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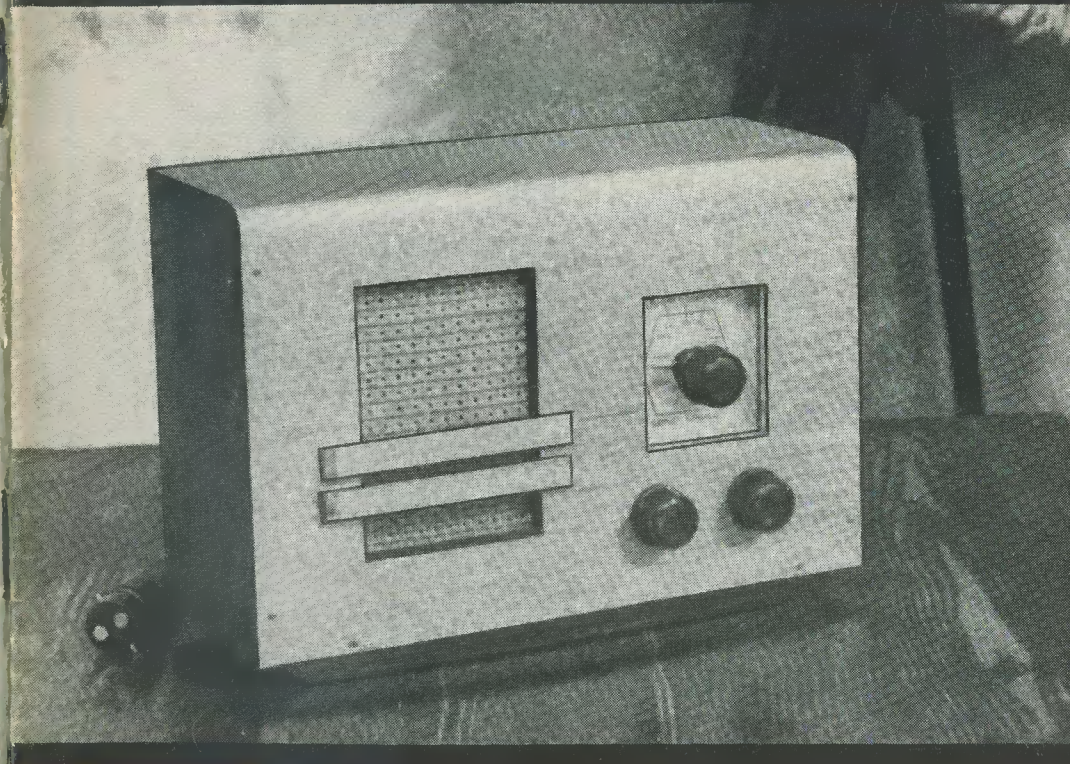
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RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



IN THIS ISSUE . . .

Constant Companion Receiver, Part I • Transportable Electric Gramophone • TV Coils on Aladdin Formers, Part I
 Wire Recording Mechanism • Practical Aerials
 Speech-Operated Switching Circuit • Focus on 144 Mcs.
 Query Corner • In Your Workshop

etc., etc.

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- (1) The International Short Wave League is an organisation of short wave listeners, amateur transmitters, and others interested in short wave radio communication.
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- (3) Membership is open to anyone, of whatever race, creed, or colour, provided there is a genuine interest in short wave radio and a desire to further the aims of the League.
- (4) The membership fee consists of an annual subscription of 2s. 6d., or its equivalent. There is no entrance fee.
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Radio Constructor

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Edited by G. W. C. OVERLAND, G2ATV

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Editorial

Warmer and sunnier weather has at last arrived, with a resultant tendency to daydreams instead of getting stuck into the work on hand—maybe you've noticed it, too?

Our thoughts have drifted to the coming months, and to portable and battery receivers. But wait! Come to think of it, we haven't had a terrible lot of battery designs in these pages. The material we print is a result of that received from readers, in the main. Is it, then, that the battery receiver is no longer so popular?

There are several items which might contribute to this. Most of the ex-WD equipment which has been our main source of supplies has, although often designed to work on low voltages, been equipped with mains-type valves. Then the proportion of people having mains supplies is much greater than it was a few years ago. And again, there is the cost of upkeep. Batteries are very expensive items, these days, and now with the recently announced increase in purchase tax there will be even more bias against them.

But despite all this, you can't cart around a mains set when going off into the country, or other preferred spot, for relaxation. Or is it this last word which is operative? Perhaps we are the 'odd man out'—for we can never seem to get away from 'thinking radio'!

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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. 6 A Speech-Operated Switching Circuit

THIS circuit is capable of switching external circuits, it being actuated by sound picked up by the microphone. It has the advantage of requiring only one valve, this valve carrying out the functions of amplifier, rectifier and relay switching. If a sensitive microphone is used the device should be capable of acting as an efficient "baby-alarm" without any additional amplification. Other applications, such as its use for an automatic "talk-listen" switch with loud-speaking intercom installations, and so on, will also suggest themselves to the experimenter.

Components

The valve used in the circuit may consist of any double-diode-triode, such as the 6Q7, EBC 33 etc.; but it should be pointed out that battery types may not be capable of passing sufficient current to operate the relay. The relay is a high-resistance model which operates at approximately 5 mA. Such relays are often advertised as Government surplus.

Although, of course, the microphone need not be a "quality" component, it should

nevertheless be fairly sensitive and, in addition should cause little background noise. The two variable resistors, R1 and R5, can be chassis-mounting types and will probably need little alteration once they have been set up. R1 adjusts the sensitivity of the device, ensuring that only noises above a certain level will cause the circuit to operate. In cases where this facility is not required R1 may be omitted, the grid of the valve being taken directly to the top of the transformer secondary.

It is important to make certain that the two capacitors C1 and C2 are not "leaky", as the circuit will not otherwise function correctly.

The Action of the Circuit

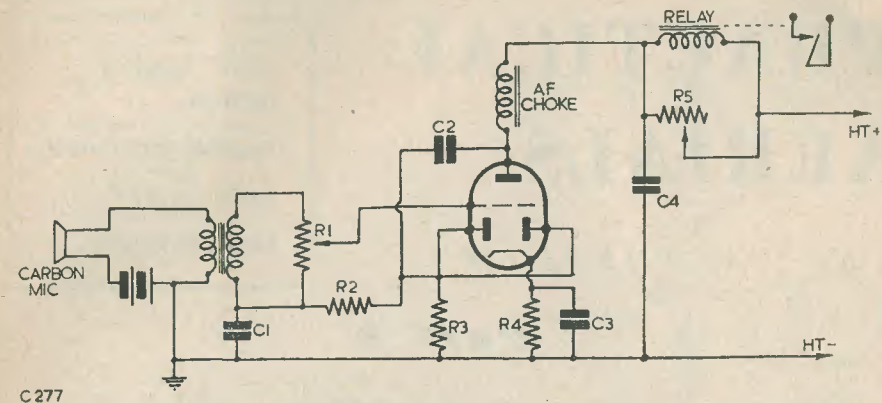
The working of the circuit is fairly simple. The AF voltages (formed by speech or noise at the microphone) are applied to the grid of the triode by the transformer secondary, the earthy end of which is effectively taken to cathode by the capacitor C1. The triode amplifies the AF, the choke forming its anode load. The amplified AF is then passed to the diode which forms a negative voltage (with respect to chassis) across its load, R3. This negative voltage charges C1, via R2, thus applying a bias to the triode section. The anode current of the valve then drops, de-energising the relay and operating its contacts.

When the sound picked up by the microphone ceases, the charge on C1 leaks away through the resistors R2 and R3, bringing the circuit back to its original condition. Altering the value of C1 (or R3) will vary the time taken by the circuit to return to its former state.

The resistor R5 is adjusted such that the relay just closes with the normal anode current of the valve. In this condition the circuit is in its most sensitive state.

DESPITE THE FACT

that we are now printing and distributing many more copies of this magazine, we are still receiving letters from readers informing us that they have difficulty in obtaining regular copies. If details are sent to us, then we can take up the matter with the people concerned. Should this prove ineffective, then we shall be glad to supply copies direct, on either 6 or 12 month subscriptions.



Speech-Operated Switching Circuit.

COMPONENT VALUES

C1, 0.1 μ F	R1, 250 k Ω
C2, 0.01 μ F	R2, 50 k Ω
C3, 25 μ F 25 VW	R3, 2 Meg Ω
C4, 0.1 μ F	R4, 500 Ω
	R5, 10 k Ω

"Radio Constructor"

QUIZ

Conducted by W. Groome

(1) Our dumb friend, Mr. Brain, had a good electric soldering iron which he had often used for quite long, continuous periods. Yet, when he left it on the stand for half an hour without switching off, the element burned out. Why?

(2) A box which completely encloses the back of the loudspeaker cone is sometimes called an "infinite baffle". This description really belongs to a very different form of loudspeaker mounting which, though excellent in many ways, has some disadvantages which make its use very rare. What, then, is a true "infinite baffle"?

(3) Most TV viewers are familiar with the staccato chatter of ignition interference.

Does the performance of the audio system have any influence on the severity of the noise, in any way?

(4) Vehicles powered by diesel engines cause no interference with radio or TV reception. Right or wrong?

(5) Logarithms are (a) electrical measuring instruments (b) mathematical 'tools', (c) degrees of loudness. Which?

(6) Ghost images, slightly displaced from the true picture, are seen by viewers in some areas. Assuming the receiver is blameless, and the viewer sober, what is the most likely cause?

(Answers on P. 376)

PRACTICAL AERIALS

by "AETHERIUM"

Part 9

Aerial Coupling
Methods

Grounded Grid Circuit

Aerial Tuners

Feeder Switching

Aerial Coupling Methods (VHF)

Coupling the feeder to the transmitter or receiver is not just a question of soldering the ends of the feeder to a small coil and pushing this tightly up to the RF circuit. Matching a feeder to a transmitter or receiver is just as important as correctly matching the feeder to the aerial.

Co-axial (or unbalanced) feeders, are usually coupled in to a receiver as shown in Fig. 1. The capacitor C1 is usually 3—30pF and is used to balance out most of the reactance and so obtain a more satisfactory match.

In the case of a receiver using a push-pull RF Amplifier such as a 6J6, it is not easy to obtain a satisfactory match from unbalanced feeder by direct coupling. A far better method is shown in Fig. 2. Dimensions are for the 144—146 Mcs band. The coupling coil L1 consists of two complete turns, the same diameter as L2, and coupled tightly over the centre of the winding. If L2 is air-spaced, the coupling may be made variable, but care should be taken over the adjustment, as maximum noise level is not necessarily the degree of coupling for maximum signal. It may be

that the RF Amplifier will become slightly regenerative as the coupling is loosened. It is, therefore, better to over-couple the aerial coil rather than under-couple.

The Grounded Grid Circuit

The 6J4 and EC91 are now being widely used as RF Amplifiers at VHF. The main reason why the Grounded Grid stage is so efficient is that it provides optimum coupling from the aerial to the receiver, apart from some useful amplification at extremely low noise level.

Co-axial feeder comes into its own again with these input circuits, and Fig. 3 shows two typical GG RF Amplifier circuits with details of aerial coupling.

The input impedance of a grounded grid valve seldom exceeds 120 ohms and is, in fact, usually stated to be the same value as that of the bias resistor. When using 300 ohm feeder, therefore, it is a matter of obtaining a step down from the feeder to the cathode circuit. This may be accomplished by tapping the cathode down the coil as shown in Fig. 4. While this provides a reasonable match, it can be seen at once that the balanced feeder is now

terminated by an unbalanced circuit, which is far from correct. Fig. 4A shows a better arrangement, which is merely the "balun" shown in Fig. 2, in reverse, together with a Transformer section.

Aerial Tuners for Transmission

Aerial tuning circuits are not often used at VHF and for some reason are not usually considered to be necessary. For the experimenter, who is trying out various aerials with different types of feeder, the aerial tuner is a necessity. If constructed on the lines of Fig. 5, the feeders may be clipped on to the hairpin inductance, and any value of feeder may be matched with fair accuracy to the output circuit.

On the LF bands, most amateurs use an RF meter in one or both of the feeders to assist in tuning the transmitter for peak output. This is very bad practice at VHF, except perhaps when wide spaced feeders are being used (2" or more). The space taken up by a meter in 300 ohm feeder represents quite an appreciable part of a wavelength, and an "impedance hump" in a feeder is most undesirable. The best method is to set up a dipole some distance from the beam or stack and, with the aid of a rectifying crystal and microammeter, to carry out adjustments for maximum reading on this meter.

Particular attention should be paid to the balance of the coupling coil to the actual transmitter. Equal amounts of RF must be induced, and the right and wrong methods of obtaining this coupling are shown in Fig. 6.

While it is true that no adjustment to the feeder at the transmitter end will improve the matching to the aerial, a compromise may be effected by simply lengthening or shortening the feeder. The standing wave ratio may be so bad that either the transmitter will not load up at all, or full load will be indicated with very

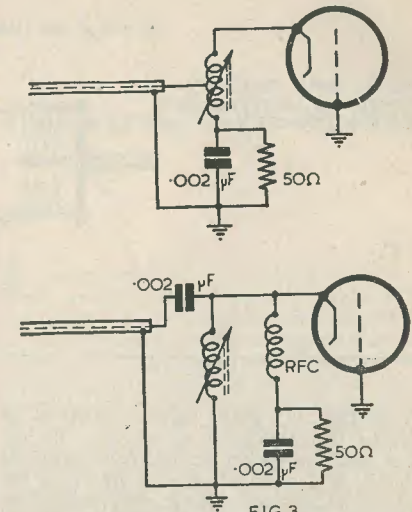


FIG. 3
TWO TYPICAL GROUNDED-GRID INPUT CIRCUITS
C293

loose coupling of the aerial coil. If the feeder is lengthened or shortened until maximum reading is obtained on an absorption meter coupled to a point approximately 34" along the feeder, you will know that a voltage node exists at the coupling coil, and a much better degree of coupling will be obtained. This procedure is, of course, not good practice, as a large amount of radiation is taking place from the feeder, and if possible every effort should be made to improve the matching at the aerial itself.

