Practical TELEVISION

OCTOBER 1966 2/-

R/C BRIDGE FOR THE TEST BENCH

Practical Television

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THE WRONG STEP?

COLOUR TV could be the greatest thing yet. Instead it may well prove another flop. Progress in the establishment of colour TV has been made in fits and starts; engineers may have taken two steps forward, but politicians, actresses, professors and others sitting on the various committees have taken one step backwards.

The Pilkington-Hoggart Committee, for instance, have paved the way for a series of minor disasters. Four PMG's, two Governments, the TAC 1960, the BBC, BREMA, Uncle Tom Cobley and—almost—all, have assumed that 625-lines u.h.f. was the desirable objective.

Spare frequencies in Band III steered to the BBC might well have been given to ITA; these channels would have made available more accommodation for the rearrangement of transmission frequencies (and associated bandwidths) for their transmitters—and for ultimate improved colour TV.

Meantime, powerful u.h.f. transmitters and high masts have been erected for BBC-2 which, generally speaking, do not provide satisfactory results beyond the 15-20 mile range. Comparable v.h.f. stations are free from snowstorms, white noise, restless black graininess, obstruction from high intervening buildings—and have greater range.

The technical shortcomings coupled with the discouraging viewing figures do not paint a very rosy picture for the future of 625-line u.h.f. television. Although we do not go along with the view that "the ratings" are the be all and end all of television, concern must be felt in view of the claim that although there are likely to be 64 high-power BBC-2 transmitters to cover the same areas as BBC-1 for colour TV, no less than 240 medium-powered and more than 1,000 low powered transmitters will be needed to fill the gaps.

Faced with these facts, and taking into account our present economic ills, surely it would be more sensible to provide a really good picture on v.h.f. with 405-lines, available in colour and monochrome on BBC-1 and ITV? The new PMG must face up to the fact that u.h.f. in its present form can be accounted at least a partial failure—unless he is going to authorise the erection of more and more transmitters. Is it too late to wipe the Pilkington-Hoggart slate clean?

W. N. STEVENS—*Editor*

THIS MONTH

OUR NEXT ISSUE DATED NOVEMBER WILL BE PUBLISHED ON OCTOBER 20th

TELETOPICS

RADIO AND TV MAKERS UP AGAINST THE WALL

RANK BUSH-MURPHY LTD. is to close its South Shields factory on October 14th and pay off its 500 strong labour force. This factory was opened only 16 months ago. This announcement follows Plessey's decision to withdraw from the set making industry.

Does this indicate the beginning of the end of the radio and television industry? Several other companies are finding the going rather hard, blaming the Government restrictions, lack of public interest and so on. The future of the Pye organisation, to mention but one of the companies concerned, is far from settled.

In an official statement, Rank Bush-Murphy said that the closure was part of a broad programme of rationalisation of their production in radio and television. Their television factories at Plymouth and Redruth in Cornwall and at Skegness in Lincolnshire will continue to operate. The South Shields factory will be handed back to the North-East Development Council, from whom they leased the premises.

ERA SUPPORTS PLEA FOR ITV 625-LINE COLOUR

THE Electronic Rentals Association, who represent a number of television rental companies, welcome the decision to start colour television broadcasting towards the end of 1967—on BBC-2. The Association also supports the suggestion that colour television should be made available by the ITA on the 625-line standard in u.h.f.

STRATHCLYDE COMMEMORATION FOR BAIRD

TO commemorate the 20th anniversary of the death of John Logie Baird, a bronze bust has been presented to Baird Hall, the hall of residence for male students at Strathclyde University.

Baird studied electrical engineering at the Royal Technical College, Glasgow, one of the colleges that now forms Strathclyde University.

The bronze bust is the second to be cast. The other is in the National Portrait Gallery in London and is the work of the late Donald Gilbert.

New Tape for 625-line colour

A NEW "Scotch" videotape has been introduced by 3M for TV broadcasting use, which is suitable for 625-line colour recordings.

This two-inch tape is supplied in a variety of lengths and is claimed to have improved signal-to-noise characteristics.

Contract for Northern Ireland TV and VHF Sound Relay Station

THE BBC has placed a contract with Messrs. J. McMullen & Son of Kilkeel, for the erection of the building for the new television and v.h.f. sound relay station which is to be built some 3 miles north-west of the town.

This relay station is one of a number being built by the BBC to extend and improve the coverage of its television and v.h.f. sound services in Northern Ireland. It will transmit BBC-1 on Channel 3 with horizontal polarisation, and the three sound services on v.h.f. and will serve Kilkeel and a three-mile wide coastal area extending from Annalong to Cranfield Point.

It is hoped that the Kilkeel relay station will be brought into service early in 1967.

RADIO SHOW

FOR news and views from the Radio Show, see page 9.

TV Centre for Manchester

MANCHESTER University after two years of experiments with educational television, are to set up a television centre within the university.

Professor W. E. Morton will run the centre. There will be a full-time director and two studios equipped for closed-circuit television and video tape recording.

MORE TV's SOLD AND FEWER ON H.P.

SALES of TV receivers in the first quarter of 1966 averaged 16·3 units per shop against 13·4 in the corresponding period of last year, according to RTRA figures.

The percentage of television receivers sold on H.P. fell sharply, and the RTRA comments, "the trend in regard to the preponderance of cash sales as opposed to credit sales is not surprising since there is no doubt that the credit squeeze is now becoming fully effective".

B.A.T.C. CONVENTION

THE British Amateur Television Club will be holding its bi-annual convention this year on Saturday, October 8th in the Conference Suite of the Independent Television Authority at 70 Brompton Road, London, S.W.3, from 10 a.m. to 6 p.m. During the Convention, an exhibition of home made equipment including two colour picture cameras, and a short symposium of papers of general television interest will be held.

Readers will be made welcome and further details concerning the Convention and the work of the Club can be obtained from M. Cox, 135 Lower Mortlake Road, Richmond, Surrey.

