Vol. 4
Number 7
FEBRUARY
1951

RADIO CONSTRUCTOR

for the Radio and Television Enthusiast

IN THIS ISSUE . . .

PUSH PULL TRIODE AMPLIFIER · FOCUS ON 144 Mcs.
IMPROVING THE SYNC SEPARATOR · Magnetic Recording,
Aerials . Query Corner · TV Picture Faults
Receiver Alignment

etc., etc.

1/3

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Vol. 4, No. 7 Annual Subscription 16/- February, 1951

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Edited by: C. W. C. OVERLAND, G2ATV

Editorial

As all short wave enthusiasts will know, we are now in the trough of an eleven-year cycle, and the result is that the 14 and 28 Mcs bands are, for the most part, of little use for long distance work. This has resulted in an exodus of transmitters to the lower frequency bands, where the congestion, already bad, will be even worse.

The 1.7 and 3.5 Mcs bands are normally used for local and semi-local working, but their possibilities become greater when ten and twenty fade out—keen users will be looking out for some real Dx, with the possibility of transatlantic contacts on 160 always in mind.

The congestion mentioned above will doubtless cause many of the present users of the LF bands to think of 'pastures new'. May we recommend them to try out the 144 Mcs band? This has shown increasing activity of late, with the 'season' now opening up, and there is every likelihood that the coming months will show even better results than last year.

144 Mcs presents problems which are different to those found on the normal SW bands. In equipment, more care has to be taken to avoid losses. Wiring must be even shorter, and rigidity is the order of the day. Valve types become unusual, sometimes — triodes are often used as mixers! Aerials become simpler, as regards size, but they also become more complex. Local surroundings are of greater importance, and the correct operating technique must be cultivated. All this if the best results are to be obtained—but it is not difficult to make a start. The series of articles commencing in this issue, written by a very well known 144 Mcs transmitter, G6UH, under the title 'Focus on 144 Mcs', will be found of great use by the newcomer to this band.

G2ATV.

CONTENTS

NOTICES

THE EDITOR invites 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 draughtsmen 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 name 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.

Suggested CIRCUITS for the EXPERIMENTER

The circuits presented in this series have been designed by G. A. FRENCH specially for the enthusiast who needs only a circuit and the essential relevant data.

No. 3 A Suggested Muting or Codan Circuit

This circuit is intended for use with receivers of relatively high sensitivity (such as a well-designed broadcast superhet with an RF stage) where it is found that tuning the receiver from one station to another (either manually or by a motor) causes a large amount of disagreeable noise to be heard from the loudspeaker. The circuit ensures that the receiver output is muted unless a carrier is actually being received.

The usual form of codan* employs a switching valve which varies the bias on one of the AF amplifying valves. This has the disadvantages that the amplifying valve is worked at a lower HT voltage than would normally be the case, and that a fault or maladjustment in the switching valve circuit may cause the amplifying valve to operate at an incorrect value of bias, thus introducing distortion.

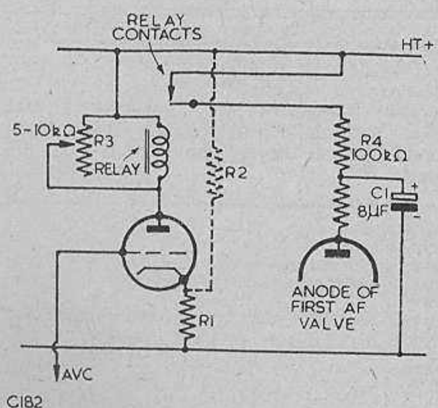


Fig. 1

In this circuit, a sensitive relay is used to mute the receiver. These relays may nowadays be fairly easily obtained in the form of surplus equipment. They have a normal construction, but the bobbin is wound with fine wire giving a resistance of 1,000 to 5,000 ohms, the relay closing between 1 and 10 mA according to its make and type.

In Fig. 1 an additional triode is used to operate the relay, its grid being connected to the AVC line of the receiver. The current drawn by the triode anode is sufficient to close the relay. On reception of a signal the AVC line goes negative, the valve draws less current, and the relay opens.

The cathode resistor, R1, is fitted to ensure that the triode is not operated with zero bias. Its value should be kept low (below 300 ohms) as it reduces the effect of the valve. With many receivers it will be found that (apart from such things as oscillator failure, etc.) the AVC line always has a small negative voltage, owing to the rectification of noise, and the cathode resistor may therefore be reduced in value, or even omitted. Alternatively, the cathode may be given a relatively fixed value of bias by employing a potentiometer circuit across the HT supply (R1 and R2), but this draws current and should not really be necessary.

R3 is used to vary the sensitivity of the relay. In some cases it may be found that this also can be omitted.

* Short for "carrier-operated device antinoise"

Switching

The muting circuit would be fairly effective if the relay contacts were used simply to short-circuit the grid of the output valve to chassis when the relay was closed, but this would have the disadvantage that the action would be too abrupt and "ploppy".

A better scheme is shown in Fig. 1 where the relay contacts complete the HT circuit to the anode of the 1st AF amplifier when the relay opens. A time delay is offered by R4 and C1. Switching the anode instead of the bias circuit eradicates any possible distortion which may occur due to incorrect values of bias.

If the relay contacts "make" when it closes, the circuit of Fig. 2 may be employed, in which the HT supply to the AF valve is short-circuited to chassis when the receiver is muted.

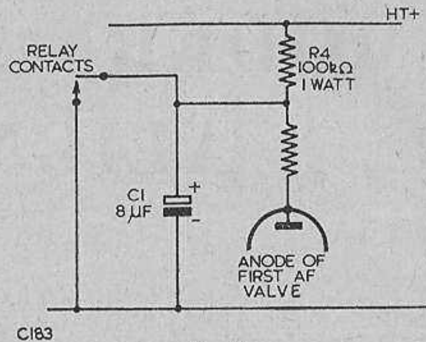


Fig. 2

In some cases the additional triode of Fig. 1 may be omitted by connecting the relay in the anode circuit of one of the AVC controlled valves, such as an IF amplifier. Unfortunately, the necessity of providing a certain amount of bias for such a valve would reduce the efficiency of the circuit.

Additional Facilities

The codan circuit may be further utilised to provide several more attractive facilities.

For instance, additional contacts on the relay could be used to light or extinguish a pilot lamp, showing whether the receiver was tuned to a station. Alternatively, an arrangement could be made such that the dial would be well-illuminated when searching for a station, but would be lit only dimly after the station had been found.

A further use might be obtained by supplying the codan circuit with its own rectifier, this being fed from a highly selective IF circuit, itself energised from the normal IF amplifier stages. The circuit would then operate only when the receiver was accurately tuned; and it would be impossible to tune the receiver incorrectly.

"RADIO CONSTRUCTOR" QUIZ

Conducted by W. Groome

(1) Mr. Brain was testing a new TV time base when he noticed a bright glow in the line output valve. A quick look before hastily switching off revealed that the screen grid was red hot, but the anode appeared to be O.K. What had the twerp done wrongly?

(2) With many TV receivers, a spot of light remains on the screen for some seconds after switching off. If it is large and dim no damage is likely, but with certain circuit conditions it may remain focused and intense, with the result that the screen may be burned. What causes the spot, and what conditions cause it to remain small and bright?

(3) Often during installation and testing, and occasionally during use, a howl may be heard from public address equipment. What is the usual cause of the trouble?

(4) When adjusting the vision receiver section of a TV set without instruments, a pair of headphones hooked into the detector or video stage can be very useful in locating the vision signal and peaking it prior to adjusting for definition. What kind of sound would you listen for?

(5) Although most constructors know better, one still meets the novice or the dabbler who, with no knowledge at all, hooks his earth lead to a gas pipe. It is 'agin the law', and can be quite dangerous. Furthermore, in the fitting or installation of gas-piping there occurs a process which makes it almost useless as a conductor to earth. What is it?

(6) Beware, catch question! What increase in scanning power, approximately, is required when converting from a 9″ cathode ray tube to a 12″ one?

Answers on P.241

MODERN RECEIVER ALIGNMENT

Part 3

By W. G. Morley

IT may be recalled that, in last month's article, we dealt with the process of aligning the IF stages of a superhet. This month we shall carry on to discuss the adjustment of the oscillator and signal tuned circuits.

Tracking a Superhet.

The major problems involved in aligning the signal and oscillator circuits of a superhet are all concerned with ensuring that the two sets of tuned circuits track over all or very nearly all of the band to which the receiver is switched. In other words, the oscillator tuned circuits must always resonate at a frequency which is removed from that of the signal tuned circuits by the frequency of the IF. As was stated in last month's article, the process of tracking should never be attempted until one is certain that the IF's are accurately and correctly trimmed.

In most superhets it is usual to allow adjustments of the oscillator tuned circuit to be made not only by the usual parallel trimmer but also by what is called the padding capacitor (or "padder"), whose purpose was explained in the first article of this series. Fig. 5 gives a typical example of the tuned circuits found in an average domestic superhet. In this diagram C2 and C4 are the signal and oscillator trimmers respectively, whilst C5 is the padder.

Examination of Fig. 5 will show that the only adjustments which can be made to the signal frequency tuned circuit are carried out by capacitor C2. As with the straight receiver, this trimmer has greatest effect at the high frequency end of the band (i.e., with tuning capacitor vanes unmeshed); and in the superhet it is once again adjusted at this end of the range. It may therefore be seen that the signal frequency tuned circuit is capable of being trimmed only at one end of its band, the frequencies at which it resonates being to a great extent governed by the permanent values of the tuning capacitor and the coil. On the other hand the frequencies given by the oscillator tuned circuit may be varied considerably; not only by the parallel trimmer but also by the series padder. As, therefore, the oscillator tuned circuit is capable of being easily adjusted at almost any part of the band, the process of tracking consists of so adjusting the *oscillator* tuned circuit that it keeps in step with the more-or-less fixed frequencies obtained from the *signal* tuned circuit.

The Purpose of the Oscillator.

Apart from the fact that the oscillator tuned circuit is the one which needs adjustment for accurate tracking, it must be remembered that the oscillator is also virtually responsible for selecting the frequency received by the set. The signal received is always the one which is selected by the IF transformers, that signal being converted to the IF by reason of the oscillator.

For practical purposes it may help if this is considered in another light. Thus, when the receiver is being aligned, the adjustment of the oscillator trimmer or padder will have the effect of tuning the entire receiver to a different frequency; and may therefore, for instance, be used to bring the tuning of the set more accurately to the frequencies shown in the dial calibration. On the other hand, alignments of the signal tuned circuit will not alter the frequency received, it will only make its reception stronger or weaker. The oscillator trimmers govern the frequency of the received signal and not their strength; the signal trimmers govern their strength and not their frequency.

The writer apologises for labouring the above points which are very probably already familiar to his readers. However, unless they are fully appreciated, the operation of tracking cannot really be properly carried out.

The Process of Tracking.

Having spent some time on the preliminary considerations entailed, let us now, as the French are fondly imagined to remark, get down to out *moutons* and carry on to the actual process of tracking the superhet.

The signal generator should be coupled to the aerial and earth terminals of the receiver. As with the straight receiver, (reviewed in the first article of this series), the band first chosen

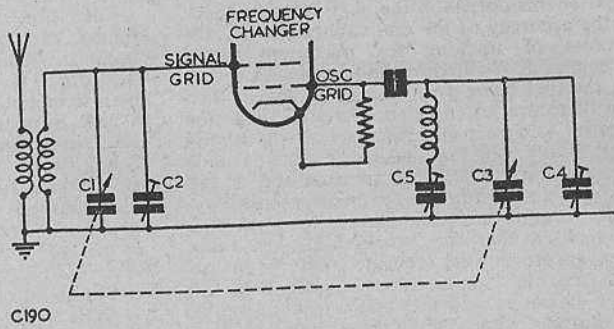


Fig. 5: Typical tracking arrangements in a frequency changer stage.

for alignment should be that covering the lowest frequencies; such as the long wave band in the case of a domestic receiver. Also, (as explained in the first article), the coupling between the signal generator and the receiver should be kept as loose as possible.

The receiver should be tuned to the high frequency end of the band, the vanes of the tuning capacitor being enmeshed by about 5 degrees. The frequency of the signal generator should then be adjusted so that it is picked up by the receiver; whereupon the frequency of the signal generator should correspond to that shown on the dial of the receiver.

If this does not occur, the receiver tuning should be left alone and the oscillator *trimmer* adjusted slowly (keeping the signal generator in step) until the dial reading is correct. The signal frequency trimmer should then be adjusted for maximum signal strength.

The receiver should next be turned slowly to the low-frequency end of the band until the tuning capacitor vanes are about five-sixths enmeshed, keeping the signal generator in step with it all the time. If the sensitivity of the receiver decreases during this operation (owing to the lowered L/C ratio and possible misalignment) the output of the signal generator should be correspondingly increased.

When the low frequency end of the band has been reached the signal generator frequency should correspond to that shown on the dial. Should this not be so, the oscillator *padder* should be adjusted (keeping the signal generator in step) until the dial reads correctly. If all is well, the signal frequency trimmer should then be found to be approximately at its optimum position.

Adjusting the padder may slightly alter the oscillator trimming, so it will be necessary to go back to the high frequency end and repeat the whole process all over again. If the set proves to be very badly out of alignment it may even be necessary to do this twice or more.

When the oscillator adjustments have been completed, the signal frequency trimmer should now be at its optimum position, both at the top and at the bottom of the band. Further checks should show that it holds its position correctly at the centre of the band as well. (It will be found in practice that the long wave bands of one or two domestic receivers do not always track as well as do the medium and short wave bands; but so long as accurate results are obtained at the centre and at the ends of the long wave band it may be assumed that the discrepancies elsewhere, if small, can be safely ignored).

Should it be found that the signal frequency trimmer is *not* at its optimum position at the bottom end of the band a slightly different technique is necessary. First of all, the receiver should be set to the high frequency end again and the signal frequency trimmer carefully adjusted to its optimum position. After doing this, the set should once more be returned to the low frequency end. The tuning capacitor of the signal generator should then be rocked backwards and forwards across the frequency received by the set whilst the oscillator *padder* is slowly adjusted (one way or the other) until the signal increases to its optimum position. If the reader recalls the earlier paragraphs in this article, he will at once realise that this procedure entails adjusting the frequency of the *oscillator* tuned circuit until it conforms to that required by the signal tuned circuit, (the latter being incapable of adjustment). It may be found that the process of swinging the signal generator backwards and forwards is somewhat awkward at first but after a little practice it is soon simple enough.

