenomenal, 2 feet of flex being sufficient for all A stations. Quality is also very good, and power is more than usually required for home reception."

ALL THE A AND B STATIONS

FROM H. J. BELL, 45 Princess Street, Williamstown, Vic. (23/8/'32):—

"If you will recollect back a few months you will remember me asking you in despair for an auto radio circuit. Well, sir, my patience was amply rewarded a few weeks ago with your publishing the 'Universal' four-valve superhet., and I feel I owe you a debt of gratitude, so I take this opportunity of thanking you with all sincerity for your splendid article. I built the job to specifications, gave it a one-night test, and sent it away up to Hamilton. The job certainly showed great promise on brief test, no trouble was experienced in pulling in all A and B stations in the Commonwealth; the only snag was the correct voltage on the screens for general stability."

OUTSUPERED!

R. MORRIS, 167 Crawford Road, Inglewood, West Australia, writes (30/8/'32):—

"Some time ago you published some A.C. superhet. circuits, among which was an article entitled 'Outsupering the Superhet.' Well, this took my fancy, so I started to build one with a few alterations, which included two 247's in push-pull in the output stage, so my set was built up of ten valves in all. I had very little difficulty in changing the resistances, etc., to suit the pentodes, and so I got the set working O.K.

"The set exceeded all my expectations so I am dropping you this note to let you know how it is behaving."

"Well, up to date I have logged the following stations, all at loud-speaker strength. I have never used headphones on the set: 2CO, 3AR, 5CK, 2FC, 6WF, 5CL, 4QG, 3LO, 2BL, 6PR, 4RK, 3UZ, 2GB, 6DN, 3BO, 3HA, 5PI, 2KY, 2HD, 2UW, 6ML, 4BC, 4TO, 3DB, 5KA, 2CH, 6KG, 2NC, 3WR, 2SM, 4BK, 5AD, 4RO, 3KZ, 4BH, 2GN, 2KO, 3AW, 7UV, 2AY.

"Also KZRM, 5 Japs, and a station which I think is Durban, although I am not quite sure, and Radio Bangkok, of Siam.

"There are also others, but I cannot catch their call-signs.

"These stations have not been heard every night, but over a period of about six weeks. Low-powered stations, such as 3WR and 2AY, gave me quite a pleasant surprise when I heard them.

"Static some evenings is pretty bad, but 5CK always provides a wonderfully clear programme until 9.30 p.m., and this evening 3UZ is still going, although it is now 9.25 p.m., local time."

46 STATIONS IN FIVE MINUTES

MR. H. WEISS, Cobram, Victoria (6/9/'32). A report concerning the Universal Four-valve Superhet.:—

"The set was built exactly as specified, and in a couple of minutes sufficed to line up the job. Then a five minutes' trip along the dial brought in 46 stations, without waiting for identification. Since then, all the stations in the 'Wireless Weekly' lists have been logged and identified, also 7UV, Ulverstone, and 4MB, not yet in your lists. Japanese stations come in very well from eight o'clock onwards, while New Zealand and Manila are also well received. An outside aerial 18 feet high and 35 feet long is used, and half of it passes within 5 feet of iron roofs. Tone, volume, and selectivity are all O.K."

"EXCELLENT RESULTS"

MR. C. HAMMOND, Newman College, Melbourne University (30/8/'32):—

"I have built the Radiokes Superhet., but have fitted it with the Cascade Loftin White (245's), recently described in your journal. Results excellent, both for sensitivity, selectivity, and, of course, tone."

"ABSOLUTELY FLAWLESS"

MR. M. E. COLLETT, of Lisarow (4/9/'32):—

"You might be interested to know that the Universal Four Super wasn't much of a success in this district owing to second spots—at night it was practically impossible to get any station free from whistle of some sort. However, having fitted a preselector unit, this job is absolutely marvellous. The man told me he had already logged 69 stations clear on one of the sets I built.

"The selectivity is uncanny—KFI comes in solidly on a 90ft. aerial till he closes down about 6.15, without a trace of 5CK.

"In conclusion, I would like to compliment you on this super job, and tender a few thanks, too, as these supers have been the best advertisement I ever had."

GOOD PUNCH IN DAYLIGHT

W. A. COOPER, Mt. McDonald, via Armidale, N.S.W.:—

"I wish to let you know what a wonderful success the battery Superhet. is that was published in 'Wireless Weekly' some three months ago, and I also wish the paper the best of luck in the future. I always take 'W.W.,' and have built several circuits out of it, and in each case they do all that you claim for them. I built the 100 per cent. battery set, and it is a splendid performer, the tone being the best I have heard for a battery set. Well, now I have built up the Superhet, and it is a splendid performer, and it works wonderfully. I put an R.F. stage ahead of the first detector, and an extra audio stage. With these additions, the set has more punch in the middle of the day up here than is necessary. The selectivity is very good, and any station in the band can be cut out completely with ease.

"I have received about 60 stations to date. I have also received KFI, KEL, KGO, and some other American stations. KZRM and several Japs. are received at good strength. When I say I got KFI I did get him, too, with plenty of punch, any amount to load the little pentode up pretty well. At night, it is quite possible to use a short piece of wire about 10ft. long, and still get more volume than is necessary on the majority of stations.

"Such stations as 2YA, 7LA, 5CL, 4YA, 7ZL, 1YA, and a few other far distant stations come in at good room strength on an indoor aerial. I have been reading up what others have been doing on this little set that you so well described, and they seem to be doing very well. I think that the Superhet., as long as it is put together well, is the receiver of the future.

"Wishing your paper continued success."

Later Information on the

1932 SUPERHETERODYNES

AFTER several hundred of the "1932 series" were built and reported upon we got a few additional ideas about their construction, etc. Here are a few paragraphs taken from a short article published after the main constructional article dealing with the "1932 Series":—

PUSH-PULL MOST EFFECTIVE

Some readers misunderstood our recommendation as to which version to build. We were inclined to the resistance-coupled job on account of its simplicity, but for straight-out results we would rather back the push-pull job, as it has quite an amount of audio gain as well as the same r.f. and intermediate gain as the other jobs. Since there is very little difference in the costs of kits of parts for the different versions, the push-pull job is probably the best value for money.

THE CURRENT DRAIN

Quite a number of readers doubted the current drain figures given. As biassed in the circuit, the two 235 valves will draw about 5 ma. each. The two detectors will only draw a fraction of a milliamp between them, not several milliamps as shown in the catalogues when speaking of the valve when used as an amplifier. And another point, of course, is simply that none of these superhets is likely to run flat out for long—the neighbors will soon put a stop to that sort of thing. And again, power transformers should all be able to stand a little overload. The drain ratings given were about 3 ma. light, and those who were doubtful were all advised to set their minds at rest by obtaining power transformers with higher current ratings, by, say, 10 milliamps.

OSCILLATION TROUBLE

In the case of the resistance-coupled version it is possible in some cases that the screen voltages will be found too high, causing oscillation trouble. The remedy is simple; the resistor R5 should be replaced with a similar type of resistor, but one having a resistance of 100,000 ohms. There is a slight variation in the screen currents drawn by different brands of variable-mu valves, and this accounts for the need for this alteration in some cases.

RESULTS AND PERFORMANCE

Apart from the minor items above, the majority of the letters were dealing with the selection of parts, or else the application of different audio systems, etc. However, a few reports were received, and some of these struck us as being too good to be true. One reader finished the set one morning, and at noon that day tuned in 3AR, 3LO, and 5CL at an outer suburban location here in Sydney. That is his claim, to be believed or not. Another report from Newcastle states that seven Yankee broadcasters were tuned in on Sunday evening. Another tall yarn to swallow. However, more reliable sources of reports proved that at least these superhets are more sensitive than anything produced by us previously. One city dealer ran one together, and it took us just half an hour to get away from him once he started to tell us of the stations received and the general merits of the job.

STATIONS THAT CAN BE LOGGED

Once the super is fairly well adjusted the following stations should be easily logged in the early evening, between 7.30 and 10 o'clock:—2AY, 2WL, 3GL, 4BH, 3KZ, 3BA, 5AD, 2MO, 3DB, 4TO, 4BC, 3HA, 3BO, 3UZ, 4RK, 7HO, 3LO, 4QG, 5CL, 5CK, 3AR, 7ZL, and 2CO, and, of course, the local stations. There will be left still a large number of stations which are unsuitably placed on the dial in respect of local stations, and in city locations a certain amount of ingenuity may be needed to log them. For example, on Anniversary Day 2KY was off the air, and added a few extra stations to our log, these being 2CA, 3SH, and 7LA. Quite an amount of experimenting with aerial lengths may be necessary to strike the happy medium, where sufficient selectivity is obtained with due respect to sensitivity. About 10 feet of aerial should make the set very selective, particularly if the earth wire is also omitted, yet with even this small aerial the range of the set should be entirely limited by the general noise level.

LOGGING OVERSEAS STATIONS

In country locations it may be possible to log American broadcasters from 5 p.m. onwards, but these are fairly hopeless in suburban locations. Even in the city overseas stations can be heard if the atmospheric conditions will allow the sensitivity to be used in full, after the local stations have closed down. Fitted to a large outdoor aerial and an effective earth, and tuned to about the same wavelength as 3AR, it should be quite an easy matter to log KZRM, Manila, between 11 p.m. and 1 a.m., particularly on Saturday nights (Sunday mornings). Several Japanese should be available also on the dial a little below this station and down as far as 2BL. Except in favorable locations 6WF (Perth) will require the same attention as KZRM. Don't forget that in summer general reception conditions are at their worst, but in the winter months there should be plenty of nights on which the full sensitivity of the set will be used without static being too troublesome.

A LONG RANGE TIP

Those who want to get the maximum sensitivity, as, for example, after the locals have closed down, can do so readily at the expense of selectivity. The idea is to cut out the pre-selector tuning stage between the r.f. valve and the detector. This can be done quite easily by taking a lead from the fixed plates terminal of the second section of the tuning gang and running it up to the cap of the second valve (the first detector). This lead can be left hanging whilst the set is used with maximum selectivity, but when it is desired to log Manila the original clip will be removed from the cap of the second detector and the new one fitted instead. A slight re-alignment of the tuning gang may be required. In bad locations the cutting out of the pre-selector will result in two-spot tuning coming into evidence, but this will not be worth considering after the locals have closed down. Fortunately, the second spot occurs 350 kc. below the normal frequency of the station, so that the second spots of all the local stations are just noticed on points of the dial which would otherwise remain vacant. The exception is in Melbourne, where 3UZ is 3½ kc. above 7ZL, so that two-spot tuning cannot be tolerated in certain Melbourne locations. With the pre-selector in circuit there is no tendency to two-spot tuning if the gang is correctly aligned, but the pre-selector cuts down the sensitivity a trifle. This is not serious if everything is correctly adjusted in the set as, either way, more sensitivity is available than can be utilised, owing to the general noise level from electrical appliances, etc., making listening intolerable. But if by any chance the coils are not correctly matched or the gang not properly aligned, then cutting out the pre-selector will at least bring up the sensitivity to a pretty high standard.

Stromberg-Carlson

A RANGE OF

Superheterodynes

TO MEET ALL NEEDS

STROMBERG-CARLSON, who pioneered the manufacture of Superheterodynes in Australia, provide to-day a range of Superheterodyne receivers which by their outstanding selectivity ensure positive freedom from the overlapping of one broadcast programme upon another, and make available a range of entertainment never previously enjoyed by the listening public.

CABINET	532 (4 valves and rectifier)	632 (5 valves and rectifier complete with Arto-matic Clarifier)
"SPENSER"	£35/15/0	£40/0/0
"CONVERTIBLE"	£39/10/0	£43/10/0
"CONVERTIBLE" Phono-Radio Combination	£55/5/0	£59/5/0
"CHAUCER"	£47/0/0	£53/5/0
"CHAUCER" Phono-Radio Combination	£61/5/0	£66/17/6

802 BATTERY-OPERATED

For the Country Listener, or for wherever Alternating Current is not available, there is no finer receiver than this 8-valve Battery-operated Superheterodyne, having the simplicity of operation of the all-electric set and equal, if not superior, performance. Gives daylight reception of interstate stations at full loud speaker strength, and with minimum battery consumption. Price, in Spenser Cabinet, complete with batteries .. **£45/12/6**

RING B7581 (10 lines) and Noyes Bros. will arrange a home demonstration by a local dealer.

Stromberg-Carlson Superheterodyne Coil Kit

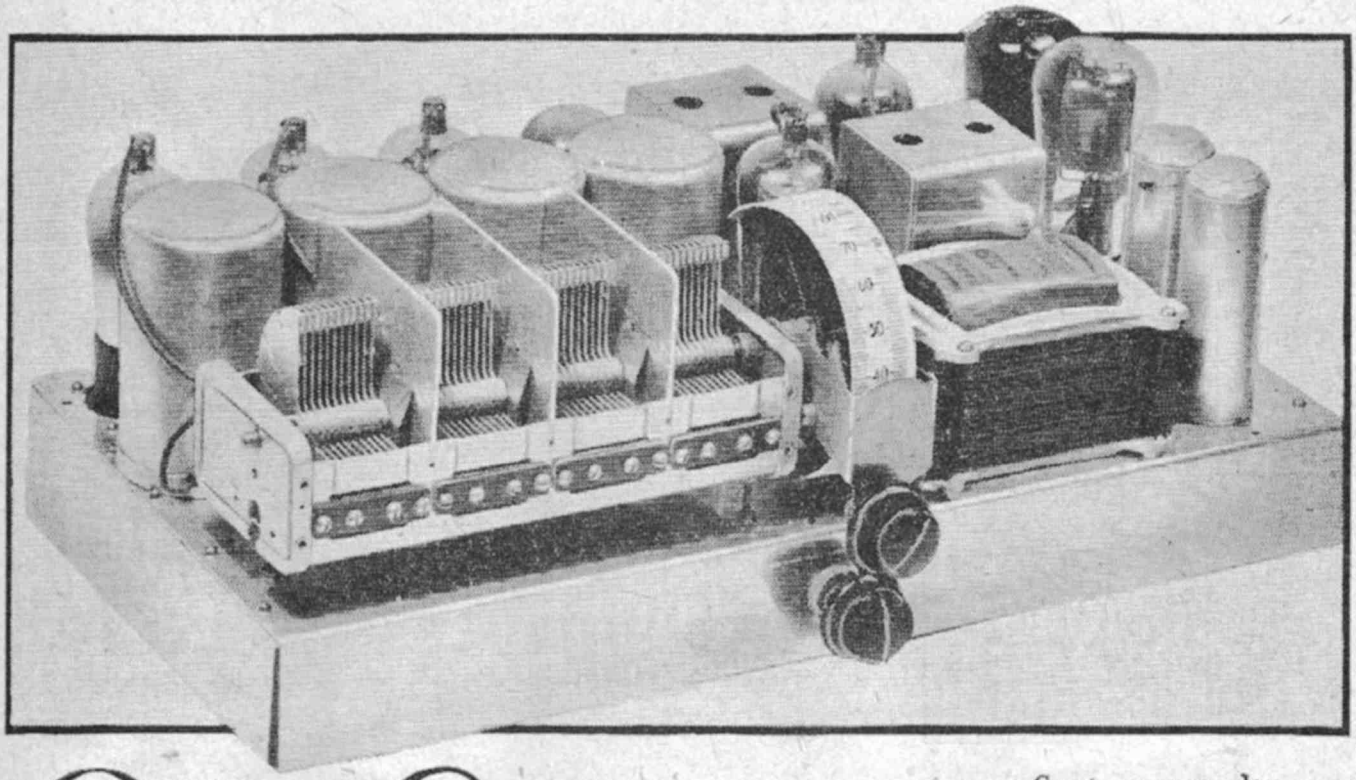
If you wish to build your own Superhet., use this kit of components, similar to those used in standard Stromberg-Carlson receivers. Comprises 1 Set of 4 Coils, a 4-Gang Condenser, 2 Intermediate Transformers, 1 Padding Condenser. Complete £6

Wholesale Distributors:

NOYES BROS. (SYDNEY), LTD.

