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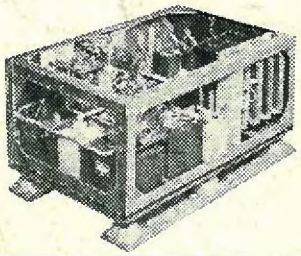

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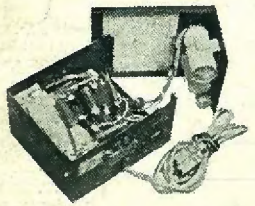

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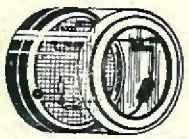

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RADIO CONSTRUCTOR

1/3

Vol. 3 No. 9

APRIL 1950

For Every Radio Enthusiast

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PART I.

Illustrated by John Cura "Tele-Snaps"

BEGINNER'S SUPERHET

by Centre-Tap

REBUILDING the R1155

concluding instalment

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1 mA.	0—1	2in.	M/C D.C.	7/6
5 mA.	0—5	2in.	M/C D.C.	5/-
30 mA.	0—30	2in.	M/C D.C.	10/6
50 mA.	0—50	2in.	M/C D.C.	8/6
150 mA.	0—150	2in.	M/C D.C.	6/-
200 mA.	0—200	2½in.	M/C D.C.	8/6
2.5 Amp.	0—2.5	2in.	Thermo	5/-
3 Amp.	0—3	1½in.	Thermo	5/-
3.5 Amp.	0—3.5	1½in.	Thermo	5/-
20 Amp.	0—20	2in.	M/C D.C.	7/6
25 Amp.	0—25	2½in.	M/I D.C.	2/11
40 Amp.	0—40	2in.	M/C D.C.	7/6
20v.	0—20	2in.	M/C D.C.	5/9

METERS—*continued*

Full Scale Deflection	Scale Marking	Scale Length	Movement	Price
40v.	0—40	2in.	M/C D.C.	5/9
300v.	0—300	1½in.	M/C D.C.	10/-
5,000v.	0—5,000	3½in.	Elect	50/-
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500 u.a.	0—500	2in.	M/C D.C.	7/6
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805	10/-	8012	10/-
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E119I (CV12)	60/-	1625	5/-
EHTT (CV19)	60/-	U19 (CV187)	6/6
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U17 (CV1113)	5/-	NS2 (CV1199)	5/-
E1232 (CV92)	20/-	CV67 (Klystron)	5/-
PT25H (CV1046)	5/-	GU50 (CV1072)	7/6
VU133A (CV54)	6/6	1626 (CV1755)	3/6

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54	275-0-275v. 60 mA., 5v. 2a., 6.3v. 2-3a.	15/-
55	250-0-250v. 100 mA., 5v. 2a., 6.3v. 3-5a.	17/6

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Editorial Offices—57, Maida Vale, Paddington, London, W.9. Tel.: CUNningham 6518
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Edited by: C. W. C. OVERLAND, G2ATV

EDITORIAL

Picture Faults

IN this issue we commence a new series of articles which we are sure will find favour with many of our readers. We refer, of course, to "Television Picture Faults Illustrated." Through the courtesy of Mr. John Cura, who is responsible for the many fine illustrations taken from an actual televisor screen, we are able, for the first time in any magazine, to give readers the benefit of seeing the effects of the faults described, instead of having to rely merely on word pictures.

As far as is possible, the text will be practical. It should be appreciated, however, that it is impossible in a series of this nature to go into complete circuit detail, owing to the numerous arrangements which are used in both home constructed and commercial televisors.

If you have any suggestions to make on this latest venture, please do not hesitate to let us have them. As our regular readers will know, we are always glad to co-operate as much as we can. For example, the series "Building Your Own Signal Generator" is being extended by two articles, solely as a result of suggestions made by interested readers. "The Design of the Superhet" is being similarly extended to cover points which have been raised, and which were not in the original schedule.

VHF Contest

Our companion journal "Short Wave News is this month holding a 144 Mcs Contest. There are two sections, one for transmitters and one for listeners, and E.M.I. Sales and Service have kindly donated two prizes, consisting of sets of valves, for each section. In addition, "Short Wave News" is issuing certificates to the leading entrants. The usual system of points scoring has been abandoned, and all entries will be judged on merit. The judging is being handled by a committee of experts who are well versed in the behaviour of the 145 Mcs band.

The Contest takes place from 0800 G.M.T. 22nd April to 2400 G.M.T. 23rd April. The full details appear in the April issue of "Short Wave News."

Data Book 4

The popularity of television is shown by the fact that we have sold some 40,000 copies of our "Inexpensive Television" since it first appeared some sixteen months ago. We hope soon to make an announcement regarding a revised version, on which we are working at the time of going to press. This new edition will be enlarged to at least twice that of the original, and will contain additional matter which has appeared in this magazine during the past year.

NOTICES

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THE EDITORS invite original contributions on construction of radio subjects. All material used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman will redraw in most cases, but relevant information should be included. All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's nam and address.

COMPONENT REVIEW. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 6518.

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BUILDING YOUR OWN
SIGNAL GENERATOR

By W. G. MORLEY

PART FIVE

In Reply to Queries

WHEN this series of articles began appearing in the "Radio Constructor," a satisfactory amount of interest was caused. Several queries concerning points raised in the articles were received, both from readers and from interested friends, and the writer would like to clear these up in this article.

Firstly, the writer was asked whether it was possible to dispense with a mains transformer having a secondary winding and use a heater transformer alone. In reply to this, one might say that it is, of course, possible to do this, the only trouble being that it would then be necessary to use an HT supply rectified directly from the mains. This would then mean that the HT negative line in the generator was "live," i.e., connected to one side of the mains. Unless a capacitor was connected in the "earthy" as well as in the "hot" output terminal from the signal-generator, it would be impossible to use it for checking "universal" receivers and similar equipment. Also the use of a capacitor in the earthy lead, instead of the direct connection, would be very liable to give mains modulation. In addition, if, in such a case, it was decided (as would be very advisable) to keep the metal case of the signal-generator insulated from the HT negative line, it would be necessary to isolate the tuning capacitor frame, and so on. It may be seen that the risks of damage, shock, and unreliable results, and the necessity of careful insulation, etc., far outweigh the trifling extra expense of using a mains transformer with an HT secondary.

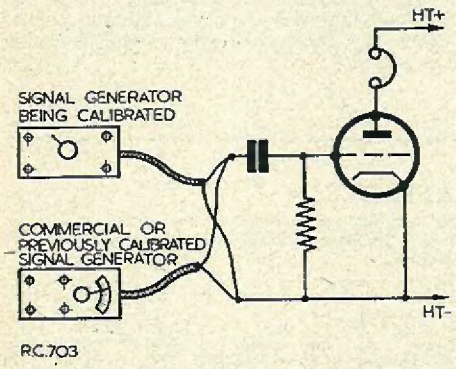

Fig. 1. A method of comparing the frequencies of two signal generators.

Secondly, it has been asked where it is possible to obtain good quality paraffin wax for the coils, as was suggested in the articles. For the small amounts that would be needed in a case like this, the writer can think of no better source than from the wax used in covering small capacitors and coils (which are usually found in profusion in surplus equipment). There is usually enough high-quality wax on, say, a wax-dipped 100pF fixed capacitor to make firm the end-wires on half a dozen coils !

The writer has also received a query concerning the calibration of the home-made generator against a commercial model. As both instruments would cover a range vastly in excess of that given by, say, a normal broadcast receiver, how may the two frequencies be compared ?

A very simple way of doing this is to connect the outputs of the two signal-generators in parallel and apply them to an untuned leaky-grid detector, as is shown in Fig. 1. When the two oscillators are on the same frequency (plus or minus 100 cycles or so), then the familiar "dead beat" will, of course, be indicated in the headphones. There is little need, however, to actually wire up a leaky-grid detector to carry out such a check, as all that has to be done, if a receiver (or amplifier) is available, is to connect the two outputs, *via* the grid capacitor, to a valve grid in an early stage of the AF amplifier section, whereupon the beat-notes may be heard in the loud-speaker.

When calibration is carried out by this method, incidentally, care should be taken to ensure that one is not working on the harmonics

of either the home-built, or the commercial signal-generator.

Again, the writer has been asked whether it is possible to extend the range of a signal-generator of this type to the television frequencies, i.e., 40-50 Mcs in the London area, and up to about 63 Mcs for the Birmingham area.

It may be remembered that, when the ranges which could be covered by Wearite "P" coils were discussed, the top frequency given for the oscillator was 30 Mcs. This top frequency enabled the signal-generator to very adequately cover all the demands met in servicing normal broadcast and all-wave, and even communications receivers. However, using the form of construction given, it is doubtful whether a signal-generator of this type would give any really reliable results if it was intended to have it oscillating, at its fundamental frequency, above 30 Mcs. If it should be desired to use it at higher frequencies, it would be necessary to use an electron-coupled oscillator circuit with a low-capacitance valve such as the EF50. Even then, however, best results would be obtained by limiting the range to about 35 Mcs and using the second harmonic for television frequencies. The calibration would not prove to be too difficult, if the fundamental frequency were checked against another model, and a fairly useful signal output should be obtained.

Really, however, the constructor would be well advised to employ a different constructional technique altogether if he wishes to build a signal-generator covering television frequencies. In the first place, coil switching should be carried out by means of a turret switch, as the long circuit paths that must necessarily accompany ordinary coil switching would cause a great deal of trouble at these higher frequencies. Secondly, a different type of tuning capacitor would be necessary. An ordinary 500pF variable capacitor, which would work quite well on lower frequencies, would be far too clumsy and large for good results on television frequencies. A small-value "miniature" component would be much better. Thirdly, it would be advisable to use Ceramic insulation as far as possible, especially when constructing the tuned circuits around the oscillator. And finally, some form of voltage regulation would prove to be a considerable asset. Commercial signal-generators having ranges of, say, 100 kcs to 80 Mcs are available nowadays ; if these are examined it will be found that most of the above points have been taken into account in their design and manufacture. For the home-constructor, however, the best probable course, if he so desires, is to construct an ordinary signal-generator as outlined in the articles for work on broadcast frequencies ; and, if he wishes to carry out a lot of work on television frequencies, build a separate specialised model for use only on these higher frequencies.

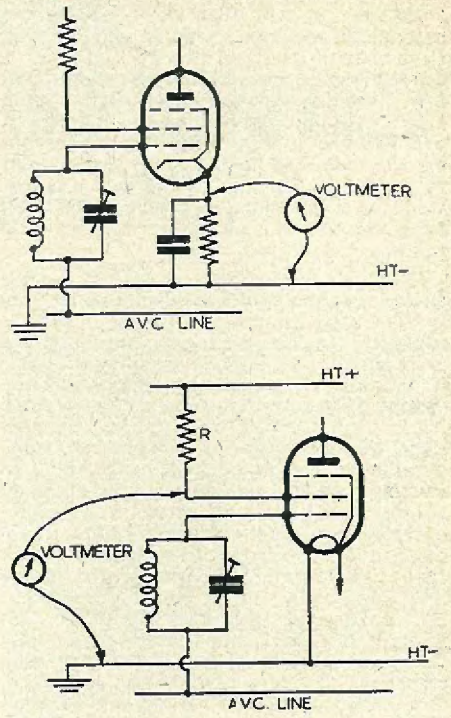

Fig. 2. Two ways in which an indication of the AVC voltage may be obtained, using an ordinary test meter. Fig. 2(a) (top) shows the method of connection for a mains type valve with cathode bias. Fig. 2(b) (below) shows the method for a battery valve.

The writer has also been asked to give some hints on using the signal-generator in practice. A few brief words on accurate alignment would not, therefore, be out of place and would round off this series nicely.

The Signal-Generator in Use

When a signal-generator is used to align a receiver, it will nearly always be found that best results are obtained by relying on visual indication, rather than on aural tests, for finding the optimum position of the various trimmers. That is to say, the use of a meter will give a better indication of trimming accuracy than would the process of simply listening for the loudest sound from the speaker.

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However, it will often be found that an experienced serviceman who is lining up, say, an ordinary broadcast receiver relies to a certain extent on aural indications, especially if he is hard-worked and short of time. But, if he is confronted with a high-quality receiver, or if he wishes to make a really good job of the set he has on hand, he will nearly always resort to the use of a meter. Nevertheless, a few words on lining up aurally might not be amiss here, especially as some readers may not be in possession of suitable meters.

When one is lining up a receiver by ear it is always advisable to use as small a signal from the generator as possible. (It is, of course, assumed that the signal-generator output is modulated). A signal that is only *just* audible is the best. There are two reasons for this. Firstly, it is far easier to judge accurately small increments in strength when using a very quiet signal than it is by using a loud one. Secondly, should the receiver be fitted with AVC, an extremely weak signal is usually insufficiently strong to cause the AVC circuits to come into operation (particularly if the set is fitted, as are most modern receivers, with delayed AVC). Many people recommend short-circuiting the AVC line to chassis during trimming operations, but this practice sometimes affects the constants of the tuned circuits, particularly of those which are completed by the AVC decoupling capacitor. If, during trimming, the signal should become louder as the set becomes better aligned, the output of the signal-generator should be reduced to the barely audible level again. This is one of the reasons, incidentally, why the writer stressed the necessity of incorporating a really useful attenuator, in the articles dealing with its construction.