When the padder has been set to its optimum position, the receiver should be re-trimmed at the high frequency end and, if necessary, slightly re-padded and trimmed at the bottom end again; whereupon it should track accurately over all or nearly all of the band

After this operation the next point to check is the accuracy of the dial calibration. If the process of tracking for maximum signal strength has resulted in the frequencies shown on the dial being only slightly incorrect, then the inaccuracies may be ignored and the receiver left as it is. However, if the tuning scale is very badly out, a decision must be made as to whether it is better to track the set for accurate dial calibration, for greatest sensitivity, or for a compromise between the two. It must be realised that the tuning scales of some receivers are *not* very accurate affairs; although with the majority, and particularly with the more expensive sets, they can nearly always be relied upon. Bad discrepancies in dial reading usually point to a fault in the signal tuned circuits or in the scale mechanism itself. The latter should be tested to ensure that it travels accurately within its limits for the complete rotation of the tuning capacitor, whilst the signal frequency tuned circuit should be checked for obvious faults such as damaged coils and so on. When iron cored coils are used it is possible that they may need adjustment; but we shall deal with this point more fully in a later article.

Aligning the other Ranges.

After the alignment of the lowest frequency range has been completed, the next ranges may be attempted, always working on the range neighbouring that already completed, and leaving the highest frequency ranges until last.

With the average domestic receiver it will be found that the long and medium wave ranges are capable of being trimmed and padded very easily. However, when the short wave band or bands are tackled, a few complications set in. The reason for the difficulty on the short waves lies in the fact that, whereas in many receivers the problem of fitting a really good short wave band has been properly tackled by the manufacturers, with other sets the reverse holds true. Bluntly speaking, the short wave ranges offered by these latter receivers are little more than a joke.

After a little experience one may soon differentiate between the good and the bad. In any case the preliminary adjustments necessary for aligning the short wave bands are the same for both types of receiver.

Owing to the fact that the padding capacitors needed for the short wave bands usually have high values (such as 0.02 μF or so), it is very rarely that adjustable components are used, fixed padders being fitted instead. All that one has to do, therefore, is to align the signal and oscillator trimmers at the high frequency end of the band; and ensure that the trimming holds true at all positions of the dial.

When the short wave bands are being aligned, care must be taken to see that the oscillator frequency is set *above* the signal frequency. If the signal generator is set to give a strong output it will probably be possible to pick it up at two points on the receiver dial, these being separated by twice the frequency of the IF. The lower of the points (i.e. the one for which the tuning capacitor vanes are more engaged) is the second channel signal and is not required; the trimming should be carried out using the higher frequency point. The signal generator should, of course, be suitably attenuated after the correct signal has been found.

With well-designed sets the signal frequency circuits should be capable of filtering out all but the strongest second channel signals at every point of the dial. With the other type of receiver, however, it will be found that the signal circuits will quite happily accept second channel signals at the lower end of the band; and, indeed anything else that happens to be within 2 or 3 Mcs or so! Still, there is little else that one can do in the latter cases but, at least, keep the high frequency end properly trimmed.

Another difficulty which will be experienced with some of these receivers is that caused by "pulling". "Pulling" is the name for the state of affairs which exists when an adjustment of the signal tuned circuits alters the frequency of the oscillator and so throws the set off tune. This renders the process of trimming very irksome, as the signal generator has to be continually readjusted whilst it is being carried out. If "pulling" is very bad, the best procedure is to slightly rock the signal generator across the frequency being received (in something of the same manner as was used when padding), whilst the signal frequency trimmer is adjusted to its optimum position.

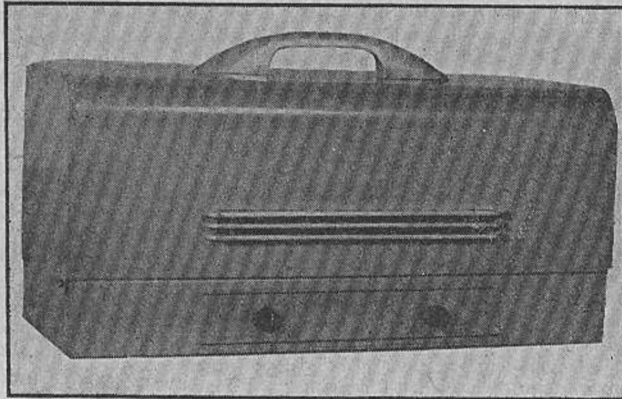
Finally, it may occasionally be found that, when the receiver is switched to the short-wave band, the AVC line is short circuited to chassis. This is legitimate commercial practice; but it has the disadvantage that it does not allow the AVC line to be used as a measure of trimming accuracy. Increases in the sensitivity of the receiver will then have to be checked either aurally or by connecting a meter across the audio output.

Next Month.

In this month's article we have discussed the alignment of the frequency changer stage of the modern domestic superhet. In next month's article we shall give a few more details on this subject and also touch upon the trimming of more complicated receivers.

(*To be continued*)

Push-Pull TRIODE AMPLIFIER



★

by JAMES N. ROE, M.I.R.E., F.R.S.A., G2VV.

THE amplifier here described is capable of delivering 4—5 watts output with a high order of quality reproduction. Straightforward in design and construction, it may be relied upon to give continuous performance if good quality components are incorporated throughout.

Circuit Discussion

V1 is a phase splitting input valve with radio, gram. or microphone input applied to its grid via C1. Input to this valve is controlled by the volume control R1. The inclusion of R2, a further variable resistor, acts to some extent as a tone control and is useful when playing records where needle scratch is too pronounced. The capacitor C2 (quoted as 0.003 μF in this particular model) may be varied to suit individual requirements. V2 and V3 should preferably be matched valves for balanced performance, and the use of common cathode resistors assists in producing equal balance. It is worthwhile checking resistor and capacitor values to make certain they are not too far off the mark. V4 and V5 should also be matched for best results. Since these valves are directly heated, it will be seen that bias is applied via resistor R16 in the centre tap of the heater winding. Particular care should be exercised in the selection of capacitors C6/C7 coupling the output from V2/V3 to the grids of the output valves. Doubtful values or capacitors which have been in use for some other job must not be trusted. Any leakage in these components will allow some of the anode voltage from the driving valve to appear on the grid of the output valve, causing the anode voltage to rise and bringing about a serious loss in valve emission. The output transformer T1 must be suitable for matching to two PX4's, and be capable of carrying the required anode current.

The power supply is quite usual, and here again the choice of good components is strongly recommended. It should be noted that the mains ON/OFF switch (incorporated with R2) is not indicated on the circuit diagram.

Constructional Points

The case used in this particular model—and illustrated in the photographs—is a commercial product. It has a pleasing appearance and gives a professional look to the whole job. However, some constructors may prefer to make their own chassis and case, and for their information the actual case illustrated measures approx: 18 ins. long, 7 ins. deep and 8½ ins. high.

On the top of the chassis from left to right can be seen V1, V2, V3, V4, V5, Output Transformer T1, Mains Transformer T2 and rectifier

V6. In the front, the left-hand knob is the gain control R1 with tone control R2 and mains ON/OFF switch on the right (Cover photo).

The cover (with handle) is ventilated, and is attached to the chassis by screws at each side.

In the underside illustration, the smoothing choke LFC is mounted bottom left hand corner near V6. Input to V1 is taken via the two terminals at the back, and leads are screened as shown in the circuit diagram. The PX4 bias resistor R16 is in the extreme right hand bottom corner. (NOTE. The transformer at the right was used as the writer's mains transformer had only two 4 volt windings. It provides the other 4 volt supply but is not required, of course, when a mains transformer with the required three 4 volt windings is available).

Wiring is carried out in 16 gauge tinned copper wire covered with sleeving. All leads should be kept as short as permissible and, where possible, components should be soldered direct to valve sockets. Resistors R14, R15 must be wired in this manner.

Mains input is taken by way of flexible ead soldered direct to circuit connection points.

The underside of the finished amplifier is completely screened by a metal coverplate held in position by four self-tapping screws.

Testing

When the amplifier is wired and re-checked (the best man can make a mistake!) connect to the mains without any valves in position. Check AC anode voltages on V6 valveholder and all heater supplies. Assuming these are in order, insert the rectifier V6 and check HT voltages at all appropriate points throughout the circuit. With HT correct at all points, the valves should now be inserted.

The following voltages will serve as a guide and were measured on the amplifier illustrated, with a Model 7 AVOMETER.

PX4 anode voltage (each) 325 volts—anode current (each) 36—40 mA.

PX4 bias voltage (each) 30 volts (measure between grid and heater).

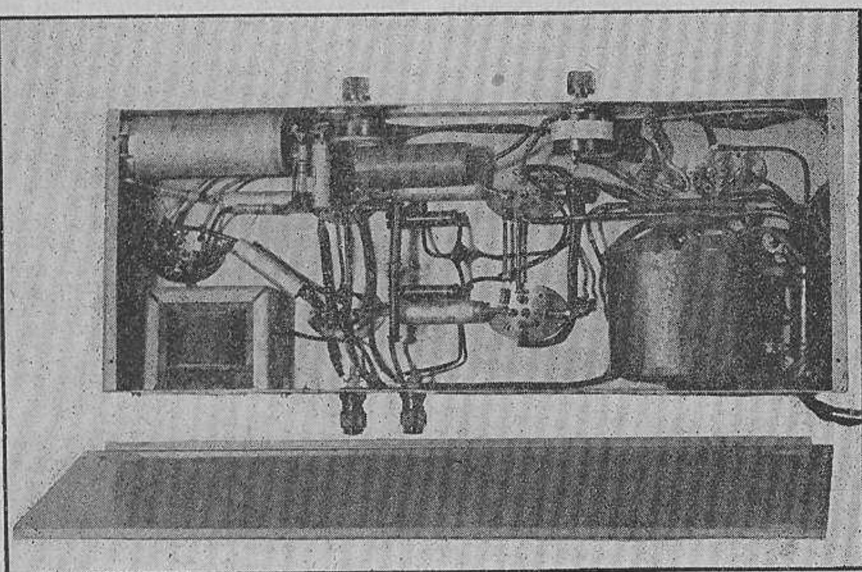
41 MP anode voltage (each) 170 volts.

MH4 anode voltage 180 volts.

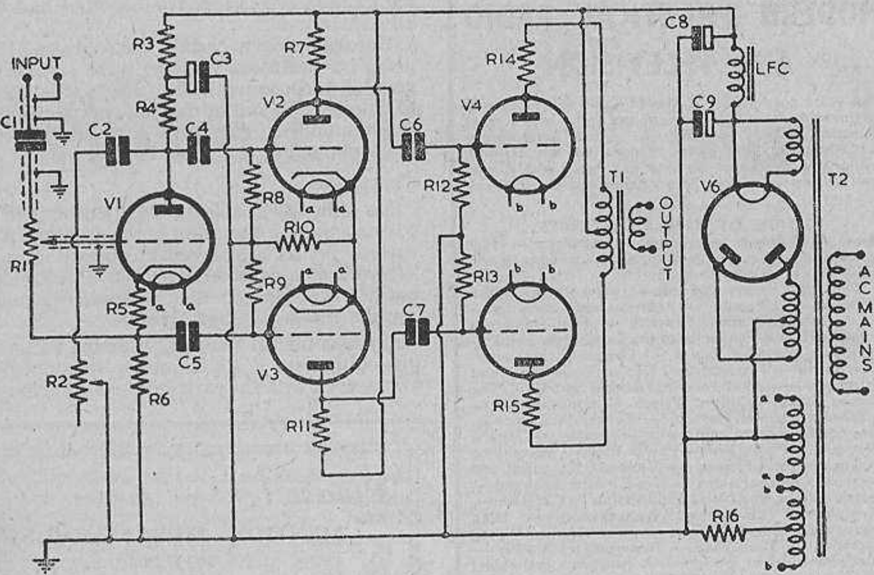
These figures must be taken as approximations as individual components and measuring equipment will naturally vary.

Results.

As a matter of interest, initial tests on reproduction were conducted with a Goodmans 12″ PM Speaker, and results with gram. input using



Showing Layout under chassis, and metal coverplate



C173

Table of Values

Capacitors

C1	=	0.01 μF mica 500V.
C2	=	0.003 μF mica 500V.
C3, 9	=	8 μF 500V electrolytic
C4, 5, 6, 7,	=	0.1 μF mica 500V.
C8	=	16 μF 500V. electrolytic

Resistors

R1	=	2 MegΩ variable
R2	=	1 MegΩ variable with SP switch
R3, 4, 6	=	25 kΩ ½ watt
R5	=	2 kΩ ½ watt
R7, 11	=	20 kΩ 1 watt
R8, 9	=	500 kΩ ½ watt
R10	=	500 Ω ½ watt
R12, 13	=	250 kΩ ½ watt
R14, 15	=	100 Ω ½ watt
R16	=	450 Ω 3 watt wirewound

Transformers etc.

T1	=	Push Pull Output matched to V4, V5
T2	=	Primary 200—250 volts
	=	Secondaries 350—0—350 at 120 mA
		4V at 2 Amps centre-tapped (b)
		4V at 3 Amps centre-tapped (a)
		4V at 3 Amps (Rectifier)
LFC	=	10 Henries 120 mA.

Valves

V1	=	MH4 or equivalent
V2, V3	=	41MP or equivalent
V4, V5	=	PX4 or equivalent
V6	=	FW4—500 or equivalent.

Case Catalogue No. Type 1056A obtainable from Alfred Imhof Ltd., London, W.C.1.

an old type large HMV armature pick-up were exceptionally good. Maximum volume was certainly far too great for the average room. Later tests, using several of the well known makes of lightweight pick-ups, have left no doubt that the amplifier is capable of providing good all round quality with ample volume for all normal purposes.

Where desired, a pre-amplifier using an MH4 or similar valve may be employed, but the results obtained during test with such an amplifier did not appear to indicate that one was necessary.

Output from several types of radio receivers was fed direct to the amplifier without any trouble arising and, in fact, the general performance was even more flexible than had been anticipated.

Results using a carbon microphone (Energised by the usual battery) were suitable for general purpose work, but where it is desired to employ a crystal or moving coil microphone a pre-amplifier (designed for the particular microphone in use) would be necessary.

Conclusion.

No difficulty should be experienced with the construction or operation of the amplifier if the various points mentioned are borne in mind. Where a chassis other than the one quoted is used it is suggested that a similar layout of components would be advisable.

Perhaps one of the most pleasing factors of this equipment is the complete freedom from hum—even with the earth connection removed.

MAGNETIC Sound Recording

Magnetic sound recording is enjoying increasing popularity, and the fact that a number of firms are now supplying kits of parts, components, wire, tape, recording heads, etc., enables the radio constructor to build all or much of the gear himself at reasonable cost. Our contributor has had considerable practical experience of home constructed recording equipment.

