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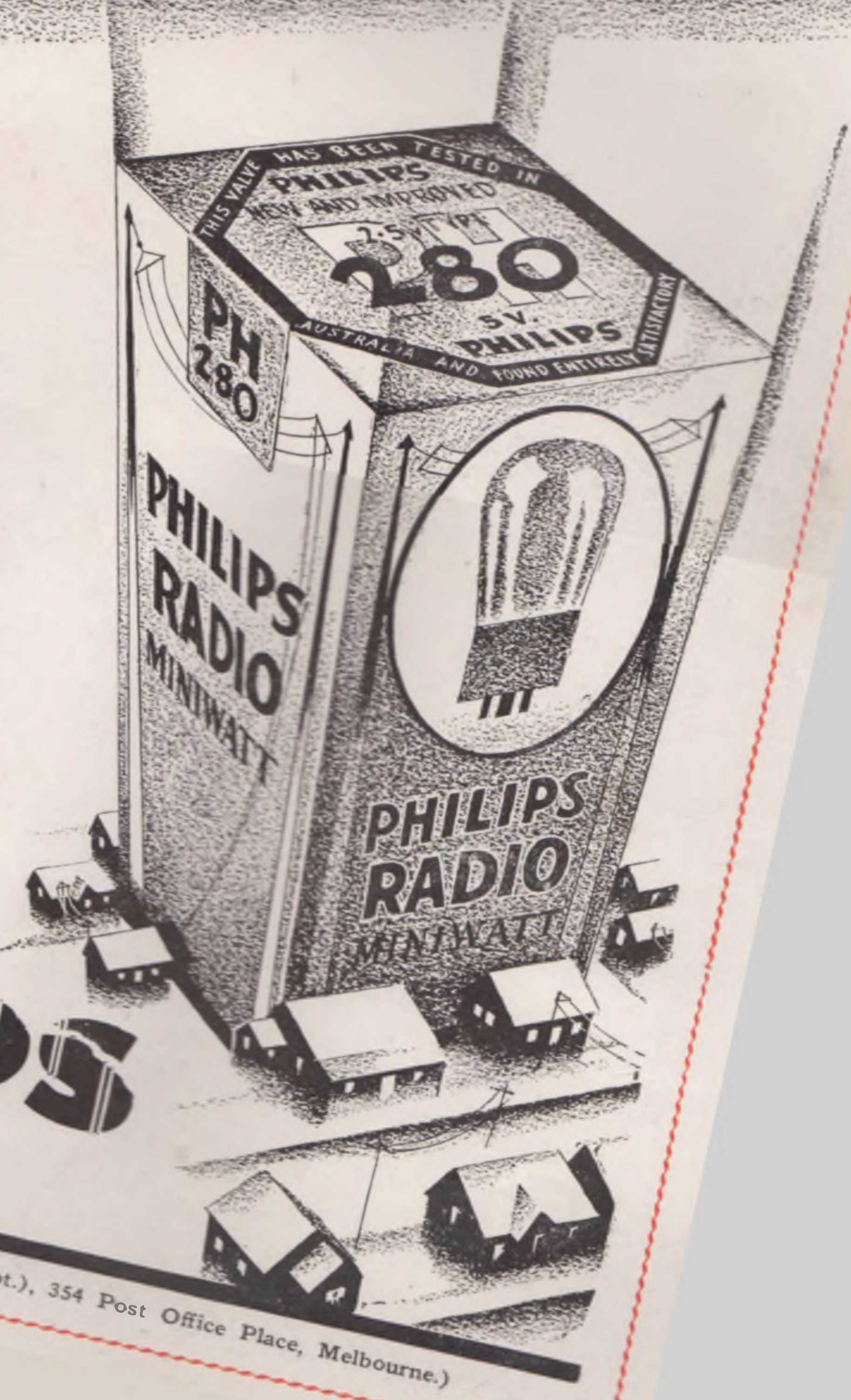

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IN THIS ISSUE

CONSTRUCTIONAL ARTICLES.

GENERAL ARTICLES.

DEPARTMENTS.

MODERN SETS

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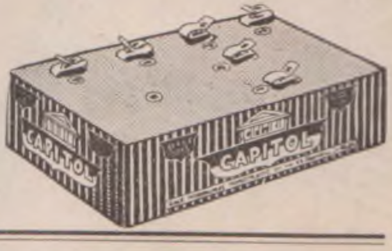

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EDITORIAL

EVIDENTLY our efforts to produce a truly radio paper for the set builder and the experimenter are receiving worth-while support. The snowball demand for the second issue was even greater than that which attended the publication of the first number. Naturally, the continued demand for "Modern Sets" will depend to a large extent on the matter which we include in each issue.

●

WHICH brings us to another point. In order that we can still further extend the descriptions of receivers and the other technical and general articles which constitute each month's contents, we have decided to set the paper in a slightly smaller type. The excellent paper and printing of the magazine will ensure the readability being quite as good as before, and, editorially, we will be able to cram even more material into the paper than it has so far contained.

●

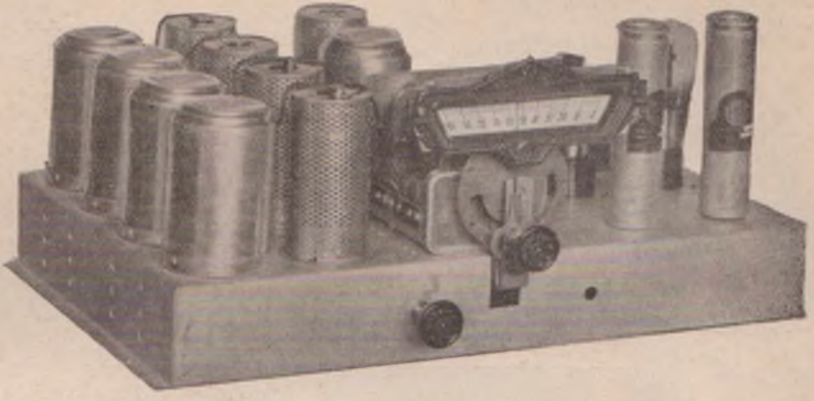
TECHNICALLY, this issue of "Modern Sets" is the best we yet have produced. The various sets which are described all have been tested by our technical experts, and represent types which will appeal to all. It will be noticed that in pursuance of our policy to deal with all phases of short-wave radio, we have devoted considerable space to the description of short-wave receiver construction.

●

BESIDES this, we have on hand for publication in the near future some interesting modifications of existing receivers, which have been prepared after checking over the contents of our mail-bag. Such comments are always of value, and again we ask readers to continue their co-operation by sending in suggestions for future articles.

THE EDITOR.

The Radiokes Simplified Super-Het



The finished super presents an imposing appearance.

Full Constructional Information on an Outstanding Superheterodyne Kit is Provided by the Writer of this Article.

By H. J. BALLARD.

THE building of a super-het has for many moons been a job shirked alike by expert and novice. The early types of super-het are too well remembered by the old-timers for the trouble they gave, and the latest types by the very complexity of their circuit arrangements have "put the wind up" the novice.

Although the more complex super-het circuits which have been developed to-day to cope with modern broadcast receiving conditions may appear difficult to build, the 1932 super-het really is little more trouble to construct and to get going than a standard two or three valve receiver. Naturally, because they employ from four to six or seven valves and a rectifier, their assembly and wiring takes longer, but the introduction by one or two manufacturers of complete super-het kits has taken all the "bugs" out of amateur super-heterodyne construction.

As a case in point, we cite the Radiokes Simplified Super-Heterodyne kit, which has been incorporated in the receiver we now propose to describe. From the foundation pressed steel chassis to the last terminal, and the last machine screw, the manufacturers of this kit have provided everything for the prospective set builder. In their constructional information provided with the kit, they deal with practically every phase of its building and operation.

So interested was the writer in the new Radiokes kit that he decided to build it up and to find out for himself exactly how easy or how hard it was to construct and to get working.

The actual construction was not difficult. As can be seen from the various pictures of the set, everything is conveniently arranged so that neither assembly nor wiring difficulties are likely to be encountered.

In assembling the kit we started off by mounting the five coils and their associate screen mountings. Then we put in the valve sockets and their screen mounts. The next job was the mounting of the gang condenser, the two electrolytic condensers and the power transformer. Although we realised that the early mounting of the latter component would make the set a bit heavy to handle, we preferred to make it possible to run the filament and power leads at an early stage of the wiring. The final assembly on the outside of the chassis was the volume control, the aerial and earth terminals, the loud-speaker socket and the strip which carried the pins which connect to the power supply plug.

Incidentally, we deviated slightly from the original Radiokes arrangement in that we did not incorporate a tone control. The mounting hole provided in the chassis for this component we probably shall use for a power switch. Again, in the assembly of the components under the chassis, we preferred to use two of the new Hydra 3 x .5 mfd. condensers instead of six separate T.C.C. condensers. We found that the two Hydras could be mounted under the securing bolts for L1, L2, and the second intermediate frequency coil L7, L8.

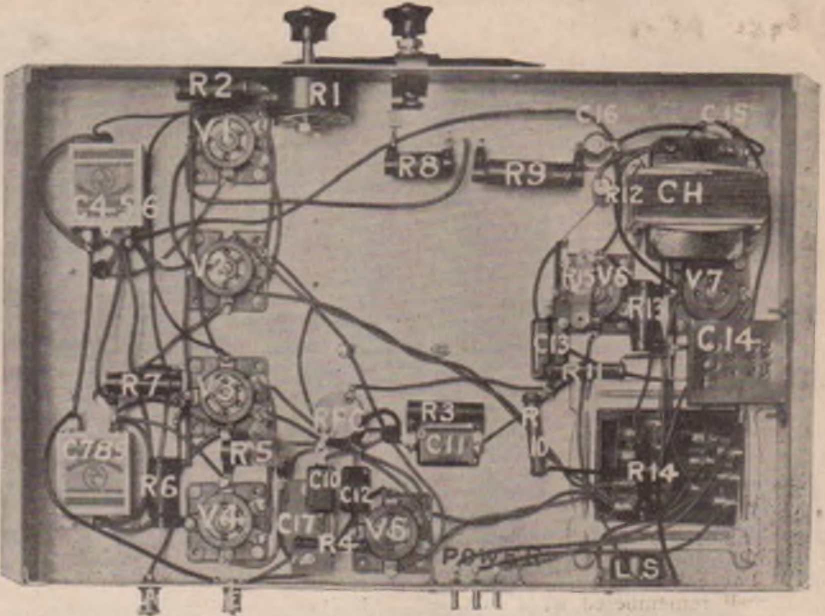
Mr. H. J. Ballard, of Veall's Technical Dept., who so fully describes his work with the Radiokes Super-Het.

These were the only deviations from the original arrangement of components and their mounting. Underneath the chassis we mounted the two Hydra condensers previously mentioned, the padding condenser C17, the 2 mfd. condenser C14, the filter choke CH, the radio frequency choke RFC, and the .01 mfd. T.C.C. condenser 11, and the .01 mfd, condenser C13. At this stage we had completed all the assembly possible. Other components which were to connect into circuit were intended to be soldered direct in or to connect to other lead wires.

The wiring of the super-het was even easier than the assembly. The braided hook-up wire which was provided with the kit proved ample for the job, and the lay-out of components was such as to facilitate construction.

The best way to start the wiring is to get the filament circuits in. Run a pair of leads from the 2.5 volt 10 amp. lugs on the power transformer to the F terminals on V5, V3, and V4, in that order. Run another pair of wires from the same filament lugs on the transformer to V2 and V1. Now connect the aerial terminal on the chassis to one outside terminal on the potentiometer, to which is connected the red lead from L1, L2. The other outside terminal on R1 is connected to one lead on the 125 ohm resistor R2, the other lead of which connects to the C terminal on the socket of V1, to the corresponding terminal on V3, and to the top left-hand lug on C4, C5, C6.

The blue and yellow leads from L1, L2 are connected together, and go to the bottom right-hand lug on C4, 5, 6. These three lugs are connected together, and to the facing lugs on C7, 8, 9, and to the earth terminal on the chassis. The yellow lead from L3, L4, connects to the P terminal on



A plan view of the under chassis wiring and lay-out.

the socket V1. The green lead from the same coil unit connects to the bottom left-hand lug on C4, 5, 6, and to the green lead of L5, 6 and the green lead on L7, 8. From this lug on condensers C4, 5, 6, a lead is taken to the electrolytic condenser C16. The blue lead from coils L3, 4 connect to the earthed lugs on C4, 5, 6. The blue lead from L5, L6, and the correspondingly coloured lead on L7, L8, connect to one of the securing bolts on the socket V3.

The yellow lead from L5, L6 connects to the P terminal on the socket V2. The yellow lead from L7, L8, connects to the P terminal on V3. The G terminal on V1 connects to the G terminal on V2, and to the same terminal on V3. From V2 a lead goes to one vacant lug on the unearthed side of C4, 5, 6. From the G terminal on V3, a connection is taken to one lug on the 25,000 ohm resistor R7. The other lug on R7 is soldered to the top left-hand lug on C7, 8, 9, and from there connects to the green lead on the oscillator coil L9, 10, 11.

From the G terminal on the socket of V3 a lead goes to the one lug on the 100,000 ohm resistance R6, the other lug of which connects to the G terminal on V4, and to the bottom unearthed lug on C7, 8, 9. On the electrolytic condenser C16 one lug of the 50,000 ohm resistor R9 is soldered. The other lug on this resistor is soldered to one lug on R8, another 50,000 ohm resistor. The other lug on R8 is connected to the metal chassis, and from the junction point between the two resistors a lead is taken to the G terminal on V1.

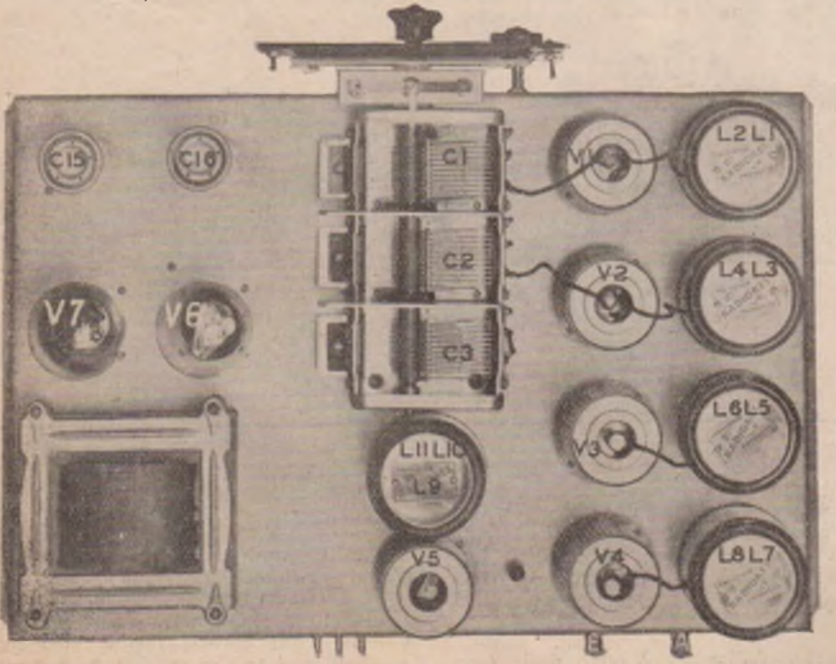
To the C terminal on the socket of V4 is soldered one lug of the 25,000 ohm resistor R5, and a lead is taken to the centre unearthed lug on C7, & 9. The other lead on R5 goes to one securing bolt on the padder condenser C17, and to the earth terminal on the chassis. From the P terminal on V4 a lead is taken to one lug on the radio frequency choke RFC, and to this choke is soldered one lug of the .0005 mfd. condenser C12. The other lug on C12 and one lead on the 2 megohm resistor R4 are connected to the earth securing bolt on C17. The remaining lead on R4 is connected to the G terminal on the socket V6, to which is soldered one lug on the .00025 mfd. fixed condenser C10.

The other lug on C10 carries the black lead from the oscillator coil L9, L10, L11, and connects to the fixed plate terminal on the variable condenser C3. The blue lead from L9, L10, L11 is connected to the unearthed terminal on the padding condenser C17. The C terminal on V6 is connected to the earth terminal on the chassis. The yellow lead from L9, 10, 11 connects to the P terminal on V6, and the orange lead from the same coil unit connects to the C terminal on V2. The red lead from L9, L10, L11 connects to one lug on the .01 mfd. fixed condenser C11, and to one lug on the 10,000 ohm resistance R3. The other lug on R3 connects to the remaining lug on C11, and to the earth terminal on the chassis.

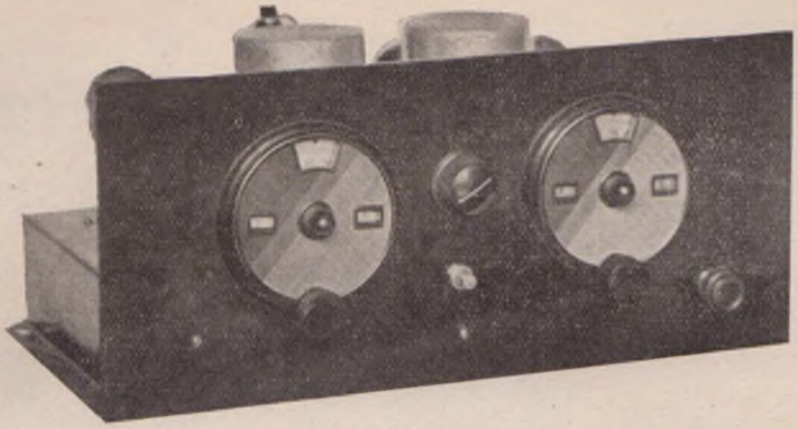
The green lead from L9, L10, L11 to the lug on C7, 8, 9, which carries the resistor R7. From the vacant lug RFC a lead goes to one lug on the fixed condenser C13, to which his soldered one lead on the resistor R10. The other lug on C13 is soldered to the G terminal on V5, to which also is connected one lead from the resistor R11.

The other lead on R11 connects to one lug on the 2 mfd. condenser C14, and to which also is soldered one lug on the 100,000 ohm resistor R13. The other lug on R13 is connected to one lug on the filter choke CH, to which also is connected one lead on the resistor R12. The other lead on R12 is earthed to one of the securing bolts on V5. The centre tap, R15, is connected across the filament terminals

(Continued on page 46.)



Accessible and simplified top panel lay-out is one of the features of this receiver.



The front panel view of the receiver showing the various controls.

The World Short Wave Four

Complete Constructional Data on a Highly Efficient Short Wave Receiver Which Employs Commercially Manufactured Plug-in Coils.

By C. M. SCOTT.

NOTWITHSTANDING the advantages of short wave adaptors and converters, and the more pronounced ones of all-wave receivers, anyone who has had real experience with short wave reception will plump for the straight out short wave set complete with its own audio amplifier system and provided with the correct condenser-coil combination. Such a receiver can be adjusted for maximum results and, because there is no changing around of sections of it, will stay adjusted for all time.

The writer has just finished some interesting tests with a four valve short wave receiver built round a well known commercial short wave coil kit. The results of these tests have convinced him that provided due care is taken in the building of the set with which they are associated, it is possible to get even better results from this commercial coil kit than from the most laboriously constructed amateur kits.

In order that our remarks relative to the coil kit may be of use to the experimenter, we propose to describe, as briefly as possible, the technical make-up of our experimental receiver. It employs a tuned r.f. stage in front of a regenerative detector, and two transformer coupled audio stages. As simplicity of design was the key-note of this, our latest excursion into the realm of s.w. receiver design, we eschewed wherever possible any freak circuit arrangements. As a matter of fact, after tuning the receiver for a while, we have come to the conclusion that, despite the added sensitivity of the screen grid detector and the single stage pentode audio arrangements, the old stand-by of general purpose valves and standard audio transformers is hard to beat.

Naturally, it was necessary, in order to get appreciable r.f. amplification on the short waves to employ a screen grid tube in the first stage of the receiver, but apart from this general purpose valves have been used.

A glance at the circuit diagram will show that apart from a variable resistance in the plate lead to the detector tube, an r.f. choke in the same lead, and two by-pass condensers, the circuit is absolutely the same as that which was so popular in early broadcast days when it masqueraded under the name "tuned anode."

Perhaps this is not altogether wise to admit but facts are facts. The present short wave arrangement works better than anything we have come in contact with, is ridiculously easy to build and to get going, and most important of all, is fairly cheap. Including valves, coils, and all the components, except batteries and loud speaker, the receiver can be built for about £7. When we remember the results it will give, we are inclined to think back to the early days of s.w. radio, when a similar set couldn't have been built for double that amount.

The pictures of the experimental model show that the detector and r.f. coils are screened from one another. This we found is quite necessary as it enables us to get greater gain, particularly on wave lengths above 35 metres, without striking instability.

Tuning of the detector and radio frequency stages is carried out with the aid of 23 plate midget condensers which have a maximum capacity of approximately .000125 mfd. and an extremely low minimum capacity. This in turn gives us a generous wave length overlap with each coil. The reaction condenser is an 11 plate midget. Three coils are used for each stage, to cover the whole wave range. The different coils are wound on variously coloured formers so that no trouble is likely to be met in selecting the right pair. The colours and wave ranges of the different coils are:—

R.F.		DET.		WAVELENGTH
Coil Base	Colour	Coil Base	Colour	Range
UX	Green	UY	Green	18 to 32 Metres
UX	Yellow	UY	Yellow	30 to 60 Metres
UX	Red	UY	Red	55 to 95 Metres

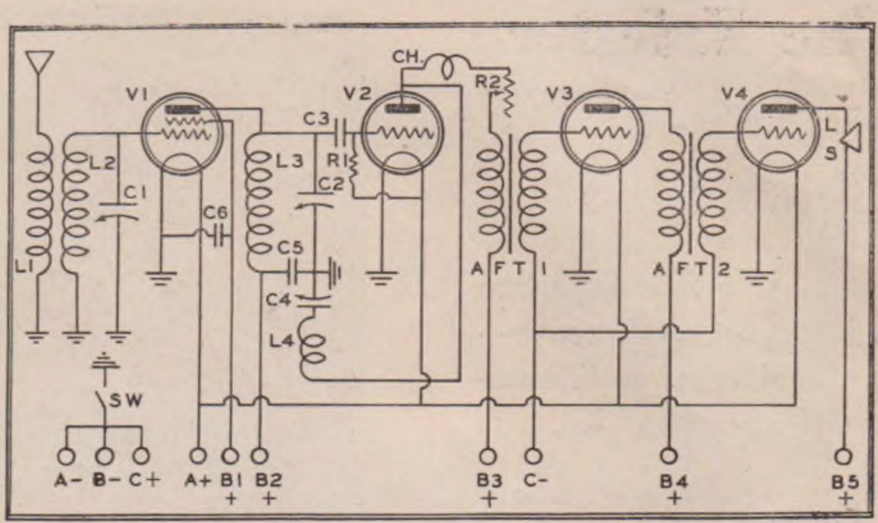
The receiver is built up on a metal chassis measuring 14½in. x 9in. x 2½in.

The two audio transformers and the bottom sections of the coil shield are mounted on the top of the chassis, whilst underneath are mounted the four valve sockets for the valves and the two sockets for the coils, the grid leak R1, the grid condenser C3, the two mfd. fixed condensers C5 and C6, and the radio frequency choke coil RFC. On the 16in. by 7in. bakelite front panel are mounted the two tuning condensers, C1 and C2, their associate vernier dials, the reaction condenser C4, the variable resistance R2, and the filament switch SW. The aerial, earth, and two loud speaker terminals are mounted on the back edge of the chassis.

When the actual assembly of the receiver is finished we can consider its wiring. This is started by connecting one of our flex wire battery leads to one terminal on the filament switch, SW. This is the "A" minus lead. From the other terminal of the switch a lead is run to one filament terminal on each of the valve sockets V1, V2, V3, and V4, and to the chassis. The remaining filament terminal on each socket is connected to the "A" battery plus lead.

From the P terminal on the first coil socket, L1,L2, a lead is taken to the aerial terminal A. The "A" plus and "A" minus terminals on the same socket are connected to the chassis. The G terminal is connected to the G terminal on V1, and to the fixed plate terminal on the tuning condenser C1. The P terminal on the socket of V1 is connected to one terminal on the 1 mfd. fixed condenser C6, and to the flex lead which is to carry the screening grid voltage "B" plus 1.

The other terminal on C6 is connected to the metal chassis as is the moving plate terminal on the tuning condenser C1. From the G terminal on the second coil socket a flex lead is taken to the top plate terminal on the Philips A442 valve V1, to the fixed plate terminal on the detector grid tuning condenser C2, and to one lug on the grid condenser C3. The other lug on C3 is connected to the G terminal on the socket of V2 from which a lead also runs to one terminal on the grid leak mount R1. The other terminal on R1 is connected to the unearthed filament terminal on the detector socket V2.



The schematic diagram is key-lettered to agree with other constructional data which has been provided.

The moving plate terminal on C2 is connected to the moving plate terminal on the reaction condenser C4, to one terminal on the 1 mfd. fixed condenser C5 and to the metal chassis. The other terminal on C5 connects to the C terminal on the coil socket for L3,L4, and carries the "B" plus 2 lead. The fixed plate terminal on C4 is wired to the "A" plus terminal on the L3,L4 coil socket, and from the P terminal on the same socket a lead goes to one terminal on the r.f. choke coil CH, and to the P terminal on the detector valve socket V2.

The remaining terminal on CH is wired to one terminal on the variable resistance R2. The other terminal on R2 is connected to the P terminal on the first audio transformer AFT1. The "B" plus terminal on this transformer carries the "B" plus 3 lead. The G terminal on the socket of V3 is connected to the G terminal on the first audio transformer AFT1, the "C" minus terminal on this transformer being wired to the "C" minus terminal on the second transformer AFT2, and carrying the "C" minus lead.

