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The Editor and Staff

wish all our readers a very Merry Christmas and a Happy and Prosperous New Year.

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. 1 TWO-STAGE GRAM AMPLIFIER

Characteristics

Without negative feedback the output is approximately 4 watts for 0.03 volts input.

With negative feedback the output is approximately 4 watts for 0.1 volts input.

Assuming a 40:1 output transformer, feedback is 0.0012.

Optimum output load (transformer primary) is 5,000 ohms.

Tone Control

A simple top-cut tone control (R6 and S1) is fitted to the amplifier. A potentiometer fitted with an on-off switch should be employed here, in order that, when the control is adjusted for minimum cut (total potentiometer resistance in circuit), the switch disconnects the circuit completely.

Supplies

Any mains transformer capable of supplying 250—0—250 volts at 60 mA may be employed. The 6.3 volt winding could be earthed at one end, although it is preferable to earth it at the centre tap as shown in the diagram.

Type of Pick-up

The amplifier will function with any high-impedance moving-iron pick-up. If a low-impedance pick-up is used, the manufacturers will advise as to the type of matching transformer and input impedance required.

The gain of the amplifier will almost certainly be too great for a crystal pick-up. If such a pick-up is employed the 6J7, (V1), may be replaced by a 6J5 or similar triode. In this case R2 and C2 will not be required, R5 should be replaced by a 150 kΩ resistor, and the value of the bias resistor, R4, should be altered to 1,000Ω. The feedback circuit may remain as it is.

Valves

The output valve need not necessarily be a 6V6, and most other pentode or beam power output valves, (6F6, EL36, etc., etc.) can be used in its place without disturbing the characteristics to a great extent. It will be necessary to change the value of R8 for some valves.

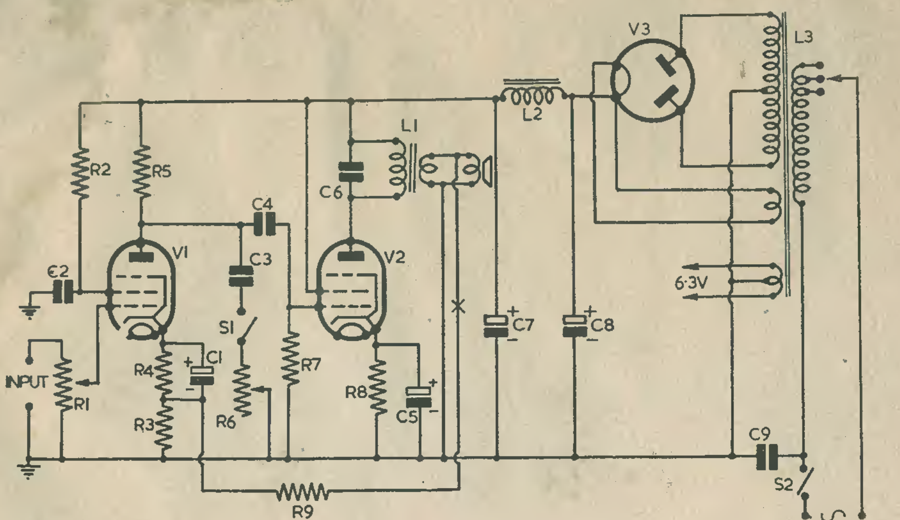
An EF36 (ex-RAF VR56) may be employed instead of the 6J7 for V1.

Construction and Testing

After completion, the amplifier should be tested with the negative feedback loop disconnected (i.e. broken at the point marked with a cross in the diagram). In this state it should be completely stable, although reproduction may be a little shrill, particularly if a small-diameter loudspeaker is used.

After this test the negative feedback loop can be connected up. It will be necessary to experiment with the connections to the speaker transformer secondary when this is being done. If the secondary is connected the wrong way round positive feedback and probable oscillation will be caused. The correct connection will, of course, result in lowered volume and increased fidelity.

Should it be found that more than adequate gain is obtained from the amplifier, the negative feedback can be increased by reducing the value of R9. (If negative feedback is increased by a large extent, the output impedance may be sufficiently lowered to necessitate



C129

Fig. 1: Circuit of the Amplifier

Component Values

Resistors (all half-watt unless otherwise stated):

R1 — 250 kΩ
R2 — 750 kΩ
R3 — 100 Ω
R4 — 1,200 Ω
R5 — 250 kΩ
R6 — 250 kΩ (with switch)
R7 — 500 kΩ
R8 — 250 Ω
R9 — 2 kΩ

Capacitors:

C1 — 25 μF, 25 WV
C2 — 0.2 μF
C3 — 0.005 μF
C4 — 0.02 μF
C5 — 25 μF, 25 WV
C6 — 0.002 μF
C7 — 16 μF
C8 — 8 μF
C9 — 0.01 μF

Valves:

V1 — 6J7
V2 — 6V6
V3 — 5Y3, or any other similar rectifier.

Switches:

S1 — Fitted to R6 (see text).
S2 — On-off switch (may be fitted to R1).

Inductors:

L1 — Output transformer (ratio depends upon impedance of speech-coil).
L2 — Smoothing choke.
L3 — Mains transformer (250—0—250, 5 and 6.3 volt outputs).

a smaller ratio output transformer.)

With some types of output transformer it might be found that the introduction of negative feedback will cause a small amount of supersonic oscillation, sometimes noticeable as a hiss. This condition may be checked by connecting a milliammeter in series with the positive HT supply; whereupon a change in reading when the output transformer secondary is short-circuited at its terminals will indicate that oscillations are present. The oscillations can usually be stopped by connecting a capacitor between the anode of V1 and chassis, its value lying between 50 and 500 pF.

Finally, results may be improved if the value of C6 is reduced or if it is removed altogether. This point should be checked experimentally.

MODERN RECEIVER ALIGNMENT

Part I

By W. G. Morley

IN the April issue of the *Radio Constructor* the writer gave several hints concerning the best practical methods of using a signal generator to align a modern receiver. It was impossible, within the subject matter of the article which then appeared ("Building Your Own Signal Generator—V") to go further than state some of the preliminary adjustments necessary for this operation. As, however, there has been a considerable response from readers asking for more information, it has been decided to supplement the brief notes then given with this present series of articles.

Preliminary Considerations

Before starting, it would be helpful if we devoted a short paragraph or two recapitulating the points made in the April issue.

Firstly, it was stated that a receiver may either be aligned aurally or by visual tests. The aural method, which consists simply of adjusting the receiver trimmers for the loudest tone (assuming that a modulated signal generator is used) does not give such accurate results as does the visual method. The second method relies on the indications of meters connected either to the audio output of the receiver (with the AVC line shorted to chassis) or connected to measure the voltage on the AVC line itself. It was contended, however, that by short circuiting the AVC line it was possible to slightly alter the characteristics of those tuned circuits which happened to be completed by AVC decoupling capacitors. The alternative method, that of reading the voltage on the AVC line, is not very difficult as only qualitative measurements are required (i.e. we are only interested in finding out whether turning a trimmer in a certain direction causes an increase or decrease in AVC voltage); and it is quite sufficient to connect an ordinary voltmeter between cathode and chassis, or screen-grid and chassis, of an AVC-controlled valve. The changes in AVC voltage will then cause corresponding changes in the voltages on the particular electrodes chosen without causing any alterations in the receiver wiring or its characteristics.

Summing up the various methods mentioned, it was stated that that which utilised the AVC voltage gave the most accurate results. However, aural tests were sufficient if the adjustments had to be hurriedly made or if really accurate trimming was not considered sufficiently important. In all cases, it was stressed that only small signals should be used for alignment purposes, either *just* audible or *just* sufficient to cause a deflection in the AVC-reading meter. If, as the set became better aligned, the indications became greater, the output of the signal generator should be further attenuated.

Tuned Circuits and their Adjustments

Having dealt with the issues raised in the April issue (and to which readers are referred if they wish to see the points mentioned above in greater detail) we may now proceed to the methods employed in the actual alignment of a receiver.

All modern receivers, with hardly any exception, rely for their tuning upon parallel resonant, or "rejector" circuits, such as that shown in Fig. 1(a). These circuits may be either pre-set to a certain frequency, as in the case of IF transformers; or they may be used for selecting different frequencies, as in the case of the pre-detector tuned circuits of a straight receiver, or the RF and oscillator circuits of a superhet. In all cases, it is necessary for them to be capable of being tuned to the frequency required, this being carried out either by varying the capacitance, the inductance, or both.

When the tuned circuits are designed to work on one frequency only, as is required of IF transformers, etc., changes in capacitance or inductance are usually of a small order, and

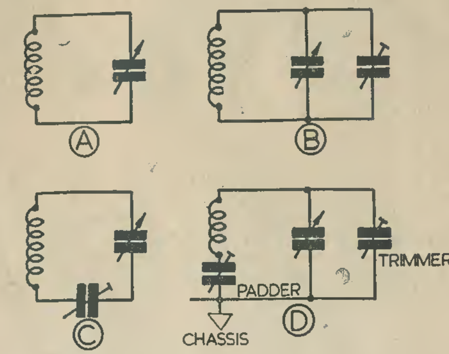
almost always are effected by pre-set adjustments. The trimmers on tuned circuits of this type usually consist of small value pre-set capacitors, or of iron-dust cores which may be screwed in or out of the coils to vary their inductance.

In the case of tuned circuits which are required to select different frequencies over a wide band (such as the tuned circuits of, say, a straight receiver) things are not quite so simple. If, for instance, it is required to have two such tuned circuits ganged together, not only must we ensure that their inductances are equal at all times but also that their capacitances are equal. In practice, it is usual to take the inductances for granted and allow only for changes in capacitance; and we then use the familiar parallel trimmer of Fig. 1(b). However, in many cases, either for greater accuracy or to conserve space, it is found that many modern receivers use not only parallel trimmers but adjustable iron cores as well. These adjustable iron cores are, of course, only found in sets which are tuned by variable capacitors. In the occasionally-met receivers which use permeability tuning (i.e. iron-dust cores which go in or out of the coils) parallel trimmers are almost always used; although the manufacturers may sometimes allow a *mechanical* adjustment of the amount of ingress of the iron dust cores (usually by such methods as adjusting the position of nuts on a threaded rod) to be made.

Added complications occur in the case of superhets, in which it is necessary to have two or more gangs of the variable capacitor covering frequency bands which are different to each other. As, almost always, the oscillator circuits tune over a range that is smaller than the signal frequency circuits, the variation in parallel capacitance across the oscillator coil does not have to be so great as that required for signal frequency tuning. The reduced capacitance is nowadays nearly always obtained by connecting a capacitor in series with the tuned circuit as shown in Fig. 1(c). If this capacitor, which is known as the padder or padding capacitor, is made adjustable it helps considerably in allowing accurate ganging of the superhet tuned circuits to be effected. It is nearly always inserted at the "bottom end" of the coil, as shown in Fig. 1(d). Permeability-tuned receivers do not, of course, require padders, the differences in range being implemented by careful design of the cores and the inductances.

Different Types of Trimmer

Various types of trimmer are found in modern receivers and it would be advisable to briefly consider the different models.



C130

Fig. 1 (a). The rejector tuned circuit, used almost exclusively in modern receivers.

Fig. 1 (b): How the rejector circuit is trimmed.

Fig. 1 (c): How the rejector circuit is padded.

Fig. 1 (d): How padding and trimming are carried out in practice.

The most popular type of capacitance trimmer is the compression type, shown in Fig. 2. This trimmer often has more than one set of leaves, these being interleaved to give a greater capacitance. The interleaved type is usually used in IF transformers, which often require parallel capacitances of 100 to 200 pF. The single-leaf type, offering a range of about 10 to 60 pF, is most often found in signal frequency and oscillator circuits. In the case of variable padding capacitors (which usually require high values of capacitance) interleaved types with a comparatively large number of plates are used. The compression trimmer is cheap and effective, but it does not always hold its capacitance very well over long periods of time, and is one of the first components to suspect in a receiver which has fallen out of alignment. In addition, if the trimmer has been left with the adjusting screw fairly tight, the leaves are liable to lose their springiness.

Air-spaced trimmers, on the other hand, hold their values very well. They are usually found either as miniature versions of the normal variable capacitor, or in developed forms such as the Philips concentric trimmer.

FIG 2
THE COMPRESSION TYPE TRIMMER

C131

In the same way, it is only rarely that properly designed iron dust cores fall out of adjustment; and, apart from the alignment of iron-cored IF transformers, it is usually unnecessary to touch them at all unless they have been tampered with.

Aligning a Straight Receiver

Although the alignment of a straight receiver is a very simple operation, it is still worthy of attention here; not only because it enables all aspects of receiver alignment to be dealt with but also to introduce the principles required for the more difficult process of aligning a superhet.

