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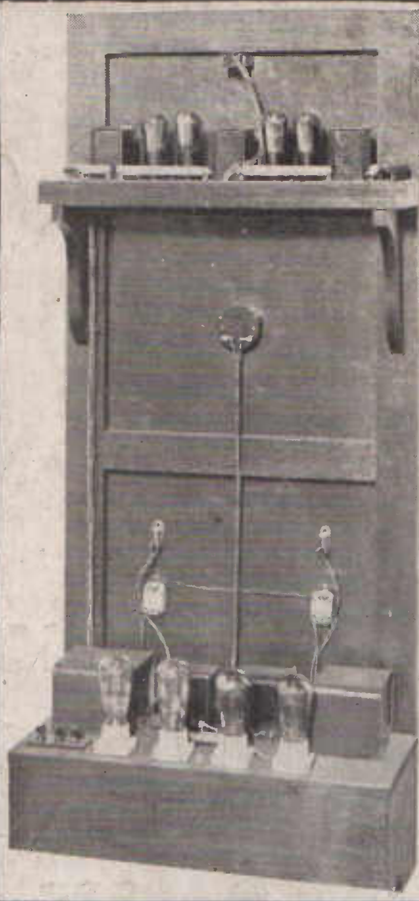
November 1, 1933.

MODERN SETS

MONTHLY

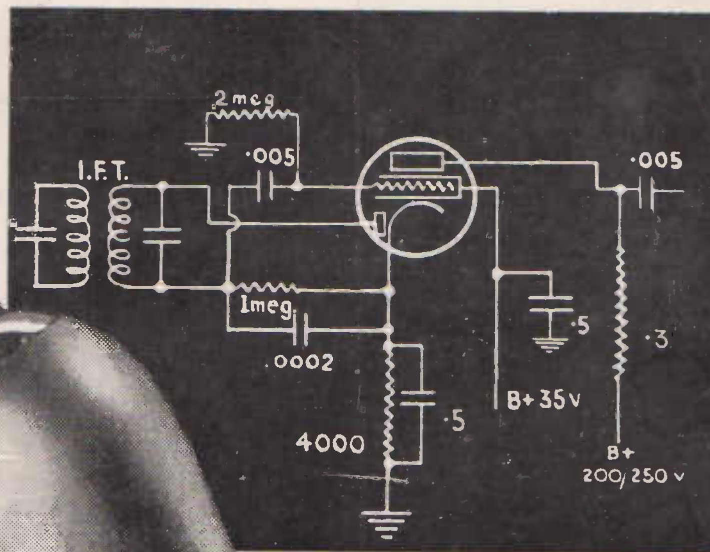
NOV 1933



THIS IS NOT THE BACK OF A GRANDFATHER CLOCK, BUT A TYPICAL "RACK AND PANEL" OUTFIT OF A MODERN SOUND EQUIPMENT WHICH YOU CAN BUILD YOURSELF. SEE FULL DETAILS INSIDE.

PRICE 9D

E 444



A typical circuit arrangement incorporating the E444 Diode Screen Grid as a combined second detector and first audio stage in a conventional superheterodyne.

GOLDEN DIODE *and* SCREEN GRID

(SIX-PIN)

THE E444 Diode Screen Grid renders possible the economical incorporation of the DIODE principle in modern set production, offering at the same time the high gain of the screen grid audio amplifier, which was lacking in the triode types.

It is capable of delivering 30 volts to the grid of the power valve with an input of only two volts, and consequently can be used successfully for gramophone as well as radio reproduction. In addition, automatic volume control is available if desired.

The Golden Range, of which the E444 is an outstanding type, offers performance of unequalled efficiency, a fact which manufacturers have quickly appreciated.

"THE GOLDEN RANGE"

TYPE	PRICE
E452T	18/6
E445	18/6
E444	19/6
E455	18/6
E443H	18/6
E443N	22/-
1561	15/-

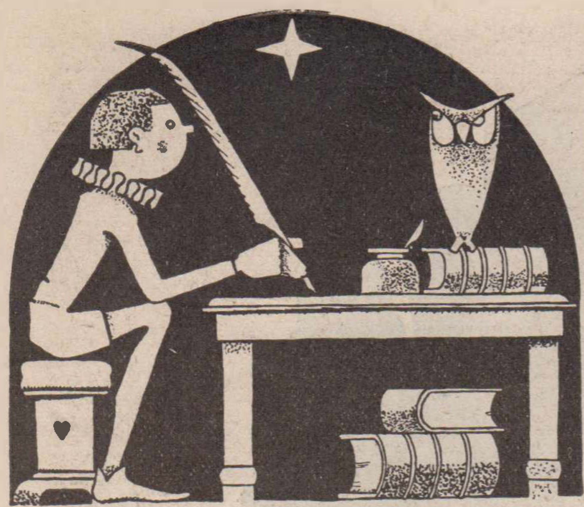
FOR BETTER RADIO

PHILIPS

GOLDEN RANGE

3R12

Advt. of Philips Lamps (Australasia) Ltd. (Radio Dept.). Head Office and Showrooms, Corner Clarence and Margaret Streets, Sydney.



EDITORIAL

THIS month we have built up for readers a modern Superhet, "The Saxon Five," which is well within the range of the average pocket, and easily constructed by the novice. A feature of this set is that it employs the new 2A7 tube, which is a combined oscillator and detector, and thus dispenses, without losing value, with an extra tube.

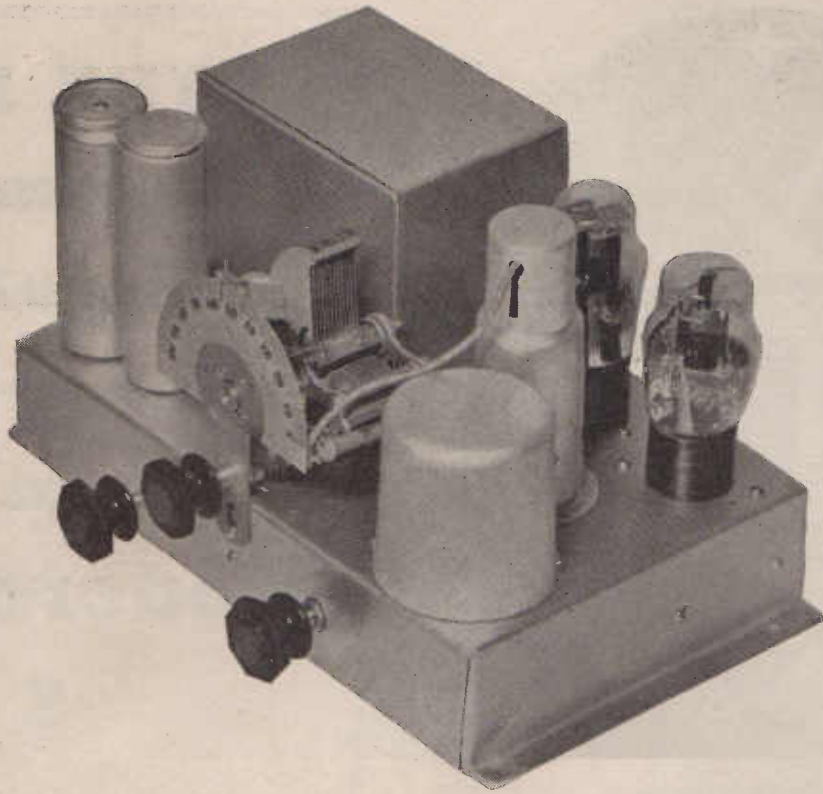
On the smaller side, we have built up a two valve A.C. job for local work, since we have experienced a continuous demand for this type of set, One of its most important features is that it employs the new 2A5 pentode, a tube capable of great amplification and output.

The various Courses we are running—"The Three R's of Radio," "Making Your Own Records," and the "Talkie Series"—still continue to attract much interest, particularly the Three R's.

We have had numerous letters from readers telling us that this particular Course has made some of the most difficult problems of radio clear to them.

As there is a continuous demand for early numbers of "Modern Sets," we would like to hear from any of our readers who have complete sets dating from June 1, 1932, and who would like to dispose of them.

We have provided a feast this issue for the shortwave fan. In the "Ham Super Six" we claim we are presenting absolutely the last word in A.C. shortwave receivers. It was designed and built up only after a careful study had been made of the latest technical developments in this direction here and abroad. Readers who build this set up can rest assured that nothing in Europe or America will be more up to date than this receiver.



General View of the Completed Receiver.

The ECONOMY TWIN

A Modern Two Valve A.C. Receiver, Employing the Latest 2A5 Output Stage with Audio Decoupling

By C. A. CULLINAN.

OUGH conditions are becom-
ich that receivers with ex-
selectivity are needed for
reception, there exists a
set builder and experi-
fers a simple receiver.
many radio writers ne-
of man in their en-
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through choice or
build a large set
set because he
build one.

that the set
article was de-
apparatus, and
all the local
strength, with
ss located near a
As a second set

THE PARTS THAT ARE NEEDED.

1 A.W.A. .0005 mfd. Variable Condenser, C1.
1 Radiokes 13-plate Midget Condenser, C2.
1 T.C.C. 0.00025 mfd. Grid Condenser, C3.
1 0.1 mfd. Paper By-pass Condenser, C4.
1 0.1 mfd. Paper By-pass Condenser, C5.
1 T.C.C. 0 01 mfd. Condenser, C6.
1 10 mfd. Electrolytic Condenser, 35v. peak, C7.
1 0 01 T.C.C. Condenser, C8.
2 7 mfd. Electrolytic Condensers, T.C C., 500v. peak, 400v. working, C9, C10.
1 Radio Frequency Choke.
1 1 megohm Carbon Resistor, 1 watt R1.
1 250,000 ohm Carbon Resistor, 1 watt, R2.
1 100,000 ohm Carbon Resistor, 1 watt, R3.
1 1 megohm Carbon Resistor, 1 watt, R4.
1 250,000 ohm Carbon Resistor, 1 watt, R5.
1 Marquis 10,000 ohm Potentiometer, R6.
1 400 ohm Wire Wound Bias Resistor, R7.
1 Shielded Aerial Coil, L1, L2.
1 Dynamic Speaker, 2500 ohm Field (Amplion), FC.
1 Radiotron 57 Valve, V1.
1 Radiotron 2A5 Valve, V2.
1 Radiotron 280 Valve, V3.
1 Power Transformer, with one 5 volt. 2 amp. Winding, one 2½ volt, 3 amp. Winding, and one C.T. Secondary Winding, 350 volts aside. PT.

2 6-Pin Sockets.
1 4-Pin Socket.
3 Terminals.
1 Valve Shield for the 57.
1 Chassis, 11 x 7 x 2 inches.
1 Vernier Dial.
3 Knobs.
Flex, Wire, Screws, Etc.

in the home, it is ideal, since it is cheap to make, and if fitted to a neat cabinet can become a real musical instrument.

The grouping of the apparatus is such that a very small chassis is needed, and it could very well be built up as a midget receiver if the builder was so inclined.

The valves used are the type 57, type 2A5 and type 80. The 2A5 is an output pentode delivering three watts into a matched speaker, and to cut down the highs of the pentode a tone control is fitted, This gives just sufficient variation to cut out the surface scratch in broadcast transmission, or pick up reproduction, of gramophone records. Unlike many of the tone controls fitted to commercial receivers, it does not mutilate speech to any extent through total elimination of the highs.

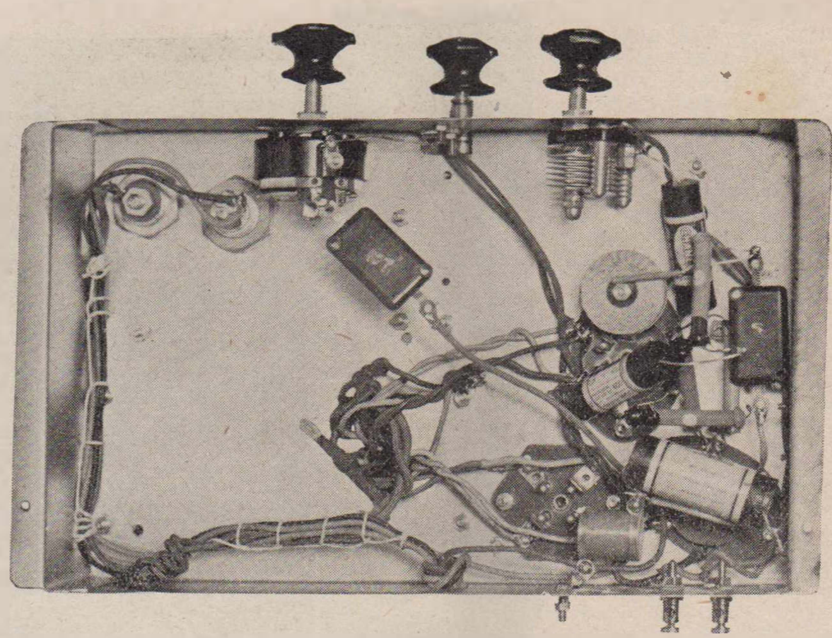
An examination of the circuit shows that it is quite a standard one, the screen grid detector being resistance coupled to the audio valve. No volume control is fitted, but the coupling resistor, R5, can be replaced by a potentiometer of one quarter megohm, the moveable contact going to the grid of the 2A5 valve. If fitted this control could be placed under the dial so that there would then be four controls.

The loud speaker should be one that will match the 2A5, and have a field resistance of 2500 ohms.

Specifications for the power transformer are that the high tension winding should be capable of delivering 380 volts each side of the centre tap, and the usual filament windings. Such transformers, in various physical forms, are available from dealers.

The coil is shielded to improve the selectivity and should be a commercial one designed for such work.

No comments are needed in regard to the building of the set as the photographs clearly show the manner in which the various parts are placed.



Plan View, Showing Under Chassis Wiring.

In wiring, the filament and high tension leads are cabled together to make for neatness. No speaker plug is employed, mainly on the score of economy, the speaker leads being connected directly, in the case of the field windings, to the electrolytic condensers.

The grid leak and condenser were connected to the variable condenser, but could very well be placed inside the coil can. If placed outside the coil can, it should be placed as far away from the rectifier as possible, otherwise an objectionable hum will be heard.

When the set has been wired a voltmeter should be used to check over the various voltages. The output of the rectifier will be in the vicinity of 400 volts, while the plate potential on the 2A5 will be about 240 volts with 260 approximately on the screen of this valve. Measuring from cathode of the power valve to earth a reading of 16.5 volts should be obtained with a plate current of 34 milliamperes.

It will be noted that the detector tube is shielded and that a cup is fitted to the top of this shield. This is necessary to avoid instability which often occurs when the various tubes are close together.

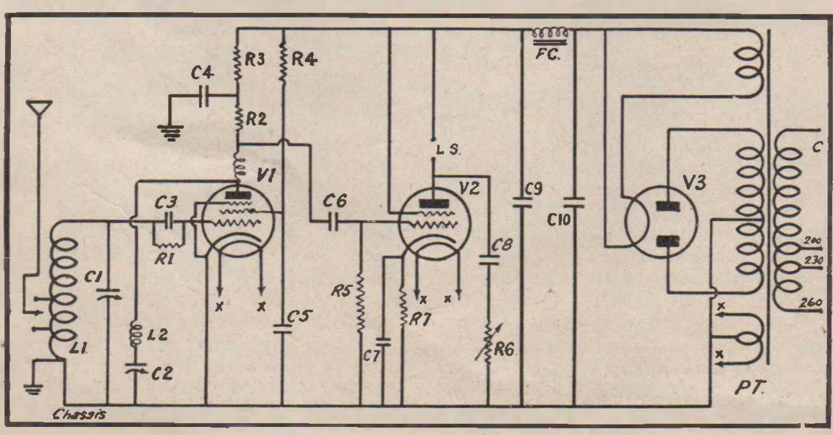
Here are some suggestions which may be of further use. As mentioned before, a volume control can be fitted quite easily, by replacing the 2A5 grid resistor by a potentiometer of the same value.

Should the builder prefer a deeper tone, then a 0.01 mfd. condenser should be connected directly between the plate and screen of the output tube, and if even greater variation of tone is wanted, the 0.01 tone condenser in series with the tone control should be replaced with a larger one. In some instances, condensers as large as 0.1 mfd. are used in this position.

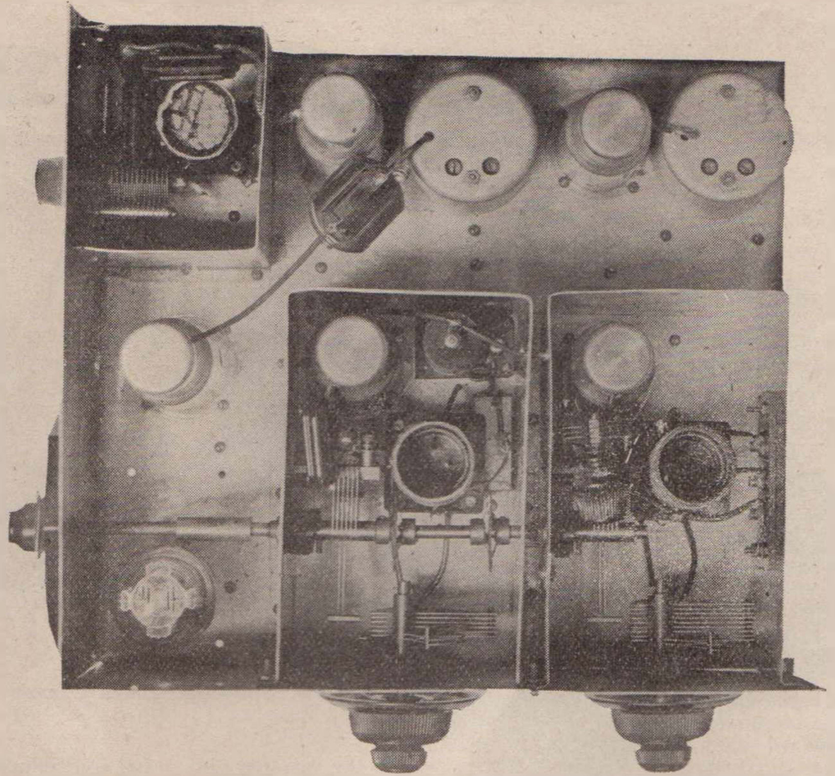
Record Reproduction.

The usual place to insert a gramo-pick-up is to break the cathode circuit of the 57, but this does not give very good lift.

Better results can be obtained by fitting a switch so that when the set is wanted for gramo. reproduction, a resistor of 1000 ohms is inserted into the cathode circuit of the 57 and by-passed with a condenser of 0.5 mfd. at least. The pick-up should then be connected between the grid of the 57 and the chassis. However, care must be taken when doing this that the stability of the receiver is not upset when used for radio reception.



The Circuit Diagram of the Economy Twin.



Looking Down on the Completed Receiver. Note How the Tuning Condensers are Ganged!

The HAM SUPER 6

The Ultimate in Ham Receivers, Employing Electron Coupled Oscillation and Separate Beat Oscillator

Constructed by V. W. White, VK3VL and Described by C. M. Scott.

WITH the increasing congestion on the amateur short wave bands, the simple detector and audio arrangement is gradually giving way to the more selective types of T.R.F. and super receivers.

Long experience with the regenerative detector has familiarised us with its ability to give great gain and sensitivity, but to a lesser degree it is poor in providing selectivity.

In simple short wave receivers regeneration is used primarily to give a beat note with the incoming signal, but in this job regeneration has been utilised to give selectivity, with gain as a secondary consideration. Of course, the two are somewhat similar, because the apparent high selectivity, due to response to the desired signal frequency, is the result of the high amplification at the regenerative circuit's resonant frequency, and only ordinary amplification at other frequencies. The regenerative circuit gives high selectivity because the resistance normal to the grid circuit is cancelled by the negative resistance provided by the valves' operation.

The Circuit.

The circuit consists essentially of the first detector using the 57 valve, a 57 as high frequency oscillator, a 58 as first intermediate amplifier, and a 57 as second detector. For high gain this feeds into a transformer coupled audio stage, using the indirectly heated 59 output pentode. A (C.W.) beat oscillator is provided at the intermediate frequency, so as to beat against the continuous wave signals to make them audible.

It is most desirable that regeneration be applied to a preceding R.F. amplifier rather than a detector. The regenerative stage should operate in a linear fashion—that is, the valve must be biased to the middle of its curve, so that its characteristics will be as constant as possible. A detector cannot operate as a detector in this way.

Secondly, it is preferable to apply regeneration where the signal is weak; that will be near the front end.

Referring to the first intermediate frequency stage in the schematic diagram, it will be noticed that regeneration is provided by the tickler coil L7 in the cathode circuit coupled to the grid coil of the input transformer. Regeneration, and hence selectivity, is controlled over the tuning or working range by the variable resistance R9, connected across the tickler through the blocking condenser C8. This control acts as a variable R.F. short across the tickler, thus effectively controlling the feedback to the grid circuit.

The blocking condenser prevents the

cathode resistor R10 from being shorted out. The I.F. transformer must be well built, as absolute stability is essential in the tuned I.F. circuits.

The Component Layout.