The P terminal on the socket of V3 is connected to the P terminal on AFT2. The "B" plus terminal on this socket carries the "B" plus 4 lead. The G terminal on AFT2 is wired to the G terminal on the socket of V4. The P terminal on this socket is wired to one of the loud speaker terminals LS, the other loud speaker terminal carrying the "B" plus 5 lead.

This completes the wiring of the receiver and it is necessary now to plug in the A442 r.f. valve into the socket of V1, connecting the plate lead from L3 to the plate (top) terminal on the tube; to plug in the A415 detector valve, the A409 first audio valve V3, and the B405 power valve V4 into their respective sockets, connect the speaker, aerial, earth, and batteries before we turn our attention to the coils.

For the "B" battery we shall need three 45 volt blocks although two blocks totalling 90 volts will give good results. The connections to the "B" battery are as follow:—"B" plus 1 to the 67½ volt tap; "B" plus 3 to the 90 volt tap; "B" plus 4 to the same tap, and "B" plus 5 and "B" plus 2 to the 135 volt tap. Suitable adjustments can be made when a 90 volt battery is being used.

As a matter of fact, it will probably be necessary to bring out two "C" negative leads, one from each audio transformer. Our tests were conducted with two similar valves in the audio stage but as the B405 requires a "C" bias of 15 volts at 135 plate volts, and the A409 requires only 4 volts

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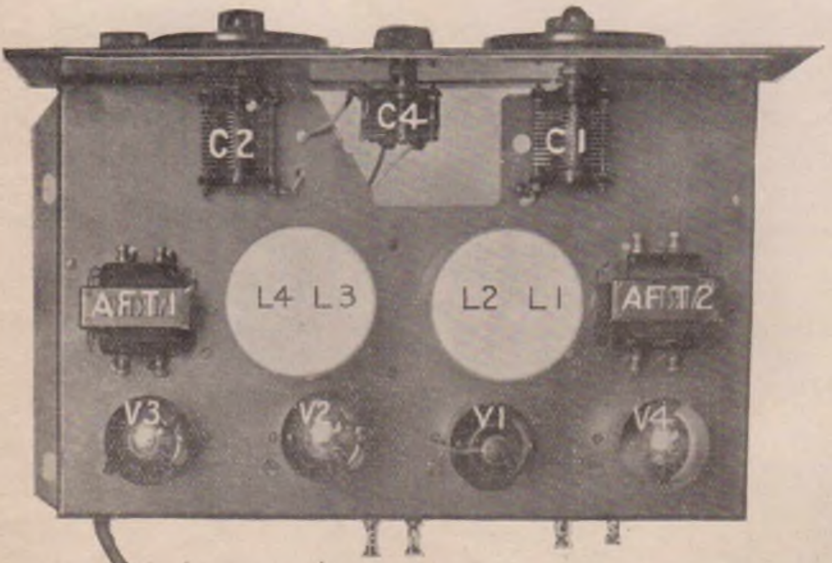
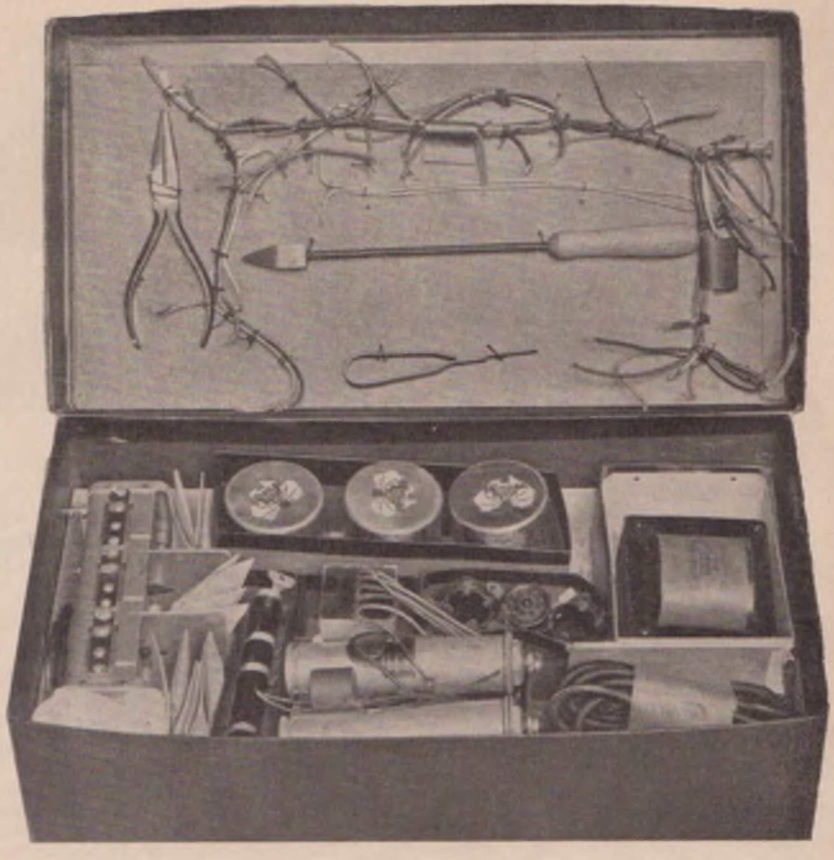


Looking down on the receiver we note the accessible mounting of the coils in their shields.

The Kriesler Super-Charged 5

Details of a New Departure in Radio Set Construction—the Provision of an "Assemble-your-own" Kit.



The complete Kriesler kit contains everything necessary to build a first class inter-State-getting receiver.

QUITE a long while ago a British radio firm brought out a kit for a three-valve d.c. receiver. Although, judged by present standards, the set now is hopelessly out of date, the kit idea still remains. This time it has been put over by an Australian firm, who have developed a four-velve and rectifier receiver which they call the Kriesler Super-Charged Five.

The modern form of home constructor's kit is nothing if not simple. Every connection is indicated by a colour code, and the complete wiring for the receiver is contained in a braided harness. The "harnessed" wires each are of a different colour, and even have been cleaned of insulation at the ends and tinned to facilitate soldering. The whole kit is put up in a box which contains everything down to the last machine screw and nut, including even the tools necessary to assemble the receiver.

Technically, the Kriesler Five is right up to the minute. Two variable mu screen grid r.f. valves, a screen grid detector, and a pentode audio tube make reliable long distance reception a certainty, while the use of the latest bias method for the 247 tube, and the employment of resistance coupling between it and the detector takes care of tone quality. Beyond dealing with the results obtainable from a test model receiver which was built up in our own lab. there seems hardly any purpose in describing the construction of the receiver other than in the words of the manufacturer. These we reprint below from the official Kriesler instruction sheet.

The results obtained from the receiver built up in our own laboratory were excellent, and included reception at full loud speaker strength of every Australian "A" class station except Perth, which was tuned in about 10 p.m. at medium strength. The "B" class stations, in the majority of the capitals, and a good percentage of the country ones also, were excellently received. The sensitivity of the receiver was excellent, its selectivity more than adequate for local needs, and the tone equal to anything we yet have heard from a receiver powered with a pentode.

Before going on to the description of the assembly and wiring, which, incidentally, will serve far better than any words of ours to illustrate the simplicity of the construction, we might mention that the good results obtained with the receiver are due, in the main, to the use of high quality components. This is particularly noticeable in the case of the National Union tubes which are employed.

Assembling Parts on Chassis.

Be careful to see that every bolt has a spring washer placed under its head and that every nut and bolt is thoroughly tightened.

The power transformer is mounted by four bolts through the laminations on to the chassis with the nuts already on same. The 240-volt lugs are pointing to back. A solder lug is mounted on the right hand, securing bolt which is nearest to the electrolytic condensers.

The electrolytic condensers are held by large nut, but care must be taken to see that the insulating washer provided with the condenser is assembled in the correct manner as follows:—Firstly, no insulation is necessary for the condenser nearest to the end of chassis, but metal earth tag is to be fitted under holding-down nut.

The second condenser must be insulated both sides of the chassis, making sure that the thickest washer with the ridge is placed on top of the chassis, seeing that the ridge is centred in the hole. The thin washer is placed on the under-side of the chassis, followed by the large metal tag and the holding-down nut.

The voltage divider must be mounted with the red end nearest to power transformer, and with the solder tags facing back of chassis; the contacts are pre-set, and must not be touched again.

The volume control is mounted as follows in the centre hole:—Firstly, the holding nut is taken off the thread and the top insulating washer is removed. Be sure to leave the small rubber ring and washer on the thread; then push the volume control through mounting hole, making sure the rub-

(Continued on page 43.)

The ARMCHAIR ENGINEER

LAST month's cold has vanished. We have been conducting some interesting technical discussions with friends, and, on paper at least, have settled every radio problem which has or ever will exist. We should feel very satisfied with ourselves, but don't. On thinking things over, we have come to the conclusion that the trouble is due to a hangover of our reaction to the new price war which has been started by Victorian set manufacturers.

Looking through "Electronics" (the leading American technical monthly) the other day, we came across an editorial which bewailed what the Yanks call "chiselling"—in plain words, skimping of manufacturing costs by national set manufacturers who were trying to meet competition on a price basis. The editorial, after pointing out the dangers of such a plan, went on to say that if conditions became much worse it would be "time for those who have the good of radio really at heart to go before the public . . . and let radio buyers really know the dangers of . . . sets which are good only for a limited time of poor service."

●

IF this is the thing they are up against in the States, what hope has the Australian "John Citizen" in the present year of our Lord? We have seen a recurrence of the famous twelve-guinea set which gave manufacturers and purchasers so much worry last year, and the year before that. The whole Australian radio industry is over-producing on cheap sets, spoiling the market for good ones and doing its best to give the public a sickener.

It is a recognised fact that in the various Victorian factories engineers who should be conducting really useful research on new methods of radio set design are kept for up to weeks at a time on the job of cutting down the number, and, consequently, the cost of the components used in the various lines of receivers. Such a manufacturing plan cannot help but bring serious troubles in its train. Despite the undoubted advances which have been made in receiver design, the average commercially-built receiver of to-day is worse, from the viewpoint of tone quality, sensitivity, selectivity, and freedom from hum, than the receivers of twelve months ago.

The only remedy seems to be the education of the public to the danger of purchasing such receiver and the encouragement of home set-building. The veriest amateur would not be hard put to it to build a better receiver than some which are turned out to-day by quite large organisations.

●

"IF the cap fits——" The truth of the old platitude was brought home to us the other day when we read the stinging reply made by the representative of an Australian radio programme paper relative to our remarks regarding super-hets.

This paper, which sets out—and very well, too—to cater for the needs of the more musically and frivolously minded members of the community also—and, to our mind, wrongly—has tried to bolster a threadbare technical reputation with the more or less disguised name of a very capable technician who, for the last year or so, has been resident in the U.S.A.

The departed gentleman certainly knew his business, but, after seeing the reaction of a section of the Sydney radio trade to a battery set creation of his successor, we have some doubt as to the latter's ability.

Naturally, with his constant review and use of the developments described in overseas technical journals—an outstanding example, of course, being the famous Loftin-White-Elephant series —our critic cannot be expected to be cognisant of past developments. His experience probably dates from 1930!

In this hard world of business the "go-getter" must shut his eyes to many palpable frailties. Even so, there is a limit to which any self-respecting technical man may go. We say **technical man**, mark you!

However, our caustic friend gives us much technical amusement. Whilst he admits, by his own statement, that a seven-valve super-het employing two r.f. stages is necessary to cut out image interference and two spot-tuning, he blithely asks us to believe that the super-het is the Alpha and Omega of radio worries. It certainly has been the former for many set-builders.

Possibly the building of the average super-het — from the constructional angle only—has been made a job for half-wits and morons, but to get really high-quality reception, ten k.c. frequency separation, and sensitivity of an extremely high order, we still back the tuned r.f. receiver.

Finally, our vituperative friend calls the magazine for which we have the honour to write an alleged technical paper.

Perhaps it is so. But in that case what can we call his own august journal—the Bell System Technical Journal, or the Proceedings of the Institute of Radio Engineers?

●

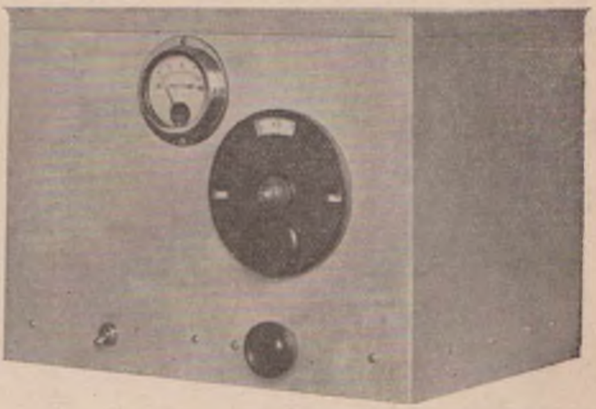
THE speaker position seems to be getting quite interesting. Besides the regular experimental work which is going on with electro-dynamic speakers, several more or less new types are arousing attention in engineering circles. Naturally, the Germans are very interested in the electrostatic type of speaker, which operates on much the same general principle as the condenser mike. The Americans, though, are branching out on the piezo-electric type of loud speaker.

This speaker makes use of the oscillating properties of Rochelle Salt crystals when fed with an a.c. voltage. The new type of speaker, like the condenser speaker, is a voltage-

(Continued on page 41.)

How to Build
A SIMPLE MODULATED OSCILLATOR

The Construction of a Very Useful Piece of Service and Test Equipment is Described in This Article.



The front view of the oscillator, showing the main tuning control, power switch, and modulation switch.

By J. S. McCUBBIN.

IN these days of multi-valve receivers the question of providing test equipment which will enable possible faults to be located quickly is of the greatest importance. Besides the usual run of meters employed by the average service man, some reliable means of simulating the transmission from a broadcast station is necessary if we are to check up and line up multi-stage tuned r.f. receivers. Although, in some cases, it is possible to line up the tuned circuits of a broadcast receiver when the latter is tuned to a station, this method does not hold good with a very sensitive receiver. The best, and, in fact, the only **real** way to line up a sensitive receiver is to connect an output meter in the plate circuit of the last tube, and to adjust the receiver until a maximum meter deflection is obtained from a given input signal.

It can quite readily be seen that the signal provided by a broadcasting station will not be constant enough for such a test. The varying degrees of modulation will have the effect of making the output meter needle kick all around the dial.

The modulated r.f. input is best obtained from a laboratory oscillator because in this case, with a given modulation frequency, it is possible to feed a substantially constant input to the receiver, and so permit accurate adjustments of tuning condensers and coil to be recorded on the output meter.

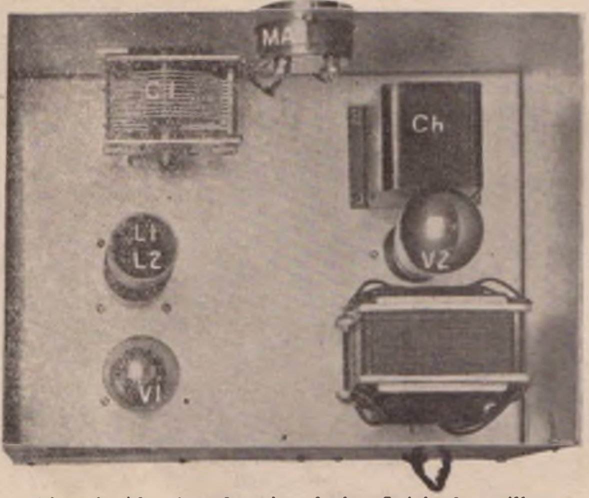
The building of a simple modulated oscillator is neither difficult nor expensive, and, considering the time and trouble it saves is well worth the consideration of the service man and the experimenter.

The writer has just completed the building of a reliable modulated oscillator, which is at present on the broadcast wave band. Neither the construction nor the calibration of the oscillator is difficult, and, as will be seen from the circuit diagram and the list of parts, no great expenditure is involved.

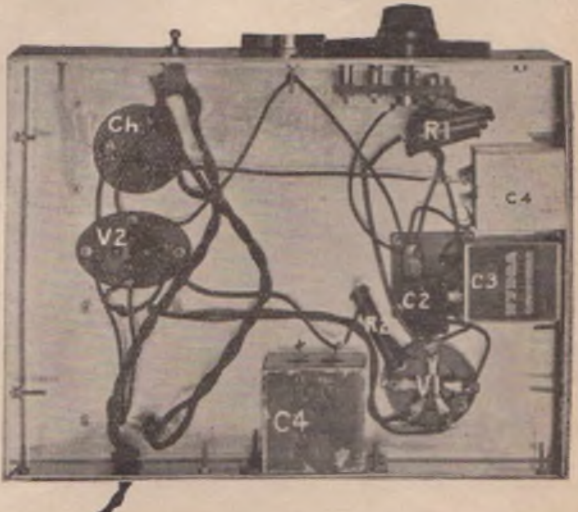
A glance at the schematic circuit shows that the familiar regenerative circuit so widely used in small bc. receivers is used. The only difference between the oscillator circuit and the receiver one is in the values of the components. For example, the usual 23-plate midget condenser used to couple the plate coil to the grid coil is replaced in the oscillator by a 1 mfd. condenser (C3). The grid condenser, C2, is of .006 mfd. capacity instead of the more usual .00025 mfd. condenser, and the grid resistance, R1, consists of five 1 meg. leaks connected in series.

The power supply is not important, and can be built up from any gear which happens to be on hand. In the particular job we are discussing, a 400-volt half-wave transformer happened to be lying idle, so it was pressed into service. The choke and filter arrangements, too, are hardly worthy of serious attention. A couple of 2 mfd. condensers (C4) and a small filter choke will settle matters; although, again because they happened to be collecting dust on the shelf, we used a 30 henry choke and a couple of 4 mfd. condensers.

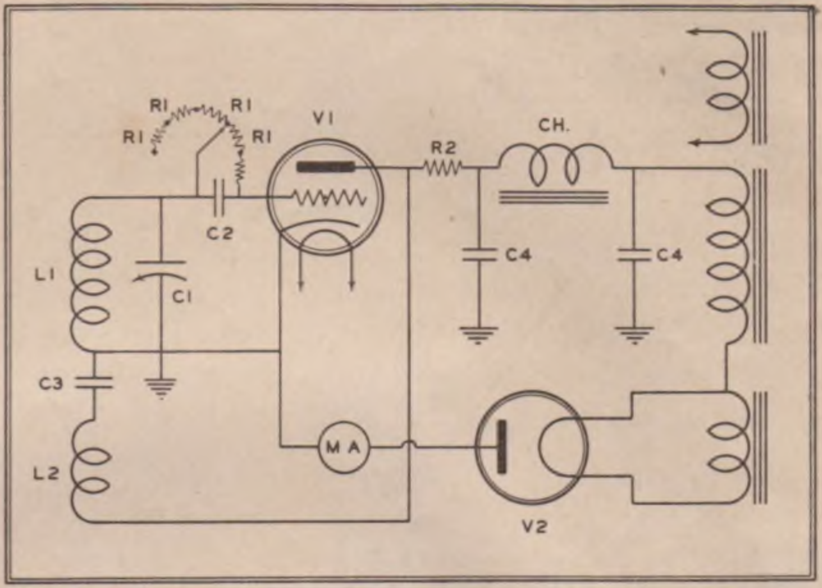
The resistance, R2, is used to drop the potential from the 400 volts supplied by the transformer to the safe



Looking inside the chassis of the finished oscillator we notice that plenty of room has been left around the coil so that no damping will be experienced.



An idea of the lay-out of the components can be gained from this picture.



The schematic diagram of the modulated oscillator.

200, which is fed to the plate of the oscillator. It happened in this case to be a 25,000 ohm 2 watt carborundum. Incidentally, it is not wise to try and operate a *227* oscillator at greater plate potentials than 200 volts, because blue glowing and correspondingly faulty and patchy oscillation will be experienced. The tuning condenser C1, is a conventional .0005 mfd. variable, and it is wise to select a condenser which has solid aluminium plates, so that calibration will remain reasonably constant.

The only other gadget of note is the milliammeter, which is connected in series with the cathode to indicate oscillation. This meter could be dispensed with if cost is an urgent consideration, but it certainly is handy if the oscillator is to operate over a wide wave-length range.

It is quite an easy thing for any oscillator to have "dead spots," particularly on the short-wave band, and, in some cases, when the coupling is increased beyond a certain point. The milliammeter is the tell-tale which indicates when oscillation stops by registering a rise in plate current.

The original oscillator was designed to cover the wave band from about 15 metres up to the 3000 metre intermediate frequency range. So far we have only built up the broadcast oscillator coil, but later we will describe the winding and calibrating of the other coils.

Naturally a simply handled plug-in coil arrangement was necessary, so another visit was made to the junk box, and a UX valve base was found. A piece of one 3-16th inch former was slipped over the base and anchored to it by means of a couple of ⅛ inch machine screws tapped into the bakelite. The coil windings consisted of 85 turns for L1 and 40 for L2. This, we found, gave us a wave range from 175 to about 650 metres. The wire used was 28 gauge d.s.c. So much for the oscillating side of our modulated oscillator.

The modulation was obtained by a variation of the grid leak value. For this purpose five 1 megohm grid leaks were connected in series, the junction points being brought out to six contacts on a rotary switch. The arrangement, then, is that any grid leak value between one and five megohms, in one meg. steps, can be obtained, and the modulated note of the oscillator shifted from something around 30 cycles up to about 500 cycles. In audible operation i.e., when operating into a receiver connected to a speaker, the oscillator has a growling note, which is neither tiring to the ears nor difficult to adjust on. However, there is not the slightest doubt that the only true line-up of a gang tuned receiver is obtained when an output meter is connected in the speaker circuit. A change in output, which is not audible, will kick the meter from zero off scale.

Calibrating the Oscillator.

Of course, output meters are fairly expensive bits of gear, but either a rectifier type a.c. meter or a meter such as the one described briefly in last issue of "Modern Sets" will solve the difficulty. Calibration on the broadcast band is quite easy, provided a receiver is handy. All that is necessary to do is to tune the receiver to the various stations which are in range, to disconnect the aerial so that the station cannot be heard, and put the oscillator into operation. The further away the oscillator is at this stage the better, because we want fairly accurate calibration points.

CIRCUIT CONSTANTS.

C1 500 mmfd.
C2 600 mmfd.
C3 1 mfd.
C4 4 mfd.
R1 5 1 meg. Velco Carborundum Resistors (1 watt type).
R2 25,000 ohm Velco Carborundum Resistor (2 watt type).
Ch 30 henry Choke.
M.A. 20 milliamp. Meter.
V1 UY 227.
V2 UX 280.

Tune the oscillator to the point where its signal can be heard at maximum strength in the receiver, and note the oscillator dial reading. A run round the local stations, from 3 AW to 3AR, will give us a wave range calibration from about 200 to 500 metres. Additional points then can be obtained by means of oscillator harmonics. For example, when once the first part of the calibration has been completed, and a tuning curve from 200 to 500 metres drawn, set the receiver, say, at 275 metres by means of the oscillator, and then bring the latter closer to the set and tune it up to the top end of its range until the harmonic at 550 metres is heard in the receiver. Repeat this procedure at every 50 metres until the top range of the oscillator, about 650 metres, is reached. The lower range from 200 to 175 metres can be obtained in a similar way by operating from 400 metres down to 350 metres on the receiver.

If a *227* tube is used in the oscillator, it will be found that the plate current, as indicated on the m.a. meter, will vary from about 5 m.a. to 8 m.a., and will go up as high as 12-14 m.a. when the tube stops oscillating.

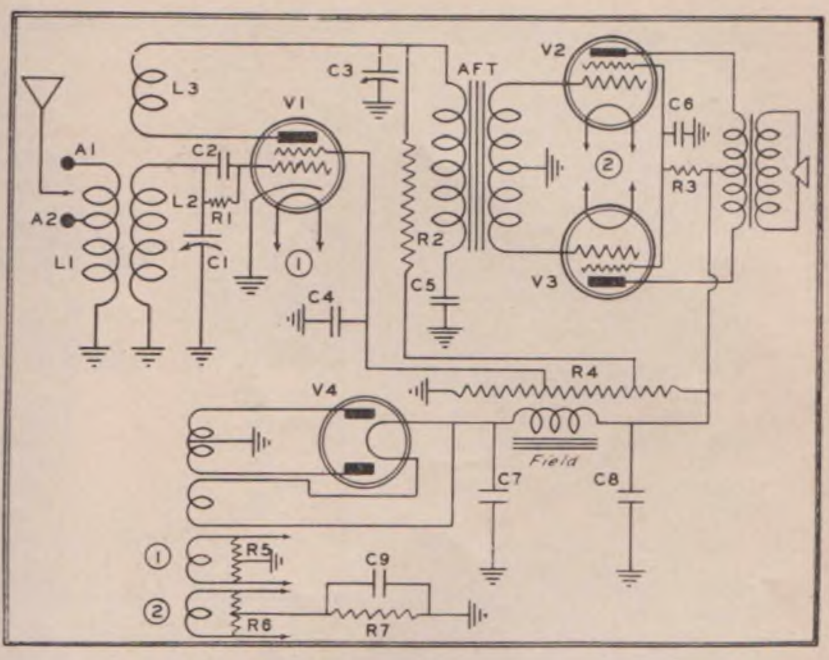
The whole oscillator is enclosed in an aluminium box. A complete chassis, 12 in. x 9 in. x 2 in., carries all the components except the milliammeter the tuning condenser, the power switch, and modulation switch. The chassis is enclosed in an aluminium box measuring 12 in. x 9 in. x 9 in., and provided with a lid. The original oscillator chassis and box were made to our order by Geo. White & Co.

A O-30 milliammeter will be found quite satisfactory for the oscillation indicator.

The Push Pull Pentode 4

An Interesting a.c. Receiver Which Employs Pentodes in Push-pull and is capable of Extreme Volume and Clarity of Tone is Described Below.

By A. K. BOX.



The schematic circuit diagram of the "P.P.P. Four."