The typical straight receiver will almost certainly have a two-, or perhaps three-, gang tuning capacitor and it will be fitted with simple parallel trimmers. Sometimes, if the receiver is a medium and long wave job, only one set of trimmers will be fitted, these being adjusted on the medium waves alone; it being assumed that tuning on the long waves is sufficiently flat not to necessitate trimming. The most selective circuit in the set will very probably be that feeding into the detector stage. If reaction is fitted this should be adjusted until the set is in its most sensitive condition, whilst trimming is being carried out.

When trimming is commenced, the set should be tuned to the high frequency end of whichever band is selected, the tuning capacitor vanes being engaged by about 5 degrees. It must be remembered that the effect of the parallel trimmer is greatest at that end of the band which has least capacitance in the main tuning capacitor. An appropriate signal is then fed into the receiver from the signal generator. If it is considered necessary, the detector trimmer is first adjusted until the dial calibration is correct, the other RF trimmers then being adjusted for maximum sensitivity. These adjustments should hold over all the band.

Checks over a band after trimming has been completed at the high frequency end may be carried out by ascertaining that the trimmers are in their optimum position at four or five

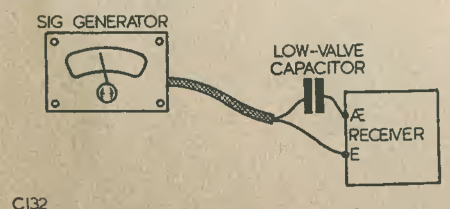


Fig. 3: Showing how the signal generator may be connected to the receiver to avoid damping the aerial tuned circuit.

different points on the dial. The set should be returned to the high frequency end again after this process, and the trimmers readjusted to make sure that they are in their original position.

Care must be taken to ensure that the various trimmers, when being adjusted, reach their optimum position and *go beyond.* For instance, there is little satisfaction in finding that the signal increases when a certain trimmer is screwed up tight, because there is always the feeling that, if the trimmer could be made just a little tighter, even better results could be obtained. The only way of making certain that the optimum position is within the capacitance range of the trimmer is by discovering whether the signal decreases as the trimmer is farther advanced. If it is impossible to obtain the required optimum position, it may be necessary to alter all the trimmers until this condition is reached; although this may sometimes necessitate a loss in the accuracy of the dial. However, the calibration can usually be put right again by repositioning the pointer.

When the RF stages of any receiver are trimmed, the lowest frequency range should always be adjusted first, proceeding to the next lowest frequency range and so on. For instance, in an all-wave receiver the long wave range should be trimmed first, then the medium, and finally the short wave band. The reason for this is that the higher-frequency tuned circuits are more susceptible to changes in the neighbouring lower-frequency coils, etc., than are the lower-frequency circuits in the reverse case.

The Coupling to the Receiver

An important point to consider when aligning the signal frequency stages of a straight receiver, (or, for that matter, of a superhet) is the coupling between the signal generator and the receiver aerial terminal. Most modern receiver aerial coils are designed to present a low impedance at the aerial and earth terminals and so it is, to a certain extent, quite permissible to connect the output of a signal generator directly to the receiver input. Nevertheless, as the impedance of the output of most signal generators is very low indeed, better results may be obtained if only a loose coupling is used, thus obviating any chances of damping the receiver aerial coil. This loose coupling may very easily be obtained by simply connecting a low value capacitor between the "hot" output lead of the generator and the aerial terminal of the receiver, as shown in Fig. 3. In practice, it is usually quite sufficient to twist two insulated wires together for an inch or two, the small capacitance existing

Continued on Page 164

TWO RECORD CATCHES

This short article describes two ingenious ways in which tape recorders have been used on the zoological front.

By K. Kemsey-Bourne

TAPE recorders have a number of obvious uses for radio and commercial organisations (to say nothing of amateur transmitters and experimenters), and some not-quite-so-obvious applications have been developed, including the storage of complex mathematical data. Here are two examples of ingenious ways in which a tape recorder has recently been used.

An American sound-engineer wanted recordings of some hippopotami in their natural haunts. Somewhere in darkest Africa he hoisted his gear into a tree above a swamp in which hippos lived in bulk (so to speak), and he prepared to spend a rather uncomfortable night. Came the small hours of the morning, and there had been only a few, weak noises to record, instead of the full-throated chorus expected. Then the recordist had a bright idea. He flicked over the switch of his tape recorder, and played back the sounds already recorded. Some of the hippos heard this, and responded by giving tongue on a more generous scale than before. Having started the ball rolling, the American again flicked his switch, and recorded the now growing volume of sound. By morning he had satisfactory recordings of all the hippos for miles around, grunting together in concert.

The second story concerns a warehouse in British Columbia that was infested with rats. Traps had too small an effect on the pests. Poison could not be used because the warehouse contained food. The manager, a radio amateur, brought down his tape recorder, and recorded the squeaks of pain of a rat that had been caught in a trap but not killed. When this recording was played through the warehouse loudspeaker system all the rats heard it and fled. But, of course, they only went somewhere else. Theoretically, it was possible to have a tape recording playing in all the warehouses all the time; that would keep the rats away, but the men in the place had also to be thought of! To dispose of the rats altogether the tape recorder was brought in again, but the technique was the direct opposite of that used before. The squeaks of an attractive female rat were recorded (attractive to other rats, that is). Arrangements for special traps, and other lethal devices, had been made with the local Pest Control people before the recording was played back in the warehouse. When the male rats sallied forth to make the acquaintance of the golden-voiced charmer they were rapidly killed off!

"RADIO CONSTRUCTOR" QUIZ

Conducted by W. Groome

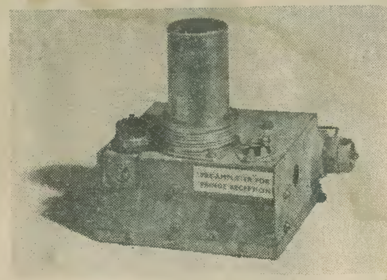
(1) Mr. Brain was tinkering with a powerful amplifier which was rather unstable. Suddenly, after delivering a series of roof-raising and unusual noises, it became silent—permanently. Examination showed that the large and expensive output transformer had been ruined by sparks which had destroyed the insulation of the windings, although the insulation rating was more than adequate for the 500V HT supply. What had caused the appearance of this very high and destructive voltage?

(2) Why is high-fidelity equipment designed to give an output of ten to fifteen watts, when it is often not required to "shout" louder than a three watt receiver?

(3) The 5000 or more volts generated by line flyback EHT systems is less dangerous to life and less prone to breakdown than a similar voltage derived from a mains transformer. Why?

(4) Cores for RF inductors may be of the familiar moulded iron-dust material, or of brass. Which of these materials increases, and which decreases, the inductance?

Answers on Page 180.



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 first of a series of articles by E. KALEVELD,
PAØXE

Principles of wire and tape recording

IT is well, at the outset of this series of articles, to remind ourselves that whilst the magnetic recording of sound on metallic wire or tape is now rapidly gaining in popularity, there is nothing new in the principles involved. Even as early as 1898, the Danish experimenter, Poulsen, found that he could record sound on a magnetised steel wire, and that he could play back the recording. This observation was, however, only of experimental interest, though he took out patents the value of which were not realised at the time. Later on, a German named Steele improved Poulsen's invention, while still another German, Blattner, saw money in the idea and toured music halls with portable equipment, recording voices of people on the stage.

These machines were further improved in England, and the Marconi-Steele Recorder was developed, which used a narrow steel tape. It was not until the recent war that German engineers found a method of coating paper and plastic tape with a magnetic substance, a ferric oxide. In the meantime, engineers in the U.S.A. were working on wire recording, and both systems have developed more or less independently. Basically, however, there is not the least difference between wire and tape recording, so when we talk about tape recording in these articles, all that is said applies equally to wire recording. The merits of the two will be discussed later.

This first article deals with the theoretical side of the subject. Others will describe the construction of a tape recording head for the benefit of those who would like to try their hand at this; circuits for recording and playback; the construction of a cheap but entirely satisfying recorder using a normal gram motor as the driving power without affecting its use as a record player; some simple designs for the home construction of wire drive mechanisms; and the construction of a wire recorder head.

If necessary, a further article will follow, dealing with any difficulties which readers may have encountered. However, don't let this last remark frighten you. The writer has constructed several units, entirely home made, the reproduction quality of which left nothing to be desired, and moreover, no special workshop facilities were available.

Let us now consider the advantages which the magnetic tape system offers. It is an absolutely noiseless system. The duration of a recording can be anything up to an hour with either tape or wire. By means of such special systems as double track recording, even longer "runs" on tape can be achieved. The frequency response is good, being better than with gramophone records (60-7000 cps at normal speeds). The recording process is very simple. A recording can be played over indefinitely without wear. One of the most useful features for the experimenter is that a recording can be wiped out, and a new one made on the same length of tape or wire. This process can be repeated indefinitely.

A few words about the principles underlying magnetic recording might be appropriate at this point. Fig. 1 shows an iron core with a coil wound round it. A gap is arranged in the core, as shown. When a current flows through the coil, the core will become magne-

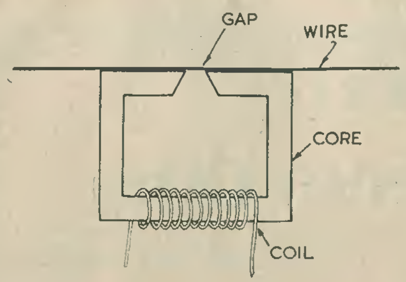


FIG. I

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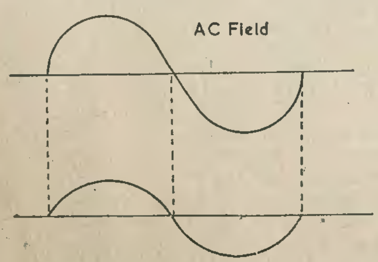
tised, with its strongest field near the gap. The greater the current, the stronger will be the field; a direct current causes a field of constant strength, whereas an alternating current causes the field to reverse with the reversing polarity of the AC. The influence of an alternating current is portrayed in Fig. 2. Now suppose we pass a length of steel wire across the gap; then this wire will be magnetised with the same intensity along its length as the magnetic field varying under the influence of the AC. For the technical highbrows, we must add that we have not taken into account the phase-shift nor the fact that the permanent magnetism curve should be the opposite way round, as this would only serve to confuse the issue and make this explanation less clear.

Some of the magnetism induced in the wire by its passage across the gap remains in the wire permanently. Let us assume that we passed five inches across the gap in one second, and in this time we just recorded one full cycle. Our frequency would then be one cycle. With two cycles per second we get two full cycles on the same length of wire at the same speed. With 50 cycles we get 50 cps, and so on. But we cannot go on indefinitely increasing the frequency. In time, the wire can accept no further increase. The highest recordable frequency depends on the ratio of wire speed to gap width of the core.



Magnetisation of the wire passed along the gap (fig.I)

FIG. 2

C106

Suppose we had a wire speed of 5 in./sec., a gap width of 0.5 in. and we wanted to record a 50 cps current. Every half-cycle lasts 1/100 secs. In this time lapse, the wire would have travelled 1/100 × 5 in. = 0.05 in. After one half-cycle, the magnetisation starts in the other direction, but this will cancel the effect of the first half-cycle, as the wire is still passing in front of the gap. So the gap must be made smaller, or the wire made to travel faster. Greater speed, however, means less playing time with a given length of wire. On the other hand, the gap cannot be made too narrow. Apart from mechanical difficulties in construction, the smaller the gap the smaller will be the field in front of the gap, and so the smaller will be the degree of magnetism in the wire. This gives little output when playing back, so a compromise must be struck between the wire speed and the gap width.

Now let us consider the playback process, which can be done with the same core. (From now on, we shall call the core the " head "). When our piece of magnetised wire is passed over the gap, the varying magnetism of the wire will cause a small current in the coil. The same discussion which we had about the speed/gap ratio for recording applies here, too.

We thus see that, theoretically at any rate, if we make a head with a sufficiently small gap, and we pass steel wire or magnetic tape across this head at a constant speed, we should be able to record any sine-wave and, as speech and music consist essentially of complex sine-waves, we should be able to record any sound. Unfortunately, it is not so simple as this. There are some properties of magnetic materials which result in such simple recordings being very distorted. This problem is discussed in the next paragraphs.

RF Bias

The curves shown in Figs. 3 and 4 are called B-H Curves, or the magnetisation curves of a ferro-magnetic substance, the flux being the " B " and the force necessary to induce this flux being designated " H ".

We see that with a small magnetic force—a small current through the head coil, in our case—the flux is quite small. When we increase the current, the flux increases, too, but not correspondingly as might be expected. There are some nasty irregularities in the curve. After the bottom bend it does, however, become fairly straight, until a further

bend occurs as we near saturation point. A sine-wave plotted on the " B " line would reproduce magnetically as shown on the " H " line. As Fig. 3 illustrates, if this is recorded at a level of magnetic flux within the bent part of the curve, we get a very broken sine-wave on the " H " line—a result giving great distortion on reproduction. If we want to reproduce this sine-wave faithfully, we must work in the straight part of the line. This could be done by giving a fixed positive or negative bias, that is, giving a little initial magnetism to lift the flux curve out of its distortion level at the bottom of the curve. This is shown diagrammatically in Fig. 4.