Referring to the top view of the completed chassis, three box shields are shown. The box nearest the front right hand corner houses the first detector and some of its associate parts; the remainder of the resistors and condensers are mounted directly below under the chassis.

Coming to the left along the front, the next box shield houses the high frequency oscillator and some of its associate parts. Next to this is mounted the 59 output valve, and directly behind, towards the back, is the second detector. The box mounted at the back left hand corner is the beat oscillator, and back towards the right again is the first I.F. amplifier.

It will be noted that the tuning condensers C1 and C2 of the oscillator and first detector respectively are ganged together and tuned by a vernier dial at the left hand side. The tuning dial in this position affords great ease in tuning over long periods. The schematic diagram is drawn in an unconventional manner, so that its layout corresponds with that of the actual arrangement of the chassis.

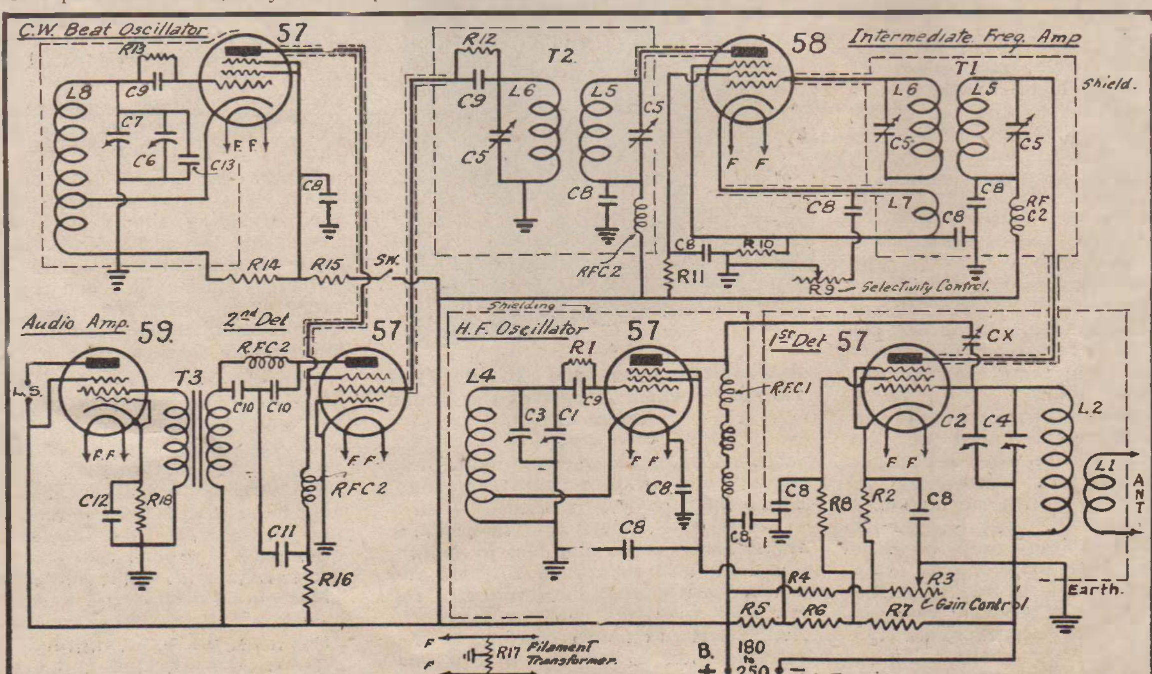
The first detector and oscillator are tuned by five plate Formo condensers C2 and C1 respectively, ganged together. Connected in shunt or in parallel with each condenser is another five plate Formo condenser C3 and C4, which are controlled from the front panel. These help in the alignment and padding of the two stages. When once adjusted for a particular band, they are left alone, and not touched any more, so that there is really only one tuning control.

The gain control R3 is in the cathode circuit of the first detector, and has a value of 5000 ohms. The detector coil is quite orthodox, but the oscillator coil has been especially designed for the electron coupled oscillation, which is another feature, by providing a tap near the bottom end of the grid coil for the cathode connection. No R.F. stage has been provided before the first detector

(Continued on page 27.)

THE PARTS THAT ARE NEEDED

- 1 2 Gang Tuning Condenser (Formo), 5 plates per section, C1 and C2.
- 2 5 Plate Formo Condensers for padding, C3 and C4.
- 1 13 Plate Midget Condenser (tuning beat oscillator), C6.
- 1 23 Plate Midget Condenser (padding beat oscillator), C7.
- 11 T.C.C. Mica Condenser, .005 mfd. C8.
- 3 .00025 mfd. Grid Condenser Mica, C9.
- 2 .00025 mfd. Plate By-pass Condensers, C10.
- 1 1 mfd. Condenser, C11.
- 1 50,000 ohm 1 watt Grid Leak for oscillator, R1.
- 1 5000 ohm wire wound Bias Resistor, 1 watt, R2.
- 1 5000 ohm Potentiometer, R3.
- 1 100,000 ohm 1 Watt Carbon Resistor, R4.
- 1 10,000 ohm 1 Watt Carbon Resistor, R5.
- 1 7000 ohm 1 Watt Resistor, R6.
- 1 3000 ohm 1 Watt Resistor, R7.
- 1 50 000 ohm 1 Watt Carbon Resistor, R8.
- 1 5000 ohm Potentiometer, R9.
- 1 300 ohm Bias Resistor, R10.
- 1 50,000 ohm 1 Watt Carbon Resistor, R11.
- 1 1 megohm ½ Watt Grid Leak (detector), R12.
- 1 50,000 ohm 1 Watt Resistor, R13.
- 1 2500 ohm 1 Watt Resistor, R14.
- 1 10,000 ohm 1 Watt Resistor, R15.
- 1 25,000 ohm 1 Watt Resistor, R16.
- 2 Intermediate Frequency Transformers, one with reaction 465 KC/s, T1, T2.
- 1 Audio Frequency Transformer T3.
- 1 Sectionalised type Short Wave Choke, 3 to 8 millihenry, RFC1.
- 4 Ordinary Broadcast Choke, RFC2.
- 1 Philips PH59 Valve.
- 4 Philips PH57 Valves.
- 1 Philips PH58 Valve.
- 1 20 ohm C.T. Filament Resistor, R17.
- 5 6 Pin Valve Sockets.
- 1 7 Pin Valve Socket.
- 1 Metal Chassis 13½ inches x 12¼ inches x 2½ inches.
- Metal Panel, 14 in. x 7 in.
- 1 Panel, 12¼ inches x 7 inches, metal.
- 5 Six Pin Valve Cans with tops.
- 1 Vernier Dial.
- 1 7 Plate Midget Condenser, CX.
- 1 4 oz. Reel No. 20 D.C.C. Wire, No. 28 D.C.C., No. 18 Enamel.
- 1 2 oz. Reel No. 36 D.S.C.
- 9 Plug-in Coil Formers and Three Sockets to take same.
- 1 450 ohm Bias Resistor, R18.
- 1 10 mfd. Electrolytic Bias By-pass Condenser., C12.
- 1 .0001 mfd. Fixed Condenser, C13.
- 1 Amplion Permanent Magnet Dynamic Speaker to suit the 59 output valve.



Schematic Diagram, showing the various stages in their relative positions on the chassis. Dotted lines indicate shielding. The common side of C10 and C11 must be earthed. This is not shown above.

SOUND ON FILM

RECORDING AND REPRODUCTION ON FILM PRESENT NO DIFFICULTIES THIS WAY

The Second of a New Series of Articles on this Interesting Subject, which will Prove of Value to Our Readers

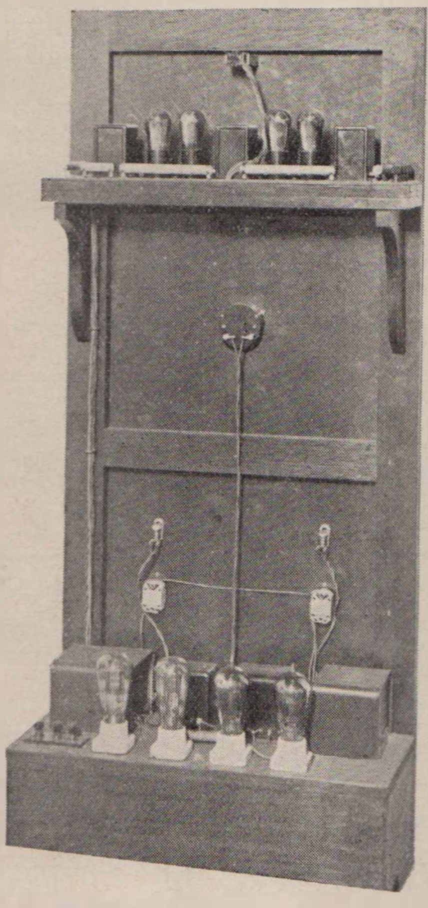
PART 2. By W. GREEN.

THE GAIN AMPLIFIER.

SO minute is the output of a condenser microphone or photo-electric cell—that is, the type of cell used in talkies—that it becomes necessary to employ at least two, and sometimes three, stages of amplification to bring the volume up sufficiently to work a pair of head phones. The amplifier that does this work is called the "gain," or pre-amplifier, and, seeing that another amplifier follows directly after it, the need for care both in construction and use becomes apparent. If the builder takes sufficient care, he will have no trouble, but the slightest error committed here can cause untold worry and possibly make it extremely difficult to eliminate unwanted noises for which there is no apparent reason. So it behoves all who construct this amplifier to remember to spare no pains to see that they use only the best material and adhere exactly to the specifications given in this article.

The circuit is very nearly the same as that of the article described in our last issue, the principles of which were fully described there, with the exception, of course, that our object this time is voltage gain and not power output, and the auto-transformer, in the grid circuit, has been omitted. Three 256 valves are employed, coupled in series, and provision has been made to supply voltage for the P.E. cell or condenser microphone, whichever happens to be used; and it will be noted that both these components are "directly coupled" in the circuit, which is something that has not been attempted before.

A gain control is provided for in the circuit, and once set need not be touched again, except when a change-over is made from microphone to photo-electric cell. In some instances it can be omitted altogether. Being all A.C., filament leads must be kept entirely away from plate or grid leads and in 16-gauge lead-covered wire, the lead covering being properly earthed, and where a joint occurs either the lead fused together or junction boxes, sold for use in lead-covered wiring systems, used. Plate and grid leads must be as short and direct as possible, must be kept well apart, and covered with braided copper shielding, which must be well earthed.



A Typical Rack and Panel Type Amplifier, which is part of the Sound Equipment.

Leads to P.E. cell and microphone **should not exceed ten feet in length,** and each lead **separately** shielded and taken directly from the interior of the amplifier case and well soldered to their respective points of contact. No terminals are permissible in this particular case, as dirty or bad joints give rise to endless noises which are very difficult to trace.

The actual amplifier components are mounted on a piece of engraver's zinc 4 in. by 12 in., which fits inside a 16-gauge copper box, 15 in. by 5 in. x 6½ in. high, with a detachable lid, which must be an extremely good fit. This box is bolted to the zinc shelf at the top of the panel, and it is preferable to place some sponge rubber to act as a shock absorber, cut to form a washer round each bolt before it is screwed up (not too tightly).

It will be noted that the base for mounting the components is smaller than the box, and the reason for this is that each corner of the base is attached to a spring which is fitted in turn to a screw-eye near the top of the box, in order to prevent microphonic ringing of the valves. An additional help in this regard would be a rubber sponge placed in the bottom of the box, and the base being just allowed to rest lightly on it.

All wiring with the exception of filaments is placed on the top of the base, and the components are mounted there, too. The chokes should be placed at an angle of 45 deg. to the edge of the panel directly between the valves to which they apply.

Where the A.C. or D.C. output and input leads enter or leave the box their shielding should be firmly soldered, and the actual leads themselves covered with braided metal covering (earthed) until they reach the base, in order to minimise the risk of jars or knocks being transmitted to the valves and causing them to ring or howl.

Considerable thought has been given to the method of coupling the two amplifiers—that is, the gain and main amplifiers—together, and, although there is a method of coupling them directly, it was deemed inadvisable to present it to the amateur owing to the fact that accidents could quite easily occur, and costly ones, too; and for a slight impairment of notes above 5000 cycles and below 50 cycles, which few speakers can reproduce, and the ease afforded, a compromise was effected and a Ferranti A.F.7 transformer substituted. This transformer should be mounted on the lower shelf with the main amplifier, and affords a ready means of coupling any device required ahead of the main amplifier. As for its tonal quality, there is no other transformer that can approach it, and resistance coupling is definitely out of the question.

The power pack is quite conventional, and in addition to supplying the current for the gain amplifier does so for the monitor amplifier, which will be described later on. The new 5Z3 rectifier is again used in this pack, and, being worked considerably under load, supplies a steady, rippleless, direct current output. Filter condensers should be the best, and electrolytic condensers cannot be used. The whole of this pack is mounted in space provided in box at the bottom of amplifier panel.

This covers most of the ground that is not readily apparent from an examination of the circuit. There are no deviations from it, and the parts specified must be used if success is to be attained.

It may be as well to mention that two or more P.E. cells or condenser microphones may be coupled in parallel into the amplifier without any alteration to the circuit, but only condenser microphones should be used. Other microphones can be used, but alterations are necessary before this can be done.

List of Parts for Gain Amplifier.

3 UY256 valves (Kenrad).
1 5Z3 valve (Kenrad).
1 Ferranti A.F.7 transformer.
1 Power trans. (Wendel), 715 x 715 at 50 mils., 5 volts at 3 amps.
1 Filament trans. (Wendel), 2½ volts at 3 amps., 2½ volts at 1 amp., 4 volts at ½ amp.
3 UY sockets.
1 UX socket.
1 Resistance R9, 500,000 ohms.
1 Resistance R1, 5 mils., 2530 ohms.
1 Resistance R2, 2.5 mils., 50,000 ohms.
1 Resistance R3, 5 mils., 1200 ohms.
1 Resistance R4, 2.5 mils., 50,000 ohms.
1 Resistance R5, 5 mils., 1350 ohms.
1 Resistance R6, C tapped, 25 ohms.
1 Resistance R7, 500,000 ohms.
1 Resistance R8, 5 mils., 18,000 ohms.
3 Fixed condensers, C 2 and 3, 8 mfd. (1500 volt test) hydra.
1 Fixed condenser, C4, 4 mfd. (1000 volt test) hydra.
1 Fixed condenser, C5, 2 mfd. (1000 volt test) hydra.
3 Chokes, 300 ohms (Wendel), special.
1 Centre tap filter choke, 60 henries (Wendel), 50 mils.
2 Fixed condensers, C 8 and 9, 4 mfd. (2000 volt test) hydra.
1 Fixed condenser, C10, 8 mfd. (2000 volt test) hydra.

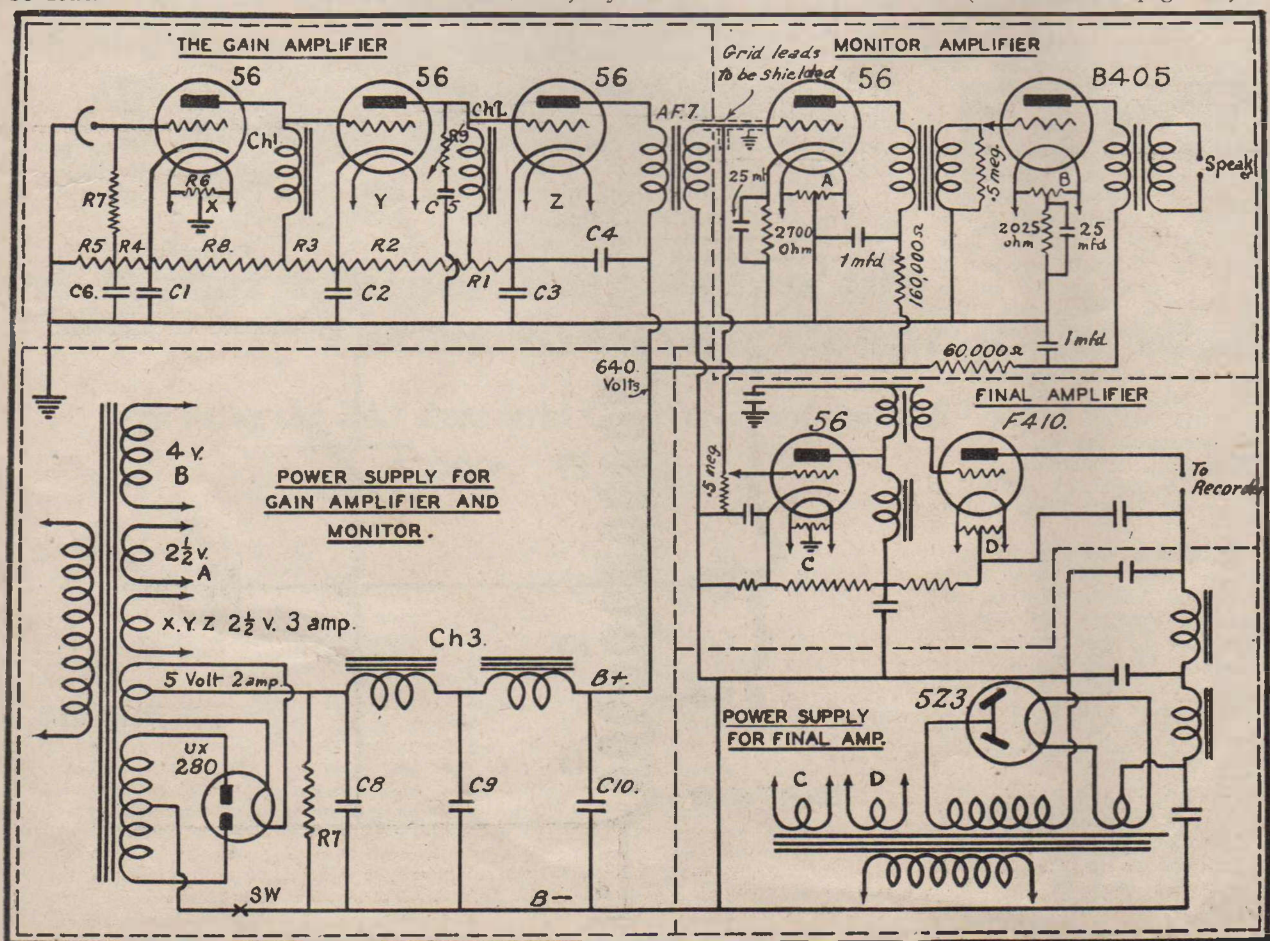
THE MONITOR AMPLIFIER.

In order to get some idea of the results that are being obtained during either recording or reproducing, a speaker is worked in the operating box or sound blimp, so that the operator can gauge the volume level and assure himself that microphone placings are correct.

Sometimes this speaker is worked directly from the output of the main amplifier, and in other instances from a small sub-amplifier fed from one of the intermediate stages of the main amplifier. In this instance it is advisable to work a small amplifier directly from the output of the gain amplifier, as matching of output impedances is essential for recording, and to use a Monitor speaker from the main output would entail departure from standard parts; and it is proposed in these articles not to incorporate anything that cannot be readily obtained by the amateur builder.

There is nothing new or extraordinary in the circuit. Two stages of transformer coupling are used, employing a 56 and B.405 valve. Power is obtained from the gain amplifier pack through series resistors, and the filament supply from a small filament

(Continued on page 31.)



Schematic Diagram, showing the Three Units and Power Supply coupled together.

Bring Your Crystal Set Up To Date

A Cheap and Selective Crystal Set for the Beginner

EVEN in this day of modern radio there is still a little scope for the old crystal set. Beginners are always starting in the experimental field of radio, and the kick-off usually starts with the construction of a simple crystal set.

We have brought the old crystal up to date, in that the whole arrangement is mounted neatly on a metal chassis, and provision has been made so that the selectivity can be adjusted according to where the listener is situated.

No crystal set in the true sense can be called selective, but we have done our best to get the utmost selectivity without losing too much volume.

The Circuit Diagram.

As may be seen, the circuit is comparatively simple, but in actual operation it is very selective. It has purposely been designed to suit a .00035 variable condenser, which is the only tuning apparatus necessary.

Selectivity.

There are three aerial taps (Nos. 1, 2 and 3), which serve to provide different degrees of selectivity. Using an average aerial of, say, 60 ft., number 1 tap will cover 3AR and 3LO (or in N.S.W. 2FC and 2BL). This tap, however, whilst it is sufficiently selective to tune in 3AR (or 2FC) without any interference, will not separate the other stations. Number two tap is more selective and will fulfil most requirements. For very sharp tuning, however, it is necessary to use number three tap.

Constructing the Set.

The wiring diagram provides all the information necessary. In regard to the coil, however, a few hints will be helpful.

Double cotton-covered wire of number 22 gauge should be used. The bakelite former is 3 in. in diameter and 3 in. in length. Pierce two holes, approximately half an inch apart, ⅜ in. from one end. Leaving about three inches clear, pass the wire twice through these holes and wind on 27 turns. Make a loop two inches long and twist it together, baring the end with a knife.

This wire will go to the second banana socket at the back of the chassis. Then wind another ten turns and make another loop similar to the previous one, connect this loop to the third banana socket.

