Practical TELEVISION

NOVEMBER 1965

2/-

UHF TEST OSCILLATOR

A NEW DESIGN FOR THE HOME CONSTRUCTOR

Practical Television

COST OF PROGRESS

NOVEMBER 1965
VOL. 15 No. 182

We had a remarkable and delightful dream the other night. A committee was discussing Colour Television Standards and as the talk of NTSC, PAL, colour bursts and luminance signals rose to an ear-splitting crescendo, a lone voice, clear and penetrating, cut through the babble with devastating impact: "But do we really *need* colour TV?" After a short stunned silence, the delegates rose cheering and chanting "Abolish Colour TV!"

At this point consciousness returned, but for a delicious moment or two we basked in this illusory world without a colour TV problem, a beauteous idyll somewhat akin to that moment when the dentist triumphantly displays that vindictive molar in his forceps.

Yet are we alone in this dream? Many people are still dubious about colour TV, including no less than Mr. Sidney Bernstein, chairman of Granada Television, whose recent letter to *The Times* argues that now is *not* the time to launch out on colour. Another eminent chief, Lord Thomson, chairman of Scottish Television, is quoted as having similar views—basically that the country could use the money to much better advantage on more urgent priorities.

If we have colour TV, it will cost plenty! Receivers will be expensive; the cost of rental will be high. But it doesn't end there. The BBC is financed partly from licence fees, and from Government grants. Since it has no commercial source of revenue the additional heavy cost of colour transmissions must be borne, in some way or another, by viewers.

If the BBC has colour, the commercial companies must also have colour if they want their share of the TV audience. Where will their money come from? They could cut their profits, get more advertising, or increase their rates. If not they would also need Government financial aid.

So—there will inevitably be problems, even if ultimately the powers-that-be have a rush of blood to the head and in a moment of reckless abandon actually decide on colour standards. And the country —which means the public—will have to pay for it. In terms of viewing pleasure and in national prestige it obviously *is* desirable. And in the cause of progress, it seems, we shall just *have* to afford it!

THIS MONTH

OUR NEXT ISSUE DATED DECEMBER WILL BE PUBLISHED ON NOV. 18th

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TELETOPICS

BREMA COMMENTS ON FUTURE OF TELEVISION

THE British Radio Equipment Manufacturers' Association has announced its future policy on television. It says that the industry's views can be summarised briefly as follows:

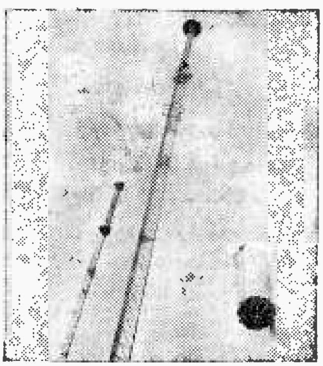
(a) All programmes, whether on v.h.f. or u.h.f., should be on 625 lines.

(b) A commercial competitive programme should be introduced on 625-line standards as early as possible.

(c) Colour television should only be introduced on 625-line standards.

(d) A colour television service should be introduced at the earliest possible date.

(e) A decision on the colour system to be employed should be taken immediately. In the light of recent developments and in the interests of European standardisation the industry would not oppose the adoption of the PAL colour system.



MODIFIED MASTS FOR UHF

BRITISH Insulated Callender's Construction Co. Ltd. is carrying out modifications to several BBC television masts so that BBC-2 u.h.f. coverage can be extended. The picture shows one of two 16ft glass fibre aerial extensions encased in protective wrapping being hoisted to the top of the original 750ft mast at Wenvoe, near Cardiff. In the background is the newer 625ft mast used for the BBC's television service to Welsh viewers.

S.T.C. SOUND AND VISION AT THE ABBEY

WHEN Her Majesty the Queen unveiled a memorial plaque to Sir Winston Churchill after the 25th anniversary service commemorating the Battle of Britain on Sunday, September 19th, visitors to Westminster Abbey not having direct sight and sound of the ceremony were able to see and hear the proceedings via television monitors and a permanent sound reinforcing system installed by Standard Telephones and Cables Ltd.

Twenty-seven 23in. and two 19in. K-B receivers manufactured by Consumer Products Division of S.T.C. were disposed at places in the Abbey where direct vision of the audience was obscured. There were also two 11in. K-B Featherlight sets placed in the belfry for the use of the bellringers.

BBC-2 EXTENSION AT TACOLNESTON

THE BBC has awarded a contract to R. G. Carter Ltd., of Norwich, for the construction of an extension to the existing transmitter building at Tacolneston to house the u.h.f. transmitting equipment for BBC-2.

The u.h.f. television service from Tacolneston is expected to start in the autumn of 1966. It will bring BBC-2 to some 500,000 people in Norfolk and the northern parts of Suffolk.

UHF AERIALS FOR DURRIS & DOVER

THE Independent Television Authority has placed a contract with E.M.I. Electronics Ltd. for the supply and installation of u.h.f. aerial and feeder systems on existing masts at the ITA transmitting stations at Durris, near Aberdeen, and Dover.

Both aerials will have a 30ft aperture and will be mounted on a steel column at the top of the masts. Each will be enclosed in a 6ft diameter glass fibre cylinder for weather protection.

Durris aerial will have omnidirectional radiation pattern and will be capable of handling four u.h.f. programmes. Dover aerial will have a directional pattern designed to avoid power wastage over the sea and interference with Continental stations. The aerial will occupy only 15ft of space and will be able to transmit two programmes. Space will be left for a second aerial to handle two further programmes.

OPENING OF TWO UHF RELAY STATIONS FOR BBC-2 IN THE LONDON AREA

THE first two of the new BBC-2 u.h.f. television relay stations for the London area are being brought into service. The **Hertford** station started operating on October 11th and the **Tunbridge Wells** station will start on October 25th.

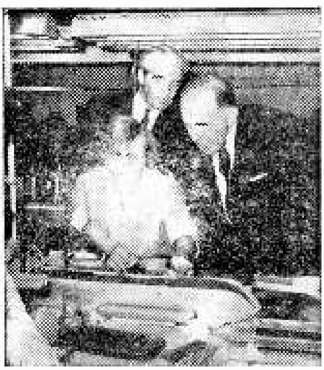
The Hertford relay station transmits on u.h.f. channel 64 with vertical polarisation and serves some 23,000 people in the Hertford and Ware areas.

As the transmissions from these relay stations are vertically polarised it is important that u.h.f. receiving aerials designed for reception on the appropriate channel with vertical elements are used. Viewers should consult their television dealers, who will be able to advise on the correct type of aerial to use and reception conditions for their area.

The Hertford and Tunbridge Wells stations are two of the four relay stations being built to fill in the gaps in the coverage of the Crystal Palace BBC-2 transmitter where, due to the screening effect of intervening high ground, BBC-2 reception from the latter station is not satisfactory.

A further two stations, to serve the Reigate and Guildford areas, will be brought into service later. It is planned to build more of these BBC-2 relay stations in other parts of the country as the main BBC-2 stations are brought into service.

M.P. Visits Mullard Transistor Factory



MR. MAURICE ORBACH, Member of Parliament for Stockport, recently paid a visit to the Hazel Grove, Stockport, factory of Associated Semiconductor Manufacturers Ltd. (one of the development and production centres for Mullard transistors and other semiconductor devices).

The picture shows Mr. Orbach (right) being shown one of the stages of transistor production by Mr. G. Fitton, unit manager of the Transistor Production Department.

EXPERIMENTAL COLOUR TELEVISION TRANSMISSIONS

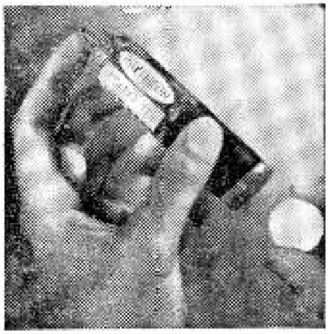
THE schedule of BBC experimental colour television transmissions from Crystal Palace Channel 33 is now as follows:

Afternoon Transmissions.—Mondays to Fridays inclusive, 1400 to 1700. These transmissions consist of 15 minutes of test card in black and white, 10 minutes of colour bars and 35 minutes of colour slides in each hour. During the latter period there will be occasional colour films on one afternoon each week.

Evening Transmissions. —Mondays, Wednesdays and Fridays. These transmissions consist of live studio scenes and colour films for 20 to 45 minutes following the close-down of BBC-2.

The transmission characteristics of the PAL colour television system are as issued in June, 1965.

MIDGET CATHODE RAY TUBE FROM RAYTHEON



THE Raytheon Co., of Massachusetts, U.S.A., has introduced a 1in. cathode ray tube, type CK1410P11. This tube has a high resolution matrix of 21 by 32 lines of information on its 1in. face and can be used in airborne photographic survey systems to present reference data on the aeroplane's position.

In a typical system the high brightness tube presents a faceplate configuration that is photographed simultaneously with the terrain below an aircraft. The resulting edge mark on the film can be used to pinpoint the aircraft's location when the photograph was taken.

A low-voltage tube for use with transistorised airborne systems, the CK1410P11 employs electrostatic deflection. The tube is 1in. in diameter and only 3in. long.

E.E.V. AT SYMPOSIUM

ENGLISH Electric Valve Co. Ltd. took an active part in the exhibition associated with the Third Symposium on Photoelectric Image Devices as Aids to Scientific Observation held at the Imperial College in London recently.

For the benefit of important scientists who came from many countries E.E.V. mounted the demonstration of their ELCON target Image Orthicons which was previously shown at Montreux in May. This showed that even after being focused for several minutes directly on to a spotlight there was no image retention.

A Transistor Test Oscillator for U.H.F.

BY R. B. ARCHER

WHEN the BBC began test transmissions on Band V a few years ago the writer described in this journal a signal generator intended to assist the experimenter to line up and adjust a receiver for the broadcasts. This instrument used vacuum tubes, was mains powered and covered only Band V. While it was useful in its own way the time soon came for a more up-to-date version and the design described in this article is an attempt to meet present-day needs in a modern manner.

This instrument is fully transistorised and is thus independent of domestic mains. There is, in fact, not a great deal of advantage in dry battery operation except that the "capital" expense of mains transformer, rectifier and smoothing components is avoided, because unless the matter is given proper attention loss of calibration as battery voltage drops in use can be a nuisance. However, the mains lead is a most effective distributor of stray radiation, especially at high frequencies, and to be able to dispense with this simplifies the quite thorny problem of preventing such leakage. For the home constructor battery operation at u.h.f. is particularly useful, since without precision machining facilities he can usually approach the high degree of screening needed.

The u.h.f. oscillator consists of a transistor arranged in a tuned-line Colpitts circuit, the common-base configuration being employed. This type of circuit is widely used in u.h.f. work whether transistors or vacuum tubes are utilised, since the inductive and capacitive circuit elements are much more manageable in regard to physical size than if any attempt were made to use very small coils and capacitors. Also the mechanical stability of this arrangement is inherently better, while losses tend to be lower if proper care is taken. In fact while a complete u.h.f. television tuner needs a specially made three or four gang capacitor—following an appropriate tuning "law"—this instrument needs only readily obtained components.

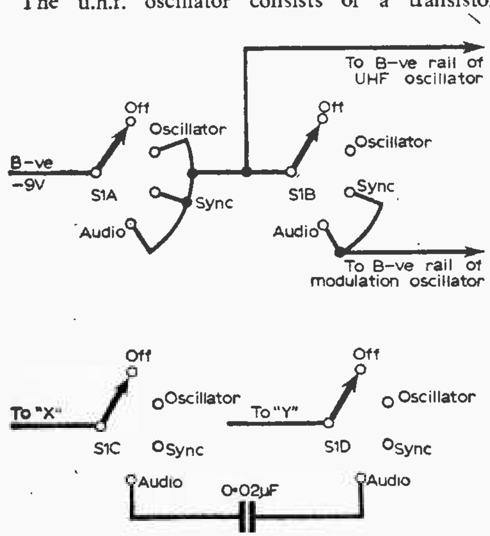


Fig. 1—Details of function switch.

The transistor specified is the GMO290 by Texas Instruments, Manton Lane, Bedford. It is available at an early delivery date at a very reasonable price. This device is capable of oscillation at 1,000Mc/s or even at a higher frequency, so no difficulty will be experienced in getting the circuit going.

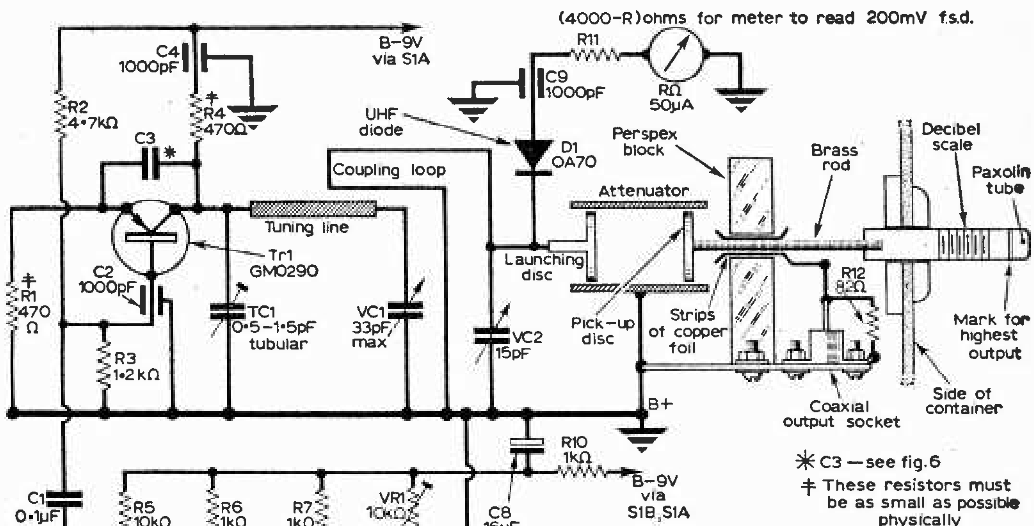
The modulator is arranged to supply line signal pulses only, although in fact irregularities in the switching waveform do actually provide something more than a blank raster when the signal is picked up by a television receiver. The provision of a complete interlaced pattern, with both live and field signal pulses, would require much more comprehensive circuitry and it would cost much more to build the generator. While this might be desirable for the service engineer, the home experimenter will perhaps find the modulation afforded sufficient for his needs.

The modulator can be switched so as to give an audio signal instead of sync pulses and the frequencv of this signal is a reasonable compromise between audibility and complexity of switching. While a little on the high-pitched side—about 2·5kc/s—it is at least distinctive! Care has been taken in design that the audio modulation causes the least possible frequency modulation of the carrier. This may seem a little surprising at first; having in mind that the receiver circuitry is intended to receive frequency modulated transmissions it may seem odd to ensure that little or nothing is actually heard when the signal is received! However, it will be remembered that when an f.m. signal is detected the discriminator has to be adjusted so that amplitude modulation disappears. Tuning the detector consists in rotating the discriminator inductor core to get a sharp null point when an amplitude modulated signal is being received. Thus a signal generator is most useful for alignment if it is capable of providing an a.m. carrier with little or no frequency modulation superimposed.

The attenuator is of the cut-off-waveguide type. The greatest difficulty exists in constructing an attenuator of the resistive type which will be useful at the ultra-high frequencies. Stray capacitances are a source of great trouble, since they offer reactances comparable with the value of the resistance itself. Also the physical size of resistors is not a negligible fraction of a wavelength; hence the voltage-current relationship along a resistor is not the same everywhere and its real value is very different from its d.c. or low-frequency value. In addition, and for the same reason, radiation is emitted and can be picked up elsewhere in the attenuator. While the exercise can be carried out it is not one for the man without a well-equipped laboratory!

The cut-off-waveguide attenuator neatly side-steps these difficulties by not using resistors at all and by employing radiation as the means of transferring energy. In Fig. 7 the elements of this device, usually called a "piston", are shown. It consists simply of a hollow tube of a good conductor (usually copper or brass) whose diameter is small compared with a half-wavelength of energy to be transmitted. At 100kc/s the half-wavelength is 15cm and a tube some 1in. in diameter or less would be suitable. At one end an insulated metal disc is connected to the source of energy, while separated from it is another insulated disc which receives energy, acting as a receiving aerial.

A TMO, *1* wave is propagated down the tube from the launching disc and because the tube is too narrow to sustain such a wave the attenuation is severe. The amount of energy picked up by the receiving disc is thus very small. However, the amount of attenuation in decibels is exactly dependent on the spacing of the two discs and if the receiving disc is movable its position will be on a linear decibel scale of attenuation. The relationship is so precise that anybody who has access to a good machine shop can make for himself a primary standard attenuator working on this principle. The method used in this instrument is much less precise than this but nevertheless gives excellent results. Fig. 2 shows the circuit diagram and also indicates the way in which the attenuator is supplied with "input". The signal at the launching disc is maintained by means of a u.h.f. diode and a microammeter with a series resistance enables it to read 200mV (full-scale deflection). This meter is in a way optional, since the instrument will work without it. It does enable the attenuator input to be brought to a definite value, however, and hence for the instrument output to be more meaningful. The adjustment



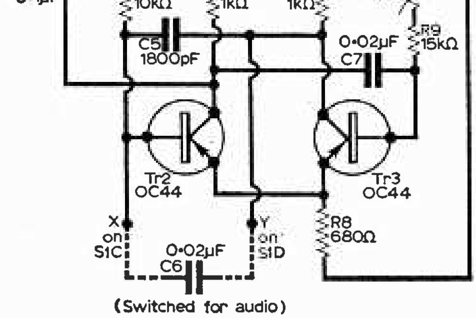


Fig. 2—Complete circuit diagram (less function switch).

of attenuator input is carried out by tuning the coupling loop, while the movable disc can be set to give a definite value of attenuation and hence a known signal in the output socket. It will be noted, however, that with the simple slide contact shown, even though the pick-up marker is terminated in an 82Ω resistor, there is always an unmatched rod of metal in the vicinity actually connected to the pick-up disc. This will give rise to errors in current distribution, since it has to be several centimetres long to work at all, and thus the attenuation scale will not be correct for all frequencies. The errors are not great provided the zero of the decibel scale is begun 5mm or so from the point where the y discs are actually touching. (This position gives the highest output at the coaxial socket).

It will be realised that good v.h.f. techniques need to be developed—and, as it were, pushed to the limit—when constructing a circuit for u.h.f.; even a few millimetres of component lead offer appreciable reactances at such frequencies. If when working on medium frequencies (say 1Mc/s) a lead length of 6in. is tolerable, the comparable lead length at 1,000Mc/s is under 1/100in.! Conversely if for practical reasons leads must be (let us say) ¼in. in length at u.h.f., the circuit may be expected to compare with a medium wave circuit using component leads over 20ft long. The constructor who has not yet made himself a thermal shunt (from a crocodile clip and a couple of inches of 12 s.w.g. copper wire) should do so as a preliminary so that, for example, transistor leads may be reduced to the minimum and still solder up without damage to the active transistor areas.

Figs. 3 and 4 show how the transistor is mounted so as to achieve minimum lead lengths. The whole u.h.f. circuit is contained in a trough of sheet aluminium measuring 10cm in length, 4cm width and 3cm depth (22 s.w.g.). A lid is folded for this trough out of another piece of sheet aluminium and is later secured in place by means of six self-tapping screws.

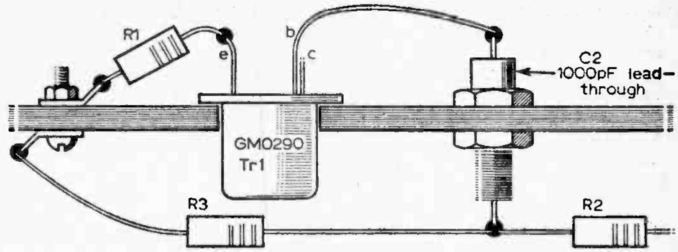


Fig. 4—Details of mounting transistor GM0290 with shortest possible leads.

The tuning capacitor is a Jackson Bros. type C804 50pF. The full 50pF is not required to achieve the tuning range and so to minimise self-capacitance and minimise capacitance some of the rotor and stator plates are removed with a hacksaw, leaving five rotor and four stator plates. The sawing operation must be done carefully and lightly to avoid distorting the assembled component. In order to make the correct connection to the timing line a small piece of copper foil is soldered to the lugs of the stator plates as shown in Fig. 8. Owing to the relatively large thermal capacity of the mounting pillars of the capacitor an instrument-type soldering iron alone will provide insufficient heat; either a heavier iron must be used or auxiliary heating given to the small iron, for example by heating in a gas flame. The tuning line consists of two tapering straight pieces of 22 s.w.g. tinned copper wire, separated by $\frac{3}{16}$in. at the tuning capacitor and joined together at the transistor end. The holes for the transistor and the tuning capacitor are 3·7cm apart and the wires should be cut to fit precisely into place between them.

The coupling capacitor which enables feedback to take place need only be very small. A component of the correct value (0·25pF) is not commonly stocked by shops but can be fabricated simply (as shown in Fig. 6) from short lengths of enamelled copper wire linked tightly together. A single link would be enough—it is not necessary to twist the wires together.