This method was used in the early days of magnetic recording and gave distortionless reproduction. Its main disadvantage was that the noise level was found to be excessively high. The reason for this was that the tape or wire was constantly magnetised in one direction only by a fixed biasing current. If an alternating current, of sufficiently high frequency as to be outside the audio range, is used for biasing, this difficulty is overcome. A radio frequency bias is now universally used, and recording without this RF bias would be quite impossible.

To get a clear idea of what happens when we add this RF bias, we shall represent the sine-wave by a triangular wave-form as in Fig. 5. Any distortion is much better seen, this way. If we record without any bias, as at " P ", we get a broken wave as at " S ", as the response. The RF, with its superimposed audio frequency, gives us " T ". The zero line of the RF has still the wave-form " S ", that is, it is itself distorted, but the real zero line, which comes into existence because of the superimposing, lies midway between the peaks of the RF voltage (i.e., the line depicted by a–b–c–d–e). This is an exact replica of the wave at " P ". It looks as if the audio distortion is cancelled by an opposite RF distortion. From Fig. 5, we can also see that the RF voltage has a value which is so determined that its peaks must be on the straight portion D–F, and G–E of the magnetisation curve.

The magnitude of the audio voltage is ½(D–F) at its maximum. If we try to record with more AF voltage, we get distortion again—which this time cannot be remedied.

We have gone into the theoretical aspect of the matter in some detail, as an intelligent application of the principles outlined will help in correcting the cases of distortion which may occur when adjusting the amplifier. From the above, it is obvious that correct values of RF and AF voltages must be applied to the head, if distortionless recording is to be obtained.

The frequency of the RF bias can be anything between 30–80 kcs. A good rule of thumb is to take five times the highest frequency to be recorded.

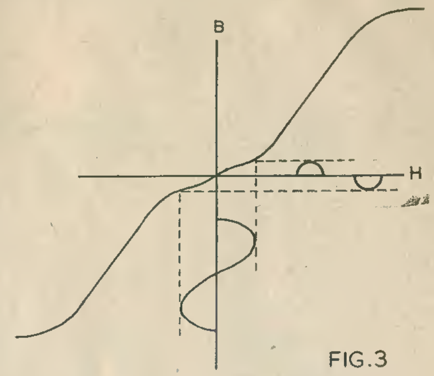


FIG. 3

C107

When we pass a wire, magnetised as above, across the gap in our playback head, its magnetism will induce a small current in the coil which, after suitable amplification, can be fed to a loudspeaker and converted into sound waves. Unless, however, special precautions are taken, in the amplifier, further distortion can still take place.

The last difficulty which we have to overcome is the frequency characteristic of the recording material and, for reasons which would involve us in too deep discussion here, the unmodified frequency characteristics of a steel wire or ferro tape recording would look like Fig. 6. That is, frequencies around 1,000–2,000 cps are in abundance, but frequencies on either

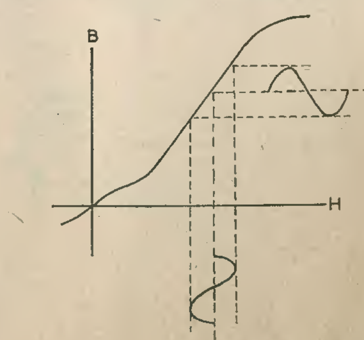


FIG. 4

C108

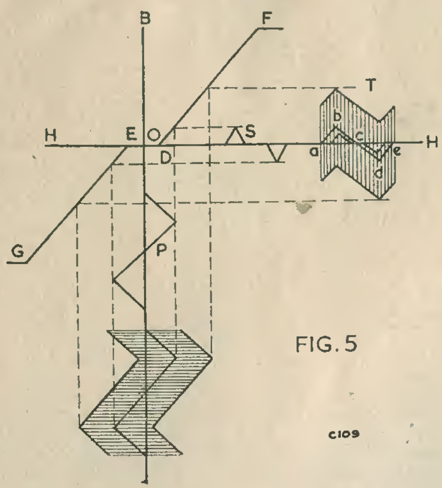


FIG. 5

side drop off. This, of course, can easily be remedied by suitably designing the amplifier. If we give more high frequencies in recording and more low ones in playback, we get the frequency curve shown by the dotted line in Fig. 6. To accomplish this, an equalising circuit must be built into the amplifier. A suitable network is shown in Fig. 7.

Across C1, all frequencies are still present. When switch S is closed, we get the following: The capacitor C2 presents a high impedance to the lower frequencies, but high audio frequencies can pass unhindered. The low frequencies try to reach the grid of the valve via R1 and R2. The junction of these two resistors is, however, grounded via the resistor R3, so the greater part of the low frequencies will flow to ground, and we get an excess of higher frequencies on the following grid. This is what we need for recording purposes.

For playback, switch S is opened. The higher frequencies then reach the grid of the valve via C2 as before. The lower audio frequencies now also reach the grid via R1 and R2, as their path to ground via R3 is broken by the switch. Part of the higher frequencies, however, are able to pass to ground via R1, R3 and C3. By changing the values of these resistors and capacitors, the characteristics of the network can be changed to suit requirements. The values shown are suitable for recording on tape at 8 in./sec. to get a flat response from 60-6000 cps.

Erasure

Two methods are in use for erasing a recording from the wire or tape. That giving least noise is by passing the tape along a head with a strong RF field. The same RF as is used for biasing may be employed. Whilst the same head can be used for recording and playback, the erase head is usually separate, as a wider gap is needed. During the period that the tape is in front of the gap, the molecules of magnetic material are thoroughly "shaken," thus neutralising the remaining magnetisation in the tape. By having a wide gap, several cycles of RF—and erasing magnetic force—can be applied to the tape.

The second method, and the most simple, is by passing the tape across the poles of a strong permanent magnet. All the molecules are then magnetised in one direction, i.e., the tape becomes permanently magnetised. This is practically cancelled out on the next recording process by the RF bias, but shows itself by a small background noise. With RF erasure, there is no remaining noise at all.

Much of the above theory is necessarily simplified, but a clear understanding of the principles as outlined will help materially in further experiments with home recording gear.

To be continued.

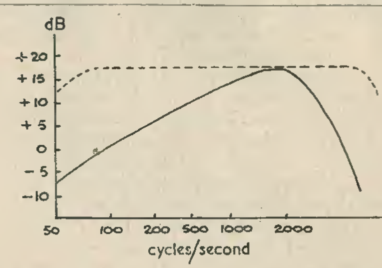


FIG. 6

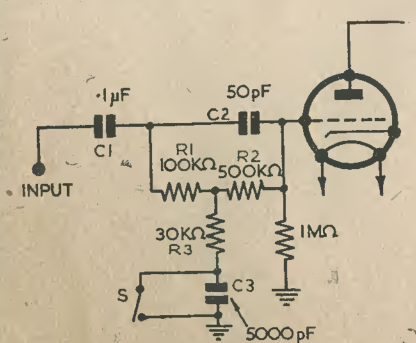


FIG. 7

QUERY CORNER

A "Radio Constructor" Service for Readers

The Television Frequency Changer

I propose to build a television receiver and after carefully considering the pros and cons of the straight receiver against the superhet I have decided upon the latter on account of the ease with which adequate sound rejection can be obtained. I am, however, a little worried about the difficulty of obtaining adequate stability of the local oscillator in the frequency changer circuit, and would appreciate a little guidance on this matter. B. Coles, Banbury.

Let us commence by first considering the relative merits of the three basic types of frequency changer which are in current use. They are the single valve or self-oscillating frequency changer, the combined mixer and oscillator using a triode hexode type of valve, and lastly the separate mixer and oscillator circuit which employs two valves. Taking these possibilites in the order mentioned, the single valve frequency changer, which normally makes use of a high slope pentode, has a major advantage for use in the cheaper class of commercial receiver in that it is economical in both valves and components. Its oscillator stability is reasonably good, but the conversion conduction is relatively low, being of the order of 0.7mA/V. The triode hexode type of frequency changer probably has a better degree of oscillator stability, and also has the advantage that there is less coupling between the oscillator and signal sections of the circuit. The conversion conductance in this case is of the same order as that obtained with a single high slope pentode. As would be expected, the advantages to be gained by the use of a two valve frequency changer circuit are rather more impressive than those mentioned so far, but because two valves are required this type of circuit will only be found in the more expensive type of commercial receiver.

The stability of the circuit is very good and by using high slope valves a conversion conductance of 3mA/V may be easily obtained. This figure corresponds to a stage gain which is in the region of 10 times and compares very favourably with the gain of a little over unity which is possible with the other types of circuits already mentioned. The noise level is very low compared with that obtained with a triode hexode, and this is an important feature when the television receiver is used in districts in which the signal level is low and the maximum gain is required; as it minimises the 'grain effect' which is sometimes visible on a picture as a result of valve noise.

So much then for what might be termed the theoretical virtues of the circuit. Now let us turn to the practical side of the problem.

As in all frequency changers, care must be taken to prevent radiation from the oscillator section. This is easily achieved by enclosing the oscillator valve together with its associated coil and components within small screening cans. The easiest way of doing this is to mount the valve on the top of the chassis, and the coils and remaining components below in their own screened compartment. The oscillator section consists of the well-known Hartley circuit, which is lightly coupled to the grid of the mixer stage by means of a low value capacitor. Mica capacitors should be used throughout, with the exception of the trimmer across the oscillator coil, which should preferably be of the air spaced con-

QUERY CORNER

"Rules"

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

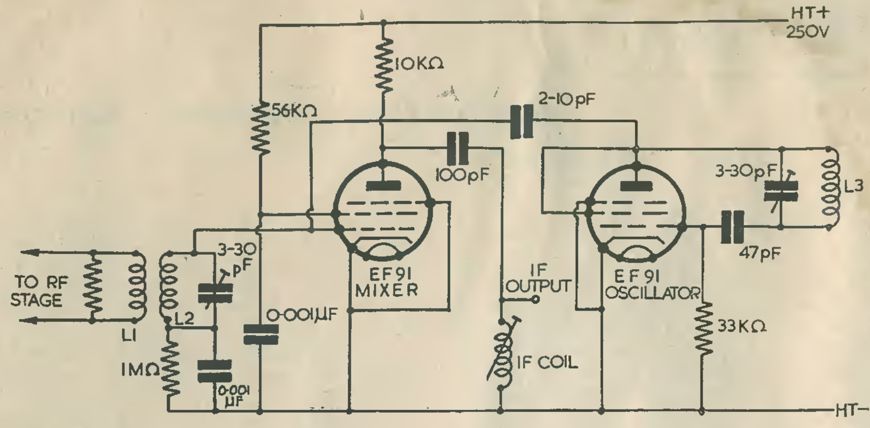
(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(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.



C112

Fig. 1: Circuit diagram of complete frequency changer stage. L1 is fed from the RF stage.

centric type, such as is manufactured by Philips. The wiring in this section must be rigid and as short as possible. Lack of rigidity will enable leads and small components to move under slight vibration and thus upset the oscillator stability. Fig. 1 shows the circuit of the complete frequency changer, whilst Fig. 2 is a table providing the coil winding data for use on either the London or the Sutton Coldfield transmission.

Grid injection is used in the mixer section, and bias is obtained by grid current passing through a 1 MegΩ resistor. The working

Fig. 2

Transmission	*L2*	*L3*
London	8 turns	4 turns centre tapped
Birmingham	6 turns	3½ turns centre tapped

Coils L2 wound with 32 swg enamelled copper wire.

Coils L3 wound with 25 swg enamelled copper wire.

Formers: Aladdin No. F804.

Coil L1 will depend on RF coupling which is used.

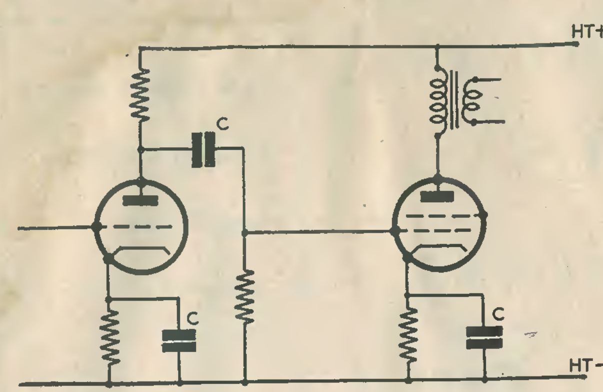
bias should be 3 volts, and thus 3 μA must flow through the bias resistor. This current is adjusted by means of the drive voltage, which in turn is controlled by the feed capacitor. This capacitor should have a value of between 2 and 10 pF, and may simply consist of two twisted leads each insulated by means of thin systoflex. A resistor is included in the screen grid circuit of the valve to limit the valve current in the unlikely event of the oscillator failing, with a consequent reduction in bias. Under normal working conditions the two valves will require about 14 mA of HT current. The intermediate frequency is the difference between the signal and oscillator frequencies, and has been chosen to cover the range 16—19 Mcs; should it be proposed to employ some other IF, the oscillator coil must be modified to accommodate the correct oscillator frequency.