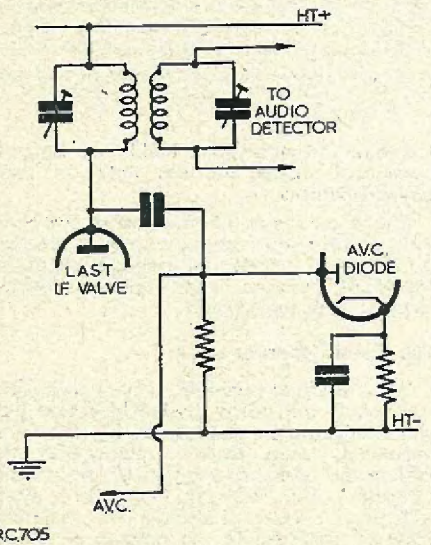

Fig. 3. Showing a fairly common way of obtaining AVC (see text).

Trimming with a Meter

If the receiver is to be trimmed by using a meter or other indicating device, then there are two main courses which may be adopted.

The first method consists of connecting an output meter across the AF output of the receiver. An AC voltmeter connected across the speaker transformer primary will usually suffice. The trimming is then carried out by adjusting for maximum indication in the meter. This method is ideal for a receiver that has no AVC circuits. When it is fitted, the AVC line may be shorted to chassis, but there is, again, always the risk that this may slightly alter the characteristics of some of the tuned circuits.

Should the receiver be fitted with AVC a better method of alignment consists of adjusting for maximum AVC voltage. If such an instrument as a valve voltmeter is not available, changes in AVC voltage may be easily noted by using a normal meter connected to read the voltage on the cathode or screen-grid of an AVC controlled valve. Fig. 2 shows how this may be done.

In Fig. 2(a) we see the meter (switched to an appropriate voltage range) connected across the cathode resistor of an AVC controlled valve. When the AVC voltage increases the valve is given a greater grid bias, and so its cathode current decreases, thereby dropping a smaller voltage across the cathode resistor. The highest AVC voltage will then correspond to the lowest indication on the meter. In Fig. 2(b) the meter (again on a voltage range), is connected between the screen-grid and chassis. In this case, as the cathode current drops owing to increased AVC voltage, so does the screen-grid current, causing less voltage to be dropped across the series screen-grid resistor, R. This time, an increase in AVC voltage will be indicated by a rise in the meter reading. Fig. 2(a) shows the method of connection for mains valves fitted with cathode bias, and Fig. 2(b) for battery valves. If the decoupling capacitors are working properly, the long meter leads will not affect the working of the receiver. It is advisable, nevertheless, to connect the meter to a valve in the IF stage or stages.

Should the receiver be fitted with a visual indicator which operates from the AVC, such as a Magic Eye or S-Meter, then this indicator may be used when trimming, instead of using an externally-connected meter.

There is one small point which should be mentioned whilst we are on the subject of

(*continued on page* 263)

Design of the SUPERHET

PART 6

By R. J. CABORN

The IF Amplifier as a Whole

IN last month's article we went into the theory of IF amplification in some detail. Let us now discuss the complete IF amplifier as a whole. Fig. 1 shows the circuit of a typical one-valve IF amplifier. As may be seen, it is exceedingly straight-forward and simple. The anode of the frequency-changer supplies the intermediate frequency to the primary of the first IF transformer. The secondary of this transformer is connected to the grid of the IF amplifying valve, an ordinary RF pentode, which then feeds the amplifier signal into the second IF transformer and thence to the detector.

It will be noticed that there is no anode decoupling. Decoupling is unnecessary because only one stage of amplification is carried out at the intermediate frequency, and the chances of feedback are therefore fairly low. It should also be seen, however, that a large capacitor, 4μF or more, is connected across the HT supply to bypass to chassis any RF or IF voltages formed in the HT positive line. This capacitor, in practice, would also serve to decouple the later AF stages, in addition to reducing hum if a mains power supply is used for the receiver.

If the second IF transformer is intended to feed into a diode detector, as is nearly always the case, its coils are usually more tightly coupled than those of the first IF transformer. This is owing to the fact that the diode detector presents a slight load and the coupling must therefore be somewhat tighter for optimum transference of IF voltage, whilst still maintaining the band-pass characteristic necessary for good-quality reception. (If an infinite impedance detector is used, then no loading is present and the second IF transformer may be identical to the first.)

It is not intended at this stage to consider the circuit of an IF amplifier with more than one amplifying stage as, without having first considered AVC and other forms of volume control, any diagrams shown could not be entirely practicable. IF amplifiers using more than one stage will be found mainly in communications-type and specialised receivers, whilst domestic receivers very rarely need more than the one valve.

Detection

At first sight several types of detector would appear to be available to detect the IF signal and make it available for AF amplification. These are, mainly, the leaky-grid, the anode-bend

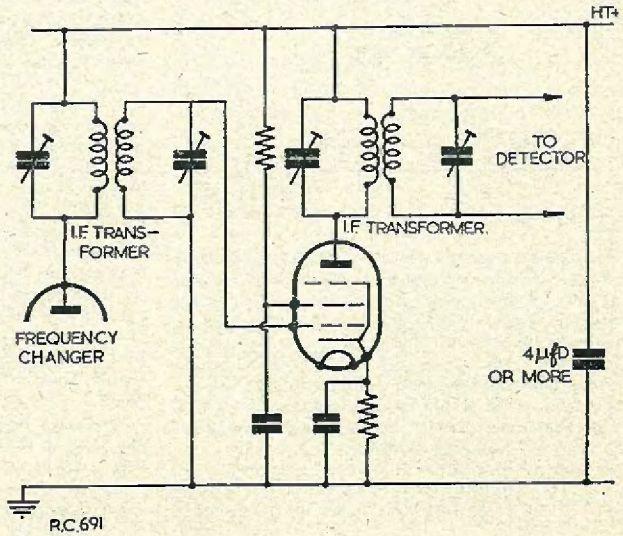

Fig. 1. A typical IF amplifier.

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and the diode detector.* It is usually stated that the diode detector is more insensitive than the other two types. Certainly, insofar as the leaky-grid and anode-bend detectors employ amplification as an integral part of the detection, may it be conceded that this is true. So far as superhet detection is concerned, however, the signal gain given by the IF amplifier makes the choice of detector almost entirely independent of any considerations of sensitivity.

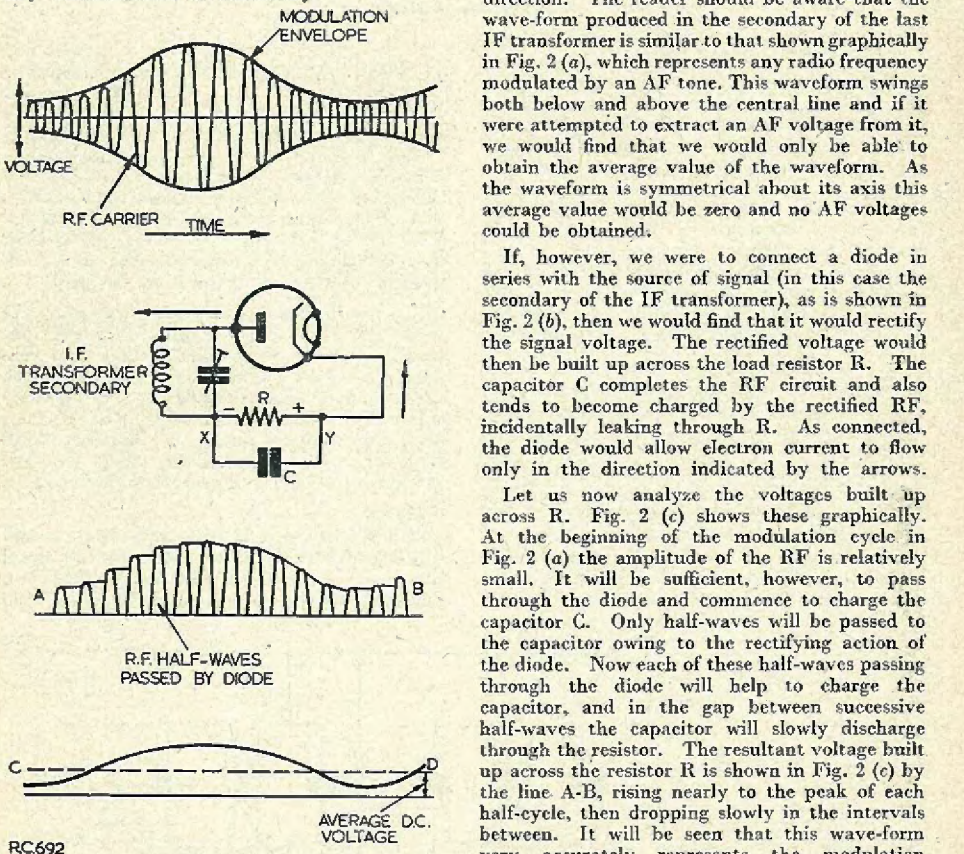

Fig. 2(a-d), reading from top to bottom. Fig. 2(a) shows the appearance of an RF carrier modulated by an AF tone. Fig. 2(b) depicts a simple diode detector circuit. Fig. 2(c) shows the voltage built up across R in the circuit of Fig. 2(b). In practice, the frequency of the half-cycles would be considerably greater than that shown here, and the "ripple" on the line A-B would be infinitesimal. Fig. 2(d) shows the DC component present in the waveform of Fig. 2(c).

* The Infinite Impedance detector will be dealt with separately in next month's article.

In practice it is found that both leaky-grid and anode-bend detectors introduce distortion, particularly so when handling signals of large amplitude. The diode detector, however, is almost entirely free from distortion and will handle even very heavy signals quite comfortably. Hence its choice as detector in a modern superhet.

Now the diode functions as a detector by reason of the fact that it may only pass current in one direction. The reader should be aware that the wave-form produced in the secondary of the last IF transformer is similar to that shown graphically in Fig. 2 (*a*), which represents any radio frequency modulated by an AF tone. This waveform swings both below and above the central line and if it were attempted to extract an AF voltage from it, we would find that we would only be able to obtain the average value of the waveform. As the waveform is symmetrical about its axis this average value would be zero and no AF voltages could be obtained.

If, however, we were to connect a diode in series with the source of signal (in this case the secondary of the IF transformer), as is shown in Fig. 2 (*b*), then we would find that it would rectify the signal voltage. The rectified voltage would then be built up across the load resistor R. The capacitor C completes the RF circuit and also tends to become charged by the rectified RF, incidentally leaking through R. As connected, the diode would allow electron current to flow only in the direction indicated by the arrows.

Let us now analyze the voltages built up across R. Fig. 2 (*c*) shows these graphically. At the beginning of the modulation cycle in Fig. 2 (*a*) the amplitude of the RF is relatively small. It will be sufficient, however, to pass through the diode and commence to charge the capacitor C. Only half-waves will be passed to the capacitor owing to the rectifying action of the diode. Now each of these half-waves passing through the diode will help to charge the capacitor, and in the gap between successive half-waves the capacitor will slowly discharge through the resistor. The resultant voltage built up across the resistor R is shown in Fig. 2 (*c*) by the line A-B, rising nearly to the peak of each half-cycle, then dropping slowly in the intervals between. It will be seen that this wave-form very accurately represents the modulation envelope of Fig. 2 (*a*); and it may be used to actuate the AF amplifying stages. It will also be noticed that there is a slight "ripple" on the detected wave-form owing to the successive charging and discharging of C. However, in practice this ripple occurs at the frequency of the RF, which is too high to have any audible effect.*

A second (and very important) result of the detection is that a DC voltage is also developed. Fig. 2 (*d*) shows the appearance of the voltage

* This type of detection, obviously enough, is known as "diode peak detection."

built up across R with the RF half-waves removed for simplicity, and it will be seen that, in addition to the AF waveform, this curve possesses an average DC voltage represented by the line C-D. Returning to Fig. 2 (*b*), this will mean that the end Y of resistor R is always positive with respect to X when a signal is being detected. The value of the DC developed will be proportional to the strength of the signal.

Now it does not need much manipulation to change the circuit of Fig. 2 (*b*) into a more practical form. To begin with, if we were to connect the cathode of the diode to chassis we would then get the circuit of Fig. 3 (*a*) which is otherwise identical to that of Fig. 2 (*b*). Our next task is to find a method of applying the AF formed by detection to the AF amplifier.

An obvious method of doing this would be to connect our AF amplifier across the load resistor R. This has been done in Fig. 3 (*b*), in which the cathode and grid of a triode AF amplifying valve has been connected, with suitable biasing arrangements, across R.

Now, however, another difficulty becomes apparent. It may be remembered that, several paragraphs back, we observed that the resistor R has a DC voltage built up across it in addition to the detected AF. This voltage, due to the direct connection between R and the grid of the triode, will be applied to that grid, thereby upsetting our biasing arrangements. As this DC voltage is proportional to the amplitude of the signal applied to the diode, a strong signal may quite easily overbias the triode, causing very heavy distortion.

The simplest way of isolating the triode grid from the unwanted DC voltage is to connect a capacitor in series. This has been done in Fig. 3 (*c*) by the introduction of C_1. A grid leak R_1 is then also, of course, necessary to provide a grid return for the triode. The value of C_1 will need to be sufficiently large to pass AF.