TWW orders more EMI cameras

THE ITA programme company for Wales and West of England, TWW, have placed an order with EMI Electronics Ltd. for four Image Orthicon Camera Channels for the Pontcanna Studios in Cardiff. This means that thirteen of these units are now in service with TWW.

GREECE AND IRAQ MAKE PYE TV

GREECE and Iraq are to start making Pye television receivers this year. Contracts have just been signed for the supply of complete TV kits from Pye's British factories.

The agreements are with Kelvinator Hellas S.A. of Athens and The Light Industries Company S.A. of Baghdad. It is anticipated that about 10,000 British TV kits a year will be exported in this way. The receivers have 23-inch screens and operate on the 625-line system.

Pye are advising on the design and setting up of production facilities in both countries.

ANOTHER CCTV INSTALLATION

OFFICERS in the Leeds Police Headquarters will be able to keep a watch on traffic using a 400-yard tunnel which is part of the first stage of the new Leeds inner ring road. Nine GEC CCTV cameras will be used.

EMI EQUIPMENT IN COMMUNITY TV NETWORK

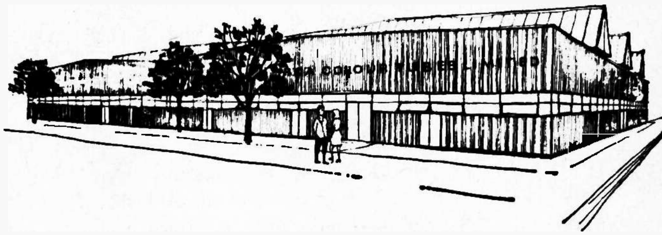
WHEN the current installation programmes have been completed, the neighbouring Hertfordshire towns of Hatfield, Stevenage, Letchworth and Welwyn Garden City will contain the biggest concentration of v.h.f. wired television, claim EMI Electronics.

Rediffusion, the main contractors, are installing and operating the network as v.h.f. Community Service Schemes. Four television and four sound programmes; BBC-1 and BBC-2, ITA London and ITA Anglia, BBC Home, Light and Third Programmes and Radio Luxembourg will be available initially.

"TELEVISION-67"

A RADIO, TV and electrical appliances exhibition is to be held at the Ulster Hall, Belfast, Northern Ireland from October 7-15th. It is being sponsored by the Northern Ireland Radio Retailers' Association (NIRRA).

NEW COLOUR TUBE PLANT



RCA COLOUR Tubes Limited has been formed by the Radio Corporation of America and Radio Rentals Ltd., to manufacture RCA colour television picture tubes in England.

Nineteen and twenty-five inch rectangular tubes will form the initial product line. D. W. Heightman is chairman of the new company (one-third British owned) which will have production facilities at Skelmersdale, Lancashire, next year.

J. W. C. Robinson, Chairman of Radio Rentals has announced that his company hope to be producing colour receivers next year.

POCKET TV RECEIVER

SINCLAIR Radionics announce a pocket-sized television set. The makers claim that this transistor receiver will be the world's cheapest midget set. Details of this receiver are included in the Radio Show Survey, page 11.

MORE BBC-2 — BY PYE

PYE TVT Ltd. of Cambridge have received another contract from the BBC valued at more than £500,000 for the supply and installation of transmitters to equip eight more high-power u.h.f. stations.

The transmitters, scheduled for delivery during 1968, will have peak sync outputs of 25kW (3 stations) and 10kW (5 stations). They are provisionally scheduled for installation at the BBC 2 stations to serve Bristol and Somerset, Hampshire, Sussex, Staffordshire, Flintshire, Londonderry, Angus, and East Lothian and Fife.

Technically the transmitters will be of interest as conventional valves are practically eliminated. The sound and vision power amplifiers will utilise vapour phase cooled klystrons and an automatic fall-back system will be employed where, in the event of a failure of either klystron, the sound and vision input signals are automatically combined and fed to the remaining tube, thus providing a lower power emergency service without separate standby equipment.

DAYLIGHT TV VIEWING

LARGE screen monochrome TV pictures it is claimed can be viewed in full daylight using Eidophor projectors with a new type of screen material which has been developed in Britain by Andrew Smith Harkness Ltd for Peto Scott. Before this, daylight screening was possible only by erecting a light shield around the screen and this limited the number of persons who were able to view.

This new unit uses a specially treated vinyl plastic screen which is claimed to eliminate many of the effects of ambient light.

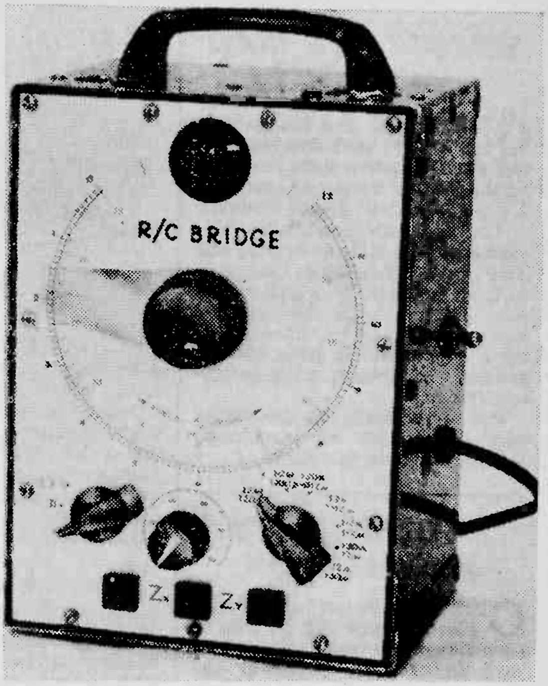
Earlier this year, before the development of the new screen material, Eidophors were used for the Chelsea-Barcelona football match and the general consensus of opinion was that the pictures shown during the second half, after the sun had set, showed a marked improvement on those of the first half.

Mr. Jack Upham, of Peto Scott, said that the next step would be to try the screen for colour working.