The third of a series of articles by E. KALEVELD, **PA∅XE**

An Amplifier for High Impedance Heads.

The circuit diagram of a suitable amplifier, together with an RF bias oscillator, is given in Fig.2. No power pack is shown, as this can be of normal design, but a double filter is advisable to minimise hum. It is best not to build the power pack on the same chassis as the amplifier, particularly if the latter is to be placed in the same cabinet as the tape driving mechanism and the head, as the strong magnetic field from the power pack will most certainly lead to hum difficulties.

The amplifier itself must have a high degree of sensitivity, as the output from the head is only some 10-15 mV. A five-bank two-pole switch can be used, so that one control only need be employed to switch from 'Record' to 'Playback', but care must be taken with the connections to this switch assembly to ensure that unwanted coupling does not occur.

The frequency-correcting network, mentioned in the December issue, is incorporated between the first and the second halves of the 6SN7GT, shown as two triodes in the circuit diagram.

No other tone controls are indicated, as these are left to the choice of the indivdual constructor. If the principles outlined when the filter was being discussed are followed, the circuit constants can easily be altered to obtain a suitable frequency response.

Valve V1 must be 'hand-picked', as it is essential that it be as non-microphonic as possible.

At first, an EF50 was tried, but though this type gave a very high amplification the writer was unable to find one which was free from microphony.

The 6SJ7, shown in Fig.2, was found to be the most suitable valve for this position.

If any motor-boating occurs, and V2 is suspected, separating the cathodes of V2 will usually eliminate the trouble. Each cathode would then be grounded via a 1 kΩ resistor and its own bypass capacitor.

The resistor in series with the head in the 'Record' position serves to provide as constant a load as is possible for the anode circuit of V2. The output circuit is conventional.

The values of coupling capacitors and resistors, together with the coupling network, have been so chosen that a flat frequency characteristic between 50 and 6000 cps is obtained with a standard tape speed of 7½-ins per second. However, different heads may cause dlscrepancies in this figure.

Provision for recording from a radio set or gramophone is made on the first half of V2, via a 0.5 MegΩ potentiometer as shown. For recording from radio, the receiver should be fitted with a pair of terminals connected to each side of the diode load resistor, so that the signal can be fed directly after rectification to the input terminals of the amplifier, via a length of screened cable.

The microphone input circuit is for a crystal type, but a moving-coil pattern could be used as well. The arrangement of the volume controls shown permits mixing the inputs of microphone and radio/gramophone.

The Bias Oscillator.

The RF bias oscillator shown needs a few explanatory remarks. A Hartley oscillator using a triode is the most usual arrangement. The writer tried this type for a period of a month, and it was a constant source of headaches. Either it oscillated so furiously that spurious oscillations occured, i.e., it went into super-regeneration, or the modulating signal prevented oscillation altogether. Several circuits were tried, but the only one found to be foolproof is that shown. The choke,

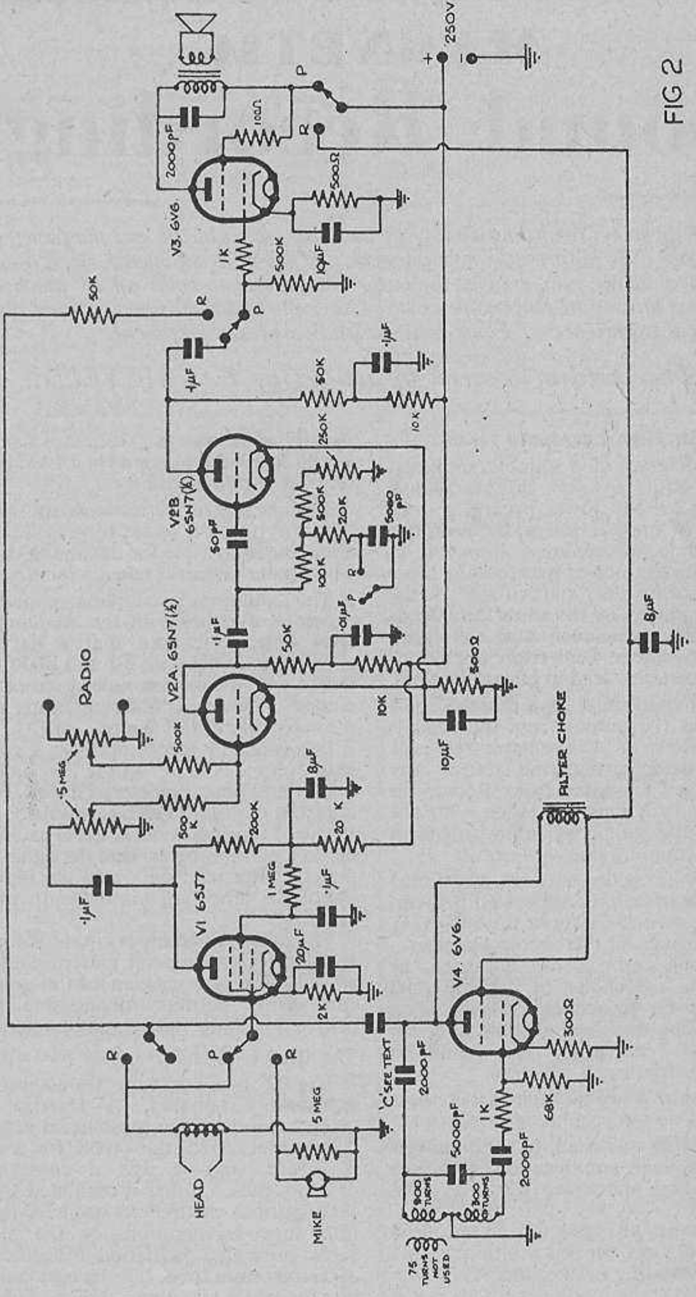


FIG 2

Suitable Amplifier for high impedance heads

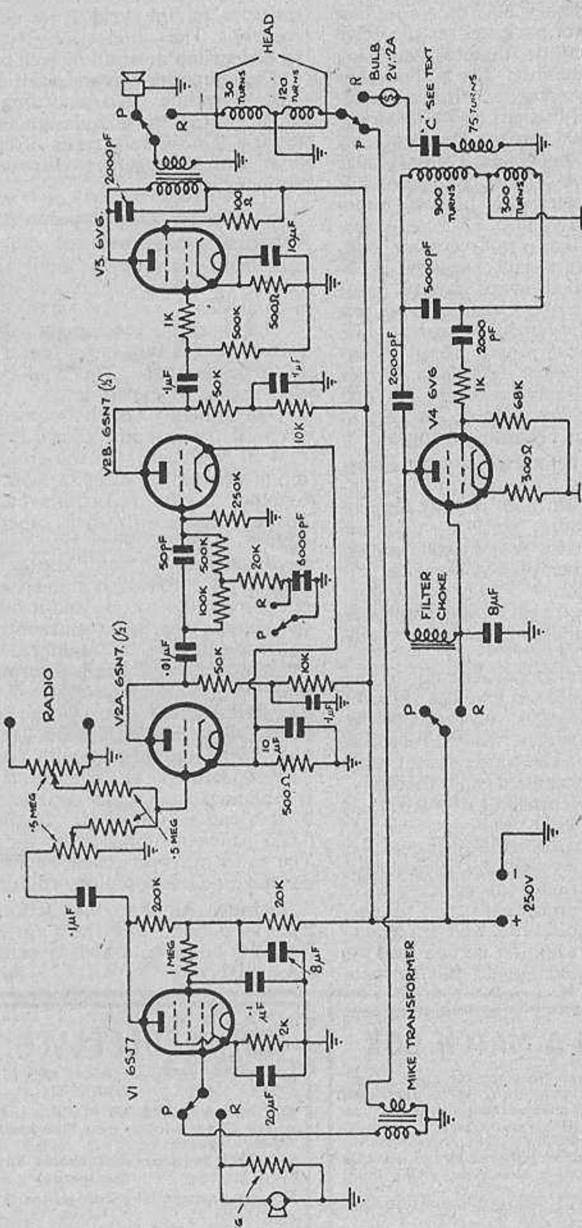


FIG 3

Suitable Amplifier for Low Impedance Heads

ALL RESISTORS IN FIGS 2 & 3 1 WATT.
USE MICA CAPACITORS IN R.F. SECTIONS.

C178

which can be an ordinary 60 mA smoothing type from an old power pack, causes the valve to work as a true pentode, thereby stabilising the circuit very considerably. The coil consists of 1200 turns 28 swg enamelled wire scramble-wound on a former 5/8-in diam. and 1½-ins long. A tap is provided at 300 turns. The frequency of such a coil will be about 40 kcs. The particular frequency used is not critical, a good rule of thumb being five times the highest audio frequency to be recorded plus 10 kcs. A frequency higher than 75 kcs is not recommended, however. The coupling coil consists of 75 turns 22 swg enamelled wire wound over the oscillator coil. In the circuit shown this winding is not required, but it is worth while putting it on, as it may prove useful in experimental work with other circuits and types of head. When finished, the complete coil should be dipped in hot wax to protect it against damp and turns becoming displaced.

The oscillator may be tested on a broadcast receiver. If placed near a receiver, the harmonics will cause whistles through beating against the carriers of broadcast stations, and the frequency of the oscillator may be determined by counting the number of kcs between two such beats.

If much recording of radio programmes is contemplated, the oscillator must be carefully screened.

The RF bias is coupled capacitively to the head, but it is not possible to give the value of capacitor needed owing to variations in the headphone bobbins which will be used in making up the head. The value is not very critical and must be determined experimentally. It will lie between 250 pF and 0.01 μF,- 0.001 μF is a good value to start with.

Apart from this, no difficulties should be met with the amplifier by the constructor who has had average experience of building such gear. All grid and anode leads up to the second half of V2 should be well screened, and coupling capacitors should be wrapped in tin foil, earthed, as also should be the two resistors in the grid lead near the volume control. The connections to the playback/record switch must all be well screened.

The amplifier circuit given here shows the bare essentials. No recording level meter is incorporated in this design, as we hope to discuss the different types of level meters in a later article, together with some additional refinements.

Amplifiers for Low Impedance Heads.

Basically there is no difference between amplifiers for high or low impedance heads, but a few minor differences of detail may be mentioned.

The correct placing of the microphone transformer is very important if minimum hum is to be assured. The final position must be determined by experiment.

One difficulty which is more likely to turn up with the low impedance input ampilfier is that of feedback. In the circuit of Fig.2 the input and output circuits, which are brought together in the record/playback switch, are out of phase with each other, but in the circuit of Fig.3 they are just in phase, so feedback between input and output may easily occur. If it does, it is most certainly due to coupling in the switch, and it may be necessary to separate the input and output leads as far apart as possible. Coupling to the bias oscillator is capacitive, C being determined as before, and lying within the range 0.01 to 0.1 μF. The RF current through the low impedance head can be judged by a 2V 0.2A flash lamp bulb, which should glow with normal brilliance. The capacitor C is varied until this brilliance is obtained in a bulb connected temporarily in the lead to the head. In the writer's case, 0.035 μF was found to be the correct value. The bulb may very well be left in circuit, if desired, and used as a 'record' indicator.

So much for the construction of the heads and amplifier. The next article will deal with the construction of a simple tape drive mechanisn. *To be continued.*

Focus on 144 Mcs. . . .

Part 1

THE RECEIVER (Convertors, choice of valves, oscillators)

by H. E. SMITH, G6UH

Foreword :

THE following notes and observations have been prepared expressly for the beginner. Every effort has been made to keep to the practical angle and avoid any confusing mathematical terms. Having been a keen experimenter on the VHF bands for some years (60 Mcs. in 1930) the writer feels that the results of these years of experience may prove to be of some value to the beginner, and assist in ironing out some of the snags and pitfalls associated with VHF work.

VHF work as a whole can be put into four sections i.e., The Receiver, the Aerial, the Transmitter and the Operator, in that order of priority. It is not proposed to weigh the merits of one converter or receiver against another, or to present any freak circuits, but, with the beginner in mind, to make a survey of 2 metre work and its problems. "What to Avoid" will be the main theme, with "hints for increased efficiency" providing the accompaniment.

The Receiver:

First and foremost, never, never attempt to use a super-regenerative receiver on 144 Mcs. While its sensitivity is high, the signal to noise ratio is usually so low that it is practically useless for receiving anything but strong signals.

Some optimists use a TRF, and with some success, but it is not recommended for the beginner. It is usually assumed that the amateur becoming interested in 2 metre work already possesses a reasonably good communications receiver, in which case, the construction of a VHF Converter does not present such a problem as would the building of a complete receiver. A great number of converters have been described and written up in the various journals from time to time, and it is not proposed to dwell on any particular circuit. The following list of "don'ts", however, should be carefully studied and rigidly adhered to; they apply to all sections, including the oscillator and mixer, of a 144—146 Mcs converter.

Don't use Octal valves of any kind.

Don't make up coils with anything thinner than 18 swg wire.

Don't use compression type trimmers.

Don't use single bearing tuning capacitors.

Don't tune the RF circuits with capacitors, always use dust-iron or brass plungers.

Don't use cheap carbon resistors.

Don't use anything but mica fixed capacitors.

Don't leave long leads between components.

But always:—

Use valves designed specifically to operate efficiently on 144—146 Mcs.

Use 16 swg wire (silver plated if possible) for all RF Coils, and ensure that the coil is rigidly supported.

Use air-spaced trimmers of a reliable make.

Use double bearing (ball bearing) type tuning capacitor, if oscillator tuning is used.

Use high-stability or similar type resistors everywhere in the circuit.

Use shortest leads possible between all coils, components, and valve-holders.

Use Ceramic valve-holders.

Use your soldering iron to make joints, not just to melt solder.

Converters:

On the Amateur Bands below 30 Mcs, atmospherics and interference from other stations are usually the limiting factors of performance. On 144 Mcs, however, atmos-

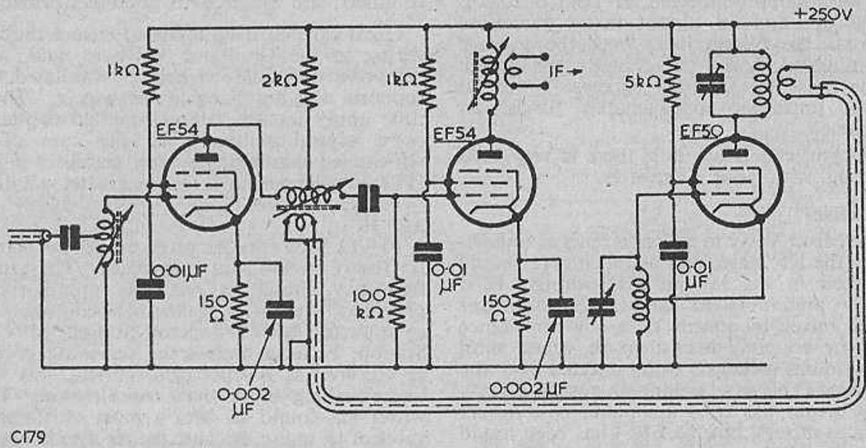


Fig. 1: Basic 2-metre converter using pentodes, EF54 RF, EF54 mixer, and EF50 oscillator/doubler.

pherics are of a negligible quantity and, except for ignition trouble, interference is rare.