The coupling loop which transfers energy from the oscillator circuit to the output socket is made up as follows: A length of p.v.c.-covered connecting wire (not flex) measuring 15cm in length is folded in half and twisted together lightly for a short portion of its length—about 3cm. The remaining portion is fashioned into a rectangular loop of sides 3cm and end 1·5cm. The loop is positioned above the tuning wires so as to afford reasonable pick-up of energy; this

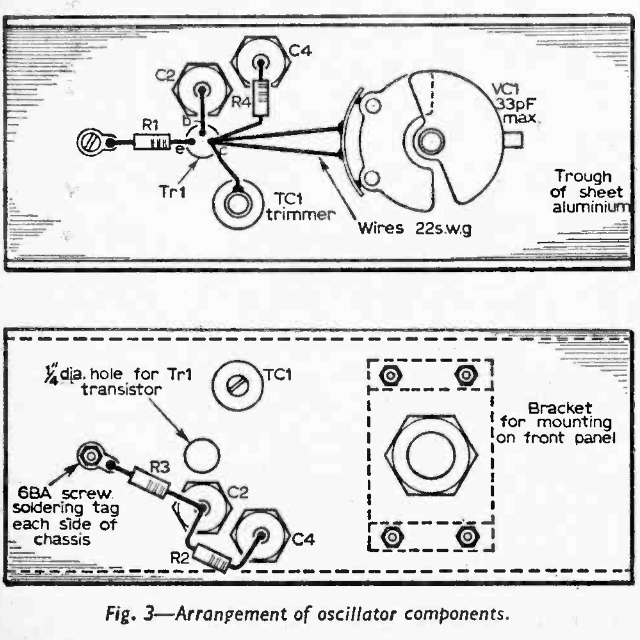


Fig. 3—Arrangement of oscillator components.

is best adjusted later when the u.h.f. diode and meter are connected. Without untwisting the remainder of the wire the ends are separated and bared and are soldered to stand-off insulators in appropriate positions. Connections are then made by strips of copper foil or heavy flex to the attenuator and adjusting capacitor VC2 (Jackson Bros. type C804, 15pF).

When the above assembly has been completed and before the lid is placed in position the oscillator circuit should be adjusted to the correct tuning range as follows: Set VC1 to its minimum position and connect power supplies. Check (for example with a TV receiver) that *Channel 68* can now be tuned by very slight adjustment of VC1. If not and the assembly is correct a fault in wiring should be looked for whereby the minimum capacitance in circuit is too large. If none appears on inspection the length of the tuning line will have to be reduced and VC1 repositioned. Next mesh the plates of VC1 fully and adjust until *Channel 21* is reached. Again adjust VC1 to its minimum and check that *Channel 68* can still be tuned. Now adjust the position of the coupling loop until a reasonable reading (say 10μA) can be obtained on any channel. Note that VC2 will need alteration to adjust the meter reading—its effect on frequency is negligible. When the loop has been put into the right position a further check of maximum and minimum frequency should be made as loop position has a small effect on the tuning.

The u.h.f. diode used will depend on what is available; an ordinary OA70 will not do very well and several advertisers offer microwave diodes at low cost. These are often of the coaxial type and, if so, need small clips to hold them into the circuit. Such clips can be made of short lengths of thin brass sheet such as can be obtained from a spent cycle headlamp battery.

The attenuator tube in the prototype was a piece of brass tubing $\frac{9}{16}$in. diameter and 2·2cm long. It was mounted by soldering on to it, centrally, a 4BA bolt. This is better than a clip as it allows for adjustment of length as needed. This gives an attenuation of 30dB/cm movement of the slide and, allowing for not starting the decibel scale at the point where the launching and pick-up discs are touching, a maximum attenuation of about 50dB. Two millimetres movement halves the output (−6dB) very closely, and marks 2mm apart

COMPONENTS LIST

R1	470Ω	R7	1kΩ
R2	4·7kΩ	R8	680Ω
R3	1·2kΩ	R9	15kΩ
R4	470Ω	R10	1kΩ
R5	10kΩ	R11	See text
R6	1kΩ	R12	82Ω

Potentiometers:
VR1 10kΩ pre-set

Capacitors:
C1 0·1μF
C2 1000pF feed-thro'
C3 See text
C4 1000pF feed-thro'
C5 1800pF
C6 0·02μF
C7 0·02μF
C8 16μF 25V working
C9 1000pF feed-thro'
TC1 0·5-1·5pF tubular
VC1 33pF Jackson Bros. (50pF) Type C804 modified. See text
VC2 15pF Jackson Bros.—type C804

Attenuator:
Brass Rod. Perspex. Copper Foil. Paxolin Tube. Copper or brass tube 1in. dia. Copper or brass discs.

Miscellaneous:
Meter 0-50μA optional, see text.
D1 Diode 0A70, coax socket.
Transistor type GM0290 Texas instruments.
Switch S1A, B, C, Yaxley 4P, 4W, 2B.
Printed circuit board or piece of Veroboard.
Aluminium for front panel and trough.

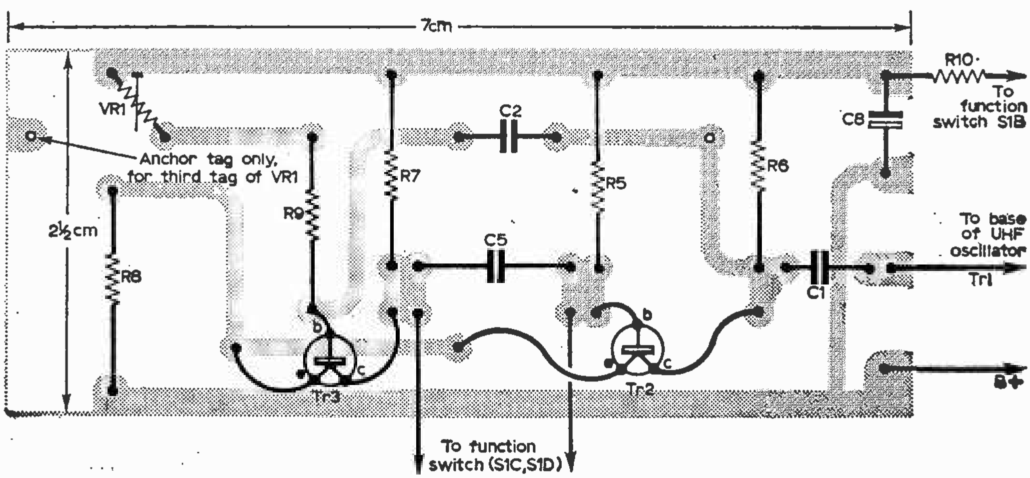


Fig. 5—Printed circuit for modulator.

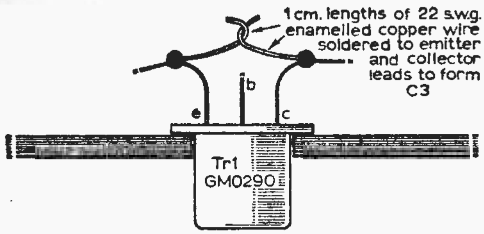


Fig. 6—Emitter-collector coupling—fabrication of coupling capacitor C3 (see Fig. 2).

on the instrument attenuator are not too close for good visibility.

If a tube of different diameter is used the attenuation can be worked out by remembering that it is universally proportional to the diameter. Thus a cigar tube of the usual aluminium type ¾in. diameter will give an alternative of 22·5dB/cm.

Care must be taken to ensure that both discs are well insulated from the attenuator tube. The method of making electrical connection to the sliding disc will be obvious from Fig. 2. The

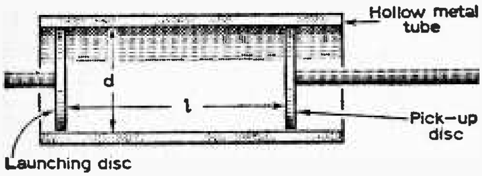


Fig. 7—Elements of the piston attenuator.

perspex block through which the guide hole for the shaft is drilled should be about 1cm thick and can be made up of several pieces of sheet perspex cemented together with a drop of chloroform. It may be secured to the chassis by means of a 4BA bolt screwed into a hole drilled and tapped in the block.

If the capacitor VC2 is adjusted so that the meter reads 5μA the minimum output from the attenuator is approximately 30μV with the two discs 2cm apart. If a smaller output still is required it will suffice to plug into the coaxial socket centre a short length of wire and use it as an aerial. This should be done in the final stages of lining up a u.h.f. receiver and is also useful when checking the instrument's tuning range and modulation with a TV receiver.

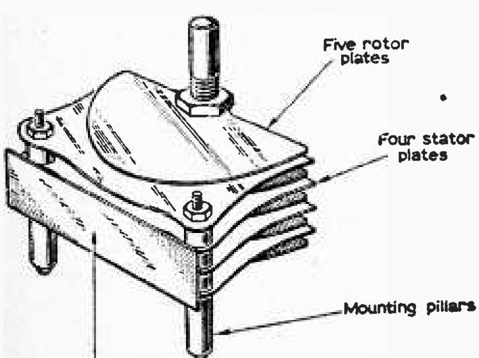


Fig. 8—Connections to stator plates of tuning capacitor

The modulator must comprise an asymmetrical astable multivibrator arranged to give the correct line scan and flyback period to a good approximation. If frequency modulation of the carrier is to be avoided a good square wave at 15,625c/s must be generated and this is accomplished by using high-frequency transistors type OC44 in a suitable circuit. The suggested printed circuit diagram is given in Fig. 5 or a small piece of Veroboard could be used. This multivibrator can be switched to a lower frequency, with almost symmetrical characteristics, for use as an audio modulator. Details of the function switch arrangements are given in Fig. 2.

The whole of the circuitry is attached to a piece of aluminium sheet which forms the front panel of a soldered-up tin of suitable size. This tin, crackle enamelled for a good appearance, also houses the PP9 battery which powers the unit. The front panel is secured in place by about a dozen self-tapping screws. The attenuator handle projects from the side of the box and the hole through which it passes is bushed to afford some support for this handle. A suitable bush can be made from an old potentiometer cut down to size and will naturally improve the appearance of the instrument.

A good slow-motion drive is essential for this instrument and suitable types are widely advertised. The prototype utilises a Muirhead epicyclic drive.

Calibration may readily be done by using a TV receiver with u.h.f. tuner. If this is not available, measurement of standing waves on parallel transmission lines (lecher lines) gives very good results so long as the wires are accurately parallel and not too far apart (an inch or less). This needs patience, of course, but results to within 0·5Mc/s are not too difficult to achieve. ■

ENCOUNTER

WITH A TRANSISTORISED TV

THE receiver, a Pye TT1, was brought in with the complaint of "sound OK—no picture". The Pye TT1 is a completely transistorised portable 14in. TV which can be operated from its own internal 10V battery, from the mains (a.c. only), which also trickle charges the internal battery, or from an external 12V battery.

It took some time to find why the tube grid (pin 2 of the base socket) did not register the correct −26V. The tube is grid modulated, the brilliance control operates on the cathode (pin 11). Since the video amplifier supply is derived from the line timebase (suitably rectified) it was first thought that this source had failed, but the line whistle, which starts up immediately the set is switched on, was quite normal if a little loud, so no red herrings were chased up this avenue.

The video amplifier showed the correct voltage as did the end of the grid lead (green)! Since the other end at pin 2 did not register this voltage it didn't take long to yield to the temptation to replace the lead. The fracture was about 1in.

BY L. LAWRY-JOHNS

from the c.r.t. base end. During the examination of the vision strip, which is on top of the box-type chassis, it was noticed that some rather clumsy soldering had been done around the detector and final i.f. stage of the printed panel. This was probed for dry joints but the picture remained firmly on the screen and so the chassis was replaced and the rear cover screwed on. As the internal battery was low the rear selector switch was set to *charge*. The red charge light came on and the set was left for a few hours to bring the battery up to scratch. The selector was then returned to mains and after the tube heater had warmed up a good picture appeared. The set was returned to the owner, who then volunteered the information that it had "been doing this off and on over a considerable period". This hardly added up to a fractured lead but it could have been, so the set was left. Two days later it was back in the workshop. The picture had failed to come on "just as it had before". The new grid lead was in order, so out came the chassis again and a signal generator was applied to the i.f. stages. A good response was obtained all along the line, which was a little disconcerting. The aerial was plugged back in and the picture was perfect. The only comment which can be recorded was: "Oh, it's one of them is it?"

A disturbance test around the detector stage caused the picture to go off and a close examination under the panel showed that the final i.f. transformer and crystal diode wiring had been subjected to some rough treatment. The soldering had been made close to the diode and it was thought that this could have been internally damaged by heat. A replacement was fitted after a struggle and a picture was displayed as soon as this was done. The removed diode showed a good reading on a meter, being high one way and low the other. However, repeated trials and disturbance testing failed to shake the picture, so the set was left on that for two days. It performed beautifully the whole time, so it was again hopefully returned to the owner. It went perfectly for a week and back it came. No picture as before. No effort was made to use the signal generator as this only seemed to restore the signal before the fault could be located. A voltmeter showed correct readings at all stages except the final i.f., which showed no emitter voltage. Then the emitter voltage appeared and along with it the picture. This was a little enlightening if the meter prod had made contact with the emitter end properly. However, it still left doubt as to whether the emitter resistor was at fault and any joint or other faulty contact or the transistor itself. As an OC171 was not to hand a little more testing was made and, as luck would have it, the picture went off and stayed off quite nicely.

The 1V emitter reading which was present when the picture was on was again absent but an ohms test showed a 1kΩ reading across the emitter resistor. Here it was then. If the resistor was intact and the connections were properly made the transistor had to be at fault as the collector read 10V instead of 9·5V and the base held steady at about 1·2V. An OC171 was fitted and back came the correct reading and the picture. This only serves to show that it is always prudent to take voltage readings before taking any other steps to locate a fault. Anyway the set was well and truly tested and then returned with a confident reassurance to the owner who, fortunately, was of a humorous disposition.

A week passed. Back it came, this time with the enquiry: "Why doesn't it work from an external 12V battery?"

Now I distinctly remembered checking this previously, when it worked well. Viewing the owner's American car with suspicion I enquired whether the set had been used in the car. "No, it hadn't; it had been used on a boat with two leads taken from the battery". The supply leads were produced with the plug and, sure enough, the leads were clear plastic with no indication of polarity. This was the trouble. It is essential to connect an

—continued on page 75

IS YOUR TV REALLY SAFE?

By A. G. Priestley

PART II

TO refer back to Fig. 8 in last month's article, supposing the fuse blows—possibly through sheer old age and not necessarily due to a fault. The electrolytics C1 and C2 on the branch h.t. lines will discharge through the bleed resistor R1, or the normal h.t. load, and you may think that all is well. But not so. How about C3? This is charged up not to the normal loaded h.t. voltage but to a higher one near to the peak value of the a.c. mains sinewave and it can only discharge through its own internal resistance, which may be quite high. So clearly we need a bleed across C3 also, shown dotted on the diagram.

Another simple precaution concerns the mains switch and fuses.

It is all too easy to touch these accidentally and many readers will think it worth while to cover these items with a hardpaper flap or some other means.

If you look at a typical receiver it is surprising how many sharp corners can be found on the metalwork. In fact you need not bother to look. The telltale evidence will be found on the backs of your hands as soon as you do any servicing! Just take a file and round off those corners.

Look After Yourself

Perhaps a word about servicing techniques would not be entirely out of place here. Before you start work check that there is no earthed metalwork within reach of your work area. Then make sure that you are wearing dry shoes and are standing on an insulated floor. A rubber mat is ideal. The worst combination in common use is damp shoes on a damp concrete floor.

There is one quite common fault condition that catches many people napping. If a receiver fitted with a semiconductor h.t. rectifier has a heater fault and is switched on, nothing appears to happen because no heaters glow. But be careful! The h.t. line will be live and well above its normal working voltage.

When working on a receiver which is switched on do you keep one hand behind your back or in your pocket whenever possible? You ought to. It is one of the best and simplest safety precautions of all.

Overheating

When we talk about overheating, what we are chiefly concerned about is, of course, the risk of fire. This risk can vary between wide limits. An ill-designed receiver will catch fire quite easily whilst, on the other hand, it may be almost impossible to set fire to one that incorporates the best design techniques.

The author once took part in a most interesting series of tests as part of an investigation into the problems of preventing fires in television receivers. As a starting point a special test receiver that incorporated quite an ordinary amount of inflammable insulating material was deliberately set on fire by means of a flame applied internally. In a very short while the whole receiver was burnt out and completely destroyed. All that remained was a heap of ashes, a tangle of wires, some blackened metalwork and blobs of molten glass. It was a most salutary experience.

At a later stage in the programme another test was carried out but this time on a receiver that had been carefully designed to minimise the fire risk. With a great deal of effort it finally proved possible to damage a fair amount of the insulation but not to set fire to the receiver as a whole. It would have been perfectly safe in anybody's home. Needless to say these fire precautions have been built into all new designs ever since.

Another aspect of overheating of lesser direct importance is that parts of the case or cabinet may get sufficiently hot to burn anyone who touches it. The problem of the deterioration of insulating materials exposed to moderately high temperatures will be considered later.

How Fires Start

When so-called inflammable materials are heated they give off a vapour and if the temperature is high enough this will ignite and burn as a flame. Electrical apparatus is particularly prone to fire risk because if a fault occurs such as a short-circuit a large amount of energy can be dissipated in a small space. The resultant localised high temperature provides the ideal conditions for starting a fire.

Fires can start due to a variety of causes and so we will now take a look at some of the more common ones. Bear in mind, however, that these seldom extend beyond the point of damaging a few components and it is very rarely that any serious incident occurs. Having considered the causes we can then go on to consider the general principles and test requirements that should be complied with and some of the practical means of overcoming the various problems that arise.

One of the main culprits is the live transformer. This handles a considerable amount of power, commonly about 20-30W, at various high voltages. If an insulating air space is too small an arc may develop. Material will vapourise at each end of it and this starts a flame which in turn provides a larger volume of ionised conducting gas. This allows a larger fault current to flow and so more heat is generated. The effect is cumulative and the fire soon spreads.

The same thing can happen when a high potential gradient exists across a piece of insulating material. Tracking may take place across the surface, a fault current flows along the carbonised path and an arc is struck.

Another cause of trouble in a line transformer, or indeed in any other power output transformer, is when two adjacent turns in one of the windings touch each other and the insulation breaks down. You then have a few volts applied across the almost negligible resistance of a shorted turn and a large current flows. Overheating is the inevitable result.

Inter-electrode short-circuits in valves are not uncommon and this usually leads to a large flow of current in anode or screen resistors which have not always been designed or chosen to take this into account. Often they overheat badly and some types burst into flames which may spread to the printed panel on which they are mounted or to adjacent insulated leads.

Inadequate clearances between points at high and low potentials on printed panels will cause tracking as in live transformers and many charred panels have been the inevitable result.

Badly dressed leads have caused innumerable short-circuits with overheating of all sorts of components. Often, too, leads are draped over hot components such as wire-wound resistors and either the insulation gets charred or a direct short-circuit is caused.

Principles of Fire Precautions

As we have already seen, it is not enough to design a receiver so that in normal use no components get quite hot enough to catch fire. It is still not an adequate criterion even if we extend it to include fault conditions such as inter-electrode short-circuits. If insulating material is overheated for appreciable periods, although not to an apparently serious extent, its physical properties will deteriorate and it may become prone to catch fire at lower temperatures.

This is particularly true of certain inflammable plastic materials which have been formulated to have flame-retardent properties. After prolonged periods at high temperatures the material may gradually lose its flame retardence.

In any case if a material is charred by excessive heat a conducting path will be established and a fault current may flow, with unhappy results. Also a quite moderate amount of overheating may cause an inflammable vapour to be given off and there is always the possibility that it will be ignited by a spark or some other circumstances.

There are two other factors to be borne in mind. In the first place the receiver may be operated on a mains tap lower than the current one and so the power consumption, and hence the internal temperature, will be increased. In carrying out safety tests it is usual to increase the nominal input voltage by 10%. This is roughly equivalent to using, for example, a 220V tap on a 240V mains input.

The other point concerns the ambient (or room) air temperature. This is usually taken as being 20°C (68°F) but, of course, we cannot guarantee that this will be the maximum. BS415 stipulates that an ambient temperature of 35°C (95°F) must be allowed for.

The considerations that we have just discussed show that a receiver must be designed so that the temperature of the various inflammable materials do not exceed a value that has been realistically chosen for each particular material.

The fault conditions specified in BS415 are very detailed and comprehensive. Broadly speaking they involve a 10% mains over-voltage; the most adverse setting of all controls the connection and disconnection of any auxiliary apparatus; an ambient temperature of 35°C; correct and reversed mains connections and the direct short-circuiting of the following items:

1. All insulation having creepage or air clearances less than those specified in the standard.
2. All clearances distances which may become closed during normal use or maintenance.
3. All insulation not capable of withstanding a d.c. test voltage of at least 1,500V or (1,000V + 2V) whichever is the greater where V = 0·9 times the peak voltage across the insulation.
4. All electrodes in valves and c.r.t.'s.
5. All electrolytic, variable or air dielectric capacitors.
6. All rectifiers.
7. All capacitors which have more than 34V across them during the period when the receiver is switched off.