WITHOUT doubt, the development of associate equipment to work with the power pentode has opened up a new vista for the set builder and the experimenter. The high power sensitivity of the pentode has permitted him to get a really high audio frequency output from a comparatively small input signal, and this in turn has made it possible to use means to cancel out many of the undesirable characteristics of the pentode, which include, of course, over-amplification of the higher register and the presence of comparatively strong harmonics in the output.

As an example of what may be done with the modern pentode when used in conjunction with suitable apparatus, we present the "Push-Pull Pentode Four" for consideration. This receiver whilst employing only a detector stage before the push-pull audio output stage, is capable of delivering as great volume as the average screen grid detector and single pentode receiver, and, at the same time, is free from overload. The trouble with the average s.g. detector and pentode receiver is that it overloads long before the maximum signal output is obtained from the detector stage.

Besides improving the power handling characteristics considerably—this combination will provide an undistorted output of around three watts—the use of a push-pull audio stage does much to cancel out the undesirable harmonics which, to a great extent, mar the tone quality of the pentode amplifier.

Technical Details.

A glance at the schematic diagram will show that the receiver employs a screen grid detector, which is coupled to the input transformer which feeds the push-pulling pentode audio tubes. Following standard practice, the field winding of the loud speaker is employed as a filter choke. An innovation, as far as many set builders are concerned is the use of the shunt fed method of transformer connection. The reason for this is to take off as much as possible the load on the audio transformer primary.

As most set builders are aware, the passage of direct current through an iron cored inductance has the effect of reducing the operating value of this inductance. If we use some other means of supplying direct current to the plate of the valve, and leaves the transformer primary to handle the a.c. signal, we shall, first of all, get better tone quality; and secondly, because, as the inductance increases so does the impedance, we shall provide a better match between the transformer primary and the high plate impedance of the screen grid tube. This in turn will mean a greater energy transfer for a given signal input, and so we will get increased volume and better tone from our output stage.

PARTS NEEDED.

2	**Philips C443 Valves (V2, V3).**
1	**Philips E442S Valve (V1).**
1	**Philips 1561 Valve (V4).**
1	**Stromberg-Carlson .0005 Condenser (C1).**
1	**A.W.A. Push-Pull Transformer (AFT).**
1	**Marquis 3-Coil Tuner (L1, L2, L3).**
1	**Radiomaster Dial.**
2	**Polymet 450-V. Electrolytic Condensers (C7, C8).**
1	**Radiokes 23-plate Midget Condenser (C3).**
1	**Velco E.V.O. Power Transformer.**
4	**Marquis U.Y. Sockets (V1, V2, V3, and L.S.).**
1	**Marquis U.X. Socket (V4).**
2	**Hydra 2 mfd. Condensers, 500-V. (C5, C6).**
1	**Hydra 4 mfd., 500-V. Test Condenser (C9).**
1	**Hydra 1 mfd., 500-V. Test Condenser (C4).**
2	**Radiokes Centre Tapped, 30 ohm. Resistors (R5, R6).**
1	**T.C.C. .00025 mfd. Condenser (C2).**
1	**Velco Voltage Divider (R4).**
1	**2 meg. Carborundum Resistor (R1).**
1	**10,000 ohm Carborundum Resistor (R3).**
1	**25,000 ohm Carborundum Resistor (R2).**
1	**500 ohm Bias Resistor (R7).**
6	**Lengths Spaghetti.**
3	**Terminals.**
	Nuts, Bolts, Flex, etc.

Care has been taken to keep the detector and audio circuits isolated. Separate filament windings are employed for the detector tube and the audio tubes, and the feed resistor, R2, stops circuit feed-backs between the detector and audio stages.

The voltage-dropping resistor in the screen grid leads of the pentode tubes is by-passed to earth by a 2 mfd. condenser. In the original receiver a standard coil kit was used, but there is no reason why the set builder should not make his own coils from the standard data which has been provided in "Modern Sets" from time to time.

The power transformer is designed to operate with four-volt tubes, and has one high voltage winding delivering 350 volts on each side of the centre tap a four-volt winding for the Philips 1561 4-volt rectifier tube, and two four-volt windings for the E442S detector and the C443 pentodes. The loud speaker used with the original receiver was a standard Amplion type K speaker specially designed for use with pentodes, and having a 2500 ohm field winding. The electrolytic condensers are 450-volt Polymets.

The various pictures of the receiver make very clear the arrangement of the different components on and below the chassis. All the components are key lettered to agree with the circuit diagram, the list of parts, and the wiring description, so that no difficulty is likely to be experienced in this direction. The receiver is built up on an aluminium chassis measuring 12 inches by 10 inches by 2 inches. The original chassis was obtained from Geo. White & Co.

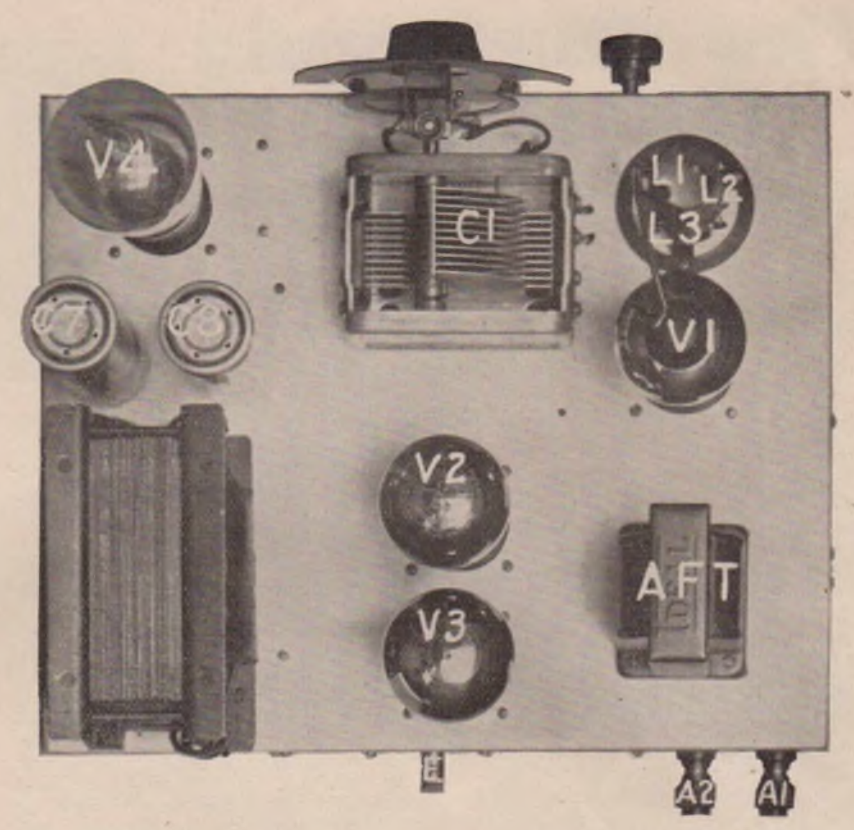
Constructional Information.

When once the components have been obtained the chassis can be drilled to take the four valve sockets on the top and the fifth, which is used as a connection socket for the speaker leads. Other holes which can be drilled at this stage include the mounting holes for the Marquis coil kit, the three holes which take the leads from this kit under the chassis the four mounting holes, and the two lead holes for the A.W.A. transformer, the two holes for the Polymet electrolytic condensers, the mounting holes for the power transformer and the tuning condenser, and the holes for the two aerial and one earth terminals.

The hole for the Radiokes midget reaction condenser also must be drilled. It is a good plan at this juncture to mount the Velco power transformer in place, and on the chassis to mark out two windows one at each end of the transformer core to take the leads from the transformer underneath the chassis. These windows can be seen in the picture showing the underneath view of the finished set. Another window must be cut to take the dial. This, however, can only be worked out after the Stromberg-Carlson condenser has been mounted. A small spacing washer, about half an inch in length, serves to keep the bracket of the dial in place. This also can be seen from the pictures of the finished set.

When all the top panel components have been mounted in place, we are ready to start the mounting of those which are fitted to the underside of the chassis. These include the four fixed condensers and the voltage dividers. As will be seen from the underneath view of the finished receiver, it will be necessary to remove condensers C5 and C6 during the wiring of the valve sockets V1 and V3. When once the assembly has been completed we are ready to start the wiring of the receiver. We have come to the conclusion that where ease and neatness of wiring is concerned, it is best to use tinned copper wire sleeved with spaghetti. Because of the better insulation it offers the leads from the high voltage side of the power transformer should be carried in rubber covered flex, and flex also is used

(Continued on page 37.)

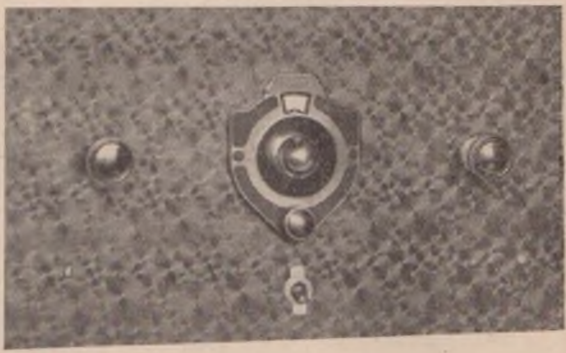


Looking down on the chassis of the finished set.

Neat wiring and convenient lay-out is a feature of the receiver as shown by this under chassis view.

The Diamond All Wave Battery Two

Complete Information on the Building and Operation of a Battery Set Which Covers the Short and Broadcast Wave Bands



The front panel view of the finished receiver.

By C. A. CULLINAN.

THE receiver we propose to describe in this article is essentially one for the novice. Although it is an all-wave receiver—i.e., one which tunes from the broadcast wave-band between 200 and 550 metres right down through the various short-wave bands to 20 metres, every step in its design and construction has been arranged so as to make the job of the new-comer to radio set-building easy.

Furthermore, the set has been so constituted that it is exceptionally economical in "A" battery consumption, and is reasonably so in "B" battery consumption. It is built round the famous Radiotron two-volt valves, and employs a screen grid detector and a high-gain pentode audio valve. A further feature is the fact that automatic "C" bias, which dispenses with the necessity for separate "C" batteries, is employed.

The wave range is so adjusted that but a single tuning condenser is necessary to cover the whole scale between 550 and 20 metres. Only four plugs in coils are needed for this complete wave range, and there are no switches or other troublesome gadgets employed to achieve the desired result.

The Components and Their Uses.

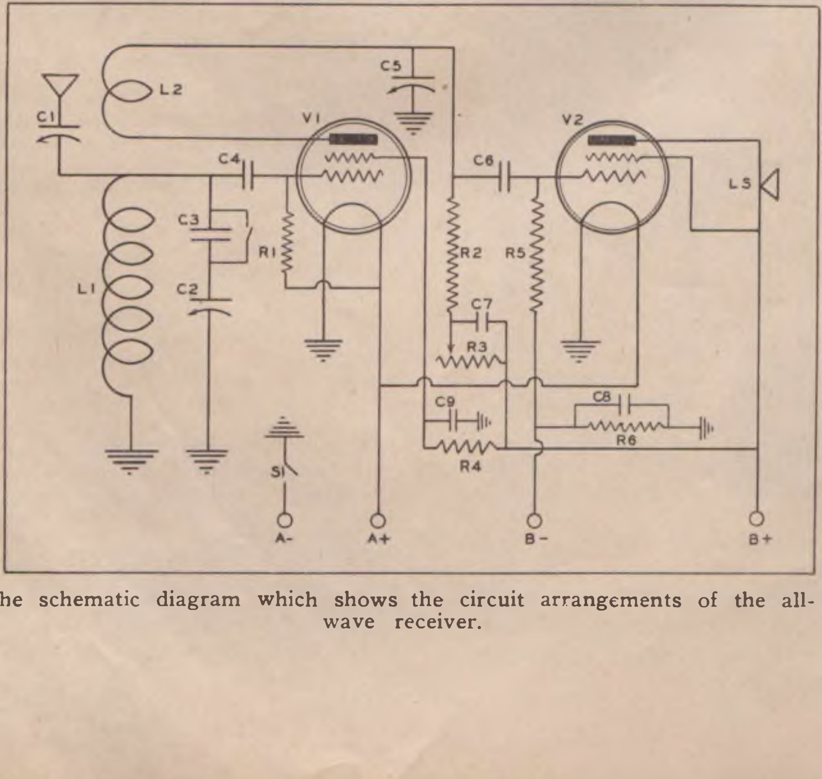
Before we detail the construction of the receiver it might be as well if we reviewed the various components used and explained their particular functions. The variable condenser, C1, is a 13-plate midget condenser, the purpose of which is to tune the aerial system so that the greatest signal input on various wave lengths may reach the grid of the detector circuit. The coil, L1, is the grid winding, which determines the wave length, or frequency to which the detector will respond: in other words, decides which stations will be received. This coil is tuned by a .0005 mfd. variable condenser, C2. In series with this condenser is a .00025 mfd. condenser, C3, which has the effect of cutting down the maximum capacity of C2 to .000166 mfd., thus permitting the short-wave bands to be covered efficiently without cramping the tuning, as would be the case if the .0005 mfd. capacity was employed. The circuit is so arranged that only when the short-wave coils are used is C3 connected into circuit. When the broadcast coil is used, the fixed condenser is short-circuited, and tuning done only with the variable condenser, C2.

The condenser, C4, and the resistance, R1, are respectively the grid condenser and the grid resistance. Note that in order to get maximum response to weak signals from the detector the grid leak is returned to A plus. V1 is the detector valve, a Radiotron UX232 screen grid valve. The plate of this valve is connected to the second coil winding, L2, which is the reaction winding.

The degree of reaction is governed by the size of this coil; the voltage applied to the plate and screening grid of V1 and the Radiokes 23-plate midget condenser, C5. The detector valve is resistance coupled to the audio valve, V2, by means of a plate resistance, R2, a grid resistance, R3, and a coupling condenser, C6.

In order to get greater control over the plate voltage applied to the detector tube, and, consequently, to be able to operate the receiver at its most favourable reaction point, a second resistance—this time variable—R3 is employed. Because of the noise heard in the headphones or loud speaker during the movement of this resistor, it is shunted with a large capacity condenser, C7. The voltage applied to the screen grid, of course, is much less than that required by the plate, so we connect a high resistance, R4, in series between the screen grid and the high voltage battery lead. The screen grid also is by-passed to earth by means of a high-capacity condenser in order that no instability will be present in the detector circuit.

The audio amplifying valve, V2, is a Radiotron UX233 pentode tube. Its plate is connected to one side of the loud speaker, whilst its screening grid is connected to the other side of the speaker and to the high voltage "B" battery lead. R6 is the bias resistor which is connected between the B minus and the A minus, or earth leads, so that the drop of voltage across it, occasioned by the flow of current for V1 and V2, will provide us with the necessary C bias voltage



The schematic diagram which shows the circuit arrangements of the all-wave receiver.

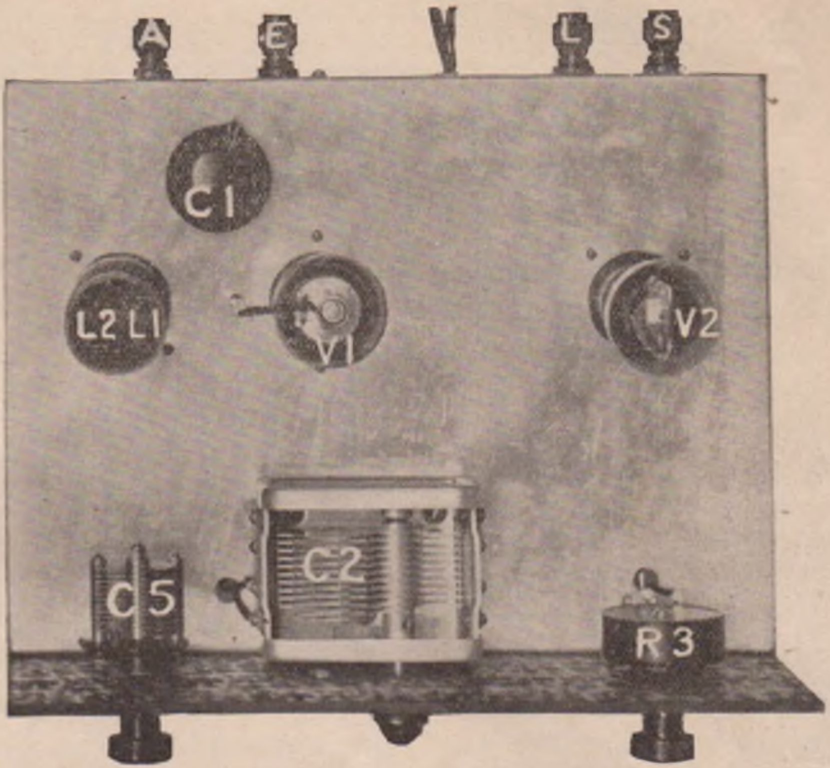
for V2. The condenser, C8, connected across it serves merely to provide an easy audio frequency current path. Note that the A minus terminal on the sockets of V1 and V2 are connected to earth, and that between earth and the "A" minus battery lead a switch is provided.

The Tuning Coils.

The next thing to claim our attention is the tuning coil arrangement. As will be seen from the diagrams, the tuning coils are wound on UY valve bases, which have been provided with bakelite formers, which fit over them. There are only four connections to be made to the short-wave coils, but the whole five pins of the base are used for the broadcast coil. This is because, in order to short-circuit the fixed condenser, C3, the P and one F terminal on the valve base must be connected together. So much for the coil details.

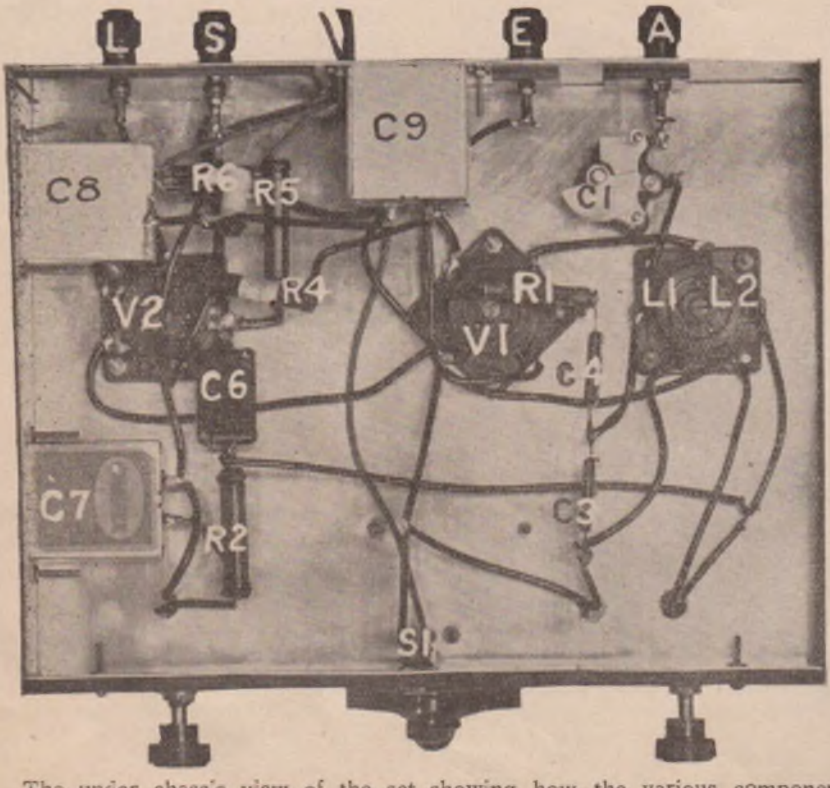
Later on we will give complete winding data for the four coils necessary to cover the wave range.

Constructional details of the receiver are as follow:—The set is built up on an aluminium chassis, to which is bolted a bakelite front panel to carry the main tuning condenser, C2, the reaction condenser, C5, the variable resistance, R3, and the filament switch, S1.



Looking down on the finished set one cannot help but be impressed by its "clean" appearance.

The front panel measures 7 inches by 12 inches, whilst the aluminium chassis measures 12 inches in length, 9 inches in breadth, and 2 inches in depth. All the components except those on the front panel are mounted underneath the chassis, holes being cut for the three sockets used for the valves and the coils.



The under chassis view of the set showing how the various components are arranged.

The terminals for the loud speaker and the aerial and earth are mounted on the back edge of the chassis, all except the earth terminal being insulated from contact with the chassis by means of bakelite or fibre washers. The various pictures of the finished set, the schematic diagram, and the layout and plan-wiring diagram will all help the prospective set-builder to make up a set exactly similar to the original one. Note that all components in the list of parts are key-lettered to agree with the pictures and diagrams of the receiver. In building the receiver it is wise to stick as closely as possible to the original layout and to pay attention to insulation from the metal chassis of such components as the midget condenser, C1, the aerial terminal, A, and the two loud speaker terminals, LS. In the plan-wiring diagram the dashed lines indicate that rubber-covered, flexible wire has been used. This is for the two "B" battery leads and the two "A" battery leads.

The following data on the coils will enable the experimenter to wind inductances which will cover the whole wave band:—

Wave Band.	Number of Turns. L1	L2
Broadcast	65 . .	30
90-55 metres	15 . .	11
31-60 metres	9 . .	11
19-36 metres	5 . .	7

Note in winding the coils that each winding must be laid on in the same direction—i.e., clockwise or anti-clock-

(Continued on page 39.)

HOW TO MAKE

A Short Wave Wave-Meter

The Necessity for Calibrating the Coils and Condensers of a Short Wave Receiver Makes this Gadget of Particular Interest to the Experimenter.

By C. M. SCOTT.

WHEN we build a broadcast receiver, we know that when it is put into operation the local broadcasting stations will be tuned in at certain positions on the tuning condenser dial. Using the standard tuning arrangement, we could almost foretell what the actual dial readings would be for each station before finishing the receiver.

Things are very different on the short waves, where many factors will affect the tuning range of the condenser-coil combination.

It is very annoying to hear many Morse and 'phone stations without knowing their wave-lengths.

For the short wave listener the wave meter about to be described is an extremely useful piece of apparatus, simple in operation and construction, and, although not highly accurate, is sufficiently so to meet the requirements of the average listener.

The meter, which is of the absorption type, consists simply of a coil and variable condenser, which form a resonant circuit.

When the coil of the wave-meter is brought into the field of the tuning-coil of an oscillating detector and tuned to the same wave-length as the detector, it will absorb energy from the grid circuit, resulting in the stoppage of the oscillation.

When properly calibrated it will be possible to read as close, or even closer, than one quarter of a metre.

Constructional Details.

The box containing the components is constructed of wood, or, if an aluminium box is available, it will suffice.

Shielding, however, is not essential, because a high degree of accuracy is impossible with this type of meter. The dimensions are 3½ inches high, 4 inches wide by 5½ inches long.

On one side of the box screw down the valve socket which takes the valve base coil. Attach two thick flex leads to two of the terminals on the socket, and bring them inside through two sma'l holes.

The .00025 mfd variable condenser is next mounted centrally and towards one end of the 5½ inch x 4 inch panel. At theother end, and mounted centrally, is an ordinary tarch globe socket to the fixed plates of the variable globe.

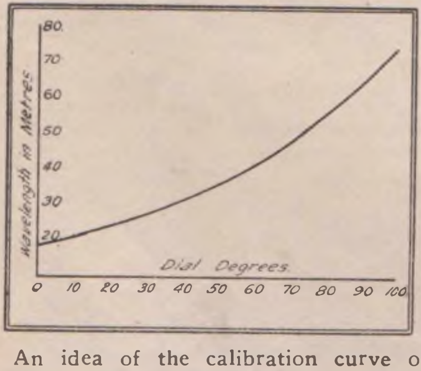
Connect one lead from the coil socket, into which is fitted a 3.5 torch condenser, and from the moving plates connect across to one side of the torch socket. The remaining side of the torch socket now connects back to the remaining flex wire from the coil.

The pea lamp has been included so as to make the meter suitable for making rough cheeks on the wave-length of transmitters.

If desired, the pea lamp can be dispensed with, the moving plates then being connected straight back to the coil.

The coil is wound on an ordinary valve base and consists of eleven turns of 22 S.W.G. enamel wire.

Either a vernier dial or a knob turning over a scale as shown in the photograph can be used.



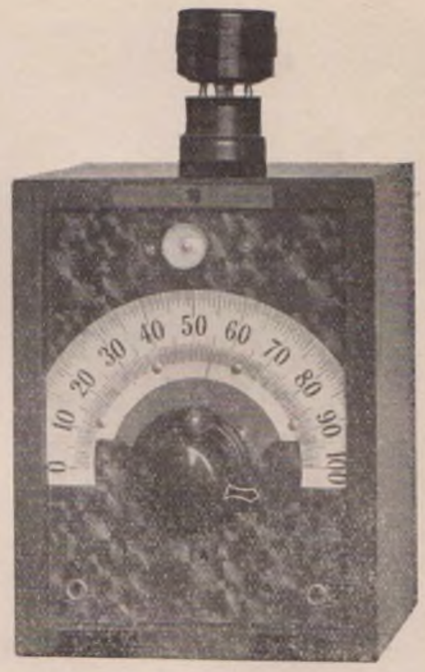
An idea of the calibration curve of the finished instrument is furnished by this illustration.

Calibrating the Meter.

If an oscillator tuned to some known wave-length on the broadcast band is available, the meter could be calibrated from its harmonics. For those who possess on'y one receiver, the best method would be to use the short-wave stations of known wave-length.

In this case stations such as RV15 70.2 metres, Moscow 50 metres, PLV 31.86 metres, and G5SW 25.53, could be used.

The detector is first set in oscillation on one of the above wave-lengths, and the dial of the wave meter rotated until a sharp point is observed where the detector goes out of oscillation. The dial reading at this point must be noted. Perform this operation for as many wave-lengths as possible.