RESISTANCE-CAPACITANCE BRIDGE

with magic-eye indication

A. B, MORRISON



THE main defects encountered in many amateur-built resistance-capacitance bridges are those of indistinct null indication and displacement of zero at small capacity values—up to 10pF, say—but in the circuit to be described the null at values as low as 1 or 2pF is sharp and perfect with a zero displacement in the region of only 0·5pF, and this using mains frequency energisation.

THEORY

A few remarks on the theory of the a.c. bridge, which is the necessary form for measurement of both R and C may perhaps be made at the outset for the benefit of beginners, When four impedances are connected in the form of a square (Fig. 1) and an a.c. voltage is presented to two opposite corners, P and R, there is zero potential difference across corners Q and S (a "null" on an indicator) when $\frac{Z_1}{Z_2} = \frac{Z_4}{Z_3}$. Pure impedances may take the form of resistance, capacitance or inductance.

In order to indicate measured values of unknown impedances two arms of the bridge are usually standard impedances, the third is a calibrated variable and the unknown is connected to terminals to form the fourth arm. Three forms of the bridge are used in this circuit, shown in Fig. 2, one each for resistance and capacitance and a third for the comparison of two external impedances, such as the two halves of a push-pull output transformer, or for checking the tracking of ganged potentiometers or tuning capacitors, etc.

In form (a) Rx is the unknown resistance, Rs is a standard, Rv is a variable resistor and Rr is a range resistor selected by a switch, and the value of the unknown is given by $Rx = Rv \times \frac{Rr}{Rs}$. In form (b), for capacitance, we now have a standard capacitor Cs instead of Rs and $Cx = Rv \times \frac{Cs}{Rr}$ (Remember that the faradic value of a capacitor is inversely proportional to its impedance). The third form, (c), gives the ratio between the two external impedances, $\frac{Zx}{Zy} = \frac{Rv}{Rs}$.

THE BRIDGE

It is obviously convenient if all three forms can be contained in a single piece of apparatus, and the circuit of Fig. 3 shows how this may be done with a minimum of easily obtainable switches. S1A and B consists of two single pole 12 way wafers, limited in this design to 8 positions. Wafer A selects the range, with a spare position for form (3) while wafer B reduces the limiting resistance in the bridge supply on the lowest R (and highest C) range. This operation is necessary because the supply voltage to the bridge must be limited to prevent damage to both standards and to components under test. On the higher ranges, with standards of megohm value, the effect of the limiting resistor is negligible and most of the voltage appears across the bridge. As the ranges decrease, a greater proportion of the voltage appears across the limiting resistor, and on the lowest range, unless reduced, it could starve the bridge of practically all its supply. The two wafers of S1 are spaced about 1½ inches apart, with wafer A closest to the switch body, and the spare tags on wafer B serve to support the common ends of the range resistors.

Switch S2 is a Yaxley type 4 pole 3 way with two sections unused and selects the mode of operation (together with S1 for external matching). It will be noted that this diagram is lettered in the same way

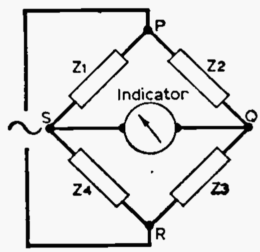


Fig. 1—Basic a.c. bridge circuit.

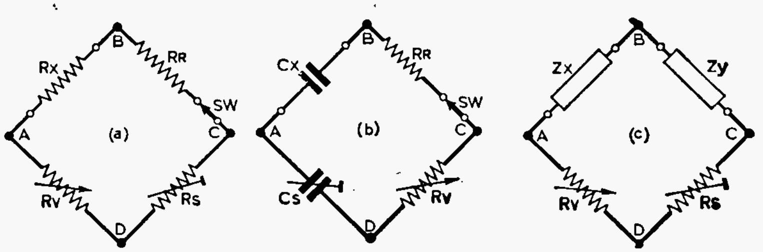


Fig. 2—The three forms of bridge used in this instrument circuit. 'a' is for resistance 'b' for capacitance and 'c' gives the ratio between two external impedances.

as Fig. 2 the supply being now across corners A and C while the indicator is connected between B and D, D being the earth.

It might be considered that it would be more convenient from the point of view of measuring components having one end already earthed for corner B to be the earthy corner, this then being one of the Rx or Cx terminals. This is true, but in the prototype this modification caused extreme deterioration of the null and introduced errors in the lowest C range, probably due to the capacitance to earth of all the wiring to Rv and the standards, and in the interests of accuracy was abandoned, the loss in facility being a small price to pay for the quality of the finished product.

Some extra components appear in this diagram and their purpose will now be explained before proceeding to consider values. The resistors R_{L1} and R_{L2} are the limiting resistors already mentioned. The variable resistor Rp is included in series with the standard capacitor Cs because some capacitors, particularly electrolytics, contain resistance as well as capacitance, and this results in a phase shift of the bridge supply, and consequent poor null indication. To correct for this, resistance is also introduced in series with the standard, and the setting of Rp required for good null gives an indication of the power factor of Cx. One advantage of this circuit, using a single Cs, is that the power factor setting is the same on all ranges, unlike those circuits which use a number of different C standards. It will also be seen that in the "External" position of S2 a different Rs is used and that another resistor Rm is introduced in series with Rv. This is done so that comparison with an external impedance Zy may be made in terms of plus or minus percent difference. Their values, and those of all other components will now be considered.

COMPONENT VALUES

The ranges all extend from 0 to 12×10^n in order to give a degree of overlap, while for the sake of availability, the values of Rx are all multiples of 10. This leaves the other main component, Rv, which may be 10kΩ to 20kΩ as available. The value used in the prototype was in fact 10kΩ, but if the values of Rs_1, Rs_2 Cs and Rm are calculated accordingly, any other value of Rv in this region may be used. In any case, its value will not be exact, but if large differences can be accommodated, then small ones obviously present no problem. The following section gives expressions for the evaluation of the remaining components, together with the values actually used in the prototype.