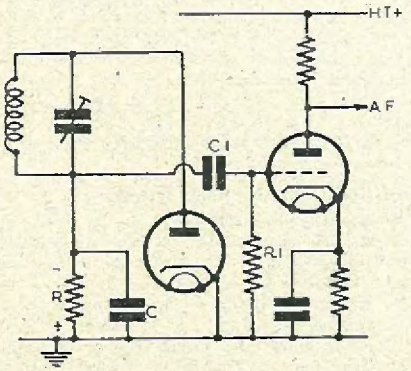

Fig. 3(c). Isolating the AF amplifier grid from the DC voltage built up across R.

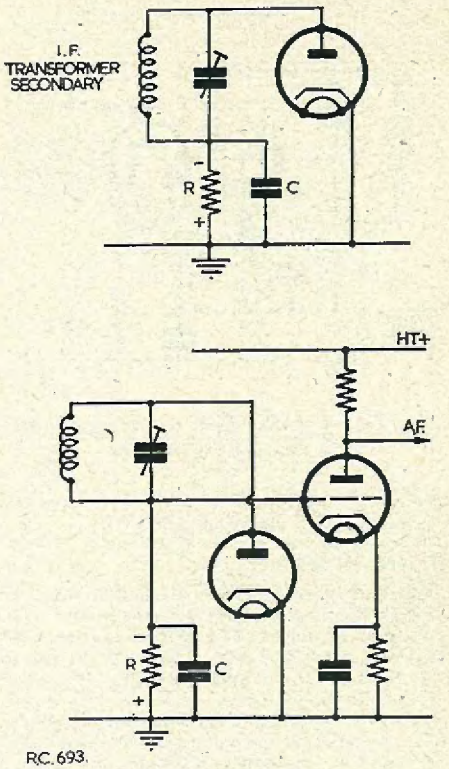

Fig. 3(a) (top). Basic diode detector.
Fig. 3(b) (bottom). Connecting to an AF amplifier.

Using a Double-Diode-Triode

Now, owing to the fact that double-diode-triode valves are readily obtainable, we might effect a saving in space and cost if we were to combine the separate diode and triode valves of Fig. 3 (*c*) into one valve. However, the cathode of the usual double-diode-triode is common to both triode and diodes. Nevertheless, if we transfer the "bottom ends" of R and C (Fig. 3 (*c*)) from chassis to the cathode of the double-diode-triode we will still have the same RF detection circuit, whilst, at the same time, maintaining the cathode bias necessary for the triode. Fig. 3 (*d*) shows how this is done.

Our detection circuit is now beginning to take a practicable shape. There are still, however, a few more snags to overcome. The next point to consider is that there is still a certain amount of RF built up across the resistor R which may possibly be amplified by the triode, causing instability. This RF can be filtered out by

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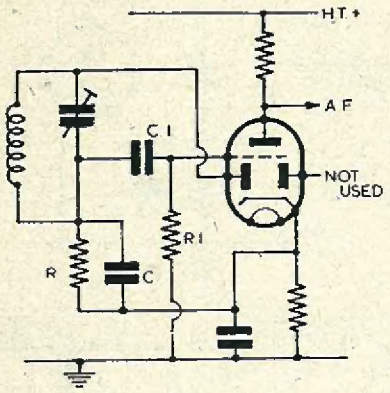


Fig. 3(d). Using a diode section of a double-diode-triode for detection.

adding an additional resistor and capacitor, R_2 and C_2 as is shown in Fig. 3 (*e*).

DC and AC Loads

All that is left now is to work out the values of components used in the detector circuit. The values of R and R_1 (Fig. 3 (*e*)) are the most critical. Now R, being connected directly in the diode circuit, is known as the "DC load" of the diode. However, as far as AF is concerned, the capacitor C_1 has negligible resistance, and the AF load may therefore be represented by R and R_1 in parallel. (Actually the AF load is usually referred to as the "AC load.") Thus we have two loads for the diode—R by itself as the "DC load" and R and R_1 in parallel as the "AC load."

Now, for the highest fidelity of detection, the DC and AC loads should have identical values. However, this is obviously impossible when the DC load is offered by one resistor and the AC load by the same resistor paralleled with another. The best thing we can do is to make the value of

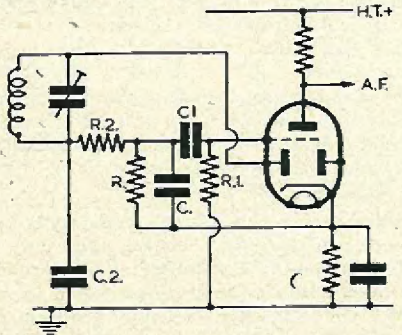


Fig. 3(e). Filtering out the RF built up across R.

R_1 so high with respect to R that the effect of connecting it in parallel is to only slightly alter its value. In practice, the value of R is usually about 150 to 250 kΩ and the value of R_1 is set at about 1 to 2 Meg Ω*. For distortionless detection of signals whose modulation depth is below 80%, R_1 should have a value at least four times that of R.

In addition, we can reduce the effect of R_1 on R by using R as a volume control, it being customary to have the superhet volume control at the diode detector stage. R may therefore be replaced by a potentiometer, as shown in Fig. 3 (*f*). The effect of this potentiometer (apart from the obvious one of controlling volume) is to ensure that the shunting effect of R_1 across R is reduced as volume is decreased, thereby ensuring that at all but the fullest volume levels our detection is almost entirely free from distortion.

Using the Detector in Practice

The circuit of Fig. 3 (*f*) is that of a very efficient and useful modern detector. It is by no means the only circuit which may be used, of course, but it is useful here insofar as it illustrates all the various points encountered in detector design. When using a circuit of this type it is advisable to have the double-diode-triode, the volume control and the IF transformer sufficiently close to each other to enable short connecting leads to be used. Screened leads (particularly to the volume control) are not always advisable, except perhaps to take a connection up to the top grid of the double-diode-triode valve, as these may possibly alter the trimming capacitances of the IF transformers at different volume levels. This is, of course, due to the relatively high capacitance existing between the centre lead of the screened wire and its screening.

As stated above, Fig. 3 (*f*) is by no means the only diode detector circuit which may be used. There are many others, nearly all being variations on the same theme, however, and the home-constructor would not be ill-advised to use a circuit of this type in his first superhet, since it is so trouble-free in operation. For this reason, component values have been given. We will by now have seen, after the various steps taken to enable us to reach Fig. 3 (*f*) from Fig. 3 (*a*), that the design of a diode detector is not so simple as it may at first appear!

Load Offered by the Diode Detector

We mentioned at the beginning of this article that the IF transformer feeding the diode is usually more tightly coupled than are the other

* R_1 cannot have too large a value as the grid of the triode may "block." On the other hand, the other resistor R cannot have too low a value as it would load the IF transformer secondary too heavily! The values given in the text therefore are a compromise.

transformers, owing to the load offered by this type of detector. This load is occasioned by the necessity of charging C at each half-wave peak. See Figs. 2 (*b*) and 2 (*c*). The secondary of the IF transformer is therefore damped for a short time on each cycle, causing a slight distortion of the wave-form. This distortion is usually too small to have a great effect on reproduction, providing that the value of the load resistor R has been made sufficiently large.

Next month, however, we shall deal with a detector which offers no load at all—the infinite impedance detector. After that we will proceed to a consideration of automatic volume control.

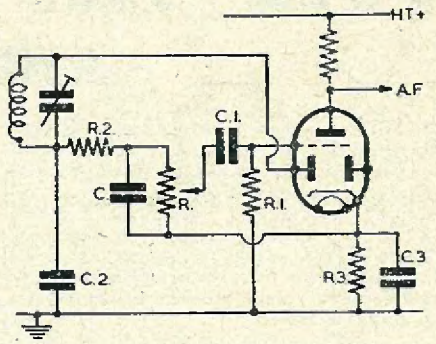
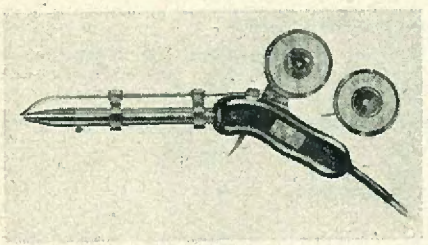


Fig. 3(f). Inserting a variable gain control, to give a complete, practical circuit.

TRADE NOTES



One of the Wolfe Solderguns which is fitted with a drum of solder and an easily controlled system of feeding.

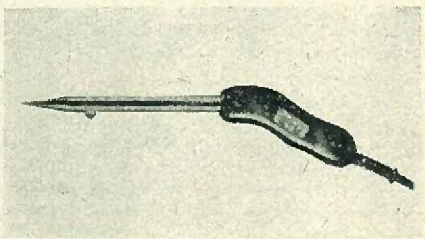
WOLF ELECTRIC SOLDERGUNS

A new introduction by Wolf Electric Tools Ltd., the famous manufacturers of portable electric tools, is a range of Electric Solderguns which they claim will overcome hitherto common criticism of this type of equipment.

Industrial soldering requirements have long called for soldering tools which will reach operating temperature quickly, will maintain a correct constant heat, prove economical in current consumption and are "easy in the hand" for long production periods.

The illustrations picture two irons from their range of six hand models and particular attention is directed to the off-straight hand grip which lends to much more comfortable control. By ingenious arrangement within the heating element, the heat is localised around the copper bit and with the elimination of wasted heat areas, considerable economy in current consumption has been effected. At the same time tendency towards excessive temperature rise is avoided and this in turn prolongs heating element life and saves oxydisation of the copper bits. Wolf solder-guns can be supplied for the following voltages :—

24, 50, 100/110, 115/130, 200/220, 225/250 ; and each gun is fitted with six feet of 3-core cable. Models are available for a wide range of purposes from fine instrument to heavy duty work. Full details obtainable from Wolf Electric Tools Ltd., Pioneer Works, Hanger Lane, Ealing, London, W.5. Telephone : PERivale 5631/4.



A Wolfe Soldergun of the plain type.

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THE SUPERHET
AND THE BEGINNER

SCARCELY a day passes without a beginner enquiring as to the simplest form of superheterodyne receiver, hopefully expecting to learn of a pleasant introduction to a sure-fire design which he can get working with but little constructional knowledge and no test equipment. Whilst kits *are* available with simple instructions for home assembly, they are inevitably expensive, entailing as they must pre-aligned tuning packs and IF transformers.

The beginner does not need to be told of such kits—he knows of them already ! What he hopes for is an arrangement he can build from the bits and pieces to be found in the average junk box, and quite honestly the only advice that can be given him is that it just isn't practicable. There is, however, a useful approach for the enthusiast who is eager to learn and to do a little experimenting for himself. After all, that is the quickest and most pleasant way to learn, and it is hoped that these notes will help in guiding such enquirers in the construction of an efficient, yet simple, superhet receiver from inexpensive parts.

From the experience gained they will later be able to tackle confidently something even more ambitious than a commercially designed receiver in the so-called "popular price class." As the beginner will discover when he has learned a little more about receiver design, the commercial set would be an infinitely better job if the public would only allow the manufacturer to spend a few more pounds on it.

Practical Considerations

Before getting down to the business of construction, it would be as well first to examine the essential difference between the straight and the superhet receiver, keeping the theory part of it to the simplest form. With the straight receiver, from the detector and following stages the signal appears at audio frequency, which makes it possible for the signal to be traced (or its absence noted) by the aid of a pair of earphones.

In the superhet, the signal is first at radio frequency, then it is changed to the intermediate frequency. Both are far above the range of human audibility, so that checking the performance is not possible without instruments, quite apart from the additional complication involved. It is only in the final stages (after the second detector, or demodulator) that the signal becomes audible.

Heterodyne reception is not such a recent development as many beginners appear to imagine. Indeed, the principle was applied as early as 1901, and the practical capabilities in more or less their present form were investigated and used in 1918. It was not, however, until 1932 that the superhet really came into its own, when the introduction of multi-electrode valves made the three or four valve superhet possible. Its high performance, low cost and one-knob tuning control quickly popularised it, particularly as one of its inherent advantages, selectivity, became in increasingly urgent demand.

Constructional Problems

Now for the snags, from the inexperienced constructor's point of view. The multi-electrode valves cause added complications. The one-knob tuning control requires that the tuned circuits should 'track' correctly throughout the tuning range—by tracking, we mean that the pre-determined difference in frequency of the RF and Oscillator sections must be constant at all settings of the dial. Further, the amplification of the signal is at the pre-determined intermediate frequency which, although it requires no further adjustment when once set, must be correctly tuned in the first instance.