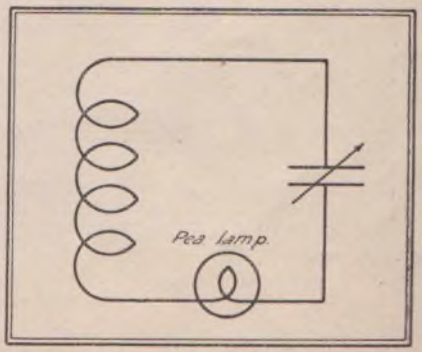
The original meter made by the writer of this article.

On a piece of tenth squared paper set out the dial degrees horizontally, say 1 inch equa!s 10 degrees, and set out the metres wave-length vertically, say 1 inch equals 10 metres.

Plot the dial readings obtained against the known wave-length and join the point by a curved line.

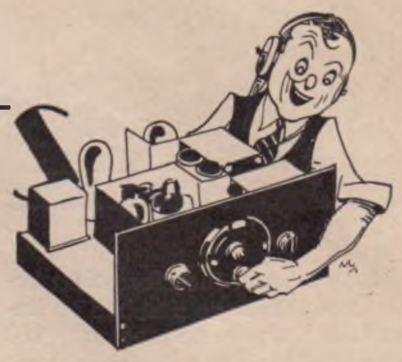
Using this curve, the wae-length of any station between 19 and 72 metres, can be found when the wave meter dial reading is known.

Having the detector circuit just in oscillation, bring up the wave metre so that its coil is brought into the field of the detector coil. Rotate the dia! of the metre until the detector goes out of oscillation and in again, resulting in two clicks. Reduce the coupling between the two coils until only one click is heard, and note the dial reading. The wave-length at this dial setting can now be read directly from the curve.



The schematic diagram of the wave meter.

WITH THE MEGA-CYCLISTS



Conducted by Charles M. Scott. (VK3CS).

FOR more successful reception throughout the twenty-four hours, the listener should tune to certain wave-lengths at certain times of the day.

Although reception varies slightly in different localities, it will be found, as a general rule, that the following times hold good for Australia:—

From 14 to 25 metres tuning should be done from daybreak to sunset during the winter months, i.e., from about April to September.

It is only possible to receive successfully long-distance telephony along a path of complete daylight on these shorter waves. Such stations include J1AA, Japan, 19.03 metres; VPD, Suva, 20.80 metres; and KKW, California, 21.77 metres.

Stations within much shorter range, such as ZLW, Wellington, and Australian stations, of course, can be heard during daylight on wave-lengths over 50 metres. During the summer months, i.e., October to March, tuning from 14 to 25 metres can be done throughout the twenty-four hours.

In winter practically all telephony stations below 25 metres become inaudible after sunset.

On wave-length between between 20 and 50 metres tuning should be done from 3 p.m. to 10 a.m. throughout the year. However, it will be found that during the winter nights there is practically nothing doing below about 28 metres. There is always a drift towards the higher wave-lengths in winter.

From 50 to 85 metres tuning should be done from sunset to daybreak. Very little in the way of "D.X." can be heard over 85 metres.

To avoid wasting time when looking for new stations, it is a good idea to listen on the hour or half-hour, as schedules are usually arranged at these times.

WAVE - LENGTH - FREQUENCY CONVERSION.

IT is much more convenient to talk in kilocycles and megacycles rather than in metres.

Mr. Startz, the famous P.C.J. announcer who has been heard by thousands of short wave listeners throughout the world.

It has been the practice, however, on the longer waves to talk in metres, and this has been carried down to the present short-waves.

To start with, 1 kilocycle equals 1000 cycles (or complete oscillations), and 1 megacycle equals 1000 kilocycles. Therefore, to change metres to kilocycles divide 300,000 (the velocity of radio waves in kilometres) by the number of metres. For megacycles divide the result by 1000.

For example, the frequency at 50 metres equals 300,000 divided by 50 equals 6000 k.c., or in megacycles, 6000 divided by 1000 equals 6 m.c.

To convert kilocycles and megacycles to metres, just reverse the order of things.

Multiply the megacycles by 1000 and the result is kilocycles; now divide the number of kilocycles into 300,000, and the answer is metres wave-length.

For example, find the wave-length at 6 megacycles, 6 multiplied by 1000 equals 6000 k.c.; 300,000 divided by 6000 equals 50 metres.

In studying wave-length-frequency conversions, we find that as the wave-length is decreased the frequency charge per metre becomes greater and greater. This is easily seen from the curve in Fig. 1.

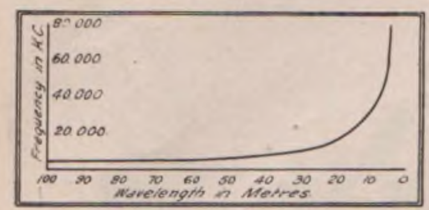


Fig. 1.

It is obvious, therefore, that because of the large number of frequencies available below 100 metres, short-waves exhibit great possibilities in the future of radio for both broadcasting and television.

Experienced short-wave listeners are aware that practically all of the short-wave broadcast and telephone stations are located at definite points in the wave-length spectrum between 13 and 100 metres.

Newcomers, however, do not always know, and until this fact is learned, a considerable amount of valuable time may be wasted in searching for stations; so some information concerning the distribution will, no doubt, be of interest.

All the useful wave-lengths from 33,000 metres downwards have been allotted by International Conference, between the various services which are likely to need them.

The services are: "Fixed" services, which are stations used for communication with other stations in all directions, such as shore stations in marine communication systems;

"Point to Point" stations, such as beam telegraph and telephone installations, where the only communication is directed between two fixed points;

"Mobile" stations, which include ships, commercial aircraft, etc.; army, navy and air force services;

"Amateur and Experimental," and, very important so far as we are concerned, Radio Broadcasting Services.

Following is the complete short-wave schedule of international wave allocations, as agreed upon by the Conference, and to which practically all of the stations of the world employing radio services adhere.

S. W. Wave-length Allocations

The Official Wavelength — Frequency Allocations of the Various Short Wavelengths Between 200 and 5 Metres.

1500 to 1715 kc. (200 to 175 metres)—Mobile.

1715 to 2000 kc. (175 to 150 metres)—Mobile, fixed and amateurs.

2000 to 2250 kc. (150 to 133 metres)—Mobile and fixed.

2250 to 2750 kc. (133 to 109 metres)—Mobile.

2750 to 2850 kc. (109 to 105 metres)—Fixed stations.

2850 to 3500 kc. (105 to 85 metres)—Mobile and fixed.

3500 to 4000 kc. (85 to 75 metres)—Mobile, fixed, and amateurs.

4000 to 5500 kc. (75 to 54 metres)—Mobile and fixed.

5500 to 5700 kc. (54 to 52 metres)—Mobile.

5700 to 6000 kc. (52.7 to 50 metres)—Fixed.

6000 to 6150 kc. (50 to 48.8 metres)—Broadcasting.

6150 to 6675 kc. (48.8 to 45 metres)—Mobile.

6675 to 7000 kc. (45 to 42.8 metres)—Fixed.

7000 to 7300 kc. (42.8 to 41 metres)—Amateurs.

7300 to 8200 kc. (41 to 36.6 metres)—Fixed.

8200 to 8550 kc. (36.6 to 35.1 metres)—Mobile.

8550 to 8900 kc. (35.1 to 33.7 metres)—Mobile and fixed.

8900 to 9500 kc. (33.7 to 31.6 metres)—Fixed.

9500 to 9600 kc. (31.6 to 31.2 metres)—Broadcasting.

9600 to 11,000 kc. (31.2 to 27.3 metres)—Fixed.

1,000 to 11,400 kc. (27.3 to 26.3 metres)—Mobile.

11,400 to 11,700 kc. (26.3 to 25.6 metres)—Fixed.

11,700 to 11,900 kc. (25.6 to 25.2 metres)—Broadcasting.

11,900 to 12,300 kc. (25.2 to 24.4 metres)—Fixed.

12,300 to 12,825 kc. (24.4 to 23.4 metres)—Mobile.

12,825 to 13,350 kc. (23.4 to 22.4 metres)—Mobile and fixed.

13,350 to 14,000 kc. (22.4 to 21.3 metres)—Fixed.

14,000 to 14,400 kc. (21.4 to 20.8 metres)—Amateur.

14,400 to 15,100 kc. (20.8 to 19.85 metres)—Fixed.

15,100 to 15,350 kc. (19.85 to 19.55 metres)—Broadcasting.

15,350 to 16,400 kc (19.55 to 18.3 metres)—Fixed.

16,400 to 17,100 kc. (18.3 to 17.5 metres)—Mobile.

17,100 to 17,750 kc. (17.5 to 16.9 metres)—Mobile and fixed.

17,750 to 17,800 kc. (16.9 to 16.85 metres)—Broadcasting.

17,800 to 21,450 kc. (16.85 to 14 metres)—Fixed.

21,450 to 21,550 kc. (14 to 13.9 metres)—Broadcasting.

21,550 to 22,300 kc. (13.9 to 13.45 metres)—Mobile and fixed.

22,300 to 23,000 kc. (13.1 to 10.7 metres)—Not reserved.

28,000 to 30,000 kc. (10.7 to 10 metres)—Amateurs and experiments.

30,000 to 56,000 kc. (10 to 5.35 metres)—Not reserved.

56,000 to 60,000 kc. (5.35 to 5 metres)—Amateurs and experiments.

60,000 kc (5 to 0 metres)—Not reserved.

What's On the Air

Reports of Outstanding Receptions and Details of Regular Transmissions which can be Tuned in by the Owners of Reasonably Efficient Receivers.

THE most recent outstanding feature was the series of special broadcasts from overseas in connection with the International Eucharistic Congress celebrations held at Dublin.

Vivid descriptions of the various scenes and brilliant lighting in Dublin were flashed to all corners of the earth, via short-waves.

On Thursday, June 23, at 4 o'clock in the afternoon—it was 7 o'clock on a sunny June morning in Ireland—the Rev. F. Moynihan, one of the representatives of Australia at the Congress, broadcast a special message to Australian listeners.

The speech was very clear and distinct, considering the number of channels it had to travel through before reaching the listener in Australia.

His voice was first transmitted through the ordinary submarine cable telephone to England, where it was picked up and broadcast from the Rugby wireless station, GBP, on 28.0 metres to A.W.A. at Sydney.

From Sydney it again travelled via land line to Melbourne, where a rebroadcast was made by some of the local stations.

H.V.J. BROADCASTS TO AUSTRALIA.

ANOTHER interesting broadcast was heard from the Vatican station, HVJ, on 19.84 metres, when the Pope delivered an address throughout the world in connection with the Congress.

The reception this time, however, was very poor, owing to the hour at which the broadcast took place.

HVJ is one of the most modern and highly efficient short-wave radio stations on the air to-day, and was presented to the Vatican State by Marchese Marconi.

Built under the personal supervision of Marchese Marconi, many new ideas have been incorporated in the transmitter. Two of the new features are: A special master oscillator to control the frequency, and an antenna system which produces a uniform current along the entire length of the antenna.

The antenna is strung horizontally between two very high masts, and is fed at the centre.

The power in use at present is 10. k.w. to the aerial.

Long before the station was officially opened, Marchese Marconi was heard daily personally conducting tests with W2XAF and other well-known stations.

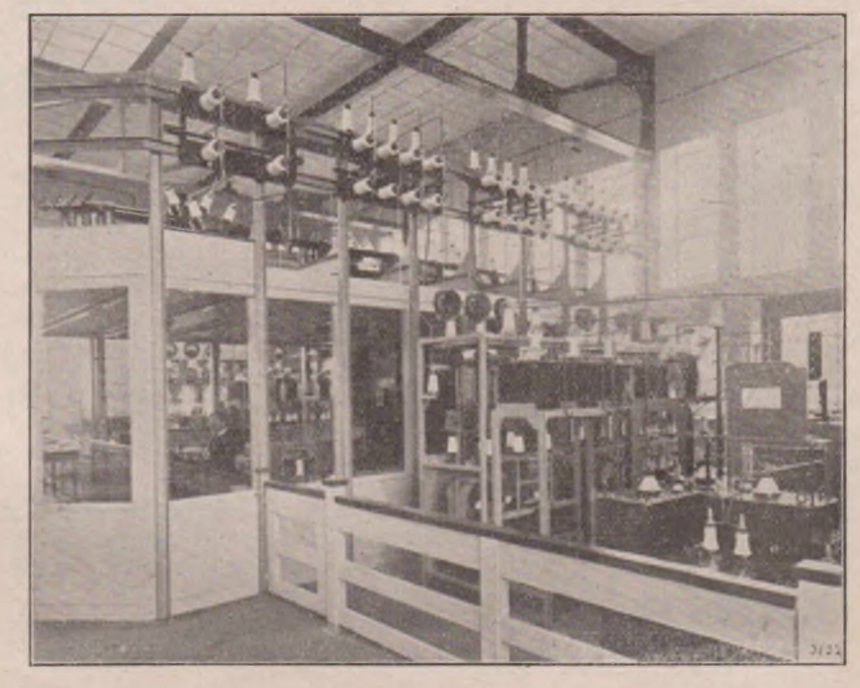
HVJ can be heard daily on 51.26 metres between 5 o'clock and 5.30 a.m., usually at excellent strength throughout the year, and on 19.84 metres in the summer time between 8 p.m. and 8.30 p.m.

REGULAR ENGLISH SESSION FROM RADIO COLONIALE.

EACH Tuesday morning, between 8.30 and 9 o'clock, Radio Coloniale, Paris, broadcasts a programme conducted by a group of Americans known as the Veterans of Foreign Wars.

The session is announced as the V.F.W. Information Bureau programme for English-speaking people of the world, and is being conducted to advertise the V.F.W. activities all over the world, and to encourage as many ex-service men as possible who fought between 1917 and 1918 to visit Paris in 1935, when a great encampment will take place.

Musical items are rendered by French and American artists, interspersed with news and V.F.W. information.



Some idea of the expensive equipment required for international s.w. broadcasting can be gauged from this picture of the rectifier plant at the Philips station PHI.

Radio Coloniale is operated by the French Government, and works on 25.60 metres during the morning transmission, and, as mentioned previously, can be received at excellent speaker strength.

Reports on this programme will be greatly appreciated by the station engineers, whose address is: Radio Coloniale, 103 Rue de Grenelle, Paris, France.

Radio Coloniale can now be also heard round about midnight on 19.68 metres, but the signal strength is very poor.

However, by September or October a big improvement will be noticed, and the signal will build up more and more as the summer approaches.

J1AA SENDS SPECIAL PROGRAMMES.

STATION J1AA, situated at Kemikawa, Cho., Japan, has been heard broadcasting between 7 p.m. and 11 p.m. on a wave-length of 30 metres. The signal strength varied between R6 and R7, QSA4, the programme consisting of Japanese music and speech, and an occasional announcement in English.

J1AA is the only short-wave station in Japan which is allowed to broadcast. It is now used mainly for transmitting special programmes to Southern Manchuria, where they are picked up and rebroadcast by the long-wave Dairen station.

The wave-lengths used by J1AA at various times are:—

38.07 metres,	7880 K.C.
30.00 metres,	10,000 K.C.
22.93 metres,	13,075 K.C.
19.036 metres,	15,760 K.C.

Directional aerials are employed, and the station sometimes tests with California, Berlin, and London. The power of the transmitter varies between 3 and 5 K.W.

BIG BEN FROM G5SW.

NOW that the reception of G5SW has improved in the mornings, nearly every short-wave listener has heard the Westminster chimes and Big Ben, which are broadcast each morning at 9 o'clock on a wave-length of 25.53 metres.

It is the largest striking clock in the world. The hour hands are nine feet, and the minute hands 14 feet long.

Big Ben, the bell on which the clock strikes the hour, weighs 13½ tons, and the hammer 400 lbs. The first note denotes correct time.

The microphone appears to be placed in the gardens, because if you listen carefully a nightingale can be heard singing with Big Ben in the background.

RADIO SAIGON CLOSES.

IT is with very much regret that we announce the closing of one of the most powerful and regular broadcasting stations, Radio Saigon.

Radio Saigon was one on which we could always depend, and was always there to try out our receivers on.

The 25 metre broadcasts from the station last summer were among the very best ever heard from overseas.

AUSTRALIA AND AMERICA EXCHANGE PROGRAMMES.

THE exchange of programmes between the various countries of the world is of far greater importance than one may at first imagine, in helping to bring about international goodwill.

On the occasion of the first anniversary of the A.W.A. Worldwide Broadcasting Service, which was inaugurated by Mr. Fisk, a special programme was transmitted from VK2ME, Sydney, on Sunday night, July 3.

This broadcast was picked up by W2XAF, the Schenectady station of the General Electric Co., and rebroadcast throughout the U.S.A. on the National Broadcasting chain.

Sir Charles Kingsford Smith, speaking from Roma, Queensland, sent his greetings to the United States, as did the American boxer, "Young" Stribling, who spoke from the A.W.A. offices in Sydney, and told of his experiences in Australia.

The following night, between 9 and 9.30 o'clock, W2XAF broadcast their special programme for Australian listeners.

THE GERMAN STATIONS.

A VERIFICATION received from the Reichspostzentralamt offices at Berlin states that broadcasts are made on two wave-lengths—31.38 metres and 19.737 metres. The call letters of the station on 31.38 metres are DJA, while the call of the station on 19.737 metres is DJB.

Both stations broadcast a special programme for the United States each Monday morning. Up to the present no reports on the reception of DJA have been received.

DAQ, 29.155 metres, is another German station which broadcasts special programmes for America.

CT1AA, PORTUGAL, ON TWO WAVE-LENGTHS.

A VERIFICATION has just come to hand from Abilio Nunes dos Santos, jun., owner and operator of station CT1AA, Lisbon, Portugal. He states that CT1AA broadcasts each Thursday between 2100 and 2300 GMT on a wave-length of 31.25 metres. That is each Friday morning between 7 o'clock and 9 o'clock local time here.

Broadcasts are, of course, also carried out on 42.9 metres at the same time each Saturday morning.

BANDOENG ON NEW WAVE-LENGTH.

BANDOENG, Java, has been heard calling VK2ME, Sydney, during the evenings a little earlier than usual. Station PLF, working on 29.25 metres is being used.

Transmission was simultaneously taking place from PLV on 31.86 metres, but the signal strength of both stations was very poor.

Short-wave Re-broadcasts

WE have heard recently many re-broadcasts of overseas short-wave stations through the local broadcasters. Some were very successful, while others were failures.

Why many re-broadcasts are failures in Australia is principally due to the lack of sufficient information on the behaviour of short-wave signals from overseas.

Every signal in the short-wave spectrum between 10 and 100 metres has a definite maximum period at some time of the twenty-four hours.

The time at which the maximum signal strength occurs depends to a large extent on the following:—

(1) The wave-length or frequency used.

(2) The angle of radiation of the radio wave from the transmitter.

(3) The season of the year.

High power, although another important factor, is not nearly so important as the angle of radiation.

Observations taken in America on VK3ME working on 31.55 metres, and VK2ME on 28.5 metres, show that at times VK3ME is just as loud as VK2ME, yet the power used by VK2ME is, roughly, six times as much as that used by VK3ME.

Whatever time we wish to listen there is usually some particular wave-length which will have a maximum period at that time.

This field of radio requires extensive research work in which the listener can play a very important part.

The work within his scope would be in the form of regular daily observations on the signal strengths from the regular overseas broadcasting stations.

Of course such observations would have to be continued for several years before reception at pre-determined times could be guaranteed.

The procedure would be to take an observation on the signal every fifteen or thirty minutes over the period at which the Station can be heard, for as many days per week as possible, and plot the results each day on a chart.

Apart from the signal strength, observations would have to be made on the type of fading, quality of transmission, local weather conditions, and interference if any.

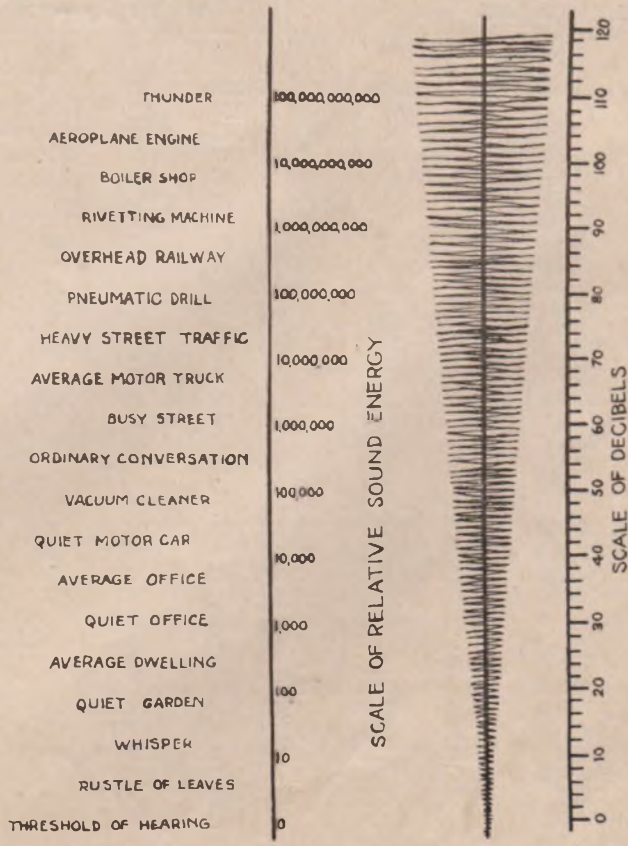
Such observations have already been undertaken in Victoria and very useful and interesting information has been obtained.

The Intensity of Sound

THE chart published on this page is of exceptional interest. It gives the experimenter an idea of the relative loudness of different sounds, and it enables him, by looking at the decibel scale on the extreme left, to visualise just how great a gain a particular audio amplifier will have.

For example, if we designed an audio amplifier having a gain of 100 decibels, we would expect it to amplify a whisper to thunderous proportions. On the other hand, the chart gives us some idea of the relative lack of sensitivity of the human ear. Ask the average man how much louder than a whisper is thunder, and he will probably reply, "Oh! About 1000 times," when in effect it is about 10,000,000,000 times louder.

The ear, luckily for us, possesses the peculiarity of being more responsive to weak sounds than to loud ones. If this was not so, we would be in a pretty pickle, for we either would have to converse in shouts, or our ear drums would be shattered by noises such as thunder.



A chart showing relative intensities of various sounds.

Technical "Shorts"

Items of Interest to the Experimenter, the Set Builder, and the Service Man.

SYMBOLS IN COMMON USE

The following is a list of radio abbreviations most frequently used as a kind of technical shorthand. It should be posted for convenient reference in every serviceman's shop.

SYMBOL	MEANING
E_B	B supply voltage
E_p	Voltage at plate of tube
E_c or E_g	Grid-bias voltage
E_f	Filament terminal voltage
I_p	Plate current
I_g	Grid current
I_f	Filament current
R_p	Plate resistance of tube
MU (μ)	Amplification constant of tuba
G_m	Mutual conductance of tube
R_L	Load resistance in plate circuit of tube
DB	Transmission unit
IR	Current times resistance

IN view of the now almost universally adopted "Watt Rating" of resistors, the following table should be of particular interest to the set builder and the experimenter.

Column R shows the standard radio resistor values in ohms; manufacturer's freaks are near enough to them to make the table useful in all cases. Columns 1W, 2W, and so on refer to size and mean "1 watt," "2 watt," etc. Example—a 1,500 ohm resistor is needed to carry 50 milliamperes. Start at 1500 in the R column, go to the right until you strike a figure slightly larger than 50, which this time means 55, under 5W. Thus a 5 watt resistor will do, but will be running at full rating, therefore hot. To run "warm" continue to the right until you strike a figure about 1½ times the load current—in this case 80, which is in the 10-watt size. To run "cool" go on to a current figure twice the current to be handled, in this case 112 in the 20 watt column. Other values can be "guessed in" as follows:

Sticking to one ohmage (resistance value); doubled current requires 4 times the rating in watts, tripling requires 9 times the rating. ½ the current calls for ¼ the wattage rating, cutting the current to 1/3 calls for 1/9 the wattage rating.

Sticking to one size of resistor (wattage rating); twice the resistance drops the current capacity to .7, three times the resistance drops it to .6 of the original. Half the resistance allows 1.4 times the current, one-third the resistance allows 1.7 times the current.

OHMS	WATTS RATING (W) OR SIZE								
R	1W	2W	3W	5W	10W	20W	25W	50W	100W
100	100	140	175	223	320	448	500	700	1,000
200	70	98	120	154	225	315	350	490	700
250	65	91	112	143	208	291	325	455	650
500	44	67	75	97	141	197	220	308	440
750	37	52	61	82	118	165	185	259	370
1,000	32	45	35	71	103	144	160	224	320
1,500	25	35	43	55	80	112	125	175	250
2,000	22	31	38	49	71	100	110	154	220
2,500	20	28	34	44	64	90	100	140	200
3 000	18	25	31	40	58	81	90	126	180
4,000	15.5	22	26	34	50	70	73	103	155
5,000	14	20	24	31	45	63	70	98	140
7,500	13	18	22	29	42	59	65	91	130
10,000	10	14	17.5	22.3	32	44.8	50	70	100
12,500	8.8	12	15	19.3	28	39	44	62	88
15,000	8.2	11	14	18	26	33	41	57	82
20,000	7	9.8	12	15.4	22.5	31	35	49	70
25,000	6.5	9.1	11.2	14.3	20.8	29	33	46	65
30,000	5.8	8.1	9.2	13	18	25	29	41	58
35 000	5.3	7.5	9	12	17	24	26	37	53
40,000	5	7	8.5	11	15.5	22	25	35	50
50,000	4.4	6.7	7.5	9.7	14.1	20	22	31	44
60,000	4.1	6	7	9	13	18	21	30	41
70,000	3.8	5.3	6.5	8.4	12	17	19	28	38
75,000	3.7	5.2	6.1	8.2	11.8	16	18	26	37
100,000	3.2	4.5	3.5	7.1	10.3	14.3	16	23	32
150 000	2.5	3.5	4.3	5.5	8				
200,000	2.2	3.1	3.8	4.9	7.1				
250,000	2	2.8	3.4	4.4	6.4				
300,000	1.8	2.5	3.1	4	5.8				
400,000	1.55	2.2	2.6	3.4	5				
500,000	1.4	2	2.4	3.1	4.5				
750,000	1.3	1.8	2.2	2.9	4.2				
1,000,000	1	1.4	1.7	2.2	3.2				

RATED CURRENTS (MILLIAMPERES)

Incidentally, we notice that A. J. Veall Pty. Ltd. have put out a handy resistor sheet which contains complete information on the colour code and resistance values of a very wide range of resistors. Apart from its value as a list of standard resistor values, Veall's sheet is valuable because all the resistors listed carry the American R.M.A. colour code marking, a point of particular interest to the service man who is likely to come in contact with commercially made receivers. We understand that a stamped and addressed envelope sent to Veall's will ensure a copy of the resistor sheet reaching those interested.