Receiver noise plays a most important part in VHF work, and it must be clearly understood that the noise level of the converter, plus the aerial noise, will be the level below which signals will be inaudible. Therefore, the aim must always be to keep RF and Mixer noise down to a minimum by using valves with the lowest "Equivalent Noise Resistance".

In the well-known and more easily obtained range of pentodes suitable for use on VHF, we have the Z77, 6AK5, EF50 and EF54. The 954 acorn pentode is omitted, as its noise resistance is inferior to any of the above types; in fact, it is almost three times that of the 6AK5.

The noise figures for the valves quoted above are:—

6AK5	2,500 ohms
EF50	1,400 ohms
Z77	1,000 ohms
EF54	700 ohms

It will at once be seen that if we are going to use pentodes, the EF54 is the valve to use; therefore, a three-stage converter using EF54 as RF Amplifier, EF54 Mixer and EF50 or EF54 as Oscillator-doubler (Fig. 2) will, if carefully constructed, give excellent results, and will have quite a good signal to noise ratio.

It may be found, when using an EF50 as oscillator-doubler, that modulation hum is present on all signals, causing them to take on a T7 tone.

The remedy for this is to isolate the oscillator heater from the AC supply and apply DC to the heater from a separate transformer and metal rectifier, with about 500 μF smoothing, or from a 6-volt accumulator.

The real stable "T9" Converter, however, is the crystal controlled type, with all tuning carried out on the IF. Several good circuits have already been described in various journals.

Then we come to the grounded grid triode and the 6J6 twin triode. The 6J4 grounded grid triode (Mullard EC91) is an admirable valve for 144 Mcs. Two of these valves feeding an EF54 or 6J6 Mixer is practically the last word in 144 Mcs Converters, and provides a very high signal to noise ratio (Fig. 2).

The 6J6 (Mullard ECC91) also makes an efficient RF Amplifier at this frequency, but great care must be taken over the neutralising as, if only a small amount of regeneration is present, results will be disappointing and the noise level will be high.

Particular attention should always be paid to the method of coupling the aerial to the input of the Converter. If coupling is too loose, the RF Amplifier will become slightly regenerative, and the additional noise thus produced will give a false indication of sensitivity. If no signal generator is available, it is always better to adjust the aerial coupling on a weak signal. A method of obtaining optimum coupling is shown at Fig. 3.

A good check on the performance of a Converter is as follows:—

With aerial connected, IF control turned well up, and an output meter connected across the phone jack, note the average reading of noise. Disconnect the aerial. The noise level should decrease by about three times (or approximately 10 dB) or more.

If you can attain this, there is very little wrong with your Converter.

The Mixer:

The Mixer Valve in a Converter is as important as the RF stage, and as much care should be taken in the lay-out and wiring. It is usually preferable to couple the oscillator to the mixer by means of a low-impedance link; the coupling may then be varied until the optimum voltage is being injected from the Oscillator (This can be done on a weak signal).

The writer has tried a number of different valves as mixers, but the EF54 has been found to give a slightly superior performance to date, and it is at present in use.

It is strongly advised that spring clips or retaining rings be used to hold all valves securely in their holders, and it is a good plan to remove all valves from time to time and apply carbon-tetrachloride, by means of a small brush, to the valve pins and the valve socket. Slight oxidisation or a thin film of "greasy dust" will often give rise to excessive noise.

The Oscillator :

Stability must be the watchword here, and one way of obtaining this is to use as high a capacity and as low an inductance as possible. High stability resistors and reliable mica fixed capacitors, and above all, air spaced trimmers, are essential to good performance.

Great care must be taken to ensure that all wiring to the Oscillator Valve is rigid, and components should be held by insulated tag supports and not hung in the wiring. These rules apply equally to a self-excited oscillator or a crystal-oscillator. In the case of a self-excited oscillator, a neon stabiliser in the HT feed will assist in obtaining greater stability.

The IF :

10—12 Mcs appears to be a popular choice for the IF in 144 Mcs converters. The actual frequency chosen is relatively unimportant, provided it is not on a channel being used by a powerful SW Broadcast Station or CW Station, because, unless the screening of the IF Receiver is 100 per cent. perfect, this will be something more than troublesome! The writer has found 26 Mcs a most satisfactory value of IF to use, because the receiver happens to be most sensitive on this particular portion of the band. The co-axial lead from the converter to the IF should be earthed well, and taken by the shortest route.

General :

It is unwise to attempt to convert a receiver such as the R.1132A to operate on 144 Mcs. Being originally designed to operate at a maximum frequency of 124 Mcs, its performance on 144 Mcs is bound to be disappointing, as the valves used (VR65) rapidly fall off in performance at about 100 Mcs. While it may be possible to hear local signals, the overall sensitivity will be too low, and it is not worth the trouble, unless an extensive rebuild, scrapping the existing RF section, is undertaken.

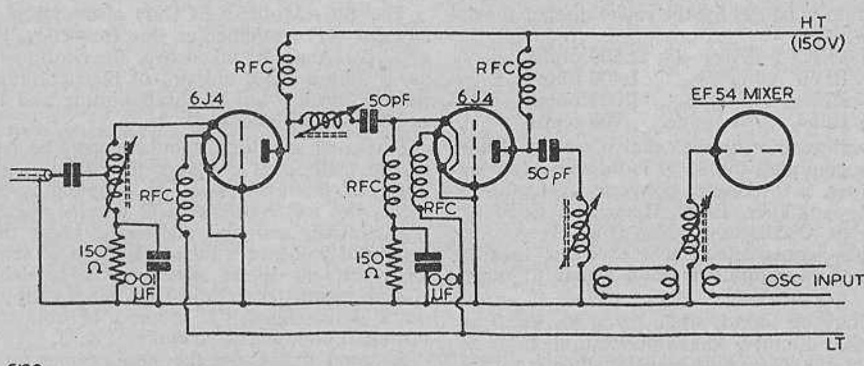
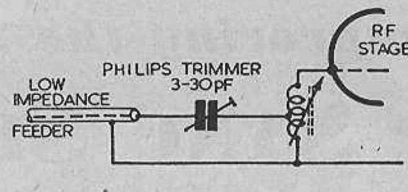


Fig. 2: Basic converter using 6J4 triodes. Mixer and oscillator as in Fig. 1.

Fig. 3: A method of obtaining optimum aerial coupling to the RF grid.



The RF27 unit is a different story entirely, and this can be modified to make an excellent Converter for 144 Mcs.

The modification of the RF27 was written up fairly recently by G2FMF in the RSGB "Bulletin".

(The writer is indebted to Mr. H. N. Gant, A.M. Brit. I.R.E., for his assistance on the subject of valve noise).

(To be continued)

ANSWERS TO QUIZ

(1) Our stooge was exceeding the power dissipation of the screen, either because the HT voltage was greater than expected when deciding the value of the resistor, or because the wrong value had been put in by mistake. The remedy was to fit a higher value resistor, capable of dropping sufficient voltage for the product of the remainder and the current to be within the manufacturer's rating.

(2) As the cathode does not cool instantly, it is still able to emit for a second or two provided the EHT is still present. EHT is usually present in the capacitors of the EHT supply, which discharge quite slowly through the CRT. With mains transformer EHT there is often a 'bleeder' resistor chain which helps to discharge the capacitors, and if the grid bias is derived from the 'bleeder' the EHT holds the grid negative, and so cannot produce a bright, small spot.

When focusing is by coil, the disappearance of HT will cause defocusing and the beam energy will be safely spread over a large area. It must be noted, however, that a permanent magnet focusing ring will maintain quite a small spot while adequate EHT is available and the grid is unbiased. A combination of mains EHT, large reservoir and smoothing capacitors, grid bias from HT, and PM focusing seem highly likely to maintain a bright spot for several seconds. In fly-back and RF EHT circuits, the smoothing capacitor is generally very small and is so rapidly discharged that the spot cannot remain for long. The PM ring is ideal for these modern circuits.

(3) The microphone picks up sound from the loudspeaker, the amplifier presents it again to the speaker and the microphone starts the circle again, each repetition having the benefit of full amplification, until the system oscillates; in two words, positive feedback. Choice of positions for loudspeaker and microphone, directional horns, and judicious use of gain control can do much to overcome the trouble.

(4) A harsh sound, mostly 50-cycle sync pulses. Although of the same frequency (or pitch) as mains hum, the sound is very different in character, due to the great difference in waveform. It is a rather metallic clatter, and some liken it to a two-stroke motor-cycle. Apart from the frame frequency and some of the harmonics of it, much of the signal is above audibility, but with very good earphones the high-pitched 10,125 cps line sync may be heard. However, frame sync is sufficient for preliminary peaking.

(5) The jointing compound used by gas fitters effectively isolates each section electrically, and not only does the piping fail as an earth line but it can be highly dangerous if the apparatus 'earthed' to it becomes faulty, for the section connected will become live and anyone touching it will receive a shock.

(6) None. The larger diameter tube is longer; the distances from scanning yoke to screen compared with screen diameters are in the same proportion for each, so the deflection angles are similar.

Improving the . . .
SYNC SEPARATOR

by W. GROOME

AFTER five or six months of experimenting with Midlands TV, the writer has decided to emerge from his little "Quiz" corner, in order to present some of the fruits of his labours. Experience, plus many earnest conversations with the gentry who crowd into surplus stores, have made it clear that of all the troubles experienced by constructors, the cajority are found to involve the Sync department.

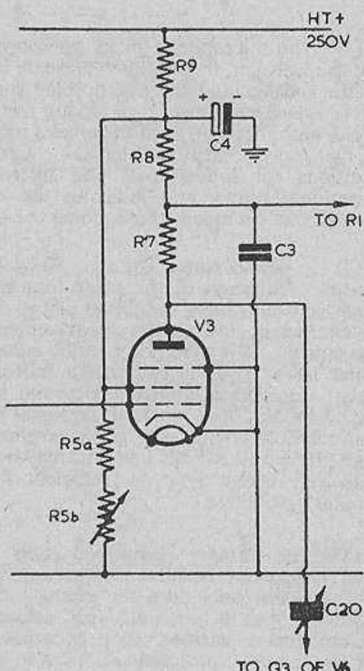


Fig. 1: Showing modifications to screen supply of the sync separator.

Values: R5A, 33 *k* Ω *R5B,* 50 *k* Ω *wire-wound variable. Al other values as in Fig.* 6/10 *of book.*

At worst, line sync is entirely absent, with the picture appearing only on split-second mcasions when the frequency control is set at a critical frequency, and then it breaks up almost instantly. The fact that the frame appears to hold may cause some to think that there are sync pulses after all. Wrong, dear Sir ! The time base is probably locking on 50 cps hum.

Where sync is present, but weak, holding is possible at critical positions of the frequency controls, but any drift in the "natural" frequency of the time bases causes the picture to break up. This is the condition usually encountered. Pulling out of lines and frame "rolling" are the usual symptons.

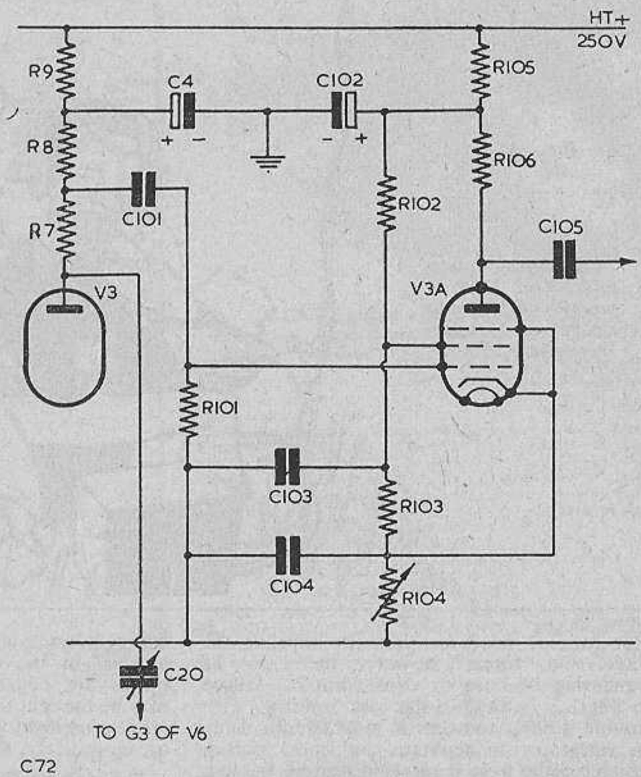
In actual fact, the user of the VCR97 should have better sync than the more wealthy "magnetic" man. With the magnetic tube, the maximum input is 25 to 30 volts, but the electrostatic variety demands 100 volts for peak white, and gets perhaps 60 or 80 volts. This larger video input means that a larger input reaches the sync separator, with consequently better chances of getting well-shaped pulses of adequate amplitude.

As the "Inexpensive" is probably nearest the heart of most readers of this journal, it shall be the object of our present attentions. That does not mean that it has a poor sync department. The writer raises his hat most respectfully to the designers of the set that has taken TV into the homes of many who would otherwise be without it. (Thank you!—Ed.). The sync separator is quite effective, and those who have had difficulty will find that it is more through variations in working conditions than design. The designers could have given rigid and unvariable specifications for HT supplies and components, and for

Fig. 2: Further modifications to the sync separator.

Values:

R7, 8, 9	as Fig. 1
R101,	220 k Ω
R102, 103,	47 k Ω 2W
R104,	25 k Ω ww pot.
R105,	33 k Ω
R106,	27 k Ω
C4,	as Fig. 1
C101,	200 pF
C102,	8 μF 350V
C103, 104,	0.1 μF
C105,	75 pF



various components which can influence working conditions, but this would have limited the constructor's scope in obtaining parts. Consequently, every set made has variations which can affect the performance, through the use of components which have a performance that is not ideal. Variations in layout and valve characteristics have considerable influence, too.

Our line of attack is not to condemn a good circuit, but to introduce modifications which will allow adjustments to be made which will offset incorrect operating conditions.

In addition to the diagrams accompanying this article, we shall refer also to Fig. 6 in the original version of "Inexpensive Television", which is Fig. 10 in the new revised and enlarged edition.