In considering the design for a simply built set, it will be easiest to first break it down stage by stage, and in doing so to see what can be dispensed with and what must be included, and the simplest way of achieving it. Firstly, the

CENTRE TAP

offers a practical article, describing a simple superhet receiver which can be easily and cheaply built by the beginner

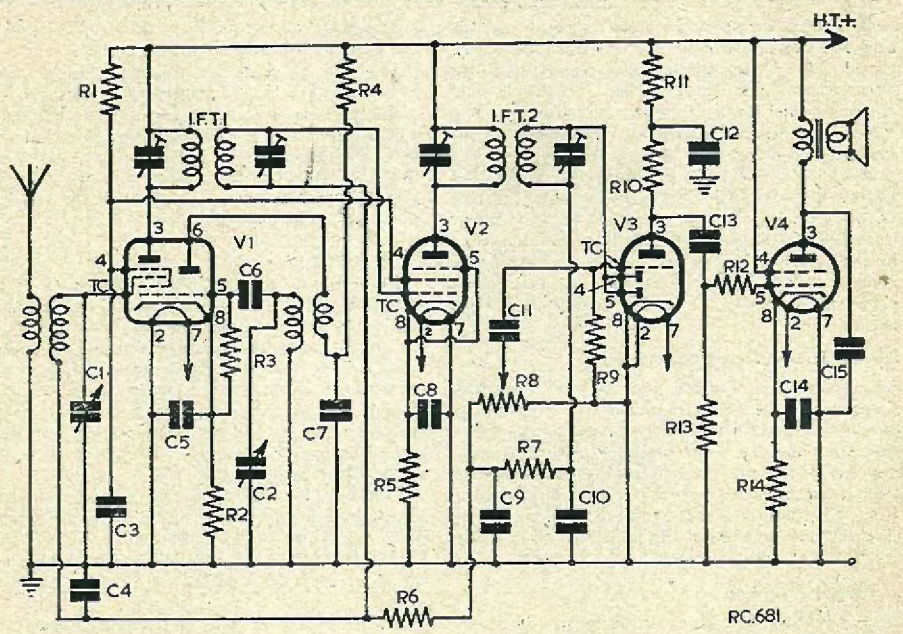

Fig. 1. Circuit of the Beginner's Superhet.

Component Values

R1, 27*k*Ω	*R11*, 27*k*Ω	*C7*, 0.1μ*F*
R2, 150Ω	*R12*, 6.8*k*Ω	*C8*, 0.1μ*F*
R3, 47*k*Ω	*R13*, 470*k*Ω	*C9*, 68*pF*
R4, 47*k*Ω	*R14*, 220Ω	*C10*, 100*pF*
R5, 470Ω	*C1*, 2, 500*pF*	*C11*, 0.01μ*F*
R6, 1*M*Ω	*C3*, 0.1μ*F*	*C12*, 8.0μ*F*
R7, 10*k*Ω	*C4*, 0.1μ*F*	*C13*, 0.01μ*F*
R8, 500*k*Ω	*C5*, 0.1μ*F*	*C14*, 50.0μ*F* 50*V*
R9, 2*M*Ω	*C6*, 100*pF*	*C15*, 0.02μ*F*
R10, 470*k*Ω		
*IFT*1, 2, 465 *kcs.*	*V1*, 6K8 *V2*, 6K7 *V3*, 6Q7 *V4*, 6V6	

RF Stage

This works in exactly the same way as it does in a straight receiver. Its purpose is to amplify the signal picked up on the aerial. When amplified, it is in the same form as when received. Although high-class communications type receivers often have two RF stages, they are rarely found in commercial broadcast receiver design. The signal from the RF stage, if used, is fed to the

Mixer or Frequency Changer

In more specialised receivers this stage comprises two valves, the second being a triode used to generate a local oscillation. In broadcast receiver design a "double-valve" is used, having a triode section for this purpose, and the local oscillation "beats" with the incoming signal to produce an intermediate (or third) frequency. Incidentally, a number of other frequencies appear, but the following stage accepts only that to which it is tuned for our purposes. Thus the local oscillator must follow the tuning of the signal frequency stage, plus (or minus) the intermediate frequency, in order to keep in step, or more correctly to "track," throughout the whole tuning range.

From the design point of view this is not a simple matter, if we are to gang the controls, and is the chief problem confronting the constructor. Although the signal is now at the intermediate frequency, it is still far above audibility and impossible to check without instruments. The signal is then passed to the

IF Amplifier(s)

This may consist of one or more stages and is, basically, a means only of increasing the magni-

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tude of what is still only a small signal. For this purpose the familiar IF transformers are used, tuned either by small adjustable capacitors or an adjustable "iron" core or slug. Once set, they should require normally no further tuning. The initial adjustment in itself is a relatively simple matter, requiring the setting which gives the maximum output. This does not mean the beginner can trim the IF's in his domestic receiver with impunity. They must be set for the correct intermediate frequency to suit the oscillator stage in the set, but it is immaterial in a home-built receiver what frequency is used as long as it suits the oscillator. The IF voltages are then fed to the

Second Detector or Demodulator

where they are rectified and for the first time become of an audible frequency. It is usual to employ a diode for this purpose, and as the valve can conveniently be a double-diode-triode (or pentode) the second diode is used for AVC and the triode (or pentode) section for amplification. From this point the AF amplification and reproduction in the speaker is the same as in the output stage of a straight receiver.

A Practical Design

Bearing this very abbreviated outline in mind, it becomes possible to settle on a suitable design. The RF stage can be discarded—it is not incorporated in any of the popularly priced broadcast receivers.

The use of a triode-hexode obviates the need for a separate oscillator, and if separate tuning capacitors are used instead of a gang the difficult problem of aligning the "tracking" is sidestepped, except that we have to tune with two knobs instead of one.

Such a receiver is certainly far less convenient, but it is infinitely easier to construct and get working. After all, from the building and use of it, the beginner will learn far more than from a bookshelf of text books, and find himself well on the road to tackling advanced designs.

The only difficulty now remaining is the alignment of the IF transformers. While a test oscillator is an advantage for doing this, it is no longer essential. All that is required is that they should be trimmed to the same frequency, and this is done by tuning to maximum hiss, or if the set has been tuned to a signal, to the point of strongest reception.

Construction

Examination by the more experienced of the circuit depicted for a suitable receiver of this kind, will show it closely follows standard practice. It has, of course, been fully tried out on experimental lines, taking liberties with the layout and screening, etc., to ensure a reasonable certainty of trouble-free performance, and it can confidently be recommended to the reader with but little constructional experience. A suggested layout is also illustrated.

The usual rules of good constructional practice should be followed: short and direct wiring, clean and electrically sound joints, short earth return leads taken to one or two points rather than spread all over the chassis, and the use of sound commonsense.

The chassis should be metal, or foil lined plywood, and the coils can be of the Wearite "P" type, Premier, Denco or similar good makes. The "way round" of the aerial coil connections is not important, but the windings of the oscillator coil must be in phase, and the leads to the 6K8 triode anode and HT+ should be reversed if there is no signal or very weak reception. The coils, too, if unscreened must be adequately spaced, and are best arranged one above and one below the chassis, preferably with the former vertical and the latter horizontal.

The IF transformers should be 465 kcs, and either of the capacitor or core tuned types is equally suitable.

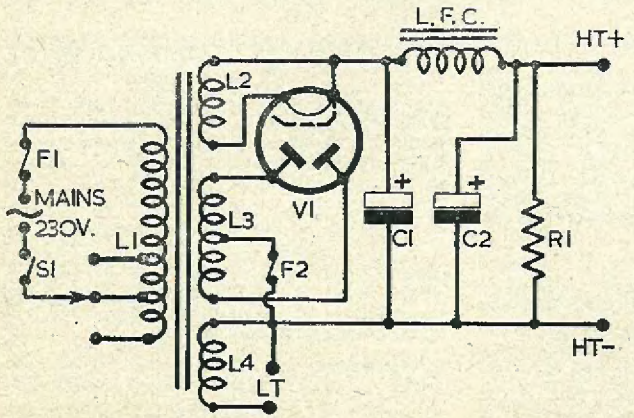

Fig. 2. Circuit of a suitable power supply.

Values

Mains transformer: L1 to suit mains. L2: 5V at 2A. L3: 250-0-250V at 80mA. L4: 6.3V at 3A. V1: U50, 5Z4G or equivalent. LFC: 20 Hy at 80mA. C1: 8μF 500V. C2: 16μF 500V. S1: Toggle On-Off Switch. F1: 1A fuse. R1 is optional. If used, to aid voltage regulation, suitable value is 20kΩ 5W.

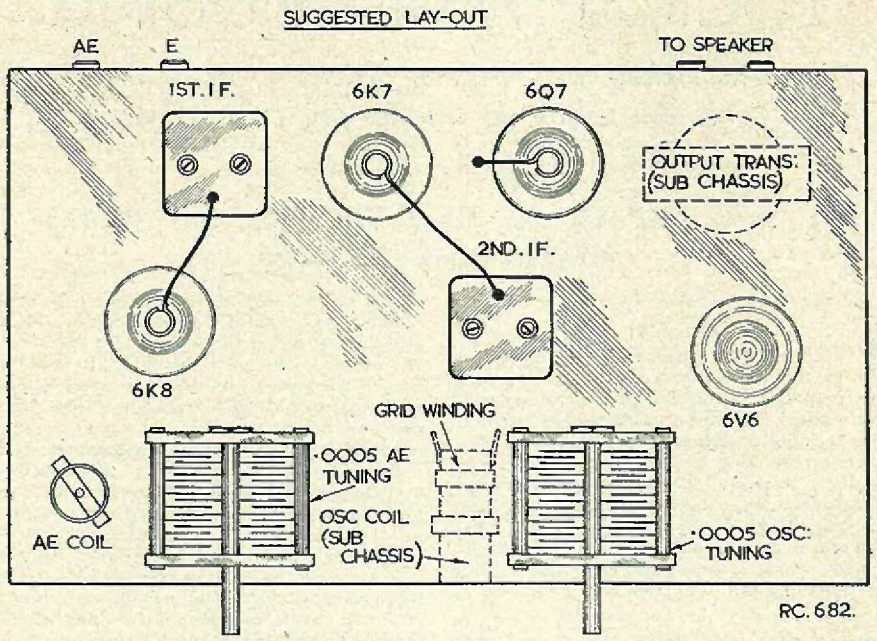

Fig. 3. Suggested layout for the beginner's superhet.

The leads to the valve pins are numbered, so no difficulty should be found with their wiring.

A power pack giving 6.3V at 1.5A or more for the heaters and 250V at 80mA upwards for the HT supply will be needed.

Constructors of somewhat greater experience may prefer to use this circuit experimentally, and for them it is suggested that a double-diode-pentode, such as the 6B8 might be used in place of the 6Q7 and the 6V6 omitted. Suitable matching transformers for such an arrangement are fairly widely available, and the output, although substantially less, will be found adequate for normal listening except for the more distant broadcasters.

Despite its simplicity, the receiver when properly made and correctly adjusted should give a performance comparable to the average domestic receiver.

Adjustment and Tuning

If a test oscillator is available, the alignment of the IF's to 465 kcs will be a simple matter, but the exact adjustment of them is not important as long as they are all tuned to the same frequency. The primary of the first IFT, that is the winding between pin 3 and of the 6K8 and HT+ should be tuned to approximately its mid-way setting. The remainder of the IF trimmers or cores are then adjusted either for maximum hiss or the strongest signal. Once they are aligned, C2 is rotated until a signal is heard and C1 adjusted for maximum strength.

Any final trimming or adjustments to the IF's can then be made, keeping the volume control well back so that the optimum points are easily detected. The circuit will be found very effective even with small aerials, and the off-station hiss (volume up and tuned to a point between stations) will, due to the AVC action, be noticeably strong. This hiss disappears when a signal is tuned in, of course, and is caused by the AVC allowing the set to operate at maximum gain in the absence of a signal.

THE EDITOR INVITES . .

● **Constructional articles suitable for publication in this journal. Prospective writers, particularly new writers, are invited to apply for our "Guide to the writing of Constructional Articles" which will be sent on request. This guide will prove of material assistance to those who aspire to journalism and will make article writing a real pleasure!**

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LOGICAL FAULT FINDING

The eighth in a series of articles to assist the home constructor in tracing and curing faults

By J. R. DAVIES

9: THE REPAIR OF DIAL DRIVES AND OTHER MECHANICAL DEVICES

Overstrung Wireless Sets

AROUND about 1930-35, when commercial radio sets were beginning to settle down to the conventional four valve superhet pattern that is still in use, manufacturers must have realised that there was little to choose, so far as technical specifications went, between their products and those of their rivals. It was at this time, therefore, that some very weird and wonderful tuning systems came into being, these consisting of all manner of scales and dials; some of conventional and others of novel design; some of simple construction, and others which were anything but that; and all advertised as being easy-to-read scales which made tuning child's play! These devices usually utilised a complicated system of pulleys and string between the tuning knob and the variable capacitor, this system serving also to move the conglomeration of pointers, etc., that graced the front of the cabinet. A large number of these devices were of sound design and were well made, very seldom breaking down or giving trouble. The remainder, alas, were not so! In these cases it was found that the string continually broke, or came away from the pulleys: or that the drive caused backlash or inaccurate tuning. Occasionally, one would encounter a drive designed in such a manner that the cord could only be fixed correctly *after* the chassis had been put in the cabinet; the result being that many weary hours of work were spent by the serviceman in getting the thing to work. Almost invariably, adjustments in cord tension, etc., had to be made with the chassis out of the cabinet.

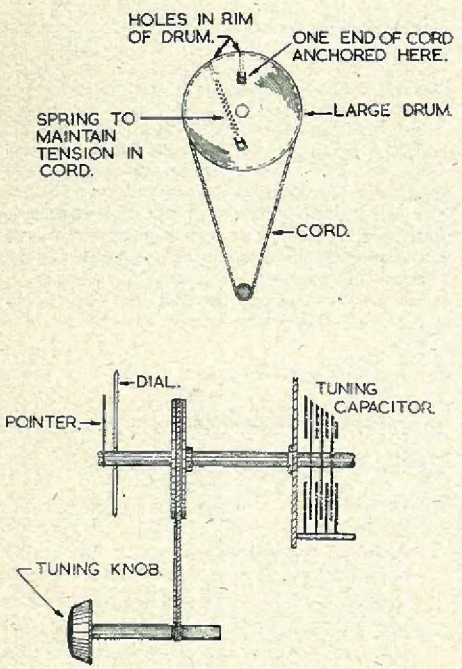

Fig. 52(a-b). A simple and effective tuning drive.