115 CLARENCE ST., SYDNEY. 'Phone B7581 (10 lines)

Showrooms: 39 York St., Sydney 11 Watt St., Newcastle. Elizabeth St., Brisbane



OUT-SUPERING The Superheterodyne

Greater range, less background noise, in this de luxe edition.

WORKING on with the superhets. recently described, we came across an easy method of improving the general performance by the addition of a valve socket and valve to the original set. The only other alterations are a couple of primaries for the coils, which can be readily wound by any amateur at a cost of a couple of pence. The completed set with the alterations is shown here, and it will be seen that it is a very attractive proposition.

THE CIRCUIT

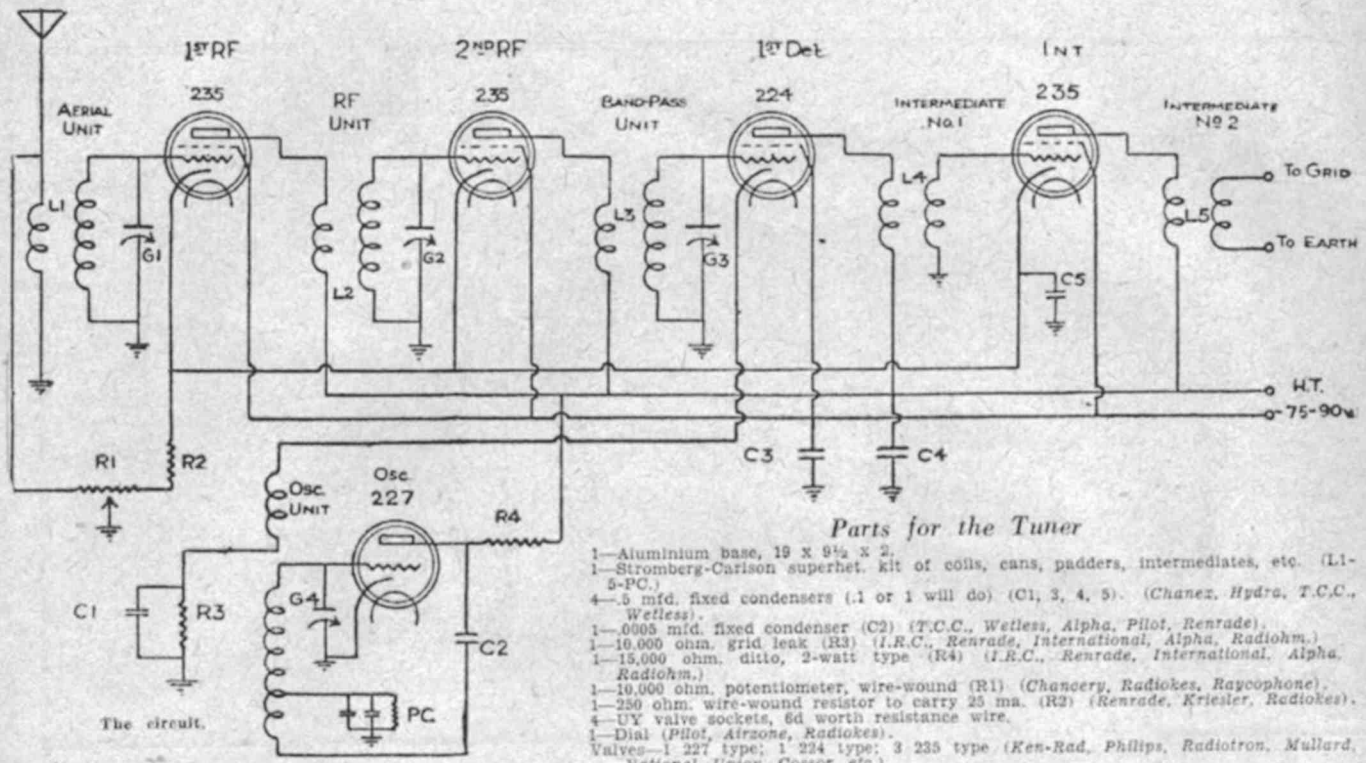
Briefly summed up, we have an eight-valve superhet. with two r.f. stages, a first detector, oscillator, one intermediate, second detector, and a resistance-coupled pentode with a normal rectifier. The speaker field is used as an additional choke, and this, together with a fully decoupled audio system, results in an entire absence of hum.

SUPERHETERODYNE SELECTIVITY

Many readers were surprised when they saw that we embodied a pre-selector circuit in the original "1932 Superhets." They expected that the superhet. was just normally selective, and that the pre-selector was not necessary. So we might explain why it was fitted. Getting back to the superheterodyne principle, it should be remembered that we generate a frequency in the oscillator, and adjust this frequency so that it beats with the frequency of the incoming signals to produce a third frequency, which is the heterodyne or intermediate frequency. However, when we have the oscillator oscillating at, say, 175 k.c. below the incoming signal it is also oscillating at the correct frequency to give a 175 k.c. heterodyne from an incoming signal of 175 k.c. below the oscillator frequency. So that if the selectivity ahead of the first detector is such that there is the remotest trace of signal from a station when the r.f. tuning is 350 k.c. off this station, then a second channel interference will result. Even if there is such a minute amount of signal left at 350 k.c. off normal tuning the extreme amplification of the superhet. will bring it through at loud volume. At the situation of the "Wireless Weekly" laboratory 2GB thunders through at great strength, and on many two-valve sets it has been known to spread right over the dial from 0 to 100. Naturally this spot showed up the second channel interference of the early superhets., and on this account we made a sure job of the Stromberg super by using the band-pass or pre-selector circuit ahead of the first detector. This cut out the trouble all right, but on second thoughts it appeared to us that we were in a sense wasting a coil, can, condenser section, and only cutting down the gain of the job with the pre-selector. As we have mentioned before, cutting out the pre-selector will increase the range of the "1932 Superhet.," but spoils the effective selectivity. So here is a scheme for taking full advantage of the band-pass coil to get even greater selectivity and sensitivity, with little extra cost.

NEW PRIMARIES

The coil kit requires slight alteration, but this is very simple. The bottom turn of the secondary of the band-pass coil unit and the normal primary of the r.f. unit are entirely disregarded. Two new primaries are wound for these secondaries. Actually we got hold of a piece of fairly thin cardboard and rolled it into a tube to fit inside the secondary coil former, and wound upon it twenty turns of fine cotton-covered resistance wire, being about 40 gauge. However, those without resistance wire can use any fine gauge copper wire. At a pinch even 34 gauge d.s.c. would serve. The turns can be wound on at a little spacing between each turn, so that they spread over an inch or so of former. This means that little care need be taken with the windings, and they can be done by hand in a matter of a few seconds. There are spare terminals already waiting on the bottom of the coil units, so these are utilised. The resistance wire is nasty stuff to solder, so is wrapped round the terminal several times, and then held in place with a lump of solder to which the lead is attached and taken through the base. The top of the primary runs to the plate of the valve and the bottom runs to high tension. The primary is just roughly mounted in position in the earthed end of the secondary so that the bottom turns of both windings will be alongside each other. It does not



The circuit.

Parts for the Tuner

1—Aluminium base, 19 x 9½ x 2.
1—Stromberg-Carlson superhet. kit of coils, cans, padders, intermediates, etc. (L1-5-PC.)
4—.5 mfd. fixed condensers (.1 or 1 will do) (C1, 3, 4, 5). (*Chanex, Hydra, T.C.C., Wetless*).
1—.0005 mfd. fixed condenser (C2) (*T.C.C., Wetless, Alpha, Pilot, Renrade*).
1—10,000 ohm. grid leak (R3) (*I.R.C., Renrade, International, Alpha, Radiohm.*)
1—15,000 ohm. ditto, 2-watt type (R4) (*I.R.C., Renrade, International, Alpha, Radiohm.*)
1—10,000 ohm. potentiometer, wire-wound (R1) (*Chancery, Radiokes, Raycophone*).
1—250 ohm. wire-wound resistor to carry 25 ma. (R2) (*Renrade, Kriesler, Radiokes*).
4—UY valve sockets, 6d worth resistance wire.
1—Dial (*Pilot, Airzone, Radiokes*).
Valves—1 227 type; 1 224 type; 3 235 type (*Ken-Rad, Philips, Radiotron, Mullard, National, Union, Cossor, etc.*).

matter if the former is a bit loose in the secondary, it can be packed up with a match or two. The coils having been altered, there is little else worthy of note. The two r.f. stages are arranged just as in any normal t.r.f. set, such as a "1930 Four" or "Advance 1932."

ALIGNMENT

The alignment provides no more difficulties than normal, and fortunately this point has not been in the slightest atom troublesome. From reports received (and published elsewhere in this book) it appears that the coils have been produced with remarkable accuracy, or else the builders have experienced exceptionally good luck.

CHANGES IN THE AUDIO

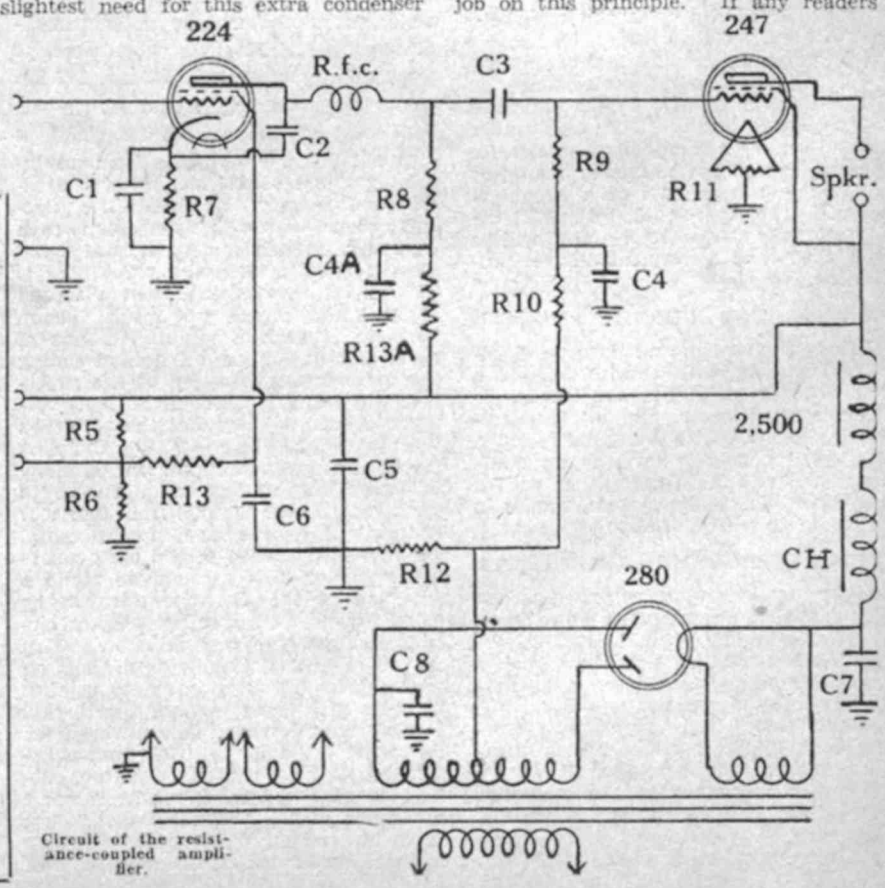
It will also be noticed that we have made one slight alteration in the audio system. This was done in a desperate attempt to obtain positively silent operation of the set. The de-coupling resistor for the plate feed de-couples the last trace of ripple from the high tension, and runs it to earth through the by-pass condenser C4A of 1 mfd. or so. The de-coupling resistor is of 50,000 ohms or more. 100,000 ohms is specified and shown as R13A. There is not the slightest need for this extra condenser and resistor, and its only purpose is to cut out the last trace of hum.