Continue on another 11 turns and pass the wire twice through two holes

The Parts That Are Needed.

1 Metal chassis, 8 inches x 5½ inches x 3½ inches.
1 Bakelite or cardboard former, 3 in. diameter, 3 in. long.
1 .0005 mfd. variable condenser, A.W.A.
1 Plain four inch dial.
2 Banana plugs.
4 Banana sockets.
2 Phone terminals.
1 Glass barrel type crystal detector.
1 4 oz. reel No. 22 D.C.C. wire.
2 Yards single flex.
1 Pair headphones.
1 Neutron or Mighty Atom crystal.

half an inch apart. Leave three or four inches of wire over for connection to the moving plate terminal on the condenser, and to the earthed or fourth banana socket. The other end of the coil, that is the start of the first turn, goes to the first socket.

The coil and condenser are mounted underneath the chassis, so that the four inch dial lies on top where the crystal detector is also mounted.

Mounting the Coil.

Two small angle brackets are attached to the ends of the bakelite or cardboard former, and mounted by means of these to the back of the chassis, they must be long enough to allow a clearance of at least three-quarters of an inch between the side of the coil and the back of the chassis, on which a strip of bakelite is screwed to take the banana sockets. A window two and a half inches long, by half an inch wide, is cut in the back of the chassis, over which the above bakelite strip is mounted.

The chassis on which the whole receiver is built measures eight inches long by five and a half inches wide, by three and a half inches deep. Either 16 or 18 gauge metal will be suitable.

Although we have specified a .0005 mfd. condenser in the list of parts, a .00035 mfd. will do just as well, although with the extra capacity it will be possible to tune in the ship stations on 600 metres.

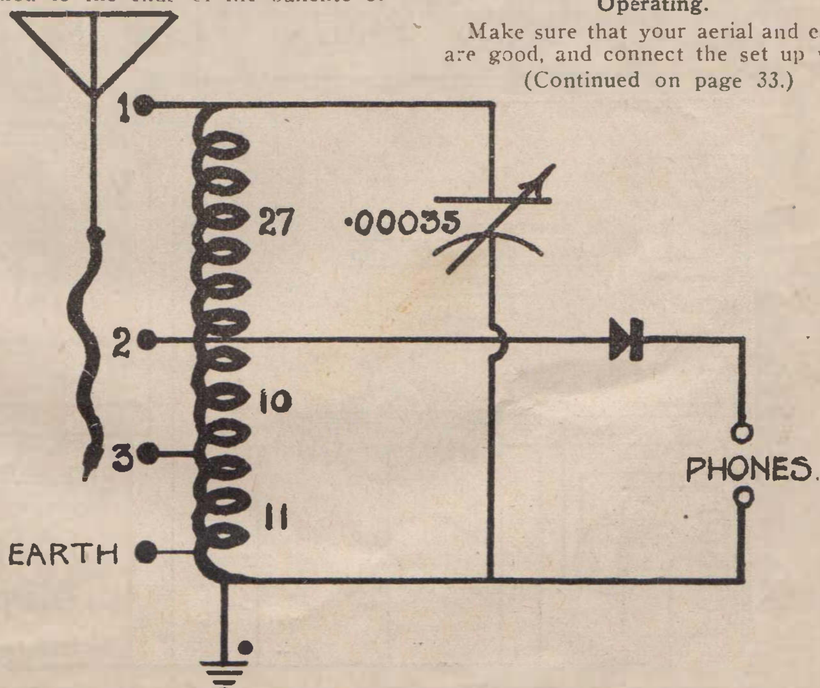
Wiring.

For wiring a thin, single flex. wire will be found the most convenient. Mark off each wire on the diagram as you put it in the set. Tighten all terminals and screws.

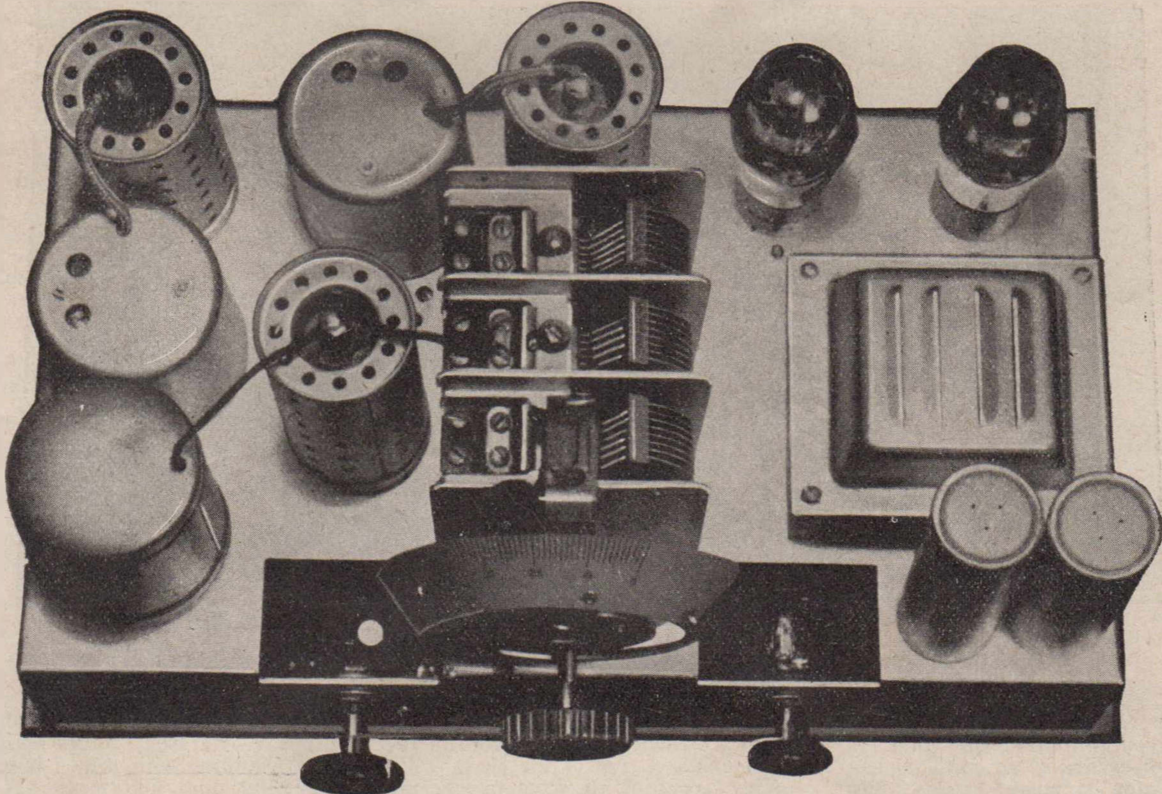
Operating.

Make sure that your aerial and earth are good, and connect the set up with

(Continued on page 33.)



The Circuit Diagram.



The SAXON FIVE

A Modern Super Employing the Latest Electron Coupled Oscillator

Featuring the 2A7 Pentagrid Converter and the 2A5 Output Pentode.

By C. M. SCOTT.

SO marked has been the development of the superheterodyne in recent months that it is now possible for even the mere novice to construct a set which will give phenomenal results, and yet be easy and cheap to build.

The trend in super design has been towards fewer and more efficient tubes, and research in this direction led to the development of the new Pentagrid converter, or mixing tube, which reduced the number of valves effectively to four plus the rectifier. It will not be out of place to state here briefly the characteristics of this revolutionary tube.

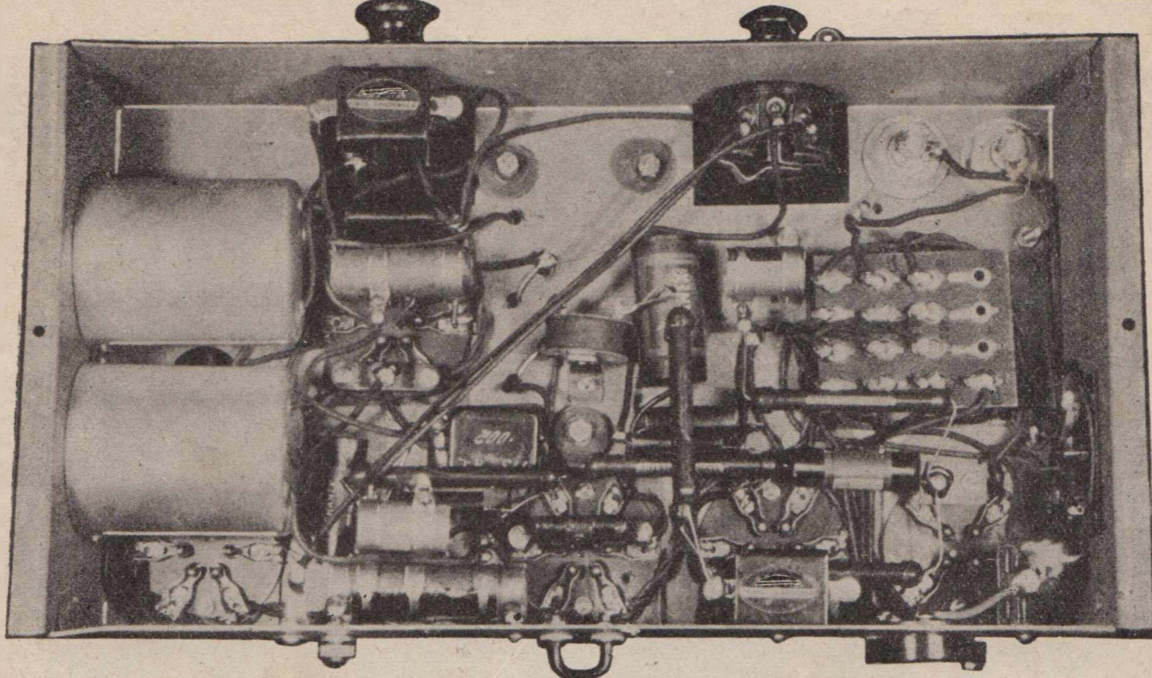
The Pentagrid converter, commonly known as the 2A7, is an entirely new tube, combining an oscillator and detector of highest efficiency in one glass envelope.

The various elements of the tube are brought out to a small seven-pin base, the control grid of the detector section being connected to the terminal on top of the glass enve'ope. As the connections to the seven-pin socket will not be familiar to some of our readers, we have included a diagram giving full particulars.

In the 2A7, as described above, we have two entirely different tubes, electrostatically shielded from each other, but coup'ed together by the electron stream from the common cathode. Actually the 2A7 replaces the usual 57 autodyne tube, which has been so popular in the past.

The autodyne system, although efficient in many ways, has a very serious disadvantage, this being the fact that the tube requires to be biased so as to act efficiently as an anode bend detector, and at the same time it must be an independent oscillator to create the beat frequency, which when mixed with the incoming signal results in the intermediate frequency.

Naturally, to try and make a valve perform both these functions efficient!y is impossible. If, for argument sake, we bias the detector for maximum sensitivity, we would find



The sub-chassis wiring and lay-out should be followed as near as possible to that shown in the above illustration.

that these conditions were not altogether favourable for the tube to work as an oscillator, so consequently the oscillator in some cases would cease to oscillate at some particular part of the band. To overcome this, the bias had to be so adjusted that we struck the happy medium where the oscillator oscillated throughout the tuning range, with a slight reduction in detector sensitivity.

Technical Details of the 2A7.

Reference to the circuit diagram will at once disclose that the 2A7 comprises one ordinary screen grid and one triode combination. Starting from the normal plate, we have the screen and then the control grid of the screen grid section. Below this comes what is known as the anode grid, which is the plate of the triode section; then the triode grid, the common cathode, and the filament.

Analysing the Circuit.

Starting at the aerial end, we have a tuned aerial coil, AER, coupled to a band pass coil, PRE, which tunes the detector portion of the 2A7, and the oscillator coil, OSC, which is attached to the triode section. This is followed by a 175 KC intermediate stage employing the 58 tube, a 57 second detector resistance coupled to the new 2A5 indirectly heated pentode. The speaker field (2500 ohms) is used as a choke, and, together with a decoupled audio system, results in an entire absence of hum.

The Saxon kit, from which this set was built, is simplicity itself, comprising everything from the smallest screw to a full range of valves. A stamped metal chassis makes assembly easy and fast, and error in component layout cannot be made.

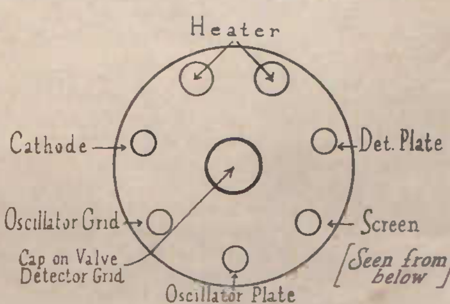
An assembly diagram has also been provided, key-lettered and marked, to aid the constructor in the layout of the components on top of the chassis.

The layout of the components underneath should be followed as near as possible to that shown in the illustration of the under chassis view. Of the two coils shown lying on their sides in this under chassis view, that nearer the back is the OSC (oscillator coil), while AER (aerial coil) is next to it on the front side. Arrange the resistors and the fixed condensers so that they are neat, and keep all leads as short as possible.

Having assembled what components we can, a start can be made on the actual wiring.

Wiring.

It is always good practice to start with the power pack and the filaments first. Begin with the twisted wiring of the filaments. The first three tubes are wired together and connected to the 2.5 volt winding marked to carry the heavier current, while the 2A5 pentode is wired to the remaining 2.5 volt winding marked to take the lower current. The 5-volt secondary supplies



2A7 SOCKET CONNECTIONS.

only the rectifier filament, which, by the way, is a 280. Shunt both the 2.5 volt windings with centre tapped filament resistors and earth the centre tap. The two outers of the high tension secondary winding on the power transformer are connected to the plate terminals on the rectifier socket, and the centre tap is taken to one side of the speaker field and to the negative terminal of one of the electrolytic condensers.

When connecting up the mains make sure that they are connected to the correct terminals on the voltage adjuster, AC.

The screen grids of the 57, 58, and the 2A7 are supplied from the high tension maximum through a 12,000 and 500,000 ohm resistor connected, as shown in the circuit diagram.

All plates of the 2A7, 58, 57, and the 2A5 derive their high tension voltage from the high voltage maximum lead, which comes from the filament of the rectifier.

The volume control is a 5000 ohm job; one end is connected to the aerial, the other end to one side of the 200 ohm bias resistor and the 8000 ohm resistor; the centre moving arm is earthed.

The distance switch, AS, is mounted on the front of the chassis. When the 90 ohm resistor is brought into action by the closing of this switch, the input signal is reduced for local stations. This will prevent overloading the 2A5 output pentode. The pressed steel chassis used measures 15 x 8½ x 3½ inches.

Wiring the Coil Kit.

The coil kit consists of three coils—aerial coil, band pass and oscillator coil. The circuit diagram explains clearly all the connections to the coils.

The aerial coil is marked A for aerial, E for earth, S for stator of 1st variable condenser, and X for the lead to the X marking on the band pass coil (second stator of variable condenser). The band pass coil has two more connections—G for the grid of the 2A7 tube and E for earth.

The oscillator coil (3rd stator) is marked E for earth, G for grid connecting to one side of .0001 grid condenser. P for plate of oscillator, and B plus for high tension lead coming direct off the electrolytic condenser.

In addition to these coils, there are two intermediate coils or transformers peaked at 175 Kc. These are standard, and the bases are clearly marked P (plate), B plus, G (grid), and E earth. All coils have been correctly lined up before leaving the factory, so no further adjustments should be necessary. Note that the E terminal on the second intermediate does not go directly to earth, but through the pick-up plug, P.U., which can be pulled out when recorded music is required from a gramo. pick-up.

The Intermediate Frequency.

The intermediate frequency amplifier, which operates at a frequency of 175 Kc/s, has a remarkably high gain, which is obtained by the use of tuned honeycomb coils.

Note that the oscillator feed back winding is not connected to the primary of the intermediate transformer, but B plus is fed direct to the primary of the T.I.T. as well as direct to the oscillator feed back winding, and from there to the oscillator plate. The cathode of the 2A7 is taken to earth through a 450 ohm resistor by-passed by a .1 condenser. The .05 (50,000 ohm) resistor is the grid leak; connected between grid and cathode, it provides a conducive return for the grid or path for the grid current. This value selected is a compromise; much higher values may sustain too high a voltage in the modulator circuit, and smaller values detract from the sharpness of the emitted oscillation frequency. Condenser .0001 is the grid condenser.

The padder condenser is in lifted position (not grounded), and it is obvious that any screwdriver will communicate hand-capacity. In adjusting padder unit, turn screw a little each time (fractional turn of driver). Note that driver has to be removed each time a small turn is made.

The oscillator coil is clearly marked, and no difficulty will be experienced in wiring the coil leads to their respective positions on the 2A7 socket.

The grid condenser and grid leak must be mounted direct over the 2A7 socket for shortest leads (see reproduced photograph of under chassis layout).

A .002 mfd. condenser not shown in the circuit is connected in parallel or shunt with the padder. This condenser **must** be used, otherwise the circuits will not track.

The Condenser Gang.

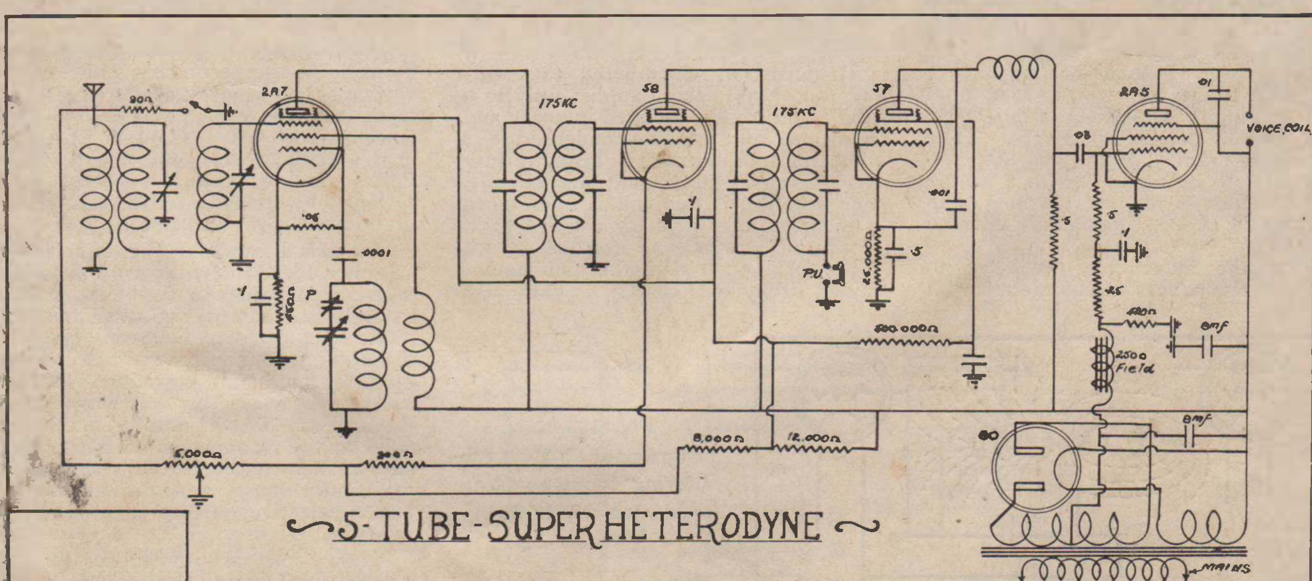
As the condenser gang has been carefully lined up, handle it gently; rough handling, naturally, is liable to damage it, which will result in trouble when the receiver is completed. The gang is mounted on rubber buffers to secure it in a floating position, so as to minimise any chance of resonance effect with the cabinet.

Two wires are soldered to the under side of the gang before mounting same, one to No. 1 stator and one to No. 3 stator. The middle gang, No. 2, has its lead coming from the grid cap of the 2A7 tube, and is soldered

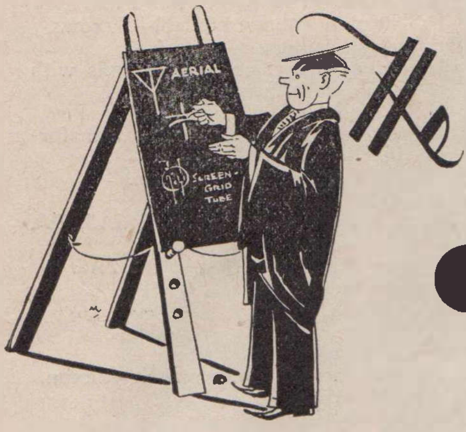
(Continued on page 25.)

THE PARTS THAT ARE NEEDED FOR THE SAXON FIVE.