Rx range	Cx range	Rr
0–12Ω	0–120μF	10Ω
0–120Ω	0–12μF	100Ω
0–1·2kΩ	0–1·2μF	1kΩ
0–12kΩ	0–0·12μF	10kΩ
0–120kΩ	0–0·012μF	100kΩ
0–1·2MΩ	0–1200pF	1MΩ
0–12MΩ	0–120pF	10MΩ

Rv = 10kΩ approx.

$$Rs_1 = Rv \times \frac{Rr}{Rx} = 10k\Omega \times \frac{10}{12} = 8{\cdot}33k\Omega$$

$$Cs = Cx \times \frac{Rr}{Rv} = 0{\cdot}12\mu F \times \frac{10}{10} = 0{\cdot}12\mu F$$

For the external mode, a range of from —25% to +25% was thought sufficient, to allow of more accurate matching at close ratios.

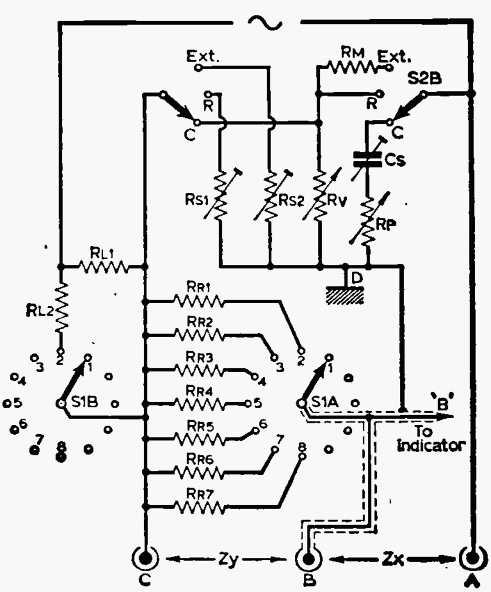


Fig. 3—Circuit of the bridge

At the plus end the ratio required is $\frac{5}{4} = \frac{Rm + Rv}{Rs2}$

At the minus end $\frac{3}{4} = \frac{Rm}{Rs2}$

Dividing the first by the second and substituting 10K for Rv gives $\frac{5}{3} = \frac{Rm + 10k\Omega}{Rm}$, from which $Rm = 15k\Omega$ and $RsZ = 20k\Omega$

Scale divisions can be computed as follows:—

x% difference represents a ratio of $\frac{100 + x}{100}$ which must be equal to $\frac{Rm + y}{Rs2}$ where y is the setting of Rv. Putting in already calculated values and simplifying, $y = \frac{25 + x}{5} k\Omega$

This is a first order equation and shows that the scale is linear i.e. it can be evenly divided into 50 one per cent divisions, with the zero in the centre, and represents the percentage by which Zx differs from Zy.

Both Rs1 and Rs2 consist of fixed resistors in series with preset potentiometers and can be adjusted to within fine limits when construction is complete. Cs is a little more complicated for it consists of good quality paper capacitors padded up with smaller value ceramic or silver mica to the required value and means a small amount of trial and error. In the prototype, Rs1 = $5k\Omega + 2{\cdot}7k\Omega + 1k\Omega$ pot. Rs2 = $12k\Omega + 7{\cdot}5k\Omega + 1k\Omega$ pot., while Cs = $0{\cdot}1\mu F + 0{\cdot}01\mu F + 5000pF$ (nominal).

R_{L1} and R_{L2} are both $1{\cdot}2k\Omega$ 1W resistors of 10 or 20% tolerance which when in parallel on range 1 present 600Ω in series with the bridge.

Lastly, the power factor resistor. A range of 50% P.F. was considered ample and the value of the pot. in ohms for this may be found approximately from $Rp = \frac{1800}{Cs}$ where Cs is in microfarads. In the prototype this came to $\frac{1800}{0{\cdot}12} = 15k\Omega$ which was obtained by using a $25k\Omega$ pot with a $39k\Omega$ resistor in parallel. The power factor scale is not strictly linear, but no attempt at scrupulous accuracy is made here, and it is considered sufficient to divide the P.F. scale into 10 equal 5% divisions. (Bear in mind also that the true P.F. of Cs is not known, although if good quality components, as specified, are used it will be nearly zero.)

THE INDICATOR AND POWER SUPPLY

The indicator is of the "magic eye" type which rectifies the signal from the bridge and displays it as a trace deflection on a fluorescent screen, and for adequate sensitivity the signal is first given one stage of amplification. Any type of magic eye may be used, in its proper circuit, the best for this purpose probably being the EM84, which gives two displays, one "coarse" and one more sensitive for "knife-edge" adjustment. The amplifier can be any small triode such as the 6C4 although in the prototype an EF80, triode connected, was used, since a spare happened to be available. The circuit is shown in Fig. 4 together with that of the simple power supply and bridge supply.

COMPONENTS

The bridge components are important and range resistors should, if possible, be checked on an accurate ohmmeter. The writer found one alleged 1% $10M\Omega$ resistor to have a true value of $9{\cdot}6M\Omega$ and a carefully built version of this instrument is capable of much higher accuracy than that.

All the resistors used in the bridge, except R_{L1} and R_{L2} should be high stability types and the range resistors should be of 1% tolerance or better. The 10Ω (and possibly the 100Ω) should be wire wound but should be non-inductive, i.e. the two halves wound opposite hand. Cs, as already mentioned, should consist of good quality paper, ceramic or silver mica capacitors with a voltage rating of at least 150V. Tolerances are unimportant here, as the final value is built up by trial and error, the smallest value required for 1% accuracy being 1000pF.

Rv and the two pots used in Rs_1 and Rs_2 should be wire wound, and Rv, which is the heart of the bridge, should be of good quality and large diameter. A diameter of 1¾ inches is sufficient, and it might be mentioned here that a $20k\Omega$ pot, being wound with finer wire, could give finer balancing. However, no difficulty in this respect is in fact experienced on the prototype. S1 should be the best available, the heavier contacts the better, but again, an ordinary paxolin switch of the self-assembly variety gives satisfactory performance in the prototype. Rp may be a small carbon type with a linear track.