Feeder Switching

For co-axial type feeders, the co-axia

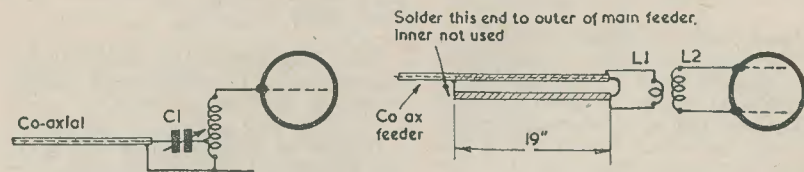


FIG. 1. NORMAL CO-AXIAL CONNECTION
TO RF AMPLIFIER

FIG. 2. CO AXIAL CONNECTION TO PUSH PULL
RF AMPLIFIER

C292

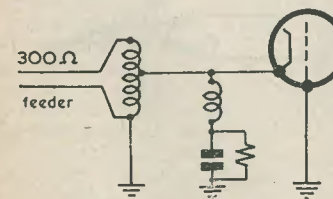


FIG. 4. FEEDING A GROUNDED GRID STAGE
WITH 300Ω FEEDER.

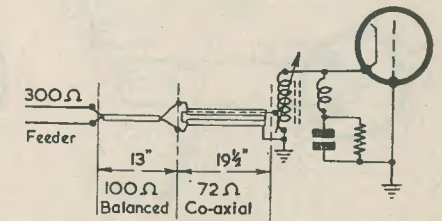
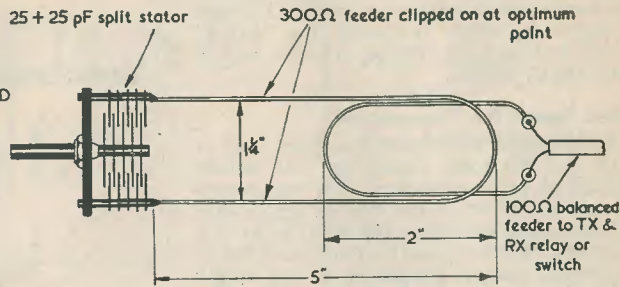


FIG. 4A. IMPROVED METHOD OF COUPLING
300Ω FEEDER TO GROUNDED GRID

C294

FIG. 5. AERIAL TUNER FOR 144-146 Mcs; No. 10 SWG USED FOR INDUCTANCES.



C295

relay is the only really efficient method of switching from transmit to receive. Failing this, a plug and socket arrangement, operated by hand, is a good alternative provided the plugs and sockets are of the correct impedance. For feeders of 300 ohms and higher, the double pole porcelain change-over switch is often used in the absence of a suitable relay. Whether relays or hand switching are used, the contacts should be frequently examined and cleaned to ensure freedom from dust and corrosion.

Summing up, the important points to remember are as follows:—

The co-axial (or unbalanced) feeder should never be coupled to a balanced input or anode circuit.

The balanced feeder should not be directly coupled to an unbalanced input circuit.

For the receiver, it is better to over-couple

than under-couple the aerial.

With push-pull receiver inputs, ensure that the coupling coil is central on the grid coil, and not coupled to one end.

When the feeder leaves the transmitter or receiver, take it by the shortest possible route to the aerial; this applies both to co-axial and spaced feeders.

Do not allow the spaced feeder to drape over metal objects, or run too close to any other wiring. At least one-foot spacing should be aimed at.

Earth the rotor of all butterfly capacitors used on all tuning circuits, including the aerial tuner.

See that the aerial coupling coil is adequately insulated, especially for the transmitter. The presence of high voltage on the feeders can be most unpleasant and *very dangerous*.

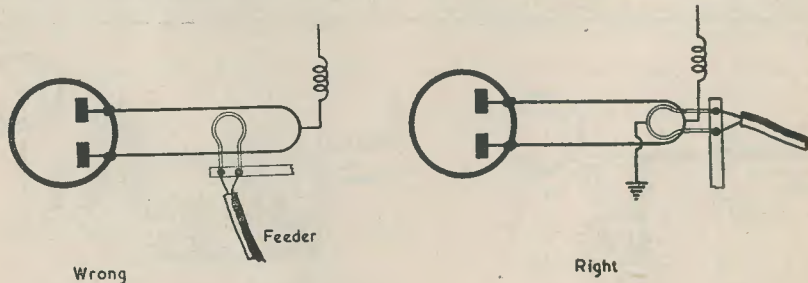


FIG. 6. POSITIONING THE AERIAL COUPLING LOOP TO A PUSH-PULL OUTPUT STAGE

C296

QUERY CORNER

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TV Interference

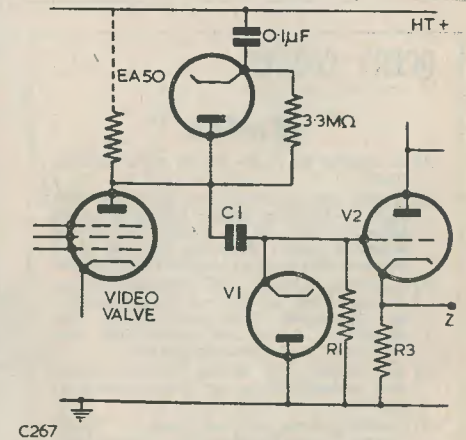
I have built the Inexpensive Television Receiver according to your instructions, and after a few initial adjustments the results obtained are most satisfactory. I am located close to a main road which is between the house and Alexandra Palace, and consequently reception is often marred by car ignition interference. Can a noise limiter be fitted to this receiver?

D. PRITCHARD, N.7.

There are several forms of interference which can prove most troublesome with television receivers, but the two most frequently encountered are those due to car ignition systems and electric motors. Interference from both these sources has a somewhat similar appearance on the viewing screen where it is apparent as a series of white spots, each of short duration and corresponding to individual electrical sparks in either the ignition system, or at the commutator of a motor. Fortunately this type of pulse interference can be readily reduced by the inclusion of a peak noise limiter in the vision channel of the television. A limiter of this type cuts off the short duration noise pulses when they exceed the peak level of the video signal, thus although the noise will still be visible on the screen as very small white dots it will have been reduced from the large white defocussed spots previously encountered. Noise limiters are therefore an undeniable advantage in districts where the signal to noise ratio is average or poor, and the majority of commercial television receivers are fitted with these refinements.

The circuit diagram shown in Figure 1 indicates the video amplifier valve of the Inexpensive Telesvisor feeding the cathode follower output stage. The video valve follows the diode detector and because capacitor feed has to be employed between valves a diode (V1) is used to restore the DC component of the video signal. At the anode of the video valve the signal is positive going, that is, an increase in voltage at this point produces a corresponding white trace on the cathode ray tube screen; thus the limiting circuit must act in such a manner that it limits the positive pulse voltage. The time constant of the

resistance-capacitance combination in the diode circuit has been carefully chosen so that the cathode of the diode remains substantially at the potential which corresponds to peak white on the viewing screen. The diode only conducts on the peaks of the video signal but because of the relatively large time constant in its cathode circuit the current which flows during normal conduction is very small and does not seriously effect the video response. However, upon receipt of a noise pulse the anode of the video valve goes positive and at some predetermined level the limiting diode conducts and the pulse is clipped. The energy contained in the pulse charges the capacitor in the cathode circuit of the diode and as this charge increases so the effectiveness of the limiter reduces. Normally, on single short duration pulses the charge on the capacitor decreases to its average value between pulses, but should a long duration pulse occur the



C267

Fig. 1: Showing a noise limiter connected to the video amplifier of the 'Inexpensive Telesvisor'. The circuit references are those used in the original description of this receiver.

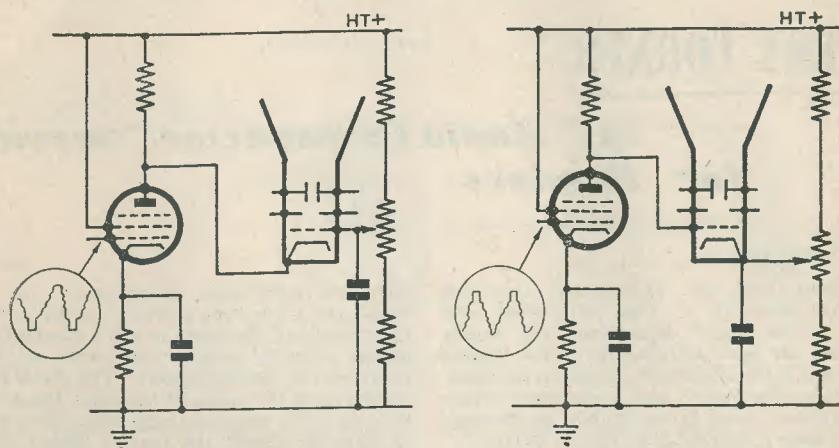


Fig. 2a: Showing cathode modulation of the CRT. Fig. 2b: Showing grid modulation of the CRT.
The inset waveforms are those found at the grid of the video amplifier valve.

limiter will be less effective at the end of the pulse than it was at the beginning. This is no serious disadvantage as most interference occurs as a number of short pulses.

The effectiveness of the limiter may be increased, but with some reduction in the video frequency response characteristic, by reducing the value of the diode shunt resistor

to 2.2 Meg Ω ; this should, however, only be necessary in areas of severe interference. Several different arrangements are possible in the video section of the Inexpensive Television, but whichever is employed the limiter may be connected across the video anode load as indicated in the diagrams.

Cathode versus Grid Modulation

I have noticed that in television receivers modulation of the cathode ray tube is obtained either by means of the control grid or the cathode; what are the relative advantages and disadvantages of the two systems?

W. J. WYATT, Essex.

The main difference between a circuit in which the cathode of the picture tube is modulated and one in which the grid is modulated is the sense of the signal which is handled by the video valve. With cathode modulation the output of the video stage is a negative going signal, that is, one in which a decrease in anode voltage corresponds to white in the picture; whereas with grid modulation the video output must be positive going. The difference between the two circuits will be apparent from Figure 2 which also shows a single line of the video input waveforms. Now in order that the grid voltage swing of the video valve should fall along the straight part of the valve characteristic it is necessary for the no-signal operating point to be at the top

of the curve for grid modulation, and at the bottom for cathode modulation; reference to Figure 3 will show this difference on the anode current-grid voltage curve of a typical high slope video valve.

This curve indicates that with cathode modulation the video valve passes very little current under no-signal conditions, and also should a fault develop in this part of the circuit the cathode ray tube beam will in all probability be cut off, thus protecting the tube against damage. To any constructor who has had to purchase a replacement cathode ray tube this latter point will prove to be an overriding advantage in favour of cathode modulation.

An advantage to be gained by applying the video signal to the grid of the picture tube is that the capacitance across the anode load of the video valve is less than when the cathode of the tube is modulated. However, this is a minor point as it is not difficult to compensate for a falling high frequency response in the video amplifier as a result of this capacitance, by either including a small inductor in the anode circuit or by carefully determining the optimum value for the cathode by-pass capacitor. This latter point is not always appreciated by the television receiver constructor, but it is possible to overcome quite bad 'ringing' or 'pulling after whites' by using the value of video cathode by-pass capacitor which provides the best frequency response. The actual

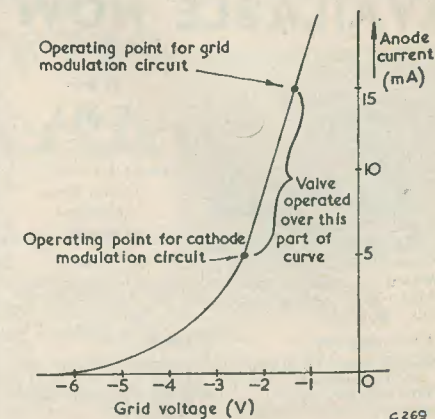


Fig. 3: Anode current-grid voltage characteristic of typical video valve.

value for this capacitor will depend upon the anode load resistor and the amount of capacitance in the circuit. An average value is 820pF, but anything from 500 to 2000pF may be required.

QUERY CORNER

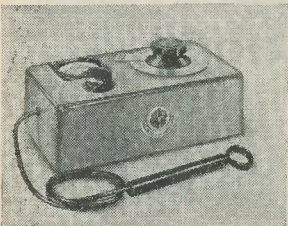
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MAGNETIC Sound Recording

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

Tape or Wire?

SO far we have dealt mainly with tape recording, and the inquisitive reader may well ask, "Why use tape in preference to wire?" So, in this article we shall give, as objectively as possible, a survey of the merits of both systems, so that the reader may decide for himself which will best suit his purposes.

Tape recording was developed during the war by the Germans, whilst wire recording was chiefly favoured by the Americans, and it was not until the war was over and considerable development of both systems had taken place, that the two could be compared. A comparison can well be made under the following headings:—

- Speed.** The standard speed for 50-6000 cps for wire is 2' per second. For tape, the comparative speed is 7½" per sec. Against this, however, must be considered storage space.
- Storage Space.** A standard coil of wire can be accommodated on a 3" spool, and will give up to one hour's play. A standard reel of tape, 7" in diameter, will give only half an hour's play.
- Signal/Noise Ratio.** In the case of wire, this depends on the molecular structure, the surface smoothness, and the equality of diameter of the wire. In the case of tape, the relatively large diameter, i.e., width, of ¼" contributes materially to a greater signal strength. The noise with tape depends also on the molecular structure of the ferric oxide powder and on the wear in the different parts of the

mechanism, plus the smoothness of the surface of the tape.

- Durability of Material.** Wire: A test with more than a hundred thousand playbacks showed no appreciable wear. Tape: Plastic tape can be played back more than 100,000 times before it wears out. Paper tape wears out more quickly, with a life of approximately 10,000 times. The accuracy of the drive mechanism and the smoothness of guides, etc., affect very considerably the life of tape, particularly the paper-base type.
- Programme Editing.** Wire recordings can be altered or improved by erasing and re-recording. Loose ends of wire can be tied together in a knot and will pass the head unnoticed. Tape, on the other hand, can easily be cut and rejoined with plastic cement or adhesive tape. Editing tape recordings is, therefore, much easier. Also, guide marks can easily be made on tape with pencil or ink.
- Atmospheric Influences.** Wire: This does not rust, as it is of stainless steel. It is also quite immune to humidity and temperature changes. Tape: A high humidity and high air temperature may make the loops of tape stick together.
- Drive Methods.** Wire: The smaller diameter of the wire makes a direct drive on the take-up spool possible, but some 'reeling'

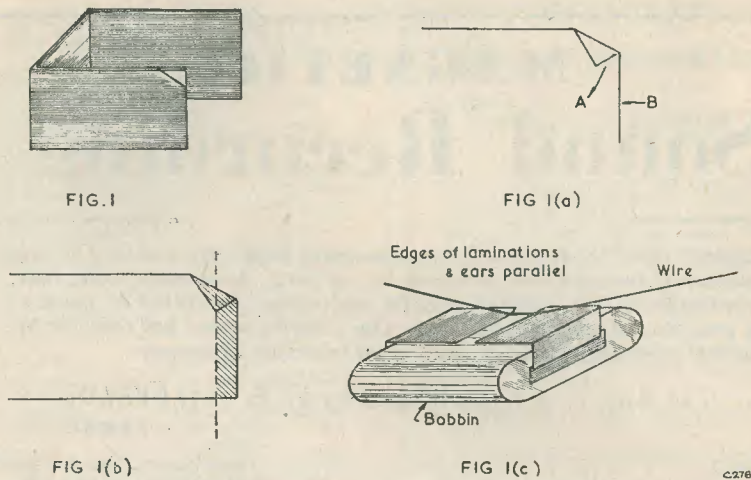


FIG. 1

FIG 1(a)

FIG 1(b)

FIG 1(c)

c.276

mechanism should be provided to lay the wire on the spool in an even manner. Tape: Normally, only capstan drive can be used. Winding on to the take-up spool requires no special provisions.