HUM ON CARRIER.

THE troublesome effect known as "hum on carrier" is usually due to ineffective r-f filtering of the power supply leads or to other stray regeneration, although excessive hum in the B-supply aggravates the matter. "Hum on carrier" takes the form that the hum in the set increases when a carrier is tuned in. The user of the set usually assumes that the transmitting station has a "rotten carrier" and is very much startled to find that a battery driven oscillater sounds the same way though it is clearly humless.

The usual causes of hum-on-carrier are:

1—Stray feedbacks.

2—Overloading of the cathode, grid, screen or plate of an indirectly heated tube.

3—Badly filtered plate supply.

In turn, the cures are:

1—Assume the shielding to be o.k. and by trial find where improvement is made by a resistance-capacity decoupler.

2—Make sure that the 224 cathode resistors are normal (250-600 for one tube, $\frac{1}{2}$ as much for two using the same resistor) and that the volume control does something besides raising the cathode resistance. Obviously, screen-overload is bad too, hence a screen-voltage control of volume is "out" in favour of such a one as just mentioned. Either set the old control at maximum gain or substitute a fixed resistance that will not be monkeyed with

Plate-overload can also happen, usually where the tube is run on some absurdly low voltage through use of a resistance coupling fed from some point incapable of supplying more than 180 volts.

The moral is to go higher on the B supply for the feed voltage, or to combine this with the scheme shown in Fig. 2, using a series R of 2000 ohms for audio 227 tubes, and about 10,000 for r-f 224 tubes. In either case, put a bypass at the left end of the series R, 1 mfd. for audio, .1 to .3 non-inductive for broadcast radio, or .01 to .1 mica for high frequency radio.

3—The cure for deficient filtering is obviously an improvement in the filter, the shifting of audio or power transformers or filter chokes, the tightening of cores to prevent vibration, and finally the replacement of dubious parts or valves.

PREFIXES USED IN RADIO WORK.

IT happens that many of the units used extensively in electrical work are either too small or too large for convenient use in radio work. Instead of using large, cumbersome numbers to indicate the fractional or multiple parts of these units, it has become customary to make use of standard prefixes ahead of the original units, for simplifying calculations and avoiding many errors.

The student of radio should familiarise himself with these terms, so that he may become proficient in their understanding and use. A list of these prefixes is given below.

Prefix.	Meaning.
"deci"	one-tenth
"centi"	one-hundredth
"mil" or "milli"	one-thousandth
"micro"	one-millionth
"micro-micro".	one-millionth of one-millionth
"deka"	10 times
"hekta"	100 times
"kilo"	1,000 times.
"mega"	1,000,000 times

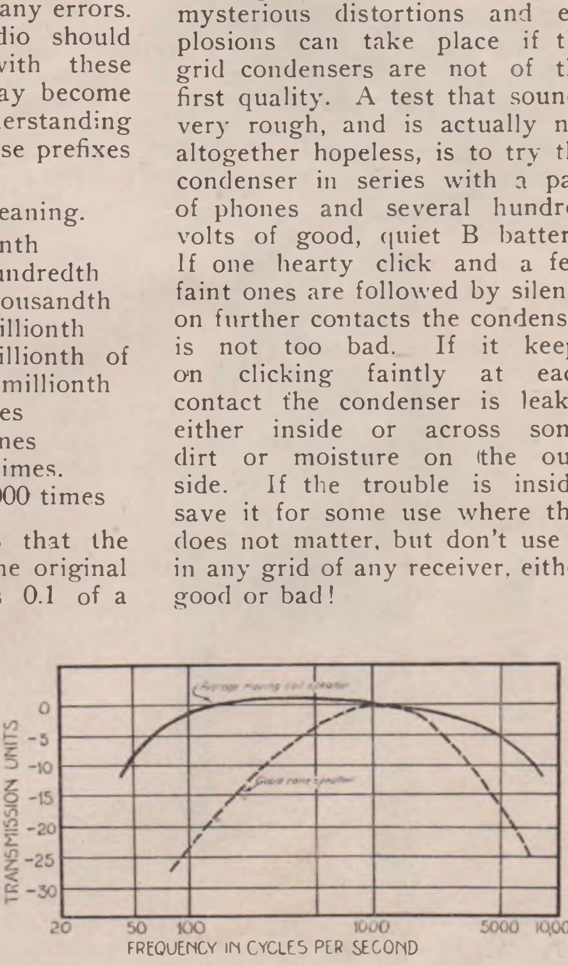
Thus, "deci" means that the new unit is 0.1 of the original unit. A decimeter is 0.1 of a meter. A milliampere is 0.001 of an ampere. A microhenry is 0.000001 of a henry. A microfarad is 0.000001 of a farad. Instead of saying that a condenser has a capacity of 0.00035 microfarads, we can say that it has a capacity of 350 micro-microfarads, etc.

A "centimeter" of inductance is equal to 0.001 of a microhenry. This unit does not follow the general rule.

The prefix "deka" means that the new unit is ten times the original unit. The prefixt "kilo" means that the new unit is 1000 times the original unit. Thus, one "kilocycle" equals 1000 cycles. One "megohm" equals 1,000,000 ohms, etc.

STOPPING CONDENSERS.

WITH everything else in the place quite right some very mysterious distortions and explosions can take place if the grid condensers are not of the first quality. A test that sounds very rough, and is actually not altogether hopeless, is to try the condenser in series with a pair of phones and several hundred volts of good, quiet B battery. If one hearty click and a few faint ones are followed by silence on further contacts the condenser is not too bad. If it keeps on clicking faintly at each contact the condenser is leaky, either inside or across some dirt or moisture on the outside. If the trouble is inside, save it for some use where this does not matter, but don't use it in any grid of any receiver, either good or bad!



Comparative curves of the a.f. response of a good quality cone speaker and the average 10 inch cone dynamic.

The Lighti St

From Philips Li

IN our last article on this subject, we traced the history of illumination of talkie studios from the days when daylight had to be used, through all the troubles and difficulties associated with arc lamps, up to the invention of the gas-filled electric lamp, which proved such a boon to the motion picture producer and enabled such tremendous advances in the technique of motion picture photography. Film producers blessed the electric lamp of high intensity for the benefits it brought them, but, with the invention of the talkie film, new difficulties arose, which were of such magnitude as almost to dishearten both the motion picture interests and also the lamp manufacturers.

A talkie recorder used with sound on film equipment.

The first type of talkie film to be invented was one which was synchronised with a gramophone disc, and this was followed later by the film which has a sound strip alongside the picture, on which is recorded photographically the sounds to be reproduced. Naturally, the first consideration when producing a talkie film of either type is complete silence in the studio—only the actors' words or other sounds desired to be recorded being permitted, because any extraneous noise would, of course, be recorded and later reproduced in the theatre. This difficulty was not of such tremendous magnitude with the old gramophone disc type of talkie film, because the disc was not capable of recording very minute, almost inaudible, extraneous noises, and, therefore, provided it was kept reasonably quiet, the clicking of the motion picture camera, and other similar sounds, were immaterial. This type of talkie film, however, was never entirely satisfactory for several reasons; one being the difficulty of exact synchronisation with the actions of the actors, and another was the fact that a gramophone disc can only record a very limited range of tones, it being impossible to record the very high notes. Still another objection was the fact that the discs wore out after a few times playing, and became very scratchy, resulting in poor quality reproduction.

When the more modern type of talkie film arrived on the scene, in which a sound strip is included alongside the film, upon which the sounds to be reproduced are recorded photographically and reproduced by means of a photo-electric cell, the difficulties of synchronisation and the reproduction of high notes disappeared, but a new trouble came in their stead. Besides the technical troubles associated with the operation of photo-electric cells, which are notoriously changeable, it was found that the super-sensitive microphones used picked up all manner of extraneous noises, and because any sound, no matter how small, is definitely recorded on the sound strip (since it is done photographically), the reproduction of the wanted sound was found to be mixed with all manner of unwanted

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Shooting a scene at the Eftee fi
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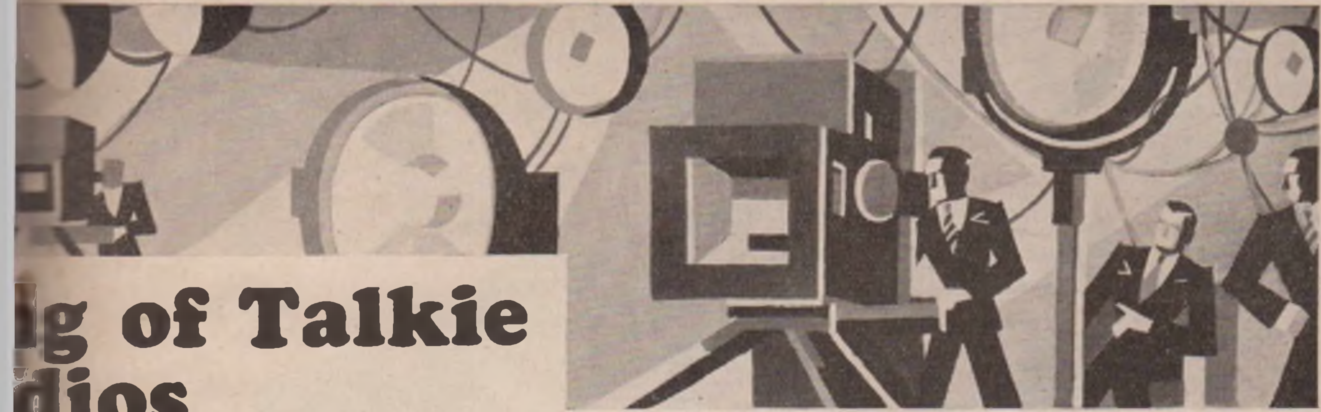

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noises. These noises arose from the mechanical sounds of the motion picture camera, movements in other parts of the studio, and even the sound of the director turning over his notes while conducting the scene.

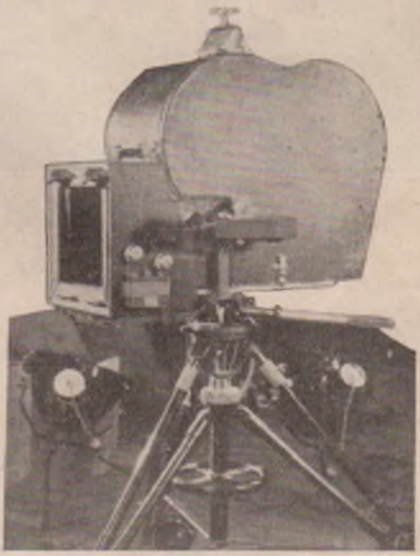
Added to these unwanted sounds, there became evident an almost unaccountable humming sound, and it was a considerable time before it was discovered from whence it came. At first it was thought that this humming sound in the reproduction of the film was in some way due to interaction between the electrical circuits in the theatre, but when these had been absolutely exonerated from blame, close investigation showed that the humming sound came from the lamps used in photographing the scene. It was discovered that the high intensity gas-filled lamps used emitted an inaudible hum, which, however, was picked up by the microphones used, impressed on the film, and, when reproduced in the theatre, made itself evident in the humming sound mentioned.

studios. Note the array of floodlights
microphone in the centre of the pic-
re.

How to overcome this humming sound was the problem set before the lamp manufacturers, and many months of intensive scientific investigation and research work was carried out in Philips lamp laboratories in grappling with this difficulty.

Whilst this investigation was being carried out, the film producers also placed before the Philips scientists some other problems which they required to be solved, so that the whole could be embodied in a new type of lamp. These improvements desired consisted of more concentrated filaments, greater actinic light output, a comparative freedom from blackening of the lamps, and smaller size in overall dimensions. The embodiment of all these improvements in one new type of lamp was indeed a problem, but science triumphed in the end, and it resulted in special film studio lamps being produced. In a casual inspection these new lamps do not appear to be greatly different from other high intensity lamps of the projection type, but if they are examined very closely, it will be noted that there are considerable alterations. Further, when the lamp is burning, additional advantages are plainly to be seen.

We will take the lamp section by section and discuss its merits.



A silenced camera for use in shooting talkie scenes.

Firstly, let us consider the overall dimensions. Film studio lamps are produced in two sizes—large and small. The larger size is for use in reflectors of big dimensions and "sun-spots," rather after the type of searchlights. The smaller dimension lamps are of very remarkably small size, and it is nothing short of amazing that lamps of such intensity could be made with a bulb so small. It would be wise to mention here that film studio lamps are made in intensities of 2000, 3000, 5000, 10,000 and 20,000 watts. A 20,000 watt lamp, of course, burns sufficient current to illuminate quite a large-size town, and when it is realised that in the larger studios quite a number of these 20,000 watt lamps, together with film studio lamps of the smaller sizes for local lighting, are used in illuminat-

(Continued on page 36.)

"SERVICE PLEASE"

A Department to Help Solve the Various Technical Problems Which are Encountered by the Radio Set Builder and Experimenter.

Practically every technical paper I read, when dealing with the question of short-wave receivers advocates the use of a radio frequency stage before the detector. The American papers suggest an untuned r.f. stage, while most of the Australian papers seem to prefer a tuned stage. On my own detector and two audio short-wave receiver I get excellent results. Can you tell me why I should use a radio frequency stage in front of the detector, and if so, which is best, a tuned stage or an untuned stage?—C. Adair (South Yarra, Vic.).

The chief advantage of the radio frequency amplifier in front of the detector in any short wave receiver is that it makes tuning much less critical because it removes the aerial load from the detector. Added to this is the actual amplification of the screen grid valve used in the radio stage. From the viewpoint of easy operation, the American technical men appear to have stuck to the untuned r.f. stage, but from personal experience we would advise the use of a tuned r.f. stage. The tuning is not critical and the actual gain in signal strength is quite noticeable. If you added an r.f. valve to your present receiver you would have a much easier time tuning the set than we suspect you have at present.

* * *

My audio amplifier which uses a pair of Ferranti audio transformers, the second being a push-pull transformer feeding a pair of UX245's sets up a popping noise when it is first switched on. This dies away as the indirectly heated valves warm up, but sometimes can be heard again when the amplifier has been running for a while. Can you tell me where the trouble is?—"C.J.W." (South Kensington, Vic.).

This is a form of audio instability—is usually referred to as motor-boating. It is due to some form of feed-back taking place between the various input and output circuits. The fact that it dies away when the indirectly heated tubes warm up indicates that the trouble is not very serious, and exists probably in the input circuit of the push-pull tubes. The possible cause of a return of the trouble during the operation of the set is an increased line voltage and a correspondingly greater voltage on the plates of all tubes. Your best solution to the difficulty is to employ de-coupling resistances and by-pass condensers in the grid and plate circuits. Resistances of the order of 100,000 ohms (.1 meg) should be connected between the C minus terminals of the audio transformers and the earth if the amplifier uses the standard "C" bias system. A 2 mfd. condenser should also be connected from the C minus terminal on each transformer to the cathode (in the case of the indirectly heated tube) and the filament centre tap in the case of the push-pull tubes. A further advantage would be the connection of 15,000 ohm wire wound resistor between the B plus terminal on each audio transformer and the "B" supply line, and the by-passing of the set side of these resistors to earth through 2 mfd. condensers.

This Free Technical Information Service is Open to All "Modern Sets" Readers. When Forwarding Your Question Be Sure to Give Every Detail Possible Regarding the Type of Receiver, Make and Type of Valves and Speaker, and All Details Which You Consider May Help Us to Solve Your Trouble. Only in Special Circumstances Can We Answer Enquiries by Post.

* * *

I intend making the Low Powered P.A. Amplifier described in July "Modern Sets." Can you tell me what sort of microphone the Harlie is, and where I can see one.—"Reisz" (North Brighton, Vic.).

The Harlie microphone used with our amplifier is a carbon type microphone built on principles similar to

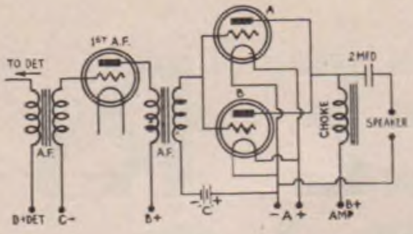


Fig. 2.

the Reisz. It is capable of giving a good quality output at reasonable signal voltage, and is very robustly made. We understand that the component can be obtained from either of the large city retail houses.

* * *

Having obtained excellent results from my broadcast super-heterodyne receiver, I am desirous of making it an all wave receiver by building up a two or three valve super-het converter and coupling this unit to the standard super-het which I shall tune to about 250 metres. Can you give me any advice on the matter, and supply me with coil data, etc.—"Super-Enthusiast" (Malvern, Vic.).

Your scheme sounds all right in theory, but in practice it will be found that the fact that the broadcast super-het oscillator is running all the time will spoil your results. So many harmonics of the fundamental signal generated by this oscillator will be picked up by the short wave super-het converter that you will have the greatest difficulty in avoiding them as you tune through the various short-wave bands. Your best plan would be to make the super-het oscillator and first detector coils plug in and by means of a number of special short-wave coils cover the band with the regular super.

* * *

My all-electric receiver was designed for use with a magnetic speaker. Now I want to use a 2500 ohm field type dynamic speaker. Will it be necessary to alter the receiver.—"J.P.A." (St. Kilda, Vic.).

Before you can use this type of dynamic speaker it is necessary to make some provision for field excitation. To be on the safe side, simply disconnect the filter choke leads in the set from all components to which they are hooked and connect the dynamic speaker field leads in their place.

* * *

Regarding automatic "C" bias on battery set. My old style battery receiver has separate "C" batteries. Can I alter the circuit to use automatic bias without affecting its operation? I understand how to calculate the bias resistor and how to hook it up.—"J.G." (Marysville, Vic.).

The change from standard to automatic "C" bias can be made with any type of receiver. In some of the more sensitive receivers it is necessary to connect series resistors and by-pass condensers in the leads between the bias resistor and the filament end of the valves to be biassed in order to prevent interaction.

* * *

During the last few months my gramophone pick-up, which is about two years old, seems to have lost a great deal of volume, and does not seem to reproduce the high note properly at all. The amplifier, valves and loud speaker are o.k., because they give first-class results on radio reception. Is the pick-up worn out?—"Musician" (Albert Park, Vic.).

The trouble is probably due to the fact that the rubber which is used to damp the pick-up movement is perished, and has lost its resiliency. Your best plan is to get some new rubber, and to dismantle the pick-up and replace the worn out rubber with the new. A piece of bicycle tube repairing rubber will do. If this fails, the permanent magnet has lost its magnetism, and will have to be remagnetised.

* * *

Why is it that although I can tune in to Corowa on my "All-Australia A.C. Four" described in June "Modern Sets" during the day time, and get good loud speaker strength reception without much fading, that at night time, although the signal strength is almost deafening at times, the station fades very badly.—"Puzzled" (Preston, Vic.).

The trouble is not in the set. The fact of the matter is that Corowa has been specially designed so that at night the station will not cover the metropolitan area satisfactorily. During the day time you are picking up only the ground wave signal, but at night the sky signal is received at almost equal strength, but out of phase with the ground wave signal. The same phenomena can be experienced with practically any reasonably distant transmitter.

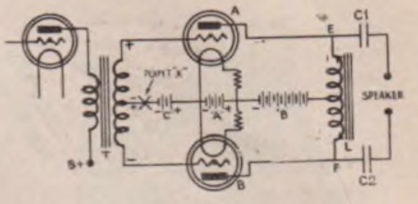


Fig. 3.

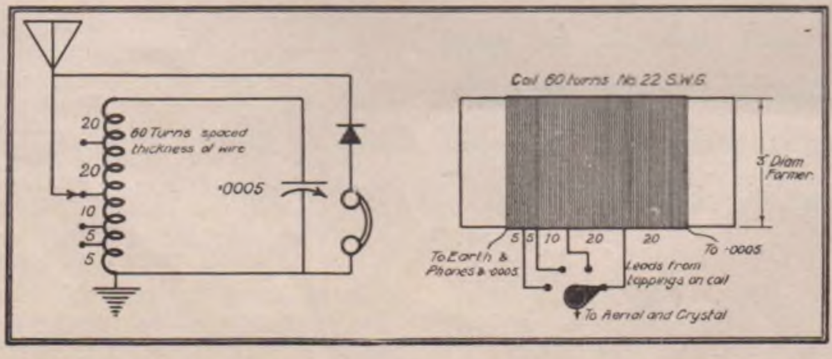


Fig. 1 gives full details of the selective crystal receiver asked for by R.M.

* * *

Is it possible to build a crystal receiver which will separate the different Melbourne broadcasting stations. I am only about two miles from 3KZ, 3AW and 3UZ?—R. Mitchell (North *Fitzroy*, Vic.).

Although the crystal receiver will not give anything like the results of even a single valve set, it is quite possible for you to get the majority at least of the local stations on a crystal set without interference. Fig. 1 gives the circuit of such a receiver, together with coil winding data.

* * *

Can you give me circuit details for connecting two valves in parallel, and the same two valves in push-pull? I am using a battery receiver with a magnetic speaker. — A.J.B. (Broadmeadows, Vic.).

Figs. 2 and 3 give the necessary circuit information. Fig. 2 shows the parallel connection of two valves, whilst Fig. 3 gives the push-pull connection. Both arrangements are shown with choke coupling output to suit your magnetic speaker. The push-pull arrangement definitely will give you greater power handling capability, although the parallel valve arrangement can be used with your present transformer. Neither scheme, though, will increase the volume of your receiver in spite of the fact that you are using an additional valve. The idea behind either arrangement is to prevent audio frequency overload from spoiling reproduction.

The THREE "R's" of RADIO

IN lesson 1, it was stated that instead of transmitting sound waves directly as in the case of one person talking to another across a room, a radio telephone transmitter converts them into corresponding electrical waves. The sound waves vary in intensity and form due to the presence of harmonics. The human voice includes a range of from about 200 to 3000 cycles per second, and the average frequency during ordinary speech is about 800 cycles per second.

The first step in broadcasting is to change the air or sound waves into corresponding electric currents, or, more exactly speaking, to make the waves control an electric current. This is accomplished by the microphone. The most popular form of microphone is the carbon type. Its operation is similar to that of the common telephone transmitter. Fig. 15 shows a cross sectional view of a simplified microphone. The diaphragm "A" of thin aluminium or iron is rigidly fastened to the polished carbon button "B," and is held fixed around its outside edge by the insulated case "E." A second carbon button "D" is fastened rigidly in place, and the space between them is filled with tiny carbon granules "C." A connection is taken from each of the carbon buttons, so that current must flow from one button through the carbon granules to the other one. The air waves created by the performer in the broadcast studio strike against the diaphragm and cause it to vibrate back and forth very rapidly, following the sound wave motion. This also vibrates the button "B," causing alternate pressures and rarefactions in the carbon granules. The resistance of these granules varies greatly as the pressure upon them is changed. It is very high during a rarefaction, when the particles are held loosely, and comparatively low during a pressure when they are packed tightly.

Thus the movement of the diaphragm alters the resistance of the microphone and so varies the current flowing through it in exact accordance with sound waves. Fig. 16A shows the steady direct current flowing through the microphone when the diaphragm is undisturbed, and the variation in current produced by transmitting the sound of "a" as in "father" is shown in Fig. 16B.

●

The third lesson of Mr. Alfred Ghiradi's wonderful radio course deals with the principles of broadcasting, and take in such subjects as wave transmission and propagation, as well as the "skip distance" effect and fading.

●

It is evident that the microphone acts merely as a variable resistance in the circuit. The common form of microphone used in most studios is the double button type, and is arranged to utilise both the forward and backward movements of the diaphragm to produce better variation or modulation of the current. The mechanism is suspended by springs to prevent noises due to accidental jarring, and is enclosed in a housing.

Another form of microphone operates by the change in capacitance due to the movement of one diaphragm separated from another one by only a few thousandths of an inch. This is known as the condenser microphone. The galvanometer type operates by the movement of a coil of wire in a strong magnetic field. The coil moved in the field by the diaphragm has small currents set up in it which vary in strength corresponding with the movements of the diaphragm.

The microphone changes the sound waves or vibrations into corresponding variations in electric current. Since the audible range of vibrations extends from about 16 to 20,000 cycles per

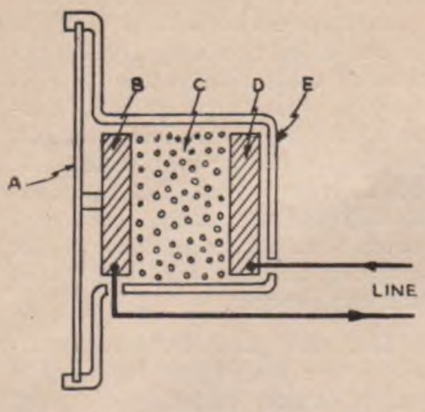


Fig. 15. Simple Carbon Type Microphone.

second, it is evident that the current in the microphone circuit must vary over this range during a broadcast programme. The next problem is to transmit the varying current through space to the receiving station.

Transmission of Modulated Signals.