Readers may well ask how they can hope to comply with this list of requirements, bearing in mind their lack of time, test facilities, equipment and material—not to mention the cost. After all, even the greatest enthusiast can hardly be expected to short-circuit every pair of electrodes in every valve (including the c.r.t.) and then sit back with equanimity and watch everything glow red hot! Even setmakers might feel tempted to skimp some of the tests, although to their credit they seldom do.

It has to be accepted, of course, that the average reader cannot hope to carry out all these tests himself and then take the necessary precautions. They have been listed here in some detail because they serve to highlight some of the weak links in the safety chain and thus help to build up the background to the whole question of safety in all its aspects.

However, any reader can check a fair proportion of these tests by rule-of-thumb techniques and a few simple experiments. For instance, the power dissipation in anode, screen or cathode resistors when an inter-electrode short-circuit occurs can be calculated from power = V^2/R where R is the resistor in question and V is the actual h.t. voltage under that particular fault condition.

In many cases the h.t. voltage under semi-short-circuit conditions can safely be measured by connecting the appropriate value of resistor between h.t. and chassis for less than a second whilst the reading is taken on the meter. The power dissipated will not tell you the temperature but is an indication of the size of the problem and will come in useful later.

If in addition to carrying out some of these tests and "guestimating" others readers build in some of the safety precautions described in this article they will almost certainly finish up with a receiver that is safer than it would otherwise have been. Not only will it be safer but it will be more reliable.

How to Measure Temperatures

Measuring temperatures can be a rather difficult process for the average home constructor. Air temperatures present no problem, because all you have to do is to place a long stemmed thermometer in the appropriate airstream after the receiver has been switched on for about half an hour. Winding temperatures in iron cored transformers are difficult to measure accurately, but a simple technique can be used to get an approximate answer. The only equipment needed is some means of measuring resistance, and a good quality multirange meter will serve the purpose quite well, although a d.c. bridge is, of course, much more accurate.

First of all make sure that the transformer is completely cold. Then measure the resistance of the winding in question as accurately as possible, and the temperature of the surrounding air—i.e. room temperature. The receiver should now be switched on for at least half an hour: preferably with a 10% mains overload if you feel that this will not do any damage to other components. Finally carefully re-measure the winding resistance. This is made easier if two leads are brought out through the backplate from the winding concerned, because it saves having to open up the cabinet and allow heat to escape.

If R1 = cold resistance of the winding

R2 = hot resistance of the winding

T1 = starting (cold) temperature in degrees centigrade.

$$T2 = \frac{R2}{R1}(234{\cdot}5 + T1) - 234{\cdot}5$$

and the temperature rise of the winding in degrees centigrade is T2 − T1.

If you only have a thermometer calibrated in degrees F, note that

$$°C = \tfrac{5}{9}(°F - 32)$$

Surface temperatures can really only be measured by means of a thermocouple instrument, because an ordinary thermometer draws too much heat from the surface being measured, and in any case will tend to measure the temperature of the surrounding air rather than that of the material in question. A thermocouple junction is so small that this problem does not arise, and it can also be fitted easily into confined spaces with the help of a piece of thin sticky tape.

Although not many readers are likely to own such an instrument, it will be quite a simple matter to make one if a source of cheap galvanometers is available. The circuit is shown in Fig. 9. When two dissimilar metals, such as copper and constantan are joined together at each end, a current will flow if one junction is at a different temperature from the other. A sensitive current measuring device, such as a galvanometer, can be calibrated in terms of the temperature difference between the two junctions. The calibration can easily be carried out by keeping one junction at room temperature and dipping the other into a saucepan of hot water stirred by a thermometer. The galvanometer can then be calibrated over most of the useful range in degrees temperature difference.

Earlier on we mentioned rule of thumb techniques. If we are completely at a loss to assess the temperature of a particular item we can get some rough idea by comparing it against something

Material	Normal Conditions	Fault Conditions
	°C rise	°C rise
External metal parts:		
(a) Which may be touched in normal use	30	65
(b) Which are not touched in normal use	40	65
External parts other than metal:		
(a) Which may be touched in normal use	50	65
(b) Which are not touched in normal use	60	65
Inside surface of case	80	100
Windings of wire insulated with enamel, lacquer, cotton, silk, artificial silk, paper and the like:		
(a) Non-interleaved, non-impregnated	50	90
(b) Non-interleaved, impregnated ...	60	110
(c) Completely interleaved with paper or other insulating material and impregnated ...	70	135
Parts made of wood, resin banded paper and the like	60	80
Phenol formaldehyde mouldings ...	80	120
Rubber insulation	30	50

Permissible temperature rises for typical materials as recommended by the British Standards Institution in their specification BS415.

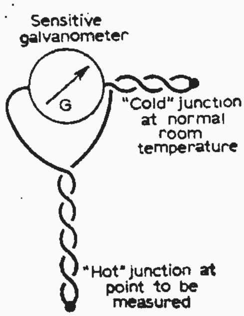


Fig. 9—A thermocouple thermometer.

whose temperature can be measured with an ordinary thermometer. A very quick, light, touch test with the sensitive tip of a finger can sometimes give a useful indication, if hardly a scientific one!

How to reduce Overheating

The first thing to do is to make sure that the maximum possible amount of cool air flows through the cabinet, and that it passes over the hot components. Either the airstream can be diverted appropriately, or the hot components re-sited in the coolest positions.

Plenty of ventilation slots must be provided in the bottom of the cabinet or backplate, and an equal area at the top. The holes at the bottom need careful siting, because if they are too near the front of the cabinet the cool air will flow over the cone of the c.r.t. instead of passing through or over the chassis. Common sense is your best guide here.

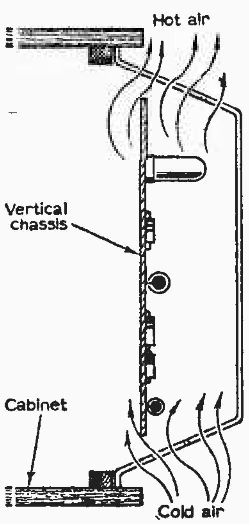


Fig. 10—The chimney effect

Although a few large holes tend to provide better ventilation than a large number of small ones, remember the standard finger test and don't over do it. Slots are much more effective than round holes in this context. A good layout is shown in Fig. 10. A chimney effect is produced which helps to promote a fast moving airstream. An obvious point to watch is that hot components such as valves and wirewound resistors are not placed immediately below temperature sensitive items such as electrolytic capacitors, line oscillator circuits and tuners.

Very hot components such as mains droppers often have to be mounted near the top of the cabinet, and it may be necessary to fit a heat baffle over them to spread out and dispense the hot airflow. Failure to do this may result in the top of the cabinet and backplate becoming unbearably hot. The temperature of the airstream through the ventilation slots can be measured with an ordinary thermometer.

Fuses

One of the simplest ways of providing protection against faulty conditions that cause overheating is to fit a fuse in the offending circuit. The fuse rating has to be carefully chosen so that it does not blow under ordinary operating conditions, but will do so when a fault such as an h.t. short circuit occurs. H.T. fuses in television receivers will commonly be of the order of 100-250 milliamps, depending upon whether the fuse carries the whole h.t. current, or is fitted in a branch h.t. line.

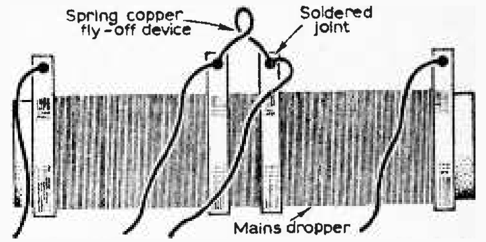


Fig. 11—Spring fly-off device.

The choice of fuse is not always easy, and its operation can not be regarded as infallible. However, in many cases it does in fact provide useful protection.

Another type of fuse is the fly-off device. This is a springy connection soldered between two tags, such as those on adjacent parts of a mains dropper. When a fault occurs that causes the dropper to overheat, the solder melts, the spring flies off, and the circuit is left in a fail safe condition, i.e. open circuit. See Fig. 11.

In most cases ordinary electrical solder can be used, but occasionally a special low melting point type will be needed. The physical details will have to be found by experiment.

Special Problems with Printed Circuits

Printed panels are often made of SRBP material which is mildly inflammable. They are not always too easy to set alight, but once they get properly started they are liable to blaze away quite merrily. Since we have, so to speak, a lot of eggs in one basket, it behoves us to take special care of them. In any case even localised overheating is liable to damage the insulating properties, and changes of lines and other operating conditions are likely to result. Tracking across the surface may well occur at a later date also.

The use of printed panels is likely to become more and more popular with readers of this journal because materials are readily available for producing one's own panels. Not only does this lead to a much more soundly constructed piece of equipment, but the design of the printed layout is a fascinating problem involving a cross between a jig-saw and a cross-word puzzle. How can we provide adequate protection for a panel upon which we are lavishing so much time and attention? Fortunately a number of simple and effective techniques have been devised by set makers, and here they are.

Stand-off Resistors

If any resistor is liable to overheat the panel, or become overheated itself under fault conditions, space it away from the panel by at least one-eighth of an inch, and preferably a quarter of an inch. This can easily be done by using ceramic beads; by bending the leads; or by using a plug-in type of resistor. These methods are illustrated in Fig. 12.

Components that should receive special attention, indeed should be spaced clear of the panel in any case, are the half watt low value (commonly 1,000Ω) anode decoupling resistors in i.f. stages, and any screen or cathode resistors in power output stages. This precaution is necessary to cater for the possibility of inter electrode short circuits in valves.

Fig. 12—Spacing resistors off the panel.

All one watt resistors, or larger, which have been chosen for their power rating should automatically be spaced clear of the panel.

Drop-off Resistors

In the case of the low value screen or cathode resistors in field, sound, or video output stages, as mentioned above, we should really take our precautions a stage further. If the panel is mounted vertically, two tags should be soldered to the print horizontally. The one watt resistor can then be soldered to the underside of the tags with ordinary solder, as illustrated in Fig. 13. In the case of horizontal panels longer tags can be used bent at right angles to give two horizontal arms.

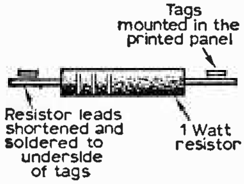


Fig. 13—Drop-off resistors.

If, under a fault condition, the one watt resistor dissipates four watts or more (a common value) the solder will melt and the resistor will fall off, leaving the circuit in a fail safe condition. Note that this technique can not be used with ordinary half watt resistors because they are not heavy enough to overcome the surface tension of the molten solder.

Areas of Cooling Copper

One of the simplest precautions of all is to leave comparatively large areas of copper printing around the connections to all hot, or potentially hot, components. All stand-off or drop-off resistors should have extra copper around the connections as a matter of course. Resistors of greater than 1W can usefully be soldered to eyelets clenched into the panel and surrounded by about half a square inch of copper. If no precautions are taken at the base of typical sound, field or line output valves the panel is bound to get too hot in localised areas. Apart from the general principle involved the anode of a field output valve commonly has a pulse approaching 1,000V on it and this may cause tracking on a hot panel. The first cure is to leave plenty of copper on the panel around the valve bases whilst still maintaining adequate clearances. Fig. 14 shows a typical example of this technique.

Special Valve Bases

In spite of extra areas of copper output valves are still liable to overheat the panel. One very useful additional precaution is to use a valve base with long tags as shown in Fig. 15a. The tags are exposed to the cooling airstream and much less heat is conducted down the panel.

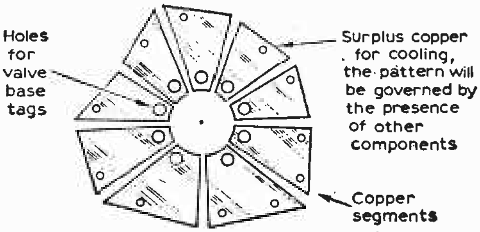


Fig. 14—Areas of cooling copper.

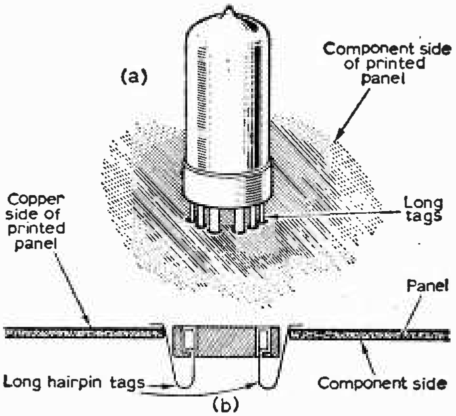


Fig. 15—Special valve bases.

Another useful type of valve base, which can be made from the one just mentioned, is shown in Fig. 15b. Here the source of heat, the valve, is on the opposite side of the panel to the components and so the whole cooling problem is reduced.

TO BE CONTINUED

Ferrite Wideband Transformers

by K. Royal

ORDINARY tuned transformers generally need to be peaked to one frequency or narrow band of frequencies. Such transformers are used extensively in television sets, in aerial amplifiers and in circuit couplings of all kinds. They are necessary in many cases so that the amplifier in which they are employed can discriminate against unwanted signals differing in frequency from the wanted signal.

The graphical symbol of a tuned transformer is given in Fig. 1, where L1 is the primary winding and L2 the secondary winding. The selectivity of the transformer as a signal coupler is influenced by the coupling coefficient between the primary and secondary windings.

Fig. 2 shows relative responses due to three coupling coefficients, tight, medium and loose. These responses are achieved when the primary and secondary are tuned to the same frequency.

A somewhat wider passband is possible by tuning one winding to a slightly different frequency than the other. It is also possible to produce a wideband amplifier by using several such transformers with each one and probably each winding tuned to slightly different frequencies over the required passband, giving a response similar to that shown in Fig. 3.

There are times, however, when an ordinary tuned transformer is not highly desirable, especially where a coupling or amplifier of ultra-wide passband is required. Wideband couplings for specific applications, serving as "baluns" (balanced to unbalanced), phase inversion couplings, impedance transforming couplings and so forth are also often required nowadays.

The author has been experimenting with such transformers for wideband amplifier applications and for aerial baluns and this article reveals the simplicity of the design of transformers of this nature. They can be very easily wound on ferrite toroids and the transformers made by the author were all wound on ordinary ferrite beads.

These beads are normally used for threading on to an insulated conductor for increasing its value of inductance so that the conductor then, in effect, acts as an r.f. choke. They are of very small dimension and those used by the author were $\frac{3}{16}$in. in length and about $\frac{5}{32}$in. in diameter. A somewhat enlarged photograph of a simple balun transformer is shown in Fig. 4. This gives some idea of the ease of winding and the simplicity of construction.

Transmission Line Characteristics

Transformers of this design provide a transmission line characteristic in that the windings are arranged so that their capacitance is a component of the characteristic impedance of the line. This technique eliminates resonances which can otherwise, with conventional transformers, limit the high-frequency response. A loss factor occurs with conventional transformers of the untuned variety by virtue of the winding capacitance resonating with the leakage inductance.

Ferrite toroid transformers can also be designed to provide a very tight coupling by employing the "bifilar" winding technique. This means that two or more windings are wound together (i.e. the wires wound in parallel) and their ends sorted out afterwards to provide the required phasing and so on.

The low-frequency response of the transformer is governed by the inductance of the primary winding and, as this is a function of the permea-

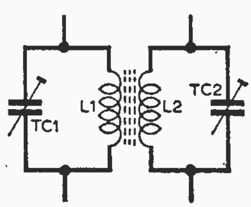


Fig. 1—A conventional tuned transformer. Here the primary L1 is tuned by TC1 and the secondary L2 tuned by TC2.

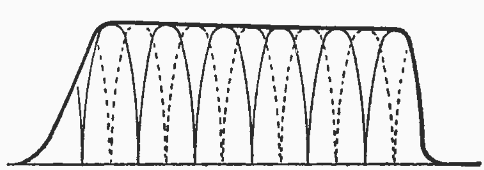


Fig. 3—A number of tuned transformers can be "staggered" over the required passband to give a response similar to that illustrated above.

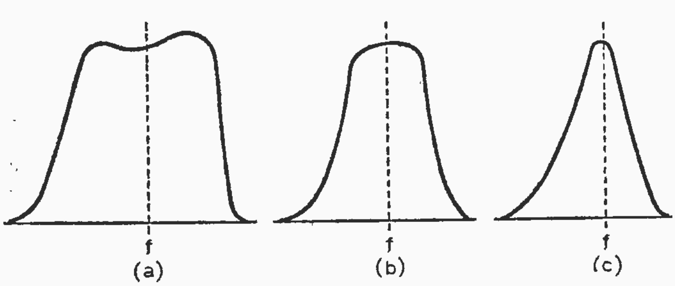


Fig. 2—The coupling coefficient between primary and secondary windings determines the passband of the coupling. At (a) is shown tight coupling, at (b) medium coupling and at (c) loose coupling.

bility of the core material, fewer turns are required on a core of high permeability for a given low-frequency response compared with the number of turns required on a core of lower permeability. This then is the advantage of employing a high permeability ferrite core of closed magnetic field.

While the permeability of some ferrite materials may be very high at low frequencies, falling off at high frequencies, the high-frequency response is nevertheless sustained by the *reactance* of the transformer being maintained due to the natural rise in reactance with increase in frequency.

The ferrite toroid has the property of endowing a conductor with a high reactance. This is the reason why ferrite beads are employed as r.f. stoppers. They simply "block" the r.f. signal by the increase in *reactance* of the conductor on which they are threaded.

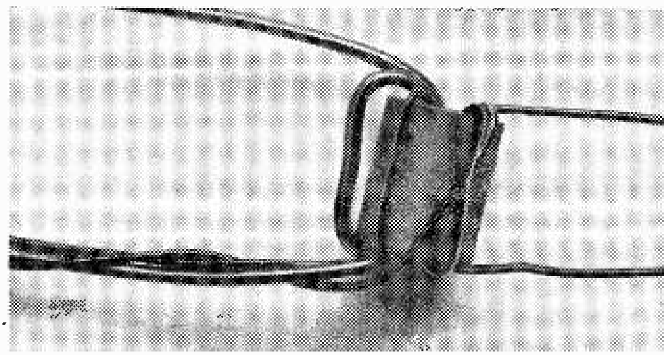


Fig. 4—This picture shows the simplicity of ferrite transformer construction.

75/300-Ohm Balun

Sometimes it is necessary to change, say, the input impedance of a piece of equipment from 75Ω unbalanced to 300Ω balanced. A very simple transformer for this purpose is illustrated in Fig. 5.

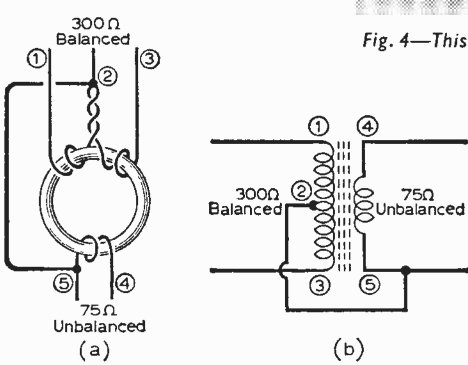


Fig. 5—Details of a 75/300Ω balun.

Here the 75Ω unbalanced winding consists simply of two turns, while the 300Ω secondary winding consists of a pair of two-turn windings connected together so as to give a centre tap. The tap is then connected to the "earthy" side of the 75Ω winding.

A large number of transformers of this kind have been made by the author for transforming 75Ω coaxial input and output circuits of television pre-amplifiers to 300Ω balanced for use on overseas television receivers and aerials. The results have been very successful and the insertion loss even at 250Mc/s amounts to little more than 1dB.

One-to-one Impedance Ratio Balun

Another type of balun transformer is shown in Fig. 6. This has an input impedance equal to the output impedance and is thus ideal as an aerial balun. A television aerial, of course, is essentially a balanced device and theoretically it should be connected to a balanced receiver input through balanced twin feeder.

This is rarely done in practice in Great Britain since British receivers are designed with an unbalanced coaxial input circuit and coaxial cable is thus used between the aerial (dipole) and the set.

This works quite well and many authorities claim that the influence of the unbalanced feeder on the aerial performance is insignificant and can be discounted. Other authorities, however, say that the connection of the unbalanced feeder to the

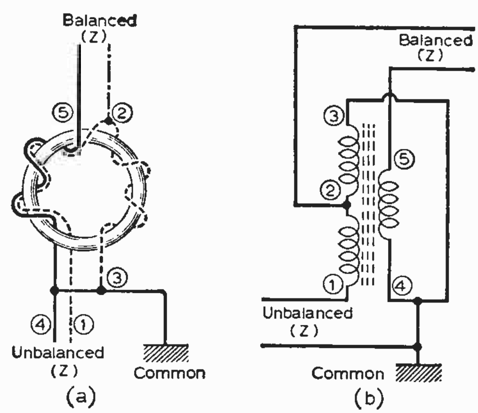


Fig. 6—Details of a constant impedance balun, suitable for aerial applications.