For the power supply, a selenium contact-cooled or silicon rectifier of about 20mA rating, is adequate, the smoothing resistor being selected to give 200V on the h.t. rail. Some difficulty may be experienced in regard to the transformer which must supply, in addition to h.t. and heater current, 40–60V for the bridge, the latter of necessity from a separate winding. Obviously, unless the constructor is very lucky, some modification will be required. The writer obtained a transformer giving 200V and 60V and the addition of a 6·3V winding was all that was necessary. A small "converter" transformer giving about 220V and 6·3V could be modified by the addition of a 50V winding, or even a separate heater transformer used for the bridge supply with the 6·3V winding removed and the space occupied by a 50V winding of thinner wire. But, remember, under conditions of shorted terminals, the load on this winding may be as low as 600Ω which means a current rating for the winding of just over 80mA.

LAYOUT AND CONSTRUCTION

The prototype was contained in a 20s.w.g. aluminium home-made box 8 x 5¼ x 4¼in deep, but these dimensions may have to be varied to suit alternative switches and transformers. The latter is mounted in the bottom of the box, with the mains switch and fuse, if desired, at the side, where the mains cable enters. The remainder of the components are mounted on the lid, which also carries the scales. Some ventilation holes in the region of the valves and rectifier are desirable in order to protect the bridge components from excessive heat, while a handle at

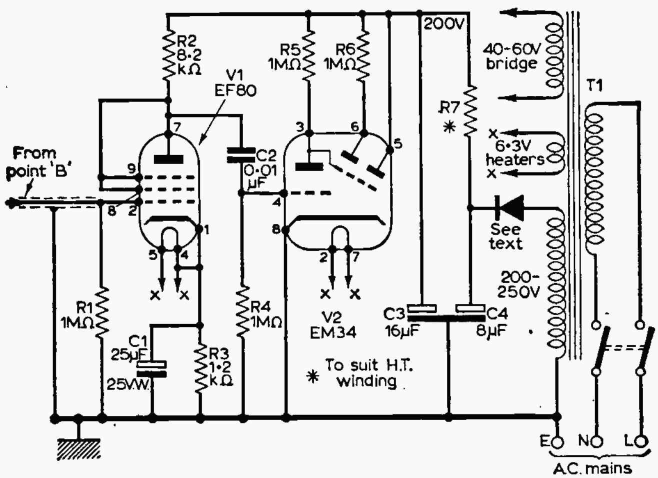


Fig. 4—Circuit diagram of the indicator and power supply unit.

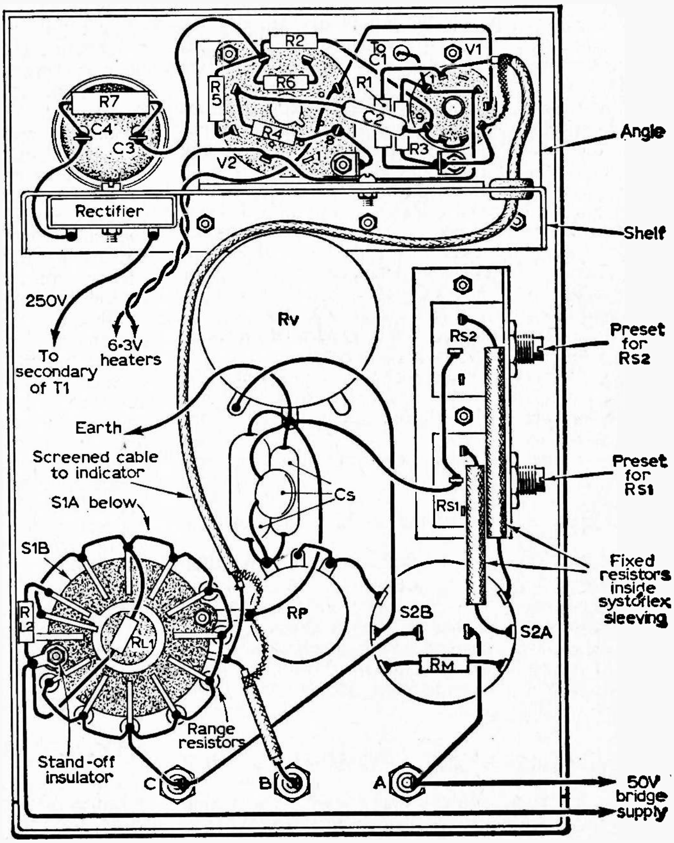


Fig. 5—Layout diagram of the complete unit.

the top of the box and four rubber feet on the base are useful additions.

About 1½in. down from the top, a shelf is bolted across the width of the lid on the underside, using 6B.A. countersunk screws, to carry the rest of the indicator components, comprising the rectifier, smoothing capacitors and V1 and V2 with their associated components mounted directly on to the valve-holder tags. V1 and V2 are mounted on a separate angled piece of aluminium bolted to the shelf by a single bolt in a slotted hole, so that the angle can slide back and swivel for valve changing, and also to enable V2 to line up with the ⅞in. diameter window in the centre of the top part of the lid.

Centrally below the shelf Rv is mounted and below this, spaced across the width are S2, Rp and S1 reading from left to right seen from the outside. Across the bottom edge, also from left to right, are terminals A, B and C, which may be screw terminals or plug sockets, as preferred. The presets for Rs_1 and Rs_2 which may be sliders or miniature rotary, are mounted on a small angle beside Rv, again using countersunk screws. The scales and lettering of switch positions are finally drawn with indian ink on thin card, and when completed, are protected by a sheet of celluloid or thin perspex, held down by 6B.A. round-head screws and nuts. The cursor for the main Rv scale is a moderately large finely milled knob with a strip of perspex stuck to the underside. A fine line is scribed along the centre of this strip, underneath, and filled with indian ink, the excess being wiped off after a few seconds.