Many constructors are applying something like 500V to the time bases, Fig. 6/10, and although this is quite in order, in fact necessary as far as V4, V5, V6 and V7 are concerned, V2 and V3 are happier on 300V or maybe less. Many people are forgetting to disconnect them from the time base HT line when the higher voltage is used. Miracles are likely to be worked by connecting the top ends of R2 and R9, Fig. 6/10, to the 250/300V line which feeds the receiver section of the set.

That change, alone, will do the trick in many cases. The following advice will be of help to others. As the screen voltage is rather critical, it is recommended that there should be some form of adjustment. This is arranged by taking out R5 of Fig. 6/10, and replacing it with a combination of fixed and variable resistors which will enable the voltage to be set above or below that value obtained with the single fixed resistor. Fig. 1 of this article shows this modification. If the time bases are all right and the signal present in correct phase, a setting of R5A will be found which will enable the picture to be locked firmly over an appreciable variation of the time base frequency controls.

As far as "line" is concerned, there is little

"Check your modulator, Old Man, you've got chronic LF instability somewhere!"

that can, or need, be done to improve the stage. On "frame", however, there may be wandering of lines or even complete failure to interlace, although the lock is firm. This trouble is likely to occur in most circuits using an integrator to separate the frame pulses, which emerge from it rather distorted, the loss of the true vertical edge resulting in inaccuracies in the time of firing the sawtooth generator.

Another cause of inaccurate firing is the fact that both line and frame pulses are derived from a common anode resistor. Here, the risk is that of line pulses getting into the frame time base and firing it at any old time. What is needed is some method of handling the frame pulses independently and blotting out any line pulses which attempt to force their attentions in an unwelcome manner. Fig. 2 shows the circuit used very successfully by the writer. The first valve, V3, is the "Inexpensive" separator, with the modifications already described. The reference numbers have been arranged to correspond with those of Fig. 6/10 in the book. Note that C3 has been purposely omitted. Line pulses are taken from V3 anode and differentiated exactly as shown in the book.

The second valve, V3A, is designated thus to avoid confusion with other valves in the book diagram, and the reference numbers of associated components are outside the book range for the same reason. At first glance, one wonders how the thing can work, for phase reversal in the valve is inevitable. As the pulses are negative-going on V3 anode, it may be thought that they will be positive-going (and so useless for a transitron) on V3A anode or, more likely, eliminated completely.

The answer lies in the RC combination C10/R101. The time constant of this is close to the duration of a frame pulse. Its effect on frame pulses is rather different to its treatment of line pulses, which get past it almost unchanged—they are negative-going and are promptly eliminated by V3A. At that point we may forget line pulses. Frame pulses, also negative-going, acquire a positive-going spike where the rear edge shoots over the zero mark. The negative portion is "wiped out" by V3A, but the positive spikes are amplified and clipped, appearing at the anode reversed to negative-going. C105, value 75 pF, is connected to V4 of the book diagram in place of R13 and C7, which should be removed.

It will be found that, with the correct settings of R5B and R104, the hold is firm over nearly a half-turn of the 2 Meg Ω frequency controls, movement of which varies width and height but not frequency. The writer's picture, on a 7-inch electrostatic tube, is rock steady, interlace is constant, and the half-line at top and bottom can be seen exactly half-way across the picture.

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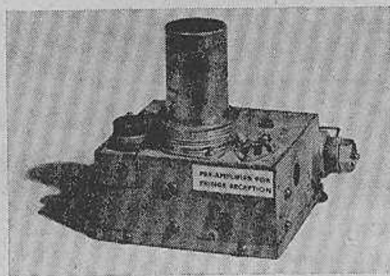

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Is it possible to use a miniature moving coil loud speaker as a microphone? If so, would you recommend the best method of connection.
K. Stanley, Ryde.

The moving coil microphone is very similar in design to the moving coil speaker, except that the mode of operation is reversed. Instead of the signal being applied to the speech coil in the form of changes in current to produce an agitation of the cone, sound waves are applied to the cone which in turn vibrates and induces a current into the speech coil. The main difference between the speaker and the microphone arises from the difference in their power handling capacities, which enable a much lighter cone and cone suspension to be employed on the microphone. The use of a light assembly of this type provides the best possible sensitivity and frequency response, but this advantage cannot be fully realised when a standard type of speaker is used as a mike. However, the results which are obtained from a miniature moving coil speaker are generally quite satisfactory, and all that is required is a suitable matching transformer having a ratio of about 50 : 1. A transformer designed to match a speaker to a battery powered output pentode has a ratio of this order and should prove to be ideal for the job.

If the amplifier is of a type designed only for use with a gramophone pick-up it may be necessary to add a further stage of amplification when the microphone is employed, because of the relatively low output voltage which is obtained from this instrument. Alternatively, if the amplifier has a triode valve in the first stage it is possible to replace this by means of a low microphony pentode, thus doubling or trebling the stage gain and providing that extra voltage amplification which is so necessary to boost the output of the microphone.

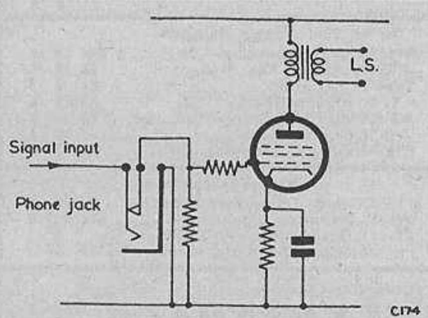


Fig. 1: Skeleton circuit showing method of connecting a phone jack in the grid circuit of an output pentode.

Headphone Connections.

I wish to use headphones for the reception of weak signals with my TR.1196 receiver. Would you advise the connection of the phones in the anode circuit of the output stage, or is some alternative method advisable? D. Clark, Preston.

Standard high impedance headphones of the 2000 to 4000 Ω type have a magnetic circuit which consists of two bobbins of wire placed one on each limb of a "U" shaped core. Owing to the limitation on the size of the bobbins, it is normal practice to wind them with a wire having a gauge of 40 swg or perhaps even finer. Now the gauge of wire used limits the current carrying capacity of the phones to something in the region of 7mA, and this means that apart from any aural discomfort which may be experienced it is advisable to limit the power which can be supplied to the phones; it being only too easy to tune from a weak transmission to a local station and find that one has forgotten to disconnect the phones, with consequent damage.

The main point to bear in mind when considering the best position for the phones in the receiver circuit is that, no matter what the signal strength, it should not be possible to seriously overload them. A second requirement is that the main loud speaker is switched out when the phones are in use. It is possible to meet both requirements by connecting the phones in the anode circuit of the output valve, but it entails a relatively complex switching arrangement and the use of an additional resistor to dissipate the unwanted energy. It is therefore better practice to make the connection in the grid circuit of the output

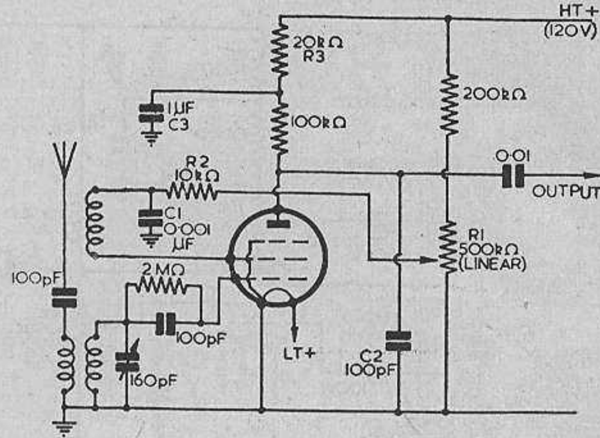


Fig. 2: Detector stage employing screen grid reaction.

valve. This arrangement is shown in the diagram Fig. 1, which indicates the method of connecting a circuit-opening jack socket in such a manner that it disconnects the signal from the output stage whilst joining the phones in circuit.

Reaction.

I am at present using a conventional form of reaction circuit on my 1—V—2 short wave receiver and, although the results are reasonably satisfactory, I am wondering if they might be improved by the use of either screen or suppressor grid reaction. What are your comments on such a conversion? *D. Tyler, Barnstable.*

Both screen grid and suppressor grid reaction have been used in the detector circuits of straight short wave receivers, and just prior to the war amateurs were proclaiming the relative advantages and disadvantages of these circuits when compared with the conventional arrangement of taking the reaction feedback from the anode of the valve. The main advantage, which is present in both systems, is that it is possible to greatly reduce, if not entirely eliminate, RF currents in the anode circuit of the valve, thereby reducing stray capacity effects such as instability, and that most annoying effect known as 'hand capacity' which either upsets the setting of the reaction control or detunes the receiver as the hand is brought up to the control panel. It is doubtful whether either of the alternative circuits offers any improvement in the smoothness of the reaction setting, as this feature is largely a function of unwanted capacity coupling between components and also of circuit losses, and can only be improved by the use of a careful layout and short leads. In the interests of short leads we favour the application of a variable voltage to one of the valve electrodes as a means of adjusting reaction, in preference to a variable capacitor. This is because the leads to an adjustable potentiometer can be made dead to RF, and may thus be of any convenient length without causing trouble.

The following brief descriptions of the screen and suppressor grid reaction circuits may prove of interest to those who wish to experiment in obtaining improved results from straight SW receivers. The circuit of the

QUERY CORNER

"Rules"

(1) A nominal fee of 2/- will be made for each query.

(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner," Radio Constructor, 57, Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with a more general interest will be reproduced in these pages each month.

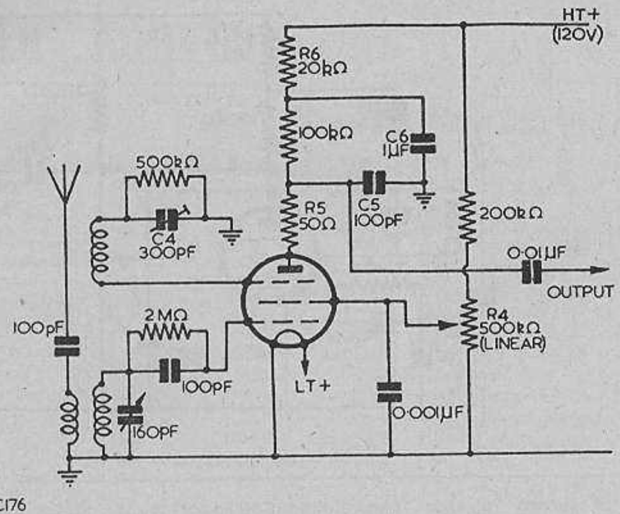


Fig. 3: Detector stage employing suppressor grid reaction.

screen grid arrangement is shown in Fig. 2, from which it will be seen that the RF component in the screen circuit is fed back into the grid by mutual inductance coupling between the tuning and reaction coils. When the energy which is returned to the grid circuit is greater than the losses in the circuit the stage will generate maintained oscillations. The degree of feed-back is adjusted by varying the amplification of the valve, which is in turn controlled by the screen potential divider. The RF current in the reaction coil passes to earth via the capacitor C1, and therefore the lead to R1 is at earth potential as far as RF is concerned. If the reaction is found to be too fierce the number of turns on the feedback coil should be reduced; no attempt must be made to reduce the feedback by including a resistor in series with the coil, as this will reduce the gain of the valve at the audio signal frequencies. The decoupling components R2 and C1 should be placed as close to the coil as possible. The capacitor C2 bypasses the anode at RF, whilst R3 and C3 form the anode decoupling at AF.

Turning now to the suppressor grid circuit, which is shown in Fig. 3, it will be seen that the reaction coil is included directly in the lead to the suppressor grid. The success of this circuit will depend largely upon the control which the suppressor can exercise upon the anode current and, although the main reaction control is obtained by means of the screen potentiometer **R4**, it may be desirable to include a pre-set control in the form of C4. Careful adjustment of these two controls enables the best compromise to be obtained between the sensitivity and the smooth control of reaction. The preset capacitor C4 is shunted by means of a resistor which provides a DC path to earth for any charge which might otherwise collect upon the suppressor grid. Decoupling of the anode is obtained by means of R5, C5, at RF and R6, C6 at AF. It must of course be remembered, when the components are being obtained for this circuit, that the valve has to be a pentode in which the suppressor grid is brought out to a separate pin on the base.

CALLING LUTON AND DISTRICT READERS

The Luton and District Radio Society have extended an invitation to all readers in the locality to pay them a visit at their meetings. Here is the programme for the immediate future:

- Feb. 19 Visit from Shefford Radio Society.
- Feb. 26 Talk by Mr. P. M. Clifford—"Long Duration Recordings".
- Mar. 5 Talk by Mr. A. J. Tearle, G3KG.
- Mar. 12 Mr. W. K. Walker, G2WO and Mr. H. W. Haynes, G2ALH—"The Murphy Lightweight Multi-Channel Aircraft R.T."

Readers wishing to attend should communicate with the Hon. Sec., Mr. A. S. E. Radford, 37, Wilsden Avenue, Luton, Beds.

PRACTICAL AERIALS

Constructional Notes

All-Metal Beams

Halyards & Guys

by "AETHERIUM"

Part 6

Constructional Notes.

THE problem most frequently encountered in the construction of beam aerials is the one of supporting the elements. This can be achieved in many ways, but one of the most satisfactory methods is that shown in Fig. 1.

As can be seen, this entails the use of a length of battening and four porcelain stand-off insulators per element, the element being secured to each of the insulators by a strip of aluminium, brass or copper. The stand-off insulators must be strong enough to withstand the weight of the elements under gale conditions, and it has been found that the small Belling (type L1277) insulator, is strong enough to hold up to ½" dural elements in almost any weather conditions.

When fixing these stand-off insulators to the battening it is recommended that the longest wood screw possible be used, and a small leather washer inserted under the screw head to avoid cracking the insulator base when tightening up (Fig. 2). Never use rubber washers, as these soon perish and fall off, leaving the insulator loose on the battening.

For experimental work, the "ladder" type of boom is recommended. This allows the distance of reflector and director to be adjusted for the best gain (Fig. 3).

For a 28 Mcs beam constructed of ½" or ¾" dural tube, 2" × 1" batten is strong enough. The holes in the battening should, of course, be drilled before assembly, to ensure that each pair are in alignment.

All Metal Beams.