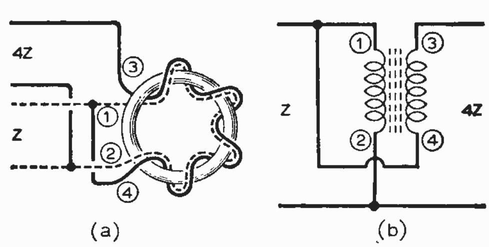


Fig. 7—Details of a 4:1 impedance ratio transformer.

balanced dipole tends to distort the polar response characteristics of the aerial and that the response is affected by the presence of the feeder near the aerial. Indeed some aerial makers go so far as to incorporate balun transformers in the dipole insulator.

The balun shown in Fig. 6 can be connected at the dipole of an experimental aerial quite easily. There are effectively three windings as shown at (b). Winding 1-2 is wound bifilar fashion with winding 4-5, while winding 2-3 is wound by itself and is connected to winding 1-2 to give a tap at 2. The method of winding is clearly shown at (a).

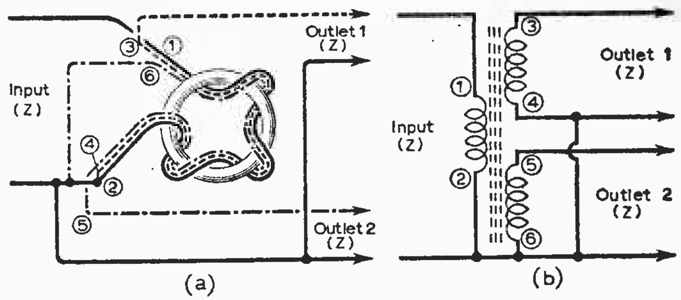


Fig. 9—A dual-outlet transformer. This can be used for operating two sets from one aerial system.

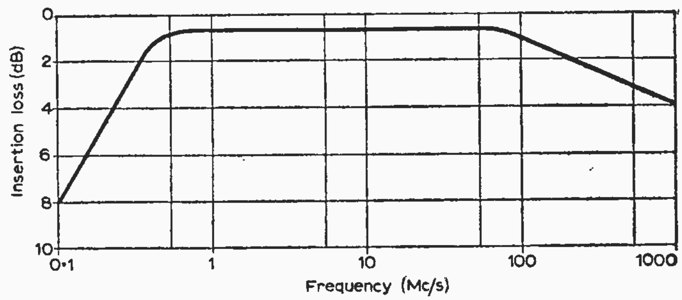


Fig. 10—Typical response of 4:1 ratio impedance transformer. Note the small insertion loss and the wide passband.

Four-to-one Impedance Ratio

It is sometimes necessary to transform an impedance up or down and a ratio of four to one is useful in the design of wideband v.h.f. amplifiers. The design of such a transformer is shown in Fig. 7. Here the two windings 1-2 and 3-4 are bifilar wound as shown at (a). The way that the windings must be phased to provide the condition is revealed at (b).

A wideband amplifier circuit employing a transformer of this kind is given in Fig. 8. The valve is an r.f. triode of high slope (gm equals 14·5mA/V) arranged in the earthed grid mode with the input signal applied to the cathode. Now if the impedance at the signal output socket is equal to (or near) the impedance at the cathode there will be a power gain of about four times (6dB).

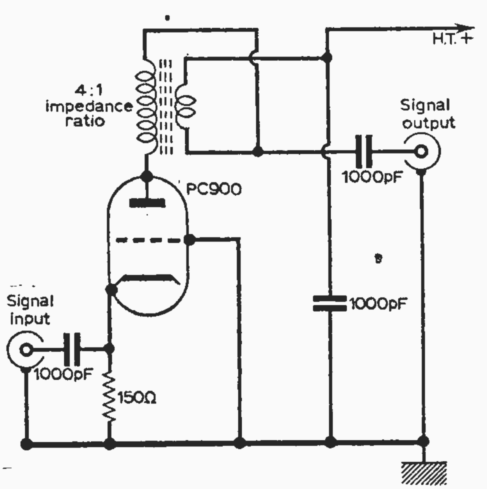


Fig. 8—A wideband single-stage valve amplifier circuit employing a 4:1 ratio impedance transformer.

The upper bandwidth is then a function of the figure of merit of the valve (gain × bandwidth), being equal to the figure of merit divided by the power gain. In practice a bandwidth in the order of 200Mc/s is feasible with the upper frequency around 250Mc/s and with a power gain of about 6dB. Such simple stages can be cascaded to provide a greater overall gain if required.

Transistors in particular lend themselves to applications of this kind and a future article will fully describe the design and construction of a wideband v.h.f. amplifier covering television Band I, the f.m. band (Band II) and the television Band III.

Two-outlet Transformer

Finally is shown in Fig. 9 a ferrite transformer suitable for operating two television or v.h.f./f.m. sets (or one of each) from a single composite aerial system. The diagram at (b) shows the symbolic transformer and its three windings, while that at (a) shows the actual construction of the transformer.

It will be seen that the three windings are in fact wound bifilar fashion as in some of the other examples of the foregoing.

Diameter and Turns

Theoretically, as has already been pointed out, the low-frequency response of ferrite toroid transformers is determined by the permeability of the core material and hence by the reactance at the low

—continued on page 87

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

WHAT has happened this month? I was complaining last month about the poor Sporadic E openings in July/August, but at least there were some openings on most days, but as I write these words, September conditions have changed all right, but for the worse!

To be really depressing about it, I must say that during many years of DX Sporadic E viewing I have never found conditions so poor at this time of the year, and the days on which there were any openings at all (even very short duration ones) have been extremely limited.

As usual I give the list below, as we have been doing recently, in the hope that it may offer some "consolation" to beginners who have had nothing yet, when they realize that the "old hands" have had nothing either! and this includes reports from DXers in many parts of Europe as well as here. Well here is the list!

24/8/65	R1. Czechoslovakia, USSR and Poland. R2. Roumania.
25/8/65	R1. Czechoslovakia and Poland. R2. Poland.
26/8/65	R1. Czechoslovakia.
27/8/65 to 1/9/65.	Nil.
2/9/65	R1. Czechoslovakia and USSR.
4/9/65	R1. Czechoslovakia.
5/9/65	R1. Czechoslovakia and USSR. E3. TVE Spain.
5-11/9/65	Nil.

There would appear to be no logical explanation for this lack of Sporadic E, it can, I feel, hardly be blamed on the weather (which has been bad enough this summer!), as unsettled weather usually is conducive to good Sporadic E reflections.

PROPAGATION METHODS

This is, of course, a year near Sun-spot minimum, and therefore there is a reduction in the degree of ionisation in the upper atmosphere, and this theoretically should reduce the amount of signal reflection, but last year was also a period of low Sun-spot activity, but this was a much better year from the point of view of DX/TV reception.

I suppose that we must just say that the name Sporadic E in connection with DX reception is apt. I only wish that it was a little less sporadic!

There is still time for a late September/October opening, so being an optimist as always, I would say be patient for a little longer before you change over to concentrating on Autumn/Winter Tropospheric DX/TV reception.

As we are speaking of Tropospheric reception just a word on current conditions by this means. Here the position seems a little better at last, and in my southern area there has been a significant improvement in the reception of French TV stations. There is a long way to go yet but once the present weather passes I feel sure that Autumn/Winter reception will be back to normal.

NEWS

I have had a French friend from Strasbourg staying with us who came up with the following information about the Strasbourg TV transmitter on channel F5, 20kW. It seems that it is situated right in the centre of the town, and this is why it is a very "difficult" one here.

There are plans, however, to improve siting and power to counteract the German TV influence from just across the border! These frontier areas are often a little "touchy" like this!

Last month I suggested that following Mr. George Le Couteur's Sporadic E reception of Divis Northern Ireland in Guernsey, Channel Islands, similar reception should be possible in Southern England from Scotland and vice versa.

Well, I am pleased to report it has been achieved. Our old friend Mr. Roger Bunney, of Romsey, Hants., has received Orkney by this method, so it certainly is worth trying.

READERS' REPORTS

In spite of poor conditions I am pleased to hear of readers' successes once again:—

Mr. I. E. Gibson of Hunstanton, Norfolk, has had West Germany Grünten E2, and his similar

" mystery " card sent to us for identification is of course E2 Jauerling, Austria. This brings his total 13 countries received, our congratulations.

Mr. N. V. Dinsdale of York, has had RAI, Italy, on IA, and IB, Labistica, Yugoslavia, E4, Bratislava, Czechoslovakia, R2, Utliberg, Switzerland, E3, Tervola, Finland, E3, and Norway E3, so he is doing well too.

Mr. Dennis Boniface of Ripon, reports both Jauerling, Austria, E2a, and Patcherkopfl, Austria, E4 (a very rare one indeed), following our identification, Bydgoszcz R1, and Warsaw R2, Poland, West Germany, Grünten E2, and Kapaonik, Yugoslavia, E3, our congratulations to him too.

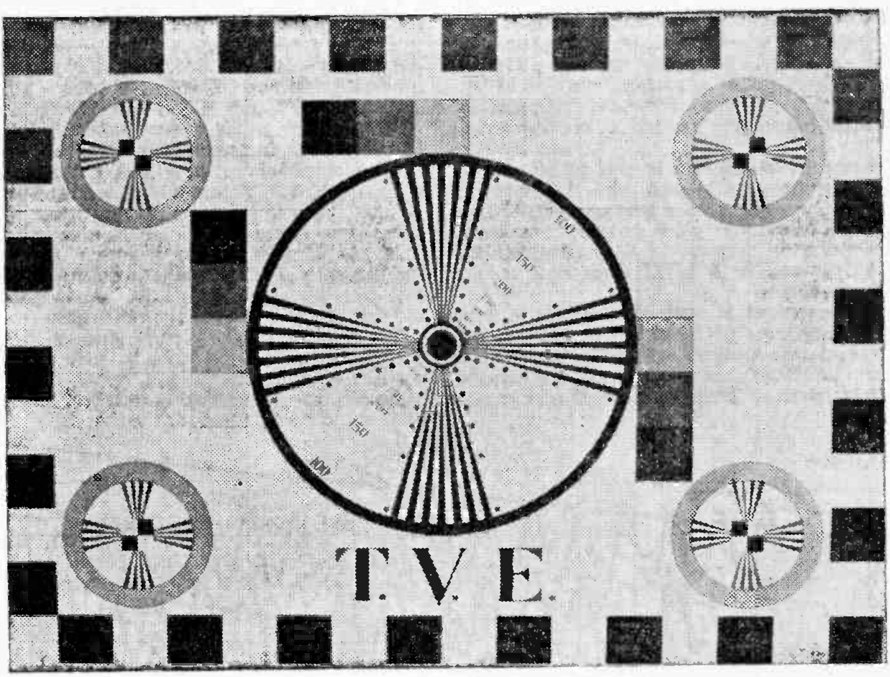
Our old friend **Mr. R. Roper** of Torpoint, has gone u.h.f. with success from Brest, France, on Channel 25.

Mr. F. R. Middleton reports reception of Spain, Poland, Hungary. USSR, Czechoslovakia, West Germany and Sweden as already logged, we now identify Coimbra, Portugal. E3, and Bydgoszcz, Poland, for him as additional ones.

Well friends that about " winds it up " once again for this month, may I hope that the DX news on conditions will be better by next month, as ever we will be delighted to hear from you about your experiences, results, and queries.

Good DX/TV to you all.

DATA PANEL-3 — T.V.E. SPAIN



Test Card—as photo.

Channels. Spanish TV transmitters operate on Channels E2, E3, and E4. E2 is Madrid-Navacerrada, and is the only TVE transmitter on this channel. E3 is either Zaragossa-La Muela, or Alicante, E4 is either Guadalcanal, Barcelona, Santiago, or Bilbao-Sollube.

Transmissions. No purely regional programmes, so no possibility of positive identification. No precise details of programme or Test Card times, but the Test Card is usually on about 11.45-12.00. Afternoon programmes start about mid-afternoon with a break for Test Card about 17.00. Evening programmes start about 17.15 and continue until after 24.00.

"SPOT-WOBBLE"

by G. K. Fairfield

Thoughts on an Old Idea

DURING the last decade the trend in modern television receiver design has been to incorporate cathode ray tubes having screen areas of ever-increasing size.

It is not unusual to find a 21 or 24in. (diagonal) screen receiver installed in the smallest of viewing rooms, with the inevitable result that the individual scanning lines comprising the picture become very much apparent to the viewer. It is, in fact, the "liniess" of the picture in the vertical direction which sets a limit to the apparent definition of the picture instead of the real definition measured in the horizontal direction in terms of the video bandwidth.

Of course the real solution to this problem is to increase the number of lines until the vertical definition matches that of the horizontal definition so that, when viewed at close quarters, the large screen television receiver would be as aesthetically pleasing as the smaller 9 or 12in. pictures we all viewed in the 1950's.

Some improvement is noticeable with the new 625-line transmissions on Band IV, but to achieve a real equality the vertical definition would have to increase to several thousand lines and this is hardly likely to occur in the foreseeable future.

produced of a thickness so that this merges exactly with adjacent bands (see Fig. 1).

In order that these oscillations themselves may not introduce vertical lininess into the raster the frequency is arranged so that one complete cycle of oscillation of the deflected spot of light occupies the same distance on the screen as the width of the unmodulated line (i.e. the spot width).

This is clearly seen in Fig. 2, which compares the bands of light produced for this optimum condition (where D=d) to that where the oscillation frequency is too low (shown as D=2d).

In practical terms a spot-wobble frequency of 10 to 15Mc/s is necessary to achieve this effect.

As a result of applying this technique the line structure of the picture disappears and the screen is completely filled with an intensity modulated light area representing the picture being transmitted. No change has, of course, been made to the vertical definition but it is generally considered that the apparent definition, as judged by the human eye, is considerably enhanced.

We can tolerate the picture at much closer range than before or (which amounts to the same thing) we can view comfortably a larger picture at the same distance as with an unmodified smaller set.

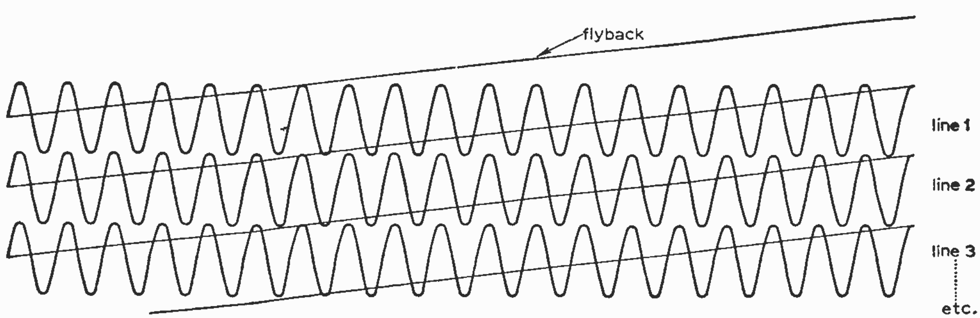


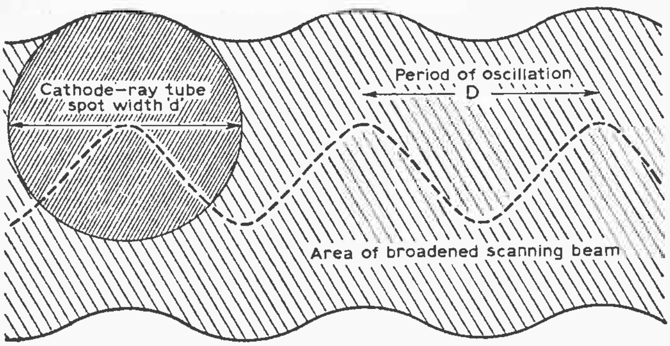
Fig. 1—Oscillatory line scan. The frequency of oscillation is shown very much reduced for clarity.

Principles of "Spot-Wobble"

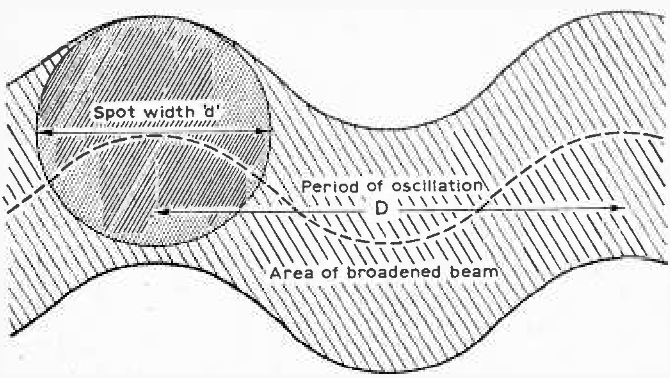
Fortunately an alternative to this impractical suggestion is possible. This is the so-called "spot-wobble" technique in which the spot of light scanning the screen is caused to oscillate in the vertical direction such that instead of tracing out a single line thickness a broad band of light is

Practical Considerations

Since the scanning sensitivity of different cathode ray tubes varies quite considerably it will be necessary in any practical circuit to include a control over spot oscillation amplitude. It will be necessary to adjust this so that each broadened scanning line just merges with its neighbour.



(a) where D=d



(b) where D=2d

Fig. 2—A section of a scanning line broadened by "spot wobble" technique.

Similarly, to accommodate different screen and spot sizes some control over the frequency of the oscillations is necessary for the reasons given earlier.

Even with the largest of present-day tubes the scanning angle over which we will have to deflect the spot will be very, very small, so that little power will be expended by the circuit used to deflect the beam. This is useful as it allows the circuit to be easily added to an existing receiver and use made of the internal power supplies of the set.

With regard to the waveform of the oscillations —ideally this should be triangular in shape in order to deflect the spot uniformly in speed between scanning line positions. In practice it is difficult to differentiate between the effects of a triangular and a sinusoidal deflection waveform for such a small deflection and, since a sinewave is much easier to generate, this is used in the practical circuit described below.

A Spot-Wobble Circuit

A suitable circuit for this is given in Fig. 3. The valve can be a small r.f. pentode such as the CV138, 6F12, 6BW6 or Z77. The oscillator circuit is a Colpitts oscillator in which the normal earthed centre tap of the coil is replaced by the stray capacitance to earth of the deflection coils L1 and L2 which comprise the tuned circuit inductance.

Adjustment of the frequency of oscillation is made by means of a preset trimmer capacitor C1, whilst the amplitude is varied by a series potentiometer VR1 controlling the supply potential.

The radio frequency choke in the anode circuit is not critical and can have an inductance of 30 to 100μH. Its purpose is to allow a low d.c. feed to the valve, anode and at the same time provide a high impedance to the tuned circuit shunted across it in order to maintain a high efficiency of operation.

Deflection of the cathode ray tube beam is obtained by the oscillatory current flowing to the coils L1 and L2. These are wound in rectangular form (see Fig. 4), bent to the shape of the c.r.t. neck and fitted exactly beneath the frame deflection coils of the scanning yoke.

Fitting the Coils

It is normally possible to find sufficient room beneath the scanning yoke assembly for this very thin pair of additional coils. Where the yoke is already a tight fit around the neck of the tube it will be necessary to remove this and carefully stretch it to increase its internal diameter a few millimeters by adopting the following procedure:

A wooden jig is made of a piece of dowel rod 2 or 3mm greater in diameter than the tube neck

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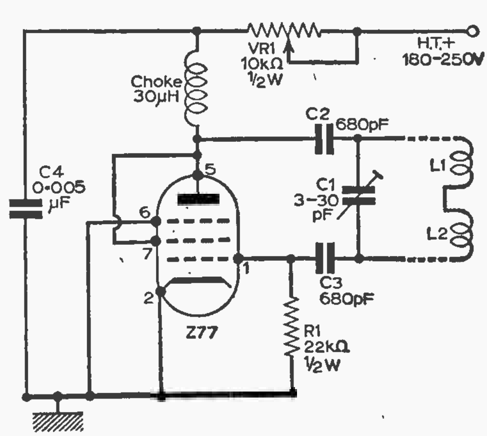
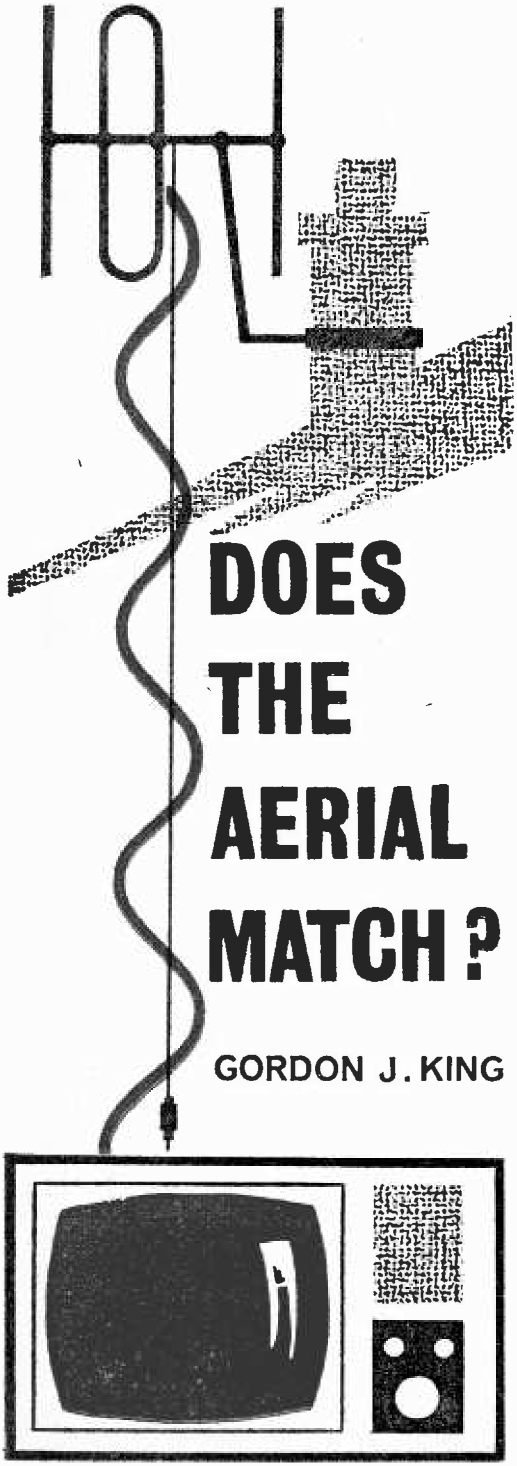


Fig. 3—A practical "spot wobble" circuit.



