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The page contains an advertisement for a company called "The Jason Motor & Electronic Company" offering kits for electronic projects. The advertisement highlights the "Jason Kit" with features and pricing information. The text is partially obscured, but it includes details about a "Build the "O.G.10 Oscilloscope Kit" with an authentic Jason Kit." The advertisement also mentions "BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (B.I.E.T.)" and offers a "FREE TO AMBITIOUS ENGINEERS" promotion. There are also sections for "THE JASON PROGRAMME" and "OTHER KITS IN THE JASON PROGRAMME." The page seems to be from a radio constructor magazine, given the context and layout.
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CONTRIBUTIONS on constructional matters are invited, especially when they describe the construction of particular items of equipment. Articles should be written on one side of the sheet only and should preferably be typewritten, diagrams being on separate sheets. Whether hand-written or typewritten, lines should be double spaced. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but all relevant information should be included. Photographs should be clear and sharp. Details of topical ideas and techniques are also welcomed and, if accepted, will be contributed by the Editor at the discretion of the Editor.

All contributions must be accompanied by a stamped addressed envelope for reply or return, and should bear the sender's name and address. Payment is made for all material published.

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

TECHNICAL QUERIES must be submitted in writing. We regret that we are unable to answer queries, other than those arising from articles appearing in this magazine; nor can we advise on modifications to the equipment described in these articles.

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suggested circuits

No. 116 An Add-on Vibrato Unit for Guitar Amplifiers

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

The electric guitar, which employs magnetic pick-ups mounted close to the strings so that their vibrations may be amplified and reproduced over a loudspeaker, is a well established member of the present-day range of musical instruments. It has the advantages that the sound provided can be raised to any desired volume level and that, by making use of suitable gain and tone controls, special playing techniques not feasible with a conventional guitar can be executed. It is possible, however, to add yet a further facility to the performance of which the electric guitar is capable, this facility consisting of the introduction of amplitude vibrato in the associated amplifier. The use of vibrato adds a further dimension to the music from the instrument, providing a noticeable brilliance and interest which is not evident with conventional amplification.

This month's article discusses the circuit of an add-on device which is capable of being fitted to most guitar amplifiers and which provides vibrato at three differing frequencies at a continuously variable depth. The device functions by varying, at the vibrato frequency, the anode supply potential of an early voltage amplifier valve in the guitar amplifier, thereby modulating the amplitude of the signal which the valve handles. In order to check the principle of operation, the prototype unit was tested by coupling it to a voltage amplifier valve in a typical amplifier reproducing guitar music. The unit was found to work efficiently, providing at its full depth control settings a vibrato level considerably greater than would normally be required. At lower depth control settings, the effects produced by the vibrato unit were, to the writer's aural sense, of a particularly pleasing quality.

Ideally, the vibrato unit should be coupled to a valve which is outside any negative feedback loop which may be present in the associated amplifier. In practice, however, the unit will function satisfactorily if the valve to which it connects happens to be inside a loop, provided that the feedback involved is not of a very high order. So far as the writer is aware, it is doubtful if the feedback level in the average guitar amplifier would be sufficiently high to prevent the unit from operating with adequate results. (The voltage amplifier valve to which the prototype unit was connected during tests was within a feedback loop.)

The circuit of the add-on vibrato unit accompanies this article. The basic oscillator which provides the vibrato frequency consists of a square wave multivibrator, in which V_{1a} forms one triode and V_{1b}, in parallel with both sections of V_2, the other. Feedback is provided in conventional fashion by C_1 and C_2, whilst S_{1a} and S_{1b} switches controlled valve in the guitar amplifier. The circuit, as shown, should function with all voltage amplifier valves likely to be encountered, even when such valves draw currents of the order of 4mA or so. (In some instances where the voltage amplifier valve draws a low current it may be possible to dispense with V_2. This point is discussed later.)

The varying voltage on the anodes of V_{1b} and V_2 forms a square wave, and this is integrated by R_5 and C_4 before being applied to the anode load of the voltage fidelity amplifier, in the sense that the function of the latter is to reproduce signals which have been originated elsewhere.

The vibrato unit should be constructed in the form of a small add-on unit obtaining power from the guitar amplifier. The vibrato frequency and depth controls are mounted on the chassis of this unit. The unit can be brought into operation by an on-off switch mounted on its chassis, or by a remote on-off switch. If the latter is employed, vibrato can be turned on and off differing values of resistance into the condenser discharge circuits in order to provide varying running speeds for the multivibrator. The reason for having V_{1a} and the two sections of V_2 in parallel, is that the relatively heavy current drawn by these triodes ensures the existence of a high change in anode potential between one half-cycle and the next, whilst allowing the use of the low-value series resistor, R_4. It is necessary for R_3 to have a low value because it passes the anode current of the

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amplifier. The value of \( R_3 \) is experimental, since it controls the depth of the vibrato modulation as well as the amount of integration. It should be advisable to commence with a value around 3kΩ, increasing or decreasing this in the light of experience. A variable panel control of \( R_3 \) is provided by potentiometer \( R_3 \), its slider tapping off a square wave of the desired amplitude.

It is intended that \( h_t \) for the add-on unit may be obtained from the smoothed h.t. line in the amplifier. Since the unit draws approximately 7mA at 200 volts and 11mA at 300 volts, it is advisable to avoid connecting to any dc-coupled points or associated decoupling resistors. The filter \( C_3, R_{10} \), which prevents the appearance of these amperes on the amplifier h.t. line, serves the secondary function of providing additional h.t. decoupling and smoothing for the controlled voltage amplifier. In most cases, best results will be given by connecting the h.t. supply line in the amplifier which immediately follows the smoothing choke or resistor.

As shown in the diagram, the end of the controlled valve anode load resistor which is remote from anode should be disconnected from its supply point and any associated decoupling condensers and re-connected to the upper plate of \( C_3, C_4 \), apart from the function of the integrating filter, will then operate as a decoupling condenser. \( C_3 \) should be mounted on the amplifier chassis close to the anode load resistor to which it is connected.

The only remaining parts of the circuit to discuss are the switching arrangements. As has already been mentioned, \( S_3 \) and \( S_4 \) switch in different values of discharge resistor, thereby varying the frequency of the multivibrator. Switch \( S_2 \), which may be mounted on the add-on unit chassis itself, disables the multivibrator by opening the cathode connection to all triodes. Alternatively, a remote switch employing the plug and switch type shown in the circuit may be fitted. If the remote switch is used, it is advisable to fit the double-core screened cable (with screening earthed at the unit end only), as shown in the diagram, this guarding against the possibility of pick-up of the multivibrator pulses by the amplifier input lead.

Multivibrator Frequencies
The three frequencies selected by \( S_3 \) and \( S_4 \), 5, 15 and 15 c/s, are nominal and may vary slightly with different valves owing to variations in the grid leak resistances. We assist readers interested in selecting other frequencies, the component values in the multivibrator circuit are calculated in the following manner.

The multivibrator is nearly symmetrical and it is sufficient to discuss the method of finding the values for one side only, such values then being repeated on the other side. A suitable choice for demonstrating the method of calculation is given by considering \( C_2 \) and its associated discharge resistors. The time occupied by the half-cycle in which \( V_1(t) \) is cut off is equal to the time taken for \( C_2 \) to discharge through \( R_b \) to 0.632 times the initial value, \( V(t) \). This rise is just above cut-off. At the instant at which \( V(t) \) has fallen to 0.632 times the initial value, the anode current of the valves for an h.t. potential of 225 volts (corresponding to some 250 volts applied to \( R_{10} \) the anode current of \( V(t) \), when conducting, is 65 volts (measured on the prototype) above chassis. The potential on the left-hand plate of \( C_2 \) falls at the moment of change-over from one valve to the other, to 225 minus 65 volts (160 volts) below chassis. The potential on the left-hand plate then rises as the condenser discharges through \( R_b \) and the grid leak of \( V(t) \), the next half-cycle commencing when the potential reaches cut-off level in \( V(t) \). At 225 volts anode potential the latter is of the order of 20 volts (from published curves).

The discharge time of a condenser into a resistor is given by

\[
(1 - CR) \log_e \frac{E_1}{E_2} = \frac{t}{CR}
\]

where \( t \) is time in seconds, \( C \) and \( R \) are the condenser and resistor values, in mfd and ohms, respectively, \( E_1 \) is the commencing potential and \( E_2 \) the finishing potential across the resistor. In this instance \( E_1 \) is 160 volts and \( E_2 \) is 20 volts, and we may say:

\[
1 - CR \log_e \frac{160}{20} = \frac{t}{CR}
\]

At 15 c/s the length of time occupied by \( t \) is 10 sec. (i.e. a half-cycle) or 0.033 sec. We may, therefore, say:

\[
0.033 = CR \log \frac{160}{20}
\]

\[
CR = 0.0165
\]

Suitable values to obtain this product of \( C \) and \( R \) are 0.05 Mfd and 5kΩ, which values are employed in the circuit for \( C_2 \) and \( R_b \) (the latter forming the grid leak of \( V(t) \) when \( S_3 \) is in the 15 c/s position). The high resistance employed in the grid leak makes it possible to ignore the relatively low value of \( R_b \), through which \( C_2 \) discharges.

The calculated values for \( V(t) \) grid leak for 10 and 5 c/s operation are 50kΩ and 1MΩ respectively. The preferred values shown in the diagram for \( R_3 \) and \( R_4 \) give grid leak resistances of 510kΩ and 980kΩ for the appropriate positions of \( S_4 \), such values being sufficiently close to the calculated values for practical purposes.

Installation
The vibrato add-on unit may be mounted at a convenient point close to the associated guitar amplifier. Unless it is entirely screened, the unit should not, however, be able to discharge stage wiring capacitances too close, or pick-up of the square wave pulses may occur. Apart from \( C_4 \) and the remote on-off switch, all the components shown in the diagram should be mounted on the add-on unit chassis.

As was stated above the value of \( R_3 \) is experimental, it being recommended that a value of 150kΩ, say 225 volts, should be the maximum value of vibrato depth desired to be obtained at all multivibrator frequencies when \( R_2 \) is nearly fully advanced. With some amplifiers it may be found that more than sufficient vibrato depth is available even when \( R_3 \) has the maximum value of 150kΩ specified in the circuit. When this occurs it is possible either to increase \( R_3 \) above 150kΩ or to dispense with \( V_3 \) and find a new, lower, value for \( R_4 \).

Currents and Voltages
In concluding, it will be helpful to list the currents and voltages applicable to the unit. Some of the figures given here have been modified from the published circuit diagram.

The heater requirements of the unit are 6.3 volts at 0.6A, 12.6 volts at 0.3A, or 25.2 volts at 0.15A, according to the manner in which the heater is connected. In a series chain the highest heater potential above chassis should not exceed 150 volts.

The h.t. requirements of the unit, as measured on the prototype, are 7mA at 200 volts and 11mA at 300 volts.

For an input voltage of approximately 225 volts, the maximum potential across the smoothest vibrato, \( R_2 \) should be given a value which is sufficiently high to allow the greatest vibrato depth desired to be obtained at all multivibrator frequencies when \( R_4 \) is nearly fully advanced. With some amplifiers it may be found that more than sufficient vibrato depth is available even when \( R_4 \) has the maximum value of 150kΩ specified in the circuit. When this occurs it is possible either

Can Anyone Help?

Requests for information are inserted in this feature free of charge, subject to space being available. Users of this service undertake to acknowledge all letters, etc., received and to reimburse all reasonable expenses incurred by correspondents.

Circuits, manuals, service sheets, etc., lent by readers must be returned in good condition within a reasonable period of time.

ARCHITECTURAL REVIEW

Transformer Paper and Empire Cloth.—C. J. Baker, 17 Fernside Road, Thornton, Nr. Leicester, wishes to locate a dealer in his vicinity with small quantities of these materials. These are required for inclusion within two or three constructed output transistors.

Admiralty Receiver P194.—S. R. Hardcastle, Rigdon Grange, East Kettering, Nr. Northants, requires information on the crystal controlled receiver to variable tuning covering the 2 metre Amateur Band.

Admiralty Receiver P194.—F. B. Mawby, "Cambria", Westcliff,fleetwood, Nr. Fleetwood, would like to receive details of the range of crystals required for this receiver and also the working instructions.

Advance Signal Generator Type B27 and BC211.-Rev. M. D. Phillips, o.b.e., Science Dept., Ampleforth College, York, would be very grateful if any readers experienced with these units and instruction data for these two instruments.

Circuit for Portable Mains TV—S. A. C. Gregory, G.R.S.E., R.A.F, Waddington, Lincoln, Lincs, wishes to obtain details or a circuit diagram of such a t.v. receiver designed as a I.C.P., or something similar, c.r.t. (If any reader has constructed a design of this nature the Editor would also be greatly interested.)
UNDERSTANDING TELEVISION

PART 30

BY W. G. MORLEY

The thirty-first in a series of articles which, starting from first principles, describes the basic theory and practice of television

IN LAST MONTH'S CONTRIBUTION IN THIS series we discussed line linearity controls, and described in detail deflector coil assemblies as employed in domestic television receivers. The available space did not, however, allow us to complete our consideration of coil assembly design and the current article commences by dealing with assemblies employing "castellated" cores. After this we carry on to picture distortion caused by ringing in the line output stage.

"Castellated" Core Assemblies

During the time that 70 degree tubes were employed in this country, deflector core assemblies of the type we have just considered were discontinued by many manufacturers owing to the simpler construction offered by assemblies employing "castellated" cores. Fig. 181 illustrates the construction of an assembly employing "castellated" cores. The method of assembly here consists of fitting two sets of rectangular-shaped coils (one set for line and the other for frame deflection) into the slots of the core. The ends of the coils are then, by means of suitable forming lugs, bent round so that the assembly may be fitted over the neck of the cathode ray tube. The front ends of the coils are, also, usually given a slight flare in order that the assembly can be positioned well forward. Due to the use of "castellated" cores, whose teeth bring the source of deflecting field close to the neck of the tube, much less care has to be taken with coil shaping; and this fact is of considerable advantage in manufacture. Deflection coils using "castellated" cores were largely discontinued when 90 degree cathode ray tubes were introduced, owing to the difficulty of bringing the cores in the assembly sufficiently far forward to obviate the need for corner curving.

In nearly all recently manufactured deflection yokes, whether of the type shown in Fig. 177 (a) or Fig. 180, the cores employed are made of Caslam, Ferroxube or Ferromatic.2 When rings of the type shown in Fig. 177 (b) are made from Ferroxube or Ferromatic, they are normally manufactured in the form of a complete ring which is then broken into two halves by cracking at opposite points. Frequently, V-forms, at 180 degrees to each other, are moulded into the ring during its manufacture to ensure that subsequent cracking occurs at the desired points. The two halves of a cracked ring have to be kept together, and are employed together in the completed deflector coil assembly. Very early versions of the assembly of Fig. 180 did not employ Caslam or ferrite cores. Instead, iron laminations were employed, or a core was provided by winding many turns of insulated soft iron wire around the coil assembly. "Castellated" cores were normally manufactured using Caslam or Ferroxube. The frame deflector coils on early 90 degree versions of the assembly of Fig. 177 (a)

1 These materials were briefly discussed in "Understanding Television", part 27, April 1960 issue.

were almost always wound on formers which were then fitted over the two half-rings of the core. Later versions (notably those employed for 110 degree deflection) have the frame coils wound direct on to the magnetic material itself.

Series or Parallel Connection

The pairs of line and frame coils employed in practical deflector coil assemblies may be connected in series or in parallel, according to the requirements of design. The series method of connection has the slight advantage that both coils of a pair must pass the same current wherever, given equal turns, the deflecting forces offered by each must be equal. If, on the other hand, two coils of equal turns are connected in parallel, it is possible for different coil resistances (due to varying winding wire diameters) to cause more current to flow through one coil than through the other, and the deflecting forces and to "cure". When the coil is cooled, after this process, the resin is set hard, with the result that the coil is "bonded" in the required shape. Occasionally, bonding wire is employed in the frame coils, as well as the line coils, of assemblies such as that of Fig. 180 in order to improve their rigidity. Some manufacturers of "castellated" core deflector coil assemblies used bonding wire for the frame coils providing them also with a marked flare at the forward end) but this practice was not common.