(h) **Accidents.** An entangled reel of wire can never be dis-entangled. The tangled part thus becomes useless and the recording lost. With tape, tangling is unlikely, and if it occurs the tape can usually be dis-entangled without much trouble.

For the home constructor, one further very important factor must be considered, viz., which is easiest to build? In the writer's opinion, tape recording heads and drive

mechanisms are somewhat simpler. Regarding the question of cost, wire is definitely cheaper than tape. The disadvantage of shorter playing time with tape can be got over by double, or even treble, track recording—this method will be discussed in a later article.

A Practical Simple Wire Recorder

The amplifying system for wire recording can be exactly the same as for tape. For top quality, the equalizing (frequency correcting) network may need to be slightly altered. A manual tone control on the amplifier may provide all the correction necessary.

The output with wire is less than with tape, due to the wire's smaller diameter. The amplification available from the amplifier described earlier is ample to cover the needs of wire as well as of tape.

Some variation in head construction is,

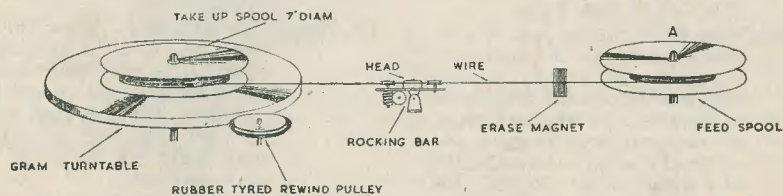


FIG. 2. SIDE VIEW OF MECHANISM

c.279

of course, necessary when wire is being used. The electrical constants, winding details, etc., are exactly the same as for a tape head described earlier in this series. As regards mechanical construction, we proceed as before, folding two pieces of mu-metal into the shape of a square U, so that they can be inserted into the bobbin. This time, however, the surface part of it is folded so as to form a little 'ear' at one corner (Fig. 1). The wire then passes behind these two 'ears' formed on the uppermost laminations. To get a good recording, side 'A' (Fig. 1A) should be parallel with side 'B'. So, after folding the ears, the shaded part, as shown in Fig. 1B, should be cut away and the side is very carefully finished again with fine emery paper. Fig. 1C shows the finished head and the position of the wire. The head itself can be either of the high or low impedance type, of course. A good way of mounting the head is to fix it into an old valve base by means of molten wax. The connections to the winding can be soldered to the valve pins and the whole unit plugged into a valve holder. This method can, of course, be used for mounting tape heads, and forms a most convenient way of changing over from one head to another during experiments.

Drive Mechanism for Wire

With the drive mechanism shown in Fig. 2, the wire runs from the feed spool, along a 'rocking-bar' past the head, and on to a 7" diam. take-up spool mounted directly on to the gramophone turntable. The feed spool is that one on which the wire is bought, and it rotates on a fixed peg, made from a piece of brass rod, suitably placed on the gramophone playing desk. It is usually necessary to introduce some friction to prevent the spool revolving too freely, otherwise the spool will spin round when the gramophone is stopped, with disastrous entanglement of the wire! A piece of felt on a strip of springy brass strip, pressing against the spool, will usually prove satisfactory.

The 'rocking-bar' needs some further explanation. It is provided to reel the wire evenly on to the take-up spool. Some ingenuity is required in order to make it. The principle of operation is that the wire rotates a small pulley, which in turn rotates a worm wheel, and this turns a gear wheel on the axis of which is a small oval cam. On the cam rides a stud, which raises and lowers the rocking-bar, so that the wire is thus fed evenly on to the take-up spool. The tape recorder scores over the wire variety particularly on this point, as, of course, no 'reeling-on' mechanism is necessary with tape. On the other hand, a capstan must be provided for tape, whereas such additional mechanical complication is not needed for

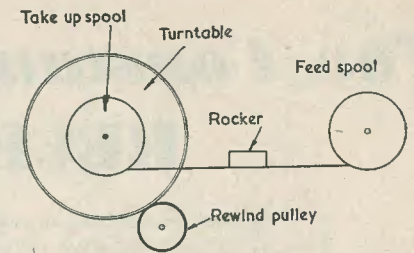


FIG. 3. PLAN OF MECHANISM

c.280

wire. The home constructor will have to use his ingenuity and look around model engineer shops, etc., for suitable parts for this rocker mechanism. Meccano parts may solve the problem, and it is worth investigating the spare parts available from sewing machine shops, as a similar mechanism is fitted to some of these machines for winding cotton on to the small bobbins which go into the "below deck" parts of the machines.

A large 7" spool is necessary on the turntable to get the required speed of 2' per sec. Its top and bottom are covered with felt to prevent slipping on the turntable, and a couple of records or so may be placed on top to add weight and ensure even running.

For re-winding, a small wheel with a rubber tyre is arranged to run against the rim of the turntable. This wheel rotates on a peg, and for re-winding the feed spool (the small one) is put on this wheel, the wire again traversing the rocking-bar. The big take-up spool is placed on peg 'A'. The speed of re-winding depends on the ratio of diameter between the

(continued on P. 376)

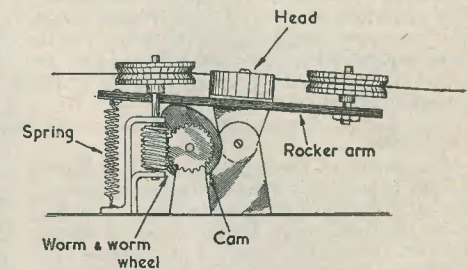


FIG. 4. THE ROCKER IN DETAIL

c.281

The Constant Companion RECEIVER

This article introduces an easily made inexpensive three-valve AC/DC receiver which will prove to be a boon in every household. Despite the extreme simplicity of its circuit, a high degree of selectivity and sensitivity is provided by means of an innovation of the designer—"Progressive Reaction".

Part 1

By J. R. DAVIES

THERE have been, in the past, many requests from readers of the Radio Constructor for details on the building of an O-V-1 receiver. The requirements expressed by our correspondents were that the receiver should be simple to construct, that it be compact, that it should allow a pleasing symmetrical cabinet layout, and that the prototype designed by us should be easy to copy. It was also requested that the finished receiver should give the best possible quality commensurate with good sensitivity and selectivity; and, as several readers pointed out, that the controls should be simple to operate without the necessity of continually fiddling with reaction, etc., whilst the set was being tuned.

These requirements constituted a fairly tall order, particularly when one realises that the amplification available from a two-valve circuit is necessarily limited. Nevertheless, after a certain amount of experimental work, we have now produced a set which meets these requests adequately and fully; and we are happy to present the finished receiver—"The Constant Companion".

The Circuit

The circuit of the receiver, which is shown in Fig. 1, is quite simple and straightforward. The set is designed to operate from AC or DC mains, a third valve being added to act as rectifier. Detection and amplification are carried out by a triode and pentode respectively, the former being used as a leaky-grid detector. The receiver works on medium and long

waves and, by means of what is described as Progressive Reaction, is in its most sensitive condition at very nearly all points of the dial. This reaction circuit is pre-set and needs no alteration once it has been originally set up, the only controls on the front panel being those for wavechange, tuning, and volume and on-off switch combined. Because of this, the set may be operated by the least technically-minded of listeners, reaction remaining in its position of optimum adjustment all the time.

As may be seen from the photographs, a symmetrical panel layout is adopted, thus enabling the receiver to be housed in a well-designed cabinet. A comparatively large speaker is used, this being chosen purposely to allow the best possible quality; but the layout and overall dimensions are such that a small and compact layout is obtained.

The heart of the receiver, its coils, presented a difficulty since most commercial coils did not quite meet the requirements necessary for the aerial coupling circuit used. However, it was found possible, after suitable modifications, to employ coils from the Wearite "P" range and these have been used in the final design.

It had, at first, been intended to use a pentode as detector in this receiver. Unfortunately, the necessity for good reaction vetoes the use of an anode-bend circuit; and it is very difficult to work a pentode with zero grid bias (as would be necessary for a leaky-grid circuit) without incurring a heavy screen-grid current. A triode was therefore finally used,

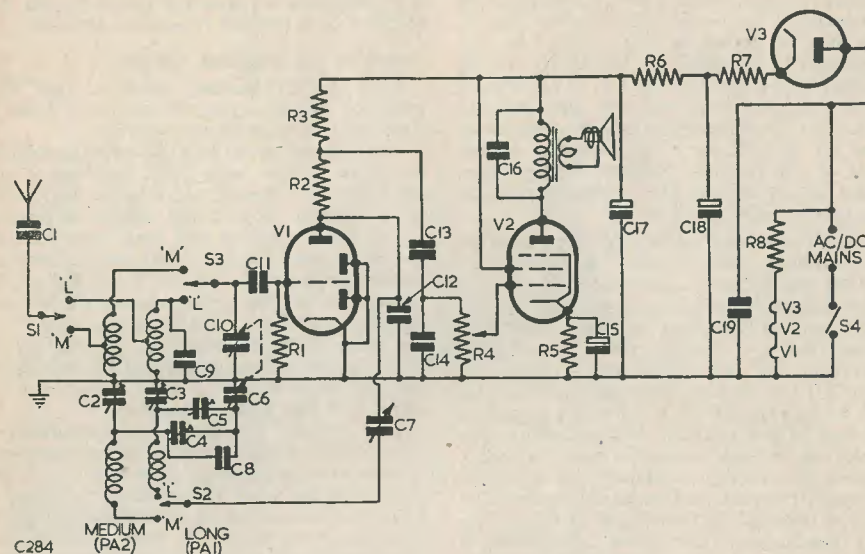


Fig. 1: The complete circuit of the receiver.

List of Values

Capacitors

- C 1 — 0.005 μ F, 750VDC working
- C 2 — 250 pF trimmer
- C 3 — 60 pF trimmer
- C 4 — 60 pF trimmer
- C 5 — 60 pF trimmer
- C 6, C 10 — 500 pF, two-gang
- C 7 — 300 pF reaction, solid dielectric
- C 8 — 200 pF
- C 9 — 100 pF
- C 11 — 300 pF
- C 12 — 200 pF
- C 13 — 0.01 μ F
- C 14 — 500 pF
- C 15 — 25 μ F, 25V working
- C 16 — 0.005 μ F
- C 17 — 16 μ F
- C 18 — 8 μ F
- C 19 — 0.01 μ F 750VDC working

Resistors

- ($\frac{1}{2}$ watt unless otherwise stated)
- R 1 — 500 k Ω
- R 2 — 10 k Ω
- R 3 — 150 k Ω
- R 4 — 250 k Ω (with switch)
- R 5 — 620 Ω , 1 watt
- R 6 — 2,000 Ω , 2 watts
- R 7 — 120 Ω , 5 watts
- R 8 — 960 Ω (3-way line cord)

Switches

- S 1, S 2, S 3 — Wave Change
- S 4 — On-off, combined with volume control

Valves

- V 1 — EBC33 (or VR55)
- V 2 — EL32 (or VT52)
- V 3 — CY31

and the results obtained confirmed the practicability of the choice.

The Reaction Circuit

Mention has been made above of the reaction circuit. This has been called "Progressive" reaction by the writer and, although he wishes to make no claims for the originality

of his circuit, so far as he is aware it has not been used in any receiver before, nor has he seen it previously mentioned in the journals devoted to radio construction.

It would therefore be helpful, in this introductory article, if we devoted some space to the functioning of this circuit. To explain its

working it would assist us also if we first of all considered a conventional reaction circuit, such as that shown in Fig. 2 (a). In this diagram, L1, C1 make up the tuned circuit, feedback being supplied by L2. The amount of feedback is regulated by the reaction capacitor C2. This circuit is quite practicable when C1 and C2 are both mounted on the panel of the receiver, because C2 can then always be set to give the optimum reaction required for each setting of C1.

As we mentioned earlier, however, reaction is a fiddling business, and a present-day receiver would not be appreciated at all by a non-technical listener if he found that he had to be continually making the fine adjustments necessitated by the reaction control. To overcome this, an improvement might be effected if the reaction were made pre-set, C2 then being replaced by a trimming capacitor mounted in the chassis. Unfortunately, this would not provide a really useful solution, because the reaction capacitor setting would not remain constant at all points of the dial. In practice, it would be found that as C1 of Fig. 2 (a) is adjusted to give more capacitance, it would be necessary to continually increase the value of C2 to keep the circuit just below oscillation point.* Thus, while the set would be in its most sensitive state at the high-frequency end of the dial, at the other end reaction would be almost non-existent and sensitivity consequently very low. Fig. 2 (b) shows the requirements of a typical reaction circuit under fairly ideal conditions.

The results illustrated by the curve of Fig. 2 (b) would be useless in a receiver such as the "Constant Companion", where the limited amplification available necessitates reaction being just below oscillation point all the time. At the same time, it is still very desirable to have pre-set reaction in order to simplify the procedure of tuning.

The obvious answer to this problem is to use some form of pre-set reaction, in which the feedback capacitance increases automatically as the tuning capacitor is turned towards the low-frequency end of the band. This can be done by the circuit of Fig. 2 (c). In this circuit, two additional capacitors in series, C3 and C4, are connected across the main feedback capacitor C2 (which may now be pre-set.)

It will be seen that, since C4 is ganged to C1, its capacitance may be made to increase as that of C1 increases. To limit the increase in capacitance of C4 to the amount required to maintain reaction, the trimmer C3 is connected in series with it, this trimmer being adjusted to allow just sufficient increase in reaction capacitance as the tuning capacitor is rotated.

In practice, C1 and C4 could be the two sections of a normal two-gang capacitor.

Switching the Feedback Circuit

Such is the functional basis of the "Progressive" pre-set reaction circuit as used in the Constant Companion receiver.

To bring the circuit into line with the requirements of a two wave band receiver, it will obviously be necessary to employ some form of switching. Fig. 2 (d) shows a possible circuit for a medium and long wave receiver. In this diagram, S1, S2 and S3 are sections of a wave-change switch, whilst C1 and C6 are the two gangs of the tuning capacitor. On the medium wave band it will be seen that C2 is the main feedback capacitor, C4 limiting the effect of the increasing value of C6; whilst, on the long wave band, C3 and C5 carry out the same two functions respectively.