Loss of Fidelity

The quality of reproduction of my two stage audio amplifier deteriorated recently, and I am at a loss to know how to correct this trouble. The valves have been tested and found to be satisfactory.

B. Lewis, Tewkesbury.

In cases of this type, the first components to suspect are the coupling capacitors, and secondly the electrolytic decoupling capacitors. Resistor faults seldom lead to loss of reproduction quality, as they either develop inter-



C113

Fig. 3: Skeleton circuit of a two-stage amplifier, showing capacitors which might cause trouble after a long period of use.

mittent trouble or become permanently open circuit. Fig. 3 indicates a skeleton circuit diagram of a two stage amplifier showing the capacitors which are to be suspected. The trouble with the coupling capacitors is that after a long period of use their insulation becomes impaired, with the result that a leakage current flows down the grid resistor of the following valve. This current produces a voltage across the resistor, thereby upsetting the bias condition of the valve with a consequent introduction of distortion into the output signal.

Electrolytic Capacitors such as are normally employed to shunt the cathode bias resistors tend to lose electrolyte after a long period of use, with the result that their capacitance may be considerably reduced. If too low a capacitance is used to shunt the bias resistor, the shunting effect will be lowered as the frequency is reduced and thus the bass response will be poor. In our opinion, it is well worth the small additional cost involved in replacing these capacitors when an amplifier or receiver is serviced after a few years use, as in most cases the improvement in the quality of reproduction will be quite noticeable.

Tone Corrector

Can you please explain the action of the simple resistor/capacitor tone corrector which is invariably found connected across the primary of the speaker transformer ?

B. Nicols, Newquay.

Tone correctors of the type in question consist of a resistor of about 10 kΩ connected in series with a capacitor of about 0.02 μF across the primary winding of the speaker transformer. At the lower audio frequencies the reactance of the capacitor is high, so that the R-C combination has negligible effect upon the load formed by the speaker and its associated transformer. At the higher audio frequencies, however, the effect is rather different as the reactance of the capacitor may be in the region of 1000 Ω, which in series with the resistor provides a shunt impedance of a little over 10 kΩ across the speaker transformer. Clearly this will reduce the load, and hence the amplification at the higher audio frequencies, and this provides the degree of treble cut which is required.

Without such a tone corrector the treble reproduction may be over amplified, as the load presented by the speaker and transformer to the valve is partly inductive and hence increases as the frequency rises. This effect is the reverse of that obtained with the tone corrector, and in a well balanced system the two effects tend to cancel each other out, thus providing a close approach to straight line reproduction.

PRACTICAL AERIALS

Multi-Element Beams

Impedance Matching

Feed Methods

by "AETHERIUM"

Part 4

Multi-Element Beams

The necessity for folding a dipole, in order to obtain a workable impedance value, will be seen more clearly if reference is made to Table I. The values stated are only approximate, but are sufficiently near to enable satisfactory results to be obtained.

TABLE I

Dimensions for 2, 3, and 4 element beams for operation on 28 Mcs.

		Element Spacing	*Approx. Radiation Resistance*
Radiator	16′ 5″	4′ 10″	25 ohms
Reflector	17′ 1″	(.15λ)	
Radiator	16′ 5″	4′ 10″	30 ohms
Reflector	17′ 8″	(.15λ)	
		(for max b/f Ratio)	
Radiator	16′ 5″	3′ 3″	15 ohms
Director	16′ 5″	(.1λ)	
Radiator	16′ 5″	3′ 3″	25 ohms
Director	15′ 11″	(.1λ)	
		(for max b/f ratio)	
Reflector	17′ 8″	3′ 3″	5 ohms
Radiator	16′ 5″	(.1λ)	
Director	15′ 10″		
Reflector	17′ 9″	6′ 6″	20 ohms
Radiator	16′ 5″	(.2λ)	
Director	16′ 1″		
Reflector	17′ 8″	8′ 3″	30 ohms
Radiator	16′ 5″	(.25λ)	
Director	16′ 2″		
Reflector	17′ 6″		
Radiator	16′ 5″	6′ 6″	14 ohms
Director 1.	15′ 9″	(.2λ)	
Director 2.	15′ 7″		

Taking the 3 element .2λ spaced beam as an example, we find that the impedance or radiation resistance is of the order of 20 ohms. Even if a Matching Transformer is used, it still remains something of a problem to feed this aerial, as the figure of 20 ohms is only approximate, but if we raise the radiation resistance value by folding the fed element, the whole system becomes far more flexible and allows the use of standard values of feeder. Tables 1 and 2 are self explanatory and are intended as a guide to obtaining a radiation resistance value approximating to that of the available feeder.

TABLE II

Folded dipole dimensions for obtaining increased radiation resistance values. Refer to Fig. 1 for Diameters A and B.

Dia. "A"	*Dia. "B"*	*Spacing (Centres)*	*Multiplier*
1″	½″	2″	2
1″	1″	2″	4
¾″	1″	1½″	5
½″	1″	1½″	6.5
⅜″	1″	1½″	8
¼″	1″	1½″	10
14 swg	1″	3″	11
14 swg	1″	2″	13
¼″	1″	1″	16
14 swg	1″	1½″	18
10 swg	1″	1″	24
14 swg	1″	1″	30

So if we have a length of 300 ohm feeder and wish to use it to feed a 3 element .2λ spaced beam, we have only to refer to Table II and see that good matching will be obtained if we construct the fed element of ¼″ dural and the folded portion of 1″ dural, making the spacing 1″ between centres. This will give a multiplier of 16 to the radiation resistance, resulting in a figure of 320 ohms, which will be a good match for our 300 ohm feeder.

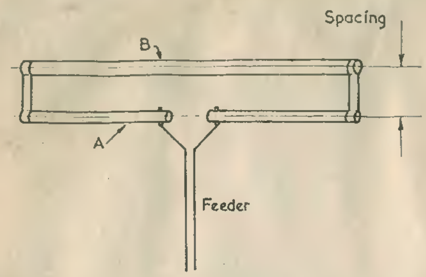


FIG. 1 FOLDED DIPOLE
See table II
C116

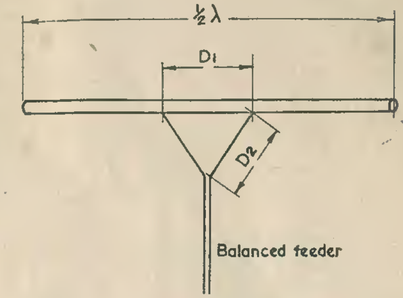


FIG. 2 DELTA MATCH
D1 & D2 = 30% of ½λ
C117

It should be remembered that when using a folded dipole as the radiating element of a multi-element beam it should never lay flat in the plane of the reflector and director, but should be fixed in an "upright" position so that the correct spacing is maintained between the parasitic elements and the radiator.

Forward Gain V Back/Front Ratio

In this country the problem of QRM is far less acute than in the United States, and it is far better as a general rule to strive for maximum forward gain rather than a good back/front ratio. The dimensions given in Table I are for maximum forward gain except where otherwise stated.

The beginner is strongly advised against attempting to tune up his beam by fitting telescopic end sections unless he has had experience with field strength measurements, or is able to enlist the aid of an experienced Amateur, as this operation sometimes results in complete frustration. It is far better, as a first step, to construct a beam with .2λ or .25λ spacing to the dimensions given, and not attempt any final tuning up.

Other Matching Methods

Folding the dipole is not the only method of obtaining a match into multi-element beams as described. The "delta" match, as shown in Fig. 2, is a good method, and as can be seen the fed element is in one length (½ wavelength). In order to obtain satisfactory operation, however, it is necessary that the standing wave ratio be measured and checked frequently during the period of obtaining the correct tapping points. This, as often as not, is not an easy job, even to the more advanced Amateur, and therefore is not recommended to the beginner.

The "T" match (Fig. 3) is another method often described in handbooks. This again

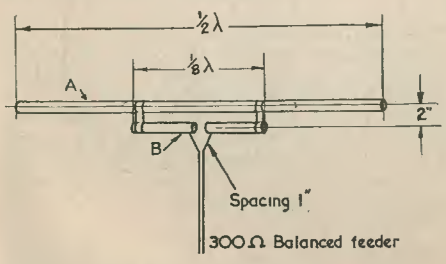


FIG. 3 "T" MATCH
A & B equal diameters
C118

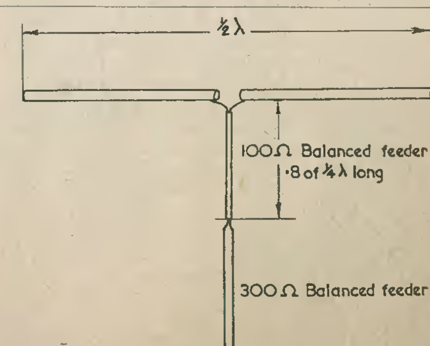


FIG. 4 TRANSFORMER MATCH
C119

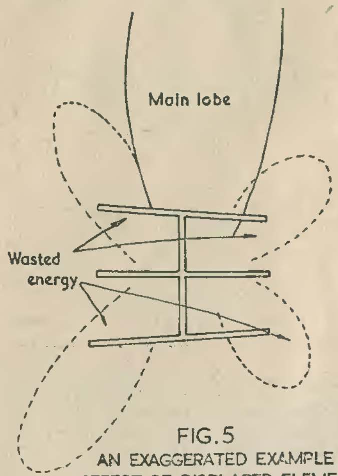


FIG. 5
AN EXAGGERATED EXAMPLE OF THE EFFECT OF DISPLACED ELEMENTS IN A MULTI ELEMENT BEAM

C120

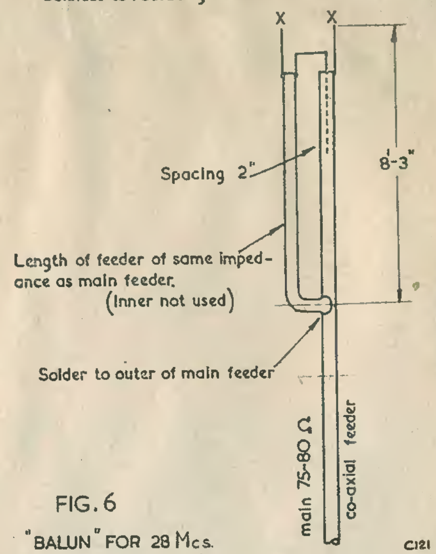


FIG. 6
"BALUN" FOR 28 Mcs.

C121

may prove to be difficult, especially when a low value of radiation resistance exists on the fed element. The Transformer match (Fig. 4) is not to be recommended except when relatively high values of radiation resistance are to be dealt with.

Alignment of Elements

It is important when constructing any type of multi-element beam to ensure that all the elements are parallel to each other, and they should be fixed in such a manner that the wind will not displace them when erected. Such displacement of the elements will produce some weird effects on signals, and the gain and directivity of the beam will be greatly impaired. An exaggerated example of such an occurrence is shown in Fig. 5. To prevent this it is usually wise to construct your beam on the so-called "plumbers delight" lines, using screwed fittings to support the elements.

It is not proposed to deal with rotating mechanisms in these notes, but there is just one point worth remembering. Do not install a system which necessitates going into the garden to rotate it. Frequent trips into a muddy garden and back to the shack are not conducive to domestic harmony.

Feeding the Beam

A beam aerial is a balanced system and as such should never be fed with unbalanced feeder of the co-axial type unless via a "balun" (Fig. 6). This is quite easy to construct and ensures that maximum efficiency and a state of balance exists at the fed point. The dimensions given in the sketch are for 28 Mcs. operation and it should be noted that as the "balun" is not an impedance transformer, the velocity factor of the feeder does not need to be taken into account, and the ¼ wave section should always be a full ¼ wavelength long.

(To be continued)

Modern Receiver Alignment

—contd. from Page 152

between them providing the coupling. It will, of course, be necessary to apply a greater output from the signal generator to the receiver when this course is adopted; and, if the set is initially too far out of alignment to enable the signal generator to be picked up, the direct connection will have to be employed until the adjustments carried out on the receiver have made it sufficiently sensitive.

Next Month

In next month's article we shall pass on in more detailed fashion to the alignment of the modern superhet, commencing with the technique of trimming the IF stages.