DOES THE AERIAL MATCH?

GORDON J. KING

INCORRECT matching between the aerial system and the aerial socket of a television set can produce symptoms which may be mistaken for trouble in the set itself. Before we investigate these in detail, however, let us get a reasonable idea as to what is meant by an aerial mismatch.

Apart from having the job of abstracting signal energy from radio waves, a television aerial must also convey that energy to the set with the minimum of loss at all frequencies. This is achieved by the aerials themselves being matched to the feeder and the feeder being matched to the set. When these conditions exist the signal is weakened only by the normal, inherent losses of the coaxial cable. In weak signal areas, then, a coaxial cable with the minimum of loss should be employed; but there is not a lot of point in going to this additional expense if signal losses are aggravated by mismatch effects.

Electrical Law

It is a well-known electrical law that maximum transfer of electrical energy occurs from one network or circuit to another when the resistances or impedances of these two circuits are equal. For instance, down to the basic facts, maximum electrical power is conveyed say, from a battery to a torch bulb when the internal resistance of the battery is equal to the resistance of the bulb filament.

The filament of a bulb has a low resistance, as also has the internal resistance of a battery when it is new and in good condition. However, as the battery ages, so its internal resistance rises and the bulb dims. There is an electrical mismatch. The same would apply, of course, by connecting a fairly high resistance in series with a good battery and bulb. Electrical energy would be lost in the resistance, and in effect there would be a mismatch between the battery and the bulb, reducing power at the bulb.

With television aerials there are other factors that come into play. The coaxial cable possesses distributed inductance throughout its length and distributed capacitance between the inner and outer conductors. When a signal is fed into one end of such a feeder, these inductances and capacitances give rise to series and shunt impedance.

Maximum power is passed when the input and output impedances equal the impedance of the coaxial cable. If matching of this nature does not exist, a signal in the aerial will produce a signal current in the coaxial cable, but as the cable is not of the correct impedance, the current in the cable will not represent all the signal energy in the aerial. Some of the energy will be reflected from the mismatched connection back into the aerial instead of into the feeder to the set.

Standing Waves

Conversely, if the coaxial cable is not matched at the set end, the signal travelling down the cable from the aerial will not all be absorbed by the set. Some part of it will be reflected back up the feeder towards the aerial. The part reflected back up the feeder is lost signal and gives rise to what are called "standing waves" in the feeder.

As their name implies, standing waves stand still, unlike the useful signal energy which passes from the aerial to the set. Standing waves cause a voltage difference between the inner and outer conductors of the cable which varies cyclically along the cable.

By plotting the changing voltage against length of the cable a sine wave is produced whose length is proportional to frequency and amplitude proportional to the degree of mismatch. Of course, the greater the mismatch, the greater the amplitude of the standing waves. Standing waves do not alter in position on the cable as long as the cable is not altered in length. However, if the cable is altered in length, the standing waves will alter in position along it. A similar effect is sometimes exhibited when a mismatched cable system is very sharply folded back on itself.

Standing waves on a cable are shown in Fig. 1. The amount of system mismatch is sometimes translated to "voltage standing wave ratio" or "v.s.w.r." for short. A ratio of unity represents a perfect match, while an increasing ratio signifies an increasing mismatch. The idea is illustrated in Fig. 2, where the curve shows how the attenuation rises as the aerial mismatch (in terms of v.s.w.r.) increases.

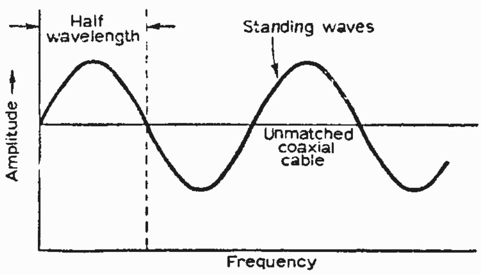


Fig. 1—When the terminating loads at either end of a coaxial feeder fail to equal the characteristic impedance of the feeder, standing waves are set up on the cable due to the presence of a signal as this diagram shows. The standing waves are fixed in position on the feeder as long as the length of the feeder and position of the mismatch are unchanged.

A television aerial is designed so that its impedance at the point of connection to the cable is as close as possible to the impedance of the cable—called "characteristic impedance"—while the set designer also sets out to arrange for the aerial socket of his set to "look" like 75 ohms, or thereabouts, to match the characteristic impedance of the cable.

Mismatch Loss

Provided all in the aerial system is in order, including the set's aerial circuit, there usually exists a fairly reasonable match between the aerial and the set. The v.s.w.r. then rarely rises above about 2, so the loss due to inherent mismatch should be under 1dB (see Fig. 2).

There are times, however, when the matching at the aerial may be reasonable but the matching at the set poor. The mismatch curve in Fig. 2 applies only at the aerial end. The combined effect

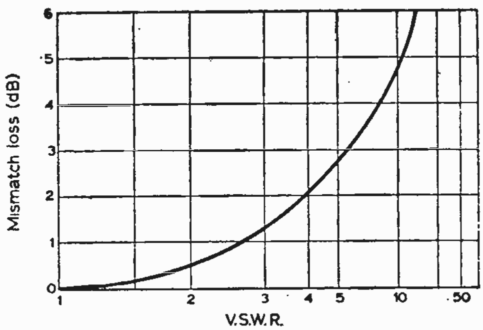


Fig. 2—This curve reveals the amount of loss arising from mismatches at the aerial end of a coaxial cable, the mismatch here being in terms of voltage standing wave ratio, as explained in the text.

of mismatch at both ends of the coaxial cable can—and does—produce losses well in excess of 1dB.

Apart from trouble in the v.h.f. or u.h.f. tuner in the set, mismatch often results from damaged coaxial cable and from the use of an incorrect plug or poor soldered connection between the cable and the plug. Joins in coaxial cable are other vulnerable points of mismatch, which should be investigated when the symptoms of mismatch are present.

This, then, brings us to the actual symptoms of mismatch. These can include poor picture definition, ringing effects on the picture, instability in the sound or vision channels (or in both), weak sound and strong picture, or strong picture and weak sound and various other intermediate symptoms.

At one time it was often written that owing to a mismatched cable causing signal to be reflected up and down, this showed up on the picture as a "ghost" image, after the style of that resulting from signals reflected from buildings and hills (i.e., multipath interference). This is not really the case. For one thing, the length of an average coaxial feeder is insufficient to cause a ghost display. A displacement time of, at least, one microsecond (on 405 lines) would be necessary for the display of a ghost image, and such a delay would need a cable in the order of 100 yards in length to cause it.

Even so, assuming that such a long cable is necessary to convey a signal from, say, a hill-mounted aerial to a set in the valley below, then if the cable has an attenuation of 12dB/100 yards and the signal is reflected at the set and back up the cable, it would lose 12dB going back up and 12dB coming back down again, assuming that reflection occurs also at the aerial end. This gives 24dB of cable attenuation. There would not be perfect reflections at the top and bottom of the feeder, so if the signal loses, say 6dB at the two reflecting points, then the total loss is 36dB. This would mean that the reflected signal would be 36dB down (about 62 times) on the main signal, so it would just not be seen as a secondary or ghost image! It would be far too weak.

However, if bad mismatch exists on a relatively short cable of very low attenuation factor, up and down reflections may occur more than once and then the signal amplitude may be still large enough to cause some effect on the picture. It is unlikely whether the displacement time would be sufficient to incite the display of secondary images to the right of the main one. There is little doubt, however, that the picture definition would suffer. For instance, a sharp, vertical picture element would appear fuzzy due to the repeated signal of very short period, an effect synonymous to vision i.f. channel misalignment.

Half-wave Definition Changes

Just how much the definition will suffer will depend upon whether the reflected signals add to or subtract from the main signal. If the reflected signal can be made to add to the direct signal, the symptom can be virtually eliminated. The simplest way to arrange for this to happen is to alter the length of the coaxial cable from the aerial to the set until the best definition is obtained. This is best done by cutting the cable a little at the time and then checking the picture after each cut. Until there appears a substantial change in picture quality, each cut can remove about an inch from the cable. However, shorter lengths—about a quarter of an inch—should eventually be cut off to provide the fine adjustment to the length. The changes in picture definition due to this action will repeat each time the length of the cable is altered by half a wavelength. The reason for this will be apparent from Fig. 1.

Another problem with short, mismatched feeders is that the set or amplifier may be presented with a reactive load, instead of a resistive one which is present across a correctly matched feeder system. Sometimes, the short, mismatched feeder will tend to become a part of the aerial input circuit and resonate with components therein.

This can give rise to instability on both sound and/or vision, and often is responsible for the "ringing" effect on pictures, which manifests as a series of light and dark images following the main image. If mismatching is responsible for this trouble, the effect on the picture will be removed or modified when the cable at the rear of the set is moved about.

Symptoms of this kind are sometimes present when a simple set-top aerial is connected to the set through a relatively short length of coaxial cable. Set-top aerials themselves are not so highly matched as their more sophisticated attic or roof-mounted counterparts. One solution to this problem lies in replacing the existing aerial cable with a longer length of low or medium loss cable. The surplus cable, however, should not be coiled up behind the set as unwanted coupling may then occur. The best plan is to locate the aerial on a window-sill or shelf some distance away from the set and run the coaxial cable underneath the carpet out of the way.

Balance Upset

On a badly matched system the sound and vision signals may seriously go out of balance. This is because the standing waves for the vision will differ from those of the sound and if the cable length is adjusted for optimum matching of one signal, matching on the other signal will be poor. If the matching is in favour of the sound signal, sound-on-vision intereference can result due to the stronger sound signal outweighing the efficiency of the sound suppressors in the set. In this event, the coaxial cable should be adjusted in length for the best compromise between sound and vision.

Conversely, of course, too much vision signal will cause vision-on-sound interference. This manifests as a buzz on sound, the character of which changes with change of picture.

In poor signal strength areas where a transistor amplifier or booster is necessary, mismatch effects may affect the operation of the amplifier. This, again, can cause ringing disturbances on the picture, and in isolated cases severe instability may result, causing oscillation which may wipe out reception on a neighbour's set. Obviously, the best plan is to correct the responsible mismatch at the aerial or at the set.

Unfortunately, the impedance at the set's aerial socket may not be the same at all channel numbers. On some sets investigated by the author, it was discovered that over the v.h.f. channels the aerial input impedance could alter from a nominal 75 ohms down to 10 ohms and up to 100 ohms! This is a design problem and there is little that the experimenter can do to rectify it.

Where a transistor amplifier is in use, however, there is one thing, at least, that can be done to "buffer" the impedance variations, and that is to use a substantial length of cable between the amplifier and the set. This applies both to v.h.f. and u.h.f. amplifiers. It has been found that medium loss cable of no less than 10 ft. in length solves the problem in nine cases out of ten.

The aerial impedance of u.h.f. tuners can also vary from one end of the tuning scale to the other. There is as yet insufficient material available to provide definite values, but the author is currently engaged in delving into these problems and will report in greater detail on them in a later article.

Stub Matching

The old artifice of cancelling out a reactive component at the end of a mismatched aerial feeder by the use of a parallel coaxial stub is still worth looking into. For readers unfamiliar with the technique, the idea is shown in Fig. 3.

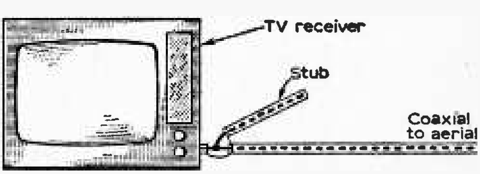


Fig. 3—The idea of stub matching. The stub length is adjusted for the best picture and/or sound.

The stub is tuned by cutting off short pieces until the best picture and/or sound is obtained. Note that the end of the stub is left open-circuit, so care should be taken to ensure that the inner conductor is not shorting to the outer conductor (braid) after each cut. Moreover, the stub only works at one particular frequency. This means that a stub tuned, say, for the best .results on Channel 2 may result in a poor picture on the partnering Band III channel. On the other hand, it may barely affect that channel, and there is the possibility that it could improve that also. The thing to do is to try it and see.

The idea also works on the u.h.f. channels, but here the length of the stub is considerably shorter. On the Band I channels, the stub should be started at about 70 in., on the Band III channels at about 18 in. and on the u.h.f. channels at about 10 in.

Stub tuning is worth trying when experimenting with the reception of distant television stations; also when using an aerial which is not specifically designed for the channel being received.

For long distant (DX) reception, a variable aerial matching device is useful. Such consists of a small two-gang capacitor of about 0·00025μF and a tapped coil, as shown in Fig. 4. The unit can easily be constructed in a small metal box with input and output coaxial sockets. The number of turns required for L1 will depend on the frequency, and can be found by experimentation and by tapping the coil. A self-supporting coil of 18 s.w.g. tinned copper wire with spaced turns facilitates construction and tapping.

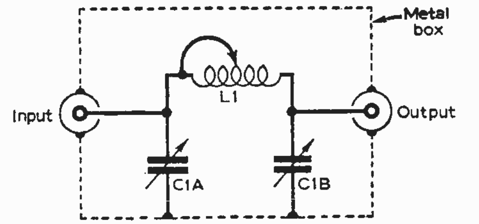


Fig. 4—A simple aerial matching unit. This is explained in the text.

While commercial sets are now designed in such a way that experimentation within is difficult, there is still the aerial system and its matching that lend themselves to adjustment. Here we have a very interesting field of experimentation, especially now that there are so many channels on the air on all bands. ■

SPOT WOBBLE—*Continued from page 71*

diameter. This is then sandpapered down at one end to slightly less than the neck diameter. The yoke is placed on this narrow end and gently forced on to the wider diameter, imparting a rotary movement to the yoke. It is advisable to slightly warm the yoke first in order to soften any protective wax coating used.

The circuit will oscillate at a frequency between 10 and 15Mc/s and it is important to avoid causing interference at the harmonics of this frequency with the television receiver r.f. or i.f. circuits. For this reason the oscillator should be constructed within a small screened compartment situated as close to the deflector coils as possible to minimise the length of the radiating connecting leads shown dotted in Fig. 3.

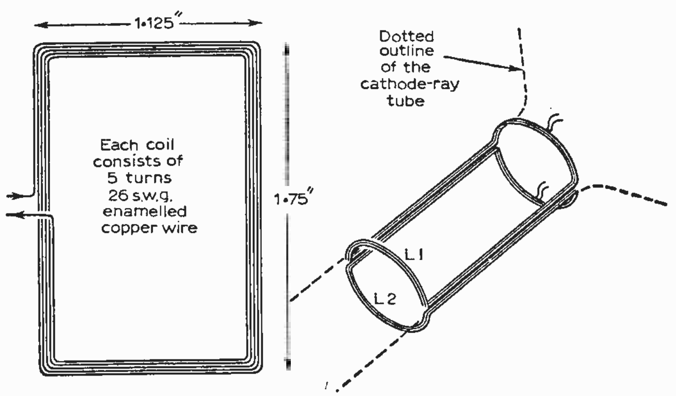


Fig. 4—Scanning coil construction details.

H.T. Supply

It will be found convenient to use the receiver h.t. supply for this circuit since the current consumption will be less than 10mA. The h.t. potential is not critical and the oscillator will work at any voltage between 180 and 250V. The modulation of the receiver h.t. supply at the spot-wobble frequency is avoided by the decoupling action of capacitor C4. ■

ENCOUNTER WITH A TRANSISTORISED TV—Continued from page 59

external source with positive to chassis, negative to supply lead. The 3A fuse under the bottom panel which handles the external 12V supply was blown. This was replaced and a supply lead with red and black clearly marked was fitted to the plug. A label was strung on this lead to remove any future doubt. Again the set was put back into service. Two weeks later back it came! Raster OK but no sound or vision signals. Now there is no common i.f stage so it was reasonable to suspect the tuner. Stripping this and taking voltage readings showed the mixer transistor (V2-AF102) was not passing current. Interchanging this with V3-AF102 local oscillator gave a satisfactory mush on the screen and a hiss on the sound. Injecting an unmodulated signal from the signal generator in place of the oscillator frequency gave a good picture and sound, thus confirming the point.

A new AF102 was fitted into the holder (no soldering) and all was well. Reassembled and tested the set functioned without fault. It has functioned well since and we are still on friendly terms with the owner. ■

Servicing TELEVISION Receivers

by L. Lawry-Johns

No. 119: The Alba T866 and T877 continued

The method of controlling the volume is a little unusual. The method used involves tapping the negative drive to the PL81 control grid, filtering out the 10kc/s content through R68-C77 and applying it as bias to V4 via tag 13 socket 1.

In the event of a loss of line drive, ECL80 failure or leakage through C76 0·01μF, there will be no bias applied to V4 and the volume will be maximum with no manual control.

This condition will also obtain should the PL81 develop an internal short of course. This symptom should have been included under the "no picture" heading as it gives a valuable clue as to whether the fault is before or after the PL81.

No Signals

If the receiver seems to function but with no sound or vision signals when the aerial is inserted, the fault is probably in the tuner unit.

In fact the fault could be in the common I.F. stage V3 EF85 but this is not often the case and the PCF86 is most likely to be found at fault. Note that a PCF80 must not be used in this position.

If the PCF86 is not at fault check the PC97 which can also be responsible for a graining or noisy reception condition. If the PCF86 is in order it is prudent to check R11 7kΩ which can be

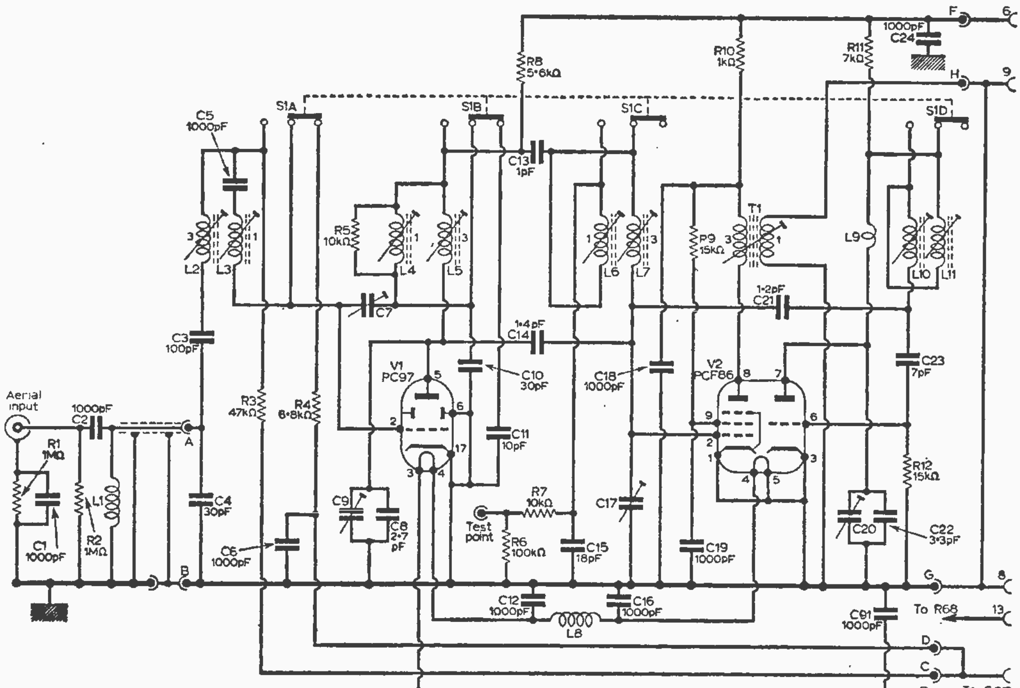


Fig. 4—The tuner unit of Alba T866 and T877.