- 1 20,000 ohm voltage divider—Saxon.
- 1 Centre tap resistance.
- 1 50,000 ohm resistance—Saxon.
- 3 500,000 ohm resistances—Saxon.
- 1 25,000 ohm resistance—Saxon.
- 1 250,000 ohm resistance—Saxon.
- 1 90 ohm wire wound resistance—Saxon.
- 1 450 ohm wire wound bias resistance—Saxon.
- 1 200 ohm wire wound resistance—Saxon.
- 1 420 ohm wire wound bias resistance—Saxon.
- 1 Saxon 3-gang condenser, complete with dial, pilot light and escutcheon plate.
- 1 Padder condenser—Saxon.
- 4 .1 by-pass condensers.
- 1 .5 by-pass condenser.
- 2 8 mfd. electrolytic condensers.
- 1 .0001 condenser—Saxon.
- 1 ea. fixed condenser, Saxon—.01, .03, .0001, rubber mountings for variable condensers.
- 1 5000 ohm volume control—Saxon.
- 1 Voltage adjustor—Saxon.
- 1 Centenary 5-v. coil kit—3 coils with aluminium cans.
- 1 R.F. choke—Saxon.
- 1 Set 175 Kc. intermediate transformers—Saxon
- 1 Power transformer—Saxon.
- 1 5 valve chassis—Saxon.
- 1 ea. Tung-Sol—2A7, 58, 57, 2A5, 280.
- 6 Valve cans.
- 1 7-pin socket, small type for 2A7.
- 3 6-pin socket.
- 2 4-pin socket.
- 1 Banana socket.
- 3 S.G. Clips.
- 1 2-way local distance switch—Saxon.
- 1 Earth terminal.
- 1 Pick-up shorting plug.
- 2 Grommetts.
- 1 A.C. cord.
- 1 B.C. adaptor.
- 3 Knobs.
- 1 .002 mfd. condenser, for use with 3-plate padder.



Schematic diagram of the Saxon Five, giving full circuit details.



the THREE "R's" of RADIO

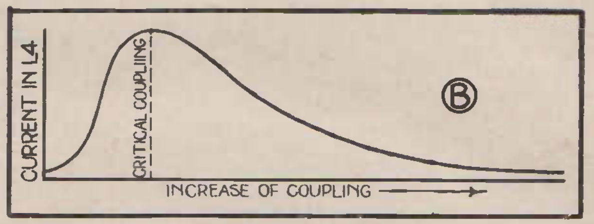


Fig. 102.B.
The graph showing the relation between increase in coupling and current.

THE design of the secondary coil for the usual type of simple solenoid transformer with untuned primary and tuned secondary will now be undertaken.

First, since the tuning unit is to be used over the broadcast range, we know that it must have a tuning range from 600 metres down to 200 metres or lower. Many combinations of inductance and maximum capacity values can be used, but present-day practice recommends either a 0.0005 mfd. variable condenser (maximum capacity with plates all meshed) or a 0.00035 mfd. condenser for tuning. The condenser will have a certain minimum capacity (plates all unmeshed), which, together with the inductance and distributed capacity of the coil, will determine the minimum wave length to which the circuit can be tuned. It is best to calculate the dimensions of the coil necessary to tune to the higher wave length with the maximum capacity of the condenser first, and then check back the minimum wave length on this basis to see if it falls within the required range. There are many formulas which can be used in the calculation of the various factors.

Let us assume then that we have a variable condenser whose maximum and minimum capacities are 0.00035 and 0.00003 mfd., respectively. The broadcast range from 200 to 600 metres is to be covered with a tuning coil 2 inches in diameter, wound with number 28 D.S.C. (double silk covered wire).

First the inductance necessary to produce resonances at 600 metres with a capacity of 0.00035 mfd. can be calculated from the formula $W.L. = 1885 \sqrt{LC}$ where L is in microhenries and C is in microfarads. It can be changed to the form

$$L = \frac{\text{Wavelength}^2}{1885^2\ C}$$

Now the formula for the inductance of a single layer solenoid is

$L = 0.025\ N^2\ R^2\ lK.$

Where L is in microhenries
N is turns per inch
R is radius of the solenoid in inches
l is the length of the solenoid in inches.
K is the form factor.

K depends on the ratio of length to diameter. Values of K for various values of this ratio are usually given in tabular form. Obviously, the calculation is complicated.

It must be remembered that this method of coil design applies only to a single coil of wire isolated in space and connected to a variable condenser. The moment another coil is brought into the vicinity, the conditions change. For instance, if this coil is to be used with an untuned primary coupled to it, it will be necessary to use one or two more turns on it than the number obtained from the charts. This also holds true when a tickler coil is used with it. If the coupling between the various coils is loose, however, there will not be much change in the inductance of the secondary, so no correction need be made. The same procedure applies to the coupling devices used in impedance or tuned plate R.F. amplifiers.

The design of the untuned primary coil presents several difficulties, and in most cases the final design represents a compromise between several factors. Since the function of the primary coil is to transfer energy to the secondary through the medium of its magnetic field, it would seem that best results would be obtained by a large number of primary turns so closely coupled to the secondary coil that all of its lines of force link with the secondary. This condition would best be met by winding the primary on a form and placing it inside of the secondary, either as a concentrated winding at the centre or a distributed winding equal to the length of the coil. If we built a coil in this manner we would find that the tight coupling produces several very serious objectionable effects. A study of this will now be made.

Let coils L_3 and L_4 (Fig. 102) be so arranged that loose coupling exists between them—that is, L_3 is separated from L_4 so that only a small number of its lines of force link with L_4. If the tuning condenser is varied from zero to maximum capacity, we find the current varies as shown by curve A of Fig. 103, having a maximum value at the resonant point. This curve has a sharp peak if the coupling is sufficiently loose, and the tuned circuit is selective; in fact, it may be too selective.

If the coils are moved closer together to tighten the coupling we might expect that as the field of coil L_3 linking with coil L_4 is stronger, the

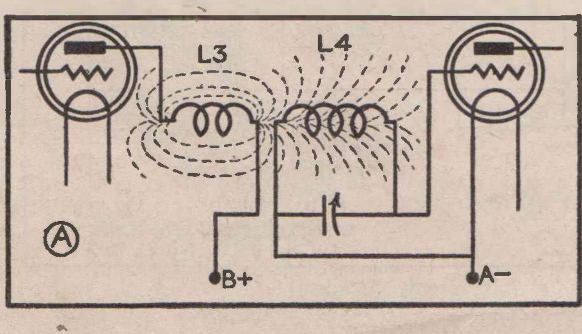
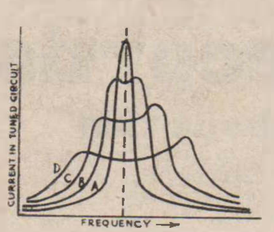


Fig. 102.A.
Diagramatic sketch showing loose coupling between L3 and L4.



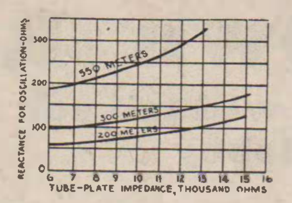


Fig. 103 (left).

Graphical representation of selectivity and broadness in a tuned circuit.

Fig. 103.A (right).

current in coil L_4 will be greater. This, however, is not the case. The current in L_4 set up by L_3 is in snch a direction as to set up a magnetic field opposing the field produced by L_3 (Lenz's Law), and this effect will be stronger the greater the current flowing in L_4. As the natural frequency of the L_4 tuned circuit is increased from zero to maximum by the variable condenser, we find that as we approach the resonance frequency the current in L_4 gradually rises. As the current becomes stronger, the opposing field also increases, correspondingly reducing the effective or inducing field.

As a matter of fact, a point will be reached where the current in L_4 will cease to increase, or actually decrease at the previous resonance point, as shown by curves B, C, and D, in Fig. 103. The closer the two coils are placed together, the more marked will this effect be, as shown by curves B, C, and D, which represent successive degrees of coupling. The double humped curve D represents an extreme condition where there are two resonance points—that is, the same station comes in loud at two points separated on the dial. This, of course, is due to too light coupling between the primary and secondary coils.

The question now arises as to just what proper value of coupling is necessary for best results. Let us consider L_3 and L_4 (Fig. 102A), situated ten feet apart. Then, since there is practically no linking of the magnetic field of L_3 with L_4, the coils have no effect on each other. If we now bring them together slowly we shall come to a point where the field of the primary links with the secondary, inducing a weak current in it. As the coils are brought closer together more and more of the magnetic field of L_3 links with L_4, resulting in a gradual increase of current in the secondary. Finally, as the coils are brought still closer, the current in the secondary reaches such a value that it reacts seriously upon the primary, as we have described, causing the effective field to be reduced and the current weakened. The point where the secondary current no longer continues to increase as the coupling is tightened is called the point of critical coupling. This is shown graphically in Fig. 102B, where it is seen that as the coupling is increased from zero the current in L_3 passes through a maximum. Therefore, for best results the coupling must be adjusted to the critical value. Looser coupling than this results in poor transfer of energy, closer coupling results in poor selectivity, and also results in the secondary condenser tuning the primary coil through the agency of the reversed magnetic field. This tuning of the primary results in oscillation tendencies similar to those in the tuned plate regenerative set. (Notice that the selectivity of coil L_3 is governed by something else besides its resistance—namely, the tightness of coupling.) Now that we have found that there is a critical value of coupling which is desirable, the next problem is to design the primary coil to produce this coupling.

Primary Impedance.

The coupling depends not only on the physical spacing relation between the primary and secondary, but also on the number of primary turns. It is evident that we have two variables. Either a small number of primary turns can be placed close to the secondary, as in Fig. 104a, a medium number of turns can be placed at a small distance from the secondary, as in Fig. 104B, or a large number of turns can be placed at a greater distance from the secondary, as in Fig. 104C. In each case, the coupling may be the same, but which is best? This is answered by considering the plate impedance of the tube. It is generally known that for maximum amplification from a three-electrode vacuum tube, the impedance of the external plate load must be equal to the internal plate impedance of the tube. For the 210A tube working as an R.F. amplifier with 90 volts on the plate and —4.5 volts grid bias, this is about 12,000 ohms. It is impractical to use a primary coil having enough turns to produce this high impedance, for then the reactive voltage across it would tend to cause violent feed-back through the plate-grid capacity of the three-electrode tube, as explained in a previous chapter.

Laboratory measurements have shown that in practical amplifiers using 201A type tubes, the tubes go into violent oscillation with an inductive plate load much smaller than that necessary for optimum amplification. This is indicated by Fig. 105, which shows the curves taken at three different frequencies (corresponding to 200, 300, and 550 metres) between the values of plate reactance necessary to produce oscillation, and the tube plate impedance. Taking the 300-metre curve, it will be seen that the tube will oscillate with the given circuit characteristics with a positive plate reactance of **less than 100 ohms,** while 6500 ohms is necessary for a primary which will match the plate impedance of the tube. The curves also show that as the late impedance is increased by decreasing the plate voltage, the amount of plate load reactance necessary to produce oscillation is also increased. (This is why oscillation control by a variable high resistance in the plate circuit is effective.)

Also, such a large number of turns, self-tuned by their distributed capacity, would tend to tune the plate circuit, further increasing the oscillation tendency. Here is where the compromise is effected. The number of primary turns and their relative location with respect to the secondary are governed in practical work by the circuit conditions. In multistage stabilised R.F. amplifiers where there is always some regeneration present, the number of primary turns on the R.F. transformers of 2 or 3 inches diameter is kept down to around 10 or 15 to keep the plate reactive voltage down, and they are placed from ¼ to ½ inch from the filament end of the secondary for proper coupling. On a one-stage R.F. amplifier a greater number of primary turns can be used. In perfectly neutralised bridge circuits, obviously the greatest number of turns can be used with high gain in both the transformers and tubes.

It is evident from this detailed discussion that the final design of the primary coil of the interstage tuned R.F. transformer must necessarily be a compromise between selectivity, gain, oscillation tendencies, simplicity, and cost.

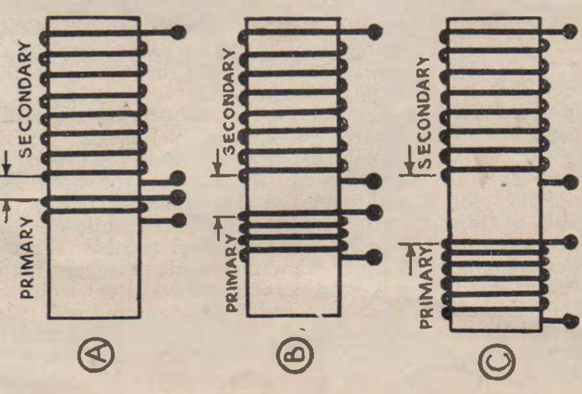


Fig. 104.
Three forms of primary and secondary coupling are illustrated here.

Making Your Own Records

A New Series of Articles which will tell you about this Fascinating Hobby

PART IX.

STUDIOS FOR ORCHESTRA AND BANDS.

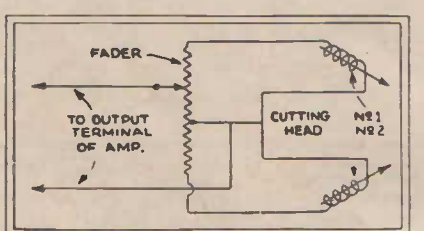
STUDIOS that are to be used for orchestral recording are naturally more elaborately equipped than studios intended for vocal work only. In the first place, two or more rooms are required, and more than one attendant is necessary.

The recording room is adjacent to the studio, and is separated from the latter by means of the double wall which is insulated against the transmission of sound from one room to the next. The advantages to be obtained in locating the two rooms adjacent to each other are two: first, the input leads from the microphone are kept as short as possible, thus minimising the picking up of extraneous noises, and second, the man at the mixer has a full view of the studio, so that at times he may anticipate the action in the studio, which in itself is a tremendous aid in obtaining a good recording.

Fig. 62 shows a black schematic of the apparatus to be used. It is recommended that at least two, if not three, microphones be used, so that proper pick-up of the different pieces of an orchestra may be accomplished.

Mixer Technique.

Under ordinary conditions the mixer dial should be set at the beginning of a record, and not touched thereafter. Of course, there are exceptions to this rule; for example, when the mixer man sees that his level indicator is jumping past the danger mark on some particular notes, he is justified in cutting down his volume and then raising it when the danger is past.



A fad-r system commonly used for mixing two cutting heads.

Some operators are not very careful in the placing of the microphones for best pick-up, and as a result of this they have to resort to twisting the mixer dials to obtain the best results. This procedure is not recommended. The less manipulation of the controls during the recording the better chance there will be for a good record.

The most common fault to be found among mixer men is their marked tendency to try and do the work of the orchestra leader. Some have their own particular ideas on how much high or low frequencies there should be recorded, and, as a result, the record is usually an interpretation of the mixer man's idea of the piece rather than that of the leader, much to the chagrin of the latter. Some maestros now have the level indicator placed in front of them to enable them to control their volume more easily by signalling their band instead of leaving the interpretation of their piece to the mercy of the mixer man, who is usually a better technician than musician.

Double Turntable.

The use of a double turntable is absolutely essential in that continuous recordings may be made. The turntables should be provided with a fader so that the cutting in of one record while the other is being cut out is accomplished without any loss of sound. The tables should have a shift mechanism so that they may be run either at 78 r.p.m. or 33 1-3 r.p.m. The large 16 inch records (33 1-3 r.p.m.) which run from 12 to 15 minutes continuously, are especially suited for the recording of radio programmes. A full quarter-hour programme can be fully recorded on one disc. If the radio recordings are to be made for individual radio stars, then it is inadvisable to give them a 33 1-3 record because of their inability to obtain 33 1-3rd r.p.m. reproducing tables. When the double turntable is used, the fading should be carefully done. Every attempt should be made to make the change-over when there is a lull in sound, for instance, when a chorus is ended, or when a change of action is being denoted by music.

Aluminium should not be used for 16 inch slow speed records, because the fibre or thorn needle that is used for playback wears its point out before the record is finished, with the natural result of poor reproduction. Only materials that can be played back with steel needles should be used for the large records.

The method of connecting the radio receiver is shown in Fig. 62. It is noted that when switches S1 and S2 are closed, the outputs of both the radio set and the mixer are fed to the cutters. This hook-up allows the studio to make novel records, for example, announcements can be made over the regular voice system to introduce any radio programme, and talks in the studio may be recorded with a radio musical programme.

The phonograph turntable provides

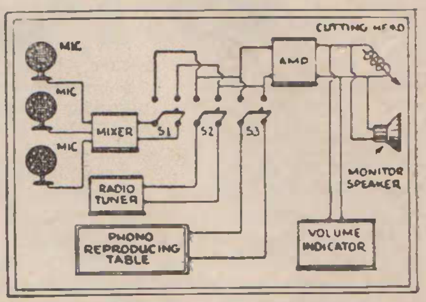


Fig 62 Switching arrangement for connecting either alone, or in any combination the microphones, radio or phonograph to the recording amplifier.

the facilities for dubbing, or re-recording, as it is more correctly known, and is connected into the circuit by switch S3 (Fig. 62).

PORTABLE RECORDING.

Portable recording machines, while fundamentally the same as studio types, have more intricate problems to be solved in their design. They must contain the same apparatus as the studio machine, but in less than half the space.

Portable machines may be either battery operated or a.c. operated. The choice of either type will depend entirely on the locality where the machine is to be used.

The a.c. job possesses the advantage that it is more compact, has fewer cases, and is much easier to carry around. At the same time, it has the disadvantage that it is not of any use where a.c. is not available. Of course, one may take a motor generator set to the d.c. district, but when it is to be used where no type of current is available, it is of absolutely no value.

The battery operated job, on the other hand, can be used anywhere, out in the open, on expeditions, etc. The biggest disadvantage that this type has, lies, of course, in the batteries. They have to be replaced and charged, and this type is a little more complicated in setting up, and the chances of mistakes are increased considerably in interconnecting.

Any portable recording apparatus should be made so compact that it is not bulky in carrying. It should be so light that whoever is to carry it, can do so without undue effort. It should be sufficiently rugged to withstand the many jars of transportation without any mechanical or electrical damage being done. Finally, the units should be so arranged that they can be connected together with certainty in a minimum of time. The equipment should be capable of picking up, amplifying, and recording a fairly wide band of frequencies.

An a.c. operated portable recording machine is built into two separate cases. One case contains the turntable, recording head, and level indicator, while the other contains the amplifier and control panel. A loudspeaker is not provided, but provisions are made for phone playback. The phones serve a dual purpose. In recording they may be used for monitoring, while in playback they may be used for listening in. An attenuator pad is provided, so that there is no danger of overloading them.

The three stage amplifier consists of three separate units, each built upon a separate panel, with all the panels being the same in size. These units are supported one over the other by four threaded steel rods, which pass through holes at the corners of the panels.

This construction has several important advantages. Any unit which becomes defective or out of date may be easily replaced. There is a minimum of unoccupied space, because the parts of one panel may be arranged to fit down into the unoccupied space of the others. As examples of this, the bypass condensers are on the bottom of the middle unit and the switch on the upper unit. The metal framework is used for the common ground connection in the system.

The lower unit is the power supply; the middle unit, the three stage amplifier; and the top unit, the switching panel which holds the microphone input transformer and current indicating meter. Two '27 type tubes are used in the first two stages, and two '45 type tubes are used in the push-pull power stage.

The chokes in the power supply were carefully chosen for weight, size and resistance. The latter figure must not exceed 300 ohms per choke to permit a satisfactory voltage supply. An electrolytic condenser was used for filtration because it combines small size and weight with high capacity.

Four wires connect the power supply to the amplifier. The two outer leads supply '27 and '45 filaments. The two inner wires, between the lower units, are the plus and minus of the "B" supply. The minus connection is used in addition to the frame work for the sake of certainty.

As shown in the diagram of the amplifier, Fig. 72, the grid and plate circuits of the tubes are isolated from each other electrically by a condenser and resistance filter network. This results in the greatest possible amplification without circuit oscillation. All of the important wiring in the three units is made with shielded wire, with all of the shields grounded. This precaution is absolutely necessary in the switching panel.

The microphone transformer is as far from the power transformer as it was possible to locate it. With the transformer, as shown, the hum picked up is sufficiently small not to be noticeable.

The switching arrangement is such that in one position the various units are connected for recording, and in the opposite position they are then connected for playing back the record through a speaker. In either the playback or the neutral position, the battery circuit supplying the microphone is open. The milliammeter is connected permanently in one of the microphone legs. To read the current in the other leg, it is only necessary to reverse the microphone plugs.

The amplifier is cushioned from mechanical shock by means of sponge rubber underneath and on the threaded steel rods.

The carryng case is of black imitation leather. The dimensions are 9 in. x 12 in. x 18 in., and the total weight is about 30 pounds.

The volume indicator panel is located in the turntable carrying cases so as to minimise the number of wires between the amplifier and the recorder.

A 250,000 ohm potentiometer, R12, is used for varying the input signal to the tube, thus controlling the swing of the indicating needle. This potentiometer is purposely located inside the case, so that once the setting is made, there is no chance of accidently changing it. A 50 ohm rheostat, R15, controls the filament voltage on the level indicator, while the plate voltage is controlled, by a 10,000 ohm potentiometer, R13.

In this turntable case are located two ordinary plug receptacles connected in parallel. One of these connects to the main lighting circuit, while the other supplies a.c. to the amplifier. The output of the amplifier is connected to the cutting head by means of a cord and plugs, the latter being three microphone plugs, which are red, green and black. The colour system is used to facilitate the making of the connections when speed in setting up is necessary. Phone receptacles are provided in the amplifier for monitoring purposes.