When one has a piece of complicated apparatus like a wireless set, it is very irritating to find that the most unreliable part of the equipment is something that should practically never break down. The writer refers, of course, to the tuning drive, whose job, after all, is the very simple one of giving a reduction gearing between the tuning knob and its capacitor.

The above remarks are an outburst on the part of the writer, being bottled up during the considerable time he has spent in getting these contrivances to work correctly. The professional serviceman will read and silently understand! It must be understood that the writer refers only to a minority of commercial receivers, the majority giving no trouble on this score. Most manufacturers go to great lengths to ensure reliability, very strong cord and a minimum of pulleys being utilised. One well-known firm uses steel cable for their tuning drives, so that, barring accidents, the tuning system should last almost indefinitely.

The writer intends, in this article, to run briefly through the various types of tuning drive commonly met, and to give some hints concerning their reliable repair. He will also deal with those reduction drives that do not rely on cords for their driving medium; as well as with a few devices which are used to indicate the wave-range to which the set is switched.

1—Cord-Driven Tuning Systems

When, for purposes of classification, the various tuning systems are examined for points of similarity we find that there are actually very few different types of cord drive in common use.

The first and simplest type that we shall consider is shown in Fig. 52 (*a*) and (*b*). The small pulley drives the larger, giving the required reduction gearing. The cord is kept constantly in tension by means of the spring on the large pulley. The pointer is mounted on an extension of the tuning capacitor spindle projecting through the scale. Alternatively a glass scale may be used, the pointer being behind it. A very simple system and one that should give little trouble in use.

Fig. 53 shows a more complicated version, in which the tuning pointer now moves horizontally along the scale. The tuning capacitor is driven as before, but another cord is now fitted to the large pulley, this cord moving the pointer. The second cord is kept in tension by means of an additional spring fitted to the large pulley. Sometimes this second tensioning spring is introduced at the point where the cord is attached to the pointer mounting. This system can cause more trouble than can that shown in Fig. 52, as the original drive system has now got more work to do. If the pointer slide is dirty, then its action will be irregular and jerky, causing wear on the cord and backlash in tuning. The slide should be cleaned with carbon tetrachloride, petrol or any other cleaning fluid, a spot of light oil being added afterwards. The movement of the pointer will soon spread the oil over the surface of the slide.

The third scheme which we shall consider is shown in Fig. 54. In this system one cord is used for both jobs of tuning the set and of moving the pointer. Faults (particularly that of backlash) are more frequent with this type of drive. Cures usually consist of cleaning the pointer slide or of readjusting the spring tension.

The Repair of Faulty Cord Drives

The repair of faulty cord drives is usually quite simple, although sometimes a certain amount of patience is needed. A good strong cord is essential for replacements, fishing twine, etc., being easily obtainable for this purpose. If possible, it is always advisable to see which way the original cord (if broken) was fixed before fitting the new one. It is surprising to find over how many different routes the cord may run in a set which can be described (for politeness' sake) as one of the multi-pulley type! Much time may also be saved if the number of turns on the driving pulley is checked before removing the old cord. In Fig. 55 we see a typical example of a driving pulley, the cord being passed around it three times to obtain sufficient grip. If too few or too many turns are used here, the cord may either slip or "crowd" at one end of the pulley.

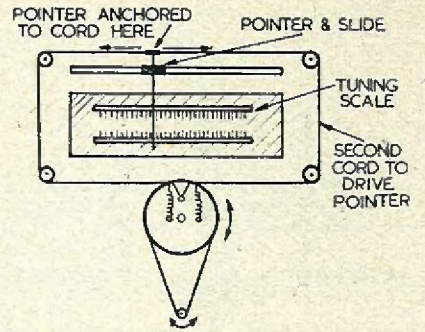

Fig. 53. A more complicated form of tuning drive.

In nearly every case, the cord can be attached to the pointer slide (see Figs. 53 and 54) after everything else is done. The usual method of fixing a new cord is to start at the point at which it is anchored to the driven or "following" drum on the tuning capacitor, take it around all the pulleys and then back to the tensioning spring, holding the latter tight with a pair of long-nosed pliers whilst the string is fastened with three or four half-hitches. Alternatively, if the spring tension needs to be relatively heavy, the anchored end of the spring may be taken off its hook on the drum and the cord knotted to it at the correct place. The spring is then pulled back and hooked on again.

Backlash is a fault that is often difficult to cure. If the tuning capacitor is mounted on rubber washers (as in Fig. 15) there is almost certain to be some slight backlash. Quite often, the manufacturers mount both the capacitor and its drive wheel on a separate chassis to clear this trouble, the separate chassis being "floating" with respect to the rest of the set. If this is not the case, a check can always be made to see that

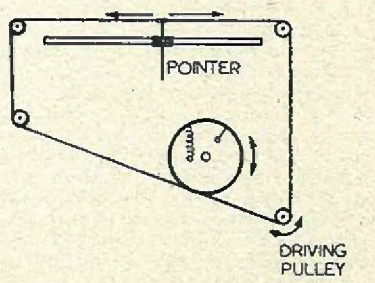

Fig. 54. A version of Fig. 53 in which one cord only is used.

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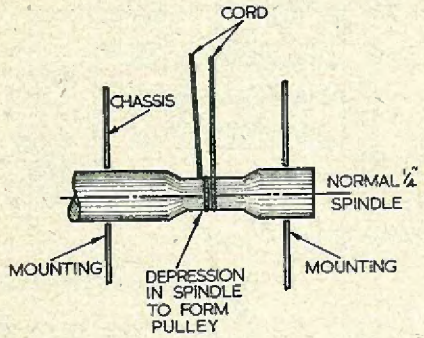

Fig. 55. A typical example of the manner in which the cord may be attached to the driver spindle.

the rotation of the moving vanes of the tuning capacitor is not unduly stiff. Alternatively, the cord may be tightened or the tuning slide, etc., cleaned and oiled. Another cause of backlash may sometimes be found in the mounting of the driving spindle itself, particularly if this is made of brass. Fig. 56 (*a*) shows how a brass axle, fitted in steel bearings may wear after use. A good cure is to re-position the spindle slightly, as shown in Fig. 56 (*b*). The method shown in the diagram of preventing lateral movement, *i.e.*, the ridge and split washer, will not, of course, apply to all types of spindle. The serviceman should alter the position of the spindle in the manner best suited to the particular type in use.

2—Non-Cord Gearing

A large proportion of present-day receivers use reduction drives which do not utilise a cord link. In other words, gear wheels are used (sometimes in combination with a cord drive).

Fig. 57 (*a*) and (*b*) depict a cog-wheel drive often encountered, particularly so with communications receivers and the more expensive all-wave sets. The larger wheel in the diagram consists of two separate cog wheels, mounted side by side. Wheel A (Fig. 57 (*b*)) is fastened rigidly to the "following" shaft, whereas wheel B is free to rotate on the shaft as axis. Both wheels locate with the teeth on the driver cog C. The wheel B is sprung against wheel A by means of two springs, D and E, so that the combined cog wheel A and B always has its teeth pressed firmly on either side of whichever teeth of cog wheel C are enmeshed. This eliminates back-lash and ensures an almost perfect mechanical transmission between the two cogs. The springs are usually sprung by compression, but individual examination is needed to prove this point.

The faults that occur with this type of drive are usually simple enough to cure. The small cog may wear after some use. If possible it should be re-positioned laterally to allow a different part of the wheel to engage with the larger cog. At other times it may be found that the spring loading has become faulty, causing backlash. (Either the gear system has been meddled with, or the springs have lost their power.) To tighten the springs, the driver and its axle should first be made free to move laterally. The driver cog is then moved so that it engages with only one of the following cogs (see Fig. 57 (*c*)). The other cog is then carefully turned until sufficient spring pressure is obtained; the small cog is then slid into position, automatically holding the springs at their new adjustment.

In some of the older receivers encountered, one may find a friction drive of the type shown in Fig. 58 (*a*) and (*b*). Referring to the diagrams we find that the small wheel A is fixed to the driving spindle, the bush B being pressed against the large wheel D by means of the spring E. This in turn is held by the collar C which is also fixed to the driving spindle. With the passage of time the bushes A and B may become worn

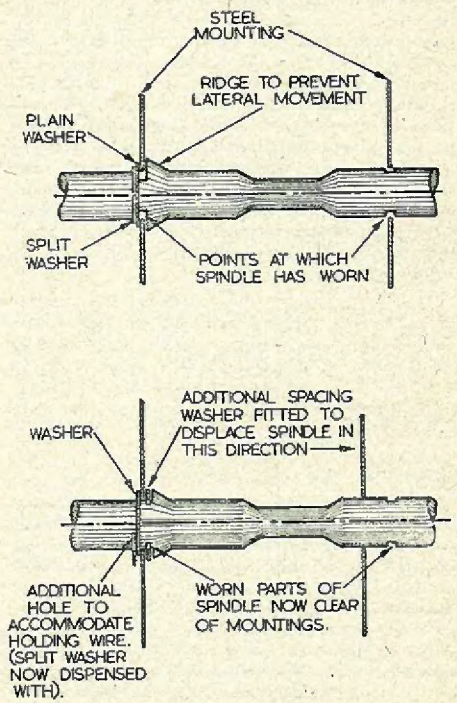

Fig. 56(a) (top). How a brass spindle, mounted in steel, may become worn with use.

Fig. 56(b) (below). How the spindle may be re-positioned to again ensure a good fit.

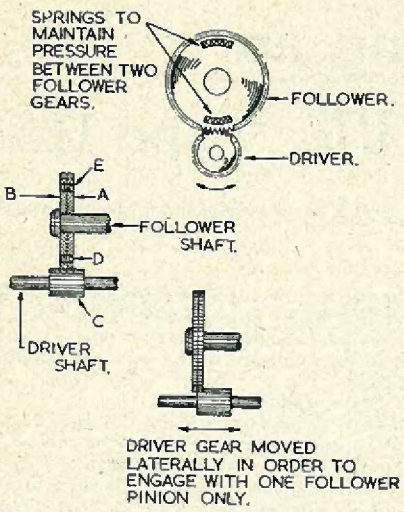

Fig. 57(a-b) (top). A typical gear reduction drive, in which spring-loaded gears are used in order to eliminate back-lash.

Fig. 57(c) (below). How to re-adjust the spring pressure (see text).

to the shape shown in Fig. 58 (*c*). To effect a repair, the bushes should be filed flat again (see Fig. 58 (*d*)), whereupon they will once more afford a good grip against the following wheel.

Epicyclic Drives

Although it is usually impossible to repair a drive of the epicyclic type, these are so often used that a word of description would not be out of place here. Fig. 59 (*a*) shows the usual appearance of a drive of this type and Fig. 59 (*b*) a cross-section showing the mechanism. The small axle A, shown in the diagram, is the driver. Three ball-bearings B bear against this axle and are held tightly by the inside of the stationary collar C. As the spindle A rotates, so do the balls, but more slowly. A second collar D, with three holes in it, is introduced to fit snugly over the ball-bearings, so that their movement is transmitted to it. The collar D is then attached to the following spindle. Rotation of the driver spindle forces the ball-bearings round, these in turn causing the collar to turn as well.

Should an epicyclic drive be "sticky" in action, the cause usually lies in the ingress of dirt. A bath of carbon tetrachloride or petrol will clean out the drive, and a very small amount of oil may be inserted after the cleaning fluid has evaporated. If the drive is slipping, the fault may be due to an excessive mechanical load imposed on it by, say, a stiff tuning capacitor. Alternatively, the drive may be worn out and should be replaced.

3—Wave Range Indicators

Several devices for indicating on the dial of the receiver the waveband to which the set is switched are occasionally encountered. These usually consist of a spring-loaded slide or drum which is tightened or loosened by means of a cord, the latter being wound on a drum fixed to the wave change switch. The slide or wheel sometimes has a hole or holes in its surface so arranged that they coincide at each wave change position with corresponding holes in the dial; thus allowing a light to shine through. The cord usually stretches after some years, causing the holes to fall out of alignment. As this type of indicator is almost always fitted with some obvious means of adjustment, the cure of the fault is very simple.

Most other methods of wave change indication are of a mechanical nature and rarely break down. It is impossible to enumerate the different types in detail here and, in any case, their repair is nearly always of a simple and obvious nature.

(To be continued)

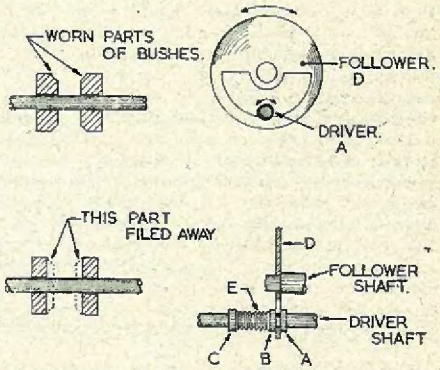

Fig. 58(a-b) (top and bottom right). A simple friction drive often encountered on earlier receivers.