For the solid "plumber's delight" beams, good use may be made of ¾" electrical conduit fittings. The 4 way "¾" Box" makes an

C184

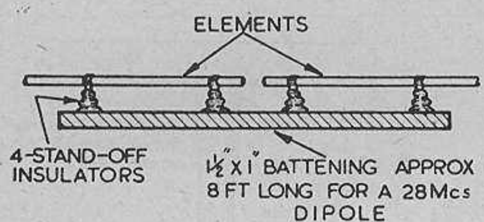


FIG 1
A GOOD METHOD OF MOUNTING BEAM ELEMENTS

4 CLAMPS OF BRASS COPPER OR DURAL

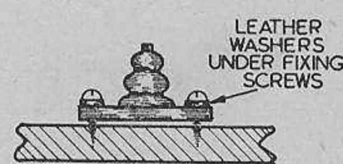


FIG 2
HOW TO AVOID CRACKING THE INSULATOR BASE

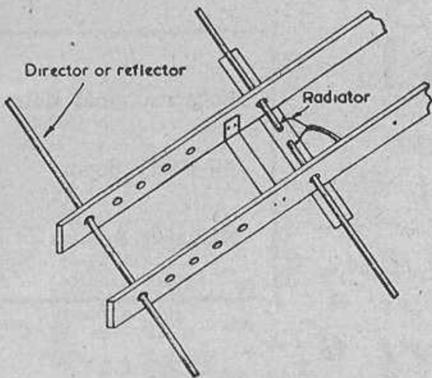


FIG 3
Ladder type boom for experimental work, drilled for easy adjustment of element spacing.

ideal centre piece, with an additional ¾″ tapped hole drilled in its base for the main support (Fig. 4).

The "T" pieces may be drilled and tapped to take a 2BA securing screw, and the elements pushed through and secured by this means (Fig. 5).

Steel conduit, although used by some amateurs for the actual elements, is not recommended, as its RF resistance is very high. It also makes the complete array very heavy. With proper support, ¾″ solid drawn conduit may be used to rotate the beam, and a method of doing this is shown in (Fig. 6). The holes in the brackets should be made with approximately 1/32″ clearance for the ¾″ tube. With approximately 4 feet of the conduit projecting above the mast, additional guys will be unnecessary, and for a 144 Mcs beam the projecting portion may be as much as 8 feet.

When coupling two lengths of this conduit together, use should be made of the thin locking nuts. Use two pairs of footprints to ensure a tight full-locked connection, and don't forget to give the connection at least two coats of good outside paint.

Fixed Aerials.

The mast head pulley can be a source of trouble, especially if the halyard breaks. A much better idea comes from America. It is shown in Fig. 7, and should the halyard break, it is a comparatively easy matter to fit a new one by the use of a weighted line or even a bow and arrow! Use only stranded galvanised wire for guys, and if operating mainly on 14 or 28 Mcs, break each guy with an egg insulator at 6 or 12 feet intervals.

Anchorage points for guy wires, if not already available, may be made from 4 to 5 foot lengths of 1″ gas piping driven into the

C186

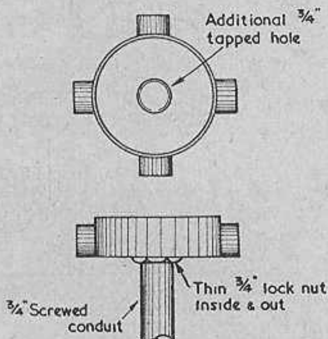


FIG 4 The 4 way box as a basis for a rotary beam.

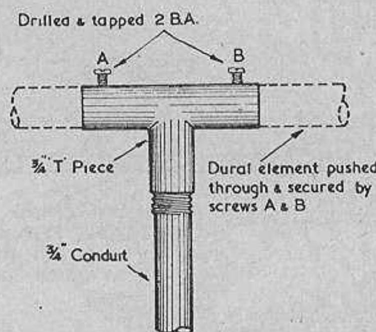


FIG 5. ¾″ T used to support parasitic element.

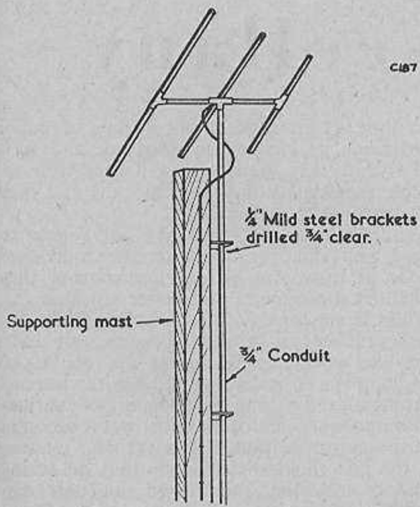


FIG 6. Using ¾" conduit as rotating mast for a beam.

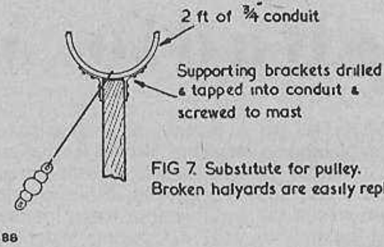


FIG 7. Substitute for pulley. Broken halyards are easily replaced

ground at an angle and leaving sufficient pipe exposed to secure the guy wire. Turnbuckles should be used to obtain the final straining point.

Feeders.

If using spaced feeders, always make an anchorage point close to the point of entry into the house (Fig. 8). With wooden framed windows, drilling is usually not necessary, and with the aid of some mica or thin perspex, the feeder wires can be bent round the top of the window and the frame made to close on them. Iron frame windows present a different problem, and it is often better to seek a point of entry under the eaves.

Drilling through the glass is, of course, a much better method in both cases, but we will not dwell upon this nor advise it, in view of certain unsurmountable difficulties which may be encountered!

Balanced and co-axial feeders usually mean that a hole has to be drilled somewhere, but there are cases where the overflow pipe of the water tank has provided a suitable means of gaining entry into the house, or down an unused chimney (but first make sure it will never be used!). If the shack is on the ground floor, the air brick entry is a good one, although this means taking up a floor board or two.

Whatever type of feeder is used, never let it hang down and blow about in the wind so that it becomes a menace to the family washing, otherwise you may be invited to dismantle the whole installation forthwith.

Aim to make your aerial system look safe, tidy, and neat, and remember that your neighbours have to look at it.

(To be continued)

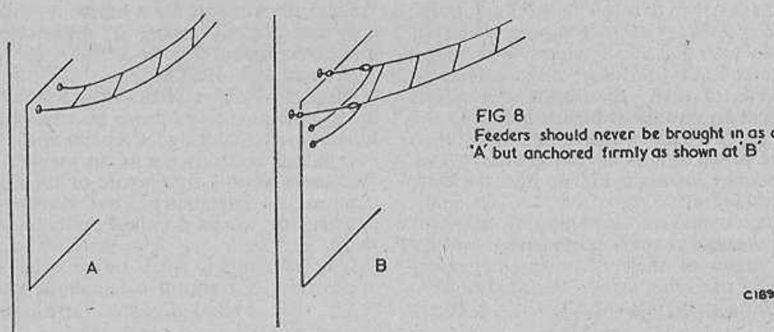


FIG 8
Feeders should never be brought in as at 'A' but anchored firmly as shown at 'B'

Radio Miscellany

TALKING to a group of enthusiasts, I happened to mention "World Radio" and for a moment I was surprised that almost without exception they looked rather puzzled. It then struck me forcibly that many of them would have been only about ten years old, and some still younger, when the War started, and could hardly be expected to know about "World Radio". Yet at one time it was a very paying publication of the B.B.C., concerning itself with technicalities and foreign programmes. It certainly had quite a vogue in the days when the man in the street built his own receiver and spent much of his time (when not otherwise tinkering with it) at knob-twiddling for the thrill of getting foreign programmes.

Once the factory-built receiver was stepped into the high gear of mass production and conditions demanded more and more complication, home construction dwindled and the circulation of "World Radio" heavily declined. It was finally absorbed by the "Radio Times" at the beginning of the War.

Looking back, the old timer will recall a long list of other casualties, many of which enjoyed enormous circulations in their heyday.

The death of any magazine is a sad occasion. Very few die because there is no longer a need of them. The cause, unhappily, is that the demand for them is not quite big enough. In the last twelve months we have witnessed the disappearance of two nationally-known magazines—the STRAND (with a circulation of 120,000) and the LEADER (circulation 400,000). The saddest part about it is that both of these publications were infinitely superior to the many trashy periodicals with their strip cartoons and cheap sensationalism which manage to run to seven figure circulations.

Even in pre-War days the production of a magazine was a costly business, and many of the former radio journals battled gamely to fill the needs of many thousands of readers, but they had to go out of business despite the fact that they still had considerable circulations. To-day the position is, if anything, even worse. Printing costs are much higher and paper is many times dearer.

This may sound a very gloomy state of affairs, and some readers might even wonder just how many of their favourite magazines are in danger of fading away. None, I hope—but one thing is certain: R.C. is not a likely candidate.

Within six months of the lifting of paper restrictions its circulation doubled, and it is still rising. My view is that it may well redouble its circulation within months and then still continue to expand.

While at first sight this may not appear to be of any direct interest to the individual reader, it must not be overlooked that they benefit by more pages and better services.

Then if we look at it a little more closely, other practical advantages become apparent. It is only when manufacturers are convinced that there is a considerable and healthy interest in amateur radio that the prospect of marketing components etc. for the constructor becomes a business proposition. Readers who remember the late thirties will recall that on seeing popular and long-established journals disappear, component manufacturers began to write off home construction as a thing of the past. Many even ceased to cater for his needs altogether. If components cannot be marketed on a reasonable scale, the supplying of them often becomes a nuisance to the makers dealing only in bulk orders. Even if the trade continues to cater for the needs of constructors, popular prices may be right out of the question.

There are many practical advantages to be gained from letting the world know our hobby is in a flourishing condition and likely to attract an increasing number of enthusiasts. Nor must we allow ourselves to fail to demonstrate it whenever opportunity presents itself.

Would You Believe It?

It is reported that during the interval of a ball game that was televised in America, a commentator borrowed a camera from a nearby newspaperman. Pointing the lens at the TV camera, he asked the viewers to "please remain still for a moment while I take a picture of you looking-in" and pretended to make an exposure.

Very funny—Ha! ha!

Maybe. But it was still funnier when during the next day or two he received several hundred letters asking for a print of the picture!

It rather reminds me of an incident in pre-War days when I first wrote of the misadventures of an imaginary Fred Karno type of constructor whom I called Ambrose Fandermere.

One evening, a week or so after his first appearance, I received a telephone call.

"Is that Mister Centre Tap?" asked an innocent voice.

Struggling to identify what I guessed to be a disguised, but familiar, voice, I replied rather cautiously that it was:

"Well, this is Ambrose Fandermere" the voice continued "Perhaps you can help me".

Still puzzled, I played for time and politely said I was rather busy, but if it would not take long I would do what I could.

"Then perhaps you will tell me where I can buy some holes" he proceeded.

"Holes?" I asked, even more puzzled.

"Yes, holes" he repeated firmly "I am building a new chassis and I'm fed up with drilling 'em. If you can get me a couple of packets of holes—assorted sizes—I shall be very obliged".

I thought this was going a bit too far so decided I would be funny too.

"Certainly" I said "What sort of holes do you want? Aluminium or steel? You can't very well have aluminium holes on a steel chassis, can you?"

He agreed and said he would like some of each.

"And where shall I send them?" I asked "They are not easy things to handle when unpacked. You can't see them, you know, and they easily get lost".

"That's alright" responded the voice "I'll call and collect them and you need not bother about the packing; I've got a hole-proof box to carry 'em in. So long!"

"So long!" I said, and as he put the receiver down he added "They'll be trade price to me, of course, won't they?"

CENTRE TAP *talks about*

MAGAZINES – WISE GUYS – ETCHING – THIS & THAT

Etching

Following my recent remarks on acid etching, I have had occasion to try my hand again at this gentle art with even more marked success. The etching solution used consisted of nitric and muriatic acids—approximately three parts of the former to one of the latter.

Beeswax was used to cover the metal with a thin film, and to ensure an even and complete covering the metal was held over a gas jet and the beeswax rubbed on to the warm surface.

The scratching (of the film, not the metal, remember) was carried out with a steel needle mounted in an ordinary penholder, the acid solution being applied lightly by painting over the scribing with the tip of a feather.

The solution bubbles freely as it bites into the metal but three minutes was found to be ample for a satisfactory depth—the amount of side-spread (under the wax covering) other than allowed for, was negligible.

After etching, most of the acid can be absorbed in a pad of cotton-wool and the beeswax is easily removed in a similar manner to its application—heat and wipe off. The filling was done with ordinary white processing ink which dries with a pleasing matt finish, for which reason alone it was preferred to Chinese white water-colour paint.

As I said before, the etching is easy enough. Regularly shaped, even-sized and properly spaced lettering is the part that most readers will require a little practice on, before simulating a professional-looking result.

Every mod. conv.

Many thanks to the reader who sent the Christmas card of ye snow-covered olde worlde cottage. To make it more appropriate he drew in a 4-element beam on the roof and added a TV H-dipole to the chimney!

Worth trying?

I am recommended, whenever talking to anyone whom I suspect to be using technical terms they don't understand, to start talking back at them in a technical jargon of my own invention. It is said to be still funnier if they pretend to understand it!

Candour.

The reader who, in comparing home-built and commercial receivers, says "At one time I thought poor reception was due to local conditions but since the War I have moved around quite a bit. I find my sets don't work much better anywhere else".

Cynic?

Broadcast programmes are dull because the B.B.C. is run like the Civil Service. Too much 'administration' and too many Controllers and Directors making jobs for themselves. Even those who have got necessary, but relatively unimportant work, seem to regard the business of broadcasting as a beastly bore. They would be far happier in their business of running the B.B.C. if the programmes could be cut out altogether. They could then get on with their cups of tea and form-filling in peace.

Spare my blushes!

"I thought magazines only had the sort of stuff you do to fill in the odd pages, but what you write is quite readable."

TELEVISION
Picture Faults

Part eleven of a series, illustrated by photographs from a Televisor screen by courtesy of

Mr. John Cura.

Part 11 — Interference, contd.

THE second group of interference sources, that is electronic equipment, includes all appliances producing signals which can be picked up by the RF circuits of the televisor. Under this heading come diathermy equipment, certain other medical appliances, oscillators, RF heating equipment, and even the ordinary domestic superhet under certain conditions.

The manner in which the signal enters the receiver depends on the frequency of the interfering radiation and its harmonic content. It may enter a superhet or straight receiver via the aerial when its fundamental or harmonic falls within the pass-band of the receiver. The superhet has problems peculiar to itself, which are complicated by the process of frequency changing. Not only can interference signals enter at the IF and RF stages, but multiples of the local oscillator may fall within the receiver pass-band. This latter effect is a problem of design, and an intermediate frequency should be chosen which will not allow this to happen.

Unwanted signals at intermediate frequencies are best eliminated by efficient screening of the appropriate stages, but where the gain is very high they may still enter via the aerial, RF and frequency changer circuits. These can be reduced by rejector circuits tuned to the frequency of the interfering signals.