Velocity Modulation

We have, earlier, discussed the fact that shock excitation of the leakage reactance in the line output transformer can cause ringing to occur in its windings, the result of which is that an alternating current at the ringing frequency is superimposed on the sawtooth current applied to the line deflector coils.4 The ringing current has highest amplitude immediately after the shock excitation of the flyback period, this amplitude reducing as the scan period progresses. We shall now consider the visible distortion on the reproduced picture caused by such ringing current.

Fig. 181 (a) A deflector coil assembly employing "castellated" cores. A circular clamp, not shown here, would be fitted around both cores to make the assembly rigid. (b) The main component parts of the deflector coil assembly of (a) become unequal in consequence. In practice, however, parallel-connected sets of coils are used quite frequently, without the introduction of too many difficulties on this count.

Banding Wire

The wire employed in flared line coils is almost always of the bonding type. Bonding wire employs a conventional enamel insulation over which is applied an additional outer covering, approximately 0.0005in thick, of a thermosetting resin, or glue. A coil employing bonding wire is wound in a mandrel which gives it the required shape (or is shaped in a jig after winding). A current is then passed through the wire of the coil in order to raise its temperature; and this causes the resin covering to flow slightly

2 Unequal resistances are liable to cause more difficulty in frame deflector coils than in line deflector coils due to the lower frequency of the amplified frame sawtooth current. The impedances offered by line deflector coils (at line frequency) contain a large reactive component which will tend to mask dissimilar resistances.

3 The term "thermostating", as opposed to "thermoplastic", defines the ability of a material to "cure" or become permanently hard, with the application of heat. Thermoplastic materials soften with the application of heat and may be moulded into new shapes which, when cooled, retain their shape.

4 "Understanding Television", part 27, April 1960 issue.

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change for the whole waveform. Between points C and D, on the other hand, the rate of change of deflection current is slower than the average. Between points E and F the rate of change of deflection current is, once again, greater than the average; whilst, between points G and H it is, once more, less than the average. The effect is repeated for the sections between points J and K, and L and M, respectively, and continues for further cycles until the amplitude of the latter becomes so small as to be negligible. In the diagram the first cycle of the ringing current causes the points is similarly greater than average. Between points C and D the rate of change of deflection current is lower than the average, and spot velocity falls below average velocity in consequence. The same effects appear between points E and F, G and H, J and K, and L and M, the velocity of the spot as it traverses the screen being alternately increased and decreased.

It will be observed that the spacings in time between the pairs of points A and B, C and D, etc., are all equal. Since, therefore, between points A and B the spot travels more quickly than the average, it will cover a greater distance than the average for the period of time concerned. Also, since between points C and D the spot travels slower than average, it will traverse a smaller distance than the average for the period of time concerned. The effect of the ringing current on the motion of the spot tracing out the line on the cathode ray tube screen is illustrated in Fig. 182 (c), the reference letters in which correspond to those in Fig. 182 (b). Between points A and B the line is "open out" whilst, between points C and D, it is compressed. Similar results are shown by Fig. 182 (d), where E and F up to L and M, the alternate expansions and compressions reducing as the scan period advances. The effect, therefore, is that there are instants of sharp transition from faster than average to slower than average velocity, and from average to slower than average velocity, but this is not, of course, true. In actual fact, the changes from faster than average to average, and from average to slower than average within the ringing cycle are gradual, these following the alteration in rate of change of scanning current shown in Fig. 182 (a).

Since the ringing current superimposed on the deflection current varies the velocity of the spot as it traverses the cathode ray tube screen, the process is described as velocity modulation of the scan.

The visual result of velocity modulation due to line output stage ringing on the reproduced lines of the picture is most evident when the area over which the modulation takes place is at a constant contrast level. It will be similarly evident on a blank raster. The effect on a single line is illustrated in Fig. 182 (e), this diagram retaining the same reference letters as were used in Figs. 182 (b) and (c). Between points A and B of Fig. 182 (d) the spot on the cathode ray tube screen travels faster than average with the result that, since there is less excitation of the screen phosphors, the section of line it traces out has lower than average brightness. Between points C and D the spot on the cathode ray tube screen is travelling slower than average, with the result that, since there is greater excitation of the screen phosphors, the section of line it traces out has higher than average brightness.

Fig. 182 (d) illustrates the visible results of velocity modulation: A and B show the picture. Exactly the same result will be evident on all lines in the raster, because the ringing current modulating each line will be in phase with the preceding flyback period. In consequence, if the whole raster is examined the result of the velocity modulation is that shown in Fig. 182 (e), wherein alternate vertical strips of less than average brightness and greater than average brightness appear, these being most manifest at the left hand side of the raster. Such stripes are called striations.

As was just mentioned, the visual result of velocity modulation is most evident when it occurs in an area of constant contrast, or on a blank raster. Due to the characteristics of the screen phosphors, or to subjective effects in the observer (or to a combination of both), the visual result tends to be most noticeable at certain (usually somewhat advanced) average brightness levels; and it is conventional practice to check for the presence of velocity modulation with a blank raster, adjusting average brightness level until any striations which may be present become most pronounced. Unless the modulation is severe, striations tend to be masked when they occur in areas carrying picture detail. They can, however, be distressingly obvious in such areas when the transmitted scene is panned by the camera.
be visibly evident at the left hand side of the picture during a blank raster, or when this part of the picture is at constant contrast level. Such distortion is not usually noticed by the lay viewer, and readers will be able to adjudicate, from their own experience of the reproduction offered by various domestic receivers, the level below which such distortion is tolerable. It should be mentioned that, in some receivers, inaudible ripple currents of velocity modulation are negligible or, even, undetectable.

During practical work on television receivers, striations on the reproduced picture caused by velocity modulation should not be confused with striations caused by amplitude modulation of the cathode ray tube beam at the line output stage ringing frequency. In the latter case, stray couplings between the line output stage and the video amplifier cause the ringing frequency voltage to be superimposed on the signal applied to the modulating electrode of the cathode ray tube. Since the strap couplings cause the amplitude of the beam current to be varied at the ringing frequency, the visible result can be almost exactly the same as that shown in Fig. 182 (a). The striations caused by amplitude modulation of the beam tend, however, to spread across a greater width of the picture than do striations caused by velocity modulation; and they can, in any event, be identified by the fact that they disappear if the modulating electrode of the cathode ray tube is temporarily bypassed to chassis via a condenser having a value around 0.05μF. In early television receivers the stray couplings which caused striations were most frequently the result of capacitive coupling between the lead to the modulating electrode of the cathode ray tube (this lead being unscreened to keep its capacity to chassis low) and the line output stage and line deflector coil wiring. In modern receivers (in which most of the line output stage components and wiring are screened) such couplings may still occur between the lead to the modulating electrode and the leads (if unscreened) to the line deflector coils. Stray couplings via other paths can also, of course, occur.

Cross Talk

Apart from velocity modulation of the line scan, shock-excitation by the line flyback pulse can cause a secondary form of distortion in the reproduced picture. Such distortion occurs when, due to stray couplings, ringing voltages appear across the frame deflector coils and become superimposed on the frame sawtooth waveform. These ringing voltages have a frequency dictated by the inductance and stray capacities of the frame coils. The result is that vertical deflection of the cathode ray tube varies at the ringing frequency, causing the lines at the left hand side of the picture to take up the appearance shown in Fig. 183. The stray couplings are always present and nearly always appear in the deflector coil assembly itself, whereupon protection against the distortion may be considered as being a function of deflector coil assembly design. The fault is frequently referred to as cross-talk in the deflector coil assembly.

A common form of reducing cross-talk consists in connecting parallel resistors across the frame deflector coils, as shown in Figs. 184 (a) and (b). These resistors have values which are much lower than the impedance of the coils on their own at the frequencies associated with the flyback pulse, but which are sufficiently high compared with the impedance of the coils at frame scanning frequencies to prevent undue loss of frame scanning efficiency. Thus, the voltage at the ringing frequency developed across the frame deflector coils is reduced because of the lowered overall impedance.

Since the coupling which causes cross-talk distortion is largely due to the stray capacities between the line and frame coils in the deflection assembly it is obviously desirable to keep these to a low level; and it is helpful in this respect to connect all metalwork in the assembly (including, sometimes, the core) to chassis. The further reduction of stray capacities by such expedients as increasing spacing between the two sets of coils is usually rather difficult to achieve, this being especially true of the more modern deflection assemblies, which have to be very compact at their forward ends.

The stray capacities existing in a deflector coil assembly form a complex network. It is feasible, at first approximation, to reduce them to the case where a capacity couples each terminal of one set of coils to each terminal of the other set of coils, a typical example being illustrated in Fig. 185 (a), wherein we have a pair of series connected line coils and a pair of parallel connected frame coils. If the pulse voltages at the extreme ends of the line coils are approximately equal in amplitude, no undue ringing voltages should appear on the frame coils when opposing pairs of capacities (such as C4 and C2) have the same value. Such a set of circumstances may be achieved in practice by so positioning the line and frame coils that they are exactly symmetrical about each other. Since accurate symmetrical positioning of the pairs of coil relative to each other is, in any case, necessary to prevent picture shape distortion, the almost complete balancing out of capacitive coupling has practically been achieved by the normal manufacturing processes for the deflector coil assembly.

In practice the pulse voltages appearing at the two ends terminals of the line deflector coils are often markedly unequal in amplitude; the voltage on the terminal which connects into the line output transformer winding nearer the boosted h.f. reservoir condenser tap having the lower amplitude. This circumstance is illustrated in Fig. 185 (b). The unbalance in voltages will cause ringing voltages to appear across the frame deflector coils even when the stray capacities

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**Fig. 183.** When line flyback voltages are coupled into the frame deflection coils vertical deflection varies at the ringing frequency of the latter, causing distortion to the line structure in the manner illustrated here.

**Fig. 184.** Distortion due to cross-talk couplings may be reduced by connecting an additional resistor or resistors across the frame deflector coils. A single resistor is employed when the coils are parallel-connected, as in (a); whilst two are used when the coils are series-connected, as in (b).

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**Fig. 185.** (a) The stray capacities between line and frame coils may, at a first approximation, be presented in the manner shown here. (b) In practice the flyback pulse voltages on the line coil terminals may have widely different amplitudes. (c) The effect of unbalance in the pulse voltages at the end terminals of the line coils may be neutralised by unbalancing the stray capacities with the aid of a trimmer connected across the lower line coil.
are symmetrically balanced out. If the consequent ringing voltage appearing across the frame coils is sufficiently high to cause distortion on the picture it may be reduced by connecting a trimmer across the lower section of the line deflection coils, as shown in Fig. 185 (c). This trimmer upsets the state of balance in the capacities coupling together the two sets of coils, and it may be adjusted to neutralise the unbalance between the pulse voltages at the end terminals of the line coils.

Some commercially manufactured receivers have, in the past, used adjustable trimmers with high voltage insulation between plates in the circuit position shown in Fig. 185 (c), but more modern receivers employing this anti-cross-talk device fit fixed condensers having values applicable to the average requirements of the particular production run of receivers being manufactured. Typical values for the condenser lie between 30 and 150pF. Anti-cross-talk condensers are not fitted to deflector coils assemblies having parallel-connected line coils.

The Sync Separator

We have now completed our examination of the time bases and deflection arrangements employed in practical television receivers. The next subject to be dealt with is the sync separator, whose function is to remove the synchronising information from the transmitted signal and to convert this into suitable pulses of correct polarity for application to the line and frame scanning generators.

We shall commence a detailed description of this section of the modern television receiver in next month’s issue.

AN FM TUNING INDICATOR

by T. WINCHCOMBE, Grad. Brit.I. R.E., G3BCW

This article describes an FM tuning indicator suitable for use with phase discriminators or balanced ratio discriminators. It provides an indication of correct tuning when the mean voltage on the audio take-off point of the discriminator is at chassis potential. The circuit can employ readily available “Magic Eyes” such as the Y63, 6U5 or EM34. (The latter should have a separate series 1MΩ resistor for each anode.)

The pattern on the eye consists of two shadows, one due to zero volts and the other due to the discriminator output. When the two shadows coincide the receiver is correctly tuned.

The circuit of the indicator is shown in Fig. 1 and the method of operation is as follows. The eye is calibrated to give a shadow angle of about 45 degrees with zero input. This enables a positive or negative input to be displayed by an opening or closing of the shadow respectively. The discriminator output is fed to the grid via the high resistance of R1 and R2. The diode forms a shunt switching circuit operated from the centre tapped 6.3V heater line. During the half cycle when X is positive and Y is negative the diodes conduct, equal voltage drops appearing across R4 and R6 so that point Z is at chassis potential and has a low impedance to chassis. Any input from the discriminator during this half cycle is dropped across R1 and R3, the shadow therefore indicating zero volts.

On the next half cycle the diodes do not conduct, offering a very high impedance. There is now 2.2MΩ from point Z to earth so that almost all the discriminator output appears at the grid of the “Magic Eye”, the shadow indicating the magnitude and sense of this voltage. This is illustrated in Fig. 2.

A matched pair of germanium diodes may be employed if this is desired, instead of the double diode valve shown in Fig. 1. The diagram also shows how two 47Ω resistors may be connected across the heater winding to provide an effective centre-tap if the heater winding, itself, is not already so provided. The function of the filter formed by the components R1 and C is to prevent 50 c/s a.c. being fed to the audio stages of the associated receiver. Should any difficulties be experienced due to hum injection into the a.f. stages, the value of C should be increased.

Third International Conference on Medical Electronics


The Electronics and Communications Section of the Institution of Electrical Engineers, in association with the International Federation for Medical Electronics, are organising the Third International Conference on Medical Electronics which will be held at Olympia from 21st–27th July, 1960.

The Conference is planned to bring together members of the medical and electrical engineering professions so that each will gain a better understanding of the problems of the other; besides sessions for experts there will also be less specialised meetings to enable those who have no deep insight of the subject to increase their background knowledge. With the many recent advances both in electronics and medicine, it is generally recognised by members of both professions that discussions on medical electronics can do much to stimulate progress.

The scope of the Conference is indicated by the following preliminary subject list:

- Instrumentation for: Medicine and Biology
- Medical Electronics in Space Research
- Isotopes and Radiology
- Ultrasounds and Microwave Radiation
- The Respiratory System
- Digestive System, Metabolism and Biochemistry
- The Circulatory System
- Electronic Aspects of Sight, Hearing and Locomotion
- The Motor and Nervous Systems

In view of the international nature of the Conference it is planned to provide simultaneous translation facilities. In conjunction with the Conference, the Institution is promoting an International Scientific Exhibition which will be held at Olympia at the same time as the Conference, and where the research organisations, universities, hospitals and industrial organisations from all over the world who are working in this important field can display their latest developments.
"I" remarked Dick dispassionately, "you intend going off for a crafty weekend at Brighton after work today, you'll have to sleep on the sands with a case as tidy as that."

For once, Smithy's assistant, no doubt stimulated by the sunny summer weather and the imminence of holidays, had arrived at work before his chief. In consequence, he felt sufficiently privileged to pass comment on the diminutive leatherette-covered case that Smithy carried as he entered the Workshop.

"The fact," replied Smithy, placing the case on his bench, "that your family has kicked you out of the house a little earlier than usual this morning is no excuse for passing comment on my latest toolbox. And the further fact," continued Smithy primitively, "that I happen to carry a small case to work on a sunny Friday morning does not imply . . . ."

"A toolbox, did you say?" interrupted Dick. "Let's have a look."

Smithy decided to forego any further comment on his assistant's opinion of middle-aged predilections, and opened the case.

Portable Foam-suspension Case

"Here you are," said the Serviceman. "What could you have better than this for carrying micrometers, vernier gauges and similar delicate instruments around with you?"

His assistant gazed, impressed, at the inside of Smithy's case (Fig. 1 (a)). "Well, that's a neat idea," he remarked. "Everything suspended in foam! How's it made?"