A General Purpose RECEIVER

by F. J. Smeed

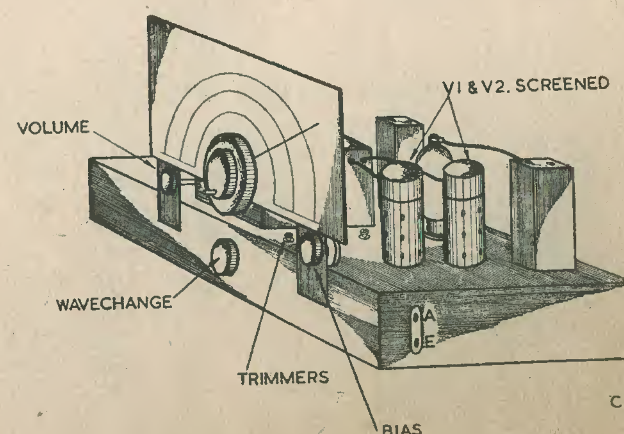
THE set to be described was built about two years ago to replace the family receiver, which was in such a state that it was not worth while repairing it.

As local station quality reception was the major requirement, some thought was given to the form which the set should take. Push button or switched tuning would meet the case, but these are inclined to develop electrical and mechanical faults, especially in these days of mains voltage fluctuations. Also, it is nice at times to have a turn around the short waves, from the comfort of an armchair by the fire.

In view of this, a semi-communications type set was the final choice, with a straightforward circuit consisting of one RF stage, triode-hexode frequency changer, followed by one IF stage, double-diode-triode for detection, AVC and first AF. Full AVC is applied to the RF and frequency changer, and approximately half the AVC voltage to the IF stages. As the main consideration was quality, the obvious choice for the final amplifier was push-pull, so the AF output from the first AF stage feeds a phase splitter of conventional design, and this is directly coupled to a pair of output triodes.

The general layout was then sketched out on paper, to ensure the correct clearance between components and to act as a guide for drilling the chassis. This latter was made from 16 swg aluminium. After completing all the bending, drilling, and punching for valveholders, and fitting together, the wave change switch position was carefully marked out. The screens were then removed and drilled for securing screws, and clearance holes made for the switch spindle. It will be noted that the switch plates are mounted direct on the screens, except the front plate and locator which are screwed to the front of the chassis. This form of construction allows

Fig. 1: Sketch showing general layout of receiver.



C13

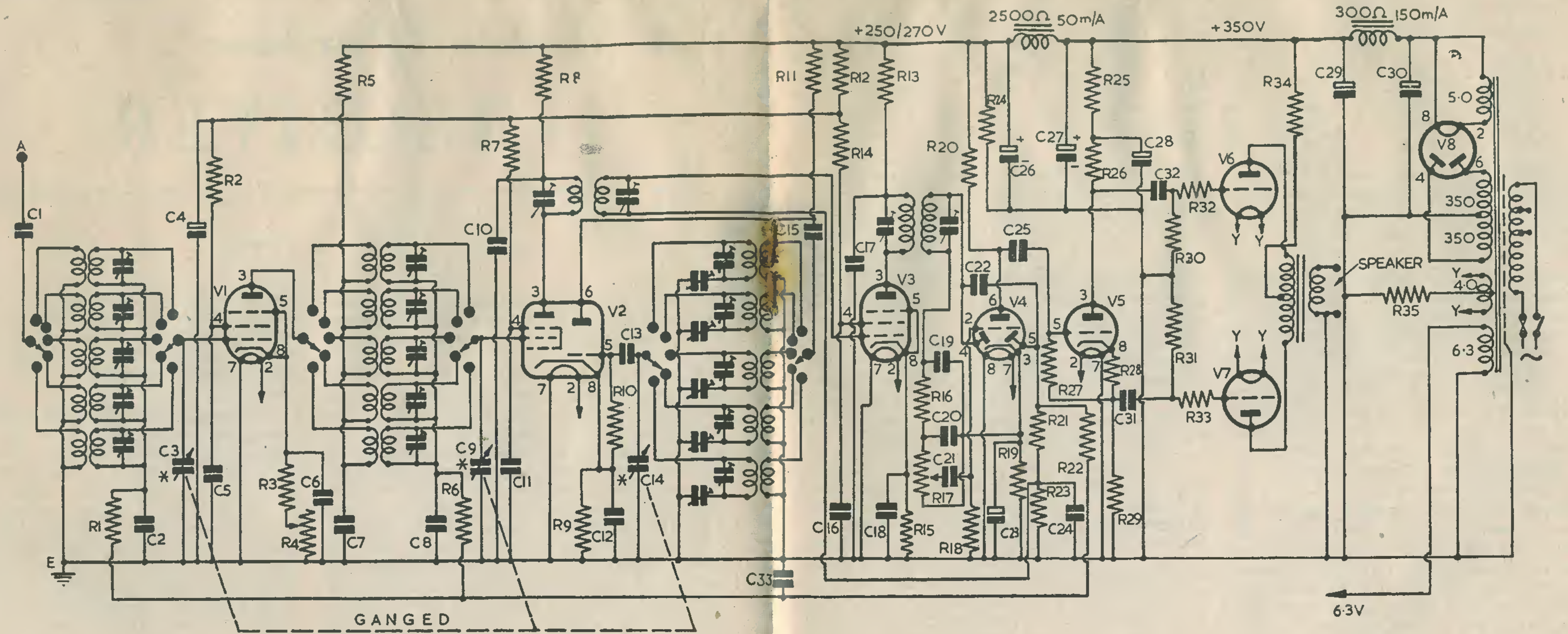


Fig. 2: Theoretical circuit of the general purpose receiver.

COMPONENT VALUES

All resistors $\frac{1}{2}$W except where shown otherwise.

C1, 500 pF
C2, 5, 6, 7, 8, 10, 11, 12, 16, 17, 18, 24, 31, 32, 0.1 µF
C3, 9, 14, 3-gang
C4, 4 µF paper
C13, 50 pF
C15, 200 pF
C19, 20, 100 pF
C21, 0.006 µF
C22, 30 pF
C23, 25 µF 25V
C25, 0.01 µF
C26, 27, 28, 8+8+8 µF 450V

C29, 8 µF 550V
C30, 4µF paper or oil, 750V
C33, 0.05 µF
V1, 3, 6K7G
V2, 6K8G
V4, 6SQ7
V5, 6C5
V6, 7, PX4
V8, 5U4
IFT's, 465 kcs.
R1, 6, 30, 31, 270 k Ω
R2, 2.2 k Ω
R3, 21, 470 Ω

R4, 10k Ω pot
R5, 8, 13, 14, 32, 33, 10 k Ω
R7, 4.7 k Ω
R9, 250 Ω
R10, 11, 47 k Ω
R12, 22 k Ω 2W
R15, 400 Ω
R16, 100 k Ω
R17, 500 k Ω pot.
R18, 2M Ω
R19, 4 k Ω
R20, 220 k Ω
R21, 22 470 k Ω

R23, 1 M Ω
R24, 80 k Ω 5W
R25, 26, 29, 27 k Ω 1W
R27, 1.5 M Ω
R28, 1.5 k Ω 1W
R34, 350 Ω 10W
R35, 500 Ω 10W

Coils, trimmers, padders, see table.
Mains trans.: 350—0—350V 150 mA,
5V 3A,
4V 2A,
6.3V 2A.

"P" TYPE COIL DATA

Aerial Coil No.	RF Coil No.	Trim. Cap. Aerial and RF, in pF.	Waverange in metres	Osc. Coil No.	Trim. Cap. in pF	Pad. Cap. in pF
PA4	PHF4	50	12-35	PO4	50	5,000
PA5	PHF5	50	34-100	PO5	50	2,400
PA6	PHF6	50	91-260	PO6	50	900
PA2	PHF2	50	200-550	PO2	75	450
PA1	PHF1	75	700-2000	PO1	75	150

The 5000 pF padder can be a fixed capacitor. The 2,400 and 900 pF padders are made up by using 750 pF compression type capacitors with fixed mica capacitors in parallel. Some experiment may be necessary with padding values in order to obtain correct ganging over entire tuning range.

the two short wave coils in each section to be mounted close to the switch, thus keeping the leads short. For the same reason, the volume control is mounted on top of the chassis, adjacent to the 6SQ7, with an extension shaft to the front of the chassis. This shaft is so spaced that it is clear of the trimmers. The variable bias control for the RF stage is mounted so that the knob is symmetrical with the others. This control is normally set at about maximum bias for local reception, in order to avoid overloading.

To simplify wiring and assembly, the screens and switch were removed, after which all trimmers, valveholders, IF transformers and coils were fixed in position. It will be observed that the trimmers are of the small air-spaced type, these being used as they are more reliable than the postage stamp type, and can moreover be purchased quite cheaply as ex-WD surplus. With the layout adopted, all trimming can be carried out from the top of the chassis. For the same reason, the padders are mounted so that they, too, can be adjusted from on top, through holes in the chassis.

Wiring is carried out in the usual way, most of the resistors and capacitors being mounted on tag boards which were wired up separately before being fixed in position. Finally, the screens and switch were replaced, and the connections from the switch to the coils, etc., completed.

Quite a few of the parts used were ex-WD, but only because they were available or suited the design; for example, the dial drive was as used on the R1155, adapted to a standard tuning capacitor. The dial itself was a sheet of cream perspex suitably engraved.

The coils used were on hand, and actually were pre-war ones, but any of the present commercial coils such as the 'P' range, Premier, etc., are suitable. As a matter of fact, another receiver has since been constructed using 'P' coils. This was made for three wavebands only, and the chassis made smaller. For convenience of constructors, the table herewith shows 'P' coils suggested, together with the values of trimming and padding capacitors.

The power pack and amplifier were built on a separate chassis, the layout of which is not so important. No details are given of the construction of this unit, as builders can no doubt arrange the components on a chassis to suit themselves according to the parts used.

The usual precautions should be taken to mount the cores of the chokes at rightangles to the mains transformer and to each other. It is recommended that the speaker transformer is also mounted on this chassis, with the low impedance output taken to a socket. With this arrangement, no damage results to power pack capacitors or rectifier if the speaker becomes disconnected. A paper or oil-filled 750V 4 μF capacitor is used following the rectifier, as an electrolytic will not withstand the voltage surge when switching on, arising from the use of a directly heated rectifier. For best results, a 12" speaker is recommended, although good results can be obtained with a 10" speaker if care is taken not to advance the volume control too far and so cause overloading.

THE INSTITUTION of Post Office Electrical Engineers, Junior Section, London Centre, has recently inaugurated a Radio Group within the framework of the Institution. The Group—consisting of a number of Sections within the London Telecommunications Region—was formed to further the knowledge of its members in the radio and television side of telecommunications. In pursuance of this aim, manufacturers and retailers are being invited to provide technical demonstrations of radio and television equipment to Members.

A large number of Members are also keen constructors and, since the formation of the Group, equipment constructed has ranged from T. V. receivers to 'electronic timers', including test equipment.

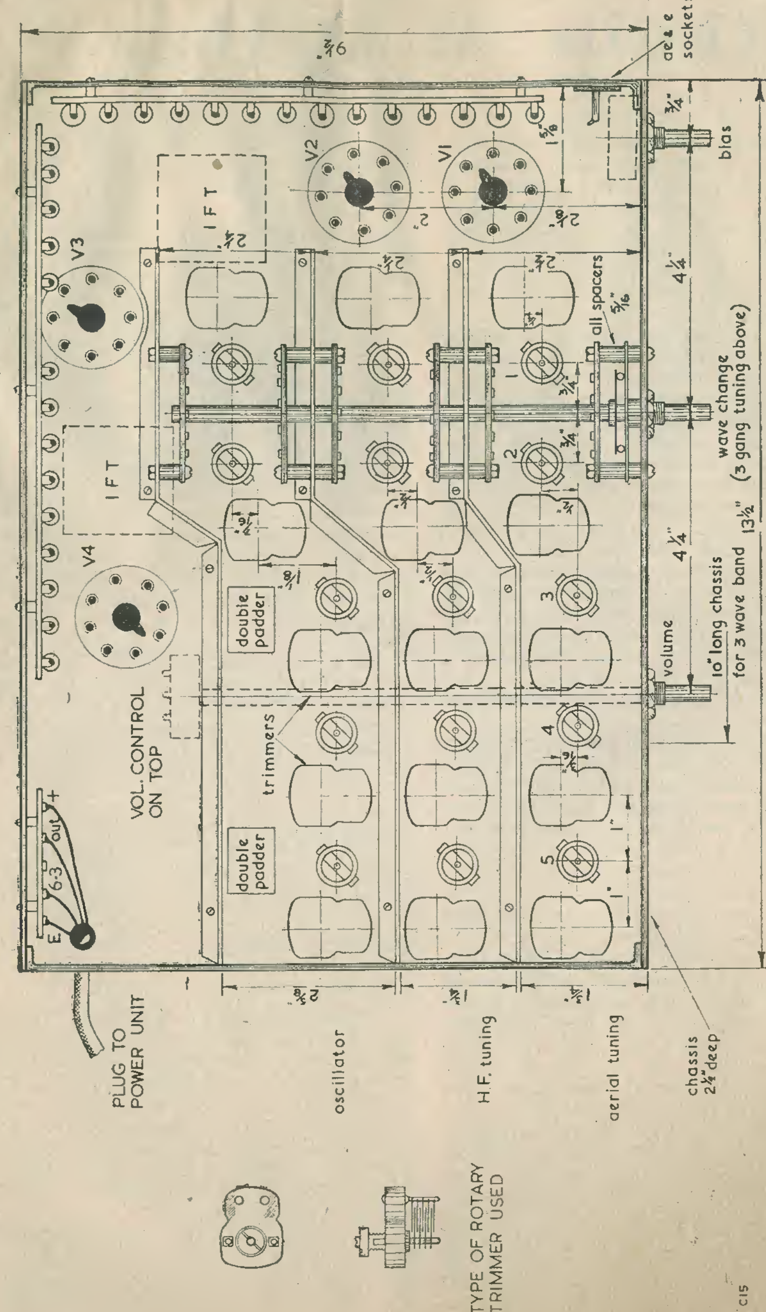


Fig. 3. Diagram showing component layout.