In general, bridge wiring should be short and direct, but the only screening found necessary in the prototype was from the pole of S1A to the grid of V1 (which, it will be noted, is d.c. connected) and to terminal B. Earthing points are reduced to a single tag at the transformer, another at S1 and one at each each valve-holder. These are interconnected by a single wire from transformer tag to switch tag and the braiding of the screened lead from switch tag to the tag of V1. This point is important, as indiscriminate earthing at a number of points may result in "hum loops" which will cause poor null indications. It may also be found to increase the clarity of null if one or other side of the heater lines is raised above earth potential by connecting to the cathode of V1. The final circuit, as stated earlier, should give a perfect null at 1 or 2pF and the constructor should be satisfied with nothing less until he has checked all earthing arrangements and tried the above amendment to the heater lines.

CALIBRATION

The first job is to establish the limits of Rv as distinct from the limits of rotation of the cursor, or stop positions. (See Fig. 5.) The stop positions should be marked with a small dot or line to facilitate resetting the cursor if removed at any time, but the limits of Rv form the ends of the scale and may be found with the aid of a sensitive ohmmeter, watching for the needle to cease moving as the cursor approaches the stops.

Having marked the ends of the scale, this now has to be divded into 12 parts of equal resistance on the main scale and 10 on the "external" scale, and these subdivided into 10 and 5 small divisions respectively. It will be found in a good quality potentiometer that there is unlikely to be any marked departure from linearity, and very little error would be introduced by dividing the total length of scale into equal parts. If preferred, however, the major divisions on both scales can be marked off using the ohmmeter, if sensitive enough, and the subdivisions put in as equal parts of the major divisions. If a temporary scale is calibrated in this way, it can be traced onto the card afterwards, aligning the mid-point with the centre-line of the dial to give an enhanced appearance. The general appearance of the scales is shown in Fig. 5.

Rs_1 and Cs may now be set up by using close tolerance resistors and capacitors as Rx and Cx between terminals A and B, setting the range switch and cursor to indicate their values and adjusting Rs_1 or Cs, as appropriate, for null. This should be done somewhere towards the upper end of the scale (between 10 and 12, say) and as many ranges checked as possible. The setting up of Rs_2 consists merely in placing equal value resistors between terminals A and B, and between B and C, setting the cursor to 0% and adjusting Rs_2 for null.* When all adjustments are complete, Rs_1 and Rs_2 should be sealed in position with a few drops of shellac or other adhesive. After the final inking of the scales the card is now installed, together with its protective plastic sheet, and the knobs clamped in position. This completes the construction of a very accurate and useful instrument to have about the workshop.

USE OF THE BRIDGE

The instrument presents no difficulties in use, but one precaution that must be observed is to refrain from touching the terminals when taking measurements, as body capacitance can upset the balance. The voltage at the terminals presents no danger whatever to the user, although a slight tingle may be felt on sensitive parts of the hands under some conditions. Shorting the terminals will not cause any damage, but should not be prolonged, or the transformer may get a little warm.

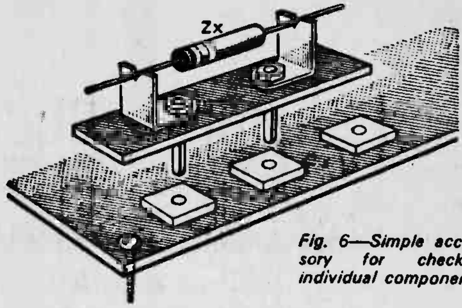


Fig. 6—Simple accessory for checking individual components.

If the value of the unknown component cannot even be guessed at, the ranges must be run through, rotating Rv on each range until a flicker is seen on the coarse sector of the magic eye, and then adjustment made more carefully until the sensitive sector opens. Capacitors give some idea of their values by virtue of their size. If a capacitor gives a poor null, advance Rp (normally kept at zero) adjusting it alternatively with Rv until the best null is obtained, when Rp will indicate the power factor of the capacitor. A high P.F. means a poor component, and this should be borne in mind when selecting capacitors for particular purposes. Electrolytics should strictly have a d.c. voltage of the correct working value and polarity applied while measurements are taken, but the omission of this does not greatly affect the measurements unless the components have been stored for long periods and are badly in need of re-forming. In any case their tolerances are much greater than other sorts. They also, in general, exhibit higher power factors and more allowance may be made on this score.

When using leads to take measurements on the lowest C range, consideration must be given to the self-capacitance of the leads. This can be measured with the leads in the position they will occupy for measurement, *but unconnected*, and should be subtracted from the final measured value.

A useful accessory for the quick checking of loose components is shown in Fig. 6. A paxolin strip carries two plugs which register with sockets A and B. Clamped or soldered to these are brass angled strips with vee notches into which the lead-out wires of the components drop. A slight pressure with the finger on the insulated body of the component gives sufficient contact for measurement to be carried out. ■

* This setting should be checked by reversing the resistors, in case their tolerances result in a 2% difference.

SERT MEETINGS IN OCTOBER

NEWCASTLE—October 5th, 7.15 p.m. Charles Trevelyan College, Maple Terrace, Newcastle'—COLOUR TV (B. J. Rogers, Rank-Bush Murphy).

LONDON—October 12th, 7 p.m. Royal Society of Arts, John Adam St., London, W.C.2.—HYBRID TV RECEIVERS (H. A. Heine, Mullard Ltd.).

SOUTHAMPTON—October 12th, 7.30 p.m. College of Technology, East Park Terrace, Southampton.—A.G.M. followed by COLOUR TV (E. J. Finn, A.M.I.E.R.E.).

GLASGOW—October 18th, 7 p.m. Visit to Honeywell Controls Ltd., Airdrie.

SWANSEA—October 26th, 7.15 p.m. College of Technology, Mount Pleasant, Swansea.—TV SYSTEMS (E. A. W. Spreadbury, Electrical & Electronic Trader).

Television Trends at the show

Earls Court 22nd to 26th August

OPENING the International Television and Radio Show this year, F. C. Mclean, C.B.E., the BBC's Director of Engineering, reiterated that this was the first show since the Postmaster General announced that Britain is to have colour television next year. "It needs most intensive preparation, considerable new equipment, and considerable new skills on the part of all concerned," he commented.