Fig. 58(c) (top left). How the bushes A and B may become worn with use.

Fig. 58(d) (bottom left). Appearance of the bushes after filing to shape again.

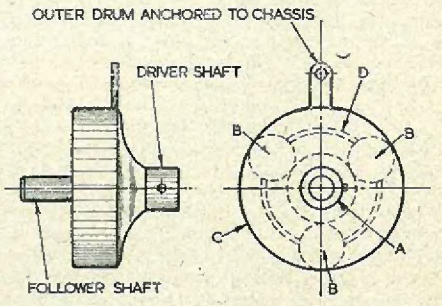

Fig. 59. The epicyclic reduction drive.

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Rebuilding an Ex-RAF RECEIVER, Type 1155

By J. COOK

Noise-Limiter

Before the signal is fed from the detector to the first of the audio stages, it passes through a series type noise-limiter (6H6) which facility is provided by one section of the double-diode. The tube is arranged under the chassis with the holder near the wave-range switch panel bushing—it is essential for this tube to be of the small metal type to fit in the space available. This device 'chops' noise peaks by means of biassing the diode which becomes non-conducting above a pre-determined signal level. The point at which cut-off occurs is selected by adjustment of the control potentiometer R27 and this is adjusted on a signal until distortion commences. The control is then retarded slightly to clear the signal of distortition and will then limit noise with a higher amplitude than that of the signal. Varying signal strengths will necessitate a readjustment of this control, but AVC action will assist under such circumstances. Care should be taken with

PRESENTING THE CONCLUDING INSTALMENT OF THE WINNING ENTRY IN OUR RECENT RECEIVER CONTEST

the screening of all wires of any considerable length carrying the audio signal from this stage up to the final amplifiers. A switch is provided to cut the limiter out of circuit as it does incur a slight loss of audio output besides complicating operation whilst tuning.

Automatic Volume Control

The remaining half of the 6H6 double-diode is used to supply the AVC voltages. The diode plate is fed from the second IF plate through a small coupling capacitor C37. The switch S3 cuts the AVC out of use by grounding the rectifier output. The time constant is arranged to give optimum results on slow fading although this part of the circuit may well be expanded by the use of a rotary switch offering a variety of time constants, if it is so desired. AVC control is not delayed in view of the fact that it may be switched off for the reception of weak signals. Control bias is applied to the SFA, Frequency-changer and first IF stages. The majority of the AVC and noise-limiter components may be located on the tag board underneath the wave-range switch bushing.

'S' Meter Amplifier

The AVC coupling capacitor C37 also provides the necessary voltages to the EBC33 tube which is used to deflect the signal strength 'S' meter. This tube is mounted horizontally on a bracket attached to the guard rail above the output transformer which, provided the bracket is made of some rigid material, provides a substantial mounting. The rear bracket of the former system switch is suitable for this purpose. A separate tube has been used here primarily to operate the 'S' meter irrespective of whether the AVC is in use or not. Usually the 'S' meter is included in the plate circuit of one the AVC controlled stages with the limitation that it becomes inoperative when the AVC is switched 'Off.' A normal 0-1 milliammeter (*i.e.*, meter scale reading left to right) in a 'Bridge' circuit is arranged so that the meter reading and signal increase together. R60 should be adjusted for zero setting of the meter whilst R57 controls the meter sensitivity. It will be found that on strong signals the meter will be overloaded but, in fact, when this condition occurs it will be found that the frequency-changer is being over-loaded also (distortion will be apparent) so that if the gain of the receiver is adjusted such that the 'S' meter does not exceed its normal maximum deflection, protection against maladjustment will thus be afforded. Calibration of the meter is difficult as there does not appear to be any fixed standard for 'S' markings but, at all events, calibration will hold good only whilst the receiver is operated at the same frequency and conditions as obtained at the initial calibration. *E.g.*, use of a converter

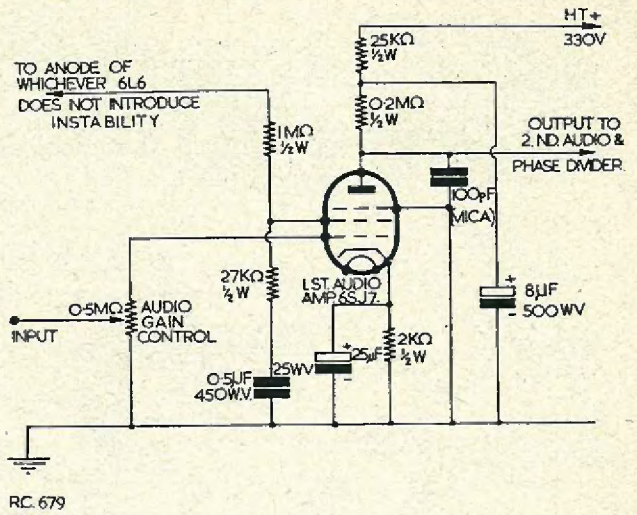

Fig. 4. Circuit of 1st AF amplifier using a 6SJ7 instead of a 6C5, with alternative method of using negative feed-back.

ahead of the receiver will result in higher gain and higher 'S' meter readings in consequence. Nevertheless, a signal strength meter is extremely useful for *comparison* of signal strengths and also for accurate tuning and alignment.

First Audio Amplifier

From the noise-limiter the audio signal is fed into the first stage of audio amplification (6C5) which is of moderate gain in view of the relatively high output from the detector. A small degree of negative feedback from the output transformer is introduced into the cathode circuit but this arrangement is controlled by a switch on the control panel as the full audio output is restricted by its use and this may not always be desirable. A jack is included in the input to enable the TRF units or pick-up to be fed into the audio amplifier. It is advisable to use a tube here that is very good mechanically if a noiseless background is to be obtained. Should higher gain be required, a 6SJ7 (pentode) may be used, instead of the 6C5, in the manner shown at Fig. 4. In this circuit an alternative method of applying negative feedback is adopted (without switching) and the coupling to the output transformer is dispensed with. Another jack, for feeding a pair of high resistance headphones, is included in the plate circuit together with a tone control giving four degrees of bass cut and two degrees of treble cut.

Second Audio and Phase Inverter Stage

A 6SN7/GT double-triode is used in the second audio and 'Floating Paraphase' phase inverter stage to drive the two final push-pull 6L6's. V8(a) functions as a normal amplifier whilst V8(b) provides the necessary phase inversion. Little additional gain is obtained from using a double tube but the advantage is that only one of the output tubes has to be driven by each section—thus it is easier to obtain the necessary 50 volts, peak to peak, required by the final pair of tubes, *i.e.*, an input of 25 volts to each grid. Further, this circuit is substantially self-balancing*, obviating the necessity of special adjustment. The variable resistor in the anode circuits has been included in order to match the anode load resistors accurately and at the same time provide a small amount of decoupling.

Push-Pull Output Stages

The two output tubes are 6L6 beam tetrodes strapped as triodes and provide a maximum output of 6.5 watts as operated here in Class 'A.' Tubes must be of the metal or 'GT' variety in view of the space limitations. Output from the transformer, which should be a high grade component, is fed via the jack J3 to a filter circuit (housed in one of the speaker cabinets) which, with a cross-over frequency of about 1,000 cycles feeds two speakers with separate high and low frequency outputs. The position of these two speakers in relation to the listener has some importance in the resultant balance also they should be mounted in cabinets or on baffles of adequate dimensions. In the author's case, two 9" 'Grampian' units are used as they provide a wide and moderately level frequency response with large power handling abilities (7 watts apiece) for a reasonable outlay.

*For explanation, see "Radio Designer's Handbook" by F. Langford Smith.

The Power Supply

The power supply is housed in a separate unit. This is necessary because there is no possible room for these bulky components on the receiver chassis which is now full to overflowing! Not only this, but it is desirable to keep the transformers and chokes away from the main receiver as these components are always a potential source of inductive hum; also extra heat is generated by

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H.T. CONSUMPTION

UNITS IN USE	MIN	MAX
AMPLIFIER PLUS ADAPTER	—	150 ma.
R.X. ONLY	135 ma.	145 ma.
RX. PLUS ADAPTER	140 ma.	150 ma.
R.X. PLUS ADAPTER PLUS CONVERTER		165 ma.
R.X. PLUS CONVERTER	150 ma.	160 ma.

L.T. CONSUMPTION

VOLTAGE	UNITS IN USE	CURRENT	
5.0V	V14	3 AMPS	
6.3V	ALL	6.63 AMPS	PLUS PANEL LAMP
6.3V	RX PLUS ADAPTER	5.6 AMPS	
6.3V	RX PLUS CONVERTER	6.03 AMPS	

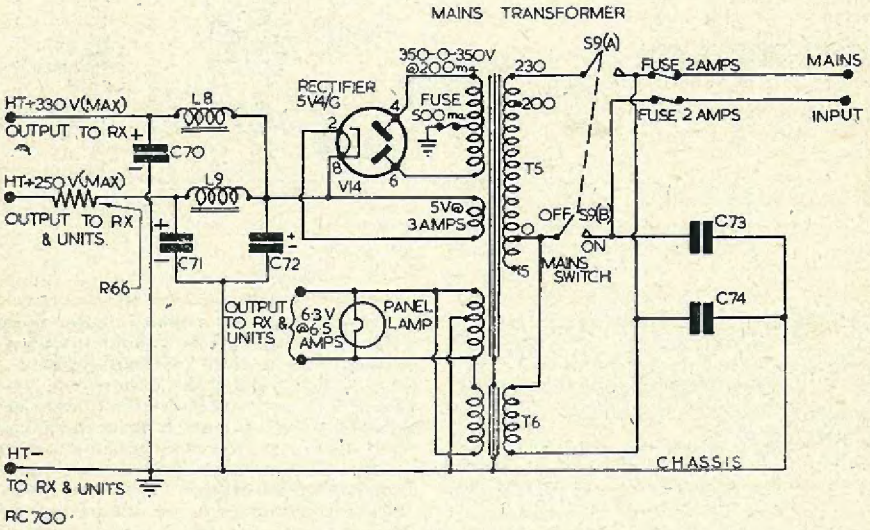

Fig. 2(c). Circuit of the Power Supply Unit.

the rectifier and dropping resistors which, again, is best isolated from the receiver.

This unit is required to supply a total of 21 tubes (excluding neon stabiliser) and, in consequence, the parts are of substantial proportions. Outputs are arranged to supply 250 volts and 330 volts to the RF and AF stages respectively. Separate smoothing chokes are used for each voltage in order that lower (current) rated chokes may be used. If chokes with differing DC resistance characteristics from those specified are used, appropriate adjustments to the dropping resistor R66 and a further dropping resistor in the output from the rectifier may be necessary to obtain approximately the above-mentioned outputs. Similar adjustments may be necessary if an alternative type of rectifier is used.

Smoothing is adequate, and if screening and layout has been given due care and attention in the receiver and amplifier, there should be negligible hum in the output.

Little need be said of construction because Fig. 5 shows the layout clearly, whilst exact dimensions and wiring are of little importance except that, once again, it must be borne in mind that the portion of the multi-cable carrying the 6.3 volts heater supply must be capable of passing the 5 amps current without any drop in voltage. The cable is terminated at the receiver end by an 8-pin 'Jones' type plug which fits into the remaining socket on the receiver chassis which now carries the supply voltages. In view of the heavy heater requirements when all the associated equipment is in use, an additional booster transformer is connected in parallel across the 6.3 volt section of the main transformer. It is important that the additional transformer is connected in the correct phase relationship—when connected in anti-phase this condition will be recognised by rapid heating of the transformer. Of course, if a transformer is obtained which is capable of supplying the requisite 6 to 7 amps the booster transformer will not be necessary—unfortunately few manufacturers seem to cater for such relatively large heater demands in the 200/250 mA class of transformer. The voltage regulator tube is properly part of the power pack but it is, for convenience, located underneath the main

receiver chassis next to and in line with the 6H6 rectifier and the associated load resistor R54 has been placed on a tag strip mounted on the coil pack near the side of the case for ventilation.

Operation

The first step in putting the receiver into operation, assuming all is well, will be to align the IF stages as it will be found that rewiring will have altered the alignment considerably. Note that it is necessary to align the two secondary winding in their respective "Narrow" and "Wide" bandwidth positions. The IF trap L2 is adjusted so that instability does not occur when the receiver is operated near the IF frequency. Alignment of the SF and Frequency-changer stages should not be necessary if this was satisfactory before conversion but it will be found necessary to decrease the capacity and/or inductance of the SFA grid circuit coils to allow for the inclusion of the antenna compensator control.

The Ultra High-Frequency Converter

The highest frequency covered by the converted receiver is 17 Mcs so that a converter unit is necessary if it is desired to extend the frequency range.