Fun and games at Christmas

by R. J. Caborn

In this article our usually somewhat solemn contributor has deserted the studies of normal radio and, with the approach of the festive season, offers a few suggestions which should help to make the Christmas party a really successful occasion.

NOW that the festive season has almost arrived it behoves us, particularly those of us who are blessed with a family, to set about making the celebrations go with a swing. Nearly all of us will be giving or assisting at parties; and if we can introduce really original novelties into these gatherings they will not only increase the fun at the actual time but will also help to provide many happy memories to look back upon in future years.

Particularly suited in the average family to prepare such novelties is the radio enthusiast. His collection of equipment, whose functionings are in any case incomprehensible to most laymen (and especially laywomen !) can easily be utilised in constructing a few temporary rigs which would fascinate and mystify the guests present at any party.

" Magic " Control

One of the easiest, and most popular devices used by " gadget-makers " relies on a very easily constructed circuit that allows quite a few mysterious things to be done. Its purpose is to provide a control of any electrical piece of equipment (radio sets, gramophones, lights, toys, etc.) simply by placing one's hand either on or near a piece of furniture, a wall, or any similar innocent-looking object.

The circuit of the device is shown in Fig. 1. As may be seen, it consists simply of an ordinary tuned-grid oscillator. In practice the unit is provided with just sufficient feedback to make it oscillate in a stable manner. A sensitive relay is inserted in series with the HT supply to the anode of the valve. To its grid is connected a length of fine wire terminating in a metal plate which could be approximately six inches square. It will be found that, by placing one's hand sufficiently close to the plate connected to the grid, the body-capacitance down to earth will cause the valve to stop oscillating. This will result in its taking a heavier anode current, causing the relay to

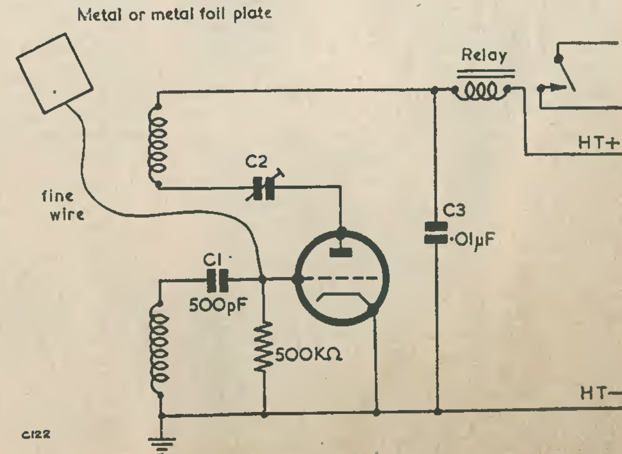


Fig. 1: The circuit of the " Magic " control.

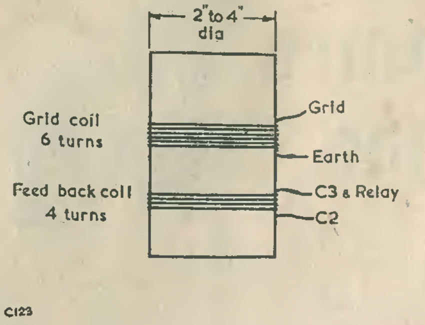


Fig. 2: *The coil used in the control of Fig.* 1.

close. The contacts of the relay may then be used to switch on whatever auxiliary equipment it is intended to employ.

Making the Control

Little time is needed in making the oscillator unit. It is advisable to use an output-type valve for the triode oscillator, as the changes in anode current would then be proportionately higher. A 2-volt battery valve, such as a PM2, would be quite suitable. Alternatively, an output pentode with its screen-grid, suppressor and anode strapped together would also be satisfactory should a triode not be available. Mains valves can also be used, of course, provided that the requisite source of supply is available. In all cases, the oscillator should be operated at a low anode voltage to ensure that the valve is not damaged during the cessation of oscillations.

There is no need for any high degree of accuracy in winding the coil. About half a dozen turns on a two to four inch former, the wire being spaced by its own diameter, would be quite adequate for the grid coil. The feedback coil could consist of four turns wound in the same manner and slightly spaced from the grid coil. (See Fig. 2).

It will be seen that no value is given for the feedback capacitor C2, as this will have to be found by experiment. The best plan would be to use a variable or trimming capacitor here, and adjust it to give just sufficient capacitance to maintain oscillations. A value of 50 to 150 pF would be needed in most cases.

In order to make the effect of the body-capacitance as great as possible, it is worth while connecting the oscillator to some form of earth. It will usually be quite sufficient to use mains conduit or any other fairly efficient earth for this purpose. In addition, to reduce the capacitance to earth of the lead connecting the plate to the grid of the valve, this wire should be as thin as possible. 36 swg black enamelled wire is ideal and has the advantage of being almost invisible.

The plate itself may be mounted behind a piece of thin wood, a picture on the wall, or any other place which suggests itself. A very effective idea is to use a piece of tinfoil sandwiched between two pieces of paper pointed and cut to represent a hand. This could be fixed to the underside of a large piece of glass, care being taken to use a fairly dark background in order to make the connecting lead invisible. People could then be invited to place their hand over the "Magic" hand (which is, of course, on the underside of the glass) whereupon lights would flash, radios blare forth, and all sorts of other "phenomena" take place.

It will be noted that no capacitor is connected across the grid coil of the oscillator. This capacitor is omitted in order to ensure that the added body-capacitance more effectively lowers the frequency of oscillations; thereby making the device more sensitive than if the "damping" effect of the body-capacitance were used alone.

A "Presence" Indicator

A more effective "gadget", but one which needs the addition of a short-wave (or all-wave) superhet, is shown in Fig. 3. This again uses a simple one-valve oscillator and once more relies upon body-capacitance, but its working is somewhat different. In this case, the grid end of the coil is connected to three to six feet of ordinary insulated wire, (such as a piece of lighting flex), and the oscillations are picked up on the short-wave superhet. It will be found that, if a person approaches within two to three feet of the ' pick-up " wire, the frequency of oscillations will change considerably; whereupon the receiver will cease to pick it up, its AVC voltage returning to zero. Switching of the auxiliary equipment is carried out by means of a valve and relay connected to the AVC line of the receiver, or by connecting a sensitive relay in series with the anode supply of one of the AVC-controlled valves in the receiver itself.

For greatest efficiency the coupling between the oscillator and the receiver should be just sufficient to generate a satisfactory AVC voltage when the receiver is accurately tuned in. If a frequency between five and fifteen megacycles is employed it will be found that the device is capable of surprisingly good sensitivity. It must be remembered that the "pick-up" wire should be mounted vertically so that a standing person will have the greatest effect upon it. In addition, the oscillator should be positioned as near to the ' pick-up " wire as possible. If this wire is mounted

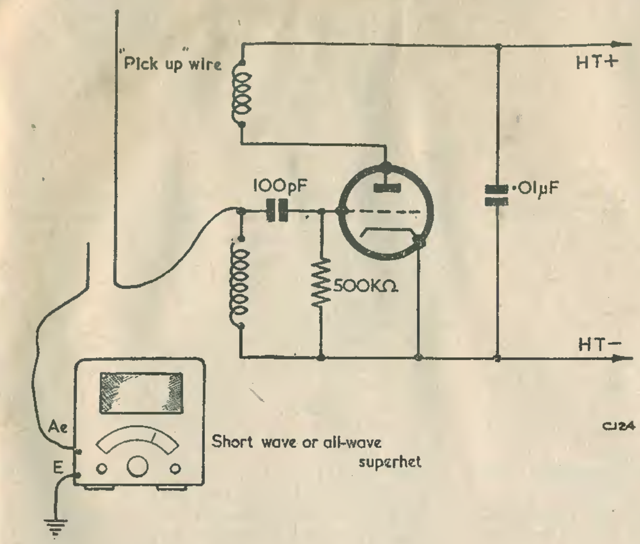


Fig. 3: *The "Presence Indicator".*

against a wall, care should be taken to see that it is kept well away from earthed objects such as mains wiring which may be inside the wall itself or on the other side.

A device such as this also proves very effective when children are present. For instance, they can obtain a great deal of fun if they find that by going up to the Christmas tree it "lights up for them". (A certain appeal to the writer's Scottish instincts by reason of the fact that no current is consumed by the tree decorations unless someone actually stands near to them has been reluctantly disallowed since it is, after all, the festive season. In addition, a suggestion that a bottle of whisky placed temptingly on a sideboard should suddenly be illuminated a bilious shade of green on the approach of a reveller is not so attractive as it may appear, because the interest of the novelty is far outweighed by the deleterious effect it could have upon the nervous system of those further advanced in the festivities).

Radiation

It must always be remembered that the two devices mentioned above are capable of radiating a weak signal. For this reason, the strength of oscillations should be kept as low as possible (preferably by using a low HT voltage) and a frequency should be chosen which will not interfere with one's neighbours' short-wave listening. The signal, admittedly, would be considerably smaller than that given by, say, a reacting one-valve receiver connected to an average aerial; but nevertheless, the possibility of annoyance to others does exist and should be fully considered.

A further point to bear in mind is the faint possibility of the oscillators "squegging", whereupon they could cause a harsh hissing noise over a large band of a nearby receiver. This may be cleared by reducing the value of the grid leak in the oscillator.

"Trick" Broadcasting

Apart from the enjoyment obtained by carrying out "home-broadcasting", (that is, by relaying a distant microphone over the AF stages of a receiver or through an AF amplifier) a lot of fun may be had by so connecting a remote microphone that one may unobtrusively cut into a B.B.C. programme without the listeners being aware of the fact.

Without considering the technical aspects of the idea, it will at once be apparent that, for its greatest effect, cutting into a programme should be done carefully, unobtrusively, and not too often. It is possible, of course, to slip false items into, say, a news bulletin without too great a fear of detection if they are carefully prepared beforehand, but the scheme will soon be discovered, or guessed at, if it is carried out too often.

Nevertheless, particularly with the children, quite a lot of fun can be had; and, once the novelty has worn off, the cutting-in idea can be relinquished and the arrangement used for

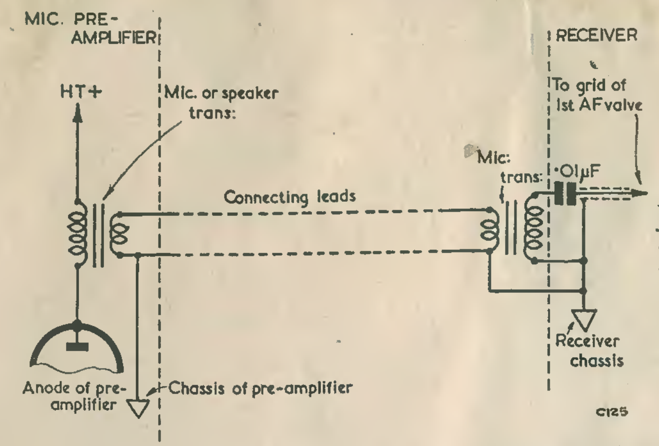


Fig. 4: A suggested method for reproducing a remote microphone through a receiver.

normal "home-broadcasting", should the guests so desire.

Three things are required for the process of cutting-in. First of all an AF feed from the microphone to the receiver is needed, secondly the remote microphone should have sufficient fidelity to enable reproduction which is reasonably comparable with that of the B.B.C. to be obtained, and thirdly some means should be provided for unobtrusively silencing the receiver itself.

The AF Feed

By far the best method of driving the receiver loudspeaker from the remote microphone is to use a separate amplifier at the microphone itself, and take a low impedance output from this amplifier to the voice coil connections of the receiver-speaker. This then eliminates all trouble due to hum pick-up in the long connecting leads which must inevitably be employed; and, in addition, makes the whole arrangement easily workable.