OTHER AUDIO SYSTEMS

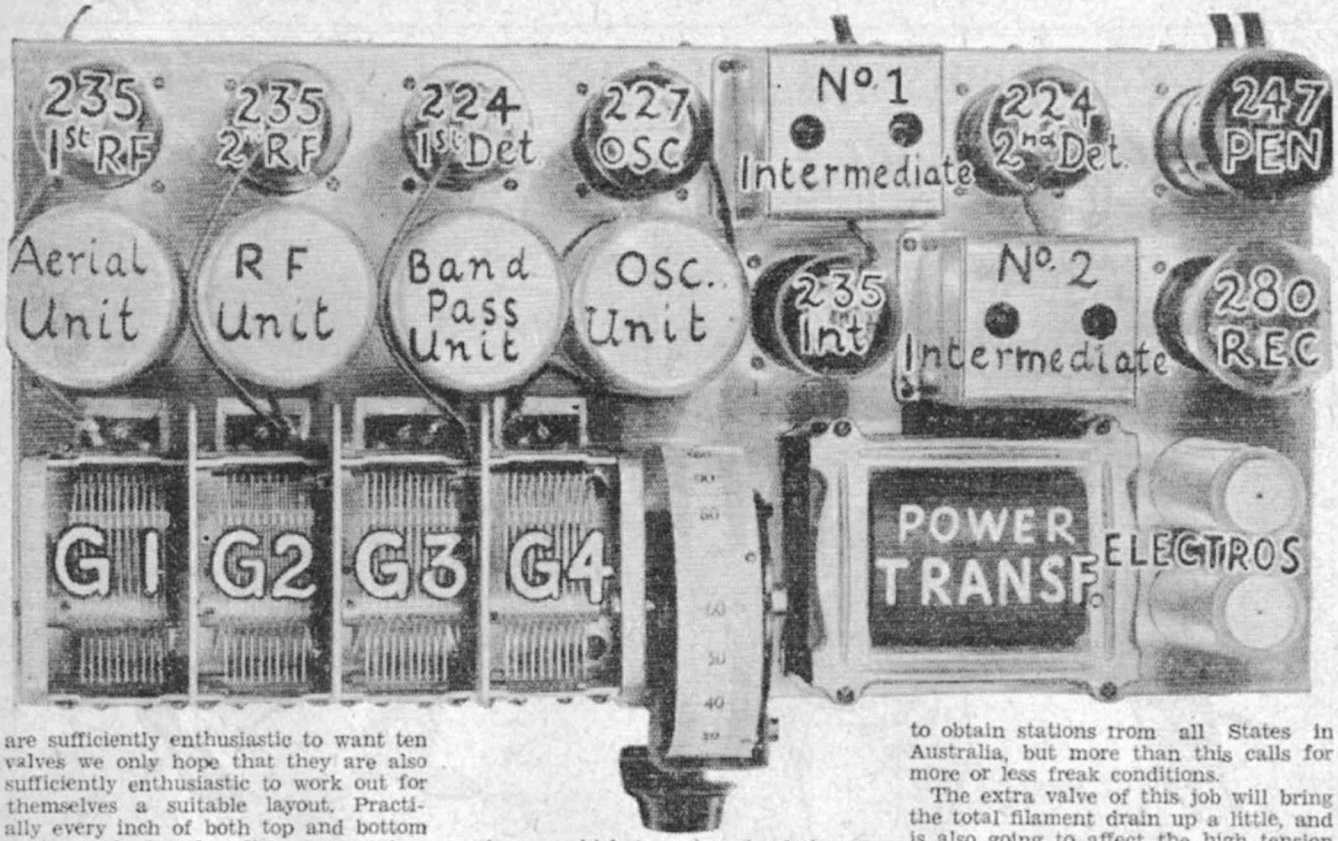
With the push-pull audio system there is no need at all for the extra valve, and it would really be over the odds to run more than nine valves in all, so we have not worried about running up an extra set in order to work out a suitable layout for a ten-valve job on this principle. If any readers

Parts for the Resistance-Coupled Amplifier

1—Power Transformer 350/350 at 100 m.a., 5v2a, 2½v9a, 2½v1½a (*Darelle, Radiokes* (1-12), *Univox, Kriesler, Raycophone*).
1—30 Henry 100 mill. choke (C.H.) (*Radiokes, Kriesler, Univox*).
1—Radio frequency choke (R.F.C.) (*Radiokes, Kriesler, Univox, Raycophone*).
1—.0005 mica condenser (C2) (*Renrade, Wetless, T.C.C., Alpha*).
1—.001 mica condenser (C8) (*Renrade, Wetless, T.C.C., Alpha.*)
1—.01 mica condenser (C3) (*Renrade, Wetless, T.C.C., Alpha*).
2—8mfd. electrolytic (C5, C7) (*Sprague, T.C.C., Polymet, Dulytic*).
2—.5 mfd. condensers (C1, C6) (*T.C.C., Hydra, Wetless, Chanex*).
1—1 mfd. fixed condenser (C4, C4A) (*T.C.C., Hydra, Wetless, Chanex.*)
1—Centre-tapped resistor, 20 ohms (R11) (*Radiokes, Renrade, Raycophone*).
1—250 ohm wire-wound resistor (R12) (*Radiokes, Renrade, Kriesler.*)
2—50,000 ohm grid-leaks (R6, 7) (*Renrade, I.R.C., International, Alpha, Radiohm*).
4—100,000 ohm grid-leaks (R5, R10, R13, R13A) (*Renrade, I.R.C., International, Alpha, Radiohm*).
1—250,000 ohm grid-leak (R8) (*Renrade, I.R.C., Alpha, International.*)
1—0.5 meg. grid leak (R9) (*Renrade, I.R.C., Alpha, International, Radiohm*).
2—UY 1 UX sockets (*Raycophone, Renrade.*)
Valves—1 224 type valve; 1 247 type valve; 1 280 type valve (*Ken-Rad, Philips, Radiotron, Cossor, Mullard, National Union*).
Speaker—2500 ohm D.C. type (F.C.) (*Jensen, Saxon, Amplion, Jubilee.*)



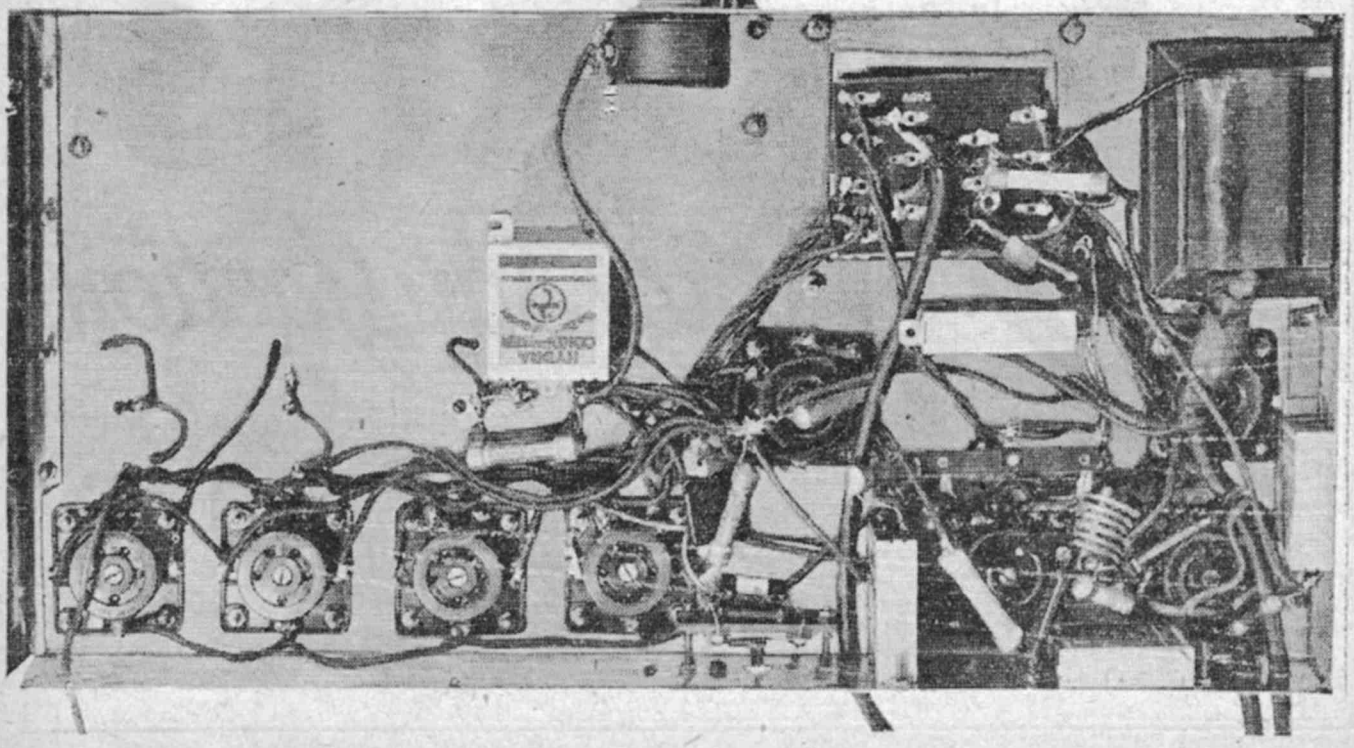
Circuit of the resistance-coupled amplifier.

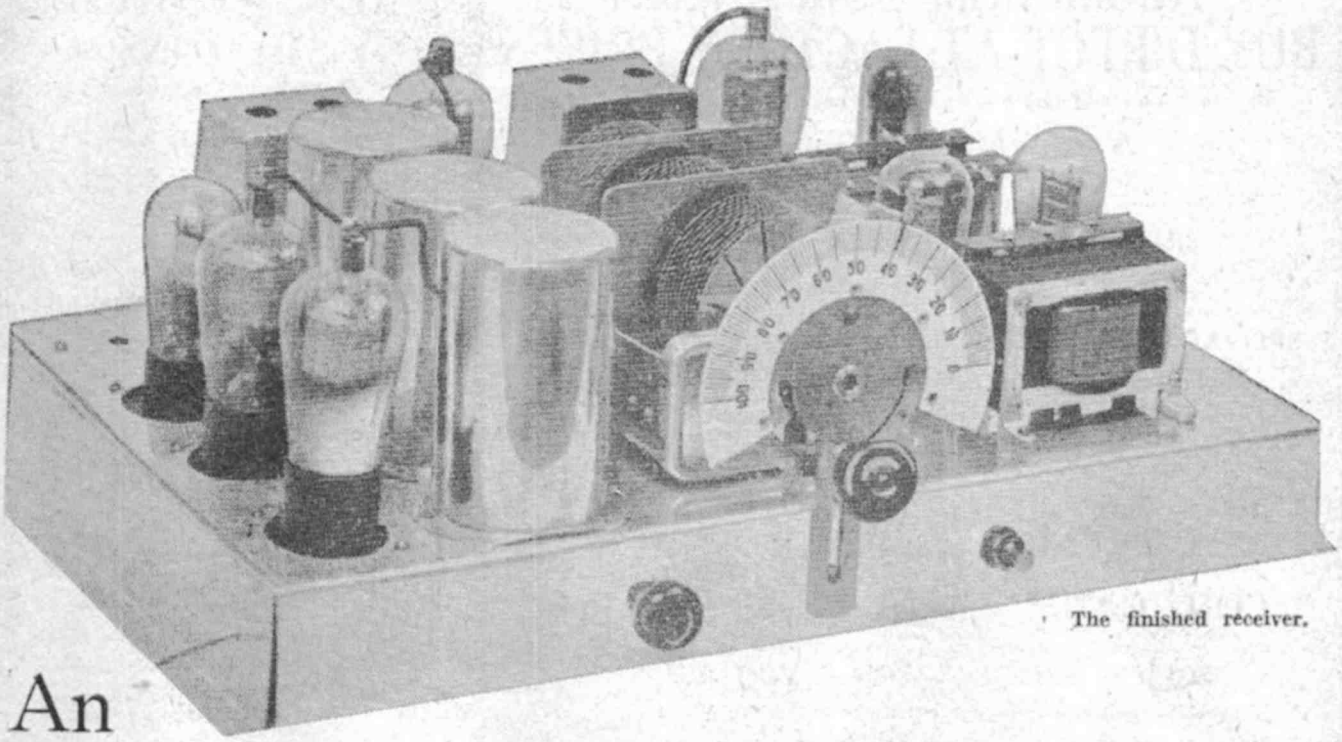


are sufficiently enthusiastic to want ten valves we only hope that they are also sufficiently enthusiastic to work out for themselves a suitable layout. Practically every inch of both top and bottom of the original push-pull base was taken up with components, and we doubt if there is an easy way out.

Whilst on the subject of the superheterodynes we wish to clear up any misunderstandings which readers may pick up from the reports received from readers about the far distant stations they are logging with superhets. These results are not necessarily achieved by simply spinning the dial over, and in many cases we can just imagine that a lot of time and patience has been spent in waiting for a suitable static-free occasion on which to fully extend the set. Probably considerable tinkering has been done also with the trimmer condensers in order to get nearly perfect alignment for the setting of the dial on which the far distant station is expected. Thrown on to any old aerial in any location, and with fairly indifferent adjustment, it should be possible to obtain stations from all States in Australia, but more than this calls for more or less freak conditions.

The extra valve of this job will bring the total filament drain up a little, and is also going to affect the high tension drain by a matter of a milliamp or two. However, most power transformers will serve the purpose quite well, and we used an ordinary standard transformer without any apparent trouble. The pack did not warm up greatly, and there was no trace of hum. This was a pack known as type H455. We ran the detector and output valves from the 2½ volt 3 amp. winding and the two r.f. valves, the first detector, oscillator, and intermediate valves from the 2½ volt 8 ampere winding, so that the filament overload was negligible.





The finished receiver.

An 8 VALVE "CLASS B" SUPERHET.

The famous "B Class" Amplification System is used in this receiver which is for battery use.

THIS is a superheterodyne which is a trifle different from the usual run. It is an eight-valve battery job, using the same coil kit as the big nine-valve a.c. job described elsewhere, and in many respects resembles that job. It employs the famous "B" class audio amplifier with two output valves working in what is called a push-push circuit. Not only does this scheme cut down the battery consumption to a very low figure, but furthermore the actual battery current consumed becomes proportional to the volume of the job. If the volume control is advanced fully and the set tuned to a nearby station, quite terrific volume can be obtained, and the "B" battery current runs up to 20 or even 30 milliamps. On the other hand, when playing softly the "B" battery current drops to about 10 milliamps, and, of course, means that the life of the "B" batteries is greatly extended.

THE VALVES

The valves used throughout are the 2-volt American type, taking only .06 of an amp for each filament. Consequently, although eight valves are used, the total filament drain is less than half an ampere. A few years ago a single valve would take this current. So although this is a big and powerful job, it is not particularly expensive to run.

THE COMPONENT PARTS

The aluminium base should be of ample proportions to accommodate all the components without crowding. The size mentioned in the parts list should be ample but for the depth. Certain types of volume controls are rather too wide to fit under a 2in. base, and on this account it may be wise to either obtain a small volume control or else a base with a depth of 2½ or 3in.

THE SUPERHET. KIT

The superhet. coil kit used in the original receiver was the standard Kriesler coil kit, exactly as used for the a.c. operated sets. The kit itself includes the coils cans, padding unit, ganged condenser, and so on, and is, of course, all matched up ready for operation with only minor attention.