The dimensions of this case are 9 in. x 13 in. x 18 in., and its total weight is about 25 pounds. It is made of the same material as the amplifier case, and one man can easily carry both of these cases.

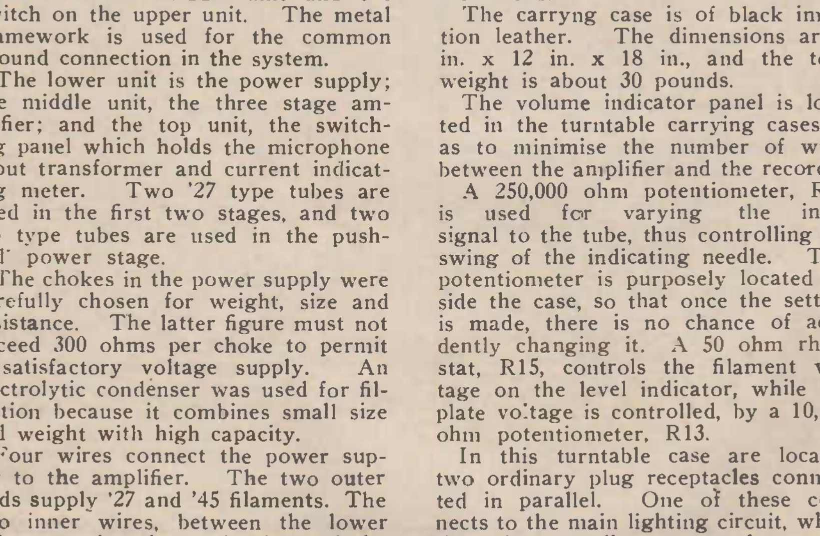


Fig. 72. Schematic circuit of the equipment with amplifier of the Portable Sound Recorder. The filtering of the power supply shown is very important.

OPERATING A SHORT-WAVE RECEIVER.

TUNING a short-wave set is an entirely different matter to tuning a regular broadcast receiver.

A great many details make up this difference, as short-waves or high frequencies have characteristics unlike those of medium waves.

Receivers, too, are made somewhat differently, inasmuch as the wavebands covered must be compensated for by a series of coils, and not just one set of coils, as in the medium wave broadcast receiver. It is simply a matter of the operator learning how to tune his set.

A good receiver does not solve the question of results on short-waves, for the operator also must learn something about short-waves and their peculiarities.

Once this is mastered it is just as simple to get distant stations in ordinary circumstances, as it is to get local broadcasters.

To start with, all controls such as aerial couplings, condenser, potentiometers, trimmer condensers, etc., should be kept near the point where maximum volume is found, or where the loudest signal is heard from the local stations.

The reaction control should be kept just past the point of regeneration, or where a swishing sound can be heard.

To turn the reaction control on too far is just as bad as not having it on enough. Now slowly rotate the dials which govern the wavelength to which the receiver is tuned to. Don't skim over the dials and expect stations to come rolling in.

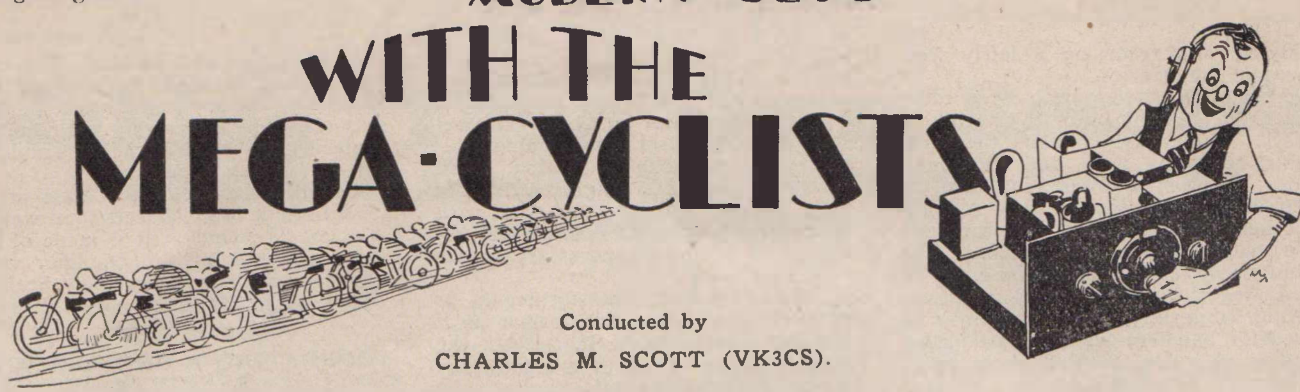
When looking for stations the listener should time his reception, or tune to certain wavelengths at certain times of the day. It is a good idea to log as many of the local stations as possible and mark down their dial settings.

Since stations do not appear on every part of the dial, these will act as guides in locating weaker and more distant stations.

Short-wave stations have a habit of changing in strength from time to time, these changes being principally due to the length of the daylight path between the station and the listener.

Difference in time is another factor which must be realised. It is no good looking for a broadcaster when the station engineers are asleep!

WITH THE MEGA-CYCLISTS



Conducted by
CHARLES M. SCOTT (VK3CS).

Solving the L.C. Problem in Short-Wave Receivers

THE determination of inductance employed in radio frequency circuits in short wave receivers presents a very interesting problem, because the theoretical computations differ from the practical interpreation.

By this we do not mean that the theory is erroneous; rather that phenomena encountered in practice are seldom considered in theory.

Referring to Fig. 1 we have a fixed inductance and a variable capacity. Suppose we wish to cover a certain waveband or wish to make the circuit resonant to a certain wavelength, or at a certain frequency. With known values we can arrange to make any circuit resonate providing that the components are available. The tuning capacity in such a circuit is of such nature that it is continuously variable between 0 and the maximum.

In order to determine the value of the inductance required to resonate a circuit to a certain frequency we must know the capacity of the tuning condenser and. knowing this, the accompanying tables can be used.

Inductance-Capacity (L.C.) Table.

Wavelength (Metres)	Inductance (Microhenrys) .000025 Mfd.	.00005 Mfd.	.0001 Mfd.
10	1.128	.564	.282
15	2.440	1.270	.635
20	4.516	2.258	1.129
25	7.020	3.510	1.755
30	10.120	5.060	2.530
35	13.784	6.892	3.446
40	18.	9.	4.5
45	22.8	11.4	5.7
50	28.	14.	7.
55	34.04	17.02	8.5
60	40.36	20.28	10.14
65	.....	23.76	11.88
70	.....	27.56	13.78
75	.....	31.66	15.83
80	.....	36.02	18.01
85	.....	40.68	20.34
90	.....	45.60	22.80
95	.....	50.81	25.41
100	.....	56.32	28.16

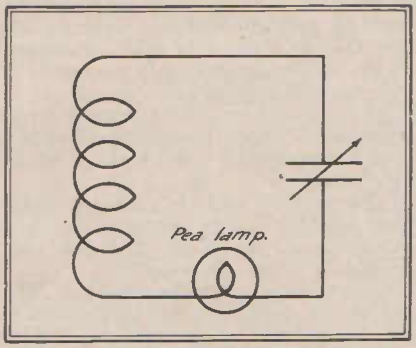


Fig. 1.

Starting with the low wavelengths, we show relation between inductance capacity and the wavelength for some of the values of tuning capacity utilised in shortwave installations. The inductance values considered in the table shown on this page range from 0 to approximately 56 microhenrys, and the capacity values from 25 to 100 micromicrofarads, or from .000025 to .0001 mfd. This table shows the maximum wavelength covered by any combination of these inductances and capacities. By utilizing this chart one can select for himself the desired value of inductance and capacity required to cover a certain waveband. The selection of the capacity will govern the extent of the band, the larger the maximum value of the condenser the greater the waveband. In connection with these capacity values, it is understood that these condensers are of the variable type and the values shown are approximately maximum.

It is usually customary when determining the waveband of a certain inductance, capacity combination to assume that the minimum wavelength is governed by the minimum capacity of the condenser. While the minimum capacity of the condenser provides a specific value of capacity, this value is not the minimum value in the circuit. When we consider that every coil possesses a certain amount of capacity between the turns, and that the wires leading to the coil from the condenser likewise possess a certain amount of capacity, and the tube capacity is in shunt with the tuning capacity, and the load placed upon the plate circuit of the tube in question adds to the effective input tube capacity, the minimum capacity across the inductance is no longer the minimum capacity of the condenser, but this value plus all the other capacities mentioned. This is the reason for the lack of anticipated waveband when a coil condenser combination is designed and placed into operation.

Using the Table.

The use of the Inductance-Capacity Table is simple. Let us say that we desire to reach a maximum wavelength of 30 metres, and our tuning condenser has a maximum capacity to 50 micromicrofrads, or .00005 mfd. What value of inductance is necessary so that we can reach this wavelength with the above-mentioned capacity? Referring to the table, if we look down under the column headed .00005 mfd. and work down till we are opposite the 30 metre mark, as shown in the column on the left. We find that the inductance required is 5.06 microhenrys. Now it is not good practice to arrange a circuit, where the desired wavelength is covered with the maximum condenser setting, so we add about 10 or 20% to the inductance va'ue given in the table.

Suppose that we reverse the problem to illustrate the further use this table can be put to. What value of capacity is required to tune a coil of 18 microhenrys to 80 metres?

From the Inductance Table we find that a .0001 mfd. condenser will be necessary. Again let us assume that we desire to know the wavelength range of an inductance of 18 microhenrys and a .000025 mfd. condenser. What would be the maximum wavelength range covered by this combination? Referring to the LC table we find that the maximum wavelength for these values of L and C is 40 metres. Should the values be in between those shown in the table, approximations can be made which will be quite near enough for practical purposes.

Having determined the inductances, let us now delve into the construction of the coils. We know what value of inductance is required; let us now determine just how many turns are necessary. Conventional practice has definitely decided that the single layer solenoid, space wound, is best for short wave inductances and we will not deviate from this decision.

In the second table is shown the relation between turns per inch and inductance with various coil diameters. Two diameter sizes are considered—namely, 2 inches and 3 inches. The inductance ranges are from .2 microhenrys to 47 microhenrys. The length of the winding has been considered to be 1 inch.

The diameter of the wire is not at all critical and is usually left to constructor to use what he thinks best.

From our L.C. table we may find that an inductance of 18 microhenrys is required to tune to some predetermined wavelength. Now if we wish to use a 2 inch diameter former look under the column headed 2 inch diam. till an inductance as near to 18 is found.

We find that in this case 18 falls between 16.9 and 21, which corresponds to 18 and 20 turns, so we can adopt 19 turns as being the correct number of turns. These 19 turns must be space wound so that the coil when finished will be 1 inch long.

These tables should prove of great value to listeners who are always trying new circuits and building new sets.

Inductance—Turns per Inch.

Turns per inch.	Inductance. 2 in. diam.	Inductance. 3 in. diam.
2	208	.258
.4	.8	1.
6	1.87	2.3
8	3.37	4.14
10	5.2	6.5
12	7.7	9.
14	10.	12.7
16	13.	16.6
18	16.9	21.
20	21.	26.5
22	25.2	31.3
24	30.	37.3
26	35.	
28	41.	
30	47.56.	

W8XAL Again

W8XAL can now be heard after 10.30 p.m. on 49.5 metres, relaying the programmes of WLW. Keep a watch for this station.

Hourly Tuning Guide

WE again present to you this month another hourly tuning guide, giving the broadcast and principal 'phone stations. Some short-wave stations are irregular in operation, and some work only at small periods of time—like fifteen minutes or so; but with a little understanding of various stations this chart should prove most helpful.

The time is given in Eastern Australian standard, which is 10 hours ahead of G.M.T.

Key to Code.—Sun., Sunday; Mon., Monday; Tue., Tuesday; Wed., Wednesday; Thu., Thursday; Fri., Friday; Sat., Saturday.

Stations followed by the letter "A" transmit for the first fifteen minutes o the hour only. Those followed by the letter "B" transmit for the first half-hour only, and those followed by the letter "C" for the last half-hour.

Midnight to 1.00 a.m.

19.68, Radio Paris; 25.02, FZS; 25.28, GSE; 25.57, PHI; 31.50, GSB; 28.00 GBP; 28.5, VLK; 49.7, Java; 58.3, PMY; 77.5, PKIAA; 31.28, VK2ME.

1.00 a.m. to 2.00 a.m.

19.68, Radio Paris; 25.28, GSE; 25.57, PHI; 28.00, GBP; 28.5, VLK; GSB, 31.50; 46.6, REN; 31.28, VK2ME.

2.00 a.m. to 3.00 a.m.

25.40, I2RO; 25.51, DJD; 31.5, GSB; 46.6, REN; 49.51, VQ7LO; 50.00, Moscow (C).

3.00 a.m. to 4.00 a.m.

25.40, I2RO; 25.51, DJD; 31.5, GSB; 46.6, REN; 49.5, VQ7LO; 50.00, Moscow.

4.00 a.m. to 5.00 a.m.

25.2, Radio Paris; 31.5, GSB; 46.6, REN; 49.50, VQ7LO; 50.00, Moscow.

5.00 a.m. to 6.00 a.m.

31.50, GSB; 46.6, REN; 49.5, VQ7LO; 50.00, Moscow; 50.28, HVJ (A).

6.00 a.m. to 7.00 a.m.

31.50, GSB; 49.6, GSA; 49.83, DJC; 50.00, Moscow; 31.38, DJA.

7.00 a.m. to 8.00 a.m.

25.25, W8XK; 25.36, W2XE; 25.60, Radio Paris; 31.33, DJA; 31.5, GSB; 48.86, W8XK; 49.6, GSA; 50.00, Moscow.

8.00 a.m. to 9.00 a.m.

25.25, W8XK; 31.36, WIXAZ; 31.38, DJA; 31.48, W2XAF; 31.50, GSB; 48.86, W8XK; 49.60, GSA.

9.00 a.m. to 10.00 a.m.

25.25, W8XK; 25.60, Radio Paris; 31.36, WIXAZ; 31.48, W2XAF.

10.00 a.m. to 11.00 a.m.

25.25, W8XK; 20.02, KAY; 19.54, KWU.

11.00 a.m. to Noon.

25.6, Radio Paris; 20.02, KAY; 19.54, KWU.

Noon to 1 p.m.

25.25, W8XK; 25.60, Radio Paris.

1.00 p.m. to 2.00 p.m.

25.25, W8XK (Sun.); 25.6, Radio Paris.

2.00 p.m. to 3.00 p.m.

25.25, W8XK (Sun.); 25.6, Radio Paris.

3.00 p.m. to 4.00 p.m.

25.25, W8XK (Sun.); 30.75, VLZ; 40.6, ZLT (C).

4.00 p.m. to 5.00 p.m.

20.00, Russian Tel. (C); 30.75, VLZ; 31.28, VK2ME (Sun); 40.6, ZLT.

5.00 p.m. to 6.00 p.m.

20.00, Russian Tel. (B); 30.75, VLZ; 31.28, VK2ME (Sun.); 40.6, ZLT.

6.00 p.m. to 7.00 p.m.

19.81, GSF; 25.53, GSD; 30.00, J1AA.

7.00 p.m. to 8.00 p.m.

19.81, GSF; 25.53, GSD; 30.00, J1AA; 31.28, VK2ME (Sun.).

8.00 p.m. to 9.00 p.m.

19.85, RAU; 20.00, Moscow; RNE, 25.00; 28.50, VLK; PKP, 28.8; 29.25, PMN; J1AA, 30.00; PK1WK, 49; 31.28, VK2ME (Sun.); 31.55, VK3ME (Wed., Sat.).

9.00 p.m. to 10.00 p.m.

14.55, PMB; 15.93, PLE; 16.30, PCK; 16.5, PMC; 16.28, PCV; 16.88, GSG; 17.12, DFB; 19.85, RAU; 20.00, Moscow; 25.00, RNE; 28.00, GBP; 28.50, VLK; 30.00 J1AA; 20.02, KAY; 49.5, Singapore; 58.3, PMY; 70.2, RV15; 31.28, VK2ME (Sun.); 31.55 VK3ME (Wed., Sat.).

10.00 p.m. to 11.00 p.m.

Same as from 900 p.m. to 10.00 p.m., except for W8XAL, 49.5.

11.00 p.m. to Midnight.

19.68, Radio Paris; 25.02, FZS; 25.28, GSE; 25.57, PH1; 28.00, GBP; 28.5, VLK; 49.5, Singapore; 49.7, Java; 58.3, PMY; 31.28, VK2ME.

New Depth Sounder

A.W.A. to Fit Echometer.

THOUGH the echometer invention, by means of which masters of ships can at any moment ascertain the depth of water beneath their keel, has not long been available in Australia, Amalgamated Wireless (Australasia) Ltd., has already been authorised to fit this device to a coastal steamer.

The Huddart Parker liner, Wanganella" was equipped with the echometer by A.W.A. when the vessel was built in the United Kingdom, and the experience of that company has prompted the latest enquiry.

The echometer, in brief, is an electrical instrument for transmitting signals from the keel of the ship to the bottom of the sea, and receiving the echo on return. By means of an exceedingly delicate adjustment, the time elapsing between the transmission and receipt of the signal is measured and is recorded by the echometer in terms of fathoms, indicating the depth of water. This instrument is now rapidly becoming standard equipment in the British mercantile marine, and no doubt it will be found invaluable for shipping in the shallow waters which characterise parts of the Australian coast.

SHORT WAVES

Notes and News

RECEPTION CONDITIONS IMPROVING.

IN the past, and even at the present time, there is a general opinion that the winter months are best for radio reception. To a certain degree this is true of medium wave broadcasting, and of static conditions; but the experienced short-wave listener knows very well that reception during the winter nights is indeed very poor, with the exception of comparatively near-by transmissions and perhaps an occasional American broadcast.

As we have mentioned before in these pages, great changes in reception conditions take place around about the equinoctial periods, and the spring equinox this year brought with it many stations which have been lost for over six months. Signals at night are steadily increasing in strength, and should reach their maximum early in December and keep this strength till somewhere near the end of February or early in March.

The summer nights are undoubtedly the best time of the year for listening, and, judging by the present conditions, we can look forward to a good season. The lower wave stations beginning to break through after 9.00 p.m. are as follows:—PLE, 15.93 metres, 18.83 megacycles; and PMC, 16.5 metres, 18.18 megacycles, are regularly engaged in telephonic communication with PCK, 16.3 metres, and PCV, 16.82 metres, Kootwijk, Holland.

The first two stations mentioned are located at Bandoeng, Java, and are all audible, and occasionally play recorded music for testing purposes and special broadcasts.

GSG, Daventry, England, the Empire broadcast transmitter on 16.86 metres, 17.79 megacycles, is also audible after 9.00 p.m., but only a carrier can be heard so far.

Radio, Paris, 19.68 metres, is also starting to come through from 11.00 p.m. onwards, increasing in strength towards midnight. Also the Empire station GSF is audible between 9.00 and 11.00 p.m. on 19.82 metres.

CQN, MACAS, CHINA.

CQN of Macao, operated by the Portugese Government authorities, is on the air now and again after 10.000 p.m. on 49.8 metres.

Reports on the transmission and request musical numbers have been asked for by the station announcer.

MANILA-U.S.A. RADIOPHONE.

KAY, Manila, P.I., 20.02 metres, 14.980 KC/s, has been heard in constant telephone communication with San Francisco between 10.00 and 11.00 a.m.

This wave is particularly good for long-distance complete daylight paths.

KAY has also been working with DFB, Berlin, on this same wave-length between 10.00 p.m. and midnight.

NEW STATION FOR SINGAPORE

A STATION whose call sign appears to be ZHI. has been heard fairly regularly recently on approximately 49.5 metres.

The company owning the station was named several times, but was unidentified through the prevailing static. Complete details of the B.B.C. Empire programmes, calls, and wave lengths were given from time to time, making it appear as if there was some connection between them. The time difference was 2 hours 40 minutes and, during the transmission the announcer mentioned the calls of other stations heard in the east and including RNE.

The station closes with "Good-night, Sweetheart," and the British National Anthem."

Landlines Down

EFFECT OF HURRICANES.

Wireless to Rescue.

THE departure of Mr. W. G. Clarke for Fiji in connection with the wireless services of Amalgamated Wireless, recalls the utility of radio communications across the rugged country in the interior of Viti Levu, the principal island in the Fiji group.

Hurricanes are one of the chief bugbears of life in Fiji, frequently sweeping the country from end to end. In 1930 the telegraph line running from Suva to Lautoka, over a distance of 150 miles, was blown down for a considerable portion of its length. This line passes through rugged country, with mountains rising in places to a height of over 4000 ft. To repair the broken wires and re-erect the telegraph poles would have been costly work.

The resources of A.W.A. were such that, at the request of the Legislative Council, modern wireless transmitting and receiving equipment was quickly transported to, and installed at, Lautoka. Three days after the storm communication with Suva was again established.

This service was found both efficient and expeditious, and shortly afterwards the Government decided not to re-erect the landlines. Instead, an arrangement was made with Amalgamated Wireless to carry on communication by radio between the two towns. That arrangements has been operative for three years, and seems likely to continue indefinitely.

The wireless services of Amalgamated Wireless on the Australian mainland are frequently called into operation following upon breakdowns of the landline.