If a separate amplifier is not available, it will then be necessary to use the AF stages of the receiver itself. This may be done by employing a microphone transformer connected as shown in Fig. 4. The secondary of this transformer is connected, via a 0.01μF capacitor (which prevents any alteration to the existing bias circuits in the receiver) to the grid of the first AF valve, this being usually the top cap of a double diode triode. The transformer may be left connected all the time and should not affect the reproduction of the receiver to any great extent. It will almost certainly be necessary to use a pre-amplifier at the microphone (a simple battery triode amplifier should be quite adequate for most microphones) the output of this being converted by a speaker transformer (or microphone transformer[1]) to low impedance before coupling it to the lines of the receiver.

It will be seen that one of the lines is connected both to the chassis of the receiver and to the chassis of the pre-amplifier.

Such an arrangement should give quite good results, the only trouble lying in the fact that hum may be picked up from the house mains wiring. If this wiring is conduit, or is lead-covered, the scheme is worth trying out (particularly when only a short length of wire is needed), the chances of picking up excessive hum then being about fifty-fifty. Should the arrangement not be successful, then screened wire or a separate amplifier at the microphone will have to be used.

It must be pointed out here that if the receiver is a "universal" model, it is inadvisable to do any "home-broadcasting" at all owing to the risk of having long leads in the house which could possibly be carrying mains voltages.

Silencing the Receiver

The best method of silencing the receiver is to short-circuit the grid leak of the output valve by means of a pair of relay contacts which can be operated from the remote point. See Fig. 5. This will silence the receiver perfectly and should introduce no tell-tale crackles at all whilst operating. If it is found that a crackle does occur when the relay closes or opens, this will almost certainly be due to the fact that the capacitor coupling the output grid to the previous anode has become

1. If a microphone transformer is used here it should be connected with its secondary in the anode circuit of the pre-amplifier and should be shunt-fed or paralleled by a low-resistance AF choke in order to avoid the possibility of it burning out.

leaky; and it should be replaced.

If the circuit of Fig. 4 is used it will be necessary to silence the receiver in the pre-detector stages. It is inadvisable to silence an AF or IF valve by breaking its cathode connection, as this causes the cathode to rise nearly to HT positive potential and may break down the cathode-heater insulation.

A better scheme is to break one of the screen-grid feeds, as shown in Fig. 6. This causes no damage to the valve and the additional connections can be fairly easily made without disrupting the internals of the receiver too much. It may be found that a slight crackle is heard when the relay opens or closes, thereby giving a clue to listeners that something "suspicious" is going on, but this can be easily cleared by temporarily connecting an 8 μF, or larger value, capacitor across the existing screen decoupler. Fig. 6 shows the idea.

Further Ideas

The above are just a few suggestions which may be employed by the radio enthusiast to help the Christmas parties along. Many more schemes will suggest themselves to the reader. The writer only hopes that he has been able to suggest one or two ideas which may bear fruition in enhanced enjoyment at the reader's festivities.

And now, to finish this article, let us add our very best wishes for Christmas and a prosperous New Year to you all, the latter being full of successful QSL's from far places and surplus gear at five shillings the ton.

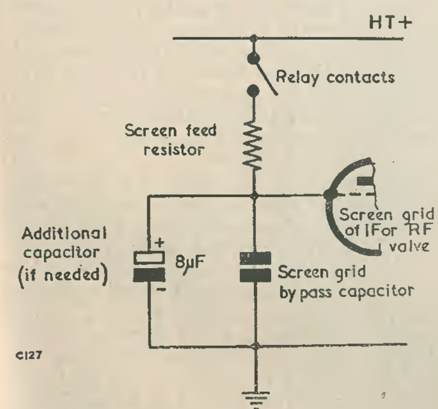


Fig. 6: A further method of unobtrusively silencing a receiver.

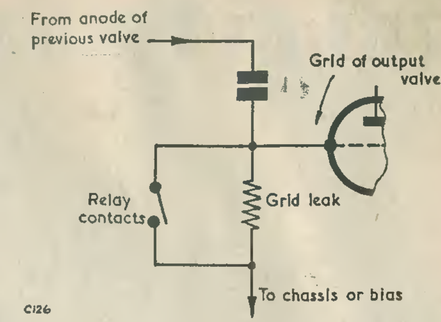


Fig. 5: A simple and effective method of silencing a receiver by means of remotely-controlled relay contacts.

WHY NOT ADD BASS CUT?

By K. English

Talking of adding a cut sounds a bit Irish, but nevertheless it is a constructional item which is of definite value, particularly to the short wave listener or transmitter.

Most receivers will already have a so-called tone control fitted. Usually, this will consist of an arrangement enabling the higher audio frequencies to be deleted from the output, and it often takes the form of a fixed capacitor in series with a variable resistor, wired across the output transformer primary, or from grid of the output valve to chassis. Another arrangement, often met, wired from the output valve anode to chassis, is not liked by the writer, as it places a high potential across the capacitor.

Top cut is very useful in reducing the effects of local interference. Bass cut will prove beneficial in reducing the effects of 'key thumps', and enables phone to be easier read through the mush which always seems to be present when Dx is around.

In the writer's receiver, a National NC156, bass cut is achieved quite simply. A 200 pF capacitor is wired in series with the 0.01 μF coupling capacitor to the output stage, and a shorting switch (toggle) is fitted across the 200 pF. With the switch "on", reception is normal. With it open or "off", the lower audio frequencies are severely attenuated. Why not try it yourself?

TELEVISION
Picture Faults

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

Mr. John Cura.

Part 9 – The CR Tube, contd.

Screen Faults

THESE may be described under two categories, screen burns due to excessive beam current confined to a small area, and ion burns.

The former can happen to both magnetic and electrostatic tubes. It is generally due to failure of the time bases when operating at high brilliance, but can appear over a long period if a bright spot is produced on switching off the receiver. The screen material is damaged by the beam current being dissipated over a very small area of the screen, and can be avoided in the case of time base failure by switching off or reducing the brilliance immediately the fault occurs. It is one of the disadvantages of fusing the HT supplies of a receiver using a mains driven EHT supply that in the event of a short or overload the EHT is maintained after the fuse has blown. The bright stationary spot thus formed can seriously mark the screen. Some provision should be made to defocus the spot or to deflect it, to obviate screen damage, if this method of power fault protection is used. Line flyback and RF oscillator methods of EHT supply collapse rapidly on switching off, or in the event of HT failure, and are therefore unlikely to cause burns on the screen.

Ion Burns

This is mostly concerned with magnetic tubes. The heavy (compared with an electron) ion particles are deflected in a wide beam down the tube towards the screen by the focusing magnet. They are affected only very slightly by the relatively small field produced by the scanning coils, and are only slightly affected by the bias on the tube. Therefore, the brilliance setting has no direct effect on the ultimate appearance of ion burns in any one tube. It is a process which goes on continuously and determines eventually the life of the tube, assuming no deterioration in emission.

Recent technique in tube manufacture is steadily overcoming this problem, and many modern types are virtually free from this defect. Ion traps which deflect the electron stream into a normal type of electrode assembly, after leaving a misaligned "gun" which allows the ion stream to impinge on some part of the electrode system, may become more common in future. Also, screen materials which are capable of dissipating greater beam currents and of absorbing ion particles without damage may in the future reduce ion burns to a thing of the past. The life of the cathode ray tube will then be determined by the life of its heater and cathode. Fig. 1 shows the dark area of ion burns on a cathode ray tube, when illuminated with an unmodulated raster.

Other screen faults due to manufacture are outside the scope of this article and will therefore not be dealt with here.

The recent tendency to higher screen voltages has produced problems which are external to the tube itself. Among these are static charges on the tube and the discharge of these to earth points close to the tube. Bulb charge, as it is commonly called, can cause areas of poor illumination, and may be produced by the method of mounting the tube. It is difficult to give any definite rule as to how to tackle this problem, and it is as well to consult the manufacturer. It may help to drain the charge away from the tube face when the mask gives efficient insulation, or conversely, an improvement in the insulation when the tube is supported at its front end by a metal clamp may be worth while trying.

Static discharge from the glass to nearby earthed points is common, and will vary with the degree of atmospheric moisture. Coupled with this is brush discharge around the anode connector. This latter may often be eliminated by smearing the area lightly with petroleum jelly—this will tend to collect dust, but if removed and replaced at intervals is very effective. It might be possible to use this method on the neck of the tube when discharges appear between the glass and the deflection coils or focus magnet, but care should be taken that the grease used does not in any way impair the insulation of windings.

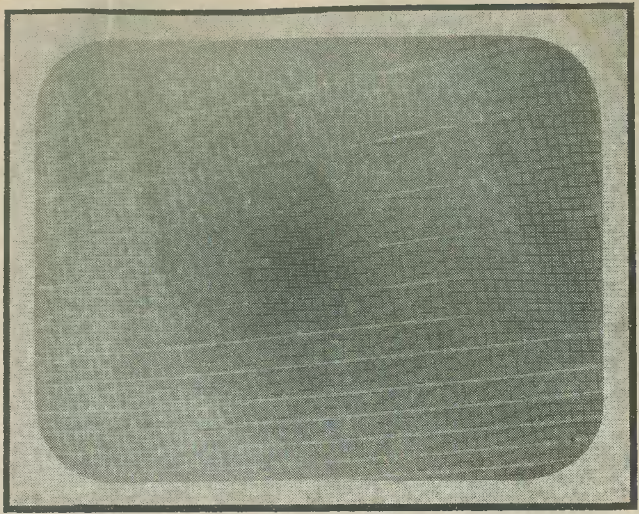


Fig. 1: The effect of ion burn on the screen is clearly shown here.

(*John Cura 'Tele-Snap'*)

The beam current of a cathode ray tube can be measured with a meter capable of indicating 100 μA. If inserted in a magnetic receiver, considerable caution must be exercised as the meter may be at EHT potential. It could, of course, be inserted in the cathode circuit of triode tubes without any possibility of error. The additional current to other electrodes is usually of a somewhat lower value. In electrostatic tubes, the final anode and graphite screen are brought out to individual pins. The meter may then be inserted between the two so that the beam current from the graphite screen may be measured. Most tubes operate with maximum beam currents of 100 μA, but

(*continued on next page*)

Fig. 2: Negative picture produced by a cathode ray tube having low emission (brilliance turned up beyond normal setting).

(*John Cura 'Tele-Snap'*)

Answers to Quiz . . . .

(1) Mr. Brain had drastically overloaded the output stage by allowing some "signal" to reach the grids which caused the valves to deliver heavy current and then cut off sharply. This may have been intermittent, as for example the clattering type of signal produced by a loose connection in an early stage receiving the full gain of the amplifier, or it may have been continuous oscillation due to positive feedback.

The loudspeaker and output transformer formed an inductive load capable of storing a large amount of energy during the time the valve was conducting. When the current was cut off, the collapse induced a high voltage (but low current) pulse in the transformer primary or caused the anode circuit to "ring", i.e., to oscillate independently at high voltage. Although similar in action to the flyback or ringing choke EHT systems, the "efficiency" was less because the cut-off was slower than that of a sawtooth waveform, but was sufficient to generate a most destructive voltage. Our stooge should have switched off at the first sign of instability and, as a precaution, wired an RC damping combination across the transformer primary.

(2) Although three watts is often too loud for middle audio frequencies, notes in the bass register require much greater power for a comparable "loudness", due to the large amplitude. Three watts is insufficient for an audible note of 30 cps, and it is necessary to determine the required output for the lowest frequency needed to be reproduced—at least ten watts at 30 cps. Such a low frequency would hopelessly overload a small amplifier already giving close to maximum output in the middle register, and the fact that distortion is not too evident is due to the elimination of the lowest frequencies by the coupling networks and loudspeaker. In many cases, the presence of harmonics of bass notes and some resonance deludes the listener into believing he has true bass, and in any case many listeners are content with reproduction which is merely pleasant, although not accurate.

The writer feels, however, that the constructor is in a better position than the average person to enjoy better reproduction, being able to produce a hand-made job using circuits which for reasons of economy and production difficulties cannot be produced commercially at an acceptable price.

(3) The current in a flyback system is very small and so, usually, is the value of the reservoir capacitor. Due to this, and to the frequency, the voltage drops considerably if the output is shunted to earth—as by the human carcase! The shock is still unpleasant and, if a large reservoir capacitor is used, still dangerous.

It is difficult to produce a mains transformer with a current output of less than about 5 mA, the reservoir and smoothing capacitors are usually 0.1 μF each, and shunt resistance does not drop the voltage so sharply as in the flyback system (the VCR97 network of 4 or 5 MegΩ does not have much effect). The shock is extremely uncomfortable, as the writer knows too well, and could quite easily be fatal.

The high current, fine wire gauge and vast number of turns, and the difficulty of insulation make the mains transformer particularly prone to breakdown. A momentary short circuit will cause it to burn out, while in the absence of a load the voltage will rise to a level where sparking may occur.

(4) Iron-dust increases and brass decreases the inductance. This can be quite useful. For example, the frequency of a tuned circuit can be raised without removing turns, by fitting a brass slug in place of the iron core.