THE SPECIAL TRANSFORMERS

For class B amplification we must use a special type of input transformer. The ordinary audio transformers cannot be used for the purpose, and only distortion and trouble will reward any efforts to use the ordinary type. Special transformers for the job are readily available and are quite essential. On the other hand, the output choke is not so important, and, in fact, is quite unnecessary when the set is to be used to drive a dynamic speaker with a built-in input transformer. For example, the Amplion type L1 speaker is available with the input transformer built into the job and specially matched for the purpose.

However, if an ordinary type of magnetic speaker is to be used, then the output choke will be necessary.

CONDENSERS

The condensers and grid leaks and so on need no special comment, being all more or less standard equipment. Any radio dealer will just naturally supply the right gear in these lines when ordered.

VALVES

The valves are of the American type, but are readily available also in the leading English and Continental brands. Other valves than those specified can be used if slight alterations are undertaken, but we do not advise this. If four-volt valves are used they are only available in types having the cap connection connected to the plate and not the grid, as is the case with those specified. This means that in order to use the four-volt valves the leads from the coil cans would need to be altered, and all sorts of oscillation and other troubles might creep into the job if the wiring of the pate circuits gets mixed up with that of the grids.

BATTERIES

The actual drain on the "B" batteries will average only a comparatively low figure, but at times when a loud passage of music is reproduced it may be possible that the drain will rise to 20, or even 30, milliamps. On this account it is very desirable to use extra heavy duty "B" batteries. They are not essential, but, taking everything into consideration, we would expect that the heavier batteries, although costing more in the first place, would actually save money in the long run. The "C" bias battery

NEW ZEALAND STATIONS

A Class

Call Sign, Station and Schedule.

1YA—N.Z.B.B., Auckland.—329 metres, 912 kilocycles: Week-days: 10.30 a.m. to noon, 3 p.m. to 10.30 p.m. approximately. Sunday: 2 p.m. to 10 p.m. approximately.

2YA—N.Z.B.B., Wellington.—416 metres, 730 kilocycles: Week-days: 10.30 a.m. to noon, 3 p.m. to 10.30 p.m. approximately. Sunday: 2 p.m. to 10 p.m. approximately.

3YA—N.Z.B.B., Christchurch.—306 metres, 980 kilocycles: Week-days: 3 p.m. to 10.30 p.m. approximately. Sunday: 2 p.m. to 10 p.m. approximately.

4YA—N.Z.B.B., Dunedin.—481 metres, 550 kilocycles: Week-days: 3 p.m. to 10.30 p.m. approximately. Sunday: 2 p.m. to 10 p.m. approximately.

B Class

1ZB—The La Gloria Gramophone Co., 157 Karanganape Road, Auckland.—216 metres, 1390 kilocycles.

1ZH—G. S. Anchor, Hamilton.—480 metres, 625 kilocycles.

1ZJ—Johns, Ltd., Chancery Street, Auckland.—225 metres, 1330 kilocycles.

1ZM—W. W. Rodgers, Massey Road, Manurewa.—247.9 metres, 1210 kilocycles.

1ZQ—Atwater Piano Co., Auckland.—252 metres, 1190 kilocycles.

1ZR—Lewis Eady, Ltd., Auckland.—275 metres, 1100 kilocycles.

1ZS—McCabe's Radios, Auckland.—211 metres, 1420 kilocycles.

2YB—The North Taranaki Radio Society, Empire Buildings, New Plymouth.—249 metres, 1250 kilocycles.

2ZB—T. H. Boston, 9 Munro Street, Napier.—238 metres, 1280 kilocycles.

2ZD—W. D. Ansell, 25 Queen Street, Masterton.—254 metres, 1180 kilocycles.

2ZE—B. E. S. Allen, Main St., Eketahuna.

2ZH—C. B. Hansen and Co., Ltd., 50 Latham Street, Napier.—236 metres, 1260 kilocycles.

2ZJ—C. T. C. Hands, Elsthorpe Avenue, Gisborne.—261 metres, 1150 kilocycles.

2ZK—D. A. Morrison and Co., The Avenue, Wanganui.—500 metres, 600 kilocycles.

2ZM—Atwater Kent Radio Service, Ltd., 258 Gladstone Road, Gisborne.—261 metres, 1150 kilocycles.

2ZR—Radio Specialities, Ltd., Victoria Avenue, Wanganui.—500 metres, 600 kilocycles.

2ZW—2ZW Broadcasting Service, Ltd., H. Nimmo and Sons' Bldg., Wellington.—268 metres, 1120 kilocycles.

3ZC—New Zealand Farmers' Co-operative Assn., Christchurch.—250 metres, 1220 kilocycles.

4ZI—G. C. Batchelor, 130 Dee Street, Invercargill.—257 metres, 1180 kilocycles.

4ZL—Radio Service, Ltd., 243 MacAndrew Road, Dunedin.—246 metres, 1220 kilocycles.

4ZO—Barnett's Radio Supplies, The Octagon, Dunedin.—278 metres, 1080 kilocycles.

4ZW—Radio Sales and Exchanges, Ltd. (A. A. E. Clark), Princes Street, Dunedin.—259 metres, 1160 kilocycles.

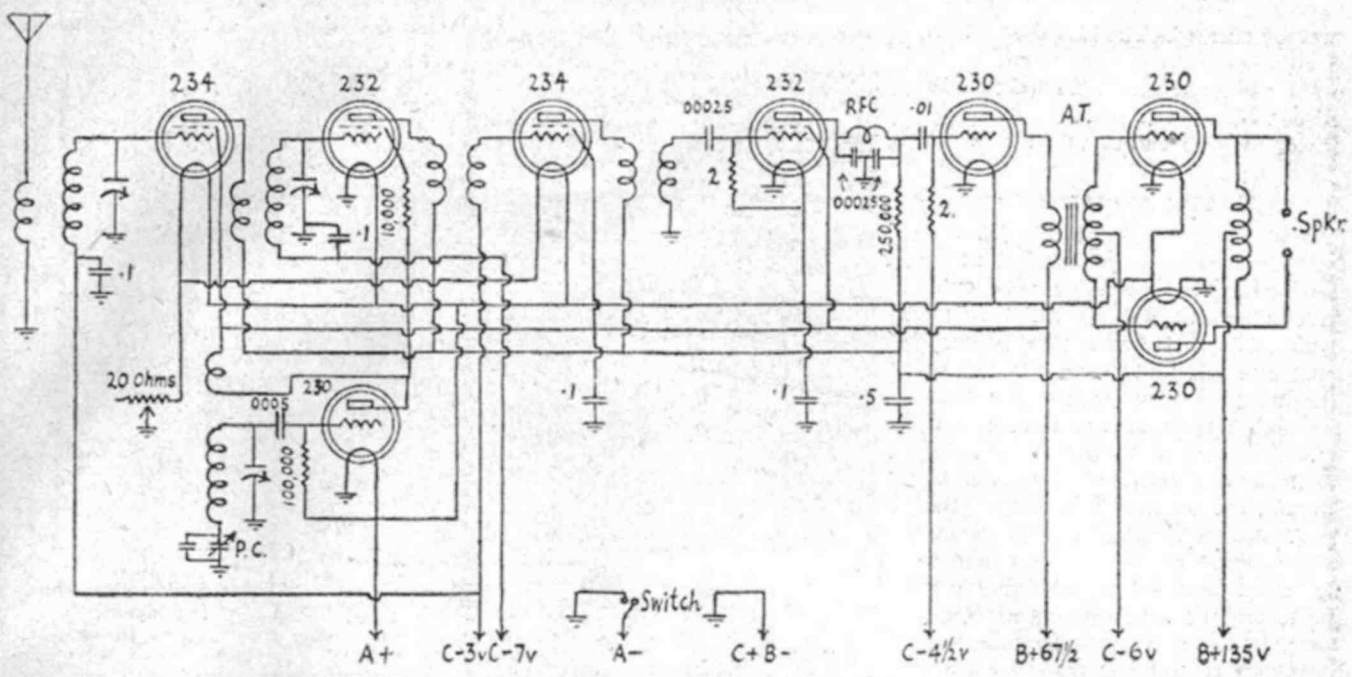
4ZM—J. D. McKewen, 21 Princess Street, Dunedin.—278 metres, 1080 kilocycles.

JAPANESE STATIONS

To be heard between 9 p.m. and 12 midnight.

JFAK—Taikoku	900	333	1 k.w.
*JOAK—Tokyo	870	345	10 k.w.
JOFK—Hiroshima	850	353	10 k.w.
JOIK—Sapporo	830	361	10 k.w.
JOCK—Nagoya	810	370	10 k.w.
JOGK—Kumamoto	790	380	10 k.w.
JOPK—Shizuoka	775	386	500 watts
JOHK—Sendai	770	390	10 k.w.
JOAK—Darien	760	395	500 watts
JOBK—Osaka	750	400	10 k.w.
JOJK—Kanayawa	710	423	3 k.w.
JOKK—Okayama	698	427	500 watts
JODK—Keijo	690	435	1 k.w.
JONK—Nagana	635	472	500 watts
JOOK—Kioto	625	478	300 watts

*JOAK transmits in addition on 590 k.c. (508m.).



needs to have plenty tappings in order to make it possible to get a fine variation of bias voltages. In the case of the first detector, this bias voltage is particularly critical, and a volt one way or another may greatly affect results.

THE ACCUMULATOR

The accumulator for the filaments is only called upon to supply a little less than half an ampere, so one with even a small capacity will give quite good service. However, the set is not suitable for running from dry cells, and either way a difficulty arises because one cell will not give quite sufficient potential for the filaments, whereas two cells will give too much, and make it necessary to fit some means of breaking down the voltage.

THE SPEAKER

The very best speaker is not too good for this job. Working on a powerful station, it is possible to get up to about 1 watt of undistorted output. This amount of volume is almost equal to that obtained from some of the all-electric sets, and will greatly overload many of the old type of horn and cone speakers. The speaker we would particularly recommend for the set is the permanent magnet type dynamic speaker. These speakers are usually fitted with special input transformers, and although their list price may be very high, it should be remembered that they will save the cost of the output choke which is otherwise necessary.

THE WIRING

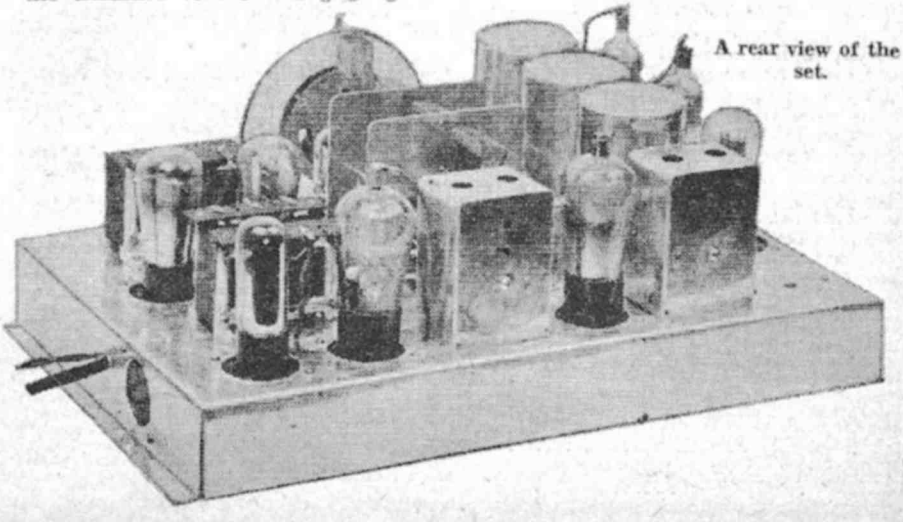
The wiring is very simple, and it should be an easy matter for even the veriest novice to follow out the circuit diagram. The aluminium base can be used as the earth return for all negative leads. For example, except in the case of the two valves upon which the volume control operates, the negative filament terminal of the socket can be simply connected to the base. In order to make an effective joint in such circumstances, it is necessary to fit a soldering lug under one of the screws and nuts holding the socket in place. It is quite useless attempting to solder a lead on to the aluminium in the usual way.

PARTS REQUIRED

1—Aluminium base.
1—Superhet kit (*Kriesler*).
1—Vernier dial (*Radiokes, Raycophone, Efco*).
1—Special input transformer (*Radiokes, Lekmek*). Type 3-7.
1—Special output choke (*Radiokes, Lekmek*). Type 3-8.
1—.5 mfd. fixed condenser (*Hydra, Polymet, Chanez, Wetless, T.C.C.*).
4—.1 mfd. fixed condensers (*Hydra, Polymet, Chanez, Wetless, T.C.C.*).
1—.01 mfd. fixed condenser (*Hydra, Polymet, Chanez, Wetless, T.C.C., Alpha*).
3—00025 mfd. fixed condensers (*Renrade, Wetless, T.C.C., Alpha, Pilot*).
1—0005 mfd. fixed condenser (*Renrade, Wetless, T.C.C., Alpha, Pilot*).
1—2 meg. grid leak (*I.R.C., Renrade, International, Alpha, Pilot*).
1—250,000 ohm grid leak (*I.R.C., Renrade, International, Alpha, Pilot*).
1—100,000 ohm grid leak (*I.R.C., Renrade, International, Alpha, Pilot, Radiohm*).
1—10,000 ohm grid leak (*I.R.C. Renrade, International, Alpha, Pilot, Radiohm*).
1—Radio frequency choke (*Radiokes, Raycophone, Kriesler, Univox*).
8—UX type sockets (*Renrade, Raycophone*).
1—30 ohm rheostat (*Radiokes*). Type 8-10.
1—Filament switch.
Valves—2—34, 2—32, 4—30 (*Radiotron, Philips, Kenrad, National Union, Mullard, Cossor*).
Batteries—3—45 volt "B" Batteries (*Impex, Ever-Ready, Diamond, Volta*).
1—9 volt "C" Battery (Impex, *Ever-Ready, Diamond, Volta*).
1—2 volt Accumulator (*Exide*).