"Oh, the construction is quite simple," replied Smithy. "You first of all make two similar halves for the case. In this instance the two halves are 11in x 8in x 1in deep internally, and consist of a "frame" of 1in x 1in wood, with a piece of thin plywood or hardboard at the bottom. (Fig. 1 (b)) The two halves are then covered with the leatherette and hinged along one edge to form the case. Finally, catches and a handle are fitted to the outside."

"That seems a very easy process," commented Dick.

"It is," said Smithy. "I knocked this particular box up in a couple of evenings at home. It took me about an hour or so on the first evening to do the woodwork and apply the leatherette, after which I left the case alone till the next evening to allow the glue which secured the leatherette to set good and hard. I then screwed on the hinges, handle and catches, fitted the foam, and the job was complete."

"Ah, yes, the foam! Which is, of course, the whole secret of the case?"

"It is," confirmed Smithy. "The foam is ordinary polyurethane, or similar plastic foam which you can buy at the popular chain stores, and the idea is to fit it into the case halves so that the top surface of the foam is level with the edges."

"I see," remarked Dick. "With the result that, when you close the case, the two lots come together and the whole inside volume is 100% foam."

"You've got it," said Smithy. "With my case the internal depth of each half was 1in and so I was able to fill this nicely with two layers of foam 1in thick. You may be able to get 1in, or thicker, foam if you hunt around, but the readily available 1in foam did the job for me. And it doesn't want to be the form with a sticky surface on one side, incidentally; what you want is just the plain stuff. A spot of glue here and there will hold it in place quite reliably."

"Sounds simple enough," commented Dick. "What I like most about the case,"

continued Smithy, "is that, due to its extreme resilience, the foam takes up the form of whatever items you put in the case and holds them completely suspended. So you can use the case for valves, ferrite rods, or anything else which is fragile, apart from tools.

"Of course, the size of the case doesn't have to be the same as that I've made for myself. Provided that the two lots of foam come together when the case is closed, the dimensions may be whatever you choose. I should add, just to illustrate the capabilities of the box, that one with dimensions similar to mine, and containing two crumbly biscuits, was posted from Abingdon to London. And the biscuits were intact when it was opened at London!"

"Well, that certainly seems to be a good proof of its efficiency," remarked Dick. "It really takes the biscuit!"

Wire-End Cleaner

Smithy's assistant glanced at the Workshop clock, then looked away hastily.

"Any other bright ideas?" he asked quickly.

"Why, yes, I think I have," said Smithy a little absentmindedly. He fished in his pocket. "Ah, here it is. This is a neat little wire-end cleaner. (Fig. 2). It's so simple that it needs hardly any explanation. It consists of two carbordum contact files approximately 4in long by 1in wide, tied or clamped, together at their centre with a 1in space in between. To use the cleaner you simply press the files together at either end, like a pair of tweezers, and draw the wire between them."

1 The originator of the foam-suspension container is Mr. L. H. Brown, Abingdon, Berks.
Dick examined the cleaner.

"The files are quite flexible," he remarked, "and they seem to be made of some sort of resin bonded paper stuff about 25 'thou' thick, with a very small rough edge." 

"Quite honestly, I don't know what they're made of," confessed Smithy. "Anyway, they certainly work very well in this little gadget."

"What's the best way to keep them clean?"

"Oh, cotton covered, enameled and oil," said Smithy, "and I've found that it works very well with the tough synthetic enamels. It's also excellent, also, for very quickly cleaning dirty resistor and condenser leads.

"Which, chimed in Dick, 'to have to be especially clean before you attempt to solder them to things like printed circuits and so on.'"

"You've got it," confirmed Smithy. "And that, so far as acceptable bright ideas and gadgets are concerned represents the lot for now."

"I assume, nevertheless," commented Dick, "that you're still interested in hearing about any further ideas, gadgets or techniques?"

"Oh, definitely," replied Smithy. "Information about things is always very welcome."

Burnt Out Resistors

"And now," said Smithy briskly, having just shaken off the feel of the shop floor, "it's definitely time we got down to some work."

"Well, there's just one little question which has been worrying me recently," said Dick quickly. It bumped into its task, only yesterday, on the last job I did here.

Smithy looked impatient.

"It's already quarter of an hour after starting time," he said severely. "So it had better be a little question!"

"It is," said Dick soothingly, "What's happened to the unit which had the same category as my present trouble?"

"Never lose faith," chuckled Smithy. "What's the cause of the open circuits?"

"That's just the trouble," replied Dick. "I can't find out! Nearly all the resistors which were burnt out were small wire-wound resistors of the same category. I've never had such a case before."

"He's had a few like that before," said Smithy, "and I always suspect a short circuit, either in the valve itself or in its grid coupling condenser."

"If possible, I check the valve for internal shorts in a valve tester, thumping it while it's under test. Or, if the valve is not available, I thump it whilst it's in the receiver to see if it exhibits any faults there."

"The obvious, Dick, is that there's been some short circuit."

"That's right," said Smithy. "But I've always suspected a short circuit, either in the valve itself or in its grid coupling condenser."

Dick probed further. "Is there any fault in the receiver that I can replace the coupling condenser as well."

"And, now, we really must get on with some work!

"With which final pronouncement, Smithy took off his jacket and applied himself resolutely to the work sitting on his bench.

Short Wave Alignment

Reluctantly, Dick turned to his own bench, whereupon he fitted the cabinet to a television receiver whose chassis (bearing the open circuit wire-wound resistor) he had repaired the day before. He checked it over carefully, and, with satisfaction, took it from his bench and carried it over to the "Repaired" rack.

The new receiver Dick picked out was a Long, Medium and Short wave receiver of the average domestic variety. He carried this set to his bench, plugged in an aerial and switched it on. Reception on Medium and Long waves was perfectly normal and Dick's face screwed into a frown.

"There's nothing wrong with this one," he called out.

Smithy glanced over his shoulder at the receiver.

"Have you tried the Short wave band?"

"Short waves? I didn't know anyone even listened to Short waves these days!"

"The owner of that set does," said Smithy. "As a matter of fact, I recognise it as belonging to a friend of mine who warned me it would be coming in for repair. He does a little Short wave listening every now and again."

"On an ordinary domestic receiver?"

"Why not? He's quite happy listening to the stronger commercial and amateur stations. I haven't broken it to him that the whistles he hears on many of the stations are due to second channel interference and that there is no difference on a more specialist receiver having an r.f. stage. He's quite happy playing around with the set as it is."Very well," said Dick, switching the receiver to the Short wave band.

About a minute later Dick's voice became audible again.

"Smithy," he called out, "I know that the Short wave band is pretty quiet on wave lengths longer than 30 metres or so during the day, but should that part of the band fade into complete silence?"

"I heard one or two stations," replied Smithy.

"Then," said Dick firmly, "I've got an intermittent tuning condenser." The technician said Smithy without even turning his head. "It would have been intermittent on Medium and Long waves as well."

"Well, there's something intermittent," said Dick. "I listen! The Short wave tuning condenser now, starting around 15 metres."

As you can hear, the set is quite lively. As I tune to longer wavelengths the set still copes O.K. And if you don't mind."

"And after that there's not a sausage."

"Tune back," commanded Smithy.

"Right. I'm now coming back. I'm at 30 metres, still nothing."

"Tune back and see what happens," Smithy advised. "I bet that the set will stay lively until I tune down past 30 metres again."

"I have no doubt that it will," commented Smithy, "Try a new frequency changer."

With a rather surprised expression, Dick obeyed Smithy's instructions. As soon as the new valve had warmed up, he tuned the dial in various portions of the band.

Dick sat still for a few moments pondering this phenomenon. Suddenly he snapped the bench with his fist.

"Well, I am a chump!"

"I was wondering," chuckled Smithy, "when the penny would drop."

"Why, it's obvious! The oscillator section of the old frequency changer had got tired of life with the result that, whilst it could change the cover of the present set Long, Medium and Short wave bands, it would only work at the high frequency end of the Short wave band. That is, when the Short wave oscillator tuned circuit is in full operation across the band. The oscillator had started working it would continue to do so until I had tuned it down to 30 metres or so, whereupon the efficiency of the oscillator tuned circuit became so low as to make tuning impossible. I would then have to tune to a shorter wavelength than that on which a tuned circuit becomes less effective for it to commence oscillating again."

"That's about it," said Smithy. "And now you've cleared the snag I was obliged to use 30 metres or so as a basis of work."

"Okey-dokey," said Dick obliquely. "Let me get the signal evenly warmed up."

The next five minutes passed uneventfully the peace of the Workshop being interrupted only by the 400 c/s warning from Dick's receiver that the signal was too weak for output to it.

After he finished, he coupled one of the Workshop aerials to his set. His face fell as he remembered the tuning dial of the receiver. "It's worse than it was when I started alignment!" he wailed.

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2 The wire-end cleaner was also submitted by Mr. L. H. Brown, who states that the carbondone contact files may be obtained from Fme and car accessory stores in 1s. 2s. each.

3 Payment is made for ideas employed in "In Your Workshop." — Editor.

THE RADIO CONSTRUCTOR

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The long-suffering Serviceman signed heavily. With an air of resignation he laid his soldering iron down on the bench and traversed the well trodden path over to his assistant's side. Dick moved to one side whilst Smithy checked the alignment.

"You know, you are a bit of a muggins," said Smithy in a matter-of-fact tone. "To start with, you've lined the signal circuits up on the second channel signal—that is, on the high side of the oscillator—at the high frequency end of the band; and even then you aren't spot on. At the low frequency end the signal frequency circuits are below the oscillator, so that you have a vast area in between where there isn't a vestige of tracking between the two tuned circuits whatsoever. With the result that the set is pretty near as insensitive as human ingenuity can make it."

"This seems to be one of my off mornings," remarked Dick dismally.

"Well, it can't be helped," said Smithy philosophically. "I think the best thing I can do is to give you a dem of how I would line up a Short wave band in a set of this nature myself, bearing in mind the fact that the signal tuned circuits are relatively insensitive and that the best way of combating second channel signals is to make the set as sensitive as possible to the correct signals. Before I start, though, I'd better quickly review the sort of tuned circuits you're going to align. (Fig. 3 (a)) The signal tuned circuit will have one gang on the tuning condenser across it, the only component in series being the a.g.c. decoupling condenser. This condenser will have a capacity lying between 0.01 and 0.1µ, 0.05µ being a favourite. In occasional cases the coil may be returned direct to chassis without a condenser at all, either because a.g.c. is applied to the signal grid of the frequency changer via a grid leak (Fig. 3 (b)) or because no a.g.c. is applied to the frequency changer on Short waves."

"No a.g.c."

"That's right. Probably the set designer found that a.g.c. variations caused embarrassing shifts in oscillator frequency and made Short wave tuning difficult. So he cut out a.g.c. to the frequency changer on the Short wave band, leaving it applied to the i.f. valve only."

"Well, that's a turn-up for the book."

"It is, rather," agreed Smithy. "Anyway, let us proceed. The oscillator tuned circuit will have the second gang of the tuning condenser across it and there will be a padding condenser, which will almost certainly be fixed, in series, this having a value lower than the a.g.c. condenser in the signal frequency circuit. A padding condenser will still be present in the oscillator tuned circuit even if there is no a.g.c. condenser in the signal tuned circuit."

"Why not a variable paddler?"

"Because," replied Smithy, "a fixed condenser with a carefully chosen value will cover most discrepancies between coils from set to set. There is the further point that the padding condenser will usually be of the order of 0.022µ, and you would need a pretty expensive variable component to get a value of this order. I should add that both signal and oscillator coils may also have adjustable dust cores, and that these can assist in padding operations."

"The usual range," Smithy continued, "you find is somewhere in the vicinity of 50 to 15 metres, i.e. 6 to 20 Mc/s. (Fig. 4 (a)) I'll stick to Mc/s rather than metres from now on as it makes it easier to explain the alignment process. To which we shall now proceed."

"The first thing to do is to get the oscillator tuned up correctly at the high frequency end of the band. Unless the service manual says otherwise I usually pick a spot around 16 Mc/s or so for this operation. (Fig. 4 (b)) I set the receiver tuning condenser scale to exactly the frequency on which I intend to start business. I then hitch the signal generator with a fairly high output to the aerial terminals, set it to approximately the same frequency, and swing its tuning dial. The signal generator modulation should then come through at two points on its tuning dial, these being spaced nearly 1 Mc/s apart. One of these signals will be below the receiver oscillator frequency and the other will be above; and the reason they are spaced nearly 1 Mc/s apart is because the interval between them will be twice 1 Mc/s in the set."

"So a set with 465 Mc/s i.f.s would respond to signals spaced at two times 465 Mc/s. That is, 930 Mc/s."

"That's the idea," said the Serviceman. "Now, the signal you want is the lower frequency one of the two. So what you do next is to set the signal generator to the lower of the two signals and see what this is in terms of Mc/s. If it is exactly the same frequency as that on the receiver dial, the oscillator is spot-on. If it isn't, you adjust signal generator tuning ever so slightly in the desired direction, and repeat the oscillator trimmer to bring it in at full strength again. You keep doing this until the signal generator frequency is exactly the same as the reading on the receiver tuning scale. The important thing in this process is..."
not to lose the signal as you adjust the oscillator trimmer, or you may accidentally hop on to the second channel. Whist! I've been talking! I've been carrying out this procedure on your receiver, Dick, and now 'walked' the signal generator and oscillator trimmer together until the latter is on its correct setting. I'll just make certain that I'm still on the correct signal.

Smithy experimentally adjusted his signal generator to give an output above and below the frequency to which he had set it. Its modulation could be heard at a setting nearly 1 Mc/s above the figure he had chosen, but there was no response below. Satisfied, he reset the signal generator to the correct frequency. Next, he increased receiver volume to maximum and adjusted the signal generator attenuators so that the modulation was just audible from the receiver loudspeaker.

"Aren't you going to short out the a.g.c. line?" asked Dick.

"There's not much point", replied Smithy, "so long as you use a signal generator output which is so weak it's just audible. If I did short out the a.g.c. line I'd do so at the detector, incidentally, to avoid upsetting conditions near the signal tuned circuit. But, quite honestly, I don't think it's necessary if I run the receiver at maximum sensitivity."

"We march on! My next job is to align the signal frequency trimmer."

"I tried that", complained Dick, "and it made the oscillator go off tune."

"That's very possible," remarked Smithy. "The oscillators in many of these domestic sets 'pull' like ill-hyoo on the Short wave band. But there is a technique to overcome that difficulty. This consists of continually rocking the receiver tuning, or the signal generator tuning, very slightly on either side of the signal, and of adjusting the signal frequency trimmer at the same time. You then get maximum sound each time you pass through the correct tuning point, and you adjust for greatest volume of that maximum sound."

Smithy proceeded to rock the receiver tuning across the signal generator signal, carefully adjusting the signal frequency trimmer for maximum volume of the burst of sound which occurred each time the tuning condenser passed the correct tuning point. As the volume of this sound increased he reduced signal generator output accordingly. He soon announced that the job was completed.

"Well, that didn't take long," said Dick, impressed. "I've got an idea that the set sounds more lively already."

"It probably does," said Smithy. "What's more, it's lively on the correct signal and not on the second channel. Now, if the coils have no dust cores your job is finished and, assuming no faults, you should get lively performance all along the band. If the coils have dust cores we choose a frequency near to the bottom end—say, 7 Mc/s—and start padding. (Fig. 4 (c)) First of all we adjust the oscillator dust core for correct dial calibration, making certain once more that the signal generator output is below and not exactly the same manner as we trimmed. We then go back to the high frequency end and finally re-trim, exactly as before."

Smithy carried out the operations he had just described.

"I sometimes get the impression", commented Dick who had been watching intently, "that the signal generator seems to damp the aerial coils."

"Short wave aerial coil coupling is very tight on some of these domestic sets", said Smithy in reply, "and a certain amount of damping by the signal generator can definitely occur. So, if you really feel keen, it's not a bad idea to finish off the job by connecting a fairly short aerial to the receiver and coupling the signal generator to this by a very low capacity, such as would be given by clipping its output lead on to the insulation of the aerial wire. (Fig. 5.) The signal generator output will still come through if you reduce its attenuation, whereupon you finally trim the r.f. tuned circuit for maximum signal generator output whilst carrying out the same rock 'n' roll business on the tuning condenser as before."