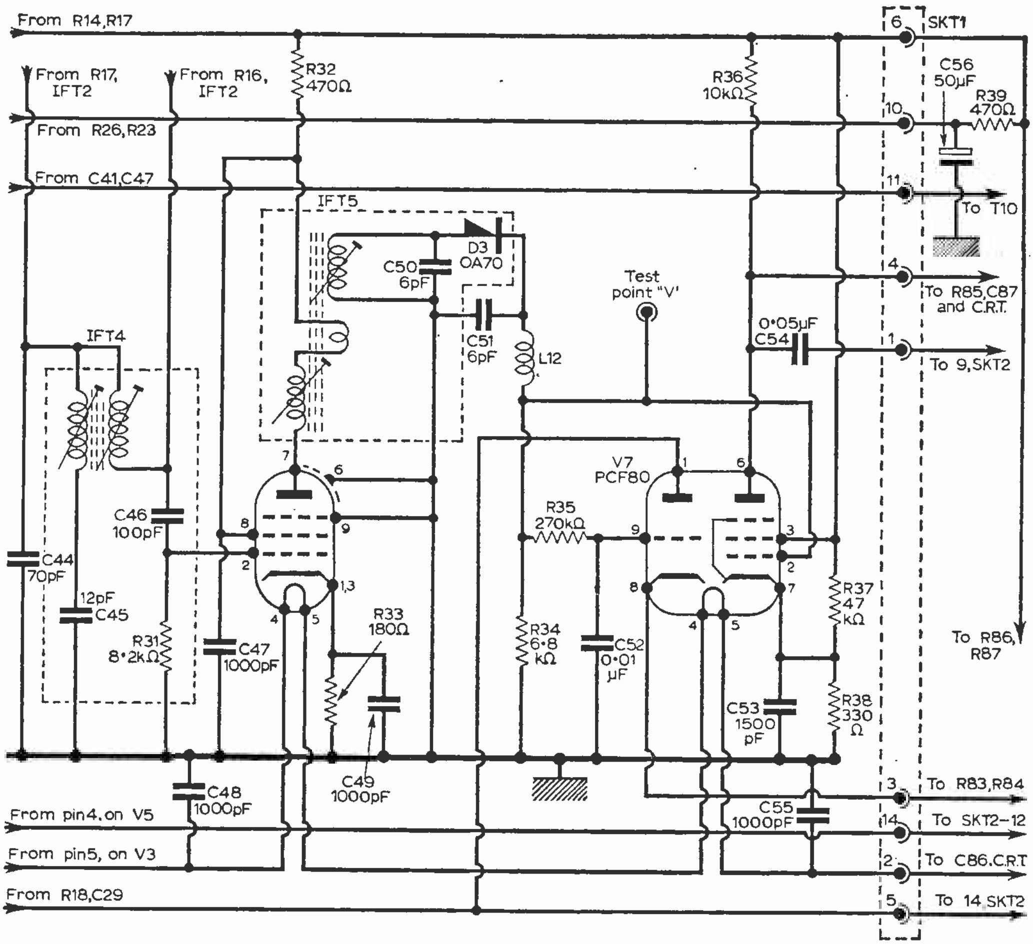


Fig. 5—Last vision i.f. and video output stages. The unmarked valve is V6 (EF80).

responsible for the symptoms of normal or weak Band I (BBC) reception but no reception of Band III.

Distorted Picture

A picture with no or poor sync, heavily shaded —say top dark, bottom light, with severely curved sides (S shaped) points to an open circuited 400μF main smoother C58. If the 100μF section goes the h.t. voltage will fall drastically to something like 100V or a little more.

Receiver Dead

No heaters glowing. This is where the neon screwdriver is very handy. With the receiver switched on a glow should be obtained at the fuse holder (assuming the mains plug is correctly wired).

If the fuse is intact some indication will also be recorded at the mains dropper at least on one or more tags. It is therefore a matter of moments to check the 67—67—110Ω sections of the heater circuit part of the dropper, thence via the thermistor VA1015 to pin 2 of the PY33 base, thence pin 7, PL81 pin 5—pin 4, PY81 pin 4—pin 5 and so on along the heater chain until the break is found.

Quite often the PY81 will be found at fault and this is also the case when switching on brings all heaters to life but as soon as the timebase warms up the PY33 and PL81 heaters glow like electric light bulbs prior to the fuse failing.

The diagnosis here is a breakdown of PY81 heater—cathode insulation as the voltage rises.

The receiver can also be inoperative although the heaters glow normally. In nearly every case this is due to a 22Ω or 18Ω section of the dropper becoming o/c. which again can be traced with the neon.

If the sections are in order the glow will be maintained to pins 3 and 5 of the PY33. The d.c. or h.t., output of the PY33 will not cause such a healthy glow on a neon unless the free hand is touched to chassis.

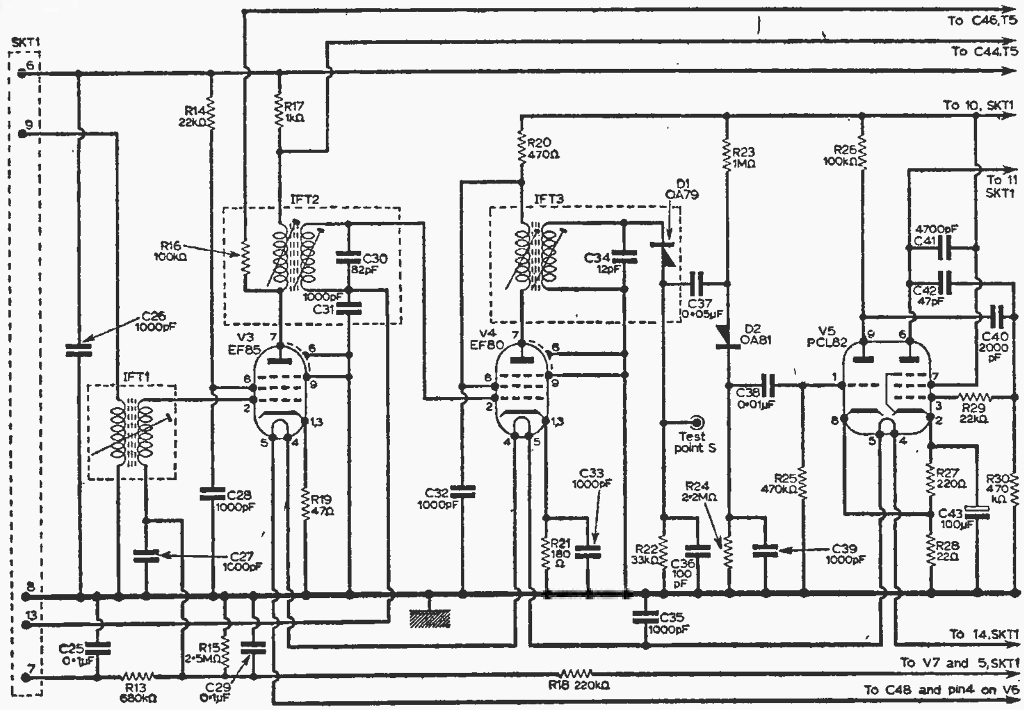


Fig. 6—Part of sound and vision i.f. stages, audio output stage.

Should h.t. be recorded at the 100μF section of the main electrolytic (pin 8 of PY33) but not at the 400μF section, the indication is that L14 is o/c. Persistent fuse failure and overheated 22Ω and/or 18Ω sections of the dropper have on more than one occasion been traced to a short to core in L14.

H.T. Shorts

Readers often seem uncertain how to tackle an h.t. short and some weird notions have been forwarded. One popular notion is to remove all valves before checking with an ohmeter.

Whilst this may hold for electrical circuits where lamps are removed, aircraft, cars, boats etc., it should be realised that these are only the equivalent of the valve heaters and do not concern the h.t. supply. So leave the valves alone. The bases are easily cracked and valve positions can easily get mixed up.

The correct way is first to have a good look at all components to see if any resistors have obviously been burned—charred—overheated, what you will. For example, and as previously stated, R37 often changes value, gets cooked, damages R38 and leaves a nasty mark on the panel.

The remedy here is obvious and one need look no further. However, if for example R17 is found badly charred it is little use replacing this and expecting all to be well.

If R17 is charred, C44 is the primary suspect with C28 the suspect if R14 overheats and so on.

Now it often happens that no resistors show any signs of overheating except the sections of the mains dropper, with perhaps L14 showing signs of distress.

The procedure is to take an ohms reading (receiver off of course) from pin 8 of the PY33 or C59 to chassis which may show a near dead short. The exact reading may be significant because a dead short would suggest that C59 itself may be at fault (disconnect and check).

A reading of some 75Ω could suggest C58 being the culprit which is speedily disconnected. If the short remains free L14 of all outward connections and check this.

If free of shorts check each main h.t. feed line in turn not forgetting the supply to the field output (T9) transformer which does sometimes develop a primary to secondary short (which is a *thorn* in the side of some Ferguson—Ultra—Marconi—HMV—Philco etc. models—apologies all round for this one!).

In short therefore if the fault is elusive, disconnect the h.t. supply lines systematically and chase the short through to the particular part of the circuit where it is hiding.

At this point it is prudent to remove the valve(s) in that part to see if one has developed an internal short.

Model T877 and others with Remote Control unit

If removing the remote control plug clears an h.t. short check the condition of R93 and C90, the former is damaged if the latter shorts.

FIRST TIME TESTS

By H. W. Hellyer

PART 3: FRAME FAULTS

FAILURE of the frame or, to be more in keeping with modern terminology, field-circuits can have a number of different symptoms, besides the familiar " thin white line " across the screen.

In the first place, if a thin white line is observed, the line circuits can be taken to be operating, even if incorrectly, and attention can be directed to the field circuits. Lack of field scan indicates that no energising current is reaching the deflection coils, or, reaching there, is either being suppressed at that point or failing to deflect the beam of the c.r.t. because of faulty coils. The first step is to prove where the failure lies.

The field circuits can be divided roughly into oscillator and amplifier sections. Many of the finer points overlap, as we shall see when investigating non-linearity, but for our present test we need to determine whether oscillator or amplifier is at fault.

There are two ways of making the first test: one approach is to check whether a frame pulse is reaching the amplifier grid; the second is to inject a test pulse and observe whether a raster is obtained. The author favours the second approach, as being simpler and needing less equipment. The method is simply to couple a 50c/s pulse to the field amplifier grid, and this can be done with a $0{\cdot}1\mu$F capacitor connected to a point on the heater line, the free end briefly touched on the grid. Select a point fairly low on the heater line—in fact, the heater of the oscillator itself may be suitable, and take care that the connection is made so that it does not slip and short-circuit the heater pins to chassis or h.t. The screen should now fill out if the amplifier section is operative, although the raster obtained may be severely distorted.

The other method is to monitor the pulse at the amplifier grid by an aural coupling, as a pair of headphones, suitably isolated by $0{\cdot}005\mu$F capacitors in each lead. A buzz should be heard, and alteration of the hold control should vary the pitch of the buzz.

Field Output Stage

If there is now no result from the amplifier, we can concentrate on this circuit. Most obvious culprit is the valve itself, and a few voltage tests should prove its efficiency, although substitution is the only foolproof test. A word of warning may not be out of place here: the author has several times been called upon to service sets whose valves are all labelled with little stickers saying: " Good ", or " Fair " or " Low emission ". Usually the owner has laboriously hauled his collection of valves to the nearest dealer and had them vetted by that magic box, the valve tester. Whereas most valve testers can indicate the state of emission, and obvious leaks between electrodes, it can not simulate the kind of conditions we expect the valve to work in. The field circuits, for example, have some very spiky pulses, and valves have to operate at high current yet with sudden changes of applied voltage, which the valve tester cannot give. Line output valves have even more severe restrictions, and even the i.f. amplifier, which may seem a perfectly normal valve to test, could have unwanted inter-electrode capacitance, rendering it microphonic or unstable at the i.f. yet not with the d.c. tests normally carried out on the tester. Again, the heater supply of the tester is transformer fed, and the valve receives its correct operating voltage. In the set, with valve heater series-fed, if a heater is faulty, the common current may not allow it to develop its full voltage, and it is the product of these two that counts—the power that provides the necessary heat!

After which digression, let us return to our muttons: following the valve, there are two very obvious causes of " no frame " faults. First, the output transformer, and second the deflection coils. If the injection test previously described fails to produce some sort of raster, and the efficiency of the valve is not in question, it is very likely that one of these two items is faulty. Likely, but not certain, for there are particular circuits which depend on boost voltage for output conditions, and others which are adjusted to require an exact degree of feedback, and which simply collapse to a dead output if this condition is not achieved. Some knowledge of the type of circuit is necessary before definite conclusions can be drawn from the results of the next tests.

The important thing to remember is that whatever its circuitry, the field output stage is a current amplifier, rather like the sound output stage—and this gives us a handy basis for our spot test. If the frame has collapsed altogether, and application of a pulse to the grid of the field output valve produces no expansion of that damaging thin bright line, we must next prove the output components. A very rough check of the output transformer is to couple it as a sound output transformer to a conventional audio circuit. Results may not exactly be hi-fi, but the production of an audio signal will at least prove the transformer. It does not prove whether the transformer is breaking down under a high voltage pulse, which is a fault that can sometimes occur, especially if the load has been removed, as when the secondary of the transformer or the field scan coils open circuit.

There is usually some indication of this latter condition, by a fierce rattle of the transformer laminations, or even a spark at the fine lead-out wires. A quick meter test will soon show an open circuit. Similarly, a scan coil winding coupled in parallel with an audio output circuit (first being disconnected from its feed), will considerably damp the audio if a short circuit has developed. When coupled in series, an open-circuit will kill the audio or reduce it to next to nothing. These are roundabout tests, which are more easily made directly with a good meter, but as we stipulated at the outset of this series, wherever possible tests will be described for a minimum of equipment. The professional servicemen must bear with us—or turn the page!

The Scancoils

The foregoing remarks may have made one point clear; breakdown of field scan coils can occur due to the high voltage pulse; leakage between the line and field coils, or between the field coils and iron core on which the coils are wound will also cause frame collapse. This will not necessarily show up with any of the foregoing tests, and what reads an open-circuit on the best of meters when tested "cold" may well be a breakdown source when the pulse is applied. A simple leakage test, which needs a meter, is necessary in these cases.

The fault does not always result in a total field collapse. Depending on the circuit, it can cause severe cramping, or excessive foldover. It is general practice to ensure that line and field coils are at the same d.c. potential, either in shunt, i.e., at chassis potential, or in series, at h.t. potential. But where the field coils are in shunt, and d.c. flows through the line coils, leakage can—and often does—occur. Fig. 1 shows a typical circuit of this type, where the line coils are in h.t. circuit, and field coils are connected across the secondary of the output transformer with an earth return. If leakage is suspected, it is possible to prove this by disconnecting the return lead and inserting a milliameter in series, using a limiting resistor of 100 to 220kΩ. For more complete proof, disconnect the lead which couples the iron core to the earth tag and reconnect the core to a tag on the line coils. Any reading on the meter then indicates that there is a leakage between the field coils and the iron core.

Leakage between coils is less common with modern construction, but was prevalent with certain types of older deflection coil yoke. The results of various types of leakages and short circuits in the coils are shown in Fig. 7. (a) and (b) show the effect of shorted turns in one or other of the coils, (a) being the effect given when line coils are faulty and the horizontal compression of (b) being caused by a shorting turn in a field coil. The amount of the compression depends on the extent of the short-circuit and its position in the winding. A curvature of the edges may also be indicative of leakage, which can occur if the short is a burn spot near the angle of the yoke where it meets the tube flare. Although it has been found possible to clear this fault by careful scraping, separation of the enamelled wires and re-varnishing, in an emergency, replacement of the coil assembly is the only safe cure.

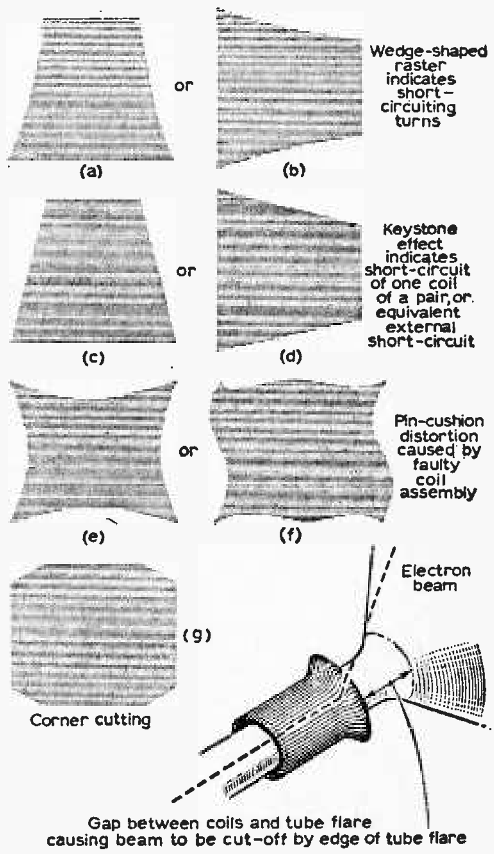


Fig. 7—Distorted raster shapes due to leakage, etc.

The keystone effect of (c) and (d) is a development of this fault, where one of the pair of coils is short-circuited. The short edge of the raster is then half the length of the longer edge. But this fault is much more likely to be caused by an external short-circuit, as when R1 or R2 in Fig. 8 should fail. Or, as is more usual, a short develop in the connecting harness. To test for this fault, disconnect the separate sections and observe the effect on the raster. No change indicates that the disconnected section is faulty.

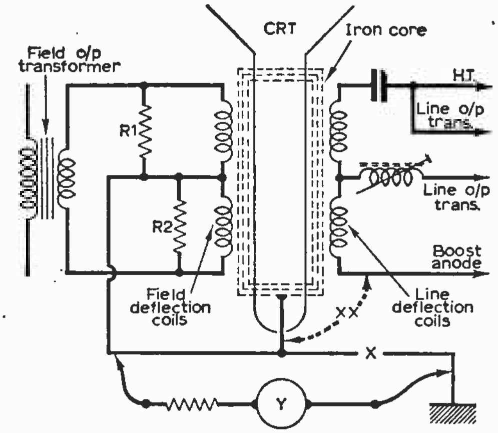


Fig. 8—Leakage tests—deflection coils.

The distorted raster of (e) and (f) may be caused by various forms of leakage between coils and core, and usually means the yoke should be changed. But (f) should not be confused with a similar effect that is obtained when a c.r.t. fault causes the raster to "grow" gradually as the receiver warms up. In extreme cases, the raster may not fill the tube face, but the edges are usually a well-defined line which can be seen to be irregular.

Shadowy edge cutting as in (g) is usually the result of the deflection coils having moved away from the tube flare so that the electron beam is deflected too soon, being cut off at the extremes of deflection.

Cramping of the Raster

A much more general type of field scan distortion is non-linearity, loss of height, cramping or stretching of the picture. There are so many different sorts of field circuit in use that it would be futile to attempt a fault-finding description of each, and the examples chosen have been those found to be typical of certain types of circuit fault. The general remarks can be adapted to the particular circumstances.

Most common fault is cramping at the bottom of the picture, which may be associated with loss of height. As the height control is advanced, the picture begins to extend then cramps, and may perhaps produce a foldover at both bottom and top in its worst condition. Loss of emission of the output valve is one obvious cause. Another is a lack of h.t. to the valve or a reduction in bias causing the valve to run into grid current when full drive is applied. This often happens when the cathode bypass capacitor short-circuits, but can also happen if it develops a leak and shunts the bias resistor. This component, C115 in Fig. 9, is usually a 100μF or greater electrolytic, with a working voltage of 25V. Shunting it is not a conclusive test, but temporarily disconnecting will often give a clue as to its condition by the worsening of the symptoms. A discoloration of the cathode bias resistor R122 is a further clue that indicates over-running, and even if this component measures correctly "cold" it may still be a likely suspect.

Fig. 9 is given in full to demonstrate one type of field oscillator and output circuit widely used in modern sets. A single valve is used, the oscillator being a cathode coupled multivibrator from the triode to the pentode section and the additional components in the circuit used to achieve linearity. It must be remembered that the production of the sawtooth current needed for linear deflection is gained by the combination of oscillator, output and feedback conditions and, indeed, by the non-linear qualities of the output transformer and deflection coils. Incorrect linearity can be caused by a fault practically anywhere in the circuit. It is for this reason that tests made with an oscilloscope are not always helpful, unless the waveforms that should be obtained on a known good model can be used as a comparison. Many service manuals give these, but we are assuming here that the reader has neither access to the manual nor an oscilloscope tucked away in his toolbox. We must thus discuss the most

—continued on page 86

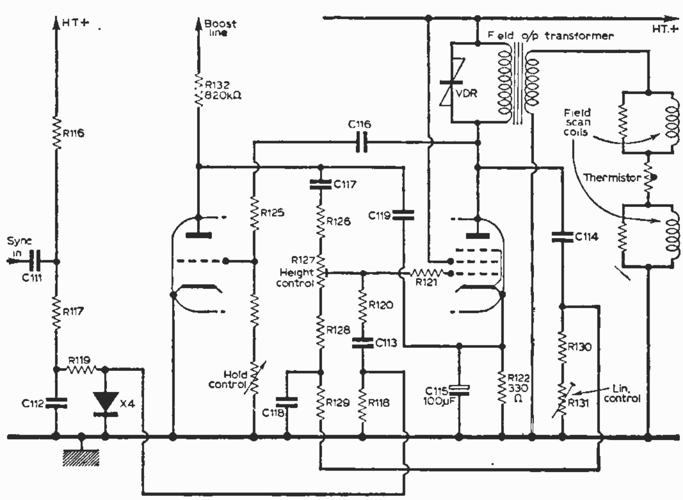


Fig. 9—An example of modern field circuitry.