The switch S3, however, introduces a complication which is not really necessary, and it may be eliminated as shown in Fig. 2 (e). This does not alter the incremental effect of C4, or C5, with C6 at all, because, although the capacitance networks of both medium and long wave feedback circuits are now connected together, the effect of one upon the other is only that of a fixed capacitor. For example, let us presume that we have set up the medium wave trimmers, C2 and C4, for optimum results whilst keeping C3 and C5 at minimum capacitance. We then set up C3 and C5 to give correct reaction on the long wave band. On switching back to medium waves again, we will find that this has put an additional capacitance across C2 and C4 in series. This additional capacitance (which in practice is only small) may be balanced by slight readjustments of C2 and C4 again. The elimination of switch S3, therefore, helps considerably in simplifying the wiring, and introduces only a little extra complication in the setting-up procedure.

Varying HT Voltage

It must finally be remembered that the particular receiver which we are discussing, the "Constant Companion", is an AC/DC model which may be connected to sources of supply varying from 200 to 250 volts AC or DC. It will follow, therefore, that the HT supply in the receiver will itself vary by fairly large amounts, possibly altering the amount of reaction feedback required. In addition, owing to the tight aerial coupling employed, the type of aerial connected to the receiver may also slightly affect the reaction. To

* This is, of course, due to the fact that, by increasing the value of C1, the LC ratio of the tuned circuit is decreased, therefore reducing its efficiency and necessitating further feedback.

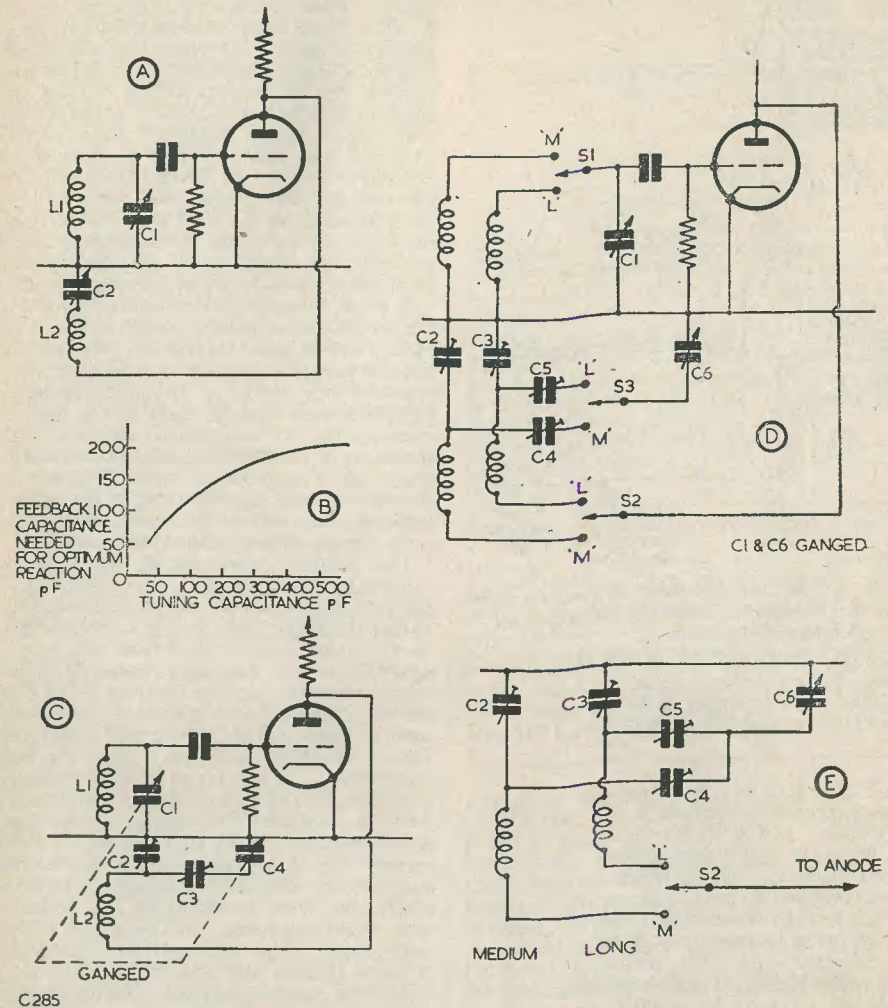


Fig. 2 (a): A simple reaction circuit.

Fig. 2 (b): A curve illustrating feedback capacitance against tuning capacitance under average conditions.

Fig. 2 (c): A form of pre-set reaction which allows the feedback capacitance to be increased

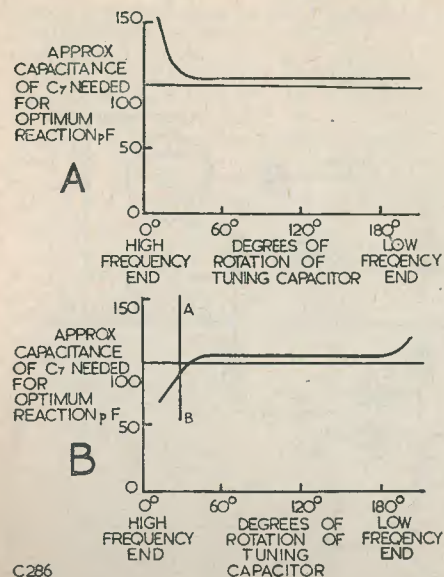
in step with the tuning capacitance.

Fig. 2 (d): A switching circuit which would make Fig. 2 (c) suitable for a two-band receiver.

Fig. 2 (e): Illustrating how S3 of Fig. 2 (d) may be eliminated.

overcome these effects another capacitor (C7 of Fig. 1) is connected between the anode of the detector and the arm of S2, (Figs. 1 and 2 (e)), this capacitor being mounted at the rear of the chassis and provided with a knob.

When the receiver is being originally trimmed it is connected to a source of supply and a typical aerial system, the capacitor C7 then being set arbitrarily to a point giving about one-third full capacitance. The trimmers (C2



C286

Fig. 3 (a): The results obtained on medium waves with the Progressive Reaction circuit fitted to the "Constant Companion".

Fig. 3 (b): The results obtained on the long wave band. By connecting a fixed capacitor across the long wave grid coil, only that part of the curve to the right of the vertical line AB is used.

to C5 of Fig. 2 (e), are then set up to give correct feedback, whereupon the trimming is completed. It will not be necessary to touch the trimmers again; but, should the receiver be connected to, say, a mains supply which has a considerably lower voltage, the capacitor C7 can be slightly increased to bring the whole circuit up to its correct working point again. On the other hand, if the receiver is connected to a mains supply of higher voltage, then the value of C7 may be slightly decreased to prevent the receiver oscillating. C7 will, of course, vary the entire reaction effect simultaneously on both medium and long waves.

Putting it briefly, the only reaction adjustment necessary in this receiver consists of slightly altering C7 when the receiver is connected to a mains supply or aerial system differing greatly from that on which the set was originally adjusted; and even then this very simple adjustment has only to be carried out once.

The Reaction Circuit in Practice

So much for the theory side of the reaction

circuit. How does it work in practice?

When it was tried out experimentally, it was found that the circuit worked very well indeed. It is obvious that the increments in capacitance required by the feedback circuit will not vary proportionately with the corresponding increases in tuning capacitor value. Nevertheless it was found that, over at least 150 degrees of rotation of the tuning capacitor on the medium wave band, and for about the same amount on the long wave band, (using modified "P" coils), the circuit worked almost perfectly. In both cases, the discrepancies occurred at the high-frequency end of the band.

A curve representing the results obtained on the medium wave band is shown in Fig. 3 (a). Here it will be seen that reaction "falls off" for the first twenty degrees or so of rotation, stays constant over nearly all the band and begins to reduce very slightly again at the low frequency end. It was found that the slight reduction at the low frequency end caused no loss at all in selectivity or strength of any but the very weakest signals; whilst at the extreme high frequency end selectivity was reduced and weak signals suffered noticeable attenuation.

The medium wave circuit, fitted to the "Constant Companion", was tested on a fairly inefficient outside aerial (approximately 15 feet at a height of 12 feet) in a screened area on the South Coast at night time; this being a situation where European transmitters are usually stronger than BBC stations (apart from the West Home transmitter) and where many superhets have difficulty in getting clear reception of the BBC (again apart from the West programme). It was found possible to receive a large number of European stations (including AFN) at comfortable volume with surprisingly good selectivity, most of the stations being entirely free of adjacent channel interference, and three or four BBC regional transmitters; whilst the West transmission (in company with several European stations) came in very well indeed. This was extremely gratifying since the receiver had originally been intended mainly for reception of local stations only.

These good results were, of course, entirely due to the presence of reaction, and proved that the "Progressive" circuit employed was efficient and practicable. It must always be remembered that the "Constant Companion" receiver employs only one tuned circuit!

The Long Waves

On the long wave band the results obtained with the pre-set reaction circuit were also quite good. However, it was found this time that, although the reaction once again "held" over most of the dial, this time it went over the oscillation point at the high frequency end. Fig. 3 (b) shows the results obtained.

This may be due to the fact that the coupling coil on the long-wave "P" coil (as with the medium-wave coil) has rather a large number of turns for reaction purposes. Some of these turns were removed on the medium-wave coupling coil but this was not done on the long-wave coil as it would only have introduced unnecessary complication in construction.

It was decided in this case, therefore, to "remove" the offending part of the curve of Fig. 3 (b) by simply connecting a fixed capacitor across the long-wave tuned coil. Although this would have the effect of reducing the coverage of the long wave band, the reduction was not sufficient to cause any loss in entertainment value. As connected, the long wave band in the "Constant Companion" covers approximately 1225 to over 2000 metres; thus allowing reception of Radio Luxembourg in addition, of course, to the "Light" programme on 1500 metres.

Using the aerial described above, it was found possible to receive these two stations at fairly good volume, whilst a later trial with a better aerial caused them both to be received very well indeed.

The Complete Receiver

Readers will have noticed that this introductory article has concerned itself mainly

with the reaction and tuning circuits used in the receiver. This is, of course, necessary owing first of all to the fact that an unconventional scheme has been used in order to get the best possible results from a circuit of limited amplification, and secondly because the rest of the set is fairly straightforward and needs little comment.

It must also be appreciated that, with a receiver like this which employs (apart from the rectifier) only two valves, the volume obtained from the speaker depends entirely upon the signal voltage fed to the set from the aerial. In most localities the receiver should work quite well in, say, a first-story bedroom with ten to fifteen feet of wire laid around the room;* but in other places it may perhaps be necessary to use a reasonably good outside aerial. It is, of course, impossible to lay down hard and fast rules about this as it depends so much upon local conditions.

In next month's article we shall pass on to the practical side and start on the construction of the receiver.

* In several cases tested, the bed springs themselves made an excellent aerial!

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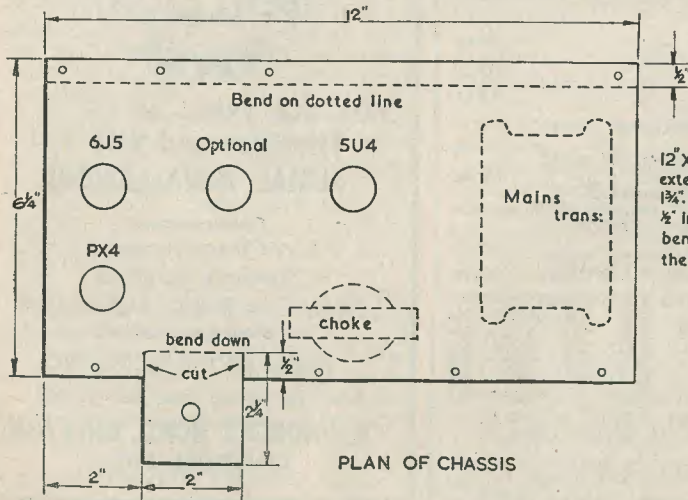
By VINCENT HILL

THE chief purpose in making this transportable electric gramophone was that it could be placed on a stool and operated from an armchair. The writer possesses a push-pull amplifier feeding a 12" speaker in a home-made corner baffle unit and, though the quality of reproduction is quite good, the effort of getting up every few minutes to change the record becomes very irksome. Though a playing desk would suit this particular form of laziness quite well, it was decided to go the whole way and add an amplifier and loudspeaker, in order to make the unit quite self-contained and therefore usable in any room.

Quality of reproduction was the chief aim in designing this gramophone and, in consequence, no attempt was made to restrict weight.

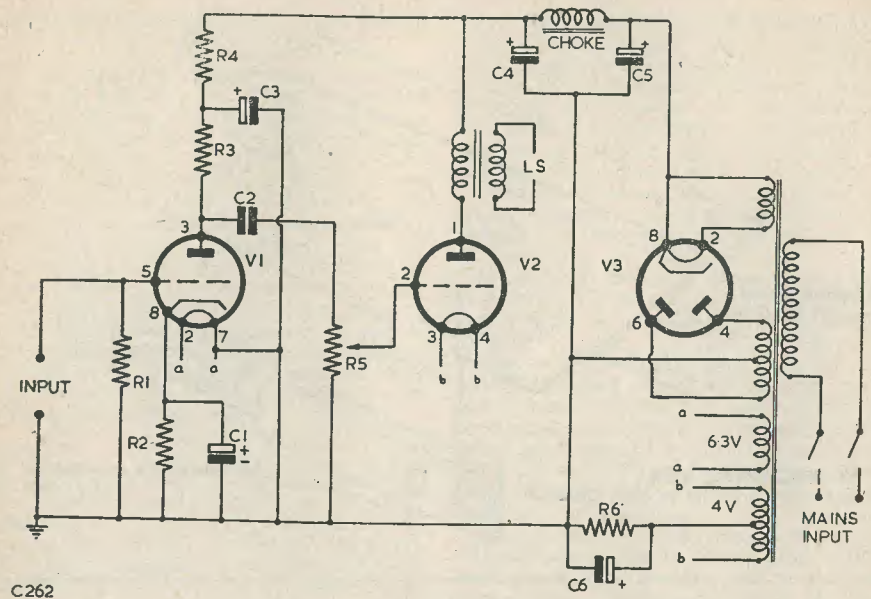
The Case

What is required is a box to hold the loudspeaker, the gramophone motor, the pick-up and the amplifier, with a built-up lid to close down on the box. There must, of necessity, be a certain amount of constructional work involved, but this has been reduced to a minimum. With wood in short supply, the writer utilized a soap or margarine box bought for a shilling from the grocer. This was by no means an elegant affair, but it was of reasonably strong construction, and was quite square. This box was very thoroughly sandpapered, both inside and out, until the wood was silky smooth under the hand. The external measurements are $19\frac{1}{2}" \times 13\frac{1}{2}"$ wide \times 8" deep, and the reader should either make or obtain a



PLAN OF CHASSIS

2254



Circuit of the Amplifier.