"If you're going to finally align with an aerial plugged in, why not simply trim up on received signals?"

"Because, my lad", said Smithy, "you may pick a second channel signal. Or you may accidentally turn the trimmer too far and lose the correct alignment point, whereupon you mistakenly align on a second channel also. On some sets, you know, there's only about half a turn of the signal frequency trimmer between correct and second channel signals."

Find the Area

Smithy carried out the final alignment of Dick's receiver with an aerial connected, whilst his assistant watched.

"By the way, Smithy," said Dick, breaking in for a moment, "I hope you haven't forgotten that little problem about the area."

"What problem?" replied Smithy, giving the last touches to the r.f. trimmer.

"You know," said Dick. "The one you talked about when we last got together. You have a square with a side of 1in. You draw

Fig. 6 (a) Smithy's problem. A square has a side of 1 in and inside it are drawn four arcs, with centres on the corners of the square, and radius 1 in. The area Next, the lines is a shaded four-sided figure, whose area has to be found. (b) In solving the problem Smithy added reference letters and several further lines. (c) Part of the figure in (b)

walls 1.5 in. high."

..."Every time I turn the r.f. trimmer I get different results!"

"Of course you do! You're only just starting the job."

"But it looks as if I've got a problem."

"Well, go ahead and try."

"I've worked it out on paper and it looks as if the area is 2.3 sq in."

"You've got it!" said Smithy. "It's the area of the shaded four-sided figure, which has to be found."

"You know, it is the area that you said was the problem."

"Well, I was very clever of you, wasn't I?"

"Yes, you were!"

"Anyhow, you can't expect me to work it out on paper, 'cos it's to do with the area of the shaded four-sided figure."

"Right. So that makes angle BAG equal to 60°. Since angle EAG is a right angle, then angle BAE must be 30°. By a similar process I can show that angle EAG is 30°. So I can finally say that angle BAC, consisting of 90° minus two lots of 30°, is 30° also. Any snags so far?"

"Not yet."

"O.K. Now let's pull the section ABDC
out of the diagram like this, (Fig. 6 (c), and add a perpendicular, AK, to BC. The two angles BAK and AKC will now be half angle BAC because AK bisects that angle. So they're each 15°. Now, the area of triangle ABC is \( \frac{1}{2} \times \sin 15^\circ \times 15^\circ \times 15^\circ \) sq. ins.

Hey, hang on a minute,” interrupted Dick, “how can you say that BK is sin 15°, and that AK is sin 15°? ”

“Because”, replied Smithy, “BK is sin 15° x AB and AK is sin 15° x AB. The same applies to AK, relative to AB.”

Dick said, “I’ll take your word for it.” chucked Smithy.

“If we return to the full diagram (Fig. 6 (b) again you will see that it contains a square BCH. Now, we already know that BK (Fig. 6 (b) is equal to sin 15°, so we may say that BC, one side of the square, is equal to 2 sin 15°. Which, to my mind, is 0.5176 ins.”

Dick said, “Something quick like that.”

“I agree with that figure,” he said solemnly.

“Thank you,” replied Smithy, suppressing a grin. “So we now come to the final bit. We have four equal segments, of which BDCK is one. And that, you may recall, had an area of 0.0118 sq. ins. So the area of the shaded four-sided figure is 4 times 0.0118 sq. ins. plus the area of the square BCH.”

That’s easy,” said Dick, excitedly. “The side of the square is 0.5176 ins, so the total area of the shaded bit is 0.5176^2 + 4 x 0.0118 sq. ins.” There was a great flurry of pen and paper and much head-scratching. “Which”, concluded Dick victoriously, “is 0.3151 sq. ins.”

“A figure we can correct,” concluded Smithy, “to three significant figures, making the area of the shaded figure in the square equal to 0.315 sq. ins.”

Research into Outer Space Temperatures

News of further research into the conditions obtaining in outer space comes from Bonn University Observatory which is shortly to begin an intensive investigation into the temperatures prevailing in interstellar gas.

To this end, special amplifying equipment consisting of copper microphones has been manufactured for the University by Marconi’s Wireless Telegraph Co. Ltd. of Chelmsford, England. This consists of a dual channel amplifying system incorporating two travelling wave tubes in cascade in each channel.

The receiving antenna, a parabollic mirror of 83 ft. diameter, mounted on a pyramidial tower about sixty feet high, scans the sky picking up the diffuse continuum radiation emanating from galactic and extra-galactic radio sources under observation. The signals in the neighbourhood of the hydrogen line frequency (1420 Mc/s) are amplified by one pair of travelling wave tubes, the other pair being used to amplify reference noise signals from a resistor at a known temperature.

The outputs from the two amplifying channels are then compared by the observer with the range selected by the effective cosmic temperature then being determined, from these data contour maps are prepared. So accurate has the system proved in initial tests that a discrimination of 0.1K has been achieved.

The research programme at Bonn University Observatory is being carried out under the direction of Professor Becker, who is assisted by Herr Heinz G. Müller.

The travelling wave tubes used were manufactured by the English Electric Valve Co. Ltd.

Mains-operated C-R Bridge

By B. H. SHAW, B.Sc., Grad.I.Mech.E.

This bridge was designed to enable resistors and condensers to be checked in value to a degree of accuracy sufficient for general amateur use, and to provide the facility of condenser leakage checks at a voltage of 250V.

In addition to the above principal use of the equipment it may be used to check a.f. amplifiers, as a variable voltage a.f. signal is available at fairly low impedance. Also, the amplifier section may be used as an a.f. signal tracer.

The circuit accompanies this article, and it will be seen that it consists of three sections: (1) the energising oscillator, (2) the bridge, and (3) the balance indicating amplifier.

The oscillator, employing a 6SN7 double triode valve, was that described in these pages by W. E. Thompson, A.M.I.P.R.E., in June 1957. This delivers a signal at about 1,500 c/s to the bridge via the 1:1 interstage transformer, T1.

The switch S1 selects the required range from the following:

Resistors: 10Ω-10kΩ, 100Ω-100kΩ, 100kΩ-1MΩ, 1kΩ-10MΩ.
Condensers: 1μF-0.01μF, 10μF-0.1μF, 100μF-1μF, 0.001μF-10μF.

The balance potentiometer VR4 provides a very wide covering range of values, the range selected by R1, and its scale tends to climb to the extreme ends. Because of this, very accurate readings are not possible below 10μF and above 1μF, i.e., below 100Ω and above 1MΩ. Readings which would appear at the extreme ends of VR4 scale on intermediate ranges may be more accurately determined by switching to a higher or lower range, as applicable. A common scale, calibrated 0.01 to 100, is fitted to the balance potentiometer, and is employed on all ranges. VR4 is a linear wirewound potentiometer having as large a diameter as possible, and a value lying between 10 and 50kΩ.

The standards R5 and C5,8 are components of 5%, tolerance or better with the exception of C5 and C8. C5 is a 250pF trimmer and this is adjusted to give a balance at 100μF when a 100μF condenser is connected to the test sockets. C8 will probably not be obtainable with the required tolerance stated and must either be selected using another bridge or using the 0.01μF range on the equipment.

The unbalance signal from the bridge is fed via the volume control VR9 to the amplifier which consists of another 6SN7 double triode, and gives adequate output for this purpose. The gain is sufficient to trace an a.f. signal directly from a crystal pick-up. The output is delivered to a 34in diameter p.m. speaker through a small speaker transformer, T2.

The power supply is quite conventional, a mains transformer being used to isolate the chassis from the mains, this being useful if connection is to be made to equipment having a non-isolated chassis. If such connection is made, however, care must be taken to ensure that the equipment having the non-isolated chassis is connected to the mains the correct way round, otherwise the co-axial sockets, bolts, etc., of the C-R bridge will be live and the operator may receive an accidental shock.

The neon condenser leakage test is made by connecting the condenser to the appropriate sockets, thus placing it in series with the neon across the h.t. supply. In the
original circuit and in the photograph, no switch was provided for isolating these sockets from the h.t., so care had to be taken to avoid shocks when comprising a condenser. Because of this, many readers will probably prefer to include the switch S₁ which isolates the sockets until connection has been made, and which, when switched off after a test, discharges the condenser through R₁.

As the layout is not critical, it is not proposed to give a detailed description of the original which was built on a Perspex panel using tag strips to hold the components. Stray capacities round the bridge circuit should be kept to a minimum as these will “blur” the balance point when reading high values of resistance. It is also advisable to keep the oscillator away from the bridge network and amplifier in order to limit unwanted pick-up.

This instrument is extremely simple and rapid in use, and the writer advises its use to check all components before they are assembled into a circuit; this may save a great deal of time at a later stage.

Resistors are simply connected across the sockets marked “R” using leads with crocodile clips, the range switch set to an appropriate position and the balance potentiometer adjusted to obtain the minimum tone from the speaker, the volume control then being turned up as the balance is approached.

Condensers are similarly tested across the “C” sockets and their insulation resistance checked by transferring the test leads to the insulation sockets and observing the neon. This will flash as the connection is made and then remain extinguished altogether, or flash very infrequently, if the insulation is good. Electrolytic condensers may not be tested for value on this instrument as no d.c. voltage is available in the bridge to maintain the necessary correct polarity.

Two components may be matched in value by turning S₁ to a vacant position and placing one component across the “R” sockets and the other across the “C” sockets.

When using the amplifier section for a.f. signal tracing, it will be necessary to prevent break-through of the 1,500 c/s tone from the oscillator. The level of this tone may be reduced to a negligible level by setting S₁ to a blank position and adjusting VR₄.

A USE FOR DISCARDED RECTIFIER VALVES

The rectifier valve in a radio or television receiver is probably the hardest worked valve in the set. Valve rectification is being largely superseded by the metal rectifier and the latest silicon rectifier. However, quite a few valve rectifiers are still to be found in radio and t.v. receivers, particularly in older models. A popular radio of a few years ago, and still giving good service today, was the a.c./d.c. type. There were many different models in this range, but most of them used a simple heater chain, with half-wave valve rectification, and usually a line-cord or an adjustable mains dropper resistance.

In order to reduce excessive heat that had to be dissipated by the series resistance, quite often the output and rectifier valves would have a higher voltage heater rating. A 25 volt heater was quite common. However, in all cases of the series heater method, one important point had to be observed, namely, that all the valves in the chain must have the same current rating. 0.3 amps was a popular current rating, in which case the series mains dropper had to be capable of carrying 0.3 amps continuously without overheating.

Recently, the writer had such a receiver of the type mentioned in for repair. A “cold” test with the ohm-meter across the mains input indicated that the heater chain was intact and also that the on/off switch was functioning normally. Further tests showed that there was a short in the h.t. line. Removal of one of the electrolytic smoothing condensers and replacing it with a new one cured this trouble.

On switching on the set for test, the heaters lit up O.K. but no h.t. was indicated on checking. It was assumed that the failure of the electrolytic condenser had “striped” the rectifier valve, which indeed it had, although the heater had remained intact.

The rectifier valve in question was a type 2SZ4. Reference to the valve data book showed that this valve was a half-wave rectifier, designed for a.c./d.c. receivers. Heater rating was 25 volts at 0.3 amp. Maximum anode volts 250 (r.m.s.). Maximum current 100mA.
Circuit Details
The circuit relating to the rectifier valve in this particular receiver is shown in Fig. 1, together with the key to the base connections. A search through the "spares" box failed to produce any similar type of valve, and some difficulty was experienced in getting an exact replacement. A further search brought to light some discarded t.v. rectifier valves of the type PZ30. These had been discarded from a t.v. through failing emission, although the heaters were intact.

Why not try out this valve as a half-wave rectifier in the receiver?
Results
Fig. 2 shows the few alterations required in the wiring together with the key to the valve base connections of the PZ30.
On switching on the receiver, it was found that the set worked normally. A check of the h.t. showed that 230 volts was available on load. Although the rectifier valve had been discarded from the t.v. set due to

Consulting the valve data book again showed that the PZ30 was a dual purpose rectifier; in fact, it has two separate half-wave rectifiers in the one glass envelope. The heater rating is given as 52 volts with a current of 0.3 amps. Also, the 52 volt heater has a centre tap, which is brought out to a separate pin on the octal base. This turned out to be extremely useful, for only half the heater need be used (26 volts) and no adjustment of the series heater resistance would be required.

BRENTFORD EVENING INSTITUTE
Clifden Road
Brentford
Middlesex

Readers wishing to improve their knowledge of radio servicing or to gain the P.M.G.'s Transmission Licence should note that classes commence at the above Institute on 20th September from 7 to 9 p.m. Classes are held on Wednesday for Radio Amateurs, Tuesday and Thursday for Radio Servicing, and on Tuesday for Morse Transmission, Instruction and Practice. The fee per term is 10s, while that for the full session is 30s.

THE RADIO CONSTRUCTOR
JULY 1960

918

The
continental SIX

Described by P. VERNON

(This article describes a six transistor fully tunable Medium and Long wave superhet with push-pull output. It is a combined car radio and portable receiver.)

—Editor

FROM TIME TO TIME THE WRITER RECEIVES requests from readers to describe a portable receiver that may be used either in the normal manner or as a car radio for use on those occasions when a little music will help to shorten the journey—or at least appear to do so! The main requirements appear to be a receiver that will produce excellent results with the minimum amount of effort, radio know-how and expense.

The “Continental 6” is relatively simple to construct, having a printed circuit board on which the position to be occupied by every component is clearly marked. In this manner, even the veriest beginner will find that wiring errors are obviated and that the assembly is simplicity itself.

Another virtue of this design is its adaptability for use as a car radio simply by connecting the external car aerial to the socket provided at the side of the attractive two-tone vinyl covered case. Such a connection removes all directional properties from the ferrite aerial whilst, at the same time, maintaining the inherent selectivity. Attachment to the car battery is not required, the internal battery of the receiver having a working life, under normal usage, of some four to six months.

The technical specification of the design is shown in the accompanying Table.

Circuit
This is shown in Fig. 1. It will be seen that the circuit is that of a perfectly straight-forward standard design, all the additional information required being contained in the technical specification. Wiring errors are obviated by the use of a printed circuit board, the positions of components being clearly marked. Frequent references to the drawings and illustration given with this article will greatly assist construction.