UNDERNEATH THE DIPOLE

BEWARE! Anything I say should be taken with caution this month! No disrespect is intended either to the Postmaster General or to Christopher Robin; nor is any ecclesiastical disrespect intended in connection with what I am now about to say. That is, the Postmaster General is saying his prayers. He is saying them to the trade, to the BBC, to the ITA, to the ITV companies and —most important of all—to the Joint Television Advisory Committee. The PMG's impatience was echoed in the speech of his colleague, Mr. Roy Mason, Minister of State of Shipping, who launched one of the recent individual exhibitions which replaced the combined TV and Radio Show at Earls Court this year. Mr. Mason gave a "wait and see" speech, to which was added a time limit of six months in which the industry must make a decision on colour systems and line standards.

Crazy TV World

This television industry has been a lively world of progress leapfrogging over progress ever since that time thirty years ago (as nostalgically reprinted in the August issue of *Practical Television*) when the Marconi-EMI combination announced the experimental transmissions of interlaced 405 lines in competition with Baird's 240 lines sequential system, with somewhat similar systems being developed in France and USA and 120 lines in Germany. That was a time when mechanical systems with scanning discs whizzed around at a high speed and Scophony gave impressive large screen television projection on a cinema screen. It seems almost to go back to the days before the motor car, when travel was anchored to a permanent railway gauge of 4ft. 8½in. (compatible with the distance between the wheels of hansom cabs and coal carts) and magnificent men were pioneering in flying machines and balloons.

Burning Midnight Oil

Ah well! The backroom boys of today are suffering from the unavoidable mistakes of thirty years ago and are burning the midnight oil and "sporting the oak" (as they say at Oxford) to solve the problem of colour and compatible black-and-white television in an international situation which is interlaced with policy and politics. I seem to recall that the BBC's early motto was "Nation shall speak Peace unto Nation"—to which must now be added "and look at one another, face to face". The boffins have less than six months in which to provide the solution to the problems of colour systems on 405 and/or 625 lines, to black-and-white compatibility, to achieve adequate band width for transmission and reception; also to accomplish impeccable line standards conversion between nations. Britain was the first nation to run a public television service in 1936, when pigeons roosted on the Alexandra Palace aerial. It's the early bird that catches the wriggling worm! But to quote a Music Hall expression, it is sometimes the pioneer who gets the "bird." You can't seem to win!

Gimmicks Galore

If the engineering sides of BBC and ITA are whistling worried-man tunes, the programme people are equally confused. Peak time programme policies "for the people by the people" are much more difficult to recite than Lincoln's "Gettysburg" speech. There must have been formidable reasons which led the BBC to drop their twice weekly serial "199 Park Lane" after only three weeks' run. Research and ratings were discouraging.

There are times when viewers so accustomed to the interruptions by commercials on ITV that (like the intervals between the acts at the theatre with three-piece orchestras playing entr'acts) they welcome the opportunity to take a cup of tea, wash their hands *or anything* (If you understand what I mean). This takes me over to the kitchen-sink and plumbing era of television plays, particularly on the BBC, which have long overstayed their off-colour perfume and have become as old-fashioned as jokes about kippers and mothers-in-law.

Presentation gimmicks are the craze at the moment, introduced by the makers of TV commercials and copied by directors of television plays and cinema films. Quick cuts, sharp zooms, out-of-focus shots, contrived halation and all the rules of good photography, continuity and cutting are broken with enthusiasm. This is unfortunate. They induce headaches and eyestrain if used too often. Quick half-second cuts of stills may seem smart to the vision mixer or cutter, but they become a mere irritant behind credits and titles, almost as confusing as the products of modern art at the Tate Gallery. After all is said and done, it is the performance of the actor, his personality and his projection of character, which is the most important factor in television plays. Presentation gimmicks are useful frills, used with discretion.

"Old Tyme" Gimmicks

The new civic theatres of today often provide a variety of presentation facilities for different types of entertainment. Picture-frame proscenium with tab-curtains in front of the stage; theatre-in-the-round; back-projection scenic effects; sound reinforcement; computer - controlled memory devices for lighting effects, all play their part. Stage revolves and orchestra lifts, respectively, twist or rise at the press of a button. Some of these devices are modern developments of the mechanical marvels of the theatre of a hundred years ago, when actors were propelled up through " star-traps " in the stage or disappeared magically down " grave traps ".

Each act ended conventionally with the fall of a curtain, just as dramatic sequences in silent films ended with a fade out to blackness. Dissolves were laboriously achieved in the early silent film days by closing the camera lens diaphragm to make a fade out, hand-turn the camera back a few feet (with the lens covered) and fading in the next required scene by overlapping. This sometimes necessitated the first part of the dissolve to be wound back into its feed magazine and stored or sealed up for weeks until the time came to add or superimpose the second scene. Later, this hazardous hand-made effect was done more accurately on an optical printer in the film laboratory. In television, complicated fades, dissolves, wipes, inter-stripes, spirals etc., are carried out electronically at the touch of a button or the sweep of a quadrant fader. The scope of these electronic effects panels and the virtuosity of the operator often add confusion when handled by a trigger-happy television director or vision mixer. Overdoing an " eggwhisking " operation on the pictures is a danger to be avoided. The omelette may become a bad egg. Straightforward fade-outs are useful conventions for time lapses in the storyline, as were the " old-tyme " tab curtains at theatres. The only drawback is that fade-outs to black at television studios become fade-outs to grey on most British TV receivers with a.g.c. (and no d.c. restoration).

Sound Effects While You Wait?

Music and sound effects for most television productions—and film or theatrical productions, for that matter—have rarely been produced immediately, off the cuff or out of the hat. They have made their contribution to the atmosphere of plays since the earliest of religious plays (performed in market squares) and the first presentations of Shakespeare's works at Stratford or at the original Globe Theatre in London. Half-coconut shells, clap sticks and sheets of iron have been the traditional methods of creating off-stage respectively the sounds of horses' hooves, gun shots or thunder. To some extent, these hand operated audio effects have been superseded in films, television and radio by the skilled use of gramophone discs and magnetic tapes, with each item carefully selected, timed, rehearsed and mixed to fit the scene.

Of course, there are many scenes in which the background noise is a natural part of the visible action, such as the clatter of tea cups, chitter-chatter or the slam of a door. Unfortunately, unless the actors are really professional, they are inclined to clink glasses and slam doors over important words in dialogue. In this day and age, it is the practise to superimpose sound tracks of chatter, applause, gunfire and what-have-you under complete control, both as to sound level and to synchronisation; hence the discs, tapes or sprocketed film tracks. All of this takes time to assemble. You have to wait.

Calamity To Calm

A new approach has been made with an extraordinary box of tricks, called the Mellotron Sound/FX console. This is a device which looks rather like a mini-piano, with a keyboard, which produces no less than 1,260 sound effects, each at the touch on the keyboard and which can be intermixed as required. Steam trains can start, run or stop, whistles blow, phones ring, aeroplanes fly, voices chatter, applause and laughter can be triggered or faded in or out as required. It is not achieved with mirrors or trap doors, but with an ingenious arrangement of 70 triple channel magnetic tapes, each carrying three sound tracks, which carry a further assortment of effects, selected in computer-fashion, by the operation of sort-of piano keys and kind-of organ stops.

In last month's article under " 405 Lines — For Keeps?" it was suggested that Britain should adapt one of colour systems to the present 405-line standard on u.h.f.—this should have read v.h.f.

Also in the last column second paragraph, reference is made to American 525 lines on u.h.f. This should also have read v.h.f.

This is one of the most ingenious contrivances I have seen—or heard. The BBC have used it successfully many times, notably in *The Great War* and *Traveller's Tales*. In the ITV field, Granada and Associated Television have acquired this Mellotron device. I have myself fought a battle with machine guns, planes, mortars and shrieks which have frightened me. Quickly fading this out, I tranquilised myself with the ripple of a river, bird noises and the moo of a cow.

Not Too Long

I don't think it will be long before many television studios—and film studios too, will bring into use this computer-type of sound effects machine. It certainly is a more exact and natural " noise off " than the mechanical effects machines that cinemas used to use in the days of the silent films, when Broncho Billy galloped beside the stage-coach pursued by red indians or General Lee's Confederates stood up to the overwhelming musketry of Grant's Union troops. This new sound device is not an ironclad " Monitor " or " Merrimac " however; it is a British invention which will fight sound battles, create storms or chirrup the birds of any nation. Even the ploughman can homeward wend his weary way electronically, in this day and age.

Iconos

REPETITIVE FAULTS

by

G. R. Wilding

QUITE frequently one comes across receivers that seem repeatedly to develop the same fault or require replacement of one particular valve. A set may regularly require a PL81, PL36 or PCL83 or constantly develop the same sort of operation defect. Invariably such a train of defects is not just coincidental but due to one undiscovered circuit fault.

Screen Feed Resistor

The most common cause of short life in a line output pentode, for instance, is a reduced value screen feed resistor, resulting in excessive anode and screen currents. However, equally true though not so well known is that a low-emission line oscillator, giving insufficient drive to this pentode, can also greatly reduce its life expectancy.

Line output pentodes, of course, are biased solely by the application of the incoming feed to the grid capacitor and, if the drive amplitude is below normal, insufficient bias is produced. Then again, if the reclaim rectifier is below par it results in the anode voltage to the line pentode being below normal, which is equivalent to the raising of the screen voltage.

Furthermore, any component defect in the line output circuit which inhibits the boost voltage will similarly impose an additional strain on this already highly stressed valve.

Boost Rectifier

The reclaim or boost rectifier normally starts to conduct (and apply h.t. to the pentode anode) 50 seconds after all the other valves are conducting, and therefore during this period the line output valve has applied screen voltage but no anode voltage.

During this time screen current can be several times its normal value, imposing a heavy strain on the valve and even momentarily causing the G2 winding to run visibly hot.

The valve manufacturers allow for this but if for any reason the reclaim rectifier is extremely slow to warm up this waiting period can extend beyond the allowable time. Such an additional warming-up period can be caused by a partially shorted heater and this possibility should always be checked.

Incidentally this is the reason why it is particularly bad practice to fit a cold replacement reclaim rectifier into an already warmed-up receiver.

In those earlier receivers which incorporated an adjustable "line drive" control, excessive feed to the line pentode, resulting in a thin white vertical line appearing about one-third of the way across the raster, is a sure way of over-running the valve.

Frame Non-Linearity

Cases of recurring poor frame linearity, apparently curable by a new PCL83 or PCL82 but which soon reappears and is impossible to rectify by adjustment of the linearity controls, is invariably due to a changed value cathode bias resistor or, more rarely, a slightly leaky capacitor from the anode of the frame generator to the grid of the frame amplifier.

When the replacement valve is new, even though wrongly biased, it may be quite possible to achieve good linearity, but after being over-run for some little time its working straight-line characteristic becomes shortened and poor linearity or foldover appears.

Due to its small physical dimensions and inter-electrode spacing the PCL83 tends to develop internal shorts rather more readily than other types and, when this occurs, the resulting high current passing through the cathode bias resistor invariably lowers its value and would rapidly deteriorate any valve replacement unless it was changed for one of the correct value.

Insufficient height which only manages to fill the screen after replacement of the frame valves is more likely to be due to a component defect than any shortcoming in the original valves as any modern receiver with new frame valves should give at least sufficient height plus 30%.

Frame Cramp

If there is a strong tendency towards frame cramping at the bottom of the picture the odds are that the high-value cathode bypass electrolytic is reduced in capacitance, but if linearity is not too bad the first suspect should be the feed resistor to the anode of the triode oscillator having gone high and reduced anode voltage to below specification.

Shrinking Height

Some Philips receivers introduced about four years ago quite commonly developed a steadily shrinking height and in many instances service engineers went through the usual process of replacing both frame valves, h.t. rectifiers and bypass capacitors as the fault progressed to keep the screen at least filled.

But the real cause of the trouble was most unusual. In common with many other designs the triode frame generator is fed from the boost h.t. rail (the higher voltage facilitating a more linear raster) and shunted across the boost rail to chassis is a miniature 1MΩ slider potentiometer feeding the focus electrode of the tube.

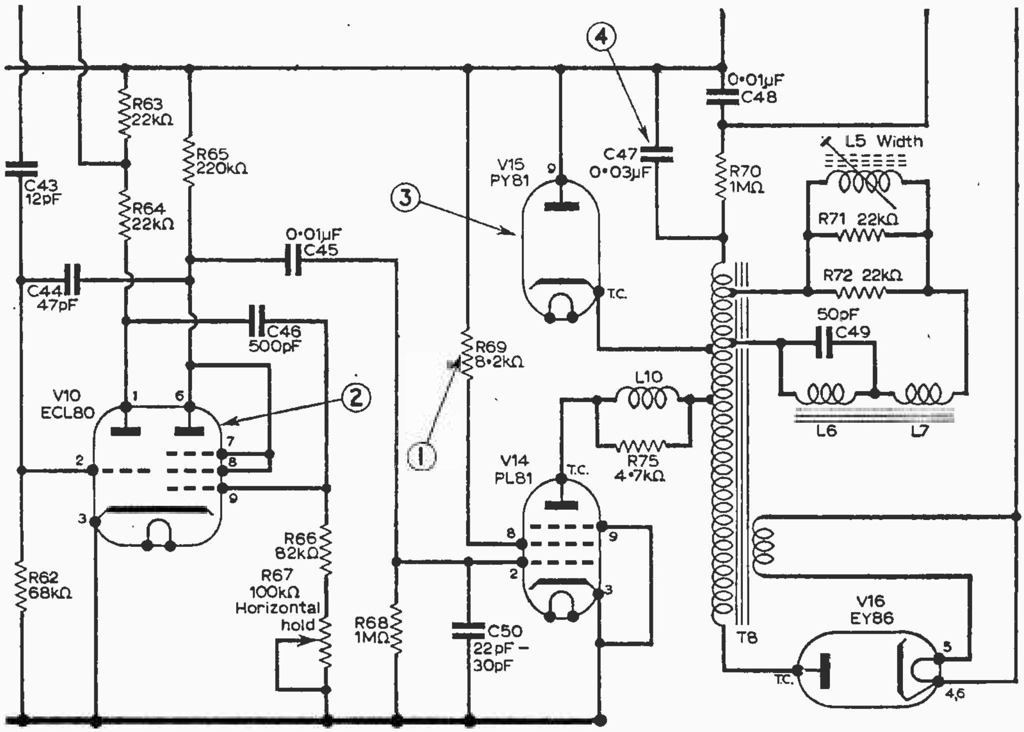


Fig. 1—Causes of reduced service from line output pentodes.
1—Decreased value screen feed resistor. (Resulting in excessive anode and screen currents.)
2—Insufficient grid drive. (Producing inadequate grid bias.)
3—Faulty Boost Rectifier. (Prolonging warm-up period or reducing anode voltage.)
4—Reduced Capacity Boost Capacitor. (Reducing anode voltage over the saw-tooth wave-form).

However, after some years of use the miniature strip pot tended to decrease in value, imposed a relatively heavy load on the boost supply and pulled this voltage down to below the figure necessary to maintain full height. A replacement potentiometer always cured the trouble and permitted the use of the original frame valves with ample height in hand.

Short-lived PY32s

Cases of short-lived PY33's and PY32's are not so much due to short-period short-circuits or spark-overs as repeated strains caused by intermittently contacting surge limiters.

For instance, one Ferguson 406T we came across with a history of being heavy on its PY32 rectifiers was found to have badly contacting clips on the surge limiter section of its multiple breakdown resistor, which invariably caused sparking on first switching on, imposing a heavy strain on the valve as the a.c. anode supply was intermittently contacted on and off.

Similarly, when investigating cases of short rectifier life in receivers employing a pair of PY82's as well as the dual-anode PY33 or quadruple-anode U801 it is often found that the surge limiter to one anode is completely o/c, causing the entire h.t. current load to be carried by the remainder. In fact when investigating the older receivers employing the U801 it is not unusual to find three of the four surge limiters open-circuit and the fourth naturally running extremely hot.

Noisy Volume Controls

Many instances of noisy volume control operation soon after the cleaning or replacement of the component are due to the sound output valve and not to any real defect in the control. In many designs the control grid of the sound pentode is directly connected to the slider of the volume control and, should it develop appreciable grid current, the passage of this unwanted d.c. would test the most silky of controls.

F/C Failure

When absence of sound and vision is found to be due to the PCF80-type frequency changer failing to oscillate on one or both bands within a short time of a similar replacement, it is more than likely that the fault is due to a defective component in the triode section rather than any lack of emission in the frequency changer itself and attention should be directed to that part of the tuner unit.

Lock Shift

Cases of line and frame hold locking position gradually shifting to the end of the hold control's travel, and apparently cured by a replacement oscillator valve, by no means indicates that in fact the valve was the pure cause, for it may well be that the locking position will still continue to move away to one end.

The setting point of timebase hold controls depends not only on the valve or valves concerned but the capacity of the charging capacitor and its associated feed resistors and the characteristics of the blocking transformer when used.

A change in any one will result in a locking shift and if, as frequently happens, one of the high-value, low-wattage feed resistors increases in value, once started it will continue to do so, even though a valve change may apparently have cured the trouble.

Faulty Pots

Finally as an example of how a faulty component can repeatedly cause a receiver breakdown without apparently being defective we can cite a modern Ultra 19in. which required three brilliance controls within a short period.

In this model, as in most current designs, the high-value brilliance potentiometer was connected from the h.t. rail to chassis, the slider feeding the c.r.t. grid and being decoupled to chassis via a 0·01μF capacitor.

However, although this capacitor seemed OK, if ever the brilliance control was advanced to near maximum, so that it was subjected to almost the full h.t. voltage, it broke down, burned the track, but completely healed up again once the slider was turned away from the near maximum position.

As only very rarely, and then accidentally, would the brilliance control be advanced so far the defective capacitor remained undiscovered till the fitting of the third control instituted some careful tests. ■

FIRST TIME TESTS

—continued from page 81

prevalent causes of non-linearity, and the best way of doing this is to describe how the circuit operates.

Baird 600 series

The circuit of Fig. 9 is that used in the Baird 600 series and the component numbers are those used by the makers. V15 is a PCL85, whose operation is as follows: the incoming negative-going sync pulse from the screen grid of the sync separator valve is applied to the junction of R116, R117, and integrated by R117 in conjunction with C112, then applied to the diode X4 by R119. The combination of resistors in series with this diode from the h.t. line allow it to be conducting until this negative pulse arrives, when it cuts off and applies a negative pulse to the grid of the pentode via C113, R120 (R121 being a 1kΩ stopper resistor).

The pentode anode current falls and the anode voltage thus rises. The pentode anode is coupled back to the triode grid by C116, R125 and the positive pulse as a result in the rise of pentode anode voltage causes the triode to conduct. This rapidly applies a negative pulse to the pentode grid, by the feedback action which is the basis of any multivibrator, cutting off anode current. Circuit values are arranged so that the positive voltage from the anode of the pentode now counterbalances the blocking of X4—this feedback circuit being the loop C114, R118. The diode conducts and the sync pulse is shorted out for the duration of frame fly-back. At the end of the flyback, the triode ceases to conduct and C119 charges slowly from the boost line via R132. The height control network C117, R126, R127 feeds this rise in voltage to the pentode grid and the cycle repeats. Linearity is achieved by first a differentiation of the positive overswing at the pentode anode when the valve has cut off by C114, R130, R131, the linearity control, and then the integration of this pulse by R129, C118 before being applied to the lower end of the height control network. It can thus be seen that correct feedback conditions are vital for linearity, and an open-circuited capacitor in the feedback loop generally causes excessive non-linear height, with the height control itself having little effect on the raster.

This type of circuit has only one obvious feed-back loop, whereas others use two or more, controlling top linearity separately from overall linearity. Where the linearity control has some effect, but even at the end of its travel the frame is distorted, a check should be made for a "high" resistor, usually one in the series chain from h.t. Shunting components with various values often gives a clue to fault source quicker than testing with a meter, as the effect of this "first-time test" on the distorted picture is noted. An increase in distortion will indicate the need for more resistance, or perhaps a leaky capacitor; bettering the conditions may mean one resistor has gone "high".

Further causes of non-linearity and distortion, plus locking faults and interlace troubles will be discussed in the next article, when alternative circuits of popular types will be given. But one point should be noted, common to most circuits used in recent sets. The oscillator is generally fed from the boost line whereas the output valve is powered from the normal h.t. line. In the circuit of Fig. 9, for example, the anode of the triode has about a hundred volts more than the pentode, measured with an AVO 7.