"Colour transmissions must start gradually and, although the regular service will not start until the end of next year, experimental transmissions must start well before then. It is much too early to give firm dates, but we have every reason to hope that they will start well before the beginning of the buying season next autumn.

The confused situation on the choice of a colour standard has now been settled and it has been decided that in this country we will use the PAL system. We have, in fact, been conducting test transmissions for some time. These amount to about 18 hours a week, with increases for special occasions such as this show. We intend in the future to increase both the scope and the duration of these tests. Early in the new year, we shall be starting to make test transmissions using some of the new equipment we shall by then have acquired, and we shall test with more ambitious types of programme . . ."

Mr. Mclean made reference to the fact that colour expertise within the BBC was in the hands of a small number of men who so far have been doing virtually all the colour work. Many more are needed and preparations for training these men are already in hand. he continued. "But I must admit that the number of men we have to train for colour is very small compared with the number that industry must train for the design, manufacture and service of the receivers. If the public is to get good and consistently faithful reproduction . . . then it is essential that sufficient numbers of trained men will be available at all points where the colour signal is handled.

In the United States, colour suffered very considerably because the handling of it in many instances was poor . . ."

Colour Receivers

Several companies had working colour receivers on show, with results which were very much better than those demonstrated at Earls Court two years ago. Cabinet styling has, however, a long way to go—most models being rather bulky and in some way resembling the early black-and-white sets.

Dynatron have overcome the size problem by putting their 25-inch colour receiver into a period Queen Anne style cabinet. This set, which will be available to the public early next year at a cost of about 310 gns., uses semiconductors in all of the low level signal circuits. Valves are, of course, retained for the timebase output circuits and for the high-voltage circuits; the e.h.t. being 25kV. In all, nine valves are employed. This British set does, however, use a Philips shadow mask tube and a Telefunken delay line.

Rank Bush-Murphy, who claim to have more PAL colour receivers than any other organisation in the world, are—to quote the manufacturers—technically in advance of any other receivers which have so far been announced, and are vastly superior in performance to any set so far offered on the American market.

It is difficult to comment, other than to mention that the pictures on the demonstration models were no better than on some of the others seen at the show.

Servicing the Bush/Murphy receivers is supposed to be easy and well within the scope of the competent black-and-white serviceman. The company is shortly to make available a simple colour slide and tape instruction course. No elaborate test equipment is necessary other than a pattern generator, details of which will shortly be available from the service department of Rank Bush-Murphy.

The two 25-inch demonstration models will be in full production by the end of this year and they are expected to be in the shops by next March. The cost: 310 gns.

Pye, another company with a lot of experience in the design of colour receivers, demonstrated a mass-produced 25-inch receiver. This hybrid receiver has many transistorised circuits and features automatic "degaussing" — the receiver being demagnetised every time that it is switched on.

Judging from the demonstration model, the company has come a long way from their first colour receiver which was a 405-line NTSC model employing 67 valves.

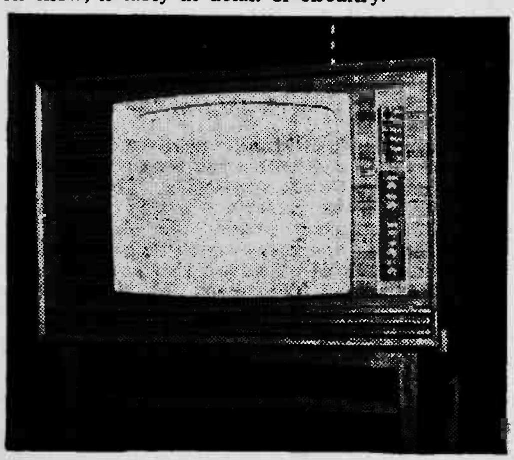
Like a number of other manufacturers, Pye are undertaking the task of training field engineers. They have set up a training school at Southend, the first two-week course in colour servicing and installation beginning on September 5th this year.

K-B also showed their skills at producing colour receivers with two 25-inch prototypes, which will be available to the public next year. The price has not yet been settled, but is expected to be between £250 and £300. These two receivers looked to be the smallest of the colour receivers on show and were only slightly deeper than the present "slimline" models.

Decca showed a colour receiver of reasonably compact design. This again was a hybrid, using semiconductors in the tuner, i.f. circuits and other low power stages and employing valves for functions such a video amplifier, timebase output stages and in some of the colour circuitry. The main receiver circuitry is contained on a long printed circuit panel.

The **B.R.C.** group also demonstrated a colour receiver. This uses valves throughout and a representative stated that at this stage it is extremely difficult to be dogmatic about the exact details of circuitry and presentation. The thought behind this remark was probably inspired by the fact that although certain manufacturers claim that production will "start in the Spring" it may be too early yet to visualise the final form of a quantity produced colour receiver.

Those who claimed that production was only a few months ahead generally gave figures of "around 200 a week" as probable quantities. This, of course, is quite low if colour gets off to a good start. We are inclined to think, therefore, that by the time colour receivers begin to appear in the shops in any great quantity, they may differ quite a lot from the demonstration prototypes on show, notably in detail of circuitry.



Decca 25-inch colour receiver.

Colour Components

Most of the major manufacturers are now making components and are offering designs for new receivers. Not one of the manufacturers would give a definite price for a shadow mask tube, except to say that they will be somewhere between £40 and £50. This is rather off putting to the home constructor who is thinking of making up a set for the inaugural transmission.

Mullard's for example, offer shadow mask tubes, valves, transistors and other components for every stage of a colour receiver. They even offer a delay line, which they claim to be superior to others since it offers the exact amount of delay and does not require any adjustment when fitted to a receiver. The actual delay in this line—a folded, reflecting glass type — is 63·943μS at 4·4336Mc/s. Accuracy of the delay time is preset during manufacture, first by precision grinding the reflecting surface of the glass block and then by adjusting the in-built variable inductors. The operation of this device is quite simple.