The converter used by the author is basically the 'Eddystone' UHF 5-10 metre converter, described in 'Eddystone' Short-Wave Manual No. 5. HT stabilisation (VR105/30) has been incorporated to mitigate frequency drift which is an especial consideration when used in conjunction with the narrow bandwidth of the main receiver. A complete set of self-supporting plug-in coils can be constructed from 14 guage wire to cover 60 to 30 Mcs, and as the converter is capable of an

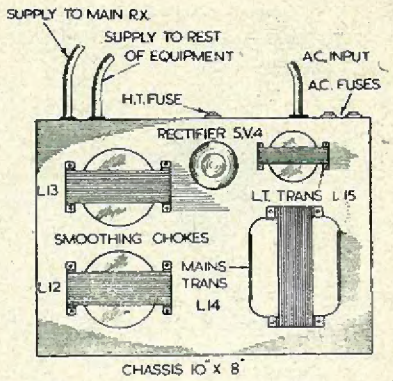

Fig. 5. Layout (not to scale) of the Power Pack.

exceptionally fine performance on the lower frequencies as well, coils may also be constructed to cover down to, for example, 14 Mcs. Formers will be necessary for these lower frequencies and polystyrene tubing will be found to be a convenient material for this purpose, using 6 BA brass rod for pins—the ends being turned down to the requisite diameter to fit the coil base sockets. The main receiver should be tuned to the highest frequency on range 3 for use with this unit, *i.e.*, approx. 1,550 kcs. It is interesting to note that this converter may be used very effectively as a two stage pre-amplifier when the SFA/Mixer gang is tuned to the desired frequency and the local oscillator coil is removed.

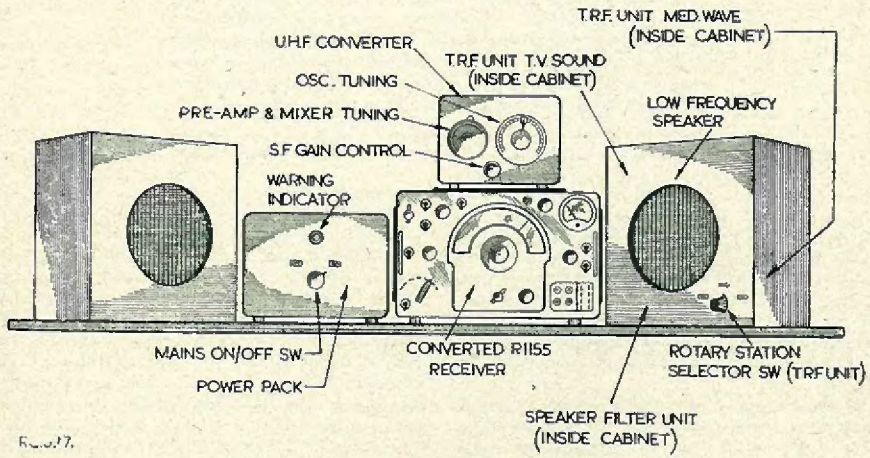

Fig. 7. General view of the equipment described.

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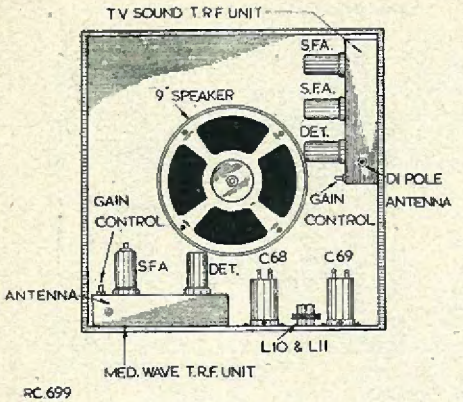


Fig. 6. Loudspeaker Unit, housing the Filter and TRF units.

Medium Wave TRF Unit

A need for a unit of this type was felt because, with a superhet, it is difficult to obtain a band-pass sufficient to cover the 16 kcs radiated without attentuation of the side-bands due to the multiplicity of the circuits in the superhet. Two tubes are used—the first being a conventional signal frequency amplifier (6K7) incorporating a gain control to counteract 'blocking' of the detector when receiving strong signals. A second SF stage may be necessary in areas of low field strength or to improve adjacent channel rejection in difficult locations. In either case, efficient coils having a high 'Q' are desirable in this and the detector stage.

The detector is of the infinite impedance (negative-feedback) type and the circuit may be similar to that employed in the main receiver.

Station selection is effected by a rotary switch which selects alternative pre-set capacitors (high-permeability type); one position on this switch breaks the HT and antenna inputs in order that the main receiver may be operated.

Television Sound TRF Unit

For reasons similar to those stated above, a TRF receiver also offers the finest results when receiving the sound accompaniment to the television transmissions. Again an infinite impedance detector has been used, this time in conjunction with two stages of SFA using EF50's in a circuit similar to the "Wireless World" or "Electronic Engineering" televisor sound sections.

The two of these TRF units together with the loud-speaker dividing network are housed in one of the speaker cabinets, thus making for a neat installation as illustrated at Fig. 6.

When operating either of the TRF units and only using the amplifier portion of the main receiver, it is advisable to switch the 'Standby' switch (S1) to the 'Off' position for best quality as well as muting the RF stages.

SURPLUS RADIO EQUIPMENT

described by B. Carter

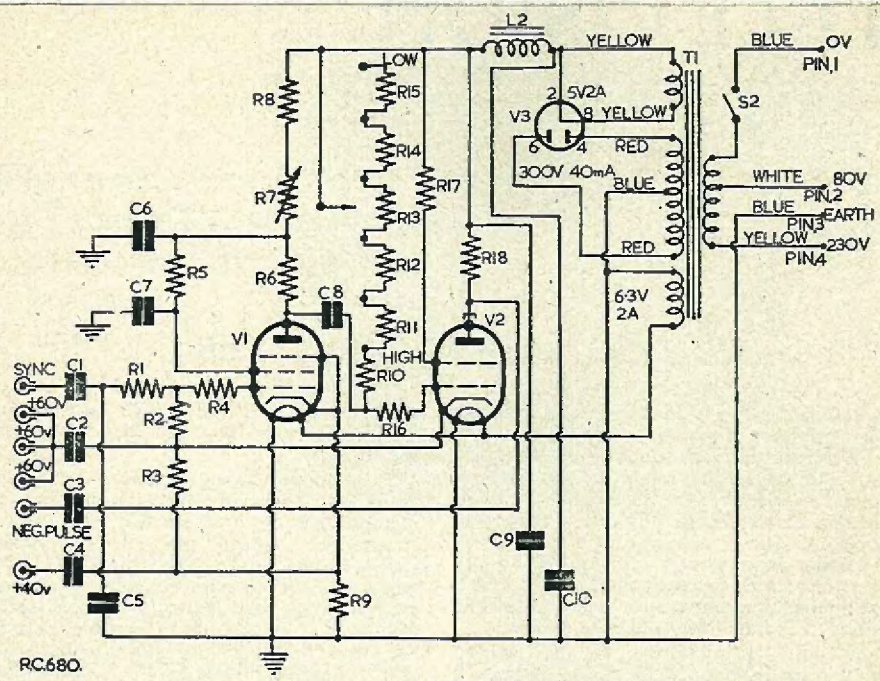
In this series of articles it is intended to describe units that have (a) *immediate application, after some modification perhaps, in the amateur world, and* (b) *to list the contents of those units that can best become sources of valuable components. This month's unit with very little modification may be of use to many amateurs as it is purchased.*

CONTROL UNIT TYPE 409 (10 LB/6009)

THE name of this unit belies its true value to the amateur, the main attraction being the power unit which feeds the control valves. The removal of the control section leaves ample room for modifications, for example as a stablised and regulated power unit, or as an output stage/power unit of the kind used for such receivers as the R1155.

The chassis and front panel are of heavy gauge steel welded together and the cover is similarly strong with louvres on all vertical surfaces. Anti-rattle clips are provided inside the front panel, making a very sturdy case 8½" long x 7¾" high x 8¾" deep.

The power unit is formed around a full-wave rectifier valve in the usual manner, employing a choke L2 and capacitor C9 for smoothing. The transformer HT secondary is labelled "300V 40mA" but it is thought that this is a very conservative estimate of its current rating, having due regard to the core size. The mains input is by way of the "W" plug, 230 volt 50 cycles between pins 1 and 4 or 80 volts 1,000 cycles between pins 1 and 2. The colour code shown may not be universal and may differ from that used in units of a different order.



Circuit of the 409 Control Unit

CONTENTS LIST

R1, 4.7k ½W	*C1, 30pF*
R2, 75k high stability 10C/3622	*C2, 0.1μF 350V*
	C3, 0.1μF 750V
R3, 110 ½W	*C4, 0.1μF 750V*
R4, 220 ½W	*C5, 200pF*
R5, 3.3k 2W	*C6, 0.25μF 750V*
R6, 22k 5W	*C7, 0.25μF 750V*
R7, 5k potentiometer	*C8, 0.001μF mica*
R8, 2.2k 1W	*C9, 4.0μF 500V*
R9, 220 ½W	*C10, 8.0μF 500V*
R10, 3M ½W	
R11, 3.3M ½W	
R12, 1.3M ½W	*L1, Mains transformer*
R13, 5.1M ½W	*L2, Smoothing choke*
R14, 2.4M ½W	
R15, 10M ½W	
R16, 220 ½W	
R17, 150 ½W	*S1, Single pole 6-way*
R18, 330 ½W	*S2, Single pole changeover*
V1, VR91 (EF50) and holder	*One 4-pin plug type W198*
	Six single pole plugs 209
V2, 807 and holder	*Carrying handle*
V3, 5Z4 and holder	*Two groupboards*
	One 807 anode clip

(*SIGNAL GENERATOR—contd. from page 244*)

aligning a receiver by measuring the AVC voltage. Fig. 5 shows the circuit of a receiver which takes the AVC voltage from the anode of the last IF valve. This method of obtaining AVC is fairly common. It will be seen that the secondary of the IF transformer is not connected to the AVC circuit. However, this secondary may be adjusted by trimming it to give a *decrease* in AVC voltage. The reason for this is that the secondary tuned circuit acts as an absorption circuit, and, therefore, when accurately trimmed, it takes energy from the primary tuned circuit.

Whilst on this topic, the writer should like to state that if the constructor uses methods such as those shown above, then there is no reason why he should not make a really good job of aligning any receiver with which he has to deal. The actual procedure of aligning a modern receiver would require another series of articles to enable it to be adequately dealt with, and these would not readily fall in line with the subject-matter of the present contribution. Nevertheless, should readers be interested (and subject, of course, to the consent of the Editor), the writer is prepared to submit a series on the subject of modern receiver alignment, which may then be published in future issues of the "Radio Constructor." (What do readers think of this suggestion? —Ed.)

——To be concluded in next issue——

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TELEVISION PICTURE FAULTS

Part one of a series, illustrated by photographs from a Televisor screen by courtesy of Mr. John Cura.

THE VISION RECEIVER

ALTHOUGH a large number of home-built televisors of the superhet type have been constructed, receivers made from new parts are most likely to be of the TRF or straight variety. The diagnosis of faults, whether the receiver be of either type, or uses an electrostatic or magnetic picture tube, will be similar in each case. We intend in this series of articles to cover most of the effects met by the home constructor when his receiver refuses to operate in the intended manner.

We will deal briefly, first of all, with the requirements of the vision receiver which, if not met, may produce effects which will negate all the hard work put into the rest of the televisor in an attempt to obtain a perfect picture.

The vision receiver should be capable of accepting signals in a "pass" band at least 2.75 Mcs wide, and also reject the sound signal which is, in all B.B.C. transmissions, 3.5 Mcs lower in frequency than is the vision signal.

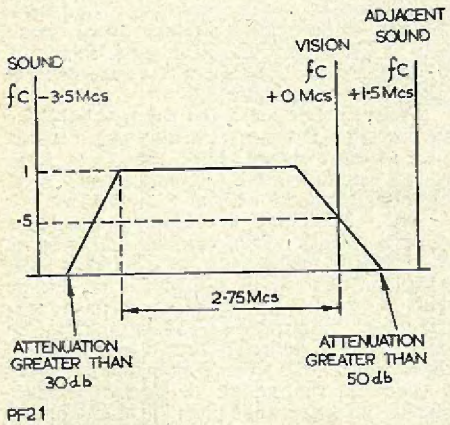

Fig. 1. Vision receiver response curve for single sideband reception.

The response curve of the ideal receiver for asymmetric sideband vision transmission (this method will be used on all B.B.C. vision transmitters except the London station) should be flat from a point approx. 0.75 Mcs below the vision carrier frequency to a point approx. 2.75 Mcs below the vision carrier frequency. At the vision carrier frequency the curve should fall to a level which is half that of the flat portion (–6db). The response at the accompanying sound frequency should be at least 30db down, while the response of the receiver at the frequency of the adjacent sound channel, which is 1.5 Mcs higher in frequency than the "wanted" vision frequency, should be at least 50db down. See Fig. 1.

Inability to meet any one of these requirements will result in a picture which will show definite effects which can quite easily be interpreted. It is very important to remember, however, that a receiver with an irregular response curve can give an excellent picture, and the receiver should be adjusted to give a picture of good appearance even though one may be, apparently, breaking some golden rule.

Insufficient Bandwidth and Vision Coil Misalignment

These defects will show as poorly defined pictures lacking either in highlights or an even background. Testing on the B.B.C. "Test Card C" transmission, the former effect will show as variation of the dark background with uneven dark patches over the image. Correction may be applied by adjusting those coils which tune near the vision frequency. The even fall in response across the vision signal frequency, referred to previously, is required for a good low frequency response.

The second effect concerns the high frequency response of the receiver, and adjustment of this

Fig. 2.