In 1928 the submarine cable connecting Thursday Island with Cape York was broken, and for over two months all the telegraphic traffic was carried by the wireless stations of A.W.A. Similar breakages in the landlines occur also in the far north-west of Australia between Broome and Wyndham. Here the A.W.A. stations at Darwin, Wyndham and Broome are brought into action to avoid delays in normal telegraphic traffic.

On occasions, the A.W.A. wireless stations have maintained communication between Hobart and Melbourne. Repairs to that cable usually are speedily carried out, but in the isolated tropical country of the North, days, even weeks, sometimes elapse before a repair gang can reach the scene of a breakage.

RADIO RECORD.

AMALGAMATED WIRELESS reports that the company's coastal station, VIC, Cooktown, recently intercepted messages transmitted from the commercial station at Nassau, Bahamas.

Nassau is 10.600 miles from Cooktown, and this feat of reception is thought to be a world's record in point of distance for the commercial wavelength of 600 metres.

Short-Wave By-Pass Condensers

It has been suggested that, to be on the safe side, it is often a good plan to use mica-dielectric by-pass condensers in short-wave receivers, in order to avoid the risk of instability that may be brought about by those of the paper-dielectric type if they are not entirely non-inductive.

You may be under the impression that the right value of by-pass condenser in a short-wave receiver is the same as that in a set designed to cover wavelengths between, say, 200 and 2000 metres.

This is a mistake. Ignoring altogether the possibility of inductive properties, a capacity very much lower than that customarily used is suitable for a set which deals only with the higher frequencies. For most short-wave sets a capacity of 0.01 mfd. is quite as effective as the value customarily employed in broadcast sets.

Generating the Ultra-Short Wave

PART 5

GASEOUS GENERATORS.

BY passing electric current through rarefied gases in transparent vacuum tubes a wide variety of visible and invisible wave-lengths can be generated, the resulting output depending on the gas, its pressure, the material of the container, and the intensity and frequency of the current. Some of these waves fall into the heat region at the shorter-wave end of the region here discussed, but the effects are too complex for discussion here.

Precautions.

In addition to the obvious precautions as to voltage stability, mechanical rigidity and protection against temperature changes, ultra-high frequency generators or amplifiers are all to be treated with care to prevent field-concentrations on any part of their glass envelopes, as local heating easily rises to the point of destruction. It is usually necessary to lower the voltage as the wave-length is shortened, to prevent this type of damage. "Mashes," or stem seals, are especially vulnerable, and should be watched for signs of brushing or other distress.

Any construction in which metal touches insulation should be watched closely if it is in or near the tuned circuit, as sharp edges or corners may cause flux concentrations which will waste power and impair stability in a small oscillator, or destroy the insulation of a larger one.

In all ultra-short wave oscillators a capacity current of several amperes flows through the tube, tending to over-heat the grid, which should be watched rather carefully. If it becomes heated to a fairly bright red secondary emission may take place with a sudden rise of current and a grid burn out. A "littelfuse" in the plate supply is of some protection.

All tubes with oxide coated filaments tend to lose emission soon, at these wavelengths, while XL (thoriated tungsten) filaments are inclined to be extremely varying in their behaviour. Unfortunately, some of the best tubes from other standpoints (type '52) have this style of filament. If there is any considerable amount of 5 and ¾ meter work, we may expect to see plain tungsten filaments again in power tubes.

With regard to electron oscillators of the Barkhausen-Kurz type, Kohl finds that there is invariably a tuned circuit present, ordinarily inside the tube itself, and that it may accordingly be designed to work best at a particular wave-length, though somewhat flexible about that point. If this is sustained we may also expect to see special B-K tubes shortly.

Power Outputs of Tubes at Ultra-Short Waves.

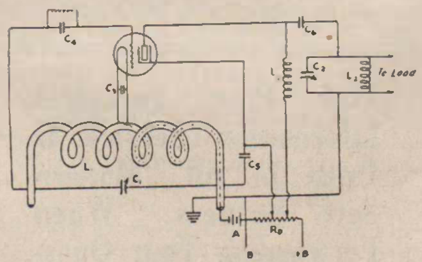
Wave Length Meters	'10 7½ watt triode	'52 75 watt triode	FH-11 magnetron	Special water-cooled triode
10	5	75	40	2800
5	5	[illegible]	35	2750
4	4	60	33	2700
3	3	47	30	2250
2	2	18	27	1100
1.75	0*	8	—	500
1.4		0	—	0*
1.3		0*	15	
.675		2½†	—	
.65			0†	

*Lower limit of oscillation in regenerative circuit.

†Lower limit of electronic oscillation.

NOTE.—Magnetron efficiencies can be run as high as 80% if an adequate load-impedance is possible, but at ultra-short waves the output drops rapidly because this impedance is impractical. This considers the plate-circuit efficiency only, not counting filament or field power.

* * *



This is the circuit of the electron-coupled oscillator described below.

ONE form of the electron-coupled oscillator. L1 and C1, with the filament, grid and screen, form an ordinary Hartley oscillator of the shunt-feed variety. Since it is necessary to put the screen at ground voltage (as far as r.f. is concerned) the right-hand end of the coil L1 is grounded, and the screen by-passed to ground through C5. Since the filament is not at ground r.f. voltage, it must be fed through r.f. chokes, and this is done very cleverly by using the coil L1 as the choke, the filament current going in through one half of the coil and returning through a wire run inside of the tubing of which the coil is made. L3 is the usual feed-choke, and, like L1, and C1, must be suited to the wevelength. C6 is as small as consistent with the wavelength, since we must avoid excessive coupling to the circuit, C2-L2, which is ordinarily tuned to the 2nd harmonic (half way) of the circuit L1-C1. Constants are determined by wavelength, as in any oscillator. Condenser C is necessary to protect the filament.

* * *

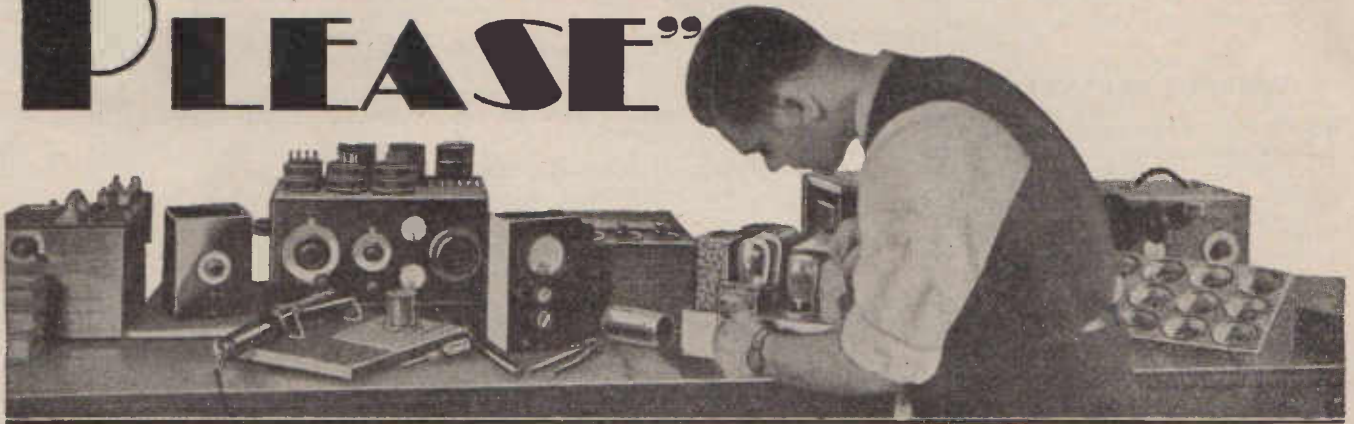
FADING EXPLAINED.

WHY do some stations in the broadcast band fade so badly, others not at all? Some semi-distant stations fade, always the same ones, while other stations, far more distant, never fade? Why are some areas poor for receiving certain short-wave frequencies of certain stations, and yet even the same short-wave frequencies of other stations come in well? Has this anything to do with sun spots? What are sun spots, and what are their effect?

The fading on the broadcast band is probably due to the same conditions that cause fading on the short-wave bands. It is believed that the transmission from the station travels on an enduring sky wave in a more or less steady angle, a sort of inverted conical representation from the transmission point, and strikes the layers of conducting media in the upper atmosphere, to be reflected back to earth. The other wave, or ground wave, is not enduring, but within short distances of the station both might be received. The reflection back to earth from the ionised strata is uneven, as there are at least four strata, and the wave may even be delayed there awhile. Hence the return to earth may result in phase displacement that also varies. When the phases on return are 180 degrees apart the reception stops. When it is less than 180 degrees apart it is diminished. When there is no phase difference the signal is full strength. This waxing and waning is fading. The reflection back to earth depends on the distance of the layers from the earth and on the frequency of the transmission (wavelength), so some stations even in the broadcast band have assignments that result in large fading areas, often semi-distant from the transmitter, whereas at greater distances the transmitter lays down its signal much more steadily. The same condition in short-wave reception is called skip-distance, as it is more pronounced, and there are areas where the sky wave does not come down, represented as the base of the isoceles triangle. Sun spots have about the same general effect on radio, in that radio reception is best when the sun-spot activity is least. We are now in a period of low-activity, and it will get still lower, so that reception now is good and will be even better within the next two years. This is one reason why short waves are holding such exceptional interest right now. The sun spots are not well understood,

(Continued on page 26.)

"SERVICE PLEASE"



A DEPARTMENT TO HELP SOLVE THE VARIOUS TECHNICAL PROBLEMS WHICH ARE ENCOUNTERED BY THE RADIO SET BUILDER AND EXPERIMENTER.

I wish to construct a four valve and rectifier autodyne superhet, using valves from the Golden Range. If you have a block on hand of such a circuit I would be very pleased if you would publish same, giving briefly the values of the various components.—R.J., Canterbury, Victoria.

Yes, it so happens that we have on hand the very circuit you require, employing the E452T, E455, E444 and the E443H, also 1561 rectifier. This circuit is shown in Fig. 1 on the next page. You will note that the tuning circuits consist of one aerial coil, one pre-selector coil, and one oscillator coil.

Where is the best place to put a volume control? I have always put it ahead of the detector, but I find many circuits where the volume control is in the audio amplifier.—A.J.S., South Melbourne, Victoria.

The type of volume control and its placement will depend considerably on receiver design. Thus, if the detector (or second detector in superheterodynes) is fully protected from danger of overload, it is permissible to put the control in the audio channel, although this should be done in a manner not to constitute change in volume a control of tone as well. One advantage of such location is the avoidance of detuning effects, otherwise inevitably present. However, in a superheterodyne these would not be serious in the intermediate amplifier. Grid bias variants have shown detuning to as much as 20 kc. for the controlled circuit near the high frequency end of the broadcast band. Theoretically, at least, the volume control should be a gain control and an input control, because the amount of gain should be cut down to reduce the noise, and the amount of signal input cut down to prevent cross-modulation and overloads of other types. So, compound controls are sometimes used. There is no altogether satisfactory volume control, so far as we know, and most engineers must feel mildly stumped when they come to the control feature. Perhaps the day will come when constant output tubes will be developed, so that one may make a permanent setting, and the volume will come up to that in nearly all instances, at least will not exceed the predetermined value. A close approximation to this could be made with the present duo-diode tubes, using the rectifier for auxiliary biasing of each tube (automatic volume control), and the amplifier section (whether triode, quadrode or pentode) for gain. However, the circuit would be awkward, and no doubt the constant output tube will see the light of day some time.

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.

Would you tell me if it is necessary to use extra heavy wire for the grid and plate leads in a short-wave receiver, rather than thinner wire? Should the losses be kept as low as possible despite the fact that I intend using regeneration?—R.K., Box Hill, Victoria.

It is not necessary to use awkwardly thick wire for the leads you mention. No. 18 or equivalent is sufficient. Especially is this true since the coils themselves hardly would be wound of coarser wire. It is assumed that you refer to frequencies no higher than 30 megacycles. For ultra frequencies thicker wire should be used, say, No. 14, 12, or even $\frac{3}{8}$-inch diameter hollow copper tubing. The circuit losses should be kept as low as possible, and regeneration should not be relied on to come to the rescue, because, strangely enough, the results are better with a low-loss circuit, using regeneration, than with the other type, where regeneration is also included. This does not seem consistent, since regeneration may be expressd as a state of negative resistance, and it would seem, therefore, that all r-f resistance has been overcome. Another consideration is that in short-wave reception the frequency range to be covered is enormously wide, and the so-called regenerative circuit may become non-regenerative at the higher frequencies unless due precaution is taken to constitute the circuit losses as low as practical. As a general rule, the simplest regenerative circuits work best, and that means circuits with the fewest parts and most sensible layout. A great deal more depends on the layout than most short-wave enthusiasts realise.

I intend to construct "The Economy A.C. Two described in the March issue of "Modern Sets," but would like a little more information on the coil winding. Would you send me the following information:—

1. The number of turns on tuning coil L2; number of turns on grid coil L1, and number of turns on reaction coil L3?

2. Could this set be converted to a three-valver if required?—C.L., Oatlands, Tasmania.

As the circuit stands, it will probably be too sharp for your locality, and the signals will consequently be rather weak. We therefore advise you to swing the connections of the tuning and grid coil over, making a standard circuit; the tuning condenser will then be earthed in the ordinary way.

The coils required are as follow:—

The tuned coil, L2, which will now become the grid coil, consists of 103 turns of 30 gauge (36 gauge will do if same is on hand). The coil, L1, which now becomes the aerial coil, consists of 15 turns of 36 gauge wire, and the reaction coil consists of 35 turns of 36 gauge wire. Either enamel or d.c.c. wire can be used.

The circuit could be easily transformed into a three valve job by substituting a 56 in place of the 59, and follow this stage by another resistance or transformer coupled stage using the 59.

Note that L1 should be raised about 1-16th inch from the tuning coil, L2, This can be done by winding several turns of brown paper about half an inch wide, round the coil L2 before you start the winding of L1.

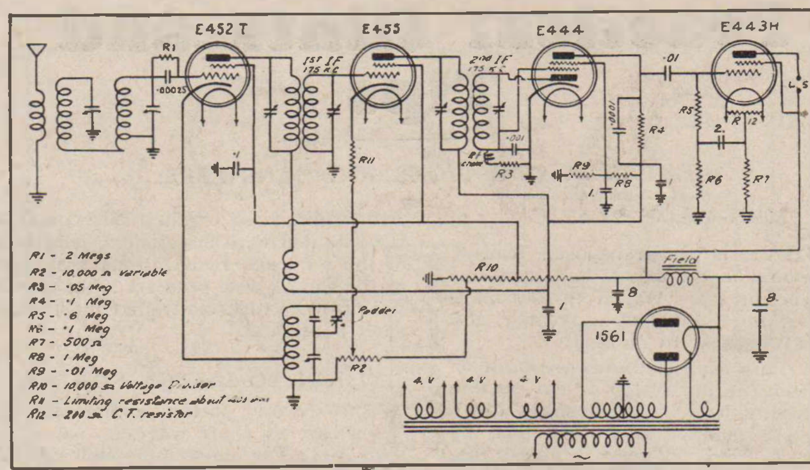


Fig. 1. The circuit diagram asked for by R. J., Canterbury, Victoria.

When resistance capacity coupling is employed in place of the more usual L.F. transformer, would it be better to err on the side of over-biasing rather than under-biasing the amplifying and output valves?—"Worried," Ringwood, Victoria.

Even in the best regulated and most ambitious amplifiers, occasional overloads are likely to occur, and it is as well to take a little trouble to minimise their ill-effects.

An over-biased amplifying valve will act as an anode-bend detector when it is overloaded, and if under-biased, grid current will flow momentarily. Of these two evils, anode-bend rectification is by far the least harmful. When grid current is flowing the coupling condenser will acquire a charge, and the audible distortion resulting from a momentary overload will be prolonged until the charge leaks away.

It is not difficult to ascertain definitely what is happening, provided that a milliammeter be inserted in series with the anode of the valve. If the meter needle kicks upwards we have an indication that bias is on the high side, as it should be. A downward deflection shows that grid current is flowing.

* * *

A COMBINED VOLUME CONTROL.

THE sensitivity of most modern sets is regulated by means of a variable resistance or potentiometer, which is generally arranged to decrease the sensitivity of the H.F. amplifier by over-biasing the grid of the valve (or valves). Those who have fitted a gramophone pick-up to an existing receiver may have wondered whether it is possible to make this resistance serve the dual purpose of radio and gramophone volume control.

Unfortunately, it is hardly practicable to do this, as a fairly elaborate switching scheme would be required in order to enable the potentiometer to carry out both functions. But if we cannot avoid the use of two potentiometers, we can at least avoid control knobs by making use of one or other of the many modern components that may be linked together mechanically in such a way that their spindles rotate simultaneously.

Although the "radio" and "gramophone" potentiometers may be mechanically linked—or ganged—it by no means follows that they will be electrically interconnected; as a rule the wiring to each will be entirely separate.

* * *

OVERHEATED GRIDS.

WHEN an A.C. mains set works satisfactorily for some time after first switching on, and then exhibits a general falling off after perhaps half an hour, it is generally safe enough to assume that grid emission is the trouble. The most probable cause of this highly undesirable effect is the application of an excessive voltage to the valve heaters when operated in this way, particles of the emissive material may be "spluttered" from the cathode on to the metallic mesh of the grid; the temperature of the latter will also be raised unduly, and it will then act as a kind of secondary cathode.

A fairly definite proof as to whether this effect is really responsible for poor performance is afforded by switching off the set and waiting for a few minutes for the valves to cool off.

Then, if the receiver is turned on again, and it behaves satisfactory for a while, but soon dies out, this secondary emission is probably the cause. It is, of course, possible that only one of the valves is defective, and the next step is to attempt to find it by carrying out a series of eliminative stage-by-stage tests.

Practical Hints and Tips

POPULAR QUESTIONS AND ANSWERS.

MAN-MADE STATIC.

WHAT is the transposed lead-in, what is its effect, how can one be put up? Will it cut out man-made static? Is there anything else you can suggest to do this?

The transposed lead-in is the connection from the horizontal or flat portion of the antenna system, brought down in such a manner as not to pick up anything. This manner is the transposition of the leads, either by using twisted pair, or by using insulation blocks, to criss-cross the two wires brought down. There must be two for transposition. One is connected to the aerial itself, and the other, which is grounded at the set end, may be open at the other end, but, if long, has to be grounded at several points, including the far end, for effectiveness. The system works in the manner you suggest to eliminate man-made static, because such interference is usually close to the earth, and if all pickup is confined to a well-elevated aerial, the other and undesirable energy not being picked up, the trouble disappears. Besides the interference coming over the air, there may be some getting in through the a-c lines, and this may be reduced or eliminated by winding two coils on two forms about 2 inches in diameter, 100 turns of No. 18 insulated (bell) wire, putting the two coils in inductive relationship, running one a-c lead through one, the other a-c lead through the other, free ends of the coils to the a-c cable to set, and condensers of 1.0 mfd. or greater capacity from the two extremes of each coil to ground (total four condensers). If there is less interference when the ground wire is off the set, but greater hum when such omission is made, reversing the connections to one of the filter coils just described may correct that condition.

* * *

LAZY MAN'S OSCILLATOR.

WOULD it be possible to construct a local oscillator that would function over one frequency band, and then use its harmonics for the higher frequencies to be covered? This struck me as feasible in a wide-frequency-range receiver, because the frequency ratio of the oscillator could be held the same (as it would be) and the frequency ratios of the r-f end lined up with that, instead of the more usual method of padding the oscillator.

Yes, this method works, but it is not very good. The fact that harmonics are used results in multiple harmonics yielding response as the frequencies become quite high. When this condition is combined with insufficient selectivity at the r-f level, two stations are heard at the same time. One set actually was produced commercially that did include such a method.

* * *

WHEN TO LISTEN FOR S.W.

IS there any particular time for listening to short waves?

Yes. The most important consideration is to try to tune in a station when it is on the air, not when it is off the air. This requires, first, that due consideration be given to the time difference, and, second, that a close check be made on the frequencies and hour. As short-wave stations are nearly all experimental, they change their transmission hours frequently, and even their frequencies occasionally, especially as some transmitters have several frequencies they can use. Besides, the general rule of the shorter the waves the earlier in the day you should listen (computed from daybreak), and the longer the wave the later the day or night, is worth remembering. In particular, from daybreak to 4 p.m. or so, try 13 to 20 metres; from 10 a.m. to 10 p.m. try 20 to 35 metres; at night try 35 to 80 metres. The higher wavelengths are for night transmission, too. Whether you are east or west of the transmitter has some effect, also.

* * *

FREQUENCY-HOLDING SUPER.

WHAT precautionsshould be taken to hold the frequencies in a superheterodyne?