A transducer is used to convert the electrical signal into an acoustical signal. This is transmitted through the block and reflected back to a point near the input where it is reconverted into an electrical signal by another similar transducer. Along with this the manufacturers offer complete circuit information on how to provide the red-yellow, blue-yellow and green-yellow colour difference drive signals of constant amplitude from a simple network: thus eliminating the problems associated with the spread of loss and gain between circuits.

Mullard's also claim to have the only complete range of colour valves marketed in Britain: PL505 line output pentode, PY500 booster diode, PD500 shunt stabiliser triode, GY501 e.h.t. rectifier, PL508 field output pentode and PL802 video output pentode.

Among Mullard's range of semiconductors for hybrid colour receivers are two new silicon planar types, BF167 and BF173. Both of these devices feature "integrated screens" which have reduced normal feedback capacitance figures by a factor of four and thus eliminate the need for neutralising in television i.f. stages.

Thorn-AEI showed two new colour tubes which they already have in production—the Mazda 19 in. and the Mazda 25 in. shadow mask tube. Both of these are 90° rectangular types and use a new brighter rare earth red phosphor. A display showing how they produce these tubes attracted a lot of interest from dealers.

Monochrome Receivers

There is little to report on the black-and-white television receiver front, except that most of the new season's sets have been pruned to a minimum; most of them being purely functional in much the same way as the pre-war "Utility" radio set.

The only technical changes our correspondents noticed was the manufacturers are making more use of semiconductors in the low level signal circuits and audio stages, and the use of integrated tuners—which mechanically combine the v.h.f. and u.h.f. tuners.

The only notable exception to what has already been said, is the introduction of small screen sets such as the new Sinclair which is illustrated at the beginning of this article. It is no doubt a remarkable feat of engineering, and we hope to give a full account of this receiver in next month's issue, full details not being available at the show.

Miniature Sets

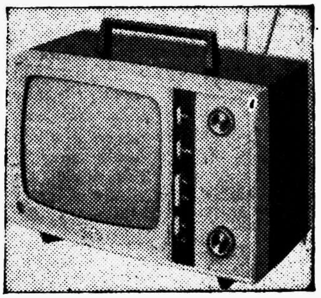
The Sinclair receiver has been christened Microvision, a very apt name. The construction of this 405-line receiver, we are told, is conventional, using 30 transistors and other discreet components mounted on separate circuit boards which plug into a horizontal interconnecting board. The actual size of receiver is 4 x 2·5 x 2 in.: weight is approximately 10·5 oz. This includes the six "penlite" cells which power the receiver and have about 4 hours' playing time.

A 20th Century cathode ray tube (70° magnetic deflection) is used in this tiny receiver, along with a lot of new circuitry, which we understand makes use of many direct coupled circuits. Another novel feature of this receiver is a piezo electric loudspeaker which is many times smaller than the conventional type, yet will provide about 100mW output.

Clive Sinclair, 26, proprietor of Sinclair Radionics Ltd., told members of the press that this type of receiver "will do for television what pocket radios have done for sound broadcasting." The Sinclair Microvision receiver is expected to be on sale early next year at 49 gns.

Another impressive set—by no means as small as the Sinclair, but one with a very much clearer picture—was the Sony TV9-306UB. Nearly 50 semiconductors are used in this 9-inch portable, which covers all the channels in Bands 1, III, IV and V. The price of this receiver in the United Kingdom is 69 gns.

The Crown Radio Corporation also showed a small portable television receiver. Known as the CTV-12, it covers all the television channels and contains an a.m./f.m. radio. Considering the size of the tube, 4½ in., the picture was not all that



The Philips T-Vette portable. Integral adjustable aerials; 11 inch screens; mains or 12 volt; receives all British programme signals. Price 85 gns., plus 18/10d., surcharge.

—Photo by Philips

sharp, but it is difficult to assess the quality of receivers in the show, since the building has a metal structure. This receiver will be making its debut in the next few weeks and is to cost about £100.

Value for money, the 12-inch portable from Ferguson takes a lot of beating at 39½ gns. This 405-line receiver operates from the mains and has been introduced for the two-set family market. Its features include flywheel sync.

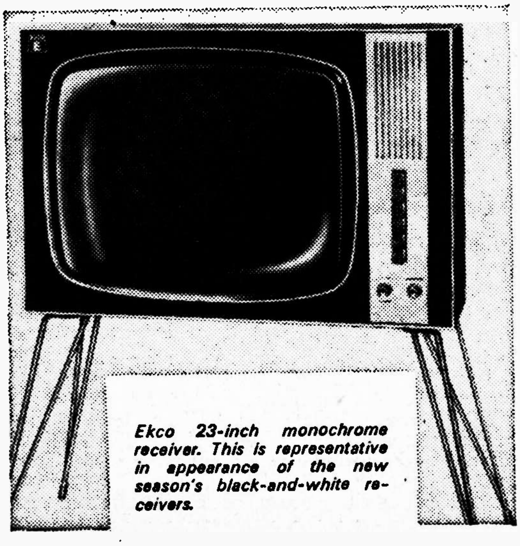
Aerials

Probably the most important single item in the whole chain is the aerial, since the finest television set in the world (which all manufacturers claimed to be exhibiting), cannot give satisfaction unless a good signal is offered to its input terminals.

The aerial manufacturers were very much in evidence and obviously had this problem in mind. The old favourite perennials were prominent, ranging from table-top V's and simple loft aerials for areas of exceptionally high signal strength, to the impressive multi-element stacked arrays for fringe area reception.

The trend this year appeared to be the marriage of higher gain with broader bandwidth. One neat multi-element array had its driven dipole element purposely cut longer than the usual $\lambda/2$ with a second shorter rod mounted immediately beside it to tune out the reactance due to the extra length. Another exhibitor displayed a broadband high gain array for u.h.f. called the "Parabeam". This they claim provides substantial signal gain over the "Standard" models which require 50% more elements. This aerial also claims broadband coverage of channels 20—33; 39—51; or 53—65. Also available is a u.h.f. add-on unit consisting of another six directors which can be fixed on to "Standard" or "Parabeam" models providing an