Component Values

R1, 500 k Ω
R2, 3k Ω
R3, 50k Ω
R4, 10k Ω
R5, 500 k Ω pot
R6, 850 Ω
C1, 6, 50 μ F 12V
C2, 0.1 μ F
C3, 4, 5, 8 μ F 350V

Choke, 20H 100 mA
Mains transformer,
Secs: 250-0-250V 80 mA
6.3V 1A
4V CT 1A
5V 2A
V1, 6J5 or equivalent
V2, PX4 " "
V3, 5U4 " "

box of similar size. The lid is easily made of strip wood $1\frac{1}{2}"$ wide \times $\frac{1}{2}"$ thick. This is simply cut to the desired lengths, and nailed and glued together. The top is a piece of $\frac{3}{8}"$ thick plywood and this is also nailed to the framework, using thin $\frac{1}{4}"$ panel pins for the purpose. Provided the built-up lid fits snugly and flatly upon the box, nothing else is necessary except the final fitting of hinges when everything has been tested.

internal measurement of the longer side of the box.

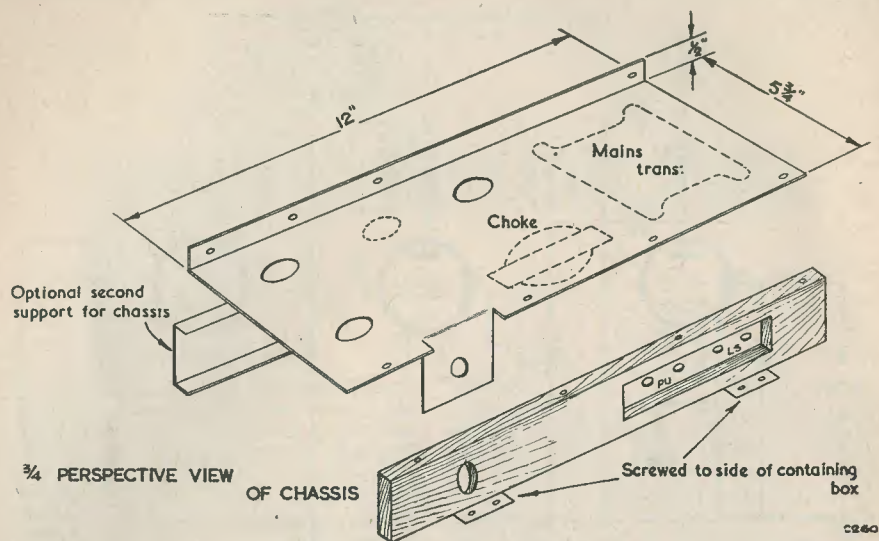
The writer used a double spring motor bolted to two thin strips of wood, the whole simply slung across the ledges and screwed down. The strips of wood were about $\frac{1}{2}"$ square, and were used in preference to a solid motorboard in the interests both of vibration and ventilation.

Assembly

Inside the box, 2 strips of wood about $\frac{1}{4}"$ thick are screwed along the longer length at a depth of $2\frac{1}{2}"$ from the top. The width of these two strips of wood does not matter, since their purpose is to act as ledges to carry the gramophone motor and the pick-up mounting; the length should be about 3" shorter than the

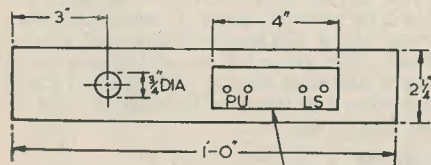
A glance at the plan of the interior of the box will indicate the disposition of the components; the loudspeaker is at one corner of one end, then comes the motor, then the pick-up mounting board and the amplifier.

The loudspeaker may as well be screwed into place as soon as the required fret-hole is made,



but the motor holding-strips and pick-up mounting board should not be screwed to the ledges until their final position is ascertained by practical experiment. With the measurements given, and using a 12" turntable, there is about 1" of latitude.

There is no reason why an electric motor should not be used, but the use of electric or spring motors must depend upon what type the reader has on hand. If a spring motor be used, the hole for the winding handle must be carefully ascertained. The motor should be positioned so that this hole faces the operator, with the speaker to the left and the amplifier to the right.



THIS RECTANGULAR PIECE CUT OUT. PAXOLIN STRIP SCREWED UNDERNEATH WITH PICK-UP & LOUD SPEAKER SOCKETS

The winding handle, when not in use, is simply slipped into a hole in the pick-up mounting board, the hole being placed quite close to the edge in such a position that the handle fouls neither the pick-up nor the output valve of the amplifier; alternatively, it could be clipped into the lid.

The pick-up mounting board is simply a piece of wood about 2" wide and 1/4" thick, its length dependent upon the internal width measurement of the box. The exact fitting of the pick-up will depend upon the type used; in all probability a hole will have to be drilled to take the pick-up leads. The pick-up should be so positioned that its needle, when swung over the turntable towards the centre pin, extends about a 1/4" beyond that pin. This slight overlap ensures rather better tracking.

The Circuit

A glance at the amplifier circuit will reveal its very simple nature. It is not worth while including bass and top cut controls unless the user has a particular desire to fiddle with musical emphasis. The use of the PX4 demands a mains transformer of a type not found usually in the junk box. (See below).

The Pick-up

The circuit shows a two-stage amplifier, which is quite adequate for a crystal or magnetic pick-up. The writer, however, now uses a moving-coil pick-up, with matching input transformer, and this has necessitated adding

another stage of amplification. There is room enough on the chassis for this extra valve.

If the reader is contemplating buying a pick-up, he will be well advised to give the matter some thought before making the purchase. The moving-coil type is probably the best, but—and this is important—the difficulty is to get that 'best' into the amplifier and out of the loudspeaker. There is no doubt that the extra amplifying stage introduces more hum, and this is difficult to eliminate. Also, the wide frequency range, which looks so attractive in theory, does in practice include so much extra surface noise that the question arises as to whether the higher frequency range is worth the higher scratch level. These are points which the reader must decide for himself, but, whichever pick-up is obtained, it should be of the modern lightweight type.

General

As before mentioned, the mains transformer in this amplifier is not a standard type, inasmuch as it has both 4V and 6.3V windings as well as that for the rectifier. Several manufacturers make such a transformer, however, and there should be no undue difficulty in obtaining one.

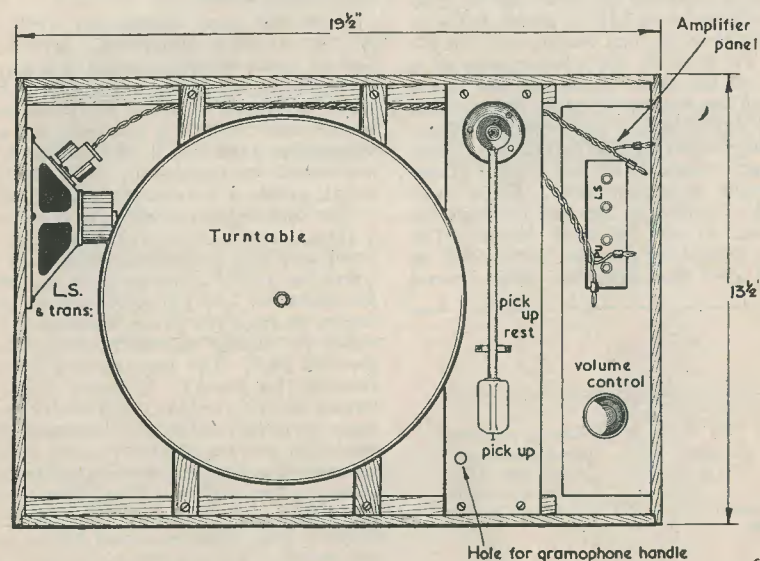
The construction of the amplifier chassis is very straightforward, it being merely a panel of aluminium screwed on to a strip of wood.

The actual shape of the aluminium panel should be noted from the plan, since the side holding the volume control is not regular. The connections to the pick-up and loudspeaker are made by plugs and sockets. A long rectangular hole is made in the strip of wood to accommodate a piece of paxolin sheet which holds the sockets. The advantage of this method of connection is that any alternative type of pick-up or loudspeaker can be used with ease. The amplifier is screwed to the bottom and side of the box.

In the lid a wooden 'U'-shaped stay is fixed. With the lid closed, this stay fits down on the pick-up arm, so preventing it from swinging about.

The carrying handle should be of stout construction and should be attached to the case by bolts. Hinges and fastening clips can be obtained quite cheaply. The twin flex to the mains point should be of adequate length, since it is annoying to be tied down to one particular spot in the room—4 yards should be regarded as a minimum.

The case can be either painted or covered with imitation leather cloth. The writer's was painted cream outside, with a contrasting colour inside. The sound quality was very good for an instrument of this nature, and well repaid the little amount of trouble to make it.



LOOKING DOWN AT DISPOSITION OF PIECES

FOCUS on 144 Mcs. . . .

Part 4

by H. E. SMITH, G6UH

The Aerial
The 'Yagi' Beam
The Stack
Feeders

The Aerial

The aerial is often considered to be the most important factor of VHF work. An efficient aerial feeding a poor receiver, however, will not produce such good results as a poor aerial feeding a good receiver, but that is by the way. The aim, for serious work, must be to obtain a high-degree of efficiency on both. Beginning with the simple dipole, this is literally the worst type of aerial to use on 144 Mcs, as so much of the energy is wasted in radiation at high angles. It is a suitable aerial for cross-town contacts and field strength measurements, and extremely simple to instal owing to the small dimensions it attains on this band. Two pieces of 1/2" dural tube 19 1/2" in length fed with a length of 50 to 60 ohm feeder, and the job is done. To improve the performance of a dipole, as on the other bands, we can add a reflector and one or more directors, thus turning the simple dipole into a multi-element beam. Before going further into the details and dimensions of such beams, there are several points which should be remembered. Dural tube of 1/2" to 5/8" diameter is the best material for the beginner to use for VHF beams. The open ends should be plugged with wood or putty, and after final assembly, given several

coats of paint or lacquer. Larger sizes of tube mean more difficulty in tuning up, as the lengths will be abnormally affected.

It is preferable to use balanced feeder systems, but if co-axial feeder is used, fit a "balun" (See various handbooks) Fig. 1. Never use cheap or "lossy" feeder; always obtain loss figures before purchasing. Any co-axial or screened feeder with a loss figure greater than 3dB per 100-ft. at 144 Mcs is unsuitable for efficient operation.

Spaced feeders or 300 ohm ribbon type feeders are recommended wherever possible.

The "Yagi" Beam

Much has been written on VHF Aerials. All the Amateur Handbooks devote a great deal of space to beam aerials and arrays, but the question of tuning up a simple beam is either dismissed in a few sentences, or some complicated procedure involving the use of a transmitter is described. It is, in fact, virtually impossible to successfully tune up a beam aerial, unless a transmitter is available.

The keen listener, wishing to construct, say, a three element beam for reception only, is faced with this problem. He can, of course, enlist the aid of a transmitting amateur at a fair distance, and persuade him to leave his carrier on for a few hours, to provide a steady signal for tuning up the beam to maximum forward gain. The alternative is to study the various Handbooks. In many cases, calculations given in the Handbooks for constructing beam aerials do not agree. As a case in point, the writer was approached recently by a fellow amateur who had, by following the calculations given in four different Handbooks, obtained four different answers! The lengths for director and reflector varied by as much as two inches. This discrepancy is not so important where the elements for a bi-directional stack are concerned, but in the case of a three

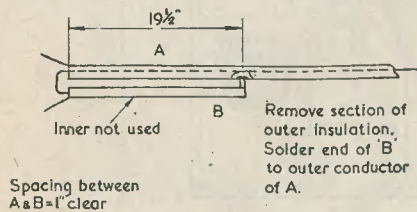


FIG. 1. 'BALUN' FOR COAXIAL FEEDER

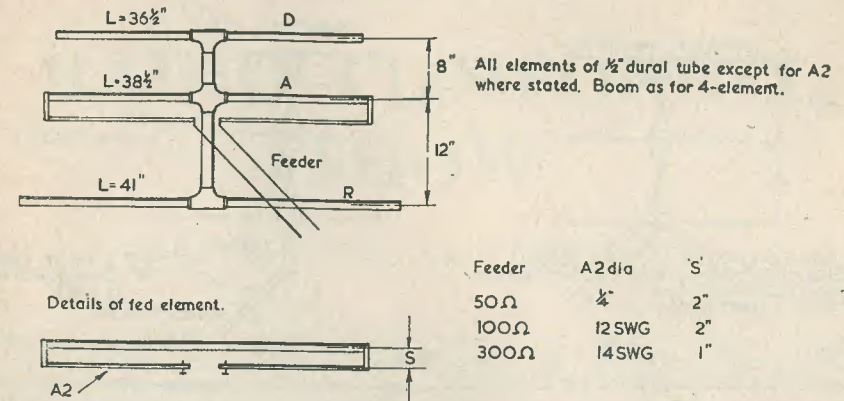


FIG. 2. 3-ELEMENT CLOSE SPACED 144 Mcs BEAM

or four element "Yagi" type beam, it is serious, as this aerial relies on critical resonance for optimum performance.

Having in mind the above difficulties, it is felt that a few dimensions of beam aerials for 144 Mcs might be welcomed. These aerials are shown in Figs. 2 and 3. If constructed exactly to the dimensions and spacing given, no final tuning up will be necessary, and they will give an excellent performance, provided

they are erected outdoors, at least 25-ft. high, and well clear of gutter-pipes and similar objects.