Assembling and Wiring the Circuit
Transistors and crystal diodes can be damaged by wrong connection or overheating when soldering the connecting wires to the printed circuit board. In order to prevent heat damage, the transistor connecting wires should be held with a pair of thin nosed pliers in such a manner that the heat is conducted away from the transistors whilst being soldered. The printed circuit board itself is quite robust but care should be taken that heat is not applied for longer than necessary to the thin copper conductors. In order to obtain a sound soldered joint, only good quality resin-cored solder should be used. All components should be treated with some care when being fitted to the board and soldered—they can also be easily damaged through bad handling or overheating. It is important that the correct polarity of the electrolytic condensers is observed. Carefully mount the condensers in such a manner that the negative connections are as shown in Fig. 2. Note also that the two germanium diodes must be mounted into position with correct polarity as shown in Fig. 2.

www.americanradiohistory.com
Fig. 1. Circuit of the "Continental 6" combined car radio and portable receiver

Components List
(Set out for easy reference to Fig. 1)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C9</td>
<td>Variable (ganged with C2). Henry's Radio Ltd.</td>
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<tr>
<td>C10</td>
<td>400pF (part of L7)</td>
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<td>C11</td>
<td>0.04µF, 150V ±20%</td>
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<tr>
<td>C12</td>
<td>0.04µF, 150V ±20%</td>
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<tr>
<td>C13</td>
<td>8µF, 6V, electrolytic</td>
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<tr>
<td>C14</td>
<td>13pF ±5%</td>
</tr>
<tr>
<td>C15</td>
<td>400pF (part of L8)</td>
</tr>
<tr>
<td>C16</td>
<td>400pF (part of L8)</td>
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<tr>
<td>C17</td>
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<td>25pF ±5%</td>
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<td>C19</td>
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<td>C22</td>
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<tr>
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<td>C26</td>
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<td>Mazda XA101</td>
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<td>X4</td>
<td>Mazda XB103</td>
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<td>X6</td>
<td>Mazda XC101</td>
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<tr>
<th>Condensers</th>
<th>Description</th>
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<tr>
<td>C1</td>
<td>0.04µF, 150V ±20%</td>
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<tr>
<td>C2</td>
<td>Variable (ganged with C9). Henry's Radio Ltd.</td>
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<tr>
<td>C3</td>
<td>350pF, 125V, Polystyrene, ±1 %</td>
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<tr>
<td>C4</td>
<td>100pF ±3%</td>
</tr>
<tr>
<td>C5</td>
<td>0.04µF, 150V ±20%</td>
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<tr>
<td>C6</td>
<td>400pF (part of L6)</td>
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<tr>
<td>C7</td>
<td>0.02µF, 150V ±20%</td>
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<tr>
<td>C8</td>
<td>8.2pF ±10%</td>
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<th>Miscellaneous</th>
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<td>T1</td>
<td>Transformer, printed circuit mounting (Henry's Radio Ltd.)</td>
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<td>LS</td>
<td>5in speaker, 25Ω (Henry's Radio Ltd.)</td>
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<tr>
<td>VR1</td>
<td>5kΩ semi-log</td>
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<tr>
<td>SW1</td>
<td>3-pole, 2-way, wavechange</td>
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<tr>
<td>SW2</td>
<td>On/off (part of VR1)</td>
</tr>
<tr>
<td>Printed Circuit Board</td>
<td>(Henry's Radio Ltd.)</td>
</tr>
<tr>
<td>TC2a</td>
<td>Trimmer (part of variable condenser)</td>
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<tr>
<td>TC2b</td>
<td>Trimmer (part of variable condenser)</td>
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</tbody>
</table>

The illustrations shown here with give a clear indication of all the component positions. The diagram shows the various circuit boards and control panels mounted on the components and connections. The circuit boards and control panels are mounted on the various sections of the printed circuit board, which is clearly visible in the photographs. The ferrite core is clearly visible in the photographs. The ferrite core is clearly visible in the photographs. The ferrite core is clearly visible in the photographs.
board. The brackets secure the board to the case by means of two 4BA countersunk screws, these being inserted from the front of the case. It will be found that these screws project somewhat through the brackets and care should therefore be taken with the soldering of the board at the rear of the brackets. Bulky soldering here may possibly cause a short circuit. Once secured into position, VR1 together with C2, C9 should be soldered into circuit.

Once the printed circuit board wiring has been completed, the speaker should next be mounted in the case as shown in Fig. 3. The board is not mounted yet. The wavechange switch control may now be fitted to the board and coupled with the wire connecting link shown in Fig. 5. The body of the switch is on the printed side of the board. The short end of the coupling wire must be attached to the wavechange switch before the printed board is mounted into the case, crimping the wire ends of the coupler with a pair of pliers. The switch should be set to the MW position (to the left when viewed from the back of the case), before fitting the coupling wire. The wavechange switch escutcheon is secured to the case ensuring that the letter "L" is fully visible when the control is at the left of two gimp pins. The two station indicators are already fitted and located at the front of the case on either side of the centre of the dial.

Fit the ferrite frame aerial to the board assembly by means of the bracket provided, this latter securing to the rear of the variable condenser by means of two 4BA screws. Complete the wiring to the ferrite frame aerial and wavechange switch which is illustrated in Fig. 3, fitting also at this stage the white lead to point R.

It will be noted that the apertures on the front of the case for the spindles of the tuning and volume controls are covered with vinyl cloth. These should be cleared with the aid of a sharp razor blade.

Mount the printed circuit board into the case. At the rear of the case will be found a small wood block covered with plastic foam. When the circuit board is finally fitted, the end of the ferrite rod aerial may be secured to this block by means of an elastic band, this being slipped into the groove provided on the block. Complete the speaker, on-off switch and battery connections shown in Fig. 3. Also, couple the wire connecting link from the wavechange switch to the cabinet control section, in the manner illustrated in Fig. 5.

The tuning dial and volume control knobs

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**TECHNICAL SPECIFICATION—"CONTINENTAL 6"

A fully transistorized MW/LW circuit incorporating a self-oscillating mixer, two i.f. stages, audio amplifier, and a single-ended push-pull output stage. Both stages include double-tuned transformers. Two germanium diodes are employed, D1 as detector, and D2 assisting the a.g.c. operation as a variable damping element.

1. **Frequency Range**
   - MW 540 kc/s to 1,640 kc/s.
   - LW 160 kc/s to 270 kc/s.
2. **Sensitivity**
   - MW at 1.000 kc/s=140 µV/Metre
   - LW at 210 kc/s=150 µV/Metre
3. **Adjacent Channel Selectivity**
   - MW at 1,000 kc/s=32dB.
   - LW at 210 kc/s=39dB.
4. **I.F. Frequency**
   - 470 kc/s.
5. **A.G.C.**
   - For signal input change of 60dB, output varies less than 6dB.
6. **Power Output**
   - 400mW at 10% distortion into 25Ω speaker.
7. **Image Rejection**
   - 50dB on LW, 38-47dB on MW.
8. **I.F. Rejection**
   - 36dB to 45dB.
9. **Controls**
   - Tuning: Direct drive via integral slow motion to ganged condenser.
   - Volume: Variable potentiometer first audio stage.
10. **Speaker**
    - 5in round, 12,000 line, 25Ω.
11. **Transistors**
    - Mazda: XA102 Self-oscillating mixer.
    - XA101 I.F. amplifiers.
    - XA101 Audio amplifier.
    - XA103 Single-ended push-pull amplifier.
12. **Power Supplies**
    - 4.5V+4.5V dry battery PP11 or equivalent. 150-200 hours life.
13. **Power Consumption**
    - 15 mA under quiescent conditions—average listening level.
    - 25-30mA.
14. **Sockets**
    - Aerial, suitable for insertion of car radio aerial.
15. **Case**
    - Two-tone, vinyl cover, white plastic spring-loaded handle.

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**Fig. 2. Layout of components on the printed circuit board. Connections and wire colours to points R.T. and Y.Z.V. together with the remaining tags A and C on the wavechange switch, are shown in Fig. 3. The oscillator coil L6, L4, L2, must be mounted with the green spot (marked below the coil), relative to the edge of the printed circuit board as shown in the diagram. The I.F. coil L8, L0, should be mounted so that the blank pin locates with the hole NOT connected to the copper pattern.**
should next be fitted. It is essential that the variable condenser spindles, which are "D" shaped, are turned until the "flats" are in line with each other. The station scale is fitted first, this being pushed on in order to clear the first section of spindle. The outer thumb wheel of the dial is then fitted by simply pushing on to the spindle. The volume control on/off switch spindle is also "D" shaped and the control knob therefore also a "push-on" type.

Check the battery lead connections carefully before switching on—wrong polarity or reversed leads may completely damage the transistors.

The circuit will operate efficiently from a source of signals. The respective procedures for these two methods are as follows:

Procedure Using Signal Generator

Equipment Required

Output power meter. (Avometer or similar instrument.)

Modulated signal generator covering the i.f., M.W. and L.W. bands.

Suitable radiator or loop. (The loop used for the accompanying measurements consisted of three turns of copper wire, 0.25 metres (approximately 9\(\frac{7}{8}\)in) diameter, plus a series resistor of 430Ω. The loop should be situated 0.6 metres (approximately 24in) from the receiver ferrite rod.

The completed receiver. Compare with Fig. 3 on opposite page.

Fig. 3. Showing the positions of the speaker, printed circuit board, battery, ferrite aerial, etc., within the case.

car radio aerial, a special socket being provided and affixed to the side of the case by means of two split pins being pushed into the holes already drilled for this purpose.

Aligning the Receiver

The circuit should be aligned by using a signal generator and an output meter. If, however, such equipment is not available, good results can still be obtained by aural methods using broadcast stations as the

I.F. Stages. (For these measurements a 0.5pF capacitor and 820Ω resistor must be used in series with the generator output lead.

1. Connect output power meter across speaker terminals.


4. Connect the signal generator to the base of mixer X1 and with C2 bypassed with a 1μF capacitor, adjust L5 and L7 for maximum output.

**NOTE:** In all cases, signal generator output should be set to the minimum level for an adequate deflection of the output meter.

![Wavechange Switch](image1.png)

Fig. 4 (right). The reverse side of the printed circuit board

![Wavechange Switch Mechanism Looking at the Rear of the Cabinet](image2.png)

Fig. 5 (left). Assembly of the wavechange switch mechanism looking at the rear of the cabinet

5. With the generator connected as in 4, the circuit switched to M.W. and the variable condenser at maximum capacity, set the generator to 540 kc/s and adjust L4 for maximum output.

6. Set the variable condenser at minimum capacity and the generator to 1,640 kc/s. Adjust TC2a for maximum output. Repeat operations 5 and 6 to ensure correct coverage.

**Signal Circuit.** (Remove 1μF from across C2.)

1. Connect loop to signal generator, set generator to 600 kc/s and adjust L1a for maximum output.

2. Set generator to 1,400 kc/s, tune the condenser to 1,400 kc/s and adjust TC2a for maximum output. Repeat operations 1 and 2 to ensure optimum tracking.

3. Switch circuit to L.W., set generator to 220 kc/s, tune gang capacitor to 220 kc/s, adjust L2b for maximum output.

**Procedure Using Broadcast Stations**

1. Connect output meter across loudspeaker terminals.

2. Tune to a strong local station by means of the variable condenser. Turn the volume control to maximum.

3. Orientate the printed board and aerial for minimum audible output.

4. Adjust L4a for maximum output.

5. Adjust L5, L6 for maximum output.

6. Adjust L5, L7 for maximum output.

7. Tune by means of the condenser to a station whose frequency is in the region 540–650 kc/s. Orientate as above for minimum audible output. (This is to prevent the a.g.c. action masking the effects of adjustment.) Adjust L5 for maximum output at correct dial reading.

8. Tune to a station in the region of 1,300–1,640 kc/s. Re-orientate if necessary. Adjust TC2b for maximum output at correct dial reading.

**The “Globe-King”**

**300/A A.G. Mains**

**SHORT WAVE RECEIVER**

Described by James S. Kent

![Short Wave Receiver Diagram](image3.png)

**Probably one of the most frequent requests received by this magazine is that from readers, often young in the hobby, who require a good and reliable short wave receiver, relatively inexpensive and easy to construct. Such a design should serve, more often than not, as an introduction to the hobby, both in the constructional and the operational sense. The romantic atmosphere of Short wave listening and operating is one that most of us know, and remember, with nostalgia, long after we have given up the active listening side of the pastime. The memories of evening and early morning listening sessions, not to mention the long night watches, crowd in upon us as we mentally scan the past.

In his "Introduction to the Short Waves" (Short Wave Receivers for the Beginner—published by Data Publications Ltd.), Frank A. Baldwin, A.M.E.I.R.E., aptly describes Short wave listening, from the beginner’s point of view, in the following manner:

"To the beginner, the Short wave spectrum represents a whole vast unexplored world—a world in which no frontiers exist, no passports are needed and no visas are required. With the aid of a very simple receiver, the beginner is able to explore this new world and to reach into the uttermost corners of the globe. To the new Short wave listener, enthusiastically tuning his receiver for the first time, such faraway places as Pernambuco, Nairobi, Karachi, Kangoon, Goa, Peking and Wellington are likely, given favourable conditions, to burst upon his ears, with their short wave radio transmissions reaching him over many thousands of miles of land and sea."

To those beginners for whom this article is intended, and who have read the above paragraph for the first time, the writer would say two things, (a) there is nothing he can add to the above, and (b) he would recommend this book to them.

**300/A General Description**

This receiver has been designed to operate from an a.g. mains supply of 200/250V. It is perfectly safe to handle due to the inclusion of a double wound mains transformer, and therefore the chassis is completely isolated from the mains. The phone jack is also safe in that it is isolated from the output anode circuit. Three new type fully enclosed coils are utilised, these being of the plug-in variety. Being fully enclosed, they are perfectly safe when handled in the process of coil changing and, in addition, impart a further advantage in that they are incapable of variation with respect to frequency coverage. The range of these coils are as follows: Coil No. 1, 30 to 17.5 Mc/s; Coil No. 2, 15 to 7.5 Mc/s; Coil No. 3, 7.3 to 3 Mc/s. Coil changing is effected by means of the lift-up lid of the attractive grey hammered case shown in the article heading. The use of plug-in coils is preferred in beginner constructed receivers by virtue of the fact that the wiring is very much...
Components List

Resistors
- R1 3.3MΩ ½ watt
- R2 470Ω ½ watt
- R3 180kΩ ½ watt
- R4 10kΩ ½ watt
- R5 50kΩ pot.
- R6 5kΩ 3-3 watt

Cabinet and Chassis
- 12in x 8in x 8in, ready drilled (Johnson's Radio)

Speaker
- Elac 7in x 4in elliptical

Transformers
- Output (Wharfedale OP3)
- Mains (Johnson's Radio)

Dials, Knobs, etc.
- Johnson's Radio

Rectifier
- 200/250V at 30mA

Switches, Hardware, etc.
- Johnson's Radio

Condensers
- C1 50µF, mica
- C2 140µF, variable
- C3 10µF, variable
- C4 140µF, variable
- C5 0.0002µF, mica
- C6 25µµF, 25V, electrolytic
- C7 0.05µF, tubular
- C8 0.005µF, tubular
- C9 0.1µF, tubular
- C10 0.01µF, tubular
- C11 0.01µF, tubular
- C12, 13 0.1µF, 250V, electrolytic

Coils and Holder
- Johnson's Radio

Valve
- ECL80 Mullard

Fig. 1.—Note that centre contact of headphone jack should be connected to opposite side of speaker and not as shown. Headphone jack inset—for C9 read C9.
simplified over that of the wavechange switch method of band changing.

Looking at the heading illustration, the panel controls are as follows: top right, bandspread (direct and 551 drive); bottom, left to right, standby switch: phone jack; on/off switch; volume control; reaction; bandset; on/off indicator panel light. These, with the speaker mesh grill, form an attractive and efficient panel layout.

A 7in x 4in elliptical speaker is mounted on the front panel, this being automatically muted when the headphone plug is inserted into the jack.

Circuit

This is shown in Fig. 1. The aerial is fed, via C1, to the primary winding L1, this being tuned by the variable condensers C5 (bandset) and C7 (bandspread). The grid bias resistor R1, together with the condenser C6, have values chosen to provide a time constant which will produce positive feedback, or reaction, free from overlap or backlash. In a receiver of this nature, this is extremely important if maximum sensitivity and overall performance are to be obtained. The combination of R2 and C4 provides the required bias for the cathode of the ECL80 miniature triode pentode. The secondary winding L2 acts as the reaction component which, in conjunction with the variable condenser C4, controls the amount of positive feedback; in addition to which it also performs as the r.f. choke. The resultant rectified output is then fed, via C3, and R4, to the volume control RV, from which latter point a controllable amount of audio is applied to the grid of the output pentode section. The, by now greatly amplified audio signal is then taken from the anode to the output transformer primary winding, and fed, via the secondary winding, to the speaker. The condenser C9 is included for tone correction purposes. The headphone output is taken direct from the anode via the isolating condenser C8. The send/receive switch is incorporated into the main b.t.+ line.

The power supply circuit consists of the double wound mains transformer, the on/off switch being incorporated in one of the a.c. mains leads. The primary winding is rated at 200/250 volts a.c., and the secondary winding at 175V at 25mA. The heater winding is rated at 6.3V at 0.6A. The metal rectifier is rated at 200/250V at 30mA. The condensers C10 and C11 are included to help remove a.c. mains ripple and obviate modulation hum. The resistor R5, together with the electrolytic condensers C12 and C13, are the required smoothing components, this resistor having a rating of 3 to 5 watts.