ADJUSTMENTS

Apart from the usual adjustment of the trimmers of the tuning gang and the padding condenser along the same lines as mentioned for the other supers, there is also the adjustment of the bias battery voltages. These are most important. For the r.f. and intermediate valves it is probable that 2 or 3 volts will be ample to stabilise the job, and yet allow plenty of amplification. In the case of the first detector about 5 or 7 volts will be needed, but the best voltage can only be found after a little experimenting. The audio stage needs from 3 to 4 volts, and anyway this voltage is not critical, being chosen to give the most gain consistent with decent reproduction. The idea is to use as much bias as possible, and thereby cut down the plate current consumed by the audio amplifier to a minimum. Again when it comes to the output valves we may find it necessary to tinker with the bias voltage. Sometimes it will be found that the set will only operate in a weak manner when a very low bias is applied, and as soon as the high bias is applied fails to operate at all. This indicates a major fault, probably in the input transformer, and is not normal at all. If a meter for measuring current (millammeter) is available it should be inserted in the "B" plus lead to the output choke, so that the current taken by the output valves can be



A rear view of the set.

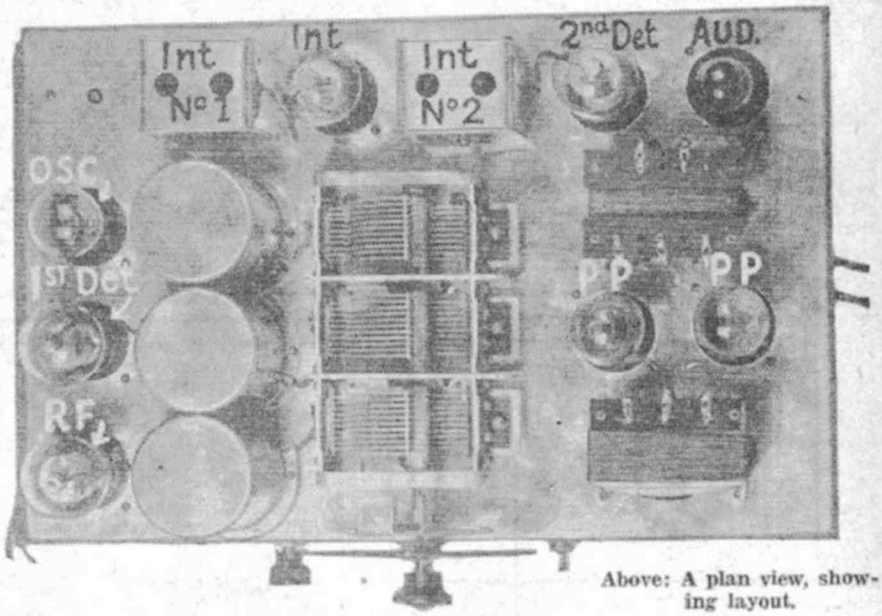
carefully checked. The bias should then be adjusted when the set is not tuned to any particular station, and should be just sufficient to cut down the plate current of the two output valves to about 2 milliamps.

THE AERIAL

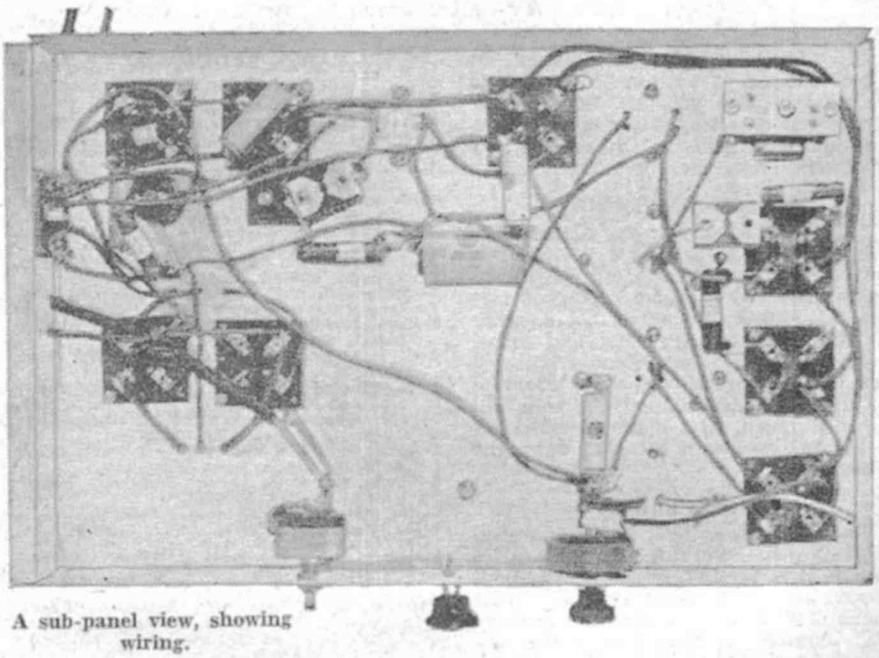
As with most suphets., this job has a certain amount of background noise, particularly when working "flat out." On this account a large aerial is an advantage in so far as it provides such signal strength that there should be little need to ever work the set at maximum setting of the volume control. For any given setting of the volume control the noise level will be constant, no matter how large the aerial. And so if a larger aerial means greater signal strength it just naturally follows that the louder signal will tend to drown the background noise. Of course, in the same way, by retarding the volume control and thereby cutting down the actual amplification in the set, the noise is decreased for a given amount of output volume.

SERVICE AND ATTENTION

The Kriesler coil kit used in this set is covered by a guarantee, and if at any time any builder of one of these sets doubts the accuracy of the matching of the coils or anything like that, the Kriesler Co. will be pleased to assist. They have also a special 'phone number for service queries or any questions dealing with any of the superhets. using Kriesler coils. This 'phone number is MA3377, and is open during the usual business hours only.



Above: A plan view, showing layout.



A sub-panel view, showing wiring.

MORE REPORTS FROM "W. W." READERS . . .

ALL STATIONS ON 10FT. AERIAL

MR. M. FREEMAN, Nicholson Street, Greensborough, South Brisbane:—

"Having been a reader of the constructional articles since 1926 appearing in 'Wireless Weekly,' I thought you would be glad of a report of the above set (Universal Four).

"The set was built as near as possible as a duplicate of the one appearing in the article, except for two small substitutions. A 1mfd. condenser was used to bypass the cathode of the second detector, and a .00025 instead of .0005 from the plate of the same valve.

"Report: Sensitivity was very good, all Eastern stations of 200 watts and over received on the speaker on a 10ft. wire thrown over the nearest picture. New Zealand, West Australia, and ten Japs.' stations received on an ordinary indoor aerial. Much greater sensitivity on shorter wavelengths—1 microvolt at 200, to 10 at 550.

"Selectivity, as far as cutting out local stations, excellent; others half a degree, 3 metres away, received clear of interference.

"Tone—fair on Amplion magnetic, curve fell sharply at both ends.

"Tuning very easy."

UNCANNY

MR. E. A. WESTCOTT, McDonald Road, Lisarow, N.S.W. (29/8/'32):—

"Acting on your recent advice, I have completed the Universal Four Battery Superhet. It is all that 'Wireless Weekly' claimed. Selectivity is almost uncanny, and tone is wonderful on a long aerial 60ft. high and 80ft. long."

* * *

FROM Mr. E. Gilbert, Devon, Maud Street, Belmont (28/9/32).—

"In my spare time lately I have been working on a Stromberg-Carlson superhet. as described in "Wireless Weekly' some time ago (January 15). Since completing it I have been getting good interstate reception on an indoor aerial without earth. I find the set very sensitive all over the dial, and have the padding unit at is peak (having just held KFI well clear of 4YA and at good volume)."

* * *

FROM Mr. Jack Hodder, of 27 Oxford Street, Paddington (27/9/32).—

"I am the proud owner of an 8-valve superheterodyne which I built up according to your article in 'Wireless Weekly,' March 18, called 'Outsupering the Superheterodyne.' I am so delighted with results that the first night I tested it out, which was, of course, a few months ago, I felt like opening all the windows and throwing my chest out, or should I say your chest? Anyway—congratulations! My super. brings in 2CO, 5CK, 3HA, and 4QG without either earth or aerial—is this good or just ordinary?"

FROM Mr. H. Carter, 49 Queen Street, Rockhampton, Q. (29/9/32).—

"I have built the Universal Four as a battery set with very gratifying results. It was intended for our shack on the coast at Emu Park, where I am giving it a try-out. So far I have received 44 stations—KFI from Los Angeles overloads the speaker from 5.30 till 6 p.m. I also like the tone. It's only when one hears a station like KFI under good conditions, with no interference, that one begins to realise the shortcomings of our Australian stations. I can hear 5CK all day long on the loud-speaker."

FURTHER REPORTS

At 1 p.m. on Monday, July 18, "Wireless Weekly" received the following telegram:—

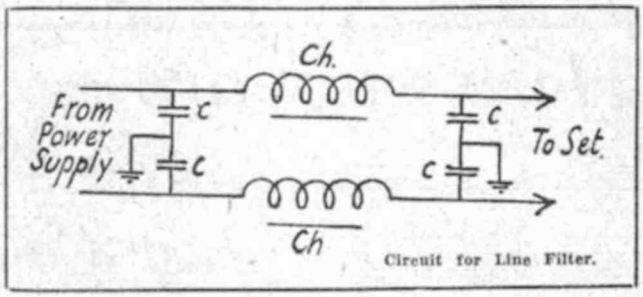
"FURTHER REPORT ON BATTERY SUPERHET. SET GIVEN CAR TEST, AND ALL A STATIONS IN VICTORIA AND THIS STATE COME IN WELL AT NIGHT. ALSO MANY B CLASS VOLTAGES OF SET FAIRLY CRITICAL, AS SET STOPS OSCILLATING WITH LESS THAN 60 ON SCREENS AND 90 ON PLATES. DRANSFIELD."

At 4.30 on the same day another telegram was received:—

"HAVE MADE FINAL ADJUSTMENTS, AND AM NOW RECEIVING LAUNCESTON LIKE SYDNEY IN DAYLIGHT. DRANSFIELD."

A subsequent telephone call from Adaminaby gave the call-signs of further stations received.

LINE FILTERS



Circuit for Line Filter.

For Suppressing Power Supply Noises

THE remarkable popularity of the superhet. and the general trend towards the use of sensitive receivers have spelt a lot of trouble for the Radio Inspector. If someone buys a nine-valve superhet. and stretches out for KFI, but only manages to pick up a roar from the nearest sub-station, then he writes to the Radio Inspector to get his assistance in suppressing the noise at its source.

However, in most cases this is not possible. For example, the ordinary suburban sub-stations that one sees mounted up on poles may be stepping down from 11,000 volts. This voltage is very high, and, naturally, no matter how perfect the insulators, there is a certain amount of leakage, and so on. This actually generates radio frequency signals very similar to those transmitted by the broadcasting stations, except that they are not tuned to any definite frequency. They are fed in on the power supply and come through the loudspeaker as a crackle or roar. When the set is operating on local stations the noise may be hardly audible, but when the volume control is fully advanced the sensitivity of the set is so increased that the noise may be amplified to such an extent that it completely ruins reception.

THE CURE

There is no actual cure for the trouble, but quite a considerable help is a line filter to stop the noises from being fed into the set via the power supply. There are several types of line filters and many ways of making them. The usual recommendation from the Radio Inspector himself is merely a couple of 150-turn honeycomb coils, one in each lead of the power supply. Others prefer to add by-pass condensers from each lead, and their capacity may be anything from .0005 to 4 mfds. each. Personally, we do not recommend the fitting of large capacity condensers across the 240 a.c., considering that .1 mfd. is ample capacity to by-pass radio frequency currents, without passing any appreciable a.c. For the chokes, any of the honeycomb coils are effective, the chief thing to watch being the gauge of wire. It should be sufficiently heavy to pass the total current drawn by the set without heating up or giving any appreciable voltage drop—18 gauge wire is about the gauge necessary for the average set.

VOLTAGE RATINGS.

When speaking of condensers, we wish to mention that the most important point of all is the voltage rating of the condensers placed across the 240 a.c.

Should the condensers break down the fuses will be blown. In order to stand up to continual working on 250 volts a.c. and the peaks which occur in the usual domestic power supply, we strongly recommend condensers rated to stand 1000 volts at least. The usual voltage rating of condensers is for momentary test on d.c., and there is a big difference between this test and constant working on a.c. After all, the voltage rating cannot be too high, and since all condensers are comparatively cheap, we recommend the highest voltage rating obtainable.

THE CHOKES.

The honeycomb chokes have several minor features to recommend them, but a description of a choke which sounds remarkably efficient has just been forwarded by Mr. Withers, of Surrey Hills, Victoria, and for the benefit of other readers, here is the description:—Each choke consists of 1lb. of 18-gauge d.c.c. wire wound on a former. The two formers are built up by using three pieces of bakelite, each 6in. square, mounted on a centrepiece of 3in. bakelite. The actual width of the slot formed between each square is 1in. The two windings are alongside each other, but wound in opposite directions. The wire is wound straight into the slots, with a thickness of empire cloth between each layer, and the whole job thoroughly covered with insulation tape. According to Mr. Withers, who built up one of our "Outsupering the Superhet." sets, he was unable to tune in 6WF (Perth) because of the noise until he fitted one of these chokes in each power lead. Now he can get this station very clearly, without any noise at all.

PRECAUTIONS.

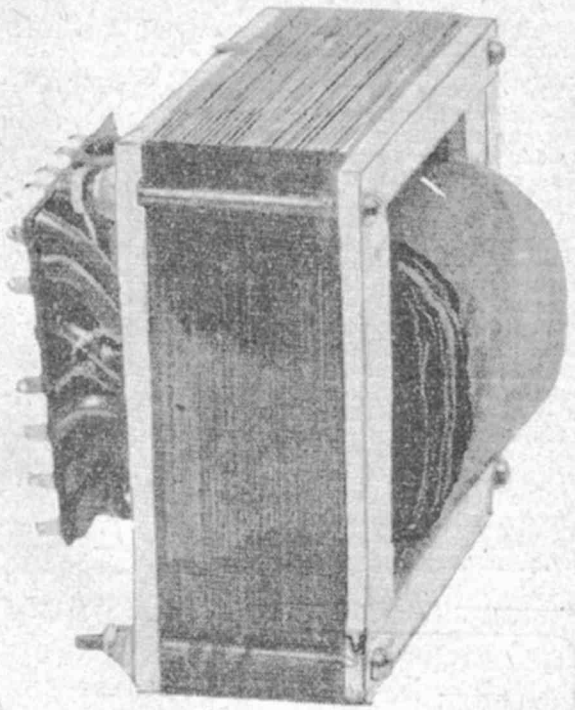
There are many precautions which must be taken to ensure adequate safety. As all readers should know, the 240 volts supply from the power mains is far more dangerous than any of the higher voltages that may be encountered in a radio set. Any of the plate voltages, for example, which are delivered from the rectifier, are not really dangerous, because, as soon as a fairly heavy current is drawn, as in the case when one accidentally short circuits the high tension with one's fingers, the voltage drops considerably. There is a limit to the amount of current which can be handled by the rectifier. On the other hand, the power supply will deliver anything up to about 10 amperes before the fuses blow, and 10 amps. is sufficient current to boil one's blood in quick time. THEREFORE, THE GREATEST CARE MUST BE TAKEN WITH ALL GEAR INTENDED FOR DIRECT CONNECTION TO THE POWER SUPPLY.