We now have an aerial that works, and it is connected up to the converter—but what happens now? We can only hear stations from the direction in which the aerial is pointing, and, if we are keen listeners, we shall have to rotate the beam every few minutes in order to find out what is coming through from

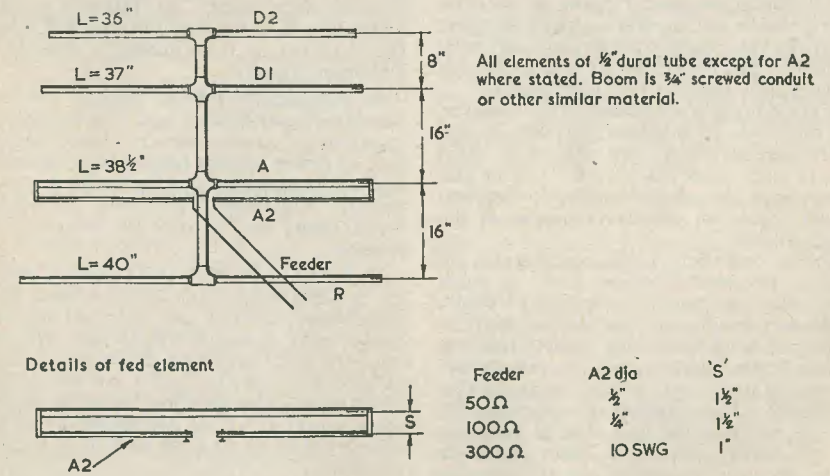
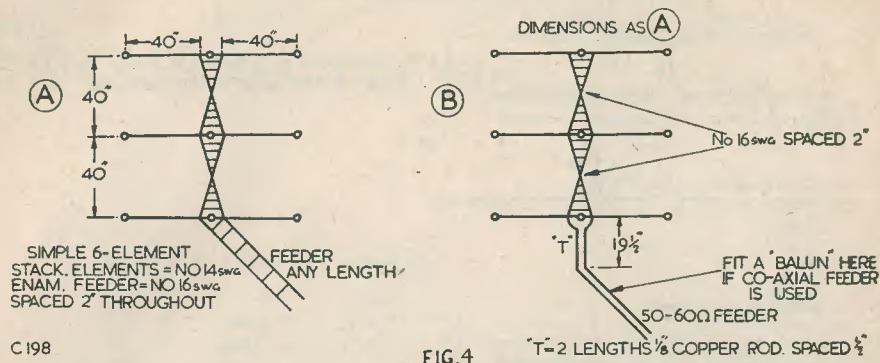


FIG. 3. 4-ELEMENT 144 Mcs BEAM



other directions. The beam width of a normal four element "Yagi" is at least 6dB down for 6 to 8 degrees. In other words, half of the received signal will be lost for a rotation of only 3 to 4 degrees. What is the alternative? Let us see what the stacked array will do.

The Stack

Many amateurs have changed to the stacked array type of aerial, and most are reporting favourably on its performance. Let us look at its disadvantages first. Due to its broad azimuth or horizontal beam, it is particularly susceptible to car ignition and other forms of local interference.

Its sharp elevation pattern (approximately 11 degrees from the horizontal) makes it a particularly disappointing aerial when "Sporadic E" conditions exist. Some of the DX stations, which are usually received at great strength during these conditions, are practically inaudible on this type of aerial, due to the fact that the signals arrive at very high angles.

The advantages of a stacked array, however, easily outweigh the disadvantages and if, say, two six element stacks are erected at right angles to each other (each with its front and rear coverage of approximately 45 degrees) you will obtain an effective coverage of the whole horizon.

The low radiation angle concentrates all energy in the useful direction, and it is much easier to feed and match into than the "Yagi". The element lengths are not critical, and for normal 144 Mcs conditions (apart from the Sporadic E conditions, which are rare) it will out-perform any "Yagi" with the same number of elements. The addition of reflectors will, of course, increase the gain, but at the same time will narrow down the beam width, so that it becomes necessary to use rotating mechanism.

Dimensions and methods of feeding a simple six element stack are given in Fig. 4.

Height is the thing to strive for, whatever type of aerial you decide to use. Every foot counts, and in one particular case it has been proved that an additional section of only four feet has made all the difference, and certain stations previously inaudible are now consistently received.

Feeders

Feeding a beam or a stacked array does not present any great difficulties, but a careful study of any good Handbook is essential, if one wishes to avoid a mis-match, and consequent high standing-wave ratio. A high standing-wave ratio means, of course, that a large amount of the RF energy is being wasted before it reaches the aerial, or in the case of an improperly matched receiving aerial, before it reaches the receiver. So, however good the aerial may be, it must be correctly fed, whether for receiving or transmitting, if one expects maximum results.

A standing-wave ratio of 2:1 or less is considered satisfactory, and this is fairly easy to achieve if care is taken in using the correct type of feeder. (This takes into consideration that the impedance at the feed point is correctly known. Matching Stubs and quarter-wave transformers are beyond the scope of this article.)

If, for instance, 400 ohm feeder is specified for a certain type of aerial in one of the Handbooks, do not use 300 ohm feeder, as being "near enough". While this mis-match may not look serious, it could easily make a difference of an "S" point on the receiver, which means the difference between hearing a weak signal at S3, or that same signal being submerged by an S2 noise level, and, therefore, inaudible.

The maxim is, where a certain type of aerial plus feeder is described, to follow it to the letter, and use only the material specified.

RADIO COMPONENT SHOW

REPORT BY A. TORRANCE

THE contents of Mr. Gaitskell's famous budget-box are now known to all our readers, and with considerable sorrow we observe that our hobby has once again suffered. In this connection it is only fair to state that quite a few manufacturers at the above show expressed keen disappointment—they had hoped that their products would have attracted the amateur, but saw a formidable barrier in a greatly increased purchase tax.

It is your writer's personal opinion that it is surely a folly of the first magnitude to discourage the radio amateur. Mr. Gaitskell may recall that these fellows formed the backbone of the war-time Service's radio. Well, there it is, chaps!

To get back to the show—progressive ideas abound, and many firms are catering both for the amateur and the receiver manufacturer. One such is the Weymouth Co. Ltd. Their familiar coil range was displayed, but of obvious interest to the constructor are their coil packs; obtainable in various ranges and with built-in bandwidth, accurate construction of a communication receiver becomes possible with simple tools. For the TV devotee, the "Weymouth" strip chassis is a fine piece of work, measuring only 12" x 4" and containing full vision and sound superhets. This can easily be seen as a basis for compact construction.

The English Electric Co., who have recently announced their 16" steel-backed TV tubes, are one of the firms who are hoping to attract the home constructor. Readers who have seen these CRT's must surely be saving furiously already. We were impressed by them, and hope in due course to be able to give details of the conversions needed to instal them into existing televisions.

Nettlefolds have introduced a new range of Parker-Kalon self-threading screws. These have a special clearance angle making them suitable for use with materials which crack easily, such as bakelite; but their real achieve-

ment is the "Sem". This has a built-in washer which is part of the bolt, and so cannot fall off, and is obtainable in all familiar radio sizes.

For the fidelity enthusiast, McMurdo have a large range of anti-microphony valve bases. Mounted in nylon-filled bakelite, these will solve a lot of those amplifier, pre-amp and car radio troubles requiring shock mounting.

As we predicted last year, transformers are changing their appearance, and the streamlined jelly and oil-filled types are now prevalent. Both Woden and Partridge have fine precision ranges to suit all requirements.

The Avo model 8 testmeter would grace even the most fastidious workshop. With the available external multipliers, the voltage ranges can be extended up to 10 kV. Incidentally, this firm has started an educational department. Lecturers are now available for radio clubs, or the lectures may be obtained in printed form.

About those maddening electrolytics. A direct approach was made, and we can assure you that manufacturers have revolutionised this side of radio. The Daly Condenser Co. stated that their ranges were conservatively rated, and would not hear of failures.

Welwyn Electrical Laboratories announce a new departure in pre-set controls. Elegant jobs, these, and just the thing for those TV line and frame holds.

Ersin Multicore presented to every visitor to this show a small green carrier and lavish samples of their very excellent solders—most welcome to a confirmed Ersin user.

The above are items that particularly impressed us. There are plenty of new and interesting components—but their availability will depend on future events. Let us then hope with the B.B.C. that 'Nation Shall Speak Peace Unto Nation'. Then, perhaps, all radio gear will be in free supply, free also, maybe, of purchase tax!

Radio Miscellany

MY recent comments on scanning discs appear to have revived considerable interest, and some sentimental recollections, among old-time TV constructors of the Crystal Palace transmission days. I have since, also, been caught up personally in one or two discussion groups and have been rather surprised to learn that even many of the old-timers seem to know little of the really early efforts to transmit pictures. Many of them were partially successful, too.

Delving back into scientific history, we find that as early as 1875 a system was developed which, if the valve had then been invented to act as an amplifier, would have given a satisfactory outline picture—transmitted by wire, of course, not “wireless”.

The early experimenters for a long time started off on the wrong foot. They tried to send a whole picture at once!

Maurice Leblanc was, I believe, the first to suggest the theory of scanning in about 1880, although others had already drawn attention to the possibility opened up by cutting the picture into strips.

The scanning disc, used to break the picture up into tiny sections, as the 1920-30 amateurs knew it, was first devised by Paul Nipkow as early as 1885. Although for a while it was known as the Nipkow disc, he seems to have received scant recognition for his trouble, despite the fact that it was the basis of practically all TV experiment until nearly 1930.

With improved selenium cells (and from about 1906, the selenium electric eye) plus valves to amplify the tiny currents, mechanical scanning did work fairly well, although, of course, not well enough for general use or entertainment purposes. Mechanically driven revolving discs and mirror drums just could not be made to move fast enough. The electron had to be harnessed to do the scanning before TV as we think of it today became possible.

As I said a couple of months back, amateur TV can look back on a history of over a quarter of a century, but TV in the laboratory goes back nearly three times as long as that.

Trans-Atlantic Pictures

It is perhaps only natural that the general public should be so vague about TV development. It was essentially for those who were technically interested. The interest of the general public could only be aroused when something comparable to cinema projection became possible. Even then, the demand for receivers was much slower than one might

have fairly supposed.

The chief fun with the early Baird transmissions was holding some sort of picture at all. At its best, it was not very satisfying. The insensitive photo electric cells did not allow a full scene and rarely anything more ambitious than the head-and-shoulders was tackled. Outdoor work was only possible under ideal conditions and, with a 30-line picture, detail of any ‘big’ scenes was inevitably lost. Flicker, too, was unavoidable, with a speed limited to 12½ pictures per second.

Yet in early 1928 Baird sent the first TV picture across the Atlantic from a short-wave station at Coulsdon, Surrey. It was received in New York, imperfect of course, but recognisable. About the same period he was also demonstrating colour and stereoscopic TV in London!

Finding Out

So the B.B.C. Listener Research are investigating why people are listening less. Perhaps you could tell them!

We do not hear so much about this Department nowadays. Not apparently because they are any less active, but for some reason they have lost their news value and do not get the same publicity.

There was quite a deal of divided opinion at high levels within the Corporation about the value of such a Department when it was first formed, and judging by the imperturbable leisureliness of the programme planners, it is hard to believe that very full attention is given to its findings. In any case, the B.B.C. frankly admits it considers that listeners’ tastes must not be the final arbiter of programme standards.

Many years before the B.B.C. thought of Listener Research—way back in the days when the austere Lord (then Sir John) Reith used to lead them like an Old Testament prophet—someone tried out the idea. I believe it was Roger Eckersley.

Sunday programmes then consisted of talks, chamber music and religious services, with a military band concert of far-from-light-music to brighten the afternoon. When, after a great deal of outside prompting, they finally leavened the mixture with a talk on gardening or some other everyday subject, it was alleged that many hands were raised in horror. It was then that Roger Eckersley went to the Welsh strongholds of Methodism where the staunchest supporters of strict sabbatarianism were believed to prevail, to test whether this was really a widespread reaction.

When he asked a large number of people what they listened to on Sundays, they all told him Radio Luxembourg or Radio Normandy! These programmes began to command such huge audiences that even the redoubtable Sir John had to make concessions to win back the audiences from these sponsored programmes. That, perhaps, is the only occasion when the B.B.C. openly allowed its policy to be influenced by listeners’ tastes. Even so, it was not until some years later that Sunday programmes with popular entertainment and variety were permitted.

One of the last published analyses of Listener Research’s probe into audience preferences did not strike me as being directly related to the proportions of programme times. Perhaps it is just as well. My tastes do not fit in with the majority. Many of the items rated high in the list rapidly convince me I have got something better to do.

At first I thought I must be a bit queer until I also found out that 57 per cent. of listeners admit they do something else while listening. Perhaps I may not be such an oddity after all.

Some of the Chief Points

To help those who do not know their short waves, here is a guide to the main characteristics of the short-wave broadcast bands.

16 metres. Best reception takes place when the whole of the path between the Station and your receiver is in daylight. Thus DX from the east is best sought during the couple of hours after sunrise, and from the west, before sunset.

19 metres. At its best when the intervening space between the transmitter and the receiver is largely (but not wholly) in daylight, and conditions normally remain good for up to two hours after sunset.

25 metres. DX is to be heard at its best when it is daytime at the transmitting station end and dark at the receiving end.

31 metres. Here we have it both ways. Stations are heard at their best when the conditions as for 25 metres prevail OR their opposite. ‘Near’

CENTRE TAP talks about EARLY TV - BBC LISTENERS - SW BROADCASTS

Short Wave Broadcasting

Some eighteen months ago I wrote of using the amateur bands as a guide to receiver performance. Their main virtue for this purpose is that amateur transmissions lend themselves to easy identification, and because of the narrowness of the bands in which they are allowed to operate they serve as useful “markers” in receiver calibration.

Since then I have been astonished at the number of experienced constructors who know next to nothing of the behaviour of even the popular short-wave broadcasting bands. To them, they are just “short-wave” as if they all had similar characteristics, or “erratic” as if they all suffered from the same eccentricities. Erratic they may be, but they all follow a definite pattern of their own and their erraticalness is, in the main, consistent.

To the uninitiated there does not sound to be very much difference between say, the 16 and the 19 metre transmissions, but if you study them even over a period of only a few days the marked difference in their behaviour is unmistakable. Stations that can be heard at full strength in the morning may be simply unobtainable in the evening, however good the receiver.

DX etc. can be expected at all hours of the day, and transmissions from “down under” are generally at their strongest for the first two or three hours after sunrise.

49 metres. The conditions exactly opposite to those described for 16 metres are best for optimum reception. During the hours when the entire path between transmitter and receiver is in darkness, prolonged spells of good reception can be depended upon.

It should, of course, be always borne in mind that on most all-wave receivers 50 or more channels may be covered in less than a quarter of an inch travel on the tuning scale, and careful tuning is essential.

The above conditions represent the average, but remain generally true irrespective of the season of the year, although unstable conditions of the upper atmosphere produce variations at times.

There is one very important point, however. If you intend to attempt to identify stations or listen for special transmissions, don’t use a Station List that is more than a few weeks old.

IN 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.

ASSUMING that it was possible to do so, it would be very interesting to record the replies of the readers of this magazine if they were individually asked the following question: "What, when building a receiver, amplifier, or similar item of radio gear, do you consider is the most boring or uninteresting part of the process?"