Three voltages are included as a guide for testing purposes, these being 170V and 125V on the positive tags of C12 and C13 respectively, and 75 to 80V at pin 3 of the coil holder. All readings obtained under no signal conditions with the volume control RV set at maximum.

Also shown in Fig. 1 are the coil connections, looking at the underside of the holder; the headphone connections and the valveholder and volume control connections.

Assembly

As received, the panel is already drilled. In addition, the valve and coil holder holes are also drilled. Firstly mount into position the valveholder so that pins 4 and 5 are nearest to the side chassis wall. Secure into position by means of two 6BA screws and nuts, not forgetting to mount a brass washer under each nut. Secure to the chassis, in a similar manner with 4BA screws, the coil holder, noting from the photograph herewith the correct orientation of this component, and also that the flanges should be situated on the underside of the chassis. To that screw nearest the valveholder, fit a solder tag, having firstly scraped away the grey hammer finish so that the solder tag makes a good contact with the bright metal underneath. Secure into position the mains transformer and the output transformer by means of 4BA screws and nuts, firstly having scraped away the grey hammer finish under the chassis so that the nuts are firmly in contact with the bright metalising of the chassis via the brass washers. See photograph of above chassis view for the correct positioning of these two transformers. With the output transformer, do not tighten that screw nearest the centre of the chassis as yet—this is also used to secure into position the tabboard at a later stage. Secure into position the aerial and earth sockets.

Mount into position, by means of the metal clip provided, the smoothing condensers C14 and C15, these being both contained within a single metal case. Secure the clip to the chassis by means of a 4BA screw, washer and nut, also mounting under the washer another earth tag. Here again, the chassis must be scraped in order to obtain a good electrical earth connection. By means of the two flat-headed 6BA screws and nuts, fasten the metal rectifier to the chassis with the positive (+) connection nearest the front of the chassis (or nearest the small output transformer), and the minus (−) tag nearest the rear edge of the chassis.

Dealing now with the front panel, secure into position the send/receive switch (extreme left—viewing panel from the front), headphone jack (all washers being behind the panel—none at the front), and the on/off switch.
Before mounting the volume control, the bandset and the reaction condensers into position, the spindles of these must be shortened to approximately 1 inch in length from the end of the threaded portion. Use a fine hacksaw for this purpose (available in any branch of Woolworths at 1s. 6d.) and follow this by "cleaning off" the rough edges with a fine file. As these controls are fitted to the panel, slip on, under the nut, one of the small scales provided in such a manner that the figure 5 is at the top dead centre, then tighten the nut securely. Looking at the three white control knobs from left to right (heading illustration), these are the volume control, reaction control and bandset control respectively. Next, fit the three knobs to the respective spindles. When dealing with the reed control and bandset controls, secure the knobs so that the pointers indicate zero with all the moving vanes out of mesh. The volume control knob should be so fitted that with the spindle rotated fully clockwise, the pointer indicates 10 degrees.

Fit the speaker to the front panel by means of four 6BA screws passing through the panel and mesh and the speaker fixing slots. Secure with small brass washers and nuts. The speaker should be so positioned that the two connecting tags are nearest the left hand edge of the panel looking at the front of the panel. Secure to the panel the on/off indicator light assembly, both the fibre washers being contained immediately behind the panel.

The assembly of the main components is now completed.

Wiring the Receiver Circuit

The first job of work here is to solder the components to the tagboard as shown in Fig. 2. Complete by cutting off to a suitable length all the wire ends of the following components: C6, C7, C10, C11, R3 and R4. Leave sufficient wire so that a couple of turns may be made around each tag, ensuring that the wire ends to be soldered are bright and clean so that a good soldered joint will result in each case. Solder to tags 1 and 7 the condenser C6, taking care that the positive end is secured to tag 7. Connect R2 between tags 2 and 8; C10 between tags 3 and 9; C11 between tags 4 and 10 and C5 between tags 8 and 11. Next, solder R4 between tags 5 and 6. With a short length of p.v.c. covered wire, bare both ends and connect together tags 2 and 4. Similarly deal with tags 7 and 8, using a short length of bare wire, and tags 9 and 10. Having completed this operation, the next task is to mount the main paxolin panel, together with the tagboard, to the chassis underside as shown in the photograph. Note that the correct position of C6 is towards the rear of the chassis. Remove that nut nearest the centre of the chassis which holds the output transformer into position. When in place in the panel position and follow this with the wired tagboard. Secure into position with the nut.

Proceed to wire into circuit the remaining remained board connections as follows: with a length of p.v.c. covered wire, bare both ends and connect one to the earth side mounted under the holding clip of C12, C13. Solder the other end to both tags 1 and 2. (See Fig. 2.) From tag 7, solder a length of p.v.c. covered wire to pin 3 of the valveholder. To tag 9, solder a length of covered wire to pin 8 of the valveholder. From there, the other end of which is then soldered to the positive tag (+) of the metal rectifier (that tag nearest the front panel). Note that here will have to be fed through the rubber grommet at the rear of, and nearest to, the tagboard. To tag 11, solder a length of covered wire to the other end of which is then connected to pin 3 of the coil holder. (See Fig. 1.) To tag 12, connect one end of R3, both ends of this resistor being first covered with systoflex and connect the other end to pin 3 of the coil holder. Also connect to the same tag, a length of p.v.c. covered wire, the other end of which is then soldered to pin 8 of the valveholder. A further connection is made to this wire that the end of which is then soldered to tag 12. The first is then taken, via the rubber grommet nearest the edge of the chassis, to the standby switch. Solder this wire to the end of switch nearest the edge of the panel. The other wire must be taken through a convenient grommet and secured to tag 1 of the output transformer. (See Fig. 3.)

From tag 6, connect a length of covered wire to tag A of the volume control R5. (See Fig. 1 for connections to R5.) Similarly connect tag 4 to tag C of the volume control, feeding both these wires through a convenient rubber grommet. To tag 3 of the tagboard, next solder two lengths of p.v.c. covered wire, and via the rubber grommets, feed and connect one to tag 4 of the mains transformer, and the other to the metal rectifier negative (−) tag. (See Fig. 4 for mains transformer connections.) Connect C5 to tags 1 & 2 of the output transformer. This completes the tagboard wiring.

From the other side, or tag, of the standby switch, solder a wire, p.v.c. covered, of sufficient length to be fed through the adjacent rubber grommet, under the chassis and through the grommet nearest the rear of the chassis, and then solder this end to the white, or plain tag of the condenser C12, C13, i.e. NOT the red coloured tag.

Deal with the remaining connections to the output transformer. (See Fig. 3.) To tag 2, solder a length of wire, feed through a grommet, and connect the other end to pin 6 of the valveholder. Also to tag 2, solder one end of C6, having firstly shorted both suitably shorted wire ends of condenser with systoflex. Solder the other end of C6 to the phone jack tag. (See Fig. 1 for connections to phone jack.) Tag 3 of the output transformer is left blank. With the two enamelled wires coming from the bottom of the output transformer, cover them with systoflex, having cut them to length, scrape away a little of the enamel at the ends to be soldered, and connect one to the top speaker tag and the other to the phone jack. (See Fig. 1.) It does not matter which of these wires is connected to the speaker or phone jack. Connect the other tag of the speaker to the phone jack. To that tag joined to the metal edge of the volume control, solder a length of p.v.c. covered wire, and connect this at the other end to the phone jack. (NOTE: Bend the wire so that it is well clear of the tags and on/off switch which will be discussed later. This last mentioned connection to the phone jack is marked "earth" on Fig. 1.) Next, join tag B of the volume control to pin 9 of the valveholder, using covered wire and feeding this through a grommet.

We now deal with the connections to the mains transformer. With a suitable length of p.v.c. covered wire, bare both ends and solder one to tag 4 of the transformer (see Fig. 4), pass under the chassis via a grommet, and up to the indicator light via the grommet nearest to this latter component. Solder this wire at that edge of the chassis nearest the outside edge of the chassis. With a further length of suitably covered wire, solder one end to the same tag, feed through the grommet, and connect the other end to pin 4 of the valveholder.

Still dealing with the mains transformer,
tags 2 and 3 connect to the chassis solder tag under C12 and C13. Connect tag 5 to the mains input lead. Firstly, pass the mains input lead through the rubber grommet on the backboard of the chassis and tie a knot in the lead, see photograph, then taking any undue strain which may be put upon the lead externally at a later date. Allow sufficient wire for the red lead to reach up through one of the front rubber grommets and on to the on/off switch. The surrounding plastic covering must, of course, be removed to expose both the inner red and black wires. Taking the black wire up through a grommet, solder the bare end to tag 5 of the mains transformer. Red—whose length must be longer than the black lead, should then be soldered to that tag of the on/off switch nearest the center of the chassis. To the other tag of this switch, solder a length of p.v.c. covered wire, pass under the chassis through a grommet and solder the other end to tag 6 of the mains transformer, having of course taken the wire above the chassis via a suitable grommet.

Dealing now with the remainder of the power supply, suitably shorten the wire ends of the resistor R6, cover with sylflow, and solder one end to the white, or plain, tag of the smoothing condensers C12, C13, and the other wire end to the red tag of the same component. Ensure that this resistor does not come into contact with the chassis or any other metal parts.

Continue now with wiring into circuit the coil holder. (See Fig. 1 for base connections.) Dealing with pin 1 first, solder one end of C9, suitably covered with sylflow, to this pin, and the other wire end to pin 3 of the valve. Again to pin 1, solder one end of C1, the other wire end of which is next connected to the aerial input tag contained on the upper chassis wall. (Note: This wire end will have to be extended by soldering to it a further length of sylflow covered wire.) Lastly, to pin 3 of the coil holder, solder a length of wire, take up through a grommet and solder the other end to the small brass tag of the variable condenser C5 (bandset), this being that component nearest the edge of the chassis. Solder a further length of wire to the same tag and the other end of this wire connect to the small tag of the bandspread condenser C2, alongside the speaker. These wires must, of course, be p.v.c. covered. With pin 2 of the coil holder, simply connect this to the adjacent earth tag.

We already have two connections to pin 3 of the coil holder and we must now add a further length of wire; pass up through the rubber grommet and solder the other end to the small brass tag of the variable condenser C4 (reaction).

To pin 4 of the coil holder, solder one end of a length of wire, p.v.c. covered, the other end of which is then soldered to pin 1 of the valveholder.

Return now to the above chassis deck wiring. With a suitable length of bare wire, solder one end to that tag of the volume control which is connected to the outer metal casing of this component. From there, continue the wire and solder to both the large white metal tags of the brass variable condensers C3 and C4. (Note: These are the earthy connections of these components and are those tags uppermost and nearest the front panel of the receiver. Continue the same wire, and solder, to the remaining unconnected tag of the pilot light assembly. From this point, cover the wire with sylflow and solder the far end to the earth tag of the bandspread condenser C5. Midway between the two brass condensers, to this bare wire, solder a further length of wire, p.v.c. covered, take through the rubber grommet, and solder the other end to the earth tag alongside the coil holder.

Lastly in the wiring-up process, we deal with the remaining few connections still to be made to the valveholder and earth socket. Obtain R1, shorten the wire ends and solder one end to pin 2 and the other to pin 3 of the valveholder. To pin 5, solder a short length of covered wire, connecting the other end of this to the earth tag alongside the coil holder. To the earth socket tag mounted on the rear wall of the chassis, solder a length of wire, the other end of which is then connected to that earth tag nearest the coil holder. A further length of wire will be required to the ear tag mounted on the rear wall of the chassis, passed through the chassis, and connected at the other end to the outer metal casing of the smoothing condensers C12, C13.

This completes the wiring details of the receiver. Beginners, for whom of course, this article is intended, should now carefully check over the wiring—both against these textual instructions and the circuit diagram.

Operating
Having checked the wiring, place into position the indicator bulb, the valve, and the coil number 2—this being the best choice for our purpose. Connect the aerial and earth to their respective sockets. Connect the mains input leads to the a.c. mains and switch on the receiver on/off switch and the standby switch. Set all dial controls to read zero. Allow a few seconds for the valve to warm up and proceed as follows: Volume control, rotate to read 10 degrees (first dial from left); Bandspread, rotate to read 90 degrees (micro-slow motion dial); Bandset, rotate to read 4 degrees (third dial from left);

Table I

<table>
<thead>
<tr>
<th>Frequency Mc/s</th>
<th>Band</th>
<th>Bandset</th>
<th>Metres</th>
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<td></td>
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<td></td>
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<tr>
<td>30-28</td>
<td>0 to 0.5</td>
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<tr>
<td>21.75</td>
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<td>9.5</td>
<td>5.5</td>
<td>Broadcast</td>
<td>31</td>
</tr>
<tr>
<td>7.5</td>
<td>10</td>
<td>Broadcast</td>
<td>40</td>
</tr>
<tr>
<td><strong>Coil No. 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.3-7</td>
<td>0 to 1</td>
<td>Broadcast/Amateur</td>
<td>40</td>
</tr>
<tr>
<td>6.2-5.95</td>
<td>2</td>
<td>Broadcast</td>
<td>49</td>
</tr>
<tr>
<td>5.05-4.75</td>
<td>4</td>
<td>Broadcast</td>
<td>60</td>
</tr>
<tr>
<td>4-3.5</td>
<td>8</td>
<td>Amateur</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>Broadcast/Commercial</td>
<td>100</td>
</tr>
</tbody>
</table>

Signals, especially long distance—or DXT-transmissions. Now rotate the fast drive of the bandspread either side of the 90 degree mark until a signal is heard. Fine tune with the slow motion drive, this being the outer control knob. A little practice and some experience with this excellent receiver will soon enable the operator to compile a list of known frequencies and to spend many happy hours searching the various bands for those interesting and intriguing transmissions that emanate from every part of the globe. For c.w. (more) operation, the reaction control should be slowly advanced until the detector goes into gentle oscillation—heard in the headphones or speaker as a breathing sound. Headphone operation is recommended when searching for those distant, and sometimes elusive DX signals.

For the guidance of beginners, Table I shows some actual frequencies, against dial readings, obtained with the prototype described herewith.

The "Continental 6" (Continued from page 926)

9. Repeat operations 7 and 8 to ensure correct coverage.
10. Set tuning dial to station selected for operation 7. Adjust L2b for maximum output.
11. Set tuning dial to station selected for operation 8. Adjust TC2b for maximum output.
12. Repeat operations 11 and 12 to ensure maximum tracking.

Switch to Long Wave band and tune to a local station. Adjust L2b for maximum output.

Car Aerial Coil
Car aerial pick-up coil L2 is placed on the rod between the Long wave winding (Lb) and the mounting bush, the two wires from the coil connecting to aerial socket. The short length of orange wire fitted to the ferrite aerial connects to C of the wave-change switch.

Next Month

A Portable Oscilloscope,
Low-Power Transmitter Modulator,
High Sensitivity Shorted Turns Tester, etc., etc.

JULY 1960
In order to calculate a typical bandwidth occupied by an f.s.k. teleprinter radio signal, we must first decide the amount of shift to be employed. This is generally in the order of 800 c/s of the h.f. bands, and this figure will be used as a basic approximation in calculations.

Since we are dealing with frequency modulation which is varying by 800 c/s from one extreme to the other, we can imagine that there is a central carrier frequency which is being shifted plus/minus 400 c/s. Admittedly, this carrier is never transmitted in reality, but looking at it from this point of view makes it rather easier to understand. If we imagine a central carrier on 3,700 kcs, being frequency modulated by a teleprinter signal, then the outer frequencies corresponding to Mark and Space will be 3,700 kcs, while that corresponding to Space would be 3,699 kcs, and the signal as a whole will occupy a bandwidth equal to the total shift—i.e. 800 c/s. It may be stated at this point that there is no standard laid down as to whether Mark or Space raises or lowers the transmitted frequency—but this is of little importance as will be seen when receiving systems are discussed.