The unmodulated signals radiated by local oscillators, superhets, etc., beat with the television signal to produce light and dark bars on the screen, the spacing between these bars depending on the difference in frequency

Fig. 3: Showing light and dark bars produced by signal beating with radiation from an unmodulated oscillator.

(JOHN CURA 'TELE-SNAP')

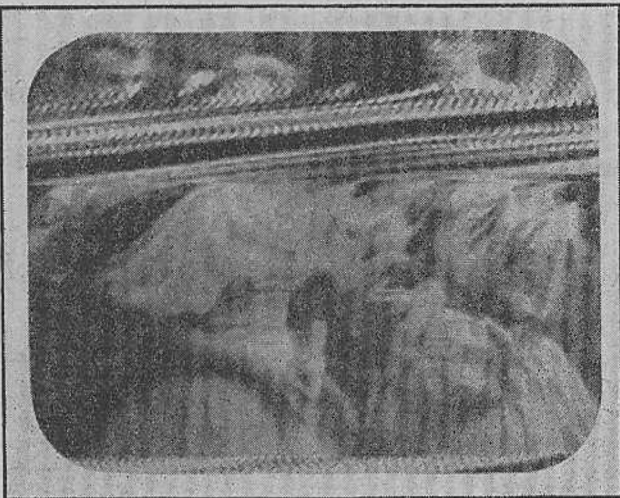


Fig. 4: Result of fairly heavy diathermy interference. Note the characteristic 'herring-bone' pattern, and in this instance, certain amount of line slip.

(JOHN CURA 'TELE-SNAP')

between the wanted and unwanted signals. The effect is well demonstrated in Fig. 1.

Diathermy and RF heating equipment produce very characteristic effects which are quite unmistakable. They are usually modulated at 50 cps, as the supply to the valves may be unsmoothed rectified AC or even raw AC. This produces on the screen definite horizontal bars of interference with a wavy or herring-bone pattern. Coupled with this, loss of synchronism and serious distortion may show in the region of the bars. In serious cases complete break-up of the picture may occur, or the television signal may be completely swamped and the picture be displaced by a single white or black horizontal bar. Some reduction of this type of interference may be obtained by reducing the bandwidth of the vision receiver, an alternative being to insert rejector circuits in the early stages of the receiver.

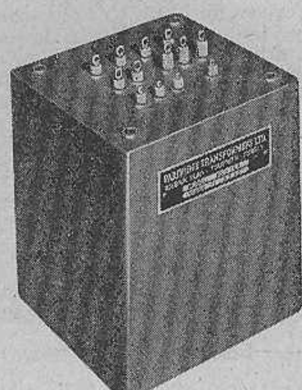
(To be continued)

Trade Review

PARTRIDGE HERMETICALLY SEALED TRANSFORMERS

The "Partridge" hermetically sealed construction as illustrated is available on all types of audio and power transformers and chokes on ratings from 5 VA to 3 KVA. These could employ the normal Silicon lamination construction or the new "C" core wound from a continuous strip of grain-oriented high permeability steel.

The components can be hermetically sealed in steel, tin plate or mumetal cases and the filling can be either compound or oil. The K.L.G. Corundite seals only are employed and these are fully approved by the Ministry of Supply for use on grade A transformers for the Services. The whole construction is ideally suited for use in tropical climates and can be operated at a temperature of up to 150° C.



YOUR WORKSHOP

In which J. R. D. Discusses Problems and Points of Interest connected with The Workshop side of our Hobby, based on Letters from Readers and his own Experiences.

In this month's article J.R.D. discusses drills and their use.

HOW does one drill a hole in a piece of metal?

Well, to begin with, one selects a drill of the right size and fits it to a brace. Probably one then marks the chosen spot on the metal with a centre punch, applies the drill to it and starts turning. Simple, isn't it?

It *is* simple, but the writer noticed that a friend whom he was visiting recently didn't find it so easy. This friend was in the middle of drilling out a steel chassis, and was expending a great deal of energy on the brace whilst the bit was doing little else but get hot. The reason for all this was obvious enough after a quick inspection of the bit, which proved to have become somewhat tired of life. A few seconds work on the grindstone would have given that drill a new lease of life and would have saved a great deal of labour; as well as giving it that nice biting action which makes the task of drilling, if not pleasurable, at least tolerable and easy.

It must be admitted that most radio amateurs do not ask much from their stock of drills other than the requirement of boring holes in aluminium panels and other relatively soft materials; with the result that it does not always seem necessary for them to keep their drills in really tip-top condition. However, a well-kept drill will soon show its advantages even with such soft materials as these; and heavier jobs that really do require a good drill are almost certain to occur from time to time. It pays, therefore, to keep one's drills in good shape and to use them correctly.

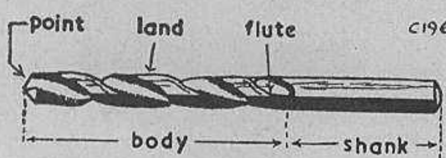


Fig. 1: The parts of a twist drill.

Twist Drill Dimensions.

There are about three or four different types of drill employed for metal work but, for general use, by far the most popular of these is the twist drill. The twist drill is usually made either of carbon-steel or high speed steel. The former type is the cheaper, but is liable to lose its temper if it is used at a high number of revolutions. The latter, as its name implies, does not suffer from this disadvantage to so great an extent and can therefore drill holes at a higher speed. If the constructor uses a hand-brace he will probably find it more economical to buy the carbon-steel drills.

Fig. 1 gives an illustration of an ordinary twist drill, naming also its various parts. The size of the drill is usually shown on the shank either by means of a number, (1 to 60); by means of its size as a fraction of an inch or more, (thus 11/32 ins); or by means of letters or metric sizes, (in millimetres). The latter two methods of indicating drill sizes are not met very often in this country.

The cutting angles of the drill are shown in detail in Fig. 2. When a drill is being reground, it is important to ensure that these angles are formed correctly. It is also necessary to see that the point of the drill is coincident with its central axis and that the two cutting edges are exactly equal. Furthermore, the two 59 degree angles must also be equal. If any of these dimensions is not correct the drill will be one-sided and, if it cuts at all, will only do so incorrectly and inefficiently.

Also important is the cutting angle of 11 degrees illustrated in Fig. 2(a). Fig. 3 shows what happens if this is ground incorrectly. Like the advertisement it should be: not too little, not too much, but just right! Incidentally, if the angle is too small, as in Fig. 3(b), the drill will bite too deeply into the metal and will probably break.

Referring back to Figs. 1 and 2 it may be seen that the "point" of the drill is not really a point at all, but that the drill is flat at its extreme end. It is possible, of course, to grind the drill to a point but it would not remain in this condition for very long as the point would soon wear away. Owing to the fact that the end of the drill is non-cutting it is therefore often necessary to use a certain amount of pressure, when drilling, to force the drill into the work. It should be remembered that the diameter of the non-cutting area is not so great as the horizontal measurement across the extreme point shown in Fig. 2(a) since, when the drill is rotating, the cutting edges, which are slightly off-set, reach very nearly to the centre of the hole.

Nevertheless, the small non-cutting section still exists and, as was just mentioned, it is necessary to exert a certain amount of pressure. When large drills, (approximately $\frac{3}{8}$ inch and larger) are being used, this pressure may become excessive. A good plan in this case consists of drilling a small pilot hole first of all before the larger drill is brought into use.

Marking Off.

Before a hole is drilled in any metal, it should be marked off by using a centre-punch. This is essential even with such soft materials as aluminium or copper, as it is otherwise impossible to drill the required holes with any degree of accuracy at all. It must be borne in mind that the point of the drill is non-cutting and it cannot therefore make its own start. It will be found that the use of the "centre-pop" takes little longer than the process of initially finding where the hole should be drilled, and it saves a considerable amount of energy which may otherwise be used in keeping the drill initially steady or in preventing the point from "skidding" across the work.

A good centre-punch should have a fairly sharp point. When used for marking a hole, it should only be tapped lightly at first. If it is found then that this initial pop mark is slightly off position the punch may be used again, held at the requisite angle, to bring it correct; this procedure resulting in a deeper, but more accurate, mark.

Drilling Large Holes.

A centre punch does not always provide sufficient guidance for a large drill. It then becomes necessary either to drill a small pilot hole first, or to employ the procedure described in the following paragraphs.

To carry out this procedure the material is first of all punched as illustrated in Fig. 4(a). Then, using the pop-mark as centre, a circle is scribed with a pair of compasses or dividers as shown in Fig. 4(b), the diameter of the circle being very slightly smaller than that of the desired hole. Four or five light punch marks are next made along the circumference of this circle.

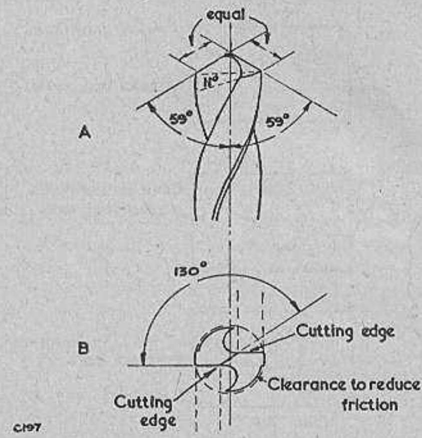


Fig. 2 (a) and (b): Showing the dimensions and cutting angles of an accurately ground twist drill.

The point of the drill is then taken to the original mark and a small amount of the material is drilled out. It may happen that the drill has started incorrectly, giving the result illustrated in Fig. 4(c). This slight displacement may be corrected by punching the metal in the correct direction with a centre punch; or, if the start is fairly deep, nicking it over with a cold chisel. The drill is started

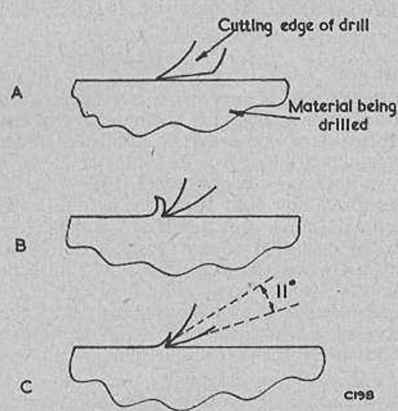


Fig. 3: The results obtained when the cutting angles of a drill are, (a) too large, whereupon hardly any metal is cut away at all; (b) too small, causing the drill to bite too deeply into the metal and thus jam or break; and (c) in which the angles are just correct.

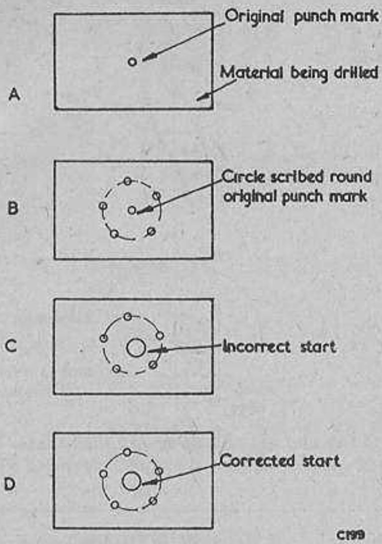


Fig. 4: The successive stages of marking out and drilling a large hole.

again and the result checked once more until finally the state of affairs shown in Fig. 4(d) has been obtained, in which the hole is perfectly concentric with the outside punch marks. It will be realised that, once the body of the drill has entered the material, it is impossible to rectify any errors.

Lubricants.

A point that is very often overlooked when holes are being drilled is the necessity of using a lubricant of some sort. Admittedly, when thin panels are being drilled, lubrication is not always necessary as the panel itself soon conducts away any heat that is generated. This statement must be qualified, however, by pointing out that if one drill is being used continually for drilling such holes it is then obviously well worth while preserving its temper by applying a lubricant to it at frequent intervals. Lubrication also helps to improve the finish of the work.

There are some amateurs and—alas!—one or two professionals also, who consider that water makes a good lubricant for drilling most metals. (The water, incidentally, being supplied in the form of good, honest spit!). However, the only thing which may be said in favour of such a procedure is that the water does at least slightly *cool* the bit; indeed, with a power-driven drill, it will sizzle and boil away in an extremely impressive manner; but its lubricating powers are problematic.

It is therefore far better to use a lubricant properly fitted to the type of metal being drilled. A list of such lubricants is given below:

Material	*Lubricant*
Aluminium	Paraffin or turps
Dural	Paraffin (possibly turps)
Copper	Soap and water ('suds')
Steel alloys (including carbon steel)	Paraffin or turps
Mild steel, wrought iron	Soluble oil or suds
Cast steel	Soluble oil
Cast iron, brass	No lubrication required

The metals shown at the bottom of the list, (cast iron, and brass), are known as self-lubricating.

Drilling Sheet Metal.

When twist drills are used for boring holes in sheet metal they should be handled somewhat carefully. This is due to the fact that, when the hole is nearly complete, the leading edge of the land is liable to catch in the work, either causing the drill to jam or break, or spoiling the finish of the hole. This trouble may be overcome to a great extent by using a lighter pressure when the hole is nearly complete.

Because of its liability to catch in the metal it is often recommended that twist drills should not be used on sheet metal at all. Instead, a straight fluted drill such as that illustrated in Fig. 5 should be employed since this type of drill does not catch so readily when it breaks through the metal. Nevertheless, it has been the writer's experience that, if used with a little care, the twist drill is capable of perfectly good work on sheet metal; and that there is little point in incurring extra expense by obtaining a further set of straight fluted drills.

On the other hand it must also be pointed out that a straight fluted drill is very useful when it is desired to drill holes in very hard *brittle* substances, (glass, etc.,) where it may be found that the twist drill, on completion of a laboriously-made hole, is liable to catch and completely ruin the job altogether.

A further point to consider is the formation of burrs. These are formed on the underside of the material although, with soft metals, a very slight rise may be evident around the top periphery of the hole. The burr on the underside should be removed before bolts or rivets, etc., are fitted in the hole; and one of the easiest methods of doing this consists of treating the underside very lightly with a countersinking bit or, failing this, a drill which is considerably larger than the one used originally.

Whilst on the subject of burrs the author remembers reading a technical journal before the war in which a certain writer several times advocated leaving the burr on the hole when it was desired to bolt earthing solder tags to it. The idea was that the sharp edges of the burr would cut into the tag and thus give a good positive contact. This scheme can hardly be recommended, however, because, to begin with, the surface area of the electrical contact so obtained would be considerably smaller than that given by a true flat-to-flat contact; and secondly, the burr cannot be relied upon to retain the rigidity and springiness needed to keep the solder tag tightly bolted down. With such materials as aluminium the idea is well-nigh worthless because the burrs would be too soft. The correct method of mounting earth tags is to drill a clean hole, remove the burrs, and fit shake-proof washers

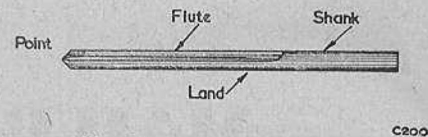


Fig. 5: A straight fluted drill.

under the nut and, if necessary, the screw head as well. The surface of the metal against which the solder tag is held should be cleaned before the tag is fitted.