The whole of the choke unit, together with the condensers, should, for preference, be mounted up inside a kerosene tin with the top soldered on, and the whole unit connected to earth with a piece of heavy-gauge wire. In this case any fault or short circuit will probably mean nothing worse than blown fuses. The chokes should be carefully constructed, then fitted in the tin, soldered down, and then, but not before, be connected to the power supply in the lead from the power plug to the set. Needless to add, rubber bushings should be fitted where the power flex passes through the sides of the tin, so that there is no chance of the flex being bared by the rough edges of the holes.

ELIMINATING HUM IN THE "1932 SERIES."

IF any hum trouble is evident with the resistance coupled versions of either the "1932 Series" or the "Outsupering" it may be advisable to make a slight alteration in the filter system. Instead of running the can of the first electrolytic condenser (the one connected to the rectifier filaments) to earth by mounting the can directly in the base, it should be completely insulated from the base. Then a lead should be taken from the can to the centre tap of the high tension secondary winding of the power transformer. By doing this the main bias resistor becomes included in the filter circuit, and should remove the last trace of hum.

HOW TO MAKE A UNIVERSAL POWER TRANSFORMER



This power transformer, having tappings for all voltages, is suitable for use in any of the receivers described in this book. It is not difficult to make, and will save the consistent experimenter many shillings. It is a reprint of a "Wireless Weekly" contribution by N. Huey.

UNDOUBTEDLY one big drawback to building in succession all the sets described in "Wireless Weekly" (and other technical journals) is the fact that power transformers of different ratings are so often specified, and in our (that is to say, yours and mine) present financial state the purchase of an additional power transformer while another perfectly good one goes to waste is quite out of the question. So we are led to the idea of a "universal" transformer, one which can be used in a set requiring a transformer of practically any specifications.

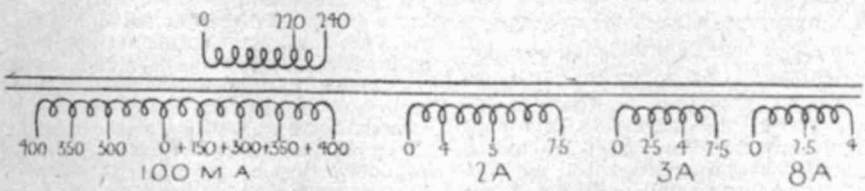


FIG 1

Such a transformer must have a high voltage secondary giving a range from 300 to 400 volts centre tapped at 100 ma. and various voltages up to 750 for half-wave rectification, with a 281 or similar tube. The filament windings must provide voltages of 2.5, 4, 5, and 7.5 at various amperages; at least, three windings will be necessary. First, a 2 amps. winding giving 7.5, 5 or 4 volts, to allow for any type of rectifier tube. Second, a 3 amp. winding for the output tube or tubes giving 7.5, 4, and 2.5 volts, to allow for type '50's, Continental, or '45 and '47 types. Last, but not least, an 8 amp. winding to heat the remainder of the tubes in the set (r.f., detector, i.f. stages, etc.), and allowing for voltages of 2.5 and 4 volts, to be used with types '24, '27, '35, etc., and Continental tubes. The windings and taps for such a transformer thus appear as in Fig. 1.

Coming now to the design of the transformer, we find first the wattage rating: We have 400 volts at 100 ma., 40 watts; 7.5 volts at 2 amps., 15 watts; 7.5 volts at 3 amps., 22.5 watts; and 4 volts at 8 amps., 32 watts; giving us a total of 109.5 watts. As it is unlikely that the windings will all be used at their full current and voltage ratings at the same time (e.g., it is unlikely that using 4-volt valves the initial stages of any set will draw more than 6 amps. from the 8 amp. winding), so we may rate our transformer at 100 watts, and design accordingly. From the usual design formulae for small transformers with stalloy cores, and allowing a flux density of 60,000 lines to the square inch, we obtain the primary turns per volt as 3.5 and the core area necessary as 2.15 square inches. Allowing from 3 to 5 per cent. for regulation, we may use a figure of 3.6 as the secondary turns per volt.

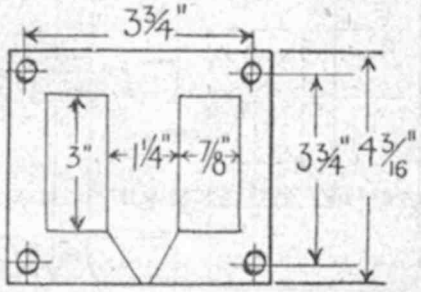


FIG 2

Turning now to the core, Levenson's and other city dealers supply laminations as shown in Fig. 2, punched with a hole in each corner for a 5-32in. bolt. The width of the central leg is 1¼in. Dividing 2.15 (the required sectional area) by 1.25, we get 1.72in. as the required depth of the core. This is near enough to 1¾in., and the slight extra core area will give us an additional margin to provide for iron losses due to the holding down bolts and the slight air gap introduced by the two cuts at the bottom of the middle leg of the core. The laminations are inserted into the coils (when wound) by bending the centre leg at an angle of about 20 degrees to the remainder of the lamination, inserting through the three formers and bending flat again. Alternate laminations should

WINDING TABLE

	Wire	Turns	Tapped
Primary	25 B. and S. 26 S.W.G. Enam. copper.	840. 18 layers of 45 turns and one of 30 turns.	765. At end of 17th layer.
Secondary	32 B. and S. 34 S.W.G. Enam. copper.	1440/1440. 48 layers of 60 turns each.	180, 360, 1440, 1980, 2520, and 2700. At end of 3rd, 6th, 24th, 33rd, 42nd, and 45th layers.
Filament— 2.5 and 4V, 8A	12 B. and S. 14 S.W.G. D.c.c. copper.	15. Two layers of 6 and one of 3 turns.	6 turns. At end of first layer. Leads 4, 2.5, 0.
Filament— 2.5, 4 and 7.5V, 3A	16 B. and S. 18 S.W.G. D.c.c. copper.	27. One layer of 15 and one layer of 12 turns.	9 and 15 turns. Leads 0, 2.5, 4, 7.5.
Filament— 4, 5 and 7.5V, 2A	16 B. and S. 18 S.W.G. D.c.c. copper.	27. One layer of 15 and one layer of 12 turns.	15 and 18 turns. Leads 0, 4, 5, 7.5.

be inserted from opposite ends. See Fig. 3.

The windings are in three formers, one each for primary and h.t. secondary, and one containing the three filament windings. The formers are made of stout cardboard 1-16in. thick, and their construction is shown in Figs. 4 and 5. First the two square ends are cut to the dimensions shown, and the corners rounded. The diagonals of the inner square are now cut along, but not the sides of this square. We now have a square of cardboard with four triangular flaps. The tips of these flaps are now cut off, as shown in Fig. 4. The next move is to wrap the long strip around a block of wood 1 15-16in. x 1 3-8in., gluing the overlapping portions; seccotine is the best adhesive, though any similar "stick-fast," or even ordinary gum, will be quite effective. Now the constructor proceeds to insert the flaps of the end pieces into the central portion of the former; after making sure that

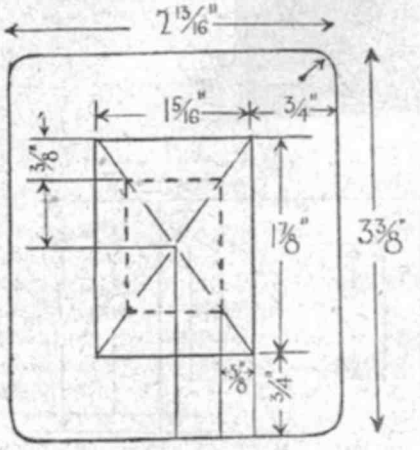


FIG 4

the end pieces fit well they may be seccotined to the remainder of the former.

When dry, the winding may be proceeded with. The former is mounted on a block of wood 1 7-8in. x 1 5-16in., and

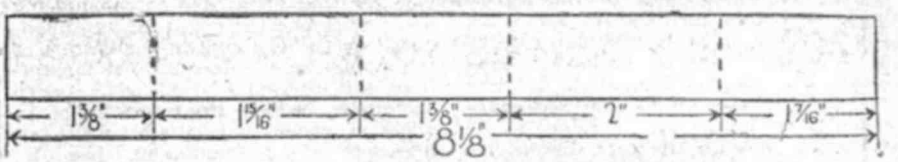


FIG 5

secured firmly by tacks at the edges and by small wedges (matches will do good service for these). Do not actually tack through the former; this is most undesirable. For convenience the operation next described may be performed before placing the former on the block. Locate accurately the centre of the block, and drive squarely into it an 1-8in. or 3-16in. metal drill, leaving a little over an inch of the shank protruding. When winding, this is gripped in the chuck of a breast drill, which in turn is mounted horizontally in a vice. The start of the winding is passed through a small hole in the end of the former, and may be secured temporarily to a tack in the block, or by a knot in the wire. All leads from the

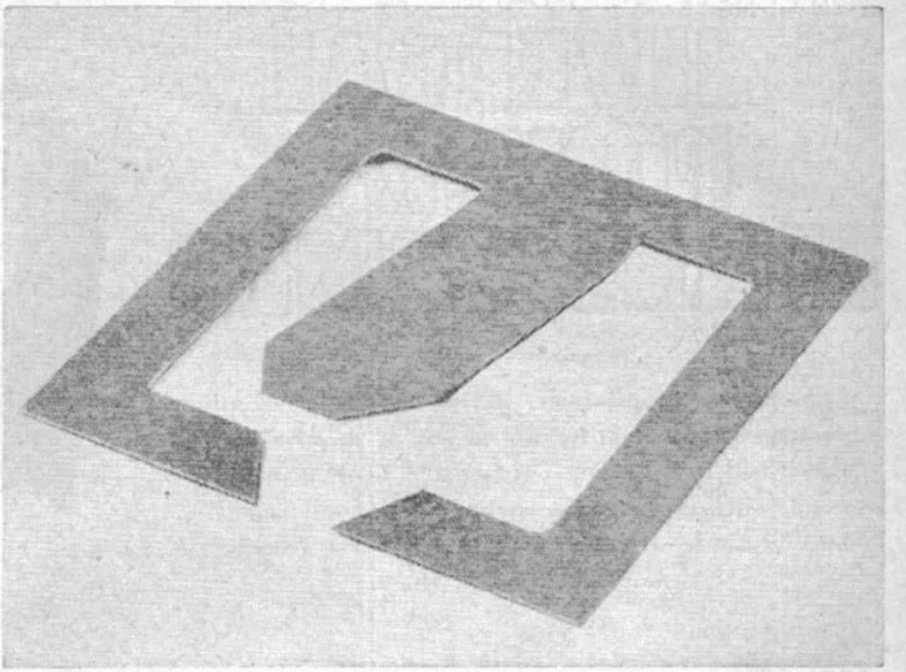


FIG 3

The Laminations

primary and filament formers should be passed out through one end of the former, while those from the secondary pass out through both ends; those leads marked 400, 350, 300, and 0 through one end and plus 150, plus 300, plus 350, plus 400 through the other. Leave a length of about six inches protruding to allow for accidents in assembly, etc. It is important to note that all leads should come out at the same side (not end) of the former. See Fig. 6. Winding may now be proceeded with, the reel of wire being mounted on a horizontal nail in preference to letting it lie on the floor. The wire should be fed on evenly and without kinks. At the end of each layer, wind a piece of white paper around the winding. Turns may be counted by observing the number of revolutions of the handle of the drill and multiplying this by the ratio of the gearing on the drill; this may be determined by counting the number of teeth on the crown and pinion wheels of the drill and dividing the former by the latter.

Taps are best brought out by soldering a length of thin flex to the correct point on the wire. The joint should be covered by sticking-plaster, this being less bulky than insulation tape. Take care not to have two of these joints directly above each other, as the mechanical pressure caused by their bulk is conducive to breakdown. If desired, Empire cloth instead of paper may be used for insulation between layers at points where taps occur. Where it is necessary to lead the flex from the tap across the width of the former, place a small strip of Empire cloth both below and above it. The taps to the filament windings may be taken out with thicker flex or normal hook-up wire. When winding the filaments, place at least three thicknesses of Empire cloth between each winding. After each coil is finished it should be thoroughly immersed in molten paraffin wax, and when dry a layer or two of Empire cloth seccotined over the top.

When winding, the figure corresponding to each tap should be marked in pencil on the former where it comes out. Each lead is then cut short, provided with the appropriate length of

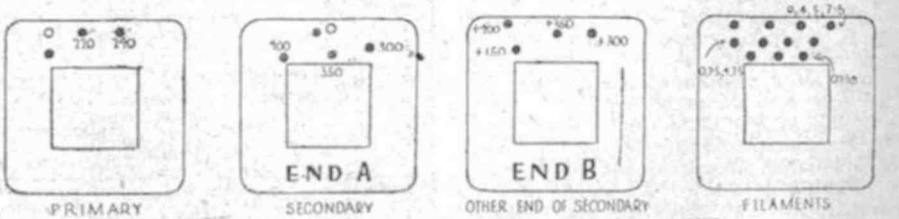


FIG 6

spaghetti and soldered to a soldering lug so that it will just reach its corresponding terminal on the panel of 1-8th inch bakelite which is drilled as shown in Fig 7. Each terminal consists of a 1-8in. screw 3-8in. long (and nut) provided with a soldering lug above the panel for the purpose of connection. The panel is supported on the four holding down screws (5-32in. x 3½in.) by means of four extra nuts; the holes for these screws should be 3-16ths of an inch in diameter. The coils should be arranged in the order shown in Fig. 8. The laminations should be screwed down tightly by means of the iron mounting clamps as supplied by Levenson's and other city dealers.