The oscillator should be stabilised, the padding of the oscillator should be done with an air-dielectric condenser, or accurate fixed condenser of mica-dielectric, which has been vacuum-impregnated with wax; the intermediate coilsshould be on moisture-proof forms (non-hygroscopic), the coils at the intermediate level should be wax-impregnated, and the condensers tuning them should be air-dielectric or accurate fixed condensers as above described. The stabilisation of the oscillator is of the utmost importance for such a precision objective as you outline. The trimming condensers on the r-f and oscillator tuning capacities should be air-dielectric, not postage-stamp type, and should have stiff spring tension. A precision dial should be used, so that dial shift or misreading will not be thought to constitute frequency shift. The travelling light type of dial should not be used, because of the inductive and capacity effects of the moving leads at the higher frequencies even in the broadcast band.

BIASING POWER STAGES.

IN the construction of an output (power) stage, using push-pull or otherwise, which is better, self-bias or bleeder-bias? I see self-bias used a great deal, but bleeder-bias gets all the praise. Also, need a condenser be used across the self-bias resistor in push-pull?

In the construction of the output stage for a receiver the difference is not enough to be noteworthy. There are conflicting considerations. The self-bias method does not require any bypass condenser, for if the stage is truly symmetrical there will be no signal current through this resistor, the phases being 180 degrees apart at any instant. The power output for the B voltage available is less by the self-bias method, or lower B voltage may be used for the same power output if the bleeder-bias method is used. However, the bleeder-bias method always requires a bypass condenser, and to be effective at the low frequencies it should be very large, high in the microfarads. If cost is a factor, since a specially-well-filtered circuit is needed, the bleeder-bias has that much against it. The difference is not great enough to make an audible impression on persons for whom such output stages are built.

* * *

IS the relationship between the maximum and minimum capacities of a condenser strictly in accord with the frequencies? What is the rule about the change in inductance in respect to frequency, also change in number of turns? Has resistance an effect on r-f resonance?

The maximum capacity divided by the minimum capacity gives the condenser's capacity ratio. The frequency ratio is the square root of that. The frequency changes approximately as the inductance. The frequency changes directly as the number of turns for small changes in turns, but for large changes (sufficient seriously to affect the shape factor) the frequency changes as the square of the number of turns. Resistance affects next 2900 to 4360, etc., with increasing frequency difference between extremes as the frequency of the bands increases.

* * *

Neon Pilot Lamp

IN a receiver I am asked to build there is small current to spare, as it is battery-operated, and so I would have to dispense with a pilot lamp, unless one could be obtained that drew only a small amount of current, around 1 milliampere or so.

You could use a small neon lamp, which would draw even less current than what you state, and could have it operated from the B batteries. There are some such lamps that light on 85 volts, so 90 volts would be perfectly safe.

THE SAXON FIVE.

(Continued from page 13.)

on top of stator No. 2. The two earth wires are taken to the under side of chassis and securely soldered to it.

Lining the Condenser Gang.

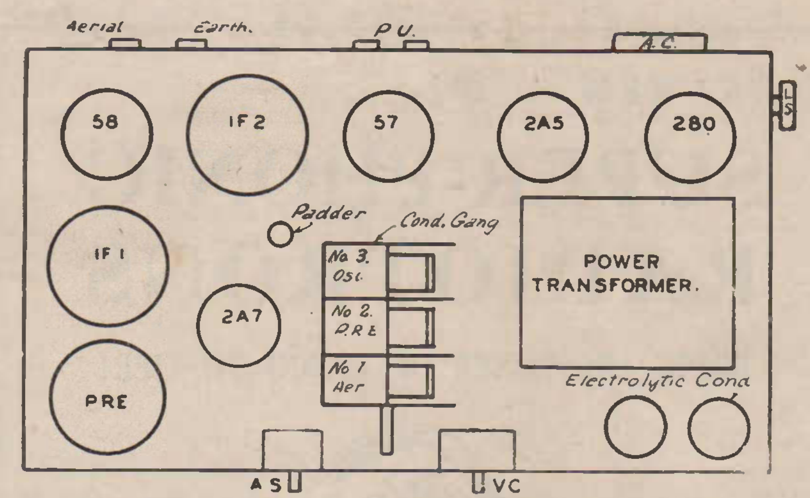
The alignment of trimmer condenser of gang as well as padder condenser is an easy matter, providing the golden rule is known.

Commence by screwing the padder all the way down (insert screwdriver through hole in chassis) then loosen it about one turn. Now swing the dial to a station low on the scale, for instance, 3AW, and adjust trimmer No. 3 (oscillator trimmer) very carefully as the signals come in. Usually the condenser gang will set itself to the trimmer No. 2. When you have adjusted No. 3 to full volume, trim up No. 1 and then go over all three trimmers in turn till you attain the utmost on this wave length. Always keep your volume control back as far as possible. This enables you to hear the slightest variations in signal strength while tuning. Then tune some station on the other end of scale, say, 3AR. Do not touch the trimmers, but adjust the padder for maximum volume. Then tune to 2CO, and by rocking the condenser backwards and forwards on 2CO adjust padder to maximum signal strength.

This completes the lining up of gang, but, of course, this should be re-checked on one or two distant stations, as, for instance, 2KY, 2BL, 2FC, or 2CO.

Stations Logged.

If lining up and adjustments have been made correctly, and for preference, an outdoor aerial used, no trouble should be experienced in logging all the Australian A and B class stations, with, perhaps, the exception of one or two of the very low powered B class stations, which usually get buried beneath the more powerful ones. Many of these stations are not on their exact frequency, and consequently heterodyne each other slightly, making logging difficult.



A plan view showing layout of components above the chassis, key lettered to conform with the text.

The Australian stations heard on actual test are to numerous to mention here, any standard station list will be as near to our log as you could possibly get. From outside Australia, when the set was operated 10 miles from Melbourne, 2YA Wellington was logged at good speaker strength. Among foreign stations heard were KZRM Manila, HSP1 Bangkok, Siam, the regular Japs, and the high powered Chinese station, XGOA. It is interesting to note that, according to official statements, the power used by KZRM is only one kilowatt, and that used by HSP1 is 2½ k.w.

For ordinary reception on Australian stations only a short piece of aerial wire will be required for good speaker volume.

The 90 ohm resistor, which is attached to the moving arm of the distance switch, is switched out of circuit when distant stations are being received.

Operation.

The volume control, VC, controls the volume by increasing the bias on the 58 intermediate tube, and at the same time as the bias is being raised the aerial is gradually being earthed. The 200 ohm limiting resistor in the cathode of the 58 prevents the tube from becoming underbiased.

These connections form a very efficient and effective form of volume control. Should you be situated only a few miles from a powerful station, the 90 ohm resistor, which is in shunt across the aerial primary coil, can be reduced to 30 or 40 ohms. This will prevent blasting if the volume control is turned partly full on.

Grid Dip Meter

YOU have not described a grid dip meter, although this type of instrument is widely used.

The grid dip meter draws too much power from the measured circuit, which it therefore detunes somewhat. While that type of meter is in general satisfactory, it cannot be said to come near to the highest requirements.

* * *

DIODES AND NEGATIVE BIAS.

IN some of the latest circuits employing the diode detector, no obvious provision for negative grid bias may be seen, it does actually obtain a suitable negative voltage from the rectified carrier wave. This is a truly automatic arrangement, as the negative voltage impressed on the valve will, enable it to deal properly with whatever signal may be applied. The bias voltage which the valve obtains is that which the L.F. valve grid circuit is in tion across the load resistance, with developed in the process of rectification under all conditions, be sufficient to parallel.

It is a convenient circumstance that bias may be so easily obtained in battery-operated sets with diode detection, and that the harmful flow of grid current may be avoided without any complications. Luckily, grid current does not commence to flow in the average battery set until the grid is made positive with respect to the filament—a condition that can never obtain in the arrangement under discussion.

FADING EXPLAINED.

(Continued from page 21.)

although their manifestations and effects are; so the situation is comparable to that of electricity itself. One may say that strong electron activity has a bearing on sun-spot activity. Sun spots lower the effective height of the ionised layers, and thus reduce distant reception, as the angle of reflection is about the same, but the distance between the points of departure and return is less.

THE HAM SUPER SIX.

(Continued from page 7.)

to give pre-selection; this causes slight double spotting or image interference, but it will be no worse than with other receivers that have no T.R.F. stages ahead. If the constructor wishes he could, as an extra refinement, provide an extra stage of R.F. before the first detector, but this would entail extra expense, three stages to line up, and more coils.

The method adopted to couple the oscillator to the first detector is somewhat different to the usual arrangement. The plate of the oscillator is coupled to the control grid of the first detector through a small 7 plate midget condenser Cx. The suppressor grid is connected to the cathode in the conventional manner.

The chassis is constructed from a piece of 16 gauge alluminium, the completed job measuring 13½ inches long, 12¼ inches wide, and 2½ inches deep. The front and left hand side panels can also be in 16 gauge metal, the dimensions for the front being 14 inches x 7 inches and the side is 12¼ x 7 inches.

The two box shields for the first detector and oscillator measure 7 inches deep, 4½ inches wide, and 4¾ inches high, while the box can for the beat oscillator is 3½ inches deep, 4¼ inches wide, and 5 inches high. Shields are fitted with ¼ inch flanges at the bottom for fixing to the chassis.

The Intermediate Frequency.

The intermediate stages do not differ very much from the usual type except for the regenerative feature.

The input transformer T1 contains the usual primary and secondary windings L5 and L6, spaced approximately 1 inch or 1¼ inches between centres, with the small tickler winding L7 coupled to the grid coil about one half to one inch to the outside of the grid coil. The intermediate frequency should be approximately 465 KC/s or somewhere between this value and 550 KC/s, and the identical coils L5, L6 should have an inductance of between 1 and 1.3 millihenrys. The size of the tickler will depend largely on the inductance of the secondary. The tickler may be made up by winding four or five turns of 30 gauge D.S.C. wire or equivalent over the former, on which the other coils go. Although four turns was found quite suitable in the original receiver, it may be necessary in other cases to put on as many as 20 turns. Have the tickler in a small bunch so that its position on the former can be varied.

First connect the transformer up unshielded while the correct size of the tickler is being determined, with the regenerative control omitted. The tickler can then be moved along the former, turns added or taken off until the valve just begins to oscillate. This state of gentle oscillation can be observed by a slight drop in current in the positive screen voltage lead. The winding of the feedback coil must be in the right direction so that feedback will be in the right phase.

Refit the can and make the final adjustments from outside by means of a screwdriver through a hole in the can.

The coupling R.F. leads should all be shielded thoroughly, the necessary shielding being indicated by the dotted line on the diagram.

The second I.F. is similar to the first except that it has no tickler winding. Like the first I.F., it should have the plate by-pass and R.F. choke inside the shield can. The second detector's grid leak and condenser can be mounted as shown in mid-air, between the transformer and the second detector valve.

The Second Detector and Beat Oscillator.

The second detector is a 57. Grid leak detection was found to give a much greater output and more sensitivity than anode bend or bias detection. This 57 is transformer coupled to the 59 output pentode, which can feed into

(Continued on page 29.)

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The "Ham" Super Six and the Parts that are Needed

2	13-Plate Midget Condensers	3/5	ea.
1	13-Plate Midget Condenser, Radiokes	3/5	,,
1	23-Plate Midget Condenser, Radiokes	4/9	,,
11	T.C.C. Mica Condensers, .005 mfd.	2/3	,,
3	T.C.C. Mica Condensers, .00025 mfd.	1/6	,,
2	T.C.C. Mica Condensers, .00025 mfd.	1/6	,,
1	1-mfd. Condenser	3/-	,,
1	50,000 ohm 1-Watt Grid Leak for Osc.	1/3	,,
1	5000 ohm Wire-wound Bias Resistor, 1 watt	1/-	,,
1	5000 ohm Potentiometer (variable)	5/9	,,
1	100,000 ohm 1-Watt Carbon Resistor	1/3	,,
1	10,000 ohm 1-Watt Carbon Resistor	1/3	,,
1	7000 ohm 1-Watt Carbon Resistor	1/3	,,
1	3000 ohm 1-Watt Carbon Resistor	1/3	,,
1	50,000 ohm 1-Watt Carbon Resistor	1/3	,,
1	5000 ohm Potentiometer (variable)	5/9	,,
1	300 ohm Bias Resistor	1/-	,,
1	50,000 ohm 1-Watt Carbon Resistor	1/3	,,
1	1 Megohm ½-Watt Grid Leak	1/3	,,
1	50,000 ohm 1-Watt Carbon Resistor	1/3	,,
1	2500 ohm 1-Watt Carbon Resistor	1/3	,,
1	10,000 ohm 1-Watt Carbon Resistor	1/3	,,
1	25,000 ohm 1-Watt Carbon Resistor	1/3	,,
2	Intermediate Frequency Transformers, one with reaction, 465 KC/s	9/9	ea.
4	Ordinary Broadcast Chokes	2/-	,,
1	Philips PH59 Valve	17/-	,,
4	Philips PH57 Valves	15/6	,,
1	Philips PH58 Valve	15/6	,,
1	20 ohm C.T. Filament Resistor	1/-	,,
5	6-Pin Valve Sockets	1/-	,,
1	7-Pin Valve Socket	1/-	,,
1	Metal Chassis, 13½ in. x 12¼ in. x 2½ in.	13/6	,,
1	Metal Panel, 14 in. x 7 in.	2/3	,,
1	Metal Panel, 12¼ in. x 7 in.	2/-	,,
5	6-Pin Valve Cans, with tops	1/3	,,
1	Vernier Dial	8/11	,,
1	7-Plate Midget Condenser	2/9	,,
1	4 oz. Reel No. 20 D.C.C. Wire, 1/-; No. 28 D.C.C., 1/10; No. 18 Enamel, 9d.		
1	2 oz. Reel No. 36 D.S.C.	3/-	,,
9	Plug-in Coil Formers and 3 Sockets to take same	1/-	,,
1	450 ohm Bias Resistor	1/-	,,
1	10 mfd. Electrolytic Bias Bypass Condenser	3/-	,,
1	.0001 mfd. Fixed Condenser	1/6	,,

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1	Bakelite or Cardboard Former, 3 in. diameter, 3 in. long	6d.	,,
1	.0005 mfd. Variable Condenser, A.W.A.	9/11	,,
1	Plain 4 in. Dial	5d.	,,
4	Banana Sockets	2d.	,,
2	Banana Plugs	3d.	ea.
2	Phone Terminals	2d.	,,
1	Glass Barrel Type Crystal Detector	2/-	,,
1	Neutron or Mighty Atom Crystal	1/2	,,
1	4 oz. Reel No. 22 D.C.C.	1/2	,,
2	Yards Single Flex	1d.	yd.
1	Pair Head Phones	18/6	ea.

VEALLS

243-249 SWANSTON STREET, MELBOURNE.
168-172 SWANSTON STREET, MELBOURNE.
299-301 CHAPEL STREET, PRAHRAN.
3-5 RIVERSDALE ROAD, CAMBERWELL.
'Phones:
Cent. 2058 (5 lines), 10524 (2 lines); Wind. 1605; W 5160.

(Continued from page 27.)

a dynamic or magnetic speaker, or through a suitable output transformer to headphones.

The beat oscillator circuit consists of an electron coupled arrangement having a small tuning condenser (13 plate midget) in parallel with a 23 plate midget, and a .0001 mfd. fixed condenser, both of these midgets being controlled by knobs on the end left hand panel for a handy beat note adjustment. Here again the R.F. leads to the grid and to the detector must be well shielded. By adjusting the beat oscillator a weak signal can be made to peak right out of the background, and if interference is experienced on one side of the carrier listening can be carried out on the other side.

The Coils.

First detector primary L1 is wound with No. 36 d.s.c. wire, and consists of the number of turns shown in the table. The number of turns on the grid coils L2 are also shown in the table. The 3500 KC grid coils L2 and L4 are wound with No. 20 D.C.C.; 1750 KC grid coils with No. 28 D.C.C., both close wound. The 7000 KC grid coils and 14,000 KC/s grid coils, are wound with No. 18 gauge D.C.C., or enamelled wire spaced to occupy a length of 1¼ inches. Taps are from the ground ends of the detector coil. All coil diameters must be 1½ inches.

Coil Data.

Band	L1	L2	L4	
1750 KC	10	55	55	tapped at ¼ to 3rd of total turns from ground end.
3500 KC	6	28	28	tapped at ¼ to 3rd of total turns from ground end.
7000 KC	5	11	11	tapped at ¼ to 3rd of total turns from ground end.
14000 KC	3	5	5	tapped at ¼ to 3rd of total turns from ground end.

The cathode tap on L4 will vary for different sets because of the slight discrepancy between the circuit constants; try various positions between ¼ to 3rd of the total turns from ground end.

The beat oscillator coil consists of 140 turns of No. 30 gauge D.S.C. wire wound on an inch and one half (1½in.) diameter former. Length of winding 1 7/8 inches. This coil must be tapped at 30 turns from the ground end.

The Power Supply.

The power supply is built in a separate unit and consists of the conventional full wave 1561 rectifier, power transformer, three 8 mfd. electrolytic condensers, and two 30 henry chokes.

A double choke filter has been used as an extra precaution against hum. The unit can be placed near the set so that the leads to the filaments and high tension points need not be long.

The pack should be capable of supplying between 180 and 250 volts to the high tension positive terminal on the set. The filament supply can be brought out in two 2½ volt lines, which must carry between them 7 amps.

Lining Up.

Rough lining can be done in the intermediate circuits by using the C.W. beat oscillator as an I.F. signal generator, although a separate oscillator using the same circuits and constants will be more satisfactory. The original circuit of this receiver was published in a recent issue of "Q.S.T.," but modifications have been made which greatly improved the overall gain without sacrificing any selectivity.

Using a separate test oscillator "Q.S.T." recommends the following procedure for lining the intermediates:

(1) Tune the test oscillator to about 525 K.C., if this I.F. is selected by checking against a broadcast receiver tuned to the extreme low-frequency end of its tuning range.

(2) With phones connected to the output (and with an 0-50 or 0-100 milliammeter connected in the detector plate lead, if one is at hand), loosely couple one end of an insulated lead to the test oscillator output, and loop the other around the grid lead of the I.F. valve. Set the regeneration control at minimum (shorting the tickler). The beat oscillator should be "off."

(3) Tune the primary and secondary of the second I.F. transformer to resonance as indicated by a hiss in the phones, or by minimum in second detector plate current. (Plate current drops with grid detection.)

(4) Transfer the oscillator coupling lead to the grid of the first detector and tune primary and secondary of the first I.F. transformer in the same fashion.

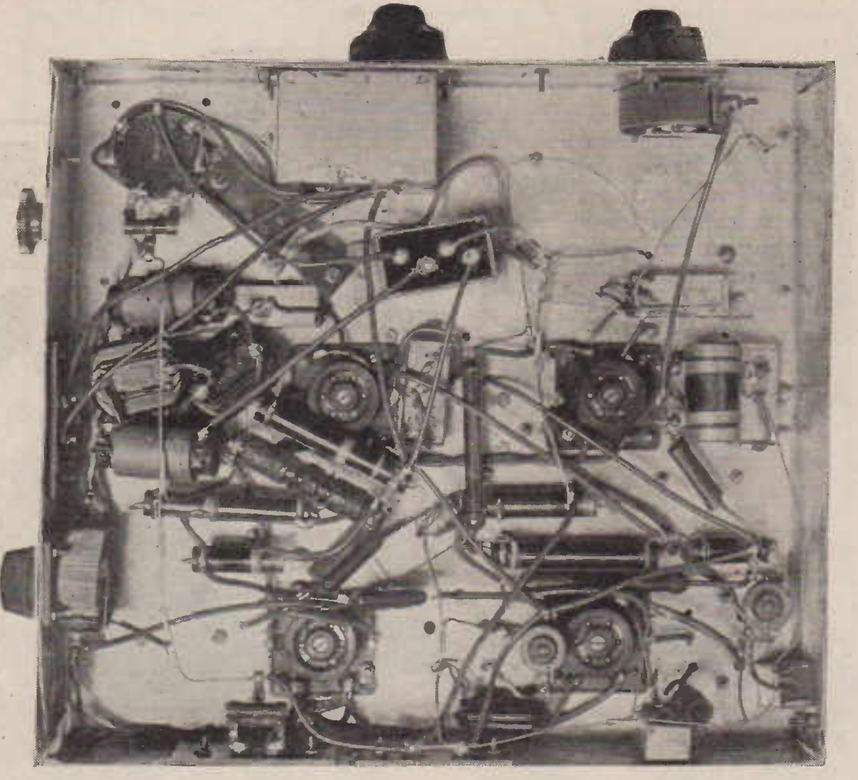
(5) Now tune in a ham band signal from a steady local oscillator, say the crystal stage of the transmitter or the frequency meter. Turn the regenerative control full on. Make the final adjustment of the tickler coupling, setting it at the point where the I.F. just spills into oscillation. Before doing this it would be well to smear collodion on the form, so that the tickler will become fast in the final position without further disturbance.

(6) Very carefully touch up the tuning of the first and second I.F. stages so that the I.F. is just on the verge of oscillation, as will be indicated by the characteristic ringing sound in the phones. Adjust the selectivity control if necessary.

(7) Switch on the beat oscillator and set it so that the beat note is of the desired pitch, with the signal tuned in right.

Reduce the sensitivity by backing off the gain control, if necessary, so that the signal does not overload the I.F. stage. to block it or throw it into oscillation. If oscillation starts, back

(Continued on page 33.)