The two ways in which energy can be transferred from the transmitting antenna to the receiving aerials are by electromagnetic induction effect and by electrostatic and electromagnetic wave radiation into space. Fig. 17 shows a simple circuit for transmission by inductive effect.

If a direct current is sent through wire AB, a magnetic field will be set up around it as soon as the current starts to flow, and will collapse as soon as the current stops. If an alternating current is sent through it, there will be a constantly changing magnetic field, which is set up and collapses every time the current changes in direction. Since the strength of the magnetic field at any instant depends upon the strength of the current at that instant, the field strength grows to a maximum and then diminishes to zero, over and over again. If the conductor CD is located in this varying magnetic field, a current will be induced in it by the action of the field, and this current will be an exact duplicate of that flowing in AB. This action is called electromagnetic induction, and is the principle upon which all transformers operate.

If AB is an antenna carrying alternating current and CD is receiving aerial near it, then it is evident that the magnetic field around AB will induce currents in the receiving aerial. However, as the distance from antenna AB is increased, the strength of the magnetic field decreases very rapidly (inversely proportional to the square of the distance) until at a comparatively short distance, depending upon the strength of the current, its effects are negligible. It is evident then that this system of transmission by pure electromagnetic induction would be unsuitable for broadcasting, since enormous power would be necessary to transmit over any appreciable distance.

In Fig. 18 the common open type transmitting circuit is shown.

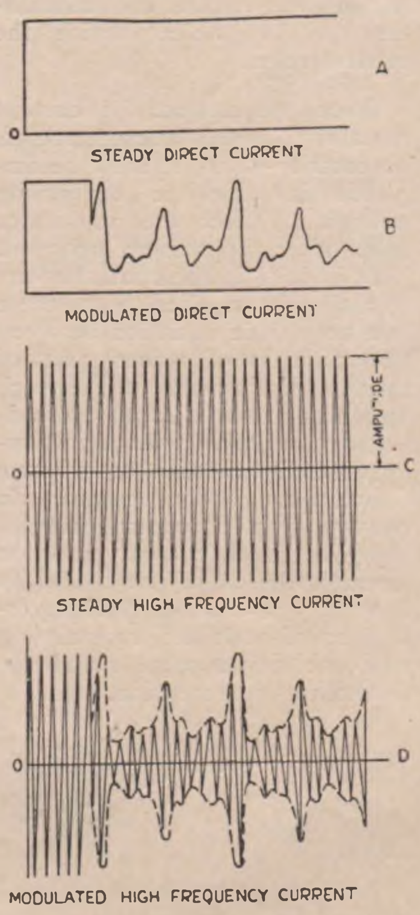


Fig. 16. Modulation of direct and high frequency Alternating Current by Impressed Speech Frequencies.

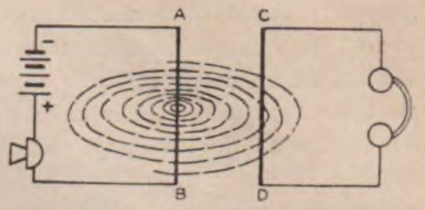


Fig. 17. Electro-Magnetic Induction.

In this circuit the disturbance in space is caused primarily by electromagnetic fields, which travel outward in all directions in the form of waves. Open circuits are much more effective radiators of electrical energy than closed ones, but even with an open circuit radiator enormous power would be necessary to send out waves having frequencies from 16 to 6000 cycles per second (same as speech and music) over long distances. The radiation from any given circuit increases greatly as the frequency of the current in the circuit increases.

This is one of the reasons why it is possible for amateurs transmitting at frequencies above 6,000,000 cycles per second (below 50 metres) to reach nearly around the world when using powers of only a few watts. It is due to these characteristics of transmission, then, that in order to transmit over long distance with the expenditure of a reasonable amount of power, the open circuit type antenna or radiator is used, and currents of very high frequencies, running into millions of cycles per second, are employed for broadcasting.

Modulation Methods.

The practical way of transmitting radio programmes by means of currents of very high frequency is to use a high frequency current which varies in strength according to the intensity and frequency of the sound waves to be transmitted. A steady current of very high frequency, determined by the operating wavelength of the station, is generated by means of large valves operated as oscillators. This is shown in Fig. 16c. Notice that it is an alternating current, and that the height or strength of the current during each cycle is exactly the same as during any other cycle. The fact that valves connected to a source of direct current, and a special circuit can be made to generate alternating currents of high frequency, commonly called oscillations, is really the foundation of our present broadcasting systems.

If the voice current of Fig. 16B is allowed to regulate the flow of the radio frequency current of Fig. 16C, that is, to "modulate" it, the result is the high frequency current of Fig. 16D, called the modulated oscillating current. This current is no longer of constant amplitude, but its strength varies in exact accordance with the variations in strength and frequency of the voice current, or the spoken sounds. That is, the steady oscillating current is modulated by the voice current. This is accomplished by a valve known as the modulator tube.

A simple analogy which may make the action clear is to think of the oscillating current as a steady stream of water flowing out of the nozzle of a hose. The voice current is represented by an adjustable opening in the nozzle which varies continuously in size. If this variation in the opening is made to take place, the diameter of the stream will be varying constantly to conform to the size of the opening in the nozzle, and it will look somewhat as shown by the dotted outline curves in Fig. 16D.

The modulated oscillating current goes to the antenna circuit, where it produces waves which radiate in all directions. The frequency of the waves is the frequency of the high frequency current, so that the frequency or wavelength of the station is controlled by adjusting the oscillator tube circuit. The actual broadcasting equipment is made up of units related to each other as shown in Fig. 19.

The exact way in which the electrostatic and electromagnetic waves travel through space is not commonly known. There are many theories attempting to explain their observed behaviour, and many of our most able scientists are experimenting constantly to shed light on its mysteries.

The speakers or artists perform in a studio where the microphone is located. This is usually a large room made sound-proof, so that no outside noises can affect transmission. The windows are covered with heavy draperies, and the walls and floor are padded to improve the acoustic properties of the room and to prevent reverberation, which might cause blasting in the reception of the programme. A signal system is included to enable the announcers to communicate with the control room.

Since the amount of current handled by the microphone is necessarily small, it must be amplified in order to be strong enough to affect the modulator tube when impressed upon it. This is done in the control room by a speech amplifier. Since there is a very wide variation between the loudness of voices and of musical instruments, the speech amplifier must be capable of adjustment so that when a particularly loud part of a programme comes through, the operator can cut down on the control and not allow as much current to pass through the amplifier. This is necessary in order to avoid overloading of both the transmitting and receiving apparatus and unnaturalness in reception.

Fig. 18. Wave forms of energy transmission by Electro-Magnetic Wave Radiation.

In most stations it is possible to cut down to a very small fraction of maximum volume. This operation is accomplished continuously by a station operator, and is known as monitoring. If the monitor is not quick and constantly on the alert, the loud notes of an orchestra come in like thunder, and the low, soft tones are lost entirely.

The next part of the transmitter is the modulator. This is a valve device, and in the usual plate power variation, or Heising method of modulation, it varies the plate power going into the oscillator tubes. The oscillator tubes are usually connected in a Meissner circuit for generating high frequency oscillations.

The plate circuits of the vacuum tubes used as oscillators must be supplied with high-voltage, direct-current power. The filaments of all the tubes take quite a large current at low voltage. In order to provide this, some stations employ motor generator sets operating directly from the electric light and power lines. The output passes through a coil and condenser filter combination designed to take out the commutator ripples. Other stations transform low voltage AC to high voltage, and then rectify it, changing it to direct current by special types of large valves.

If the broadcasting originates at some point removed from the station, as in the case of a football game, the microphones and usually the speech amplifier are installed at the field and a wire telephone line is run to the transmitting apparatus in the broadcasting station. Some stations employ a portable radiophone transmitter of low power which is sent to the scene of activity and the programme is broadcast directly from there to the main broadcasting station, where it is re-broadcast with increased power.

Production of Radio Waves.

An explanation of the way in which the radio waves are produced and travel in space enables one to understand and appreciate the wonders of radio transmission, and the many difficulties encountered. We cannot see, hear or feel these waves, but it is possible to visualise their actions by the things they accomplish.

In a previous chapter we found that whenever a current flows through a conductor, it sets up a magnetic field around it. Also, whenever a body has an electric charge on it, an electrostatic field is created around it. Let us consider the plates, and the space between the plates, of a condenser. When a condenser is charged, the charge on one of the plates sends out from that plate a large number of lines of electric force which traverse the space between the plates, and end at the other plate, Fig. 20A. These lines of force coming from a charged body are called electrostatic lines of force to distinguish them from electro-magnetic lines of force.

The space in which these lines occur is called the electrostatic field. The important point to remember is that any conductor which has an electric charge on it has an electrostatic field set up around it. If the charge on the conductor is in motion, in which case there is said to be a current of electricity flowing through it, then the conductor also has a magnetic field set up around it. It is necessary to remember that the magnetic field does not exist until there is a motion of the charge.

The electrostatic lines of force, Fig. 20B, are radial about the conductor, while the magnetic field is concentric about it. The two fields are always at right angles to each other. The strength of the electric field depends upon the charges. In the antenna, when the current ceases to flow at the end of the cycle, the charge is greatest, and the electrostatic field around it is maximum.

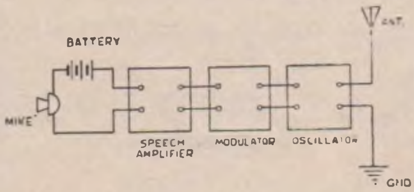
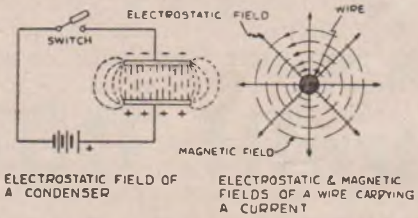


Fig. 19. Fundamental arrangement of Circuit Elements of a Radio Transmitting Station.

When the current has its maximum value, the electric field around the antenna is zero, since at this time the rate of change of the current is a minimum. When the charges are at rest on a conductor, the electric lines of force are also at rest and extend out radially from it. These lines are supposed to have a certain amount of inertia or resistance to any changes that may take place, so that if the charges on the conductor change rapidly from a condition of movement to one of rest, as is the case in a high frequency alternating current, the lines lag behind and they behave as if they were detached from the antenna, and start to travel away from it at a speed of 186,300 miles per second. This is the radiated electrostatic field which plays the important part in transmission.



Figs. 20a and 20b illustrate graphically how radio waves are produced and radiated.

Just as the motion of a charge, with its associated electrostatic field, sets up a magnetic induction field around the conductor carrying it, so the motion of the radiated electrostatic field travelling away from the antenna sets up its own magnetic field as it travels. When the radiated electrostatic field is at its maximum value, the magnetic field which it creates is also at its maximum value. It is important to keep clearly in mind the fact that the radiated magnet field, which is produced wholly by the moving radiated electrical field, is entirely distinct from the magnetic field of induction, which is produced by the antenna current, and which does not travel any great distance from the antenna. The radiated magnetic field and radiated electrostatic field are closely related. We cannot have the first without the latter.

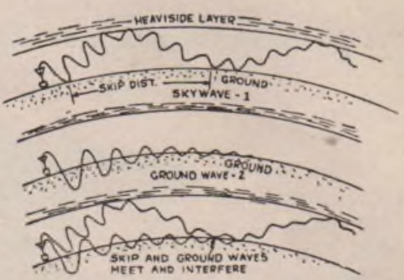


Fig. 21. Fading and Skipping Action of Radio Waves.

The two radiated fields move outward from the antenna, at all times perpendicular to each other, the magnetic being parallel to the ground, and the electrostatic field being perpendicular to it. At the same time, both fields are at right angles to the direction of propagation of the waves. At great distances from the antenna, the electric waves would be exactly perpendicular to the earth. If the earth were a perfect conductor. Actually the resistance of the earth's surface causes the waves to tip forward somewhat, as shown in Fig. 18.

Dr. Fleming's Explanation.

Possibly, the following description by Dr. Fleming will serve to make this clear:

"If we can imagine a being endowed with a kind of vision enabling him to see the lines of electric strain and magnetic flux in space, he, standing at any spot on the earth's surface, would see, when the antenna was in action, bunches or groups of electric strain fly past. Near the earth's surface these strain lines would be vertical. Alternate groups of lines of strain would be oppositely directed, and the spectator would also see groups of magnetic flux fly past, directed in a horizontal direction or parallel to the earth's surface. The strain and flux lines would move with the velocity of light, 186,300 miles per second, or 300,000,000 metres per second, and the distance between two successive maxima of electric strain, directed in the same direction, would be the wavelength of the wave."

At the receiving station the antenna may take the form of an open wire or a loop. In either case, the radiated waves from the transmitter striking across it, cause currents of electricity to flow in the receiving circuit. This will be studied in detail later.

Fading and Its Cause.

In some localities the signals from certain stations, especially short-wave stations, seem to fade in and out in an irregular manner. This usually is more marked at night than in the daytime. The probable explanation of this curious phenomenon is that as the waves travel outward from the transmitting antenna, they may be considered as taking the form of ground waves and sky waves. The ground wave is greatly weakened as it travels through obstructions like frameworks of steel buildings, etc. The sky wave apparently goes up into the air perhaps fifty or a hundred miles, and is reflected so that it comes down again to combine with the other wave which has travelled along the earth. The two waves arriving at the receiving aerial combine to produce the resulting wave which affects the receiving apparatus.

Since the sky waves travel a much longer distance than the ground waves (Fig. 21), it is possible that the two are not in phase with each other when they meet.

When they are both in the same phase at the time of meeting, the resultant signal is strong. When they differ in phase the resultant signal is weak. The constant minute-to-minute variation in distance travelled, changes the phase relation with consequent fading or swinging of the signal. Fading is a function of frequency, being more troublesome as the frequency is increased. It is more pronounced at night than during the day, and decreases as the distance from the transmitter is increased. The reflection action on the sky wave is explained by a theory advanced by Sir Oliver Heaviside.

Seventy-five or a hundred miles up, the atmosphere surrounding the earth is very rare. The molecules, consisting of equal positive and negative charges, are split up —"ionized" into positive and negative portions by the ultraviolet light from the sun during the day. This ionized layer of atmosphere is a conductor, and is known as the Heaviside layer. During the day the layer comes closer to the earth because of additional ionization of the molecules by the sun. At night, during the absence of the sun, the positive and negative portions of a part of the molecules reunite, and the layer rises from the earth. During the day the sky wave is very materially reduced by absorption from the conducting Heaviside layer, and so practically all of the energy comes through the ground waves, to all but those receiving stations located close to the transmitting station. At night, both the ground and sky waves are stronger, so the receiver signal is much stronger.

The Heaviside layer is always present then, but at varying heights, depending on the sunlight and changes in barometic pressure. Due to the varying height and possible uneven surface at places, the angle of reflection of the sky wave is constantly changing so that the phase relation between the ground and sky wave changes, with consequent fading.

With very high frequency (low wave-length) transmissions, this effect of the Heaviside layer is so marked that the radio waves appear to skip over certain localities entirely, and reception in most places is impossible. That is, the intensity of received signals first decreases as the distance from the transmitter is increased, reaching a value too low to be detected. As the distance is further increased, the signals become readable again.

The skip distance effect at night is much greater than in the daytime. It gradually increases up to about midnight. It is also greater in winter than in summer, because the ionization is less then due to shorter periods of sunlight.

It has been found that on 15 metres the daylight skip is about 900 miles, and is about 1000 miles at night. On 27 metres the day skip is 100 miles, and the night skip 450 miles. On 33 metres the day skip is 100 miles and the night skip 400 miles. On 50.2 metres there is no apparent skip. The amount of skip decreases as the wave-length is increased, and, above about 150 metres, the effect is negligible, so that broadcasting stations are not affected.

About an hour before sunset there usually occurs a rise in the average intensity of radio signals, then a drop at sunset, and a rise to a first maximum about an hour later. During the night the average intensity varies, but shows its greatest value about two hours before sunrise.

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As to results. As far as selectivity is concerned, the receiver gave excellent results at Hawksburn, but in localities fairly close to transmitting stations some few adjustments may be necessary. The tone and volume were excellent, and left little to be desired.

Although the push-pull pentodes naturally want more driving than a single pentode, they give wonderful results as far as power output, and both the volume and power handling capability of the receiver is greatly in excess of that of the conventional single pentode set.

In passing, we may mention that all the material for the original receiver was made available to us through the courtesy of A. J. Veall Pty. Ltd.

THE LIGHTING OF TALKIE STUDIOS.

(Continued from page 27.)

ing one set or scene, the difficulties surrounding the supply of power and also the intensity of the illumination used, can be realised.

Let us now examine the filament of these wonder lamps. It will be seen that not only are they comparatively short, but the spirals are very closely spaced, so that the entire filament occupies a remarkably small area. This concentration of the filament enables very accurate focussing, and complete freedom from what is called "hot-spots," or bright sections in the beam which is thrown from the lamp.

The next point for consideration is the photographic value of the light emitted by the lamp. Ordinary lamps have a very great percentage of red and yellow rays in their light output, and this light is of very little value photographically, because it is the light at the blue and violet end of the spectrum which has the most marked effect on photographic film and is of greatest photographic value. If we examine the output from a film studio lamp through proper scientific apparatus, we find that the light is extremely rich in rays at the violet end of the spectrum, the blue and vio-

have a greater cooling effect and better circulation than others, and by careful control of this property, together with improvements in the method of circulation and the construction of the filament, enabled the lamp manufacturers to run their filaments at a much higher temperature than normal.

The high temperature burning filament used and the special gas circulation was found to result in a quick deposit of black from the evaporated filament on the inside of the glass bulb in the smaller sizes of film studio lamps. To overcome this trouble, the manufacturers included in the bulb when it was being made a quantity of special tungsten powder, which normally lies at the bottom of the neck of the lamp. When the blackening becomes evident on the bulb, by inverting same this powder is allowed to run into the bulb, where it can be rolled around, and it removes all black deposit whenever desired. When it is remembered that a 5000 watt film studio lamp of the small size is very little bigger than a 1500 watt normal floodlighting lamp, it is realised what a wonderful production is the new lamp.

The extremely high temperature generated in the filament of the film studio lamps required further scientific search in producing a glass bulb which would stand up under the conditions imposed upon it, and also in the invention of internal supports and glass parts which would not melt under the temperatures reached. Science again tri-
umphed in this, and finally a
which met all the require-
of the motion picture
cers was evolved on a com-
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modern lamps are used in
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Prominent amongst these
s are the Efftee Films
studios in Melbourne, Fox Movietone News studios in Sydney, and the Australasian Film Laboratories, which have their studio at Bondi Junction, Sydney.

So great is the light output of these new lamps that they are now being used also by other interests than film studios. An example of this is the utilisation of 5000 watt film studio lamps by Messrs. J. C. Williamson Limited, who are using a bank of 4-5000 watt lamps for the illumination of the stage during their present Grand Opera season. The illumination provided by these four lamps has resulted in a stage which is better lighted than has ever been experienced in Australia before.

The foregoing will, no doubt, indicate to the interested reader what a complicated and varied set of problems are placed before lamp manufacturers in their business of producing the means of illumination for any and every class of work for which it may be required. There is no doubt that the production of special film studio lamps has been one of the greatest triumphs for the lamp scientists that has ever been experienced in the history of the lamp industry.

Since the sky waves travel a much longer distance than the ground waves (Fig. 21), it is possible that the two are not in phase with each other when they meet.

When they are both in the same phase at the time of meeting, the resultant signal is strong. When they differ in phase the resultant signal is weak. The constant minute-to-minute variation in distance travelled, changes the phase relation with consequent fading or swinging of the signal. Fading is a function of frequency, being more troublesome as the frequency is increased. It is more pronounced at night than

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THE PUSH-PULL PENTODE 4.

(Continued from page 15.)

for connection to the travelling dial light on the dial.

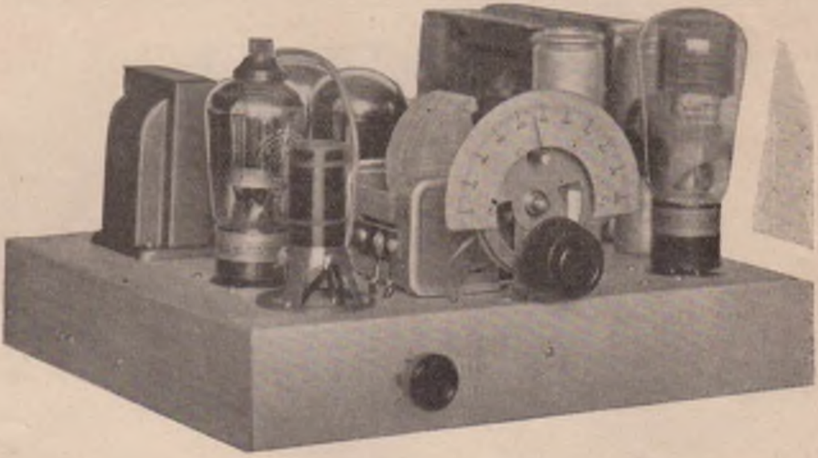
Point to Point Wiring.

The wiring of the receiver is started by running a lead from the top end of the aerial coil, L1, to the first aerial terminal. The centre tap on this coil goes to aerial terminal number 2, whilst the bottom end of L1 is connected to the bottom end of L2, and to the C terminal on the detector valve socket, C1. The top end of L2 is connected to the fixed plate terminal on C1 and to one lug on the grid condenser, C2, around which the grid leak, R1, is connected in parallel. The other lug on C2 is soldered direct to the G lug on the socket of V1.

It is best now to turn our attention to the power transformer, and take a lead from each of the top four-volt lugs to the F terminals on the socket of V1. The centre tap resistor, R5, then is soldered to these same terminals on V1, and the centre connection wired to the C terminal on the socket. The next pair of four-volt lugs on the transformer carry leads which go to the F terminals on the sockets for V2 and V3. The centre tap resistor, R6, also is connected across one pair of F terminals.

Now bolt the two condensers, C4 and C5, to the side of the chassis and connect a lead from the P terminal on V1 to one lug on C4, and from this lug continue the lead to a point about 1½ inches up from the negative end of the voltage divider, R4. (This is the end nearest to the loud speaker plug.) From the bottom end of L3 a lead goes to the top (plate) terminal on the E442S detector valve, V1.

The remaining lead on L3 is connected to the fixed plate terminal on the midget condenser, C3, to the P lead on the audio transformer, AFT, and to one lead on the Velco resistor, R2. The B plus lead on the audio transformer is connected to one lug on the 2 mfd. condenser, C5. The remaining lead on R2 carries a lead which is connected to a lug set about one inch down from the positive end of the voltage divider R4. One of the grid leads on the audio transformer, AFT, is wired to the G terminal on V2, whilst the other audio transformer grid lead is connected to the G terminal on V3. The P terminal on V2 is connected to the P lug on the loud speaker socket, the corresponding terminal on V3 going to the C lug on the loud speaker socket. The C terminal on V2 is connected to the corresponding terminal on V3, to one lead on the Velco Resistor, R3, and to one lug on the 2 mfd. condenser, C6, which now may be bolted to the chassis. The remaining lead on the resistor R3, is connected to the maximum positive lug on the voltage divider, R4. From this same lug a lead is taken to the G terminal on the loud speaker socket, to one of the F terminals on the same socket, and to the positive lug on C8. The remaining F terminal on the l.s. socket is wired to the positive lug on C7 and to one F terminal on the rectifier valve socket, V4.



Another view of this interesting A.C. Receiver.

We now are ready to connect some earth leads. From the high voltage centre tap on the power transformer run a lead under the chassis to the negative end of the voltage divider, to the earth terminal, to the vacant lug on the three condensers, C6 C5, and C4, to the C lug on the detector valve socket, V1, and to the moving plate terminal on the midget condenser, C3.

A lead from the moving plate lug on the tuning condenser, C1, is connected to the C terminal on V1. The C minus lead from the audio transformer, AFT is soldered to the earthed terminal on C5. The bias resistor, R7, has one of its leads soldered to the centre tap on R7, and its other lead is soldered to the earthed lug on C6. A lead from the 4 mfd. condenser, C9, is connected to the centre tap, R6, whilst the remaining lead from C9 goes to the C lug on the socket of V1.

This completes all except the power pack wiring. One of the outside 350 volt leads is wired to the P lug on the socket of V4 the other outside 350-volt lead going to the G lug on the same socket. One of the remaining four-volt leads goes to one F terminal on V4, the other going to the F terminal to which there already is a lead from C7. From the four-volt winding which carries the detector filament supply a pair of leads are taken to the travelling dial light.

Loud Speaker Connections.

This finishes the wiring of the receiver, and we are now ready to try it out. Plug the Philips E442S tube into the detector socket and the two C443 pentodes into the audio sockets. The 1561 rectifier also should be plugged in. The connection of the dynamic speaker involves the use of a UY valve base. One of the field leads from the speaker is connected to one F pin on the UY base, the other F pin carrying the remaining field lead. One of the output transformer leads goes to the P pin on the base, the other output lead going to the C pin.

The centre tap on the output transformer is taken to the G pin. The actual operation of the set is pretty simple, and, beyond giving a rough guide as to voltages, little advice should be necessary. The detector is to operate from the 250-volt tap on the voltage divider the screening grid clip being set at about 45 volts. The pentodes, of course, are connected to the maximum voltage tap.

As to results. As far as selectivity is concerned, the receiver gave excellent results at Hawksburn, but in localities fairly close to transmitting stations some few adjustments may be necessary. The tone and volume were excellent, and left little to be desired.

Although the push-pull pentodes naturally want more driving than a single pentode, they give wonderful results as far as power output, and both the volume and power handling capability of the receiver is greatly in excess of that of the conventional single pentode set.

In passing, we may mention that all the material for the original receiver was made available to us through the courtesy of A. J. Veall Pty. Ltd.

TECHNICAL PERFECTION

Technical Perfection in Radio Set Construction is only possible when the Constructional Article is written by an expert and the Required Components are purchased at a reliable accessory house.