The core contains 5½lb. of stalloy laminations. Suitable clamping brackets will be required to hold the core laminations together. The other material needed is as follows:—

½lb. 12 B. and S. or 14 S.W.G. d.c.c. copper wire.

½lb. 16 B. and S. or 18 S.W.G. d.c. copper wire.

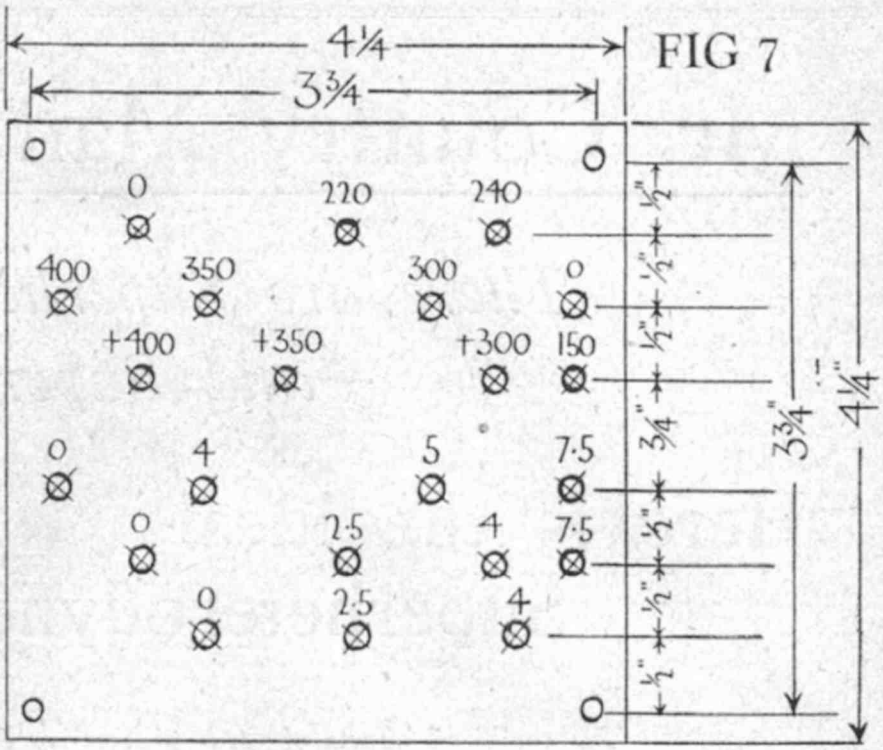


FIG 7

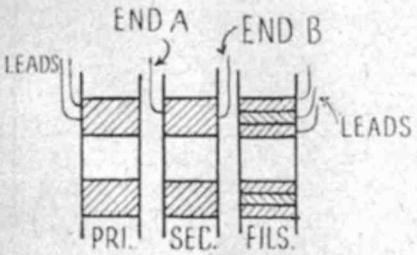


FIG 8

½lb. 32 B. and S. or 34 S.W.G. enamel copper wire.

½lb. 25 B. and S. or 26 S.W.G. enamel copper wire.

22 1-8in. x 3-8in. screws with nuts.
4 5-32in. x 3½in. screws.
12 5-32in. nuts.
44 soldering lugs.
About 1 yd. spaghetti.
About 1 yd. thin flex.
About 1 yd. thick flex.
About 12ft. strip Empire cloth.
Cardboard, paper, seccotine, paraffin wax, etc.

To prevent vibration it is desirable to wedge the coils tightly on to the core by thin slips of wood. It will be found convenient to follow the winding table as set out. Constructors should be careful to use the correct formers to wind each coil on. This transformer will give long and efficient service to anyone building it, being the home-made version of the Radiokes "Universal" power transformer lately placed on the market.

MAKE USE OF THE "W. W." INFORMATION SERVICE

READERS should note that they can obtain information about any of these sets from "Wireless Weekly." There are three separate information services, all under the personal supervision of the technical editor. (1) A free service through the columns in the back of the "Wireless Weekly." (2) A free service, queries being answered over the air from Station 2CH on Wednesday evenings between 8 and 8.30. (3) A reply-by-return-mail service, for which a fee of 1/- is charged. For the 2CH service letters should be addressed "Hull, c/o 2CH, 77 York Street, Sydney," but for both of the other services the address is "Radio Information Service, Box 3366PP, Sydney."

FORWARD THIS COUPON WITH YOUR QUERY

To the "Wireless Weekly" Radio Information Service Box 3366PP., G.P.O., Sydney.

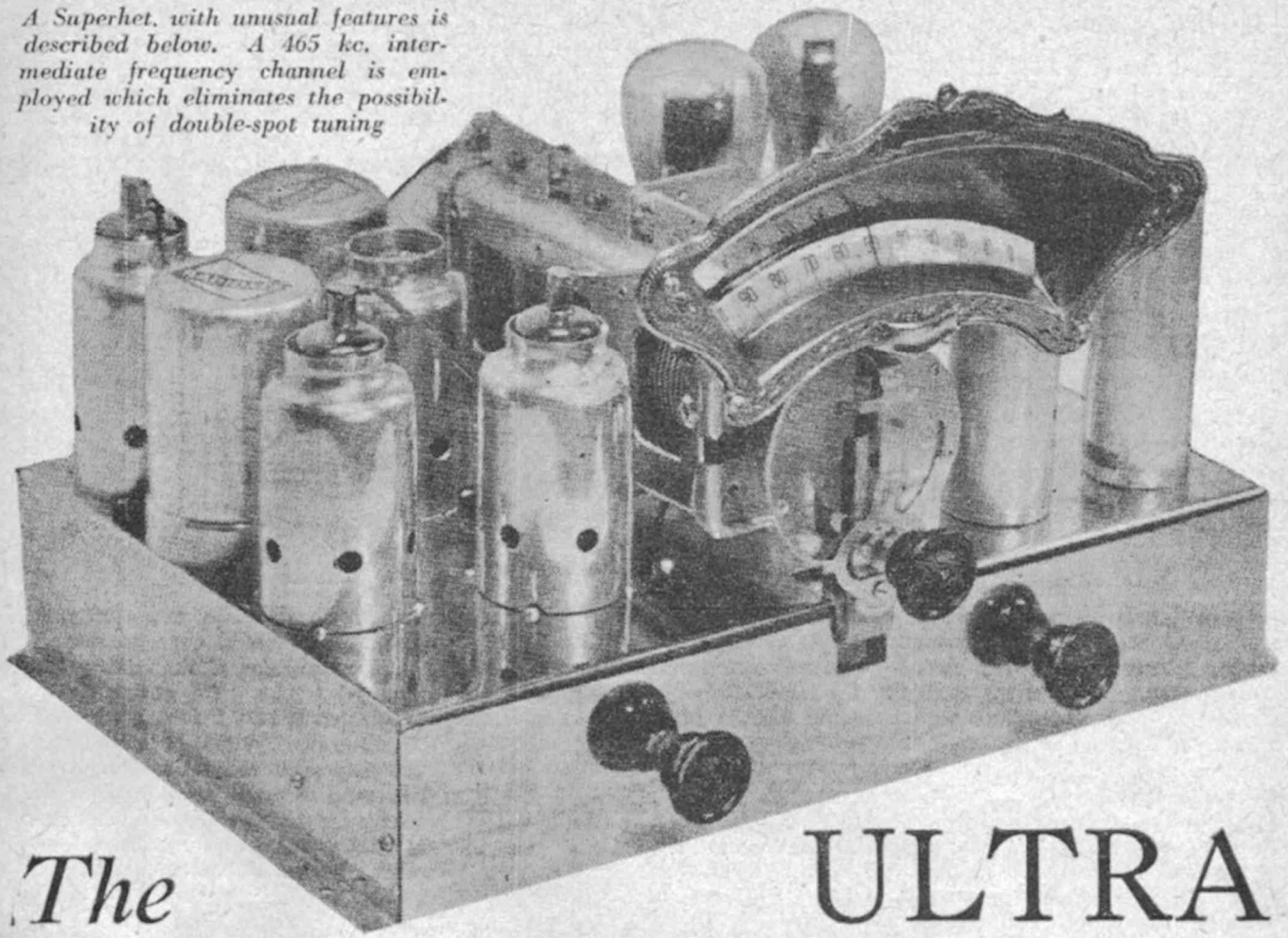
Please answer the accompanying query

(a) Free of charge through the columns of "Wireless Weekly" at your earliest convenience.
(b) Free of charge over the air during your session from 2CH at 8.0 p.m. Wednesday.
(c) In a special letter by return mail for which I enclose one shilling in { postal notes / money order / stamps }

{ STRIKE OUT SERVICE NOT REQUIRED. }

RULES: *All branches of the "Wireless Weekly" Information Service are governed by the following rules: (1) Readers are requested to limit the number of questions and to be as concise as possible; (2) Replies by post will not exceed 500 words; (3) Information cannot under any circumstances be given over the telephone; (4) As nearly as possible all preferential distinctions between trade brands will be avoided; (5) No special circuits can be supplied, and no special designs for transformers, coils, or other such apparatus can be given; (6) The scope of the service does not include the answering of general questions, such as "What is Electricity?" Readers are invited to make suggestions for articles dealing at length with that phase of radio in which they are interested; (7) All questions are answered sincerely and efficiently to the best of the ability of the Technical Editor, and to the extent of the channels of information available to him. No liability attaches to "Wireless Weekly" for any misinterpretation or misdirection of the information thus supplied.*

A Superhet, with unusual features is described below. A 465 kc. intermediate frequency channel is employed which eliminates the possibility of double-spot tuning



The ULTRA *Superheterodyne*

IN these days of rapid changes in circuit design, improvements in vacuum tubes, etc., it is very difficult to obtain a receiver which will stay modern and still give results as good as "the latest."

In the "Ultra" superheterodyne, we think we have gone a long way towards solving the problem. The circuit embodies certain features which lift it above the ordinary, even in superhets. In the first place, the circuit employs the 465 kc. intermediate channel, used in conjunction with 58 as intermediate amplifier.

This combination has certain advantages which the older type could not attain.

If the 465 kc. channel is used with the 35 type amplifier, the gain is definitely not good enough. Hence, 175 kc. is essential. Even with the 35 the noise level at satisfactory sensitivity figures is in general too high. With the 58, the noise level is quite unmanageably high. The higher amplification of the 58, however, enables improved sensitivity to be obtained, using the 465 kc. channel, and, at the same time, a noise level which is on a par with a good, straight t.r.f. receiver.

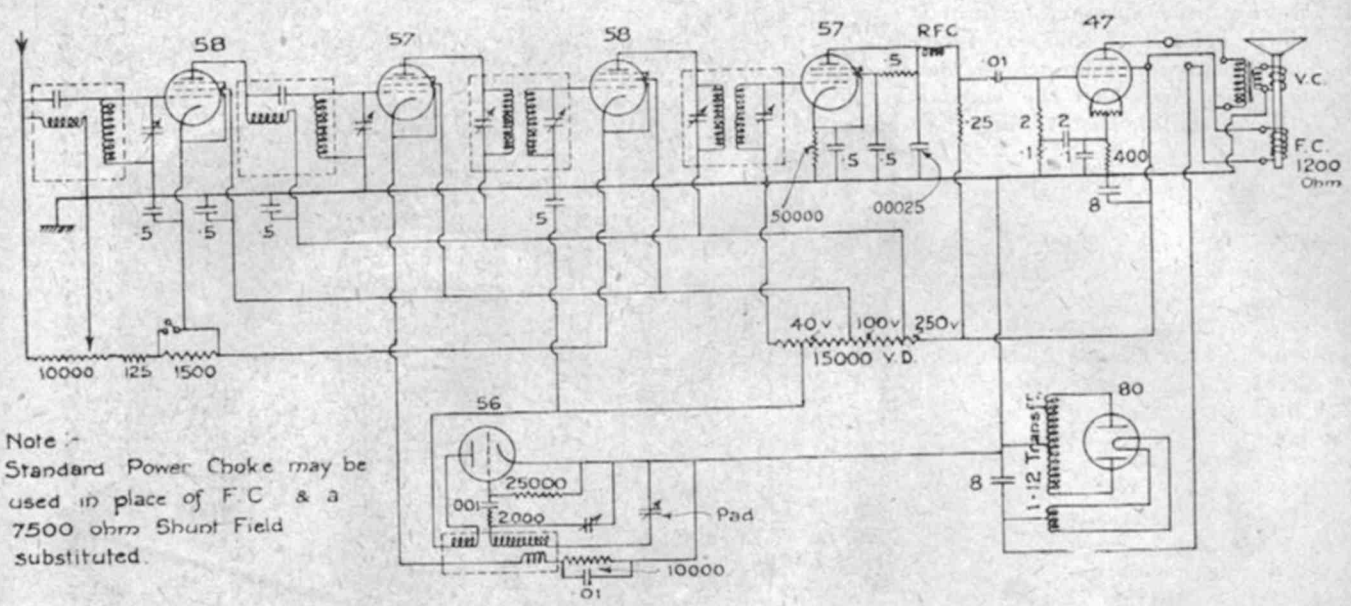
Another advantage, very considerable in its effect, is the absolute elimination of double-spot tuning.

Consider a station of frequency 1500 kc. An image effect occurs at a frequency lower by twice the intermediate frequency. When 175 kc. is used, this image will appear at 1150 kc., when, with two average tuned circuits, and high gain intermediate stages, there is generally sufficient r.f. signal allowed through to at least produce objectionable whistles on stations of about this frequency (1150 kc.).

However, when the intermediate frequency channel is 465 kc., the image of a station on 1500 kc. must appear at 1500—(2 x 465) kc., i.e., at 570 kc. For example, the image of station 3AK, Melbourne, would appear midway between 7ZL and 2CO, while that of the station with next lowest frequency, 2AY, would appear at 550 kc., above 2CO on the wave-band. Naturally, all other stations would have their images at still higher wave-lengths. We say "would have" advisedly, for even the most unselective of r.f. circuits has sufficient attenuation to prevent serious trouble when mistuned by over 900 kc.! However, as shown above, there is no possibility of double-spotting, on any station in the broadcast band, no matter how unselective the r.f. stage or stages may be. This feature, as anyone who lives under a broadcast station will witness, is in itself a great improvement.