It can quickly be seen that the "bandwidth" on the keyboard must be the total shift produced by the modulation, but this is not quite all. During transition from Mark to Space the carrier is rapidly changing from one frequency to the other, and since sidebands must therefore be generated, it has been shown in earlier articles that the rapidity with which this change takes place is governed by the number of harmonics of the fundamental 25 c/s signal which we are prepared to pass from the transmitter to the receive position—and we have also concluded that transmission of the third harmonic was sufficient, i.e. a frequency of 125 c/s. For our "modulation frequency" we have, therefore, 25 c/s, 75 c/s and all frequencies corresponding to maximum figures, and we must now consider the overall bandwidth required to transmit this composite signal by f.m.

As all f.m. enthusiasts will know, the detailed calculation of the bandwidth of these signals is very involved—but for our purpose a very simple treatment will suffice. Assuming that modulation is 100% (as it must be with teleprinter keys), the criterion of an f.m. signal is the ratio between frequency deviation and modulating frequency. This formula is, of course, a modulation index. Using a standard shift of 800 c/s (which will be 400 c/s relative to the imaginary central carrier), our signal will have three modulation indices (400/25 = 16, 400/75 = 5.3 and 400/125 = 3.2).

Reference to any frequency modulation textbook will reveal a diagram or table which indicates the bandwidth, or number of sidebands, appropriate to various modulation indices. We may summarise by saying that when the modulation index is 16, sidebands up to the 25th will be significant, when the index is 5.3 then nine sidebands will be present, and when the index is 3.2, five sidebands will be present. At first glance this looks a pretty grim picture until calculation is carried further. Twenty-five sidebands of 25 c/s only equals 625 kcs, and sidebands of 75 c/s equals 675 kcs and five sidebands of 125 c/s equals 625 kcs. Further, the 75 c/s and 125 c/s sidebands of the signal are only 1/3 and 1/5 the amplitude of the main transmission, being somewhat attenuated at the start. It appears therefore from the above that transmission will not need to be transmitted to 675 kcs either side of the imaginary central carrier, making a total bandwidth of 1,350 c/s—but, in fact, this is being rather generous and in practice satisfactory operation can be obtained by limiting the sidebands to plus/minus 500 c/s, making a 1 kc bandwidth overall. Although it might appear from the foregoing that all the harmonics could be transmitted, since the lower modulation indices that result with the higher frequencies, but since these sidebands only exist at the moment of transition from Mark to Space or vice versa, they will sound like key clicks, being very objectionable, particularly to local stations. Some sort of low pass filter, therefore, attenuates all frequencies above 125 c/s, should be employed between teleprinter and modulator. It may, in practice, be a mechanical clicker or simply a low pass filter which is not used—this may be due to several different reasons, one of the most likely being that since frequency modulation is normally produced at the oscillator, the subsequent passage through the doubler and/or amplifier tuned circuits will attenuate the upper harmonics before they can do any harm. It is, however, far better to use a filter in the first case, these types of key clicks being most objectionable when they occur.

In the above example we quoted the shift as being plus/minus 400 c/s—i.e. 800 c/s in all. This figure has largely become standard on the h.f. bands, although there is no essential reason why the amateur should use it, except it is most desirable that a definite standard is laid down. Reducing the shift will reduce the bandwidth occupied and this would, of course, be beneficial on the amateur bands, particularly as it would enable teleprinter...
signals to be copied through the simple type of crystal filter found on some older receivers. There is a figure for minimum shift which can be employed, but this is in the order of 60 c/s, being bound up with the operating speed in bands, and will obviously not concern the amateur. If amateurs were to use, say, 400 kHz working through interference would be possible, though increased stability on the part of transmitters and receivers is, of course, necessary. If two transmitters working on the same frequency are amateurs and stations use unstable equipment these days, therefore the use of reduced frequency shift should be seriously considered.

Having calculated the bandwidth involved in the use of this system, let us now examine it as a practical working system for use in the crowded h.f. bands. It can be said straight away that other amateur users cannot grab at the frequency without the interfering signal figure arriving at being much lower than that required even for "well-tailored" telephony. It is far greater than that required for c.w., although it must be borne in mind that since communication speed is 66 w.p.m., the receiver will not be on for as long as would be required to transmit the same amount of intelligence by c.w.—note—the equipment point of view, no large modulator is required, and the methods by which frequency control of this sort can be brought about are remarkably simple as well will be seen later. Overmodulation is impossible, and in fact the signals being transmitted, since the on/off shock wave is absent.

The system will obviously discriminate against many types of interference. Since it is essentially F.M., discriminator circuits precede limiters and can be included at the receiving end, fading becoming of no importance (unless the signal fades completely when any communication system must fail). The Space and Mark signals are transmitted, interference cannot occur during an "off" period as with amplitude modulation. The amount of interference that can be tolerated is really a receiver problem and will be dealt with under that section, it being clear at this point that the system is likely to show up well from this angle.

Selective fading can be troublesome at times—when perhaps either the Mark or Space signals will disappear. Suitable receiving coils with this at least limited extent of absence of one signal leaves an open path for interference to cause trouble.

The system caters adequately for the preservation of the d.c. component and a Mark signal can go on indefinitely. During this time, the receiver is protected against random bursts of interference and will only receive when a Space signal is received.

Distortion of the signal may appear in any radio system, though this is not likely to trouble a properly designed system. When reflected signals are received a fraction of a second later than those arising by a shorter path or, under certain circumstances, when signals of different frequencies are received at the same time, spurious short paths round the world. With amplitude modulation, the effect will be the prolongation of the original signal by the later reflected one. With the f.s.k. system this is not so troublesome since any reflected signal is likely to be weaker than the direct one. The receiver is arranged to follow the strongest signal so that if this direct signal changes from, say, Mark to Space, and there is still present a much reduced Mark signal due to reflection, the receiving circuit should move directly to the Space condition, responding to the full strength Space signal rather than to the weaker Mark. Of course, under very adverse conditions, strong multiple reflections may occur and then printing is likely to be faulty. All known conditions where c.w. signals flare suddenly, especially in low RTTY is unlikely to work them! Sometimes the Mark and Space signals, being on slightly a different frequency, will follow different paths, thereby causing the original position to be misplaced on arrival at the receiving end—in other words, distortion occurs. Nothing can be done about this—though by means of special repeaters the signal may be cleaned up before being passed to the printer. However, this is delving more into the commercial than the amateur field, in view of expense involved, and the necessity for commercial communications to receive 100% copy at all times.

To achieve one other mode of transmission to consider—is one which is really a receiver problem and will be dealt with under that section, it being clear at this point that the system is likely to show up well from this angle.

Selective fading can be troublesome at times—when perhaps either the Mark or Space signals will disappear. Suitable receiving coils with this at least limited extent of absence of one signal leaves an open path for interference to cause trouble.

The system caters adequately for the preservation of the d.c. component and a Mark signal can go on indefinitely. During this time, the receiver is protected against random bursts of interference and will only receive when a Space signal is received.

At the receiving end it is well known that the output of the modulation contained in a carrier cannot be as great as that of the carrier itself, therefore a much larger signal will be needed at the receiving end in order to produce a useful output signal compared with the forward f.s.k.

The combined a.m./f.m. system (known as "amplitude modulated f.s.k.", or "a.f.s.k.") can, however, achieve one result that the a.m./f.s.k. system cannot—and that is to handle several different teleprinter signals simultaneously. Two or more printers can be used at the transmitting end, each working into different audio oscillators and producing different pairs of tones. These tones can all be amplitude modulated to the carrier, being separated by audio filters and passed to different printers at the receiving end. This enables multi-channel information to be conveyed on one carrier. A much modified form of this system can be applied to the h.f. bands, and will be mentioned again later, although multi-channel systems have little application in the amateur field.

The paper will also show that for normal h.f. teleprinter operation the only satisfactory method is to use a "flash" mark. A visible run in an inspection lamp up from the house lighting. This should be suspended somewhere in the loft to shed as much light as possible. The loft forms an ideal "heat-trap" and it is not advisable to work there for long periods. Come down for a "breather" occasionally. Also, particularly in old houses, the loft may be very dirty, so go suitably clothed. Having considered most of the general points, we can now consider the various aerials in detail.

**Loft Aerials for Fringe Area Reception**

By F. E. ASH

ANYONE who lives in a fringe area, with usually a Christmas tree appearance of the house, must have problems with aerials for Bands I, II and III. Local authorities are also disturbed by it, and in many cases insist that shared aerial systems are being installed.

From the point of view of appearance, there is a good case for employing internal aerials, if these can be used in fringe areas. From the constructor's point of view, such aerials can be made easily and installed without much trouble. The cost is relatively low, being only a few shillings, whereas the cost of an H aerial plus erection cost is about £10, and that of an F aerial about £5.

It must be remembered that the signal strength inside a building is very much lower than outside, and an internal aerial must therefore have a higher gain than an external one to give a signal of comparable strength to the receiver. On the other hand, an internal aerial does not have to face the weather, and can therefore be made much lighter and less robust than the outdoor type. Light copper rods and even lighting flex can be used for the elements. It is possible, in view of the greatly reduced cost, to add suitable output from the internal aerial so that it will give a better signal than an outdoor aerial.

Before venturing into the loft—a few words of warning. Stand only on the joists, not the regions between, otherwise you may descend to the bedroom below, and your "cheap" aerial may cost you a lot in ceiling repairs!

A tip is to put a few lights across the joists to make a working platform. Some form of lighting will be necessary. A candle is being dismissed, and the best run in an inspection lamp up from the house lighting. This should be suspended somewhere in the loft to shed as much light as possible. The loft forms an ideal "heat-trap" and it is not advisable to work there for long periods. Come down for a "breather" occasionally. Also, particularly in old houses, the loft may be very dirty, so go suitably clothed. Having considered most of the general points, we can now consider the various aerials in detail.

**Band I Aerial**

The main problem here is the question of height. A dipole for use on Channel I measures about 50 ft from tip to tip, and as the maximum height of most lofts is only about 8 ft, some special design must be employed. One solution is to use a "short aerial" as illustrated in Fig. 1. For vertically polarised transmissions an ordinary dipole will have its maximum dimension in the vertical plane, and the short aerial will have its maximum dimension in the horizontal plane across the wavefront.

A more adaptable aerial is the ground plane type illustrated in Fig. 2. Basically the normal array can be cut in half along the
To avoid serious mismatch, a folded dipole aerial is used. Most t.v. receivers have an 80Ω input, this being the impedance of a dipole aerial at the point of feed. The addition of a reflector reduces the impedance to about half this value, and the addition of a director reduces the impedance by a further factor of two, giving an impedance of about 20Ω for a normal 3-element array. When a dipole is folded, the impedance is increased as the square of the number of "elements" in the fold. This a single folded dipole has a centre impedance of 80 x 2² = 320Ω, and the addition of a reflector and director brings the impedance back to 80Ω. Further directors may be added without seriously affecting the impedance.

A further advantage of using a folded dipole is that it has a wider bandwidth than a normal dipole, which is a useful asset as the addition of reflector and directors tends to reduce the bandwidth of an aerial.

Dimensions are given in Table 1 for all Channels in Band I. The key dimension in making your own aerials is \( \frac{\lambda}{4} \). This will be the length of one arm of the dipole. Elements behind the aerial must be slightly longer (about 5%), whilst elements in front of the aerial should be slightly shorter, again about 5%. Various systems of spacing can be used. All the aerials considered in the present article are designed so that the reflectors are spaced slightly more than \( \frac{\lambda}{4} \) from the dipole, whilst the directors are spaced slightly less than \( \frac{\lambda}{4} \). Some references give a reflector spacing of 0.15 and a director spacing of 0.1 as giving optimum gain, but in general close spacing of the elements results in a lower aerial impedance than that quoted above. Some designs employ equal spacing (of about 0.2) for all elements.

The following formulae may be useful to constructors designing their own aerial arrays:

- Dipole length = \( \frac{462}{f} \)
- Reflector length = \( \frac{476}{f} \)
- Reflector spacing = \( \frac{246}{f} \)
- Director length = \( \frac{434}{f} \)
- Director spacing = \( \frac{140}{f} \)

The above answers are in feet, where \( f \) is in MHz; \( f \) is taken as the mid-frequency of the transmitted signal.

**Band II Aerials**

Fig. 4 shows a suggested aerial for reception of the B.B.C. f.m. transmissions in Band II. It may be found that your f.m. receiver will work with a length of flex of suitable length along the picture rail or even inside the cabinet. But a much higher signal, with consequent improvement in signal/noise ratio, can be obtained by installing a loft aerial.

The aerial illustrated has a centre impedance of about 20Ω, and there is therefore a mismatch when connecting to a receiver with an input of 80Ω. The solution would be to use a folded dipole as in the case of the Band I aerial already considered, but practical tests show there is no noticeable improvement when doing this. If the aerial input to the receiver or tuner is for 300Ω, the mismatch would be more serious and in this case it might be advisable to use a folded dipole.

Alternatively, a slight alteration to the receiver would give a better match. Fig. 5 shows a balanced 300Ω input, and the changes necessary to use this with an 80Ω coaxial cable.

The "backbone" of this aerial is again made of timber, and the elements of copper rods. An alternative arrangement consisting of ordinary lighting flex mounted on a wooden frame is shown in Fig. 6. It is a lot easier to make folded dipoles with flex than it is with copper rods. Great care must be taken in bending copper rods.

It will usually be necessary to assemble both the Band I and Band II aerials in the loft itself. The "backbones" may be drilled and the elements cut to the right length in the workshop. Drill holes in the aerials in the positions shown to attach the aerial down-leads.

**Band III Aerial**

The dimensions of a suitable aerial for Band III reception are shown in Fig. 7. This should be mounted as high as possible in the roof. A folded dipole is essential in order to obtain a reasonable impedance and adequate bandwidth. Owing to the relatively small size of this aerial it may be possible to construct this entirely in the workshop and then install it in the loft. The construction of this aerial is similar to the two previously described. The folded dipole in this case is made of strip metal, which is easier to bend than copper plated rods. The number of elements used will depend upon the signal strength. An alternative construction is shown in Fig. 8. In this case a wooden framework is employed, and the elements are made of flex or similar wire. This array is very directional, having a pronounced forward lobe in its polar diagram, but also a number of secondary lobes. Two such arrays mounted side by side 0.5λ apart, and connected in parallel, have an improved forward gain, and the secondary lobes are entirely eliminated.

**Aerial Down-leads**

Most modern t.v. receivers use coaxial cable in preference to twin feeder. The Band I aerial illustrated is unbalanced and ideal for coaxial cable. The Band III aerial is, strictly speaking, balanced, but can in fact be used with coax, without any ill-effects. The upper part of the folded dipole should be connected to the inner conductor and the lower one to the outer. It is recommended that low loss coaxial cable is used for the Band III aerial.

The Band II aerial should preferably be
An alternative method is to take the cable out under the eaves, down the outside wall, and back in through the edge of the window frame. When doing this the cable should be chipped back to the wall at frequent intervals, and should be led down and up through the window frame. (See Fig. 9.) This prevents rainwater from running down the feeder and into the room.

Positioning the Aerials
Because of its height, the Band I aerial will probably have to be placed near the centre of the loft, under the peak of the roof.

If the Band II aerial is laid on the joists, it must be clear of the ground plane of the Band I aerial, and on the signal side of it.

Avoid pointing aerials at water tanks; if possible, place the aerials so that any water tank in the roof space is behind the aerial.

If the Band II aerial must be placed over the ground plane, it should be supported at least 2 ft above it. It is not advisable to drive nails into the joists: tin tacks (or staples in the case of the ground plane) can be used. If wooden struts have to be fitted, screws should be used.

The Band III aerial should also be placed well away from the ground plane, otherwise its polar diagram may be severely distorted. Mount it as high as possible in the loft. All three aerials should be installed facing roughly in the direction of their respective transmitters.

Aerial Orientation
Having installed the aerial it must be oriented for the best possible results.

The simplest method of doing this is to run a pair of leads from the loudspeaker in the receiver to an extension loudspeaker or pair of headphones in the loft. The aerial can then be oriented for maximum signal.

If the receiver is of the "live chassis" type, care should be taken to ensure that the extension speaker leads are not alive.