THAT IS WHY VEALLS CAN RECOMMEND THESE TWO RECEIVERS AS DESCRIBED IN THIS ISSUE OF MODERN SETS.

Parts Required for—

THE "DIAMOND" ALL WAVE BATTERY TWO

Qty	Item	£	s.	d.
1	Radiotron 232 Valve 24/-	1	4	0
1	Radiotron 233 Valve 26/-	1	6	0
1	Stromberg-Carlson Variable Condenser 7/10		7	10
3	Marquis Valve Sockets 1/- ea.		3	0
4	Ebonite Terminals 3d. ea.		1	0
1	50,000 ohm. Chanex Variable Resistor		9	6
1	Radiokes 23-plate Midget Condenser ..		8	0
1	Radiokes 13-plate Midget Condenser ..		6	0
2	T.C.C. .00025 mfd. Fixed Condensers 2/1 ea.		4	2
1	T.C.C. .006 mfd. Fixed Condenser		2	8
1	Electrad 4 meg. Grid Leak		3	2
2	Hydra 2 mfd. 1500V Condensers 8/- ..		16	0

Qty	Item	s.	d.
1	Hydra .5 mfd. 1500V Condenser	5	0
1	12in. x 7in. Panel	2	6
6	Lengths Spaghetti 2½ ea.	1	3
4	U.Y. Valve Bases 3d. ea.	1	0
1	4oz. reel 28 gauge D.S.C. Wire	3	3
18	¾in. Nuts and Bolts 7d. doz.		11
2	Lengths Resin Core Solder 5d. ea.		10
1	H. and H. Filament Switch	2	3
3	yds. Single Flex		4
3	Lengths 4½in. x 1½in. Former	2	3
1	650 ohm. Velco Resistor	1	3
1	Vernier Dial (Velmo)	3	11
1	.25 meg. Carborundum Resistor 2 watt .	2	7
1	200,000 ohm. Carborundum Resistor ..	2	7

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See our full page advertisement elsewhere in this issue—a free coupon that entitles you to a copy of Vealls Big New Catalogue — over 500 Illustrations. Contains circuits, wire tables, etc., of interest to all fans. Post YOUR Coupon to-day.

Parts required for—

THE PUSH PULL PENTODE 4

Qty	Item	£	s.	d.
2	Phillips C.443 Valves 22/-	2	4	0
1	Phillips E 442S Valve	1	2	0
1	Phillips 1561 Valve	1	1	6
1	Stromberg-Carlson .0005 Condenser		7	10
1	A.W.A. Push Pull Transformer 26/-	1	6	0
1	Marquis 3 Coil Tuner		4	9
1	Radiomaster Dial		13	4
2	Polymet 450V Electrolytic Condensers 7/- ea.		14	0
1	Radiokes 23-plate Midget Condenser		8	0
1	Velco E.V.O. Power Transformer	1	3	9
4	Marquis U.Y. Sockets 1/- ea.		4	0
1	Marquis U.X. socket		1	0
2	Hydra 2 mfd. Condensers 500V 5/3 ea.		10	6
1	Hydra 4 mfd. 500V Test Condenser		8	2
1	Hydra 1 mfd. 500V Test Condenser		3	4
2	Radiokes Centre Tapped 30 ohm. Resistors 2/8 ea.		5	4
1	T.C.C. .00025 mfd. Condenser		2	1
1	Velco Voltage Divider		4	9
1	2 meg. Carborundum Resistor		2	9
1	10,000 ohm. Carborundum Resistor 2 watt		2	7
1	25,000 ohm. Carborundum Resistor 2 watt		2	7
1	Bias Resistor 500 ohm.		1	3
6	Lengths Spaghetti 2½d. ea.		1	3
3	Terminals 3d. ea.			9

Vealls

(Arthur S. Veall Pty. Ltd.)

168-172 SWANSTON ST., MELBOURNE, C.1. 243-249 SWANSTON ST., MELBOURNE, C.1.
302 CHAPEL ST., PRAHAN, S.1.
'Phones: Cent. 2058 (5 lines), 10524 (2 lines), Wind. 1605.

ALL-WAVE BATTERY TWO

(Continued from page 17.)

wise. The grid windings, L1, always are at the bottom end of the coil—i.e., nearest to the chassis—when the coil is plugged in. The best way to make the coils is to finish the windings on the bakelite formers before slipping the ends of the windings through the holes in the pins of the valve base, and securing the former to the valve base by means of a ⅛ inch machine screw, which is tapped into former and base.

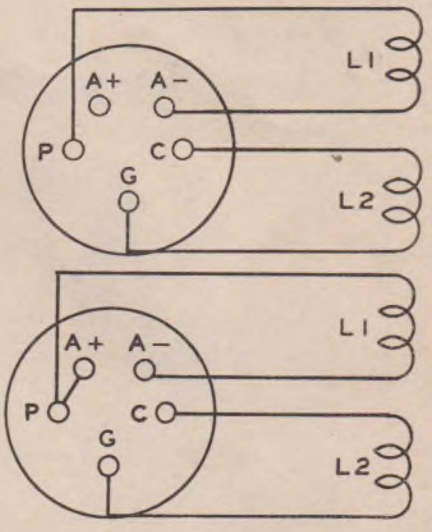
The start of the grid-winding for the broadcast coil connects to the P pin on the base, and a little jumper wire connects this pin with the "A" plus pin. The finish of the grid-winding—i.e., nearest to start of reaction-winding, L2—connects to the "A" minus pin. The start of the plate-winding connects to the C pin on the base, and the finish of this winding to the G pin. The connection of the short-wave coils is exactly the same, except that the "jumper" wire between the "A" plus and P pins is left out.

The separation between the two windings will vary in different circumstances, but the following can be taken as a rough guide. Broadcast coil ⅜ inch and all short-wave coils 3-16th inch.

The "B" batteries used in the original receiver were heavy duty 45-volt "Diamonds." Three batteries, giving a total of 135 volts, were employed although it is possible to get quite good results from a 90-volt battery. The total current drain at 135 volts is in the vicinity of 14 m.a., which will ensure long and satisfactory service from the heavy duty type of Diamond "B" batteries.

Tunes in the World.

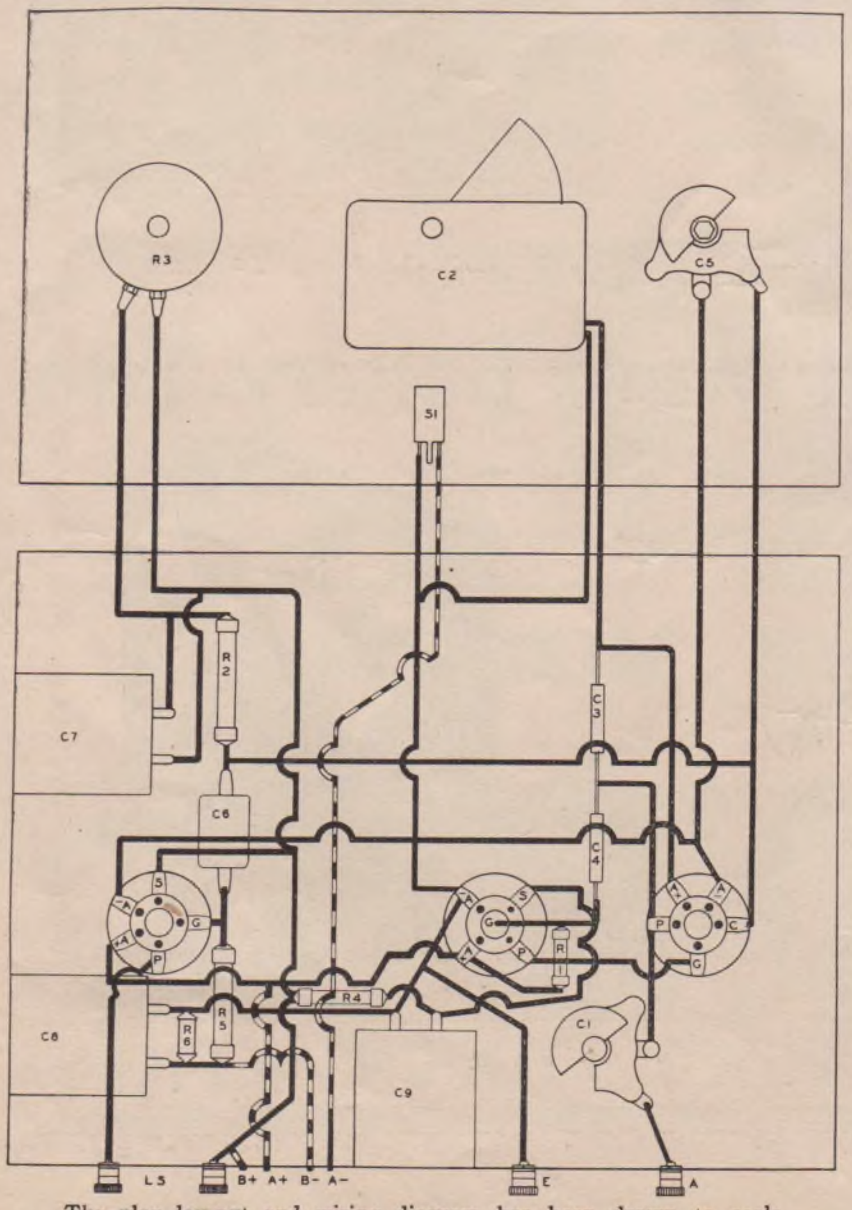
As to results, this little receiver must be heard to be appreciated. It is capable, when properly operated, of bringing in all the local broadcasting stations at full loud speaker strength, and, in very favourable circumstances, will even give satisfactory reception of inter-State broadcasting stations. On the short-wave band we already have logged J1AA, Japan; RV15 Kharbarovsk, Siberia; 5SW, Chelmsford, Radio Pontoise, Paris; 2XAF, Schenectady, U.S.A.; RV59, Moscow; about half a dozen Australian commercial and amateur short-wave broadcasters and literally hundreds of amateur and commercial code transmitters.



At the top we have the details of the coil connections for short waves. The broadcast coil connections are shown in the lower sketch.

THE PARTS YOU WILL NEED.

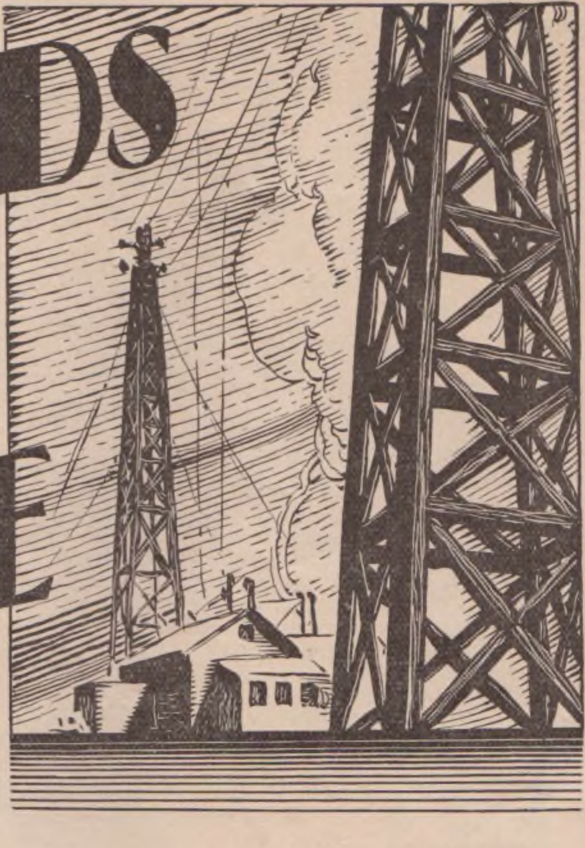
- **1 Radiotron UX232 Valve (Vi).**
- **1 Radiotron UY233 Valve (V2).**
- **1 .00045 mfd. Stromberg Carlson Condenser (C.2).**
- **1 50,000 ohm Variable Resistance (R3).**
- **1 Radiokes 23 Plate Midget Condenser (C5).**
- **1 Radiokes 13 Plate Midget Condenser (C1).**
- **2 T.C.C. .00025 mfd. Fixed Condensers (C3, C4).**
- **1 T.C.C. .006 mfd. Fixed Condenser (C6).**
- **1 Electrad 4 megohm Grid Leak (R1).**
- **2 Hydra 2 mfd. 500 Volt Test Condensers (C7, C8).**
- **1 Hydra .5 mfd. 500 Volt Test Condenser (C9).**
- **1 12in. x 7in. x 3-16in. Bakelite Panel.**
- **1 H. and H. Power Switch (S1)**
- **1 650 ohm Velco Resistor (R6).**
- **2 .25 meg Carborundum Resistors (R5, R4).**
- **1 UX Marquis Socket for V1.**
- **2 UY Marquis Sockets for V2 and coils.**
- **4 4½in. Lengths of 1½in. Dia. Former.**
- **1 100,000 ohm Carborundum Resistor (R2).**
- **4 UY Valve Bases.**
- **1 Velco Baby Dial.**
- **1 Aluminium Chass. 12in. x 9in. x 2in.**



The plan lay-out and wiring diagram has been drawn to scale.

The list of broadcasting stations given above all have been heard at excellent strength — indeed, some of them loud enough for good loud speaker reception. The controllability of the receiver on short-wave, particularly on wave-lengths between 20 and 30 metres, must be experienced to be appreciated, and there is no doubt that this ease of control has contributed in no small measure to our success in initial tests.

All the materials for the original receiver were obtained from A. J. Veall Pty. Ltd., the metal chassis being made to our specifications by Geo. White & Co.




LASTING
POWERFUL
B
DIAMOND
BATTERY
EMF
SILENT
EFFICIENT
DIAMOND DRY CELLS

THE ARMCHAIR ENGINEER.

(Continued from page 11.)

operated device as distinct from the power-operated magnetic and dynamic types of speaker. Consequently, as many as ten crystal speaker units may be connected in parallel and operated from the same receiver at the volume level previously obtainable from a single dynamic or magnetic speaker. The Rochelle Salt crystal speaker possesses also the feature of high sensitivity—a thing which should make it of particular interest to battery set users.

* * *

ALTHOUGH we admit that the high sensitivity of the average receiver makes the question of an aerial of secondary importance, there are many experimenters, particularly those who go in for short-wave reception, who pay particular attention to aerial design and installation. When we look back on the 80 feet high masterpieces of early "wireless" days, and compare them with the highly-efficient doublet aerials which are used by the up-to-date short-wave experimenter, we begin to wonder why it is that progress comes from continued effort—and, believe us, it was effort, the effort of a gang of men and a mass of tackle to get an 80 foot stick up and settled!

The point which inspired this par. was the outcome of a conversation with a visitor from the East—Singapore, to be exact. In a tropical location such as this the greatest drawback to reception is static. The local fans found that aluminium aerials gave them a hundred per cent. better reception, as far as static was concerned, than did copper wire aerials, whilst the drop in signal strength was hardly noticeable. The scheme seems worth trying, anyway.

TALKING about Singapore. It seems to be a radio enthusiast's paradise. Although there is not a great deal of regular broadcast reception obtainable during the day, the short-wave stations in all parts of the world romp in pretty well throughout the twenty-four hours. There's no need to get up at 5 o'clock in the morning or to stay up until 1 or 2 o'clock to listen to any s.w. broadcasters in Singapore. French, German, Russian, African—in fact, all the European and Asian broadcasters except 5SW come in from about 11 a.m. onwards.

About 4 p.m. the Yanks start up and bring their high-powered jazz programmes to the Singapore fans until pretty well midnight. Australia, through 3ME and 2ME, also is in the picture, the latter station until recently being the supplier of the Australian Saturday sporting news to the Aussies in the Straits Settlements.

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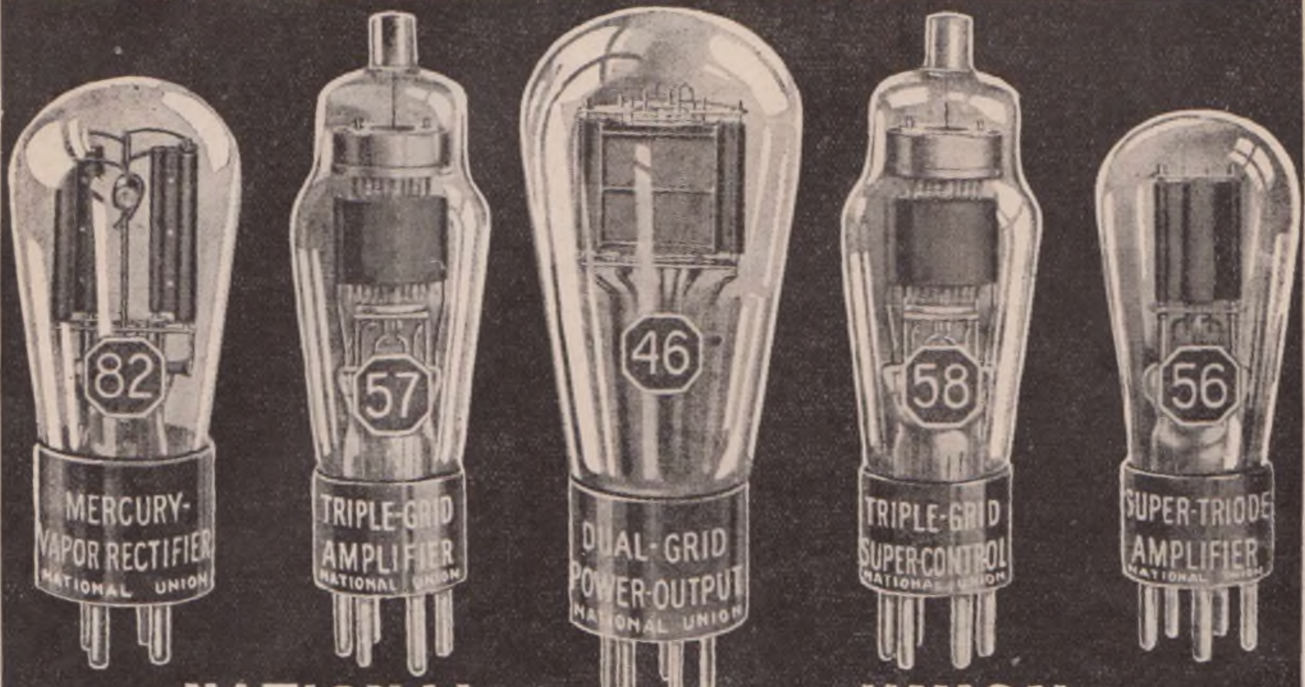

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THE KRIESLER SUPER-CHARGED 5

(Continued from page 10.)

ber is centred. Then place on the remaining washer, and lock tightly into place with nut.

There are three coils to be mounted. The first of these is the aerial coil, and is designated by a green spot. The coil is mounted by two bolts, with the green spot to the back. A solder lug is placed under the holding bolt nearest the centre of the chassis.

The remaining two coils are marked with a red spot, and are mounted in the same manner. The centre coil (next to the aerial) has a solder lug placed under the bolt nearest the right-hand end of the chassis.

The third coil is mounted direct on to the chassis without any solder lug, but making sure, as before, that the red dot is facing the back of the chassis.

The valve shields should be mounted on the chassis next, as they will provide a convenient support for the chassis when it is turned up for wiring, and will also protect the coils from accidental damage. Three shields are provided, and are placed in the slots around the three sockets marked 224, 235, 235.

The variable condenser already has three mounting bolts fitted to it, and it is only necessary to place the condenser downwards on the chassis with the holding bolts through the three holes provided. The condenser is then bolted into place with three nuts. A solder tag must be placed under the front mounting bolt just behind the volume control.

There are four terminals to be mounted. Two of these are at the back of chassis, one being mounted as an earth terminal directly on to the chassis in the hole marked "E." The aerial terminal is mounted on the insulating strip in the hole marked "A," making sure the terminal is clear of the chassis on all sides. A solder tag must be mounted under the holding nut on the aerial terminal. The correct position is shown by a blue dot on the chassis.

The remaining two terminals serve as connections for a gramophone pick-up, and are mounted on the top of the chassis at the front left-hand side. One terminal is mounted direct on to the chassis, and has a solder tag mounted under the nut. The other terminal is mounted on the insulating strip with a solder tag under the nut. This is indicated by a maroon dot on the insulating strip.

The R.F. choke mounts on to the under-side of the chassis by means of the brass bolt provided with the choke. The tag marked with a green dot should be nearest the centre of the chassis. The uncoloured tag then becomes the "spare lead," and, as such, is dealt with in the wiring instructions.

The final point is to always see that every nut and bolt is definitely tight, and a spring washer is placed under the head of the bolt.

Wiring Details.

After mounting all components firmly and in the correct places, a start can be made on the wiring.

Reference to the photographic plan of the wiring provided with the Kriesler kit will serve to familiarise the constructor with the position of the lacing and connections.

This being done, the lacing should be placed in position on the chassis, making sure that the branch which connects to the volume control and dial lamp is placed **under** the voltage divider. This is shown clearly in the photograph.

Having placed the lacing in position, the ends of the leads can be soldered to their respective contacts on the sockets, power transformer, voltage divider, and other parts. To do this it is only necessary to follow the colour coding and connect the leads to the nearest contact tag of corresponding colour.

It will be readily seen from the photograph that all the leads from the lacing cannot be connected until the small parts (resistors, etc.), which are supplied, are mounted into place.

The parts should be taken from the packets in which they are packed and identified with the parts, as shown in the plan of the completed wiring.

Three of the resistors are definitely marked with the size, but two are coloured with a dot. The one with a white dot is 400 ohms, and the one with a yellow dot is 200 ohms. The 10,000 ohm resistor mounts between dark red contact of front valve socket on right-hand side (looking at underside of chassis from front), and earthing tag next to pick-up terminal.

The .002 condenser mounts between uncoloured contact on same socket and earth tag in corner of chassis.

The spare lead on R.F. choke connects to same socket contact as .002 mfd. condenser by a piece of plain copper wire.

The 400 ohm resistor connects between yellow and black tags on power transformer. To avoid any possibility of this resistor fouling any other part of the wiring, the tinned leads should be cut down to about one inch in length.

The 2 meg resistor connects to yellow tag on transformer and free end connects to free maroon lead near power transformer. Point of connection is shown by a maroon dot on chassis, making sure resistor is not touching anywhere.

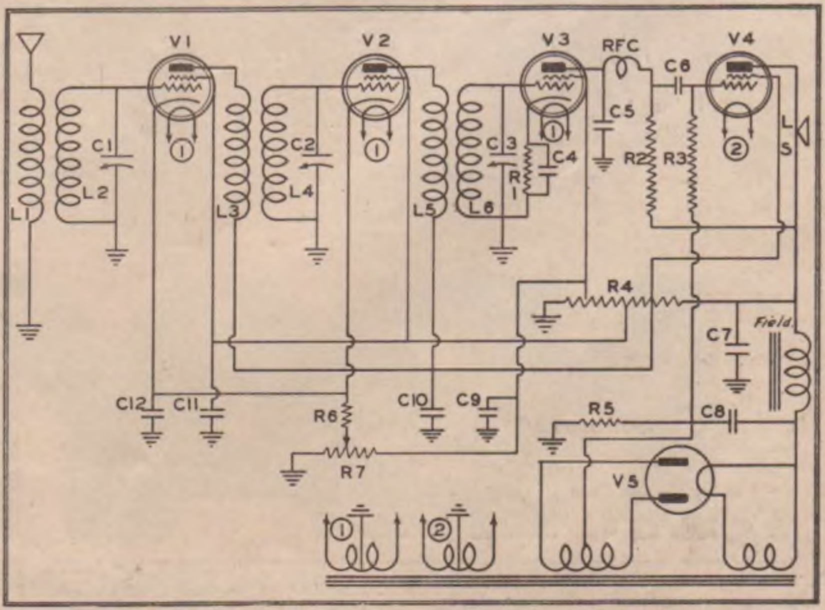
One end of the ½ meg resistor mounts on to red contact of 5 pin valve socket nearest to power transformer, free end connects to one end of .1 mfd. waxtite condenser, other end of .1 mfd. condenser connects to maroon (dark red) tag on same socket.

Free green lead coming out of lacing connects to junction of ½ meg and .1 mfd. condenser. One end of 200 ohm resistor connects to maroon tag on centre 5 pin valve socket on right-hand side of chassis (opposite end to power transformer). Free end connects to blue lead coming out of lacing. Point of connection is marked by a blue spot on chassis. The leads on this resistor should also be trimmed back in order to make the mounting firm.

The condenser block must then be mounted firmly on to side of chassis with bolts and nuts through holes provided.

There are five leads coming from block, and the block must be mounted so that the blue lead comes from the

(Continued on page 46.)



The schematic diagram of the Kriesler Super-Charged Five.

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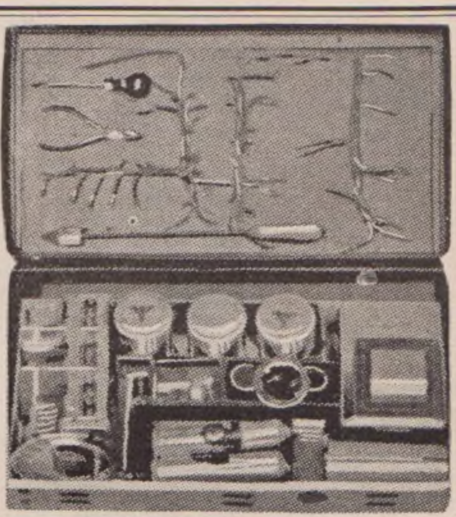

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THE KRIESLER SUPER-CHARGED FIVE.

(Continued from page 43.)

side nearest the front of chassis (near R.F. choke).

The five leads are then connected as follows:—

Blue lead connects to maroon contact of front 5 pin socket, to which the 10,000 ohm resistor is connected to yellow contact on same socket.