A Plan View of the Under Chassis Wiring and Lay-out.

WHAT ABOUT A NEW BATTERY.

On page 33 appears an advertisement for batteries on terms. This struck us as a particularly good idea for those of our readers who have not the ready money to put out at once for a battery, and, as a consequence, are being deprived of a considerable amount of pleasure and instruction.

We have investigated the offer made by this particular firm, and can assure our readers that they will receive an absolutely square deal.


Ken-Rad
The Fine Valves of Radio
58
Ken-Rad
DEPENDABLE
LONG LIFE
K
KEN-RAD

SOUND ON FILM.

(Continued from page 9.)

transformer in the box at the base of the panel.

The whole of the gear is mounted on a piece of engraver's zinc, which is bolted to the bottom of a copper box 12 inches long, 4 inches wide, and 5½ inches high, the base panel being held away from the bottom of the box by ½ inch spacing washers to prevent sub-panel wiring from shorting. The lid of the box must be a good fit.

When the whole of the gear is assembled and placed in the box, it must be bolted to the front panel immediately below the gain amplifier, a hole having been previously cut in the front panel to accommodate the locking nut and shaft of the volume control.

Particular care must be taken to see that the grid lead of the input tube is well shielded, and the shielding properly earthed, using flexible metal braid for the purpose.

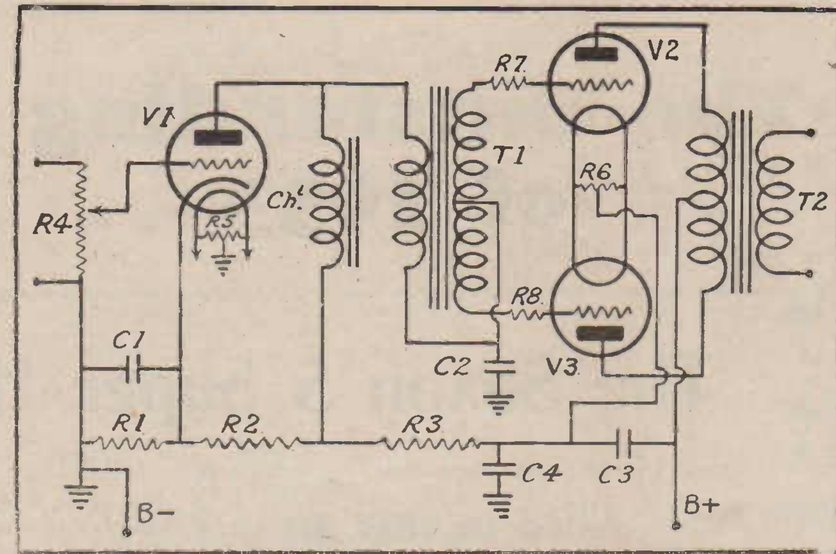
A close study of the circuit will supply all the detail necessary to enable the constructor to go ahead with the job without difficulty.

Any reasonably good parts can be used, but those specified will certainly give much better results, so it would be advisable to adhere to the list given and avoid trouble.

A small dynamic speaker is recommended, but if a magnetic speaker is available it can be used in the output of this amplifier. Field excitation for a dynamic speaker can be taken from the gain amplifier pack, as indicated in the circuit; but in this case be sure to put resistance in series with the field in order to maintain the current flowing in the resistor at 44 milliamps, which is the usual current for 2500 ohm speakers. In this case the total resistance would be 14,545 ohms, less 2500 ohms, leaving 12,045 ohms.

List of Parts.

1 UY256 valve, Radiotron or Kenrad.
1 B405 Philips valve.
1 Ferranti A.F.5 transformer.
2 25 mfd. condensers, hydra 1000 volt test.
2 1 mfd. condenser, hydra 1000 volt test.
1 160,000 ohm resistance, 15 mils.
1 60,000 ohm resistance, 20 mils.
1 16,000 ohm resistance, 50 mils., for eliminator bleeder.
1 500,000 ohm resistance (variable).
1 UY socket.
1 UX socket.



Schematic Diagram of the Perfect Push-Pull Amplifier.

THE PERFECT PUSH-PULL AMPLIFIER.

TO call this amplifier the "Perfect Push-Pull Amplifier" is apt to be a trifle misleading. It is as perfect as tubes and speakers will permit it to be, and the "permission" of some speakers is sufficient to cause one to have designs on the lives of the people who foist them on an innocent and unsuspecting public.

This amplifier is definitely not for use in recording, and only for those who desire the utmost in tone for reproducing either from pick-up or radio. The principles involved are identical with those described last month, with the exception that the last valves are in push-pull.

A 256 valve is coupled from its plate directly to the grids of the final valves, passing the speech frequencies through the primary of an auto transformer, which gives an added impetus to the signal input, and at the same time puts the grids of the 2A3's out of phase. These 2A3 valves must be perfectly matched, and for this reason I would reccommend that major makes of valves be used, otherwise difficulty will be experienced in matching up.

Common sense and a study of the circuit and parts list should make further comment on this amplifier unnecessary. Those who build it will be more than satisfied and find that the tone and 7 watts undistorted output it delivers is all that is claimed for it and justify any expense incurred.

List of Parts.

1 500,000 ohm var. resistance, R4.
1 UY socket.
2 UX sockets.
2 Centre tap resistors, 25 ohms, R5 and R6.
1 25 mfd. cond., C1.
1 2 mfd. cond., C2.
1 4 mfd. cond., C3.

(Continued on page 33.)

The Outstanding Success of 1933 . . . . .

The Saxon 5 Super-Heterodyne

The Saxon 5 A.C. Super-Heterodyne Kit is undoubtedly the outstanding Super of 1933. Build this receiver with every confidence; it will give you all that you desire in radio reception.

	£	s.	d.
1 3-Point Voltage Switch (Saxon)	0	1	6
1 Chanex Condenser, .0001 mfd.	0	1	0
1 Chanex Condenser, .001 mfd.	0	1	0
1 Chanex Condenser, .03 mfd.	0	1	0
1 Chanex Condenser, .01 mfd.	0	1	0
1 Chanex Condenser, .002 mfd.	0	1	0
4 Chanex Condensers, .1 mfd., at 1/2 each	0	4	8
1 Chanex Condenser, .5 mfd.	0	1	8
2 Polymet 8 mfd. Condensers, at 5/- each	0	10	0
1 Saxon 2-gang Condenser	1	2	3
1 Velco Aerial Coil	0	3	6
1 Velco Oscillator Coil	0	3	6
2 Velco Intermediate Transformers, at 8/9 each	0	17	6
1 Velco Padder Condenser	0	3	0
1 Local Distance Switch (Saxon)	0	2	6
1 Saxon Midget Speaker	1	4	9
1 Saxon No. 16 Transformer	0	18	3
1 Pr. Pickup Terminals	0	1	0
4 Velco Resistors, at 1/- each	0	4	0
2 Radiokes Resistors, at 1/6 each	0	3	0
6 Carb. 1-Watt Resistors, at 1/3 each	0	7	6
1 Radiokes R.F. Choke	0	2	0
1 Marquis 5000 ohm Potentiometer	0	5	9
1 Saxon Chassis	0	10	3
1 Radiotron, 2A7 valve	0	18	6
1 Radiotron, 58 valve	0	15	6
1 Radiotron, 30 valve	0	17	0
1 Radiotron, 2A5 valve	0	17	0
4 Darley Sockets, at 5d. each	0	1	8
1 Darley Socket, 7-pin	0	0	6
3 Valve Cans, at 1/3 each	0	3	9
1 Radiotron, 57 valve	0	15	6

. . . . also in this issue

The Economy Twin

Parts Required

1 A.W.A. .0005 mfd. Variable Condenser	9/11	ea.
1 Radiokes 13-plate Midget Condenser	3/5	,,
1 T.C.C. 0.00025 mfd. Grid Condenser	1/7	,,
1 0.1 mfd. Paper Bypass Condenser	1/2	,,
1 0.1 mfd. Paper Bypass Condenser	1/2	,,
1 T.C.C. 0.01 mfd. Condenser	2/9	,,
1 10 mfd. Electrolytic Condenser, 35v. peak	3/-	,,
1 0.01 T.C.C. Condenser	2/9	,,
2 7 mfd. Electrolytic Condensers, T.C.C., 500v. peak, 400v. working	6/-	,,
1 Radio Frequency Choke	2/-	,,
1 1 megohm Carbon Resistor, 1 watt	1/3	,,
1 250,000 ohm Carbon Resistor, 1 watt	1/3	,,
1 100,000 ohm Carbon Resistor, 1 watt	1/3	,,
1 1 megohm Carbon Resistor, 1 watt	1/3	,,
1 250,000 ohm Carbon Resistor, 1 watt	1/3	,,
1 Marquis 10,000 ohm Potentiometer	5/9	,,
1 400 ohm Wire-wound Bias Resistor	1/-	,,
1 Shielded Aerial Coil	3/6	,,
1 Dynamic Speaker, 2500 ohm field (Amplion)	31/6	,,
1 Radiotron, 57 valve	15/6	,,
1 Radiotron, 2A5 valve	17/-	,,
1 Radiotron, 280 valve	12/6	,,
1 Power Transformer, with one 5v. 2 amp. winding, one 2½v. 3 amp. winding, and one C.T. secondary winding, 350v. aside	21/-	,,
2 6-pin Valve Sockets	1/-	,,
1 4-pin Valve Socket, Velco	10d.	,,
3 Terminals	2d.	,,
1 Valve Shield for 57	1/4	,,
1 Chassis, 11 x 7 x 2 inches	8/-	,,
1 Vernier Dial, full vision	8/11	,,
3 Knobs	6d.	,,

VEALLS PAY FREIGHT ON RETAIL ORDERS

Vealls pay freight on all Victorian Retail Orders excepting Radio Cabinets, and on all Retail Inter-State Orders excepting Batteries, Accumulators, and Radio Cabinets. You can therefore buy with confidence that you are not paying any more for your radio goods than the customer who buys at our counters. **Get the habit. Try Vealls first—always.**

VEALLS

168-172 SWANSTON STREET, MELBOURNE.
243-249 SWANSTON STREET, MELBOURNE.
299-301 CHAPEL STREET, PRAHRAN.
3-5 RIVERSDALE ROAD, CAMBERWELL.
Cent. 2058 (5 lines), 10524 (2 lines); Wind. 1605; W 5160.

THE PERFECT PUSH-PULL AMPLIFIER.

(Continued from page 31.)

1 8 mfd. cond., C4.
2 100,000 ohm resistors, R7 and R8.

Next month we will describe some new departures in microphones and describe how to use and get the best out of them and the other equipment associated with this apparatus before dealing with sound-heads and recorders.

BRING YOUR CRYSTAL SET UP TO DATE.

(Continued from page 10.)

the banana plug in No. 1 socket. Turn the dial around at the same time as you adjust the cat's whisker. When a sensitive point is found you will hear a station, during broadcasting hours.

If you require more selectivity to separate the stations, use number two or three sockets.

Convenience of the Set.

All the components have been mounted on the chassis so that a cabinet will not be necessary. The set may be laid horizontally or vertically. Neither way will affect its operation. If at any time an amplifier is desired, that described in the December issue of "Modern Sets," 1932, will be most suitable.

THE HAM SUPER 6.

(Continued from page 29.)

off on the selectivity control also. When the adjustment seems satisfactory, tune the receiver through the zero beat, and check the ratio of the signal on the peak to the signal on the image. If the adjustments are correct, the ratio should be something like R9 to R1 or R2. The image should be barely audible.

Do not expect to get the full measure of performance at the first trial. As with every piece of radio gear, realisation of the maximum performance comes with familiarity and experience in handling.

Go over the adjustments until you are completely familiar with the whole thing. The constructor must use his initiative in laying out the components and wiring up, as space will not permit a point to point wiring detail. It is no use wiring up the set any old way, and then blame the circuit design because poor results are obtained.

In conclusion, let us discuss briefly the various merits of the finished job.

(1) Controllable R.F. selectivity such that response at least 40 db. down can be obtained at 2kc off resonance. With not more than two transformer coupled I.F. stages of usual frequency, this order of selectivity is practicable only when there is a high-selectivity single circuit, such as a piezo-electric (quartz) filter, or one using negative resistance (regeneration or dynatron action).

(2) Overall stability commensurate with the high selectivity.

(3) A separate oscillator coupled to the second detector to beat with the intermediate frequency for heterodyne C.W. reception. An autodyne (oscillating) second detector, for instance, would not serve.

In general the receiver comes up to all these requirements.

On actual test this outfit definitely had it all over any other ham receiver we have ever tried. The selectivity is really remarkable, and makes contact with other countries during the peak periods when conditions are good very much more easier and satisfactory.

The results are good, and there is no reason why any other Ham cannot be successful, if he goes about the job in the right way.

BLIND WORKERS' COURAGE.

(Continued.)

The products of these brave Victorians are sold throughout the State in competition with these foreign goods. So, when you next buy a mat, or matting, remember the Blind Institute hand, and help our skilful workmen to earn a living for themselves and their families. Remember, too, that these blind craftsmen keep themselves, by their own labour, assisted by the compassionate allowance which generous citizens subscribe to the Institute to encourage them in their work.

Blind Institute workmen also produce basketware and brushware, and tune pianos and pianolas.

Their Eyes Are in Their Fingers.

The skilful craftsmen employed at the Blind Institute have overcome their tremendous physical handicap—and how tremendous it is—and perform really marvellous feats of technical skill by touch alone.

The coir mats and matting produced by these workmen are of equal, if not superior, quality, to that manufactured by native sighted labour in other countries. The products of Victoria's blind workmen, branded "Blind Institute" mats and matting, are on sale practically everywhere. When you buy mats give a thought to these brave people who, facing difficulties that one can hardly realise, earn a living for themselves and their families and keep themselves, assisted by the compassionate allowance which generous citizens subscribe to the Institute to encourage them in their work.

Insist always on "Blind Institute mats and matting."

Piano tuning is another activity that occupies workmen from the Blind Institute.

NEARLY 6,000,000.

The total number of registered listeners in England is now nearly six millions.

POLICE BROADCASTING.

All patrol cars in the service of the London police will in future be equipped with a short-wave transmitting installation. In order to avoid interference with regular broadcasting, the police will make exclusive use of Morse signals for their communications. So Londoners will not be able to join in the excitement of tracking down criminals, which is nowadays such a popular pastime in America.

PARLIAMENT ON THE AIR.

We are informed that microphones are being fitted up in the assembly-room of the Spanish Parliament both for the purpose of sound amplification and for the broadcasting of certain meetings by the Spanish broadcasting organisation.

HEAR DOUBLE!

A French radio journalist who apparently feels equal concern for the enjoyment of listeners and for the interests of the radio trade, recommends the simultaneous use of two receiving sets. According to him, the stereoscopic effect obtained in this way makes a "surprisingly agreeable" impression on the listener.

RADIO ON RACE CARS.

The idea is contemplated of equipping race cars with a short-wave radio installation, the object being to keep the driver in communication with his helpers in the fuelling-pit throughout the race, enabling him to give them instructions and to receive information about his position or about the movements of his competitor.

NOTES ON ROUMANIAN BROADCASTING.

At the recent annual meeting of the Roumanian Broadcasting Company numerous details were furnished, which give an interesting insight into the scope and trend of Roumanian broadcasting. Thus, it was stated that during the past year the company had performed in their own studios a total of nine operas, twelve operettas of Roumanian composers, and fifteen operettas of foreign origin, besides giving weekly broadcasts of opera and symphony concerts from the Bucharest concert hall. The programmes further included twenty festive performances and commemorations, nineteen choir evenings, forty-two broadcasts of a religious nature, nineteen broadcasts of church services and fifty-two chamber music evenings. Over 250 artists performed before the Roumanian microphone.

BREDOW'S RESIGNATION.

Practically the entire European radio press has devoted words of praise to the German broadcasting director, Dr. Hans Bredow, who was recently relieved of his important post at his own request. He is mentioned as one of the pioneers of wireless communications and as the founder of Germany's broadcasting organisation. As already reported, Dr. Bredow intends to commit to paper the experience gathered by him in the course of thirty years in the domain of wireless telegraphy, wireless telephony, and broadcasting. In addition to this, however, it appears that he is still continuing active work in his domain. At any rate, we understand that he has accepted the invitation of a Spanish committee that is at present studying the broadcasting conditions in Germany to go over to Spain in order to assist in the organisation of Spanish broadcasting. It is stated that Dr. Bredow will accede to this request, and be shortly leaving for Spain.

SUPER-POWER TRANSMITTER FOR INDIA.

The Government of British India is planning to build a powerful broadcasting station which will serve chiefly for disseminating the programmes of the British Empire Station throughout India. Up to the present there have only been a few unpretentious local stations in India.

IN JAPAN.

We understand that the Japanese Government is making every possible effort to prevent Japanese listeners from listening to foreign stations. Considering that the European and American stations are hardly heard at all in Japan, it is obvious that these measures can only be directed against the transmissions of the 75-kilowatt station at Nanking and (in the future) against the programmes of the new Russian 100-kilowatt station in Siberia, both of which will probably be used for the purpose of Communistic propaganda.

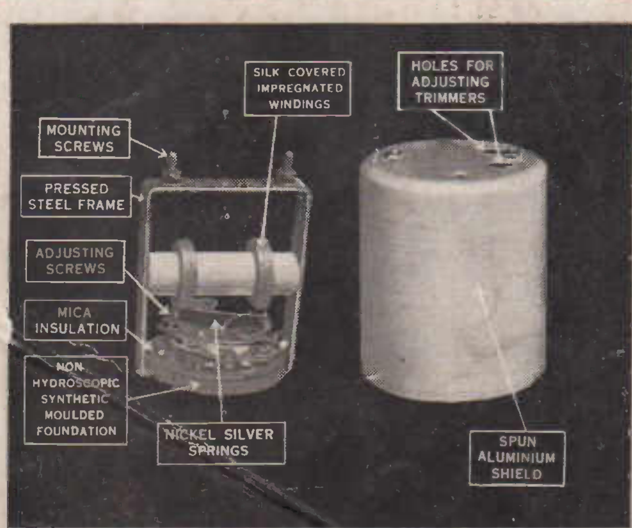
NO SUBSIDY FROM BROADCASTING FUNDS.

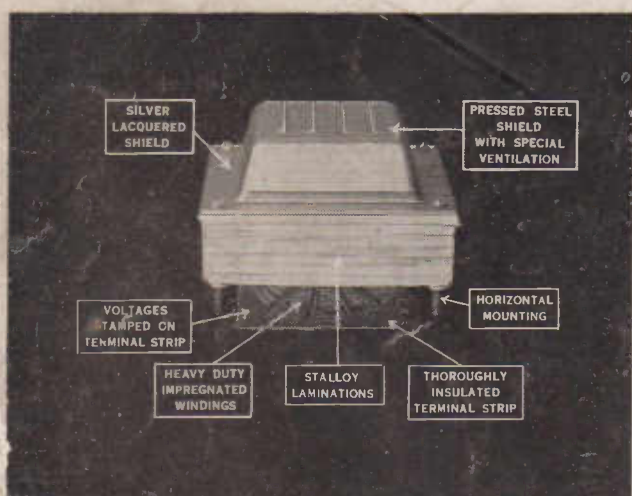
The English Postmaster-General has requested Parliament to abolish the annual subsidy of £17,500 which the B.B.C. have to pay to the Covent Garden Opera for a period of five years on the strength of an agreement entered into in 1931. The reason given was that the financial position of the B.B.C. no longer warrants the payment of such a sum.

WE REGRET THE DELAY IN THE PUBLICATION OF THE SHORT WAVE HANDBOOK. THIS BOOK WAS HELD UP SO THAT NEW CIRCUITS COULD BE INCLUDED.

HOWEVER, COPIES WILL SHORTLY BE AVAILABLE.

Build your Own!





even if you have never built a radio before, you can build the "Saxon Superheterodyne Five" with

SAXON PARTS

The fascinating hobby of radio is open to all now that these easy-to-fit Saxon parts are available. You can now build the very latest in Five-valve Superhets., employing the wonderful new 2A7 and 2B7 Valves, and, if you wish, Automatic Volume Control, the famous Saxon Five, the wonder circuit. This receiver has a truly remarkable performance, and is capable of receiving inter-State and foreign stations. You save pounds buying your radio this way, and have the fun and pleasure of building it yourself; and it is a pleasure with these specially-designed Saxon Parts. Experienced radio builders, too, like the way these Saxon Parts slip together, and the professional air of the finished job—the smart silver finish of all coil cans, variable condensers, valve shields, chassis frames, etc. Special Saxon Parts Literature, giving chassis photos., circuit diagram, and assembling instructions, is free at all dealers.

SAXON CONDENSERS, COILS, INTERMEDIATES, & PADDER UNITS ARE ALL PERFECTLY MATCHED & TESTED.

Above is shown the Saxon intermediate and can, whilst the lower picture illustrates the new type Saxon power transformer. Saxon parts may be had for the construction of any circuit from a midget or a car set to the most complicated Superhet.

Obtainable from Leading Dealers in All States.

Made in Australia by
ECLIPSE RADIO PTY. LTD.,
Melbourne, Sydney, Adelaide, Brisbane.

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