The Band I aerial can be mounted by means of a screw and a cocoon tin lid, as illustrated in Fig. 10, and is then easily drop in signal strength is noticed. Mark these points, and set the aerial to the mid-point of the arc.

The Band II aerial can be aligned in a similar manner. The maximum will not be clearly defined. The Band III aerial, on the other hand, has a much narrower angle of acceptance, and the maximum is therefore more sharply defined.

### OBITUARY
It is with great regret that we have to record the recent death of Centre Top, Mr. R. E. Copp, G2DUV.

We know from the letters Centre Top received that many of our readers will feel a sense of personal loss on learning this sad news. "Radio Miscellany," which Centre Top contributed regularly to this magazine for more than a decade, before ill health intervened, was a very popular feature and revealed much of his personality and the wide range of his interests.

To his widow, on behalf of our readers and ourselves, we extend the deepest sympathy.
RADIO

TOPICS

BY RECORDER

IT WON'T BE LONG BEFORE THE NATIONAL Radio Show is upon us again. I find myself looking forward to it this year with a little extra whetting of my appetite because of the absence, in April, of the usual R.E.C.M.F. component exhibition. The latter has gone to ground for the moment and will emerge once every two years in future.

I must confess that my approach to the Radio Show these days is rather more blase than it was when I made my first visit quite some years ago. I now find myself looking around for friends and acquaintances almost as much as for new and interesting design trends. The reason for this is probably the current tendency of many exhibitors to concentrate on showing cabinet styling and the like rather than on demonstrating "the works". One can hardly blame them for this: attach yourself to any group around a stand featuring, say, television receivers and note how much more frequently you hear, "Coo, isn't the woodwork lovely?" than you hear, "Not so bad, old man, I think they've even managed to go two and a half megohms higher."

To the general public the appeal of a domestic receiver rests more on its external appearance than on its performance, and this fact is largely appreciated by the manufacturers. Whilst there is the comforting fact that a predispersion is growing amongst budding television set purchasers to check performance more critically than in previous years (this being due to the fact that they are buying replacement sets and know from experience what a reasonably good picture should look like), it is quite true that the term "oscillograph" is used by comparison with the performance of several receivers in Television Avenue (that dates this story!) we had, as it were, a quite a comfortable strolling brief. The main stand had, as an attendant, one of the uniformed sergeants who are members of the Earls Court staff. When my friend and I arrived, we found that he had everything completely weighed up. "The sets are going fairly well," he announced, as we arrived an hour and a half before the Exhibition opened. "The first set on the left is a bit poor on interface. And I shouldn't run the middle set on the I.T.A. signal if I were you, because I think its tuner's a bit dirty. It's O.K. on the B.B.C. signal, though. The others are going quite nicely."

We switched over exactly right, and adjusted the height controls to give a slight amount of overscan (that was in the days when "frame shrinkage"-loss of height due to mismatching of the frame areas as they warmed up—was rather more prevalent than it is today). We next checked the sets in Television Avenue and decided that we then had a boring hour or so of waiting before the doors were opened to the public. This was not to be, however. In the next minute Test Card C, fed from the studio in the Exhibition Hall, had developed from the receiver screens around us and we were confronted with the face of the Exhibition compère, who then proceeded to give a seemingly funny programme just for the benefit of the engineers and sales staff in the building. This impromptu show ended with a long and very solemn appeal for someone to look after two children who had been discovered sleeping in one of the stands and who had presumably been locked in all night. Just as they were scattered amongst us was a melting of the "children" was flushed on to the screens. They turned out to be two coloured ladies of uncertain age and marked distinction.

After that, a sober Test Card C returned to the screens and, when the public entered a quarter of an hour later, the Exhibition was pervaded by the correct and proper atmosphere of modern electronic efficiency.

Which? Reviews TV Sets

The May issue of Which?1 contains a report I have been looking forward to seeing for some time. Which? is a monthly publication which gives details of tests carried out on branded products available to the public, giving recommendations in many cases on what the Association feels to be the best value for money amongst the range tested. Brands are quoted by name and details of shortcomings, or failures during the tests, are recorded. This style of writing in Which? is almost always beautifully crisp, technical details being presented and explained in a manner which is not only capable of being understood by the lay public but also cut to the minimum number of words without the introduction of inaccuracies due to over-simplification.

The report in the May issue of Which?2 covers tests carried out on nineteen different makes of TV receiver and whilst, for various reasons, it would be preferable for me not to give a detailed description of the tests themselves, I think I can say that they were of a commonsense nature and were adequately done and carefully explained. Only once was I puzzled by the report, this being due to a reference to a whistle other than line output transformer whistle which was evidence on some receivers. The source of this whistle was not identified.³ In the conclusion of the TV set review, the Consumers' Association state what they consider to be the best value for money amongst the range of receivers tested.

An Oscillograph By Any Other Name

During my thirteen years (ta-ra!) in the Services I once made the acquaintance of an Irishman who had developed to a fine art his particular contribution to the social life of the camp at which we were both stationed. Whenever my friend spotted a group of people in animated conversation he would join them. After a few carefully chosen interjections on his part the group would suddenly find itself engaged in bitter argument, under cover of which my friend would unobtrusively depart.

If ever there had been an Order of the Wooden Spoon, Paddy would have been its Patron.

I am convinced that, when his Service career ended, my Irish friend attached himself to groups of electronic engineers in a similar fashion. I agree that the only way I can explain the acrimonious wrangles about terminology which continually appear in the correspondence columns of our "more technical" magazines. Without having to refresh my memory by looking up the material I can distinctly remember quarrels in print over the use of such words as "valve", "datum", "oscillograph" (in place of "oscilloscope"), "potential", and many more.

Whilst such discussions are of considerable interest to those who indulge in them, I don't feel that they achieve a great deal. I must admit in fairness, though, that a partial degree of success has been evident in the case of "oscillograph" which is more correct than "oscilloscope". The recommended change in terminology here, and elsewhere, has not extended down to many of the engineers handling these instruments, however, as they still rely entirely on the abbreviation

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1 Published by Consumers' Association Ltd., 333 High Holborn, London, W.C.1.
2 Since writing these notes I have been informed by Consumers' Association that "the reference is to a heterodyne whistle with the line tone band."
An Impromptu Group Board

by S. Pollard, ZS9AI

When a quick hook-up is wired to try out a circuit, there is always a danger that floating connections between the wide ends of resistors may short to the chassis if a suitable blank terminal cannot be found for anchoring them.

The nearest way of mounting resistors and small condensers, once the apparatus is wired in its final form is, of course, a group board. It is rarely worth the trouble of designing a group board layout in the hook-up stages, as changes may have to be made before reaching the final version.

An old valve holder serves admirably as an impromptu group board to anchor floating “hot” connections—such as the junction between a decoupling resistor and an anode of a valve resistor. It can be mounted flat on the underside of the chassis in any convenient position as the wiring proceeds. It is necessary to drill only one hole in the chassis to mount a hook-up tool needed for stamping out and forming a mass-produced product is known as a suite of tools. Just how grandiose can you get?

Quite a lot of confusion was caused in the word-mongers’ camp a few years after the war ended when it was found that many plugs had appeared in the industry which, whilst having bodies capable of being inserted into sockets, made connection to pins therein and were, therefore, of the nature of sockets themselves. At the same time, the completeness of members, whilst accepting the plugs, still had pins, whereupon they took on the nature of plugs! The arguments on nomenclature for these hermaphrodite assemblies waged for quite a long time and it was finally capped, to my mind, by a delightful limerick which appeared in the correpondence columns of Wireless World around 1954. I cannot trace the particular issue (and I would be in the debt of any reader who can help me out here) but the limerick was constituted from memory, went something like this:

An etymologist said, very smug,
As he looked into “socket” and “plug,”
“If you have a male socket,
Why not call it a pluglet?
And refer to its plug as a sag?”

STEREOPHONIC BROADCASTING


The monograph discusses the various methods by which stereophonic programmes can be produced for sound recording or broadcasting, with particular reference to stereophonic reproduction under domestic conditions.

The problem of transmitting stereophonic programmes on existing radio-frequency channels, while providing for “compatible” reception on ordinary broadcast receivers, is considered; the principles and potentialities of the main systems so far proposed are discussed. Attention is drawn to the difficulties which would arise in distributing stereophonic programmes to transmitters by lines at audio frequency.

A brief reference is made to the possible application of stereophony to television sound.

This monograph is No. 29 in the B.B.C. Engineering Monograph series and can be obtained from the B.B.C. Publications, 35 Marylebone High Street, London, W.1., or through newsagents and bookstallers.

MODEL RAILWAY DEMONSTRATES PHOTOCELL APPLICATIONS

An ingenious method of demonstrating the industrial applications of their latest photo-conductive cadmium sulphide cells, which work without intermediate amplifiers, was employed by Mullard at the 1960 Instruments, Electronics and Automation Exhibition. Mullard installed, on their stand, a model railway consisting of 30ft of track complete with two trains, a level crossing, points, and a station. The entire operation was controlled automatically by the cells. Typical instances of the control provided were the ringing of an alarm and subsequent opening of the level crossing gates on the approach to a train (analogous to clearing the way in a factory for mechanical handling gear), prevention of collision at points and junctions (analogous to factory designations), the switching of trains into pre-selected routes by recognition of coding symbols on the engines (analogous to pre-selected routing of industrial products), and indication of train position on a remote indicator panel (analogous to automatic conveyer progress monitoring).

TEMPORARY MAINS CONNECTIONS WITH SAFETY

Temporary connections without plugs and sockets to the mains is a source of shock hazard, and especial attention to this point has been paid in the design of the Rendal Safebox Mains Coupler*, recently introduced by Rendal Instruments Ltd., Burgess Hill, Sussex. The Safebox consists partly of a plastic platform on which are mounted three clips capable of taking the three stripped ends (live, neutral and earth) of the mains lead to any appliance. The Safebox is also provided with a plastic lid which, when lowered, completely shrouds the clips and lead ends. Interlocking contacts in the lid isolate the clips when it is raised, thereby allowing connections to be made without risk of shock. Provision is made for fusing the live line up to a maximum of 13 amps. The Safebox may be secured in any convenient position on the bench or on a wall.

HAM HOP CLUB MEETING

The recent welcoming of Mr. John F. Dormois, W3GDH, of Kansas City, the World President of the International Ham Hop Club, by Mr. G. A. Partridge, G3CED, Hon. Gen. Sec. of last month’s Radio Topics at Broadstairs, was given very adequate coverage in the local Thanet Times for 24th May. Also present were Mr. and Mrs. Ken Mitchell, Mr. Mitchell, ZS1R, is national representative for South Africa. The Thanet Times report included a full description of the aims of the club and was presented alongside a four column photograph of Mr. Dormois, Mr. and Mrs. Mitchell, and Mr. Partridge in the latter’s shack.

AUTUMN AUDIO FAIR IN SOUTHPORT

The Autumn Audio Fair, 1960, will be held at The Palace Hotel, Southport, on Friday, Saturday and Sunday, 7th, 8th and 9th October.

Excellent road and rail communications make Southport convenient for the large populations of Liverpool, Manchester and Lancashire generally.

Full details will be sent to potential exhibitors in due course.

The organisers are Audio Fairs Limited, 22 Orchard Street, London, W.I (WELbeck 9111).

[946] THE RADIO CONSTRUCTOR JULY 1960 [947]

www.americanradiohistory.com
Smoothing Circuit

DESIGN

by R. H. PALMER

Although the average constructor takes great care in the design of most equipment, the design of the power supply unit smoothing circuit is normally left to tradition. That is to say, a pair of 8uF's and any choke which fits the space available.

As a rule this method gets away with it, but the time comes when the H.T. supply is required to have a minimum ripple voltage in the output. When this occurs, the following procedure may be used to decide the components needed.

Consider the full-wave rectifier with capacitor input filter, the most widely used circuit. Ripple frequency - 100c/s. (See Fig. 1.)

\[ I_1 = \frac{1}{\omega^2LC} \quad \text{(in amp)} \]

As \( RRF = \frac{V_2}{V_1} \), then \( LC = \frac{RRF}{\omega^2} \)

Multiplying by \( 10^6 \), \( LC = \frac{RRF \times 10^6}{\omega^2} \quad (\mu F.H) \)

This answer divided by the value of the choke available gives the minimum value of \( C \).

Example

Required output of 250V at 60mA with ripple voltage not more than 0.1V.

Full-wave circuit with \( C_r = 16 \mu F \).

(a) \( I_1 = \sqrt{2} \times I_d = 1.414 \times 60mA = 0.085 \text{ amps} \)

(b) \( V_1 = I_1 \times X_C = 0.085 \times \frac{1}{2\pi f C} = 8.5 \text{ volts} \)

(c) Required ripple = 0.1V

\[ RRF = \frac{1}{85} = \frac{1}{\omega^2LC} \]

85 = \( \omega^2LC \)

\[ 85 = \frac{1}{40 \times 10^4} \]

(e) Multiply by \( 10^6 \), \( 85 \times 10^6 = 212 \mu F.H \)

(f) Using 10H choke, the value of \( C = \frac{212}{10} = 21.2 \mu F \), in practice 16\( \mu F + 8 \mu F \) in parallel.

Load resistance = 1,000 hens"y

When the power supply is required to deliver a large current, better regulation is obtained by using a choke-input filter. The design procedure is similar except that there is a minimum value for the choke. This is to prevent the rectifier being destroyed by surges of current, especially important with gas-filled valves.

Minimum value of choke

\[ C = \frac{800 \times 10^6}{\omega^2L} \]

(c) Multiply by \( 10^6 \), \( C = \frac{800 \times 10^6}{40 \times 10^4 \times 3} = 60 \mu F \)

This is impracticable, so either \( L \) must be increased or a double section filter used.

I.A.R.U. Region 1 Conference

-Folkstone June 13th-17th

It is surprising that the work of the International Amateur Radio Union, particularly that carried out by Region 1, is not better known to the amateur radio fraternity. One feels this acutely on occasions such as the Region 1 conference, recently held at Folkstone, Kent. Quite apart from the extensiveness of the agenda—which has to be considered by several individual committees in order to cover the whole ground during the five days of the conference—the enthusiasm of the delegates is such that it would convince even the most sceptical that amateur radio is a hobby of unparalleled vitality. Generally speaking, Region 1 of the I.A.R.U. covers the countries of Europe. Region conferences are held, more or less, once every three years, a different "host country" staging the conference on each occasion. Last year, Sweden and Rad Godseberg have been recent venues, this time it being the turn of the United Kingdom. The Radio Society of Great Britain had the responsibility of organising the conference on this occasion—which they very ably arranged at the Grand Hotel, Folkstone. A total of some fifty delegates attended from Italy, Western Germany, Eire, Norway, France, Luxembourg, Great Britain, Finland, Yugoslavia, Sweden, Belgium, Switzerland, Holland and, for the first time, from Poland. Mr. A. L. Baddeley, W1GBD, well-known secretary of the A.R.U. and a distinguished visitor and observer.

The pattern for the future development of amateur radio may well be set by the deliberations of these delegates. Among the items on the present agenda for instance are such matters as draft specifications for amateur transmitters and receivers. The ultimate intention here is to reach an agreement on the technical and mechanical standards to which amateurs, or commercial firms building this type of equipment for sale to the amateur, must work, in the full knowledge that when such designs comply with these specifications they would bear a recognised hall mark of approval.

RTTY is just getting started in this part of the world and another paper presented for consideration deals with the technical standards to be used in this mode of communication. A special committee will consider the question of v.h.f. activity in the Region, much discussion appearing likely to revolve around the future development of amateur radio emergency services. Interest in this aspect of amateur radio has been greatly stimulated by the recent series of floods, earthquakes and other natural catastrophes, in which amateur radio communications have played a prominent role. Amateur television, reception of radio signals from inter-planetary satellites, s.s.b. interference by amateur radio transmitters with essential t.v., and other radio services are but a few of the items which catch the eye as one turns the pages of the document which the delegates will have to consider. The bright sunny weather which graced the opening sessions and brought added beauty to the picturesque town of Folkstone gave many of the delegates a favourable impression of their first visit to the United Kingdom.

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