SHOWING EFFECT OF POOR LOW FREQUENCY RESPONSE

(John Cura 'Tele-Snap')

is generally easier to obtain than the former. On "Test Card C" there are two blocks of ruled lines equivalent to vision signals between 1 Mcs and 3 Mcs, in steps of 0.5 Mcs. The coils which tune to frequencies off the vision signal frequency should be adjusted so that these lines are clearly defined, and are even in contrast. Typical examples of poor frequency response are shown in Figs. 2 and 3.

Extension of the response curve of the vision receiver beyond the normal limits may allow reception of the sound transmission at the same time as the vision, and this will show as a series of horizontal dark bands moving up and/or down the screen, associated with loud passages of sound. In severe cases the picture may be completely broken up, and correct synchronisation difficult to obtain except when no sound is being transmitted. These effects are well demonstrated in Fig. 4.

In the case of transmissions other than that from the London station, rejector coils will be required to give the vision receiver good rejection at the accompanying sound frequency and also the adjacent sound frequency. The adjustment of the latter will also affect the even fall in gain across the vision signal frequency, which gives the low frequency

Fig. 3.

RESULT OF POOR HIGH FREQUENCY RESPONSE

(Both effects may also be obtained by wrong adjustment of contrast and brilliance controls).

John Cura 'Tele-Snap')

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Fig. 4.

SHOWING EFFECT OF INTERFERENCE ON VISION FROM SOUND BREAK-THROUGH

(*John Cura 'Tele-Snap'*)

content of the picture, previously referred to. It is very important that these rejectors should have a very high "Q," giving maximum attenuation over a very narrow band of frequencies, otherwise the bandwidth of the vision receiver will suffer.

A similar effect to this may occur in a few localities in close proximity to a short-wave transmitting station, where a harmonic of the transmission may interfere with the vision signal, and sound interference may occur which may be difficult to remove without the use of special rejector coils. Identification of the interfering signal is probably best carried out by connecting earphones to a suitable section of the vision receiver, and listening for a beat note between the unwanted signal and a calibrated oscillator. Rejector coils may then be constructed for this frequency.

Suitable coils may be wound on coil formers having iron dust cores for tuning, using enamelled copper wire of a gauge most suitable for high "Q."

For a former approx. 7/16-in. in diameter, 18 swg wire spaced one diameter will give a good "Q," and this may be shunted with a capacitor of approx. 20pF. Four to five turns will be suitable for use in a Midlands area receiver.

The coil may be inductively coupled to one of the normal vision receiver coils by placing them in close proximity. The "cold" end (the end of the coil from which adjustment is made) should be earthed with a short heavy gauge lead to the chassis.

Rejector coils will not generally be required on receivers for the London transmissions. Receivers for Sutton Coldfield may, however, require two rejectors for each of the sound and adjacent sound channels. The latter will only be of special significance when new transmitters come into operation.

——To be continued——

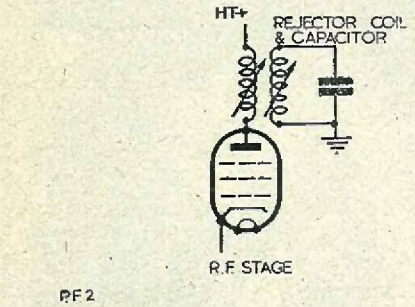

Fig. 5. Skeleton circuit showing method of inserting rejector.

WHEN WRITING TO ADVERTISERS, PLEASE MENTION THIS MAGAZINE.

Query Corner

A "Radio Constructor" service for readers

VHF Decoupling

"It appears to be common practice in both short and ultra short-wave receivers to connect a small mica-type capacitor across the HT smoothing electrolytic. I fail to appreciate the need for this second capacitor as presumably a high capacity electrolytic would provide more than enough decoupling at high frequencies."

K. Lewis, Addlestone.

It is agreed that many short-wave receivers employ added decoupling in the form of small mica capacitors which are connected across the high capacitance electrolytics. On the face of it such an arrangement seems to serve no useful purpose, and yet in many cases it will be found to add to the general stability of the receiver. The need for these additional capacitors arises from the fact that although an electrolytic may have an extremely high capacitance it may also possess inductance; this being the case the unwanted inductance is virtually in series with the capacitance. This inductance is low in value and may be disregarded for most applications, but at very high frequencies it is advantageous to by-pass it by means of a low value mica capacitor, a typical value for this capacitor being 0.001μF. The use of a mica component is essential in this application on account of its very low self-inductance.

Parasitic Oscillation

"My home constructed superhet receiver appears to suffer parasitic oscillation in the local oscillator stage, because when it is tuned to the high frequency end of the band it emits a variety of squeaks and howls. Before taking steps to cure the trouble I would like to carry out a few tests to ensure that the fault is really in the oscillator section. Can you recommend a simple test?"

C. Roberts, Birmingham.

The symptoms mentioned in this letter certainly indicate that the trouble is due to a parasitic occurring in the local oscillator stage. It is a fair generalisation that if instability occurs at one end of the tuning range the fault will most likely be found in the local oscillator, but if instability occurs over the complete turning range it is most likely traceable to the IF stages.

A parasitic oscillation is an unwanted oscillation which normally occurs at a very high frequency and is the result of the formation of one or more resonant circuits by means of lead inductances and stray capacitances. This unwanted oscillation may be easily recognised in the local oscillator stage of a superhet by noting the changes in grid current. To achieve this, connect a 0-1 milliammeter in series with the earthy end of the grid leak, the meter leads should be as short as possible. Now whilst rotating the tuning control, note the change in meter readings. If the operation of the oscillator is satisfactory the reading will remain fairly constant, falling slightly at the low frequency end of the tuning range.

If parasitic oscillation is present, its commencement will be marked by a sudden jump either up or down, in the value of grid current.

The remedy for the complaint is simply the connection of a resistor in series with the oscillator feed-back coil; the actual value of the resistor must be found by trial and error, but it must not be high enough to materially affect the value of oscillator grid current. With most oscillator circuits a value of between 100 and 1,000 ohms should prove to be satisfactory.

A Mains Powered Preselector

"I have a home constructed short-wave receiver which provides fairly good results. I find, however, that there are a large number of stations which are only just audible, and I believe that the addition of a preselector will vastly improve the performance. Can you please recommend a suitable circuit?"

B. Jackson, Highgate.

It appears safe to say that the problem of improving both the sensitivity and the selectivity of a short-wave receiver confronts the majority of Dx enthusiasts. Many resort to the addition of one or more valves to the audio side of the receiver, but are disappointed to find that although more noise is emitted by the loud speaker, the readability of the signal remains unchanged. In other words, although the signal is amplified, so also is the background noise and general interference. Anyone who has attempted to design and build a really powerful receiver will have experienced the difficulties of reducing background noise. Much of this noise is generated within the valves themselves, the first RF amplifier and the frequency changer being the worst culprits in this connection. Because of this, the addition of an extra IF stage may not improve

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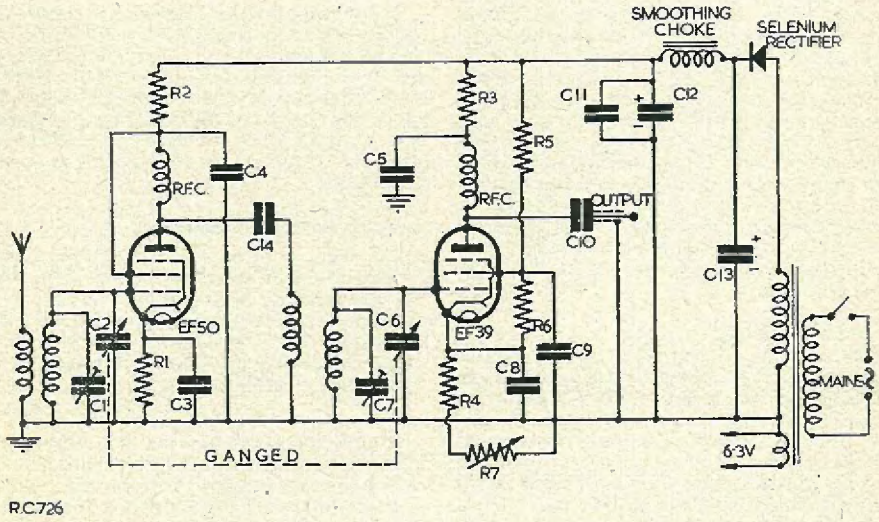
the signal to noise ratio, but it will, of course, improve the selectivity. Amplification prior to the frequency changer will, however, improve the signal to noise ratio because it does not amplify the frequency changer noise. It also has the added advantages of improved sensitivity and selectivity, and greater freedom from second channel interference. This introduction is probably an over-simplified version of the complete story, but it does indicate that it is better to add further stages of RF amplification to a receiver than to increase either the IF or AF amplification.

The preselector which is about to be described consists of a high gain two-stage RF amplifier which, if used in conjunction with any average short-wave receiver, will hot it up to "communications" standard. The first stage of the preselector consists of an EF50 valve operating as a straight RF amplifier. The value of the cathode bias resistor has been so selected that the operating anode current is 10 milliamps; the valve, therefore, operates on the optimum part of its characteristic and the maximum stage gain is obtained. Parallel choke coupling is used between the stages, as it is recommended that plug in coils are employed. It will be appreciated that the use of a series coupled arrangement would result in the anode current of the first valve being passed through the coupling coil. Under these circumstances, should the unit be operated temporarily without the coil in position, the screen grid dissipation of the first valve would be excessively high and might result in possible damage to the valve.

It is necessary in a high gain preselector to provide some means of controlling the gain, otherwise there is a likelihood that the first stage of the receiver will be seriously overloaded on strong signals. Use has been made, therefore, of a variable-mu valve in the second stage together with an arrangement for adjusting the bias. This is achieved in the conventional manner by an adjustable bias resistor in the cathode circuit of the valve.

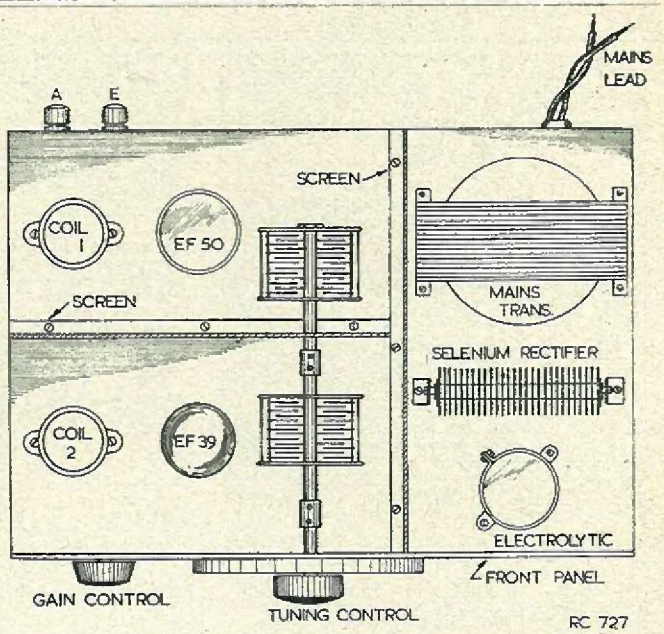


R.C.726

Fig. 1. Circuit diagram of the 2-stage pre-selector

COMPONENT VALUES

C1, 15*pF*	*C9*, 0.001μF	*R2*, 5*k* Ω
C2, 6, 100*pF* 2-*gang*	*C10*, 100*pF*	*R3*, 5*k* Ω
C3, 0.01μF	*C11*, 0.001μF *mica*	*R4*, 200 Ω
C4, 0.001μF	*C12*, 16μF	*R5*, 33*k* Ω
C5, 0.001μF	*C13*, 8μF	*R6*, 50*k* Ω
C7, 15*pF*	*R1*, 150 Ω	*R7*, 20*k* Ω
C8, 0.001μF		



RC 727

Fig. 2. Showing general component layout. The screen between the RF components and the power pack should be constructed from tinplate. The smoothing choke is mounted below the chassis.

A small fixed resistor is also em loyed in this circuit to prevent the bias being reduced to zero. To preserve the stability of the unit adequate decoupling has been provided in the anode, screen and cathode circuits of the two valves. It is most important that all the decoupling capacitors are of the mica type, whilst the RF chokes located in the anode circuits of the valves should be of the type designed to cover the required wave range. The complete circuit diagram of the preselector is shown in Fig. 1, and Fig. 2 indicates the component lay-out employed in the original model. This lay-out was chosen as it enables all lead lengths to be kept down to a minimum whilst at the same time making possible a symmetrical control panel. It is always considered that the location of the tuning dial in the centre of the panel greatly enhances the appearance of the equipment. The use of screened cable, except for the output lead, must be avoided, as it introduces unnecessary capacitance into the tuned circuits. Tuning is effected by means of a two-gang capacitor, each circuit being aligned by means of a small trimmer. For simplicity these trimmers are mounted at the top of the plug-in coil formers and, once adjusted for optimum results, the formers should be marked to ensure that they are always employed in the same stage.

The power consumption of the complete unit is 16 milliamps at 250 volts for the HT, and 6.3 volts, 0.6 amps for the LT. These supplies may be obtained from the main receiver power pack, but it is felt that the constructor would wish to make the preselector entirely self-contained by providing it with its own power supply. The circuit shown in Fig. 1 indicates the manner in which a simple half-wave rectifier may be used to provide the HT from a 250-volt transformer. Such an arrangement results in an entirely self-contained and highly efficient preselector which may be employed with any short-wave receiver.

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