Brown lead connects to black contact on rear 5 pin socket.

Green lead connects to maroon contact on same socket.

Red lead connects to red tag of coil nearest to block (centre coil).

The power flex connects to two tags on power transformer marked "0" and "240." These are painted black to avoid any mistake. Care must be used in connecting the power flex, as any stray ends of wire will cause a serious short-circuit should they come into contact with each other or the chassis.

Grid Leads and Coil Cans.

Three double pieces of wire are provided for grid leads.

The joined end of these wires is soldered to the remaining tag on each coil after all wires under the chassis have been connected. This tag is marked with a black dot on top of the chassis, and the lead is so connected that the short end is on the side nearest to the condenser gang. These connections are clearly shown in the detail photograph of the coil mounting.

When the grid leads have been soldered to the three coils, the cans can be bolted into place, first making sure that the leads are brought out through the holes provided in the sides of the cans.

The short lead is placed through the lower hole and the long lead is brought out through the upper hole on the opposite side.

This will meant that the cans must be mounted with the lower hole on the side nearest to the condenser gang. When the cans are finally fitted into place with bolts and nuts through the holes provided, the leads can be soldered into position.

The three short leads coming from the side of the can nearest the condenser are soldered to the three tags on the gang in the same order as they come from the cans—i.e., front lead to front section of condenser, and so on.

The three remaining leads coming from the top of the cans on the side nearest the valve sockets are then placed through the holes in the top of the valve shields, and the three grid clips are soldered on to the ends for connection to the caps of the valves.

This being completed, the two pick-up terminals on top of the chassis (near the 224 socket) must be bridged with a short piece of wire.

The set is then ready for operation, and the valves can be placed in their respective sockets. These are all marked, and care should be taken to see that they are all seated down firmly. The three grid clips must be fitted to the caps of the 235 and 224 valves. If the clips do not make a firm connection, they should be taken off and sprung in slightly so as to grip the cap of the valve tightly.

The speaker should be plugged into the socket on the back of the chassis, marked "Speaker," and an aerial and earth connected to the terminals marked "A" and "E" on the back of the chassis.

The flex lead from the power transformer can then be connected to the 240-volt A.C. supply, and after waiting a while for the valves to heat up, the set can be tuned in.

The only operation then left to complete the set is balancing the condenser gang.

This is necessary to obtain maximum volume and selectivity from the set, and the procedure is as follows:—

Tune in a station fairly low on the dial, such as 3UZ or 3DB, and reduce the volume by means of the control until the station is just audible. Then, with a screwdriver, adjust the trimmer screws on the right-hand side of the condenser gang until the station comes in at maximum volume. Should it be found impossible to get a definite setting on any of the trimmers, turn up the volume control and retune the station.

Then reduce the volume by detuning the dial—that is, tuning off the station until it is just audible, leaving the volume control at the same setting. This "detuning" should be done on the lower side of the station setting; for example, should 3UZ come in loudest at 40, tune **down** to 38 or even 37, until minimum audible volume is reached. Then proceed as before, bringing up the station to maximum volume by adjusting the trimmers.

This having been done, the set is ready for operation, and can be tuned in on all stations in the normal manner.

THE RADIOKES SIMPLIFIED SUPER-HET.

(Continued from page 7.)

of V5, and the centre connection of this resistor is earthed to one of the socket-holding bolts, and connects also to the vacant terminal on C14.

From the 2.5 volt 3 ampere winding on the power transformer, a pair of leads are taken to the F terminals on the socket V5. The centre tap resistance R14 is connected across the 5 volt 2 ampere winding on the power transformer, and the centre lug on this resistance connected to the vacant lead on R10, and to one filament terminal on the loud-speaker socket (L.S.). From the centre lug on R14 a lead also goes to the positive terminal on the electrolytic condenser C16, which in turn is connected to the (insulated) electrolytic condenser, C15.

The two 5 volt 2 ampere lugs on the power transformer are connected to the F terminals on the socket V7. One of the 350 volt lugs on this transformer is connected to the G terminal on V7, the other 350 volt lug going to the P terminal on the same socket. The centre tap on this high voltage winding goes to the negative side of the insulated electrolytic condenser C15, and to the vacant lug on the filter choke CH. From the centre tap on the 350 volt winding, another lead is taken to the second filament terminal on the L.S. socket. From the positive lug on the electrolytic condenser C16, a lead is taken to the C terminal on the socket V5. The P terminal on this socket is connected to the P terminal on the L.S. socket, and the G terminal on the L.S. socket connects to the F terminal which carries a lead to the centre tap resistor R14. The C lug on the power transformer connects to the centre pin of the power plug, the 240 volt lug connects to the pin nearest the speaker socket, and the 200 volt lug connects to the remaining pin.

We now are ready to turn up the chassis, but first should solder a lead from the earth terminal on the chassis and bring it up to connect to the moving plate lug on the gang condenser C1, C2, C3.

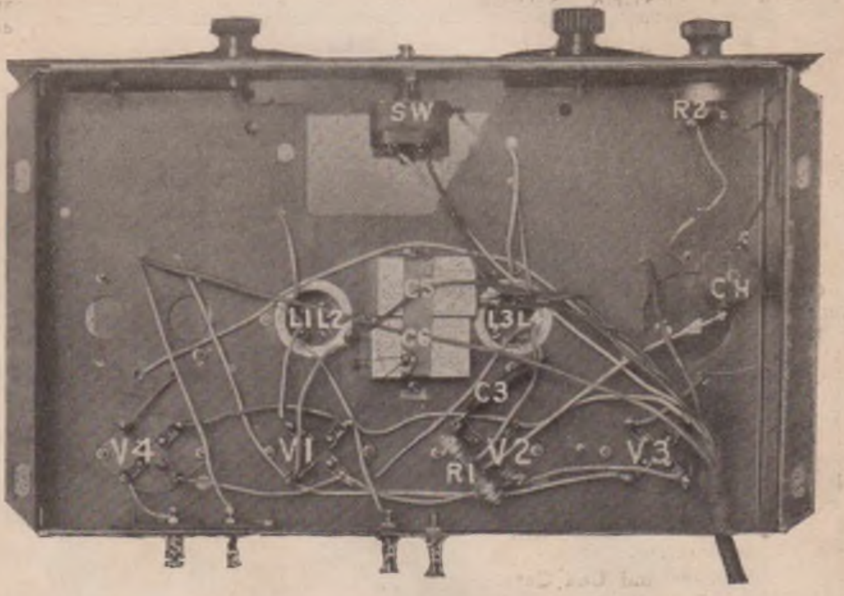
We now can complete the wiring by connecting the grid circuits of the r.f. and first detector stages, and the two i.f. stages. The black lead from L1, L2, is connected to the grid clip for V1, and to this clip also is connected a lead from the fixed plate lug on the C1 section of the gang condenser. The black lead from L3, L4, connects to the grid clip for V2, which carries also the lead from the fixed plate lug on the C2 section of the gang condenser. The black lead from L5, L6, connects to the grid clip for V3, and the black lead from L7, L8 connects to the grid clip for L4.

Naturally these leads will be taken out of the coil cans, and the latter locked into position. It's not much use soldering them up and then trying to put the cans on. All that we need do now is to run a pair of flexleads from the dial light to the 4 volt 2 amp. winding on the power transformer.

We feel at this stage that it is as well to switch on to the official Radiokes description of the testing and adjustment of the receiver. Their scheme worked excellently as far as we were concerned, and later tests with a modulated oscillator, and an output meter showed that the receiver was very accurately ganged up over the whole wave range.

Having thus completed the wiring, go carefully through the circuit, stage

(Continued on page 50.)



An underneath view of the experimental receiver shows that the set is chiefly notable for the few components used.

THE WORLD SHORT-WAVE FOUR.

(Continued from page 9.)

bias at 90 plate volts we will need separate "C" battery connections. The common "A" minus lead also connects to "B" minus and to "C" plus.

When the various battery connections have been made we are ready to try the receiver out. Select the two yellow coils and plug the one with the 5 pin socket into the r.f. coil socket (L1,L2), then tune the two variable condensers (C1, C2), around from full out to almost full in. If the detector is made to oscillate at this stage by means of the reaction condenser (C4), and the variable resistance (R), several carrier waves should be tuned over. (Note that we are presupposing that the set will be given its first try-out at night because on the 45-55 metre wave band it usually is possible to pick up several good overseas stations each night. If the tests are made in the morning we will operate on the 25 metre wave band, and use the pair of green coils.) When once an uninterrupted carrier is tuned in bring the detector out of oscillation and retune the detector tuning condenser (C2), slightly. Then if the carrier is at all up to strength, the voice or music of the overseas station should be heard. The user of this receiver will find that the variable resistance (R), when used in conjunction with the reaction condenser (C4), will give him an excellent control over regeneration. The ideal state of regeneration control in any short wave receiver is that in which the detector valve can be brought from a non-oscillating condition to an oscillating one with only a slight hiss. A "plop" when the detector goes into oscillation indicates that the regeneration is fierce and a few experiments with higher resistance grid leaks and lower "B" battery voltages will be of value.

Incidentally, the test for oscillation is the touching of the grid terminal on the detector valve socket (V2), with the moistened finger. If, when your finger is removed from the grid terminal on the socket a "plop" is heard in the 'phones or loud speaker, the tube is in a state of oscillation. The sound is quite distinct, and so is not likely to be missed. In operating the receiver it is wise to start off with a fairly high "B" battery voltage on the detector and by experimenting with the variable resistance (R), the value of the grid leak and the position of the plates in the midget condenser (C4), gradually reduce the detector "B" battery voltage to 45 or lower. Incidentally it may be found that on some wave lengths it will be necessary to increase the detector plate voltage in order to obtain detector oscillation. This state of affairs is known as a "dead spot" and usually can be cured by connecting a midget condenser, of say 11 plates, in series between the aerial and the aerial coil (L1).

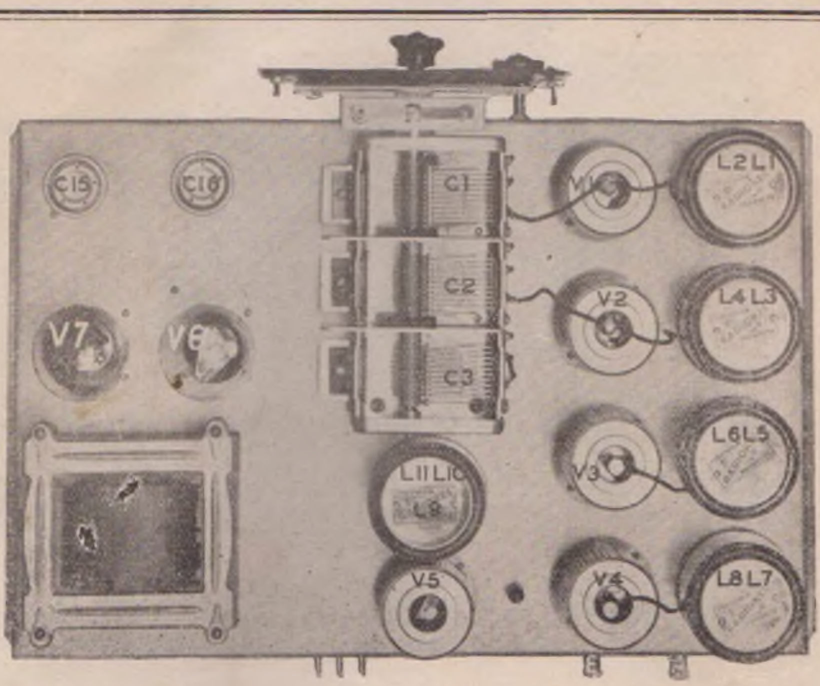
THE PARTS REQUIRED TO BUILD THE RECEIVER.

1 R.C.A. UY Manufacturers Socket.
5 R.C.A. UX Manufacturers Sockets.
1 Midget Clarostat (R2).
1 Manufacturers Type R.F. Choke (CH).
1 Mullard 5 meg. grid leak (R1).
2 1mfd. Hydra Fixed Condensers (C5, C6).
1 Simplex Grid Condenser (C3).
1 Capitol Battery Switch (SW).
2 Aeon Audio Transformers (AFT1, 2).
2 R.C.A. 19 Plate Midget Condensers (C1, C2).
1 R.C.A. 11 Plate Midget Condenser (C4).
1 Homecrafts World S.W. Kit (L1, 2, 3, 4).
1 Metal Chassis.
1 Bakelite Front Panel.
1 Aluminium Front Panel Shield.
2 3in. Diameter Coil Shields.
1 yard 7-way Battery Cable.
2 Terminals (L.S.).
2 Clix Plugs and Sockets (AE).
1 Philips A442 Valve (V1).
1 Philips A415 Valve (V2).
1 Philips A409 Valve (V3).
1 Philips B405 Valve (V4).
2 Front Panel Vernier Dials.

The original receiver gave excellent results and during our tests with it we were able to tune in practically every short wave broadcaster of note throughout the world. The English session through station RV59 was heard on several mornings at full loud speaker strength, and, between 8 and 9 a.m., the Chelmsford station 5SW also could be relied on for speaker strength reception. Radio Pontoise also was a speaker strength station, as were both Zeesen and 2XAF, Schenectady, on occasion. The latter two stations varied, but we found that on several occasions, when only medium results were obtained on another s.w. receiver we had on hand, "The World" brought them in at considerably better strength.

Taken all round the receiver will be found excellent and should, because of the few components and absolute elimination of constructional difficulty, appeal to the newcomer to short waves.

Incidentally, all the parts for our original receiver were obtained from "Homecrafts," who are the makers of the famous "World" short wave coil kit.



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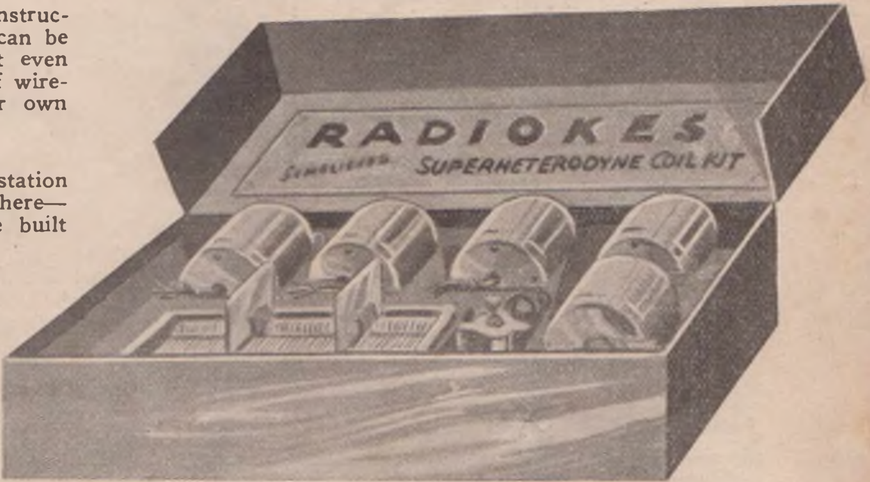

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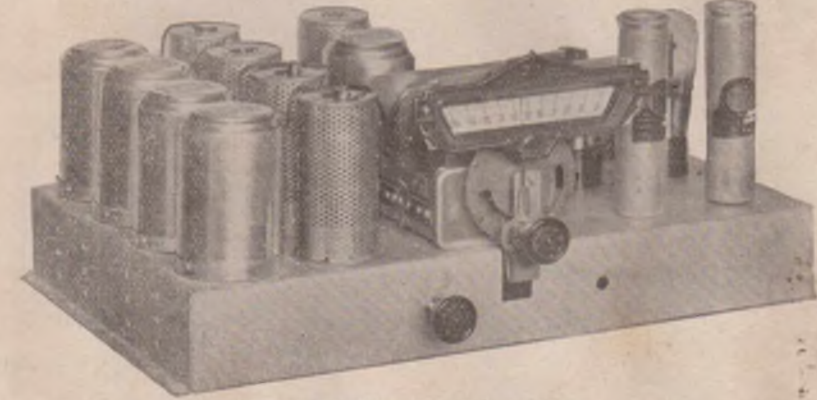

Assembled Chassis: Front View.

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Other Parts Required in Addition to Radiokes Coil Kit!

1 Radiokes 10,000 ohm Volume Control.
1 Radiokes 125 ohm 50 M/A Pigtail Resistor.
1 10,000 ohm 10M/A Radiohm.
2 25,000 ohm 10M/A Radiohms.
2 50,000 ohm 10M/A Radiohms.
2 100,000 ohm 5M/A Radiohms.
1 Radiokes 250 ohm 100M/A Pigtail Resistor.
2 Radiokes 50 ohm C.T. Resistors.
1 H4554 Radiokes Power Transformer.
1 C3CHS Radiokes Power Choke.
1 Radiokes Honeycomb R.F. Choke.
1 Radiokes Full Vision Dial.
8 Polymet 8mf. Condensers.
2 235 Ken-Rad Valves.
2 224 Ken-Rad Valves.
1 247 Ken-rad Valve.
1 227 Ken-Rad Valve.
1 280 Ken-Rad Valve.
1 2.0 mf. T.C.C. By-pass Condenser.
5 0.5 mf. T.C.C. By-pass Condensers.
2 0.01 mf. T.C.C. By-pass Condensers.
1 0.0005 mf. T.C.C. By-pass Condenser.
1 0.00025 megohm Durham Leak.
1 2.0 megohm Durham Leak.
1 Simplex Tone Control Condenser Assembly.
1 "Tasma" 4-point Switch.
6 Marquis (Pat.) UY Sockets.
2 Marquis (Pat.) UX Sockets.
1 Marquis Loud Speaker Plug.
1 Amplion Loud Speaker, Type K.75, 7500 ohms field.
5 Austral Valve Screening Cans, 2in. diameter x 4¼in. high.
1 Acorn Chassis.

All Technical inquiries should be addressed to Desk M.S., G. P. Embelton & Co., 579 Bourke Street, Melbourne, or Desk M.S., Metropolitan Electric Co., Ltd., Tracy House, George and Cleveland Streets, Redfern, Sydney, and must be accompanied by stamped and addressed envelope covering return postage.

RADIOKES--*The Name to Know in Radio!*

THE RADIOKES SIMPLIFIED SUPER-HET.

(Continued from page 46.)

by stage, paying strict attention to the diagram of circuits in order to thoroughly check over the wiring. Care should be taken to connect the loud speaker leads to the plug in corresponding order to that in which the socket in the chassis is wired.

The receiver is now ready to be lined up and tested.

Testing and Adjusting the Completely Wired Chassis.

Having carefully checked over the wiring, the final step is to adjust the various trimmers and padding condenser. Before outlining a method of doing this, the following will be a great help should a voltmeter be available:—Max. "B"+ volt. to chassis: 240 to 250 volt. Between I.F.C. and chassis, 50 to 60 (neg.). This is the drop through the Penthode bias resistor and the power choke. Plate volts on 235's and 1st det., 240 to 250. Screen volts on 235's and 1st det., 90 to 100. Max. bias volt. on 235's, 15 to 20. Min. bias volt. on 235's, 3. (It will be noted that the maximum is not sufficient to entirely suppress plate current in the variable Mu tubes, but the aerial is directly earthed when the bias is at max. value, and thus complete attenuation of signals is possible.) Oscillator plate volts., 40 to 50. 2nd detector is leak-fed, and hence voltages may not be read. It will be found advisable to use a metallic bottom plate for the chassis, since the great sensitivity of the receiver will cause pick-up on the lead from the aerial terminal to the aerial coil can, if this is not screened as suggested above. Now set the receiver up, attaching speaker, and about 10 to 15 feet of aerial and an earth; switch on power and allow tubes to warm up. Put vol. control to max. and tone control to the vacant stud on the 4-point switch. (Should the set howl when it has warmed up, it is a sure sign that one of the de-couplers has been omitted, most likely that one de-coupling the plates.) Tune in a low wave length station (e.g., 3DB). Adjust trimmers on variable condenser until max. signal is obtained. (Note that when the adjustment is nearly complete, the local station will be too strong, so that it is advisable to change to an interstater for the final adjustments.) Having thus adjusted the circuits at the low wave lengths, we must finally adjust the padding condenser, to ensure that the tracking is in order. (Note that the padding condenser is untouched up till now. Tune in a fairly high wave length station (such as 3AR). Do not touch triple gangs trimmers. "Rock" the triple gang, i.e., tune from one side of the station to the other, and at the same time screw the padding condenser. It will be found that (excluding the very improbable case in which the padder is found dead right) on screwing padder out, and rocking, signals decrease in strength, and on screwing in and rocking, signals increase in strength, or vice versa, depending on whether the padder was too big or too small to start with. The receiver is now lined up, and on returning to low wave length stations it will be found that they still are received at full strength. The superheterodyne is now complete, and stations now may be sought for.. The operator will have a choice of about 30 different stations, all of which will give good entertainment consistently, and up to a dozen others will be heard if conditions are favourable.

As to results they must be heard to be fully appreciated. We had no difficulty in the first night of the set's operation in tuning in every A class station and the majority of the B's at excellent speaker strength.

The long lists of call signs produced as the super-het's qualification don't mean a thing. We must admit that the tuned radio frequency receiver is equally as sensitive, and certainly nearly as selective. Where the super does win, though, is in its ease of construction, particularly when kits such as the Radiokes are used.

LIST OF PARTS

1 only Radiokes Superhet. Coil Kit comprising:—
1 only Strom Carlson Triple Gang C1, C2, C3.
1 only Radiokes Aerial Coil L1, L2.
1 only Radiokes R.F. Transformer L3, L4.
1 only Radiokes Oscillator Coil L9, L10, L11.
2 only Radiokes Intermediate Transformers L5, L6, L7, L8.
1 only Radiokes Padding Condenser C17.

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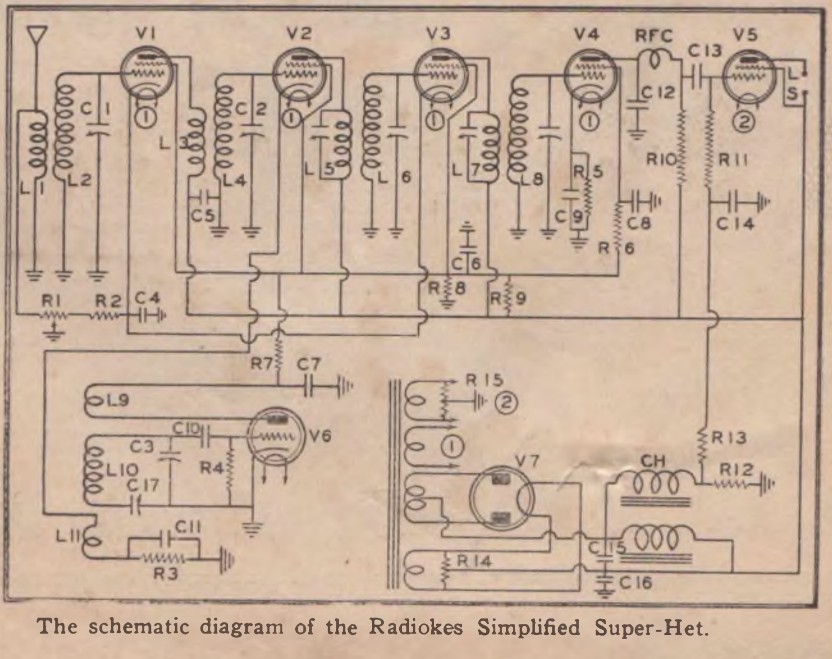
1 only Radiokes 10,000 ohm Volume Control R1.
1 only Radiokes 125 ohm 50 M/A Pigtail Resistor R2.
1 only Radiokes 10,000 ohm 10 M/A A10A Radiohm R3.
2 only Radiokes 25,000 ohm 10 M/A A25A Radiohm R5, R7.
2 only Radiokes 50,000 ohm 10 M/A A50A Radiohm R9, R8.
2 only Radiokes 100,000 ohm 5 M/A A100D Radiohm R13, R6.
1 only Radiokes 250 ohm 100 M/A Pigtail Resistor R12.
2 only Radiokes 50 ohm Centre Tapped Fil. Res. R14, R15.
1 only Radiokes H4554 Power Transformer.
1 only Radiokes C30 HS Power Choke CH.
1 only Radiokes Honeycomb R.F. Choke Type RFHC, RFC.
1 only .Radiokes Full Vision Dial Complete.
2 only 8 mfd. Polymet Condensers C15, C16.
1 only 2.0 mfd. T.C.C. By-pass Condenser C14
2 only 3—.5 mfd. Hydra By-pass Condensers C4, C5, C6, C7, C8, C9.
2 only 0.01 mfd. T.C.C. Fixed Condensers C11, C13.
1 only 0.0005 mfd. T.C.C. Fixed Condenser C12.
1 only 0.00025 mfd. TCC, Fixed Condenser C10.
2 only 0.5 megohm Carb. Resistors R10, R11.
1 only 2.0 megohm Carb. Resistor R4.
6 only Marquis UY Sockets.
2 only Marquis UX Sockets.
1 only Marquis Loud Speaker Plug.
1 only Amplion Loud Speaker, Type K75, 7500 ohm Field.
5 only Valve Screening Cans, 2in. dia. x 4½in. high.
1 only Pressed Metal Finished Chassis.
2 Only 235 Ken-Rad Valves (V1, V3)
2 only 224 Ken-Rad Valves (V2, V4).
1 only 247 Ken-Rad Valve (V5).
1 only 227 Ken-Rad Valve (V6).
1 only 280 Ken-Rad Valve (V7).



The schematic diagram of the Radiokes Simplified Super-Het.

ERRATA

On page 18 there seems to be a bit of a mix up in the wiring dope on the s.w. wave-meter. The correct wiring description is:—Connect one lead from the coil socket to one side of the torch socket. From the other side of the torch socket connect to the moving plates of the tuning condenser. From the fixed plates of the tuning condenser, connect to the other coil socket terminal. The pea lamp is a 3.5 volt torch globe.

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