From this we can see that a loss of boost voltage can cause loss of height and poor frame stability. In fact, in one classic circuit used in several Ultra receivers, a faulty boost capacitor, while still allowing the line apparently correct operation, causes frame collapse. Reason for the line being apparently in order is that the reduced raster requires little drain on the line output stage and a fairly bright horizontal strip is obtained.

TO BE CONTINUED

FERRITE WIDEBAND TRANSFORMERS

—continued from page 67

frequencies. The reactance is increased by increasing the number of turns on a core of given permeability, but for the bottom end of Band I very few turns are required.

Indeed a winding consisting of just a single turn of wire is adequate for some applications. The high-frequency (v.h.f.) response is not so much affected by the number of turns but too great a winding capacitance should be avoided for really top v.h.f. applications.

The turns indicated at (a) in all the diagrams are the best found by the author for wideband operation over Bands I, II and III with the least insertion loss. Some idea of the insertion loss up to 1,000Mc/s using a top-quality core material is shown in Fig. 10.

The wire gauge is not unduly important so far as the author has been able to ascertain and the transformers illustrated were wound with enamelled covered copper wire of 26, 30 and 36s.w.g., depending on the nature of the transformer (i.e. the total number of turns to be accommodated on the ferrite bead) and on the number of separate windings. The windings are best identified by employing either different enamel colour or different diameter wire for each coil.

There is no doubt whatever that these transformers have quite a big potential in television applications and they lend themselves to extremely interesting experiments. ■

LETTERS TO THE EDITOR

SPECIAL NOTE: Will readers please note that we are unable to supply Service Sheets or Circuits of ex-Government apparatus, or of proprietary makes of commercial receivers. We regret that we are also unable to publish letters from readers seeking a source of supply of such apparatus.

The Editor does not necessarily agree with the opinions expressed by his correspondents

VALVES AND THEIR HABITS

SIR,—I should like to make some comments on the article " Valves and Their Habits " by H. Peters. Firstly, the PCL84 does not have the same base connections as the PCL82, and secondly, the 30P4/30P19 is not always interchangeable with the PL36. The PL36 has pins 1 and 4 internally connected—so check that pin 1 on the valveholder is not used as an anchoring point or earthed. (This was done, for example, on the majority of the Ekco/Ferranti ranges going back at least eight years, and a PL36 in these sets would put screen volts to the a.g.c. line, or earth the screen!) Only on their later models, T418 onwards, are these valves interchangeable. The best idea, if in doubt, is to cut off pin 1.

Using the normal straight-sided envelope PY32 there is no need to check that pins 3 and 5 are joined on the valveholder, as these pins are permanently joined together inside the valve. Only when using the older type " shaped " bulb PY32 should one check that pins 3 and 5 are joined together or have separate equal surge limiters on them. Pin 6 of this older valve is the heater centre-tap, so it is important to check that pin 6 is blank on the holder. (On some Ekco models this is not so, and blows the fuse with this other valve in.)—R. NAGLE (Eastwood, Essex).

[*Mr. Nagle is right regarding the mistake connected with the PCL82 and PCL84—my apologies.*

Re the 30P19, he is perfectly right, but as I have been using this substitute in the sets he mentions for a number of years I must be very lucky. — H. Peters.]

A PIONEERING ACHIEVEMENT

SIR,—Allow me to extend my congratulations to you on your work in the field of transistor TV receivers for amateur construction. The PRACTICAL TELEVISION Olympic II is a pioneering achievement.—A. J. MCEVOY (County Antrim, Northern Ireland).

MAINS DROPPER SECTIONS

SIR,—With reference to Mr. Wildash's letter in the June issue of PRACTICAL TELEVISION, I would like to point out that Radiospares power sections are available in almost any value likely to be used in a television mains dropper. Furthermore, these units can be obtained in about five different current ratings.

The cost of these units is 1s. 8d. or 2s. (trade price) according to the value. They can be obtained fairly easily from any retailer who stocks Radiospares components.

TV mains droppers cost about 17s.—20s., and a dropper of eight sections made up using power sections would cost roughly the same. Also, these units are electrically of a much more sound construction than the average mains dropper and the tolerance is only 5%.—J. G. KEUTGEN (Wembley, Middlesex).

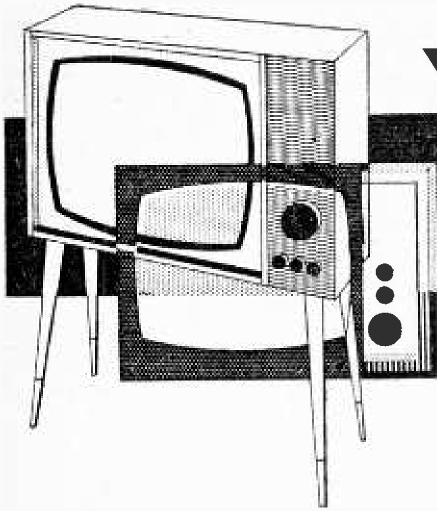
OLYMPIC PRINTED CIRCUIT BOARDS

SIR,—The first three printed circuit boards PC1, PC2 and PC3 for the Olympic II can be supplied, already etched and roller tinned but not drilled, for £1 plus postage from Bondlens-Spemco Ltd., 4 New Road, Rochester, Kent.

In the April, 1965, issue, Olympic II, Fig. 7a, an omission on the bottom right-hand corner would cause considerable trouble. Three more dark-shaded rings should be shown for the i.f. coil connection, i.e. both on left and upper on right.—A. H. WAGHORN (Gillingham, Kent).

The price of the PC boards seems very fair (see also page 512, August 1965 issue).

Regarding the matter of the " rings ". If constructors use ready-made coils with stiff wire pins the rings will be useful. If sleeved flexible wires are brought out of the i.f. can, rings are not needed.—Editor.



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 93 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

SOBELL T171

I want to remove the chassis from its cabinet. I need to do this in order to clean the tube face and glass screen but the fact that the controls are mounted on the side of the cabinet has presented some difficulties.—B. A. Austin (Solihull, Warwickshire).

The tube and speaker are integral with the chassis on your set. Pull off the control knobs, remove cabinet back and panel, unscrew plastic escutcheon on side of cabinet, remove the cover plate under the chassis, unscrew the four fixing bolts under the chassis and then withdraw the chassis from the cabinet, feeding the control panel through the side of the cabinet as the chassis is withdrawn.

BUSH TV93

When first switched on, the picture contracts inwards for about an inch each side in about 30 seconds and then fills out again to a full picture after about two minutes. I have replaced PL81 and PY81 but this has had no effect on the fault. —S. Heston (Hayes, Middlesex).

The ECC82 line oscillator valve could be at fault, but the fault could be equally due to varying h.t. output of the LW15 metal rectifier.

SOBELL T176

The picture on this set keeps slipping. Adjustment of the vertical hold control does not alter this situation.—R. P. Milner (Chislehurst, Kent).

There is a small diode in a gate circuit associated with the field timebase valve (ECL80, V10). This diode is connected via a 0·003μF capacitor and 47kΩ resistor to pin 1 of the valve mentioned. Replace this diode. A Mullard OC81 diode is suitable.

MURPHY V240

When this set is switched on, the sound comes on as normal, but the picture takes about 15 to 20 minutes to come up to viewing brightness and sometimes it is very poor. If I try to brighten the picture any more, it just disappears.—G. Williamson (Shetland).

The symptoms you describe indicate a faulty cathode ray tube. It may be possible to boost its heater by using a 13V c.r.t. transformer, but we would say that if the tube is of any great age this is unlikely to be very beneficial.

EKCO T217

There is a black band 1in. wide down each side of the screen and a black line which gradually creeps up from the bottom of the picture after the set has been on for about ten minutes. Slightly above this black line, there is a light shadow of a line.—W. Ford (Co. Durham).

Your fault appears to be due to low h.t. caused by failure of the U801 h.t. rectifier valve, or a number of its 50Ω surge limiter resistors. Check also the 10P13 frame output valve, approximately in mid-chassis, which will affect the picture at the bottom of the screen.

FERGUSON 3624 (THORN 900 CHASSIS)

This set has recently developed a low frequency buzz or hum on sound—the picture is not affected, but the hum appears to alter in loudness with change in the content of the picture. The hum gets louder as the volume control is advanced and the volume has to be kept very low or the noise is unpleasant. The picture is perfect. Removing the aerial eliminates the hum. K. Gunn (Ross-shire).

The symptom mentioned in your letter is that of

vision interference on sound, due to the vision signal getting into the sound channel. Apart from overloading troubles, resulting from a too strong aerial signal, the effect can be caused by misalignment of the sound i.f. channel. If the set has previously been working all right, the sound i.f. channel alignment could have drifted due to an i.f. transformer tuning slug vibrating loose or an associated component could have altered in value.

SOBELL TPS173

When first switching on, provided that the set has previously been switched off for at least ten minutes, sound and vision are perfect, and one can bash it and hit it without any effect. When switched to f.m. however, the sound is completely absent but will reappear after about two minutes, starting very faintly and distorted, and gradually building up to its proper level. This also happens when switching from f.m. to television in exactly the same way.

In short, whenever the f.m. switching is used, this fault shows itself. The picture is always totally unaffected. I have changed all the valves associated with the sound and two semiconductor diodes which I have been told could cause it.—A. I. Peters (Hounslow).

It is possible that the f.m. channels are not properly adjusted at the tuner. As the set warms up, therefore, there could be an oscillator drift which gradually pulls the oscillator towards its correct frequency, the f.m. discriminators then taking over. Incorrect f.m. tuning also results in bad distortion. Check the f.m. tuning therefore.

D.E.R. 514

I think this set has the symptoms of a faulty e.h.t. rectifier (EY86). That is, the picture is very dark and when the gain or contrast is turned up the picture increases in size and finally disappears. However, the EY86 has been replaced but no improvement in the set's performance has been noticed. A spark can be obtained from the e.h.t. lead to the c.r.t.—T. Davis (Bromley, Kent).

This is the symptom of poor e.h.t. regulation—and as you say—is often caused by low emission EY86. However, impaired efficiency of the booster diode or the line output valve can cause similar trouble, as also can low h.t. voltage (resulting from a worn h.t. rectifier) and increase in value of the resistor connected to the screen grid of the line output valve.

ALBA T524

When switched on I get no sound or picture, although all valves light up. I have checked valves, resistors and capacitors for overheating. I have got e.h.t. to the c.r. tube.—B. Goalby (Walsall, Staffordshire).

Since the heaters are alight all round, it is possible that a feed resistor from the h.t. supply to the sound and vision stages has failed. This would cut off both sound and vision, though would not affect the raster or e.h.t. voltage to the picture tube. You should check the h.t. feeds to the i.f. amplifier stages and tuner very carefully.

RGD T600

This set produces a perfect picture but no sound, not even a slight hum. One can hear a slight whistle coming from the set (not the speaker) I have renewed both PCL82's and ECL80. I have also tried another speaker, and wired in a standard speaker transformer. Most of the components around the speaker transformer and nearby PCL82 and ECL80 have been checked with no result. There is continuity through both the primary and secondary of the transformer and there is voltage at pin 6 of PCL82. I am wondering whether the trouble is around the tuner, as this component looks as though it has been removed, and resoldered back again. G. Cartwright (Stoke-on-Trent).

Since the picture is O.K., the tuner is probably all right. Lack of residual mains hum definitely points to trouble in the sound output stage. We would say that the fault lies either in this stage or in the coupling from it to the speaker.

REGENTONE 143T

The picture breaks up and appears to have been accompanied by loss of brilliance and focus. When the focusing sleeve is fully forward the picture just begins to come into focus. I have tried substituting many valves without improvement.—R. Powis (Birmingham 23).

It is possible that the h.t. voltage is low. Check the h.t. rectifier and if the d.c. output voltage is less than the a.c. input voltage, the rectifier is either down or it is heavily loaded by a fault in the line timebase. It is likely that the electrolytic capacitors are worn or low value. This trouble would also aggravate the ripple effect mentioned.

PETO SCOTT 733

The picture has a 1in. wide line in black down each side. When the brightness is increased above that normally required, the picture tends to fill the screen but goes out of focus. The h.t. voltage at the PY82 cathode is 210V.—D. J. Morris (Sutton Coldfield).

The h.t. voltages seem a little low. Check the emission of the PY82's and replace if low. Also check the surge limiter resistors, making sure that both are O.K. Finally check the electrolytic reservoir and smoothing electrolytics. If the trouble persists, check the PL81 and PY81 valves.

PHILIPS 1768U

Lately when we switch on and the picture appears it is stretched to the left of the screen, and after about 10-15 seconds, it jumps over to the left and is then central. This takes place every time the TV is switched on.—F. Martin (Plymouth).

This would appear to be simply the result of a maladjusted line hold control. Let the set warm up fully and then carefully adjust the line hold control finding the point on the control where the picture breaks up, say, to the right and then likewise to the left. The centre position between these two points is the correct position for the control.

PILOT PT651

The 100 pF Condenser which is connected to the top of the 30P4 valve burned out. After it was replaced I found I have a rectangular picture with a space of about 2in. on either side. I could fill in the top and bottom by using the height control but the picture was distorted. I have a good enough picture but to keep it perfectly proportioned I must have a space at the top and bottom also. The horizontal control is very critical, and often it has to be adjusted.—Michael Leighton (Greenock).

The shorting capacitor may have put a load on the h.t. circuit and reduced the efficiency of the h.t. rectifier. It is possible now, therefore, that the h.t. rectifier has suffered, causing its output voltage to be low. This would affect both height and width of the picture. Check this rectifier and replace if it is low.

BAIRD P2117

I have changed the valves PL81, PY81, EY51 but no picture, and not boost h.t. on the top cap. The PL81 gets red hot, and I have checked various capacitors. Is the fault in the L.O.T.? I have checked various voltages in the line oscillator stages and all appear to be correct. B. D. Smith (Southampton).

If the line whistle can be heard with the aerial removed and when the line hold control is rotated, then shorting turns in the L.O.T. are probably responsible for the troubles expressed in your letter. If there is no sign of whistle, however, make a special check of the line oscillator (ECC82), VII and associated parts, for lack of line drive would overheat the PL81.

ALBA T436

I have no picture but sound is perfect. There is no line whistle and the EY86 does not light up, although it is a new one. I have had it tested and it is O.K.—W. Charlestown (Derby).

Lack of e.h.t. and line whistle signifies trouble in the line timebase. If the line output valve is running very hot, lack of line drive could be the cause, resulting from failure of the line oscillator. However, if a very weak whistle can be heard as the line hold control is rotated (with the aerial removed) the oscillator is working and the trouble would be in the line output stage. Shorting turns in the line output transformer is a possibility, if the associated valves are in order.

PYE V210

When this set is first switched on, there is a "snow-storm" effect on the screen. When the set is switched to ITV, two white lines appear vertically on the right of the screen. These lines vary from ½in. to 3in. in width and sometimes there is a rugged line to the extreme left of the screen.—G. F. Pattenden (London, W.1).

The symptoms you describe indicate brushing in the e.h.t. circuits. The most common cause of this is moisture in the plastic EY86 valveholder cup. This is frequently filled with wax, which can trap the moisture. With care, however, most of this can be run out with a soldering iron and the set checked again.

REGENTONE 10/17

The sound faded out and so I replaced the output valve PCL82, as the original was very low emission when tested. The sound was restored for only few hours when the new valve was fitted and then the same thing happened. I have checked C88, R76, R77, C60, C61, R78, R83, C64, C66, and R82 by substitution, also valves 3 and 9 (EF80) and C63 with still no sound. The frame output transformer was replaced about six months ago as it was O.C. primary and since then there has been a very loud buzzing from this. Would this affect the sound output in any way? I have had the new PCL82 checked and it reads O.K. on test.—E. J. Foster (Luton).

It is possible that a poor soldered connection exists on the PCL82 valve holder and that this was temporarily corrected when the valve was replaced. The same symptom would thus indicate that the fault has shown up again this time with the new valve. The buzz from the field output transformer would not affect sound, but the buzz could be cured by tightening the transformer laminations.

PHILCO 17in. 1010

Firstly the picture started breaking up so I switched the set off. When I switched on again the picture had disappeared altogether, sound and raster are perfect.—J. Berry (Widnes).

Lack of picture with raster and sound normal would indicate trouble somewhere in the vision i.f. amplifier stages, including the vision detector and up to the control grid of the video amplifier valve In particular, check the video signal coupling from the vision detector to the grid of the video amplifier valve. It is possible that a small choke in this circuit has failed.

MURPHY V240

All valves light up, raster seems good, yet weak sound. Have managed to clean turret tuner, and get flashes on c.r. tube when turned.—M. W. Russell (Sheffield 9, Yorkshire).

Your trouble appears to be in the turret tuner, or its adjacent vision i.f. stage. Check that the sensitivity controls have been fully advanced and that the tuner has the coils appropriate for the channels you require to receive. Suspect particularly failure of the 8·2kΩ 2w. local oscillator anode feed resistor for the tuner, which is located at the end of the tagstrip beneath the chassis near the h.t. rectifier.

FERGUSON 306T

About 30 seconds after switching on a high-pitched sound is heard from the speaker which lasts only a few seconds. Picture and sound are otherwise normal.—R. C. Lane (Sidcup).

This would appear to be either the line timebase pulling into correct frequency, or some kind of instability in the sound channel as the sound i.f. valves reach correct working temperature. In the former case, correction to the line hold control should solve the problem. In the latter case, however, a faulty EF80 valve may be responsible, and to prove this it may be necessary to check the sound i.f. channel valves by substitution.

DECCA D1735

It is necessary to operate the receiver with the brilliance control at minimum to obtain a viewable picture, otherwise the picture is too bright. After a period of time the picture becomes gradually too bright to view. It is impossible to black out the raster with the aerial removed, and contrast and sensitivity controls at minimum. Voltages measured at the tube sachet are Pin 6 (grid) 50-150V according to brilliance. Pin 7 (cathode) volts vary also between 100-150V according to brilliance control.—R. Deveau (Guernsey, C.I.).

The trouble mentioned could be caused by (a) fault in the picture tube, causing slight increase in grid voltage or decrease in cathode voltage; (b) fault in video amplifier valve or associated components, and (c) fault in a component associated with the brightness control. You should check these possibilities, having in mind that the trouble results essentially from insufficient tube bias. Also check the capacitor between the tube grid circuits and the field timebase, as this may be low insulation.

EMERSON E1188

This set has a pull out switch, which was not very satisfactory. But the set failed to light up recently, removing the back and taking out the chassis, I found that the switch was hard and brittle, and it fell to bits. I have in mind to replace with a double pole single throw d.p.s.t. toggle.—S. J. Williams (London, S.W.9).

A d.p.s.t. switch would be suitable for mains on/off. It should be wired so that the switch simultaneously breaks both the live and neutral leads from the mains supply. You will have to trace these leads to avoid crossing them, and of course, you will have to ascertain the two poles on the switch itself.

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PRACTICAL TELEVISION. NOVEMBER, 1965

TEST CASE -36

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions, but are based on actual practical faults.

? *An experimenter acquired two sets with the same symptom—the display of closely spaced horizontal white lines at the top of the picture. There was also slight top compression and the test pulses radiated by BBC1 were visible.*

In the field timebase section, one set employed a multivibrator field oscillator and the other—which was a somewhat older model—a thyratron oscillator valve.

The experimenter put the trouble down to a slow field retrace (flyback), and as a consequence tested by substitution the components in the charging circuit, the components associated with the linearising negative feedback network and the field output transformer.

Eventually, the trouble in the model with the multivibrator was cured, this being caused by increase in value of the resistor connected in the anode circuit of the first triode of the multivibrator pair. That is, the anode load resistor. All the components mentioned above, however, were proved to be in order in the model with the thyratron oscillator valve.

What was the most likely cause of the trouble in this set? See next month's "Practical Television" for the solution to this problem and also for a further Test Case item.

SOLUTION TO TEST CASE 35

In many of the more recent sets the field oscillator is supplied with h.t. voltage from the boosted h.t. line and not direct from the normal h.t. line. There are several reasons why this is done. One is to provide a greater charging voltage than is possible from the h.t. line direct, thereby facilitating a more linear scanning stroke. Another is to give some degree of field stabilisation relative to the line timebase.

The boosted supply voltage is generally fed to the field oscillator through a fairly high value resistor, the field timebase end of which is decoupled by a capacitor.

Now it sometimes happens that either this resistor increases in value or that the capacitor develops a slight leak when the temperature inside the set rises. It could be here, then, that the trouble mentioned in Test Case 35 exists. It is also possible for something to happen in the boosted h.t. circuit, such as a fall in insulation resistance of the boost capacitor or a drop in efficiency of the line output stage, to cause the symptom. In modern sets, therefore, one may have to look in places other than the field timebase circuits themselves to find the cause of a field timebase symptom.

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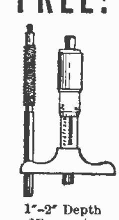

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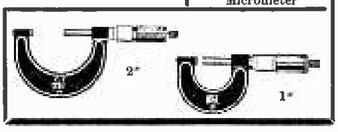

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