It is probable that the replies to this question would reflect, to a great extent, the general approach of each reader to the hobby. The "all-round" person would perhaps find all parts of a constructional job equally interesting; whilst some of the more experimentally-minded would be irked by the necessity of building a chassis and of carrying out the initial wiring before they could get down to the more engrossing phase of finally adjusting and "tuning up" the gear.

It is very easy to understand the point of view of those in the second category. Few things can hold one's interest more than working with home-built equipment (incorporating perhaps some new designs and ideas) which is at last on the threshold of completion.

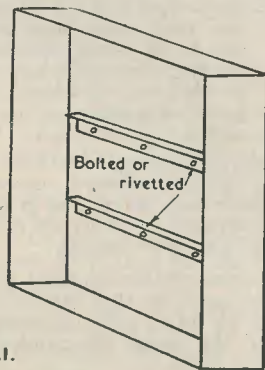


FIG. 1.

Fig. 1: Fitting angle-brackets beneath a large chassis will strengthen it considerably. Under-chassis screens may be used for the same purpose.

When the constructor is fitting his final components such things as meals and other obligations become an irritation instead of a pleasure; and it is at times like this that XYL's start thinking of returning to the comforts of their maternal hearth.

The Right Materials

However, the process of "getting started" and building a chassis is not really very tedious provided that it is set about in the correct way. What is needed are the right materials, the right tools, and the aptitude to make a quick but accurate layout diagram to work from.

Let us consider first of all the materials used in chassis construction. Of these, the most popular are aluminium and sheet steel. Several other alternatives are occasionally mentioned in technical literature (particularly in magazines published before the war), the most frequently met of these being wood or ply-wood, covered sometimes with copper foil, etc., for screening. Whilst it must be admitted that a bread-board layout is extremely useful for making hasty experimental lash-ups, "permanent" chassis made of wood are really not worth while. Aluminium is fairly cheap, is easy to drill and bend, and gives a far more reliable and cleaner finish than wood could ever do. The only useful attribute of wood for radio work is that it is "easy to screw things to"!

One of the best materials for home-constructed chassis is aluminium. This has the advantage just mentioned that it is extremely pliable; added to which is the fact that it is still nowadays reasonably cheap. Unfortunately its pliability makes it necessary to use a little care when large chassis which need to be rigid or which will carry heavy components are being designed, but this disadvantage can usually be overcome by fitting angle-pieces (also of aluminium, if desired) underneath the chassis. It will very often be found that under-chassis screens also help in the same way, to strengthen a large chassis. See Fig. 1. Another disadvantage of aluminium is given by the fact that it cannot be soldered for

screening and earthing purposes (unless the constructor possesses a supersonic soldering iron!) and this detracts somewhat from its usefulness for equipment designed for VHF and higher frequencies.

In the writer's opinion, dural is not a good material for home-built radio chassis. It is hard and brittle and is liable to crack when bent. Nevertheless, it has possible uses for portable gear owing to its extreme lightness. Other alloys of aluminium may occasionally be met, although they will probably not have the extreme hardness of dural. Pure aluminium is easily recognisable, incidentally, because a groove can be cut in its surface with a very light application of a screw-driver or pen-knife; and because of its lightness.

Sheet steel is an excellent material for chassis and is, of course, used extensively in commercial radio equipment. It has the advantages of strength, of being easily soldered, and of being fairly easy to work. The home-constructor will need better tools if he wishes to work with steel instead of aluminium. A good method of combining the advantages of the two metals consists of having a chassis made of aluminium with a front panel of steel. Steel enamels easily and remains rigid. In addition, when it is used for a front panel, it does not necessitate much drilling or bending.

Bending Sheet Metal

We mentioned earlier that it is necessary to use the right tools for making a chassis. We do not intend to expand this statement over-much here, as the subject of tools has been dealt with in previous articles. However, it would certainly be to advantage to give a few hints on bending and parting.

To bend sheet steel or aluminium it is necessary to use angle-irons which can be mounted in a vice. Fig. 2 shows the appearance of two typical angle-irons. (Fairly good angle-irons can sometimes be obtained from brackets, frames, etc., these usually being found lurking in odd piles of junk). Fig. 2 also shows how the irons may be strengthened by nuts and bolts at each end.

The piece of metal to be bent should be scribed, on the *inside* of the bend, and fitted to the angle-irons. The metal should then be gently bent over, *all* of the projecting metal being forced down at the same time. If possible, the metal should always be fitted to the irons so that a large area projects above, thus allowing it to be bent more easily. The bend may be completed by lightly tapping the metal with a hide-faced hammer above the angle-irons. Alternatively, when a large part of the metal is being bent, a long piece of hardwood may be placed over the bend, the wood being tapped instead of the metal.

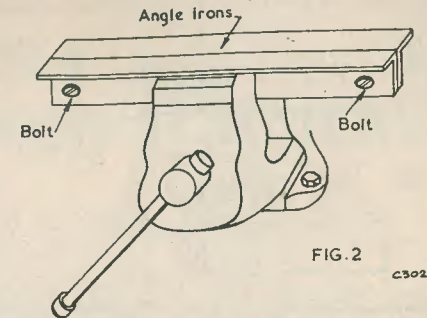


FIG. 2

c302

Fig. 2: Angle-irons inserted in a vice for bending. Note the bolts fitted at the ends.

The position of the bend should always be scribed on the inside of the angle. If it were marked on the outside the scribe line might tend to weaken the metal and cause it to crack.

AUDIGRAPH DEMONSTRATE



TAPE RECORDING EQUIPMENT

at

THE BRITISH SOUND
RECORDING ASSOCIATION
EXHIBITION—MAY 19 & 20

Waldorf Hotel, Aldwych
London, W.C.2

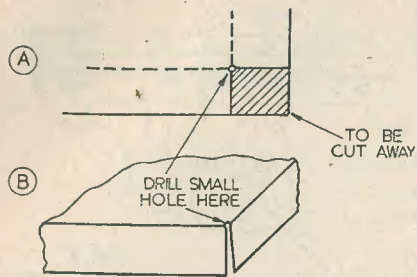
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C.303

Fig. 3: (a) A piece of sheet metal marked out for bending and cutting at a corner. The dashed lines indicate the lines along which the metal is to be bent.

(b) The completed bends. The hole drilled before bending prevents compression of the metal at the point of the corner.

This applies particularly to aluminium and similar materials. It is sometimes recommended that a heavy scribe line be made with aluminium as this gives a cleaner bend. This practice certainly ensures that there is less metal on the inside of the angle, therefore preventing excessive stretching of the outer surface and so reducing cracking; but at the same time it must be remembered that it makes the metal *thinner* at the scribe line and may therefore weaken it.

When it is necessary to bend a sheet of metal in order to form a corner, it helps very con-

The Editor Invites

articles from readers, of a nature suitable for inclusion in this magazine. Articles submitted for publication should preferably be typewritten, but ordinary writing is acceptable if clearly legible. In any case, double spacing should be used, to allow room for any necessary corrections. Drawings need not be elaborately finished, as they will usually be redrawn by our draughtsmen, but details should be clear. Photographs should preferably be large (half-plate) but in any case the focus must be good. Much useful advice to prospective writers is given in our "Hints for Article Writers", which will be sent free on request.

siderably if a small hole is drilled where the scribe lines meet. Fig. 3 shows how this is done. If the hole is not drilled the metal becomes compressed at the point of the corner, giving an ugly and weak bend that is difficult to finish.

Angle-irons can also be used to part soft sheet metal. If a sheet of aluminium is scribed deeply on both sides, (preferably with something like a pen-knife), placed in the angle-irons and bent backwards and forwards, it will be found that it breaks off very cleanly along the scribe lines.

Whilst on the subject of treating sheet metal for radio chassis, it would incidentally be advantageous to point out that the more laborious processes can often be obviated by using some of the special tools sold for the job. Particularly is this true of chassis-cutters for making valve-holder holes. The writer has saved many hours of hard work by using a chassis-cutter, the holes made by which can also be used for under-chassis wiring to IF transformers and other components.

Planning the Chassis

Everyone planning an item of radio gear has a fairly clear view in his mind of its final appearance. Unfortunately, mental pictures cannot be relied upon for accurate measurements, and so a layout should always be planned with the aid of pencil and paper. A projected layout should never be attempted unless all the components needed are available.

It is usually sufficient to make a preparatory rough layout and follow this with a full-dimensional diagram, the latter using the measurements of the actual components to be fitted. Such small items as capacitors and resistors should not be ignored in this layout as they have an unhappy knack of needing more space when fitted than would primarily be imagined. Particularly is this true of the "cluster" around "double" valves, such as frequency-changers. A good design always takes account of what is below the chassis when positioning components above it; and should also take full advantage of the screening properties given by the chassis itself.

Some writers advocate the use of squared paper for working out layouts. One or two even go so far as to recommend screwing the components onto the squared paper (using the outlines previously drawn on it) and tearing it away afterwards. The idea of having odd scraps of paper sandwiched between components and chassis with bits torn off appeals not at all to the present writer. A dimensioned diagram should be sufficient for all purposes; although it does help sometimes to use the components themselves in order to trace their outlines on the paper.

TELEVISION COILS on ALADDIN FORMERS

by

F. L. BAYLISS, A.M.I.E.T.

Part 1

We present the first of a short series of articles on an interesting topic. The views expressed are, of course, our contributor's and are not necessarily held by us, but there is no doubt that the coil, and its circuit, plays a most important part in any television, and this series will have served its purpose if it causes the television enthusiast to devote some thought to this subject.

Home Built versus Ex-WD.

DESPITE the immense popularity of ex-WD radar receivers and indicators as a basis for the construction of fairly inexpensive televisions, there must be many constructors—real, dyed-in-the-wood, start-from-scratch enthusiasts—who are not entirely satisfied with such half-and-half methods.

There must be many, in fact, who feel that they can scarcely claim the results as their own, and who wonder secretly if they are really getting results they'd be satisfied with had they built their own receivers.

From the point of view of rapid results from a minimum expenditure of time and labour, of course, the ex-WD unit scores every time. Great care was taken in the manufacture and design to give a foolproof and serviceable unit, BUT—and it is a big BUT—have these units got "IT" from the quality reproduction point of view?

The answer, in the writer's opinion, is that they have not.

Valves—And Coils

First of all—and this has nothing to do with quality—there is the great predominance of the SP61 valve in these units. Now, I do not decry this valve as an RF amplifier, even at 60 Mcs, but there is no escaping the fact that its 0.6A heater current can cost one an extra pound in cash when providing a transformer to supply, say, nine or ten of them, in vision, sound and timebase circuits.

Moreover the thoughtful constructor may already have noted the cheapness and plentiful supply of special VHF metal pentodes such as the EF50 and EF54, which average about 5s.

each new and also of that little used but almost equally useful valve the 6SH7; the writer has purchased ten of the latter, brand new, at 2s. each!

The use of any of these three types lops several Amps off the LT current—they all have 0.3A heaters—and there are the added advantages of metal construction and base grid connections.

"These facts, then, do seem to weigh rather in favour of starting from scratch", you may say, "but what of the quality—that something extra—of which you first spoke?"

Now, that is precisely where Aladdin, that genie with the iron-dust core, steps in and takes complete charge.

In the straight receiver, as distinct from the superhet which will not be considered in this article, there are, broadly speaking, three possible methods of RF intervalve coupling.

There is also a fourth, the HF transformer, which, whilst excellent in the sound section, has no application in the vision receiver owing to its inherent selectivity and consequent attenuation of bandwidth—at least, when such transformers have iron-dust cores.

Of the three first-mentioned, undoubtedly the most popular are (a) the tuned anode, and (b) the tuned grid methods.

Tuned Anode

This system, in which the coil, tuned to the required frequency, is inserted as the load in the anode circuit of each RF amplifier, has points both in favour and against it.

Presenting, as it does, a very high impedance at the resonant frequency, probably the greater part of the valve's amplification factor is made

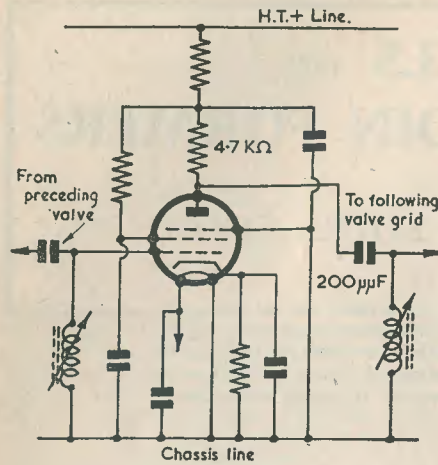


FIG. 2. TUNED-GRID COUPLING

C298

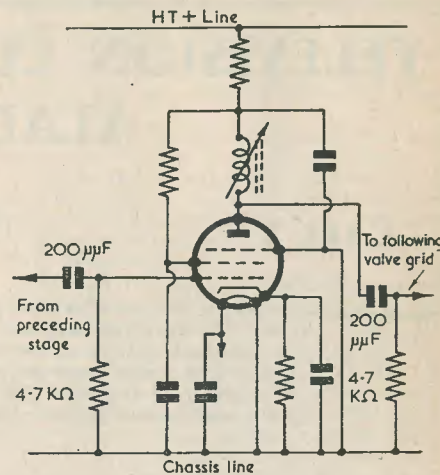


FIG. 1. TUNED-ANODE COUPLING

C297

use of, giving a very high gain figure for the circuit as a whole.

In operation, however, a coupling capacitor to the following valve grid and a grid-leak thence to chassis or cathode are necessary, and both, especially the grid-leak, introduce losses and complications which detract seriously from the circuit's first promise.

In order to maintain the high gain, the grid-leak should be large with respect to the internal cathode-grid impedance of the valve itself. This, however, would mean a grid-leak of the order of 500 Ωk, or even 1 MegΩ.

Now, a grid-leak of this value, in combination with the usual 200 pF or 300 pF coupling capacitor gives an almost ideal leaky-grid demodulator, and the valve therefore tends to become a self-biased detector, with RF amplification occurring only as a sort of unwanted by-product.

To offset this, the grid-leak is often made small in value—5 kΩ is a popular figure—but in so doing, the valve gain is very considerably reduced, whilst the demodulation effect is not entirely eliminated.

Tuned Grid

Probably the more satisfactory method, from the quality point of view, is the system in which the resistor is used as the anode load, whilst the tuned coil is inserted in the grid circuit of the following valve.

In view of the almost negligible DC resistance of the coil, demodulation cannot occur, but

the great drawback is that to maintain a good anode potential the value of the resistor must be kept small. The current drawn by the average VHF pentode is about 10 mA, and even a 5 kΩ resistor as the load—and this is a usual value—will result in a drop of 50 V.