A useful "wand" can be made by fitting a short non-metallic rod with an iron-dust slug at one end and a brass one at the other. This can be used to test tuned circuits, by putting the ends inside the coils. If response improves with the iron-dust core in, more turns or more capacitance is indicated, and vice versa.

TV PICTURE FAULTS—continued

some modern tubes have a maximum rating of 150 μA. These latter are usually of the aluminised screen types.

A final word of caution—when removing a cathode ray tube from a receiver which has just been in use. High static charges can form internally after the EHT connection has been removed. It is possible to receive a sharp shock from the anode pip of a magnetic tube when touched some while after the tube has been removed from the receiver. This may cause sufficient surprise, when unexpected, to lead to the tube being dropped.

(To be continued)

THE COVER

. . . . . . shows the deck and control panel of the E.M.I. Tape Recorder, type BTR/1. This is a really super job with many refinements. Note the Time Indicator set between the two spools, by means of which any part of the recording may be located speedily and accurately. Details and price are available on application from E.M.I. Ltd., Hayes, Middlesex.

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.

Accumulator Charging

THERE is nothing extra special about charging accumulators at home. Chargers of all types and for all currents may be purchased, or they can be made up fairly easily from surplus equipment.

If nothing further than "trickle" charging of say, several two-volt accumulators is to be carried out the arrangements are quite simple. The main things to ensure are that the terminals of the accumulators are well greased with mineral jelly or "vaseline", and that the vents are left unscrewed to allow gases which may be generated inside the accumulator case to escape easily. It goes without saying that the accumulators should be stood on a piece of glass, wood, or metal, etc., to prevent any damage; they should not be left on a polished surface.

If continual heavy charging of a lot of accumulators is to be done in the workshop you *might* find yourself breaking local byelaws or the terms of insurance policies and so on. In any case it is advisable to charge the accumulators away from the living rooms in the house because, in a case like this when a lot of charging is being done, acid fumes *will* penetrate and perhaps cause damage; they may also be unpleasant for other members of the family.

It is also advisable to provide a supply of alkalis to overcome any damage which may be caused by accidentally spilling acid. A solution of washing soda should be kept available and may be used if acid is spilt on clothes, the skin, or on the floor. If acid gets into the eyes or the mouth, etc., a fairly weak solution of sodium bicarbonate should be used to neutralise the effects, followed by washing the organ with clean running water.

Batteries under charge may be checked by reading the voltage on the terminals and by measuring the specific gravity with a hydrometer. A fully-charged accumulator should have a voltage of at least 2.1 volts *off* charge and a specific gravity of 1.250 or more (unless the makers advise otherwise).

Heavy Soldering

It is impossible to carry out good soldered connections on large area surfaces, such as steel chassis, unless a really heavy soldering iron is used. The normal fifty to sixty watt affair used by most constructors will rarely possess enough heat for a job like this.

As it might prove expensive to buy a large electric iron for an operation which will only be done occasionally, a saving may be effected if a large non-electric iron is used. A good heavy iron having a bit whose cross-section is about an inch square should be ideal, and should not cost too much. It may be heated in a fire or over a gas-ring, etc., but the flames should not reach the tinned portion at the end. Nor should the iron be over-heated: a green flame indicates that this is happening.

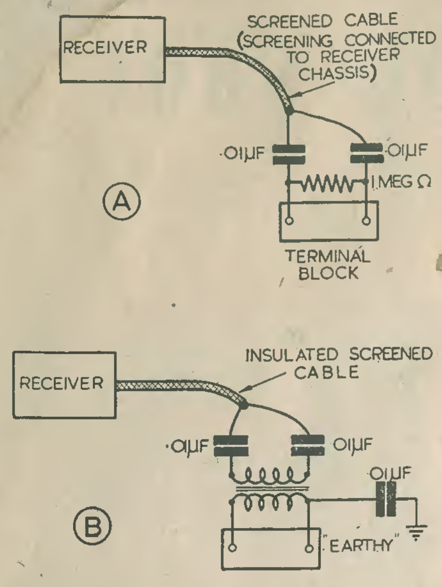
The steel chassis should, of course, be well cleaned before the soldering is carried out. Most patent fluxes have ingredients which enable steel (which is a fairly difficult metal to "wet") to be soldered; although it may be found that a lot more flux is needed than would be used for a copper or tin joint.

Workshop Lighting

Considering the amount of fine work which is usually carried out by radio constructors, the writer believes that a bright, well-placed light is essential. In addition, the utmost use should be made of natural daylight, and the work bench should therefore be placed under or near the window.

With respect to artificial light, this should be strong and should cast few shadows. For instance, it is a good plan to have a 75 or 100 watt bulb mounted directly over the centre of the bench and close to the ceiling. This may be augmented, if desired, by a smaller, adjustable lamp mounted on the workbench itself.

Strip lighting and fluorescent lighting provide a good source of "shadowless" light. Fluorescent lighting has a slight disadvantage insofar that it is intermittent. Although no noticeable flicker is evident it is liable to "strobe" moving machinery such as lathes,



C115

Fig. 1 (a): A method of using AF obtained from a receiver for testing amplifiers, etc.

Fig. 1 (b): If the receiver is an AC/DC model, the AF test terminals should be isolated by a transformer. The screened cable shown should be "earthed" to the chassis of the receiver, the screening then being insulated.

etc., giving the somewhat dangerous impression that they are stationary. In addition, the delay units are liable to spark and cause radio interference; although the writer has been given to understand that this fault is not evident on present day installations.

AF for Test Purposes

A source of good quality AF is extremely useful for checking amplifiers and the AF sections of receivers.

The best method of obtaining the AF in a case like this is to rely on broadcast programmes as picked up on a normal receiver; and, should the workshop possess a "permanent" set, this may be brought into service. If the receiver is a superhet, the AF may be obtained immediately after the second detector, either by connecting across the volume control or by connecting between the grid of the double diode triode (or the AF valve which immediately follows the second detector) and chassis.

The AF may then be taken, *via* a screened lead, to a conveniently placed terminal block, clearly marking the "Earthy" terminal. It may help if the lead carrying the AF is isolated by two capacitors at this terminal block, as illustrated in Fig. 1 (a). The 1 MegΩ resistor shown in this diagram is included merely to provide a resistive impedance at the terminals. If the workshop receiver is an AC/DC model, the AF should be passed through a well insulated "inter-valve" transformer (with, unfortunately, a certain loss of quality) and the output earthed *via* a capacitor. Fig. 1 (b) gives the idea. In the case of a straight receiver, the AF may be taken, *via* a capacitor, from the anode of the detector. If a television receiver is available, then this may be used, as it will be capable of giving better quality than that obtained from a broadcast receiver. In all cases the connection to the receiver may be made permanent, if desired, as it should not make any noticeable difference to its performance. The receiver speaker should be silenced while the AF is being used.

The AF offered by this method will, of course, consist of the programmes radiated by the B.B.C. (only local stations should be used) and should be of fairly good quality (up to 6 kcs or so in the case of medium and long wave stations). Musical programmes, and not speech, should be used for making checks; and if one has a good ear, one can soon spot any troubles in amplifiers or speakers tested on this input. The best checks are provided by symphony orchestras (not brass bands or jazz) and particularly by instrumental music. Transients, such as are given by hand-clapping and plucked instruments, also provide useful tests.

Tools

The "essential" tools which will be needed are several good screwdrivers, pliers, cutters and files. The screwdrivers could consist of a large heavy type, a medium sized one, and a small thin screwdriver of the "pocket" type with an insulated handle. Several pairs of pliers are useful: a normal sized pair, a small pair and a taper-nosed pair, all preferably with insulated handles.

As regards cutters, most pliers will have side-cutting blades, but these are awkward to use for radio work and cannot readily be sharpened. A pair of tin snips are very useful as, also, are side-or diagonal-cutting nippers. The latter may, however, be found somewhat expensive.

A few files are necessary, ranging from smooth four inch to rough six or eight inch flat files, all hand safe-edge. A half-round (four or six inches) and a thin "rat-tail" will also be found extremely useful.

The above are really the "essential" tools. However a few more tools are needed if any really useful constructional work is to be done.

(*continued on page* 184)

"*from our* MAILBAG"

Inexpensive Television

Dear Sir,—I am situated 200 ft. above sea level, and have a high "H" aerial, but as you know this is outside the official service area, and we are screened by a 500 ft. ridge 3 miles inland from here.

I have been experimenting with small adaptations to your set during the past year.

I have rebuilt a type 24 Unit to take two SP61's and a 6K8. The first is a broad-band pre-amplifier for vision and sound, the second and third valves being the sound RF and frequency changer respectively.

There was a loop (1 turn) coupled to the grid coil of the second RF valve, and this came out, via co-axial, to the 25 Unit in the 1355 vision receiver through another single turn coupled to the RF coil. I have improved signal strength and bandwidth enormously by abolishing the loose coupling, and tapping the co-axial down 2 turns from earth on the sound unit coil, and 1 turn on the first coil of the vision unit (positions found to be best by trial and error).

I now have enough signal to widely stagger the 1355 IF stages and to keep my contrast control turned back, thus avoiding valve noise "graining" which was present before. With a slightly detuned vision oscillator I can just make out the 2 Mcs. bars on test card 'C'
—H. S. Brodribb (St. Leonards-on-Sea).

Neat Wiring

Dear Sir,—Some of your readers may be interested in a 'wheeze' of mine. I enclose a sample. The rings, I think, are for making rabbit snares, and can be obtained from any gun and fishing tackle shop.—J. Smith (Aberdeen).

(*The rings referred to are brass eyelets, as used on shoes, but brass finished. Where a connection has to be made on to a terminal, the wire is twisted round the eyelet, which is then hammered down, resulting in a very neat connection.—Ed.*)

EHT Unit for 7/6

Dear Sir,—Further to the article in the September issue, by H. W. Arundel, the accompanying sketch shows how the need for high insulation on the rectifier heater winding can be overcome, by putting the rectifier on the earthed side of the circuit. One diagram shows the EHT negative 'hot' to ground, and the other EHT positive 'hot' to ground. Both these systems have been well tried out by myself in practice, and are quite satisfactory.—
C. Jenks (Birmingham).

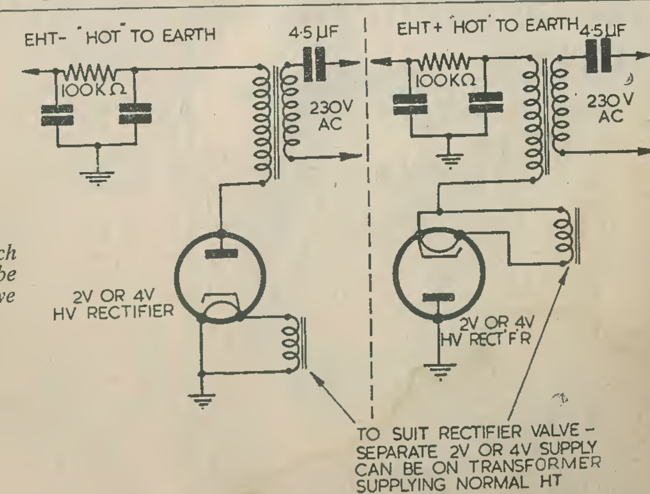
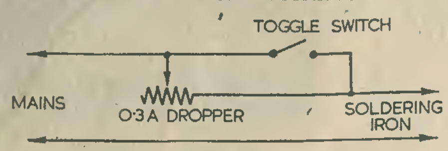


Fig. 1: Two ways in which the EHT rectifier may be connected—see letter above

MB3

SOLDERING IRON CONTROLLER



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by G. R. WILDING

One of the most useful gadgets in my radio workshop is the soldering iron temperature controller illustrated herewith, for in common with my radio colleagues, I frequently use a soldering iron for periods of up to three hours—and this usually means that unless we keep switching it on and off, a most unsatisfactory business, the iron overheats with bad effect on both itself and the soldered joint which it makes.

However, with this gadget, I can maintain the working temperature of the iron at optimum throughout the longest soldering operation, by adjusting the tapping on the resistor, while it in no way impedes initial 'warming-up' since the switch can be operated to short-circuit it out.

The resistor is a standard shrouded 0.3A Dropper, which in my own case was mounted on an asbestos covered 6 × 3 inch electricians block fitted under the bench.

Your Workshop—cont. from P.182

A hand-brace with several well-kept bits is very useful, as are a set of BA spanners; and a chassis-cutter for making valve holder holes is also a sound investment. A pair of tweezers should be obtained, and may be bought in a stronger form in the shape of eyebrow pluckers. In addition one thinks of a hacksaw, a vice (fitted with lead or fibre vice clamps) and all the rest of the tools which experience shows are needed as time goes by.

All these tools represent a fairly heavy outlay and it is usually best to start with the essentials and build up the tool kit with extra items whenever it is possible. Owing to the fact that most wireless jobs are of a "light" character, it is not always necessary to buy expensive tools, those offered by bargain chain stores very often being quite adequate for the work that is to be carried out.