Next Month.

So much for drills and drilling which seem, this month, to have taken up all our space. We shall pass on, in the next article, to the discussion of other points which are of interest and importance in the efficient running of the amateur's workshop.

TRADE REVIEW

New Range of Philips Variable Transformers.

Philips variable transformers, built on the auto-transformer principle, are now made in 10 different types varying in output from 130VA to 2080VA. Those having a capacity of 130—520VA are housed in a 'Philite' casing whilst the heavier types with 1040VA and higher have a metal casing.

The bench types in 'Philite' housings have a safety fuse in the brush lead, and are supplied with two spare fuses. Those intended to be built into an existing installation have no safety fuse because it may be assumed that the apparatus is already safeguarded in some other way.

With these transformers, which are fitted with a graduated scale and a knob, a secondary voltage can be obtained that is variable from 0V to 20% above the nominal primary voltage; the maximum output with any secondary voltage is limited by the permissable secondary currents listed in the table below, which may not be exceeded.

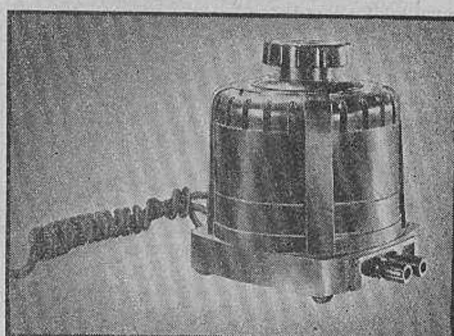
The efficiency of Philips variable transformers is high, the graduated scale permits exact regulation to the fraction of a volt, and owing to the low voltage loss there is constant regulation.

They are of simple but robust construction and, if properly used, should have an unlimited service period.

TYPE FOR 220V MAINS.

Output VA.	Secondary V.	Secondary A.	No-load Losses W.	Type Numbers Building-in Type	Bench Type
130	0–260	0.5	5.6	84512	84513
260	0–260	1	6.8	84514	84515
520	0–260	2	9	84516	84517
1040	0–260	4	17	84518	84519
2080	0–260	8	25	84520	84521

Philips variable transformers are extremely suitable for regulating the intensity of illumination of shop-windows, stage lighting etc., and whether incorporated as integral part of an apparatus or used on their own, have a wide field of application in research, testing and repair departments. In combination with valve rectifiers they can quite easily be used to give an efficient and continuously variable D.C. supply unit.



"*from our* MAILBAG" . . . .

Dear Sir,.....Whilst writing, can I pop in a question about the amplifier circuit on p.149 December issue. Is this a "paper" design or has Mr. French really made it up and had it working? I'm rather sceptical about that tone control circuit between the two stages, for it is **within** *the feed-back loop. My experience has been that attempts to raise or lower the ends of a response curve must be made either before or after the N.F.B. loop, otherwise the action of feed-back is to try and keep the overall response level. I am therefore wondering whether Mr. French has met with any better success than many well-known authorities, D. T. N. Williamson included.*

Sincerely yours,
W. E. THOMPSON,
(St. Leonards-on-Sea).

With Reference to Mr. Thompson's letter dated 13/12/50.

I am indebted to Mr. Thompson for his observations concerning Suggested Circuits No. 1, and I can assure him that this particular design has been made up in practice and it has been found to work quite well. I should further like to set his mind at rest insofar that I had no intentions, when publishing the circuit, of discrediting the work of any well-known authorities whatsoever. At any rate none of those authorities has written to complain as yet.

It is, of course, quite true to state that negative feedback tends to level the overall response, and it would be ridiculous to apply any ambitious form of tone control to any stage within the feedback loop. In this particular amplifier, however, we are using only a small amount of feedback and all we need is a simple top-cut control. This control could have been placed in the feedback circuit itself (but there is hardly enough feed-back to make it really useful), or in the grid circuit of V1. In this latter case it would would hardly be advisable to shunt a capacitive circuit across, say, a magnetic pick-up.

The only simple course left is to fit the tone control to a stage within the feedback loop itself; whereupon it would be found that although its efficacy would be reduced by virtue of the feedback it would by no means be cancelled out completely.

This point may soon be proved by the use of a few simple figures. Let us presume that the voltage gain of the amplifier (to the speaker transformer primary) without NFB is 3,000 (an average figure for such a circuit) and that we are applying a fairly high audio frequency, say, 6,000 c/s, to the input. With the tone control fully out the gain will be 3,000; and if NFB (factor .0012, as in this particular amplifier) is introduced the gain will drop to approximately 650.*

Let us now presume further that we once more remove the NFB and set the tone control to give "full cut". Our 6,000 cycle tone will then be attenuated by reason of the capacitor C3 which is now connected between the anode of V1 and chassis. The amount of attenuation may be decided roughly by considering the anode resistance of V1 in series with C3, the attenuated voltage being taken across C3 for further amplification by V2. The reactance of C3 at 6,000 c/s is approximately 5,000 ohms (5,305 actually) and the anode resistance of V1 would be at least a megohm in a circuit of this type. R5 and R7, which are virtually in parallel with C3, may be ignored as their values are considerably higher than the reactance of this capacitor.

It will be appreciated that, by reason of the potentiometer circuit offered by the anode resistance of V1 and the reactance of C3 in series, only 1/200 (approx.) of the 6,000 c/s note will be passed to the grid of V2; and the voltage amplification of the amplifier at 6,000 c/s will drop to $\frac{3,000}{200}$, i.e. 15.

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 2d. per word, minimum charge 2/-. Trade advertisements will be accepted at 6d. per word, minimum charge 6/-. If a Box Number is required, an additional charge of 1/- will be made. **Terms:** Cash with order. All copy must be in hand by the 10th of the month for insertion in the following month's issue.

PRIVATE

FLYING SAUCERS IN ABERDEEN. Ex-YL gets tough with OM. He shouldn't have used up his black crackle on the bath, but Oh boy! you should see his rig. Sample 2/-. Large tins 5/-. Post free. Full easy instructions.—Geoff. Wheatley, G8QB, 80, Millmead Road, Margate.

WANTED. Constructors, Experimenters, surplus gear. (Anything). S.A.E.—A. Blockley, Wild-revel, Heather Road, Binley, Coventry.

1116 ALL WAVE double superhet, double pentode output eliminator, phones, data. £5.—Blackwell, 2, Oxford Cotts., Nursery Lane, Ascot.

WANTED. Valves. State type, quantity, price. Box No. A140.

CONSTRUCTORS BASIC KIT D.C. multi-range milliameter, comprising new $2\frac{1}{4}''$ M.C. meter 0—1.5 m/a. Paxolin panel, seven terminals, five way Yaxley switch, circuit, layout, 5/9 post free.—Box No. A142.

FOR SALE. Best offer. 75 watt phone C.W. transmitter coils 160—10 metres. 150/500 phone C.W. transmitter bands 10—80 metres. VFO or crystal driven power unit. All commercially built.—Box No. A141.

£15. Ten valve radio chassis 0.13 to 43 mcs. with power pacl. Aiken, 30 Fawepark Road, S.W.15. Evening after 7.30.

S.W.L. disposing of equipment components and S.W. periodicals. Offers. Details from G2762, 23a, Victoria Road, Oldbury, Worcs.

R.C.A. A.R. 88D grand order and matched speaker. Owner gone abroad. £45.—Moore, "Earlsway," Birkenhead Road, Hoylake, Cheshire. Tele, 3221.

1155N converted with bandspread £8. 1155A £7. 1224 coverted for mains £5.—34, Birch Avenue, Romiley, Cheshire.

TOP BAND crystal 1950 kcs., with holder £1. Ferranti meter 0—100 M.A. 10/-.—G2ATD, 101, Hurst Road, Erith, Kent.

R107. Metered with set of spare valves £13. MCR 1 complete with special 10—16 metre coil and Loudspeaker Amplifier £9. 600 volt power pack £4. 250 volt power pack, £2. IT4. IT5. Components for QRP rig described Vol. 1, No. 1, £4. Certain spare copies of Radio Constructor, Wireless World, and Practical Wireless. SAE for list. All offers considered.—Hughes, Llanarth, Penygroes, Llanelly.

WANTED. 813's, 5R4GY's. Price to Box A144.

TRADE

TX/RX PANEL TRANSFERS, write C. and K. Norvall, (Printers), 5, Torrens Street, London, E.C.1.

"GLOBE-KING". Short Wave Kits and Components. Production fully booked up until new series commence Autumn, 1951. Watch this magazine for later announcements.—Johnsons (Radio) Macclesfield.

LARGE quantities of the following units held in our stores and ready for immediate disposal:—T.1154 Transmitters at £10 each. Power units type 32, 33, 34, 35 at £4 each. T.R.1196, Transmitter/Receivers at £7 10 0 each. J.J. Trading Company, Gatwick Airport, near Horley, Surrey. Telephone, Horley 1510

"MAGNETIC SOUND recording wire, .0036 ins. dia., $1\frac{1}{2}$ hours playing time at 2 ft./sec.; temporary wooden spools; 14/- per spool, post free.—A. T. Smart, 40, Grange Road, Halesowen, Worcester.

WIRE RECORDER, Constructional Details, 1/3. Stainless Steel Recording Wire, 3,600 ft., reels 5/6.—16, Catherine Road, Swinton, Manchester.

BOOKBINDING. Volumes of Radio Constructor and Short Wave News fully bound in cloth with gold lettering on cover and spine and sprinkled edges. 7/6 post free. Rates for other publications on application. G3AGR, 19, Helmsdale Rd., Streatham, S.W.16

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FREE ! Brochure giving details of Home Study Courses in Radio, Television, and all Branches of Electronics leading to A.M.Brit.I.R.E., City and Guilds Telecommunications, R.T.E.B., and other Professional examinations. Whatever your need the College operated by Britain's largest Electronic organisation can help you. Very moderate fees. Write to E.M.I. INSTITUTES, (associate of H.M.V.) Dept. RC.12, 10, Pembridge Square, London, W.2. Bayswater 5131/2.

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AMERICA'S leading magazines. One year subscriptions. Radio Electronics 32/-, C.Q. 28/6., Popular Mechanics 32/-. List free.—Hobson, 79, Southbrook Road, Exeter.

Thus we find that, without negative feedback, the use of the tone control on a 6,000 c/s note causes a drop in voltage amplification of $\frac{3,000}{15}=200$; or, in other words, a loss of 46 db.

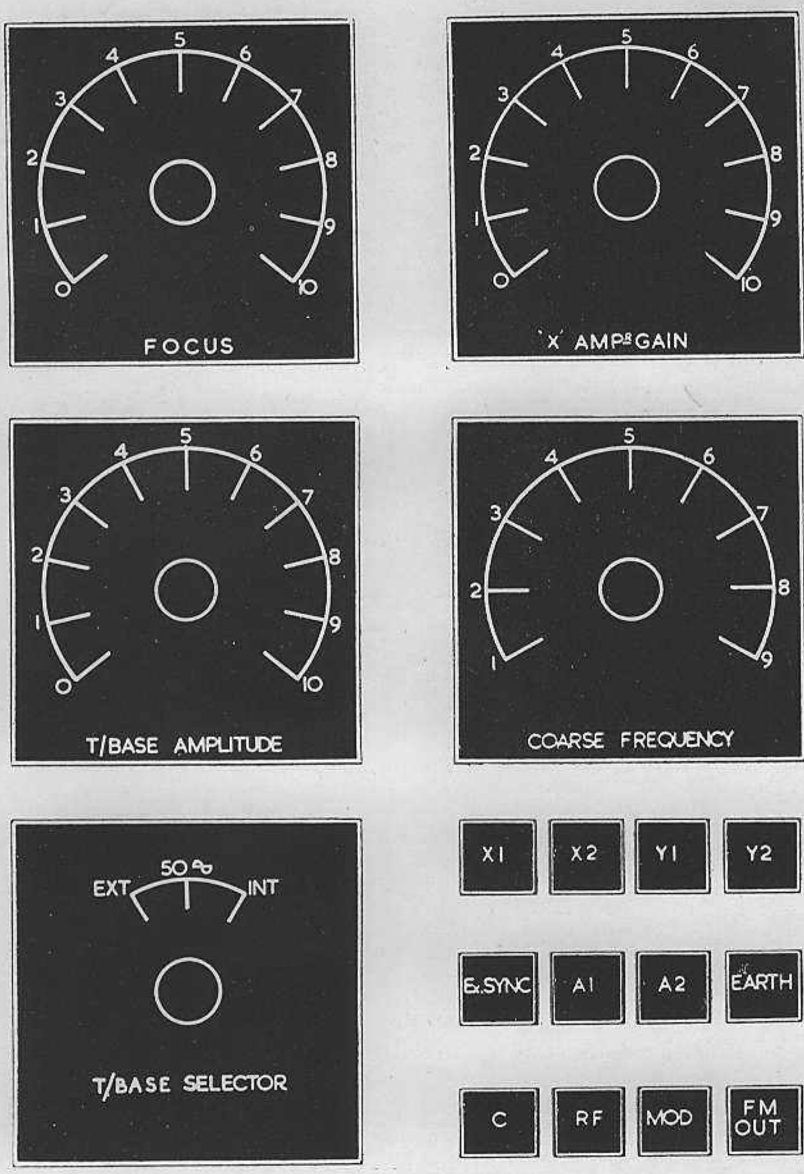
When negative feedback is used the loss is $\frac{650}{15}$ (full voltage gain with NFB is only 650), representing a voltage loss of 43, or 32 db.

? Voltage amplification $=\frac{A}{1-AB}$
When A = amplification in the absence of feedback and B = feedback factor.

G. A. FRENCH.

VHF CONTEST

The Second Annual "Short Wave News" VHF Contest will take place on the week-end of April 21st/22nd. In addition to Certificates of Merit and yearly subscriptions to "Short Wave News", offered by the sponsors, E.M.I Sales and Service Ltd., through the courtesy of the Managing Director, are offering a Dual Range Power Output Meter to the winner. Full details will be published in the March issue of "Short Wave News". The Contest is open to both Transmitters and Listeners.



Panel Sheet No. 8.

Oscilloscope Controls (2)
Protect with Sellotape or Clear Nail Varnish