Such a resistor, of course, results in only a small fraction of the possible value of gain being used, but from the quality point of view tuned grid is, perhaps, slightly preferable to tuned anode.

Typical circuits of these two methods are shown in Figs. 1 and 2.

Choke Feed

Thus, we are left with method (c), the third of the three main systems in use, and this, which we may conveniently call choke-fed tuned-grid, I propose to discuss and propound from the practical standpoint.

It is, in the writer's opinion, infinitely preferable to either (a) or (b) for, whilst embodying the good points of both, it has none of the drawbacks.

As with all good things, however, a little extra care and additional work is involved in winding the coil, but these are amply repaid by results that can scarcely be bettered—by either straight or superhet circuit.

The basic circuit, shown in Fig. 3, consists of a choke feed to the anode of the valve, followed by a tuned-grid arrangement for the following valve. Intervalve coupling is effected by the capacitor C1.

Both of these coils may be wound upon the same former. The choke, which may conveniently consist of 80 turns 40 swg enamelled wire, is wound in a single layer, close wound, at the lower end of the former. This winding will occupy about half the space on the former.

The grid coil, 5 turns for Birmingham and 7 for London, is wound at the top of the former and in the same direction as the choke. This winding should be of 30/34 swg enamelled wire, spaced to about 40 turns per inch.

To maintain the coils firmly in position, a thin film of Polystyrene varnish should be applied over the whole surface of the coil and former; alternatively, Seccotine may be used very *thinly*. Another plan is to rub the windings with one of those ex-WD capacitors which are enveloped in wax, thus transferring some of the latter to the coils.

Advantages

The advantages offered by this type of coupling may be summarised as follows:—

- (1) The anode choke, having negligible DC resistance, maintains the anode at the original DC voltage—or slightly less, allowing for decoupling.
- (2) The choke also, by virtue of its high impedance to RF signals, allows a much larger proportion of the valve amplification factor to be used, thus giving greater all-round gain.
- (3) The tuned-grid coil, whilst presenting a low resistance DC path and thus defeating

demodulation, also presents a very high RF impedance circuit, thus maintaining the additional gain outlined in (2).

(4) The rising loss in the higher frequencies dealt with, due to stray and unwanted capacitance, is compensated for by the rising gain given by the anode choke—since, of course, the impedance of the choke, $2\pi fL$, is greater for higher values of 'f' as, conversely, the reactance of a capacitor $\frac{1}{2\pi fC}$ is lower for those same values.

Circuit Considerations

The higher gain given by the circuit calls for one or two extra precautions in the way of stabilising it.

It allows, too, some of the gain to be dispensed with in favour of a broader bandwidth.

So far as stability is concerned, it is a good effective plan to use two cathode bias resistors, totalling to the required bias value, and to bypass only one of them, the lower one, reserving the one nearest to the cathode for regeneration—feedback—purposes.

Additional stability is also given by the grid resistor R1, whilst damping of the tuned circuit is effected by R2, giving a more level response and better overlapping.

Constructional Notes

In a further article in this series, the writer hopes to give details of a complete coilpack, constructed as one unit on a single paxolin strip.

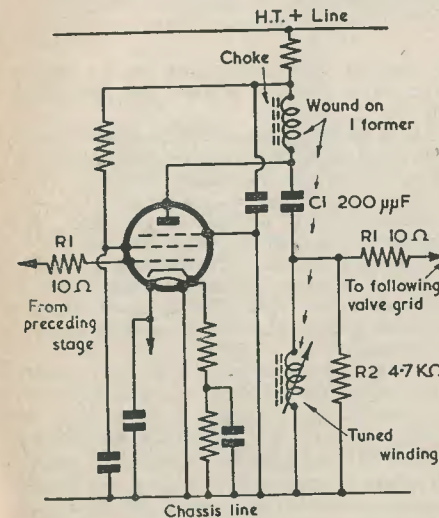


FIG. 3. CHOKE-FED TUNED-GRID

C299

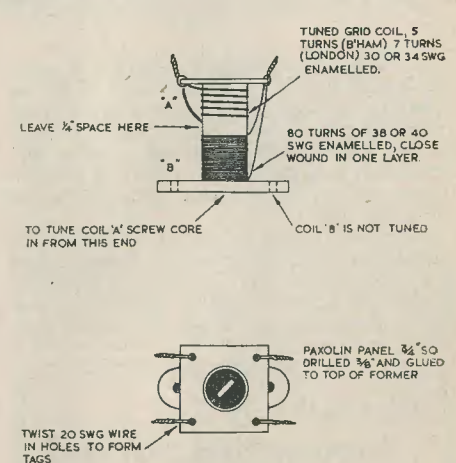


FIG. 4. SHOWING METHOD OF WINDING AND ASSEMBLING

C300

For those constructors wishing to use the coils and rejectors separately in their receivers, however, he strongly advises the use of a paxolin tag strip glued to the top of the former, and provided with 20 swg wire tags as shown in Fig. 4. Besides making a neater and stronger unit, they save one the irksome messing about trying to get thin wire leads on to valve base tags without breaking off the frail wire-ends.

Ex-WD Formers

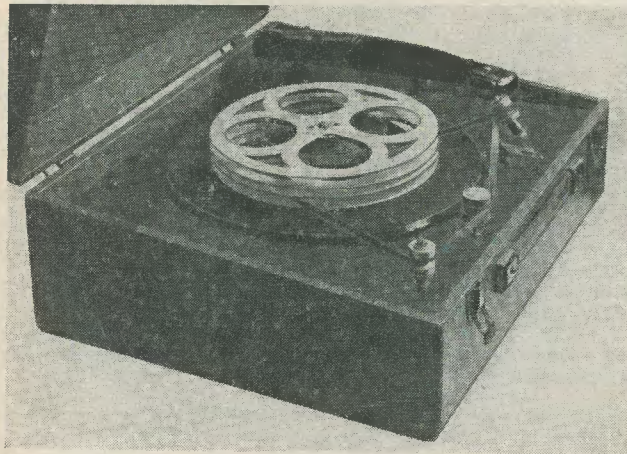
The enthusiasts who, like myself, have their noses glued well and truly to the lists of

ex-WD equipment published from time to time, will already have noted the availability of Aladdin formers.

Most of these are already wound to some frequency or other, and these usually have two or more paxolin discs, with tags, that may be used when re-winding.

Some, indeed, don't even need stripping, for a dozen recently purchased for half-a-crown (less cores) had five turns on already—an ideal grid (a) or anode (b) coil.

(To be continued)



TRADE REVIEW

In our last issue we gave details of a home constructed tape drive mechanism. Now, the building, as apart from assembly, of such apparatus is not 'everybody's meat', for some readers will not have the necessary tools, and others will lack the ability to work in metal—though all may be proficient when it comes to the radio side.

Our illustration shows a very similar type of mechanism which possesses no disadvantages in this respect, as it is supplied as a kit which anyone can assemble without difficulty. As is clearly shown, the use of this mechanism does

not prevent the employment of the record player, with which it is used, for its normal function.

It may be that a reader will be able to tackle some constructional items, but not others. In this event, he can purchase just those items which he cannot tackle.

Briefly, the unit consists of two reels, one supply and one take-up, which are attached to the turntable spindle. The recording head is mounted adjacent to the turntable, with a roller on either side. These latter, besides acting as guides, also apply suitable tension to the tape.

This unit may be used with any existing amplifier, by the addition to the latter of an RF bias oscillator, which is used also for erasing. This extra stage can also be supplied in the form of a kit, built around a 6SN7 valve.

Readers interested in recording are invited to apply for further information on the above, and other useful equipment, from Judge Industries, 783 Romford Road, London, E.12.

Please!

MENTION THIS MAGAZINE
WHEN
WRITING TO ADVERTISERS

from our Mailbag

Tone Control Circuit

Dear Sir,—I fear that Mr. French has branched off on the wrong track in explaining the query of Mr. Thompson in the February issue.

He has explained that the tone control is effective, which of course is perfectly correct, but he has missed the main point of why tone control should not be introduced within the feedback loop.

To be true high fidelity, the feedback must be exactly opposite in phase. This means that within the loop there should be virtually no phase shift.

The introduction of such type tone controls produces phase shift, and so the feedback signal does not truly oppose the input and produces harmonic and other distortion.

It is true that this introduced harmonic distortion is masked to some extent, due to the higher frequency attenuation of the tone control, but nevertheless the distortion is still present due to this phase shift.—L. F. Sinfield (Luton).

With reference to Mr. Sinfield's letter.

To reader Sinfield I bow my head! He is perfectly correct in stating that the tone control used in the amplifier will cause phase shift. Apologies also, therefore, to Mr. W. E. Thompson, (page 260 of the February issue).

Mr. Sinfield states further that the harmonic distortion introduced by the tone control will be masked to some extent by the high frequency attenuation resulting from its use. Nevertheless a large shift (approaching 90 degrees) is possible when full "cut" is applied. On the other hand, of course, only a small amount of feedback is provided.

Many readers familiar with the average "four-plus-one" radiogram will recognise the similarity of the amplifier circuit with the usual triode and pentode AF amplifier used in such receivers. The extra gain given by the use of an AF pentode instead of a triode is equalised by the feedback.

Perhaps the best point for connecting a tone control is, after all, in the input circuit, despite the inductive characteristic of a magnetic pick-up. A more ambitious scheme could utilise a cathode-follower between the pick-up and the tone control circuits.

In any case, I am indebted to Mr. Sinfield for raising this point. G. A. French.

Dear Sir,—I am grateful to Mr. G. A. French for his detailed reply to my query concerning the tone control circuit in his amplifier design. He has obviously gone to some trouble to allay my suspicions regarding the efficacy of a tone control circuit within a feedback loop, and up to a point he has succeeded. Having led me by the hand to the end of his seventh paragraph he allows me to slip from his grasp in his eighth, by pointing out that the loss without feedback will be 46 db, and loses me entirely in his ninth by proving that the loss with feedback is only 32 db. Since the first is more correctly expressed as —46 db and the second as —32 db, the net result of applying feedback over the tone control circuit is to raise the level by PLUS 14 db relative to —46 db. In other words the N.F.B. is trying to cancel out the effect of the tone control, and is succeeding to a degree.

Perhaps the authorities to whom Mr. French and I have referred abstractly know this property of N.F.B. so well that they assume everyone else does also, and so have not seen fit to mention it again, for one of these No. 8 hats penned the following words of wisdom some years ago when his article "Negative Feedback Calculations" was published in WIRELESS WORLD . . .

"The absurdity of feeding back over a tone control stage or one incorporating a volume control might be mentioned here also as it is sometimes overlooked. The feedback will obviously try to cancel the changes in tone or volume one is trying to obtain." W. E. Thompson (St. Leonards-on-Sea).

Mr. Thompson's letter arrived just after I had sent off my reply to Mr. Sinfield and so some of the points he raises have already been dealt with. When he slips away from the French grasp on the eighth and ninth paragraphs, he does so only because he refers to certain quantities in a different manner than was used by me.

I stated that the high frequency (6,000 c/s) loss at "full cut" was 46 db without FNB, and 32 db with FNB. Thus, with FNB, high frequency attenuation does exist, although this attenuation is less than it would be without FNB. The fact that FNB tends to cancel out the effect of the tone control is self-obvious and was the sole reason of my going to some lengths to explain why I chose that particular circuit

position for the tone control and why I indulged in the numerical examples to prove this point. When Mr. Thompson states that NFB raises the high frequency level by 14 db he is merely quoting my figures.

To refer to a loss of 46 db or 32 db is perfectly in order, the minus sign being by no means necessary in the context mentioned. I do not wish to quote the Scriptures for my own ends (I trust, indeed, that I am not fitted to do so) but I must point out that such a phrase is in

frequent usage, not only in WIRELESS WORLD but in any other technical publication that I can call to mind.

However, by far the most important objection to the tone control was voiced by Mr. Sinfield when he referred to the phase shift resulting from its use. That the effect of a tone control is reduced by the presence of NFB is not necessarily a positive evil: the fact that such a tone control, in itself, introduces distortion is a definite condemnation. G. A. French.

ANSWERS TO QUIZ

(1) Electric soldering irons are designed to maintain the correct temperature whilst in actual use, that is, when some of the heat is being absorbed by the work. If its maximum heat was the temperature required to melt the solder, the loss due to transference of heat to the work would cool the bit. The element must, therefore, be able to produce an excess of heat, and some means should always be provided to hold it down. If it is not convenient to switch off, the iron should be left with the bit in contact with a metallic surface which can dissipate the excess heat. Otherwise, as in Mr. Brain's case, there is the danger of the element burning out.

(2) An infinite baffle is one of a size sufficient to isolate the back radiation of the loudspeaker from that of the front, at the lowest audio frequency reproduced. This means a size similar to a room wall. In order that the air loading may be equal back and front of the cone, the volume of air behind the baffle must be equal to that in front. These conditions can only be achieved in one way—by mounting the loudspeaker in the wall between two rooms. The back radiation of most loudspeakers is inferior to that of the front, particularly when the double-cone type is used, so that the quality in the room behind the speaker will not be equal to the results which may be obtained in front. The infinite box baffle is fairly easy to make, but unless carefully matched to the speaker it is likely to be disappointing.

(3) An AF amplifier having a narrow frequency response will produce more noise from ignition interference than one having very little distortion and a good response at high frequencies. The waveform and 'frequency' of ignition is not well produced by a speaker, nor easily detected by the ear, and if it can be passed through the amplifier without mutilation the audible noise is not likely to be too offensive. In an amplifier of poor

quality, the waveform will be converted into one which can produce that awful 'machine-gun' noise.

(4) Diesel engines have no electrical ignition equipment, and so do not contribute to the 'snow showers' that mar many screens. (Maybe—but have you seen and heard the horrible interference emanating from the windscreen wipers of a diesel engined London bus?—Ed.)

(5) Mathematical tools—and very useful ones, too. A short time spent in learning the use of logarithm tables is well worth while.

(6) Ghost signals occur when the signal is received from two or more sources, one direct from the transmitter and others by reflection from some such object as a gas-holder or telephone exchange. The displacement is due to the time-lag between the reception of the direct and indirect signals. It might be possible to calculate the distance of the reflecting object from the amount of displacement of the images. The writer has not yet met anyone who has used this 'radar' treatment to track down a gasometer 'ghost'! Generally speaking, the cure is to site the aerial, which must have directional properties, so that the strength of the unwanted signal is at a minimum.

Magnetic Recording

continued from P. 351

small rubber-tyred pulley and the turntable. Short lengths of test recordings may, of course, be easily re-wound by hand.

Once again, it must be stressed that the above is only a suggested method of construction. Other ideas will present themselves, and it is left to readers' initiative to work out more ambitious schemes.

(To be continued.)

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