It will be observed that the first harmonic of the frequency difference is on a frequency of 930 kc. (exactly on 3UZ). Thus it is essential to have "clean," sinusoidal oscillations. A 56 is used as oscillator. The separate oscillator tube is thus seen to be an advantage, as it is difficult to get autodyne quite harmonic-less. With a 56, used in a circuit of suitable constants, and with a suitably designed coil, practically pure sine-waves are generated, thus eliminating possible trouble due to the interference of the harmonic with 3UZ. It may be stated that 3UZ is not the only station that would suffer, as a region of instability would obtain for 30 kc. or so either side, with the set working at maximum sensitivity.

The circuit employed then is the plain, straightforward six-tube and rectifier. A 58 is used as r.f. amplifier before the detector; high gain is obtained in this stage, due to the full amplification of the 58 being made use of. This is possible, due to the high efficiency aerial and r.f. coupling units. These are pure impedence capacity couplers.



Note :-
Standard Power Choke may be used in place of F.C & a 7500 ohm Shunt Field substituted.

The aerial and r.f. coupling chokes are so arranged that the electromagnetic coupling between primary and secondary is a minimum. Thus the coupling is practically pure electrostatic, with a minimum of damping on the tuned circuits.

It will be found that when receiving locals, the output circuit overloads before the volume control is anywhere near full on. To make possible smooth control of local stations, a 1500 ohm "sensitivity attenuator" is embodied in the bias control of the r.f. and i.f. amplifiers.

The intermediate frequency transformers give a splendid band-pass effect on 465 kc. Adequate selectivity is given by the four tuned circuits, while the gain of the stage brings the overall sensitivity to a remarkably satisfactory level.

A 57 occupies both first and second detector sockets. A 58 may be used as first detector, but results are not so good unless special arrangements are made regarding the pick-up from the oscillator.

The audio circuit is simple resistance-capacity coupling, the only features differing from normal being that the screen of the 57 is fed direct from its anode, instead of from B positive. This makes for smoother amplification, since any variation in anode current and voltage is automatically recorded in screen constants also. The penthode grid-leak is decoupled back to cathode, increasing bass response considerably. The third control may conveniently be used for tone. The form of this may be left to personal taste. The four-point switch working in conjunction with a tri-valued condenser, from pentode grid to earth, is perhaps the simplest. A continuously varying tone control is, of course, productive of better results, but necessitates a 250,000 ohm rheostat, in series with, say .05 mfd. The best position for this is to use the quarter meg. variable as a potentiometer, feeding the plate of the 57 second detector, the moving arm goes to the .05 condenser, the other side of which goes to earth.

A power transformer capable of delivering 70-80 ma. at 420-430 volts enables the use of a 1200 ohm series speaker field as power choke. Transformers are available which will do this, and also furnish up to 120 ma. at 250-260 volts, so that the usual filter choke may be used, and a shunt speaker field makes up the total draw from the pack to about 110-120 ma. Either of these alternatives is quite satisfactory.

THF ULTRA SUPERHET.

Parts List

1—Suitable base, 14 x 10 x 2¾.
1—"Ultra" inclined full vision dial (*Radiokes*
1—Kit of superhet. coils, &c. (*Radiokes*).
1—Power transformer (*Radiokes* (1-12), *Kriesler, Raycophone, Univox*).
1—15,000 ohm voltage divider (*Renrade, Radiokes, Raycophone, Kriesler, Univox*).
1—10,000 ohm ditto (*Radiokes, Renrade, Raycophone*).
1—10,000 ditto (*Radiokes, Renrade, Raycophone*).
1—400 ohm ditto (*Radiokes, Renrade, Raycophone*).
1—125 ohm ditto (*Radiokes, Renrade, Raycophone*).
2—50 ohm c.t. resistors (*Radiokes, Renrade, Raycophone*).
1—2 meg. grid leaks (*Renrade, Pilot, I.R.C., Alpha, International*).
1—¼ meg. grid leak (*Renrade, Pilot, I.R.C., Alpha, International*).
1—½ meg. ditto grid leak (*I.R.C., Renrade, Pilot, Alpha, International, Radiokes*.)
1—10,000 ohm potentiometer (*Chancery, Raycophone, Univox, Radiokes*.)
6—.5 mfd. fixed condensers (2 blocks of 3) (*Wetless, Hydra, Chanex, T.C.C.*).
2—.01 mfd. ditto (*Wetless, Renrade, T.C.C., Alpha*).
2—.001 ditto (*Wetless, Renrade, T.C.C., Alpha*).
2—.00025 ditto (*Wetless, Renrade, T.C.C., Alpha*).
2—Wet Electrolytic (*Sprague, Dulytic, Polymet, T.C.C.*).
1—100000 ohm grid leak
1—2mfd. fixed condenser
1—.1 mfd. fixed condenser.
1—Radio frequency choke (*Radiokes, Raycophone, Univox, Kriesler*).
Sockets—4 6-pin, 2 5-pin, 1 4-pin (*Renrade, Raycophone*).
Necessary screws, wire, solder, &c.
Valves—1—56 (*Ken-Rad, Radiotron, Philips, National Union, Cossor*).
1—57
1—47
3—58 (*Mullard*)
1—80
Speaker—D.C. dynamic, with 1200 ohm field coil and input transformer, matched for pentode (*Amplion, Saxon, Jensen, Jubilee*).

The construction of the receiver presents no trouble. The chassis in the photograph is 14in. x 10in. x 2¾in., and all components fitted in quite easily. The only point needing watching is to be careful to mount the components in such order that it will not be necessary to remove one in order to mount another. For example, it is necessary to mount the triple gang before the tuning unit, which comprises the three tuning coils (aerial, r.f., and oscillator). The tuning unit is mounted sub-panel, under the triple gang. The whole layout has been arranged with a view to keeping the leads as short as possible.

The same layout may be preserved with a larger chassis, which will make the job easier to assemble and wire, although no difficulty is presented with the small chassis if due care is taken.

In adjusting the receiver, the following method is recommended as giving perfect alignment as quickly as possible.

Turn the set into a three-valve, two-tuned circuit job by placing the grid clip of first detector on second detector, having first removed the lead from the second i.f. assembly to second detector. Now line up the r.f. circuits exactly, making a note of the tuning positions of the locals received.

Having set the dial on a high frequency station, such as 2SM or 2CH, revert to the full superhet. circuit. The station tuned to may or may not still come in; without touching the triple-gang's tuning knob, adjust the capacity in the oscillator circuit to maximum sensitivity, by means of the trimmer on the gang member, and the padder. The trimmer should on no account be left nearly hard in.

Now proceed to a low frequency station, such as 2FC or 3AR, or thereabouts. Set the gang to the position to which the station tuned with the set as a three-valve. Then adjust to maximum output by means of padder alone. Unless things were perfectly

balanced, this will have the effect of throwing the alignment out at the high frequency end of the spectrum. Hence, to finish the job of lining up, return to the high frequency station selected in the first place and check the alignment by adjusting the **trimmer** on the oscillator gang member. A slight adjustment will in general be necessary. It may be that a further trip to the low frequency end and back will result in a finer adjustment, but, in general, this should not be required.

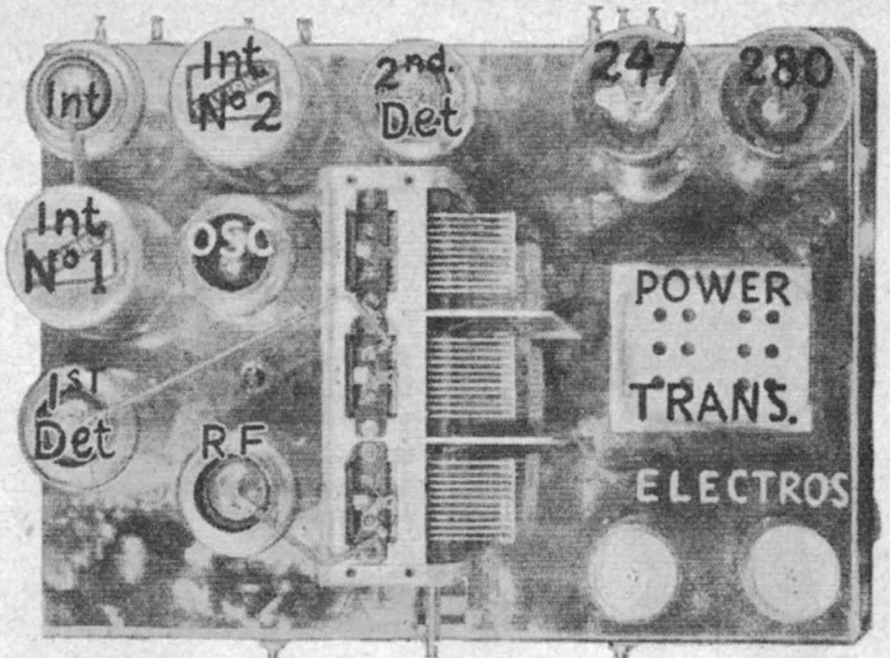
Actual tests of the receiver show that it is capable of very fine performance.

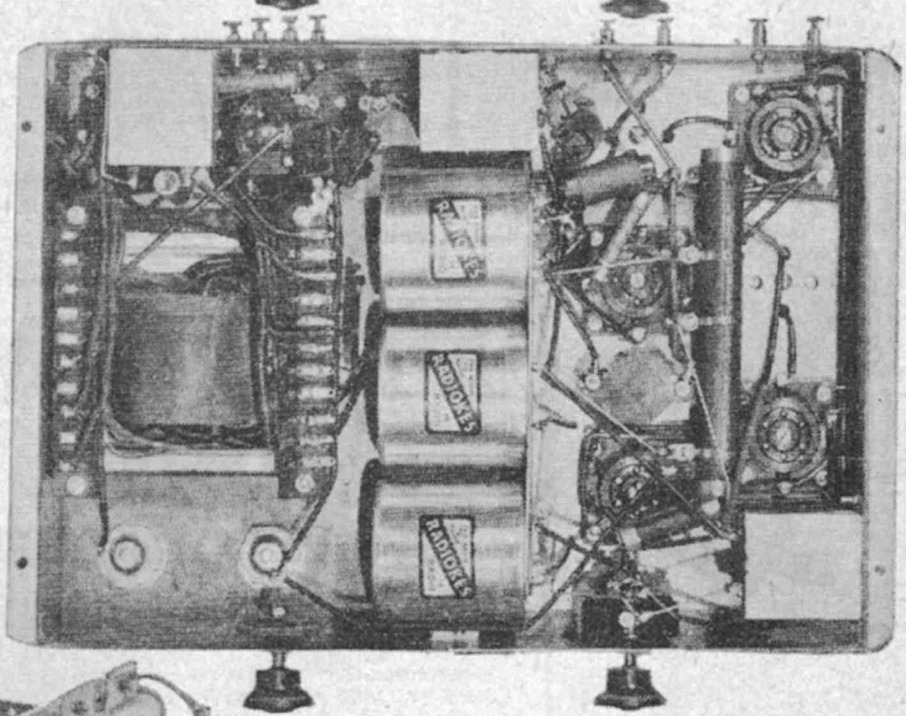
The high sensitivity is accompanied by a lower noise level, as explained above. This means that the effective sensitivity has been considerably increased from the value possible with 35 tubes and 175 kc. i.f. channel.

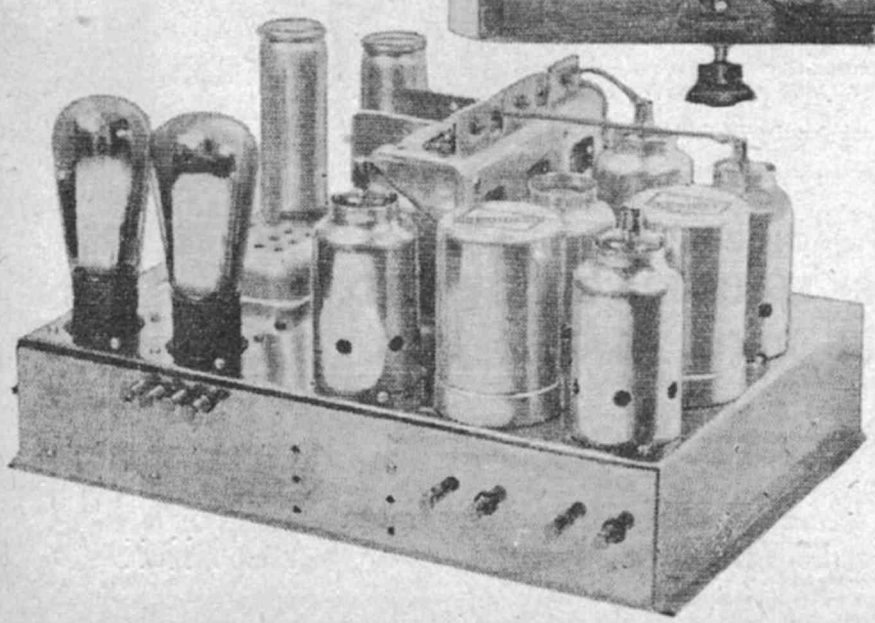
When making these tests, for input to the receiver, the signal generator was coupled to the antenna circuit by means of a standard dummy aerial, constants 20 mh., 200 mmfds., and 25 ohms. To match the single penthode output tube, a resistance load of 7500 ohms was connected to the tube. In order to prevent its loading effect, the voice coil circuit was opened during test.

Average sensitivity recorded during tests was 2.5 microvolts absolute, equivalent to 0.6 microvolt per metre. Maximum noise level occurred at 600 kc., equivalent to 45 per cent., and minimum was 35 per cent. at 1400 to 900 kc. Band width at 1400 kc. and ratio of 100 times field strength 18, and at 1000 kc. 17, and at 550 kc. 18.5.

It will be seen from the above figures that the job is a definite advance on current practice, and this, coupled with the ease of construction and adjustment from the guaranteed parts available, should commend itself to all those readers who demand and get the best in radio.







At the top of the page is shown the layout of the Ultra Superhet. Immediately above is the sub-panel wiring diagram. On the left is a rear view of the receiver.

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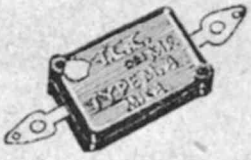
1 Watt Type, 10,000 ohms to 5 meg. ohms.
2 Watt Type, 2,000 ohms to 2 meg. ohms.
3 Watt Type, 10,000 to 50,000 ohms.



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8 mfd. 9/6
7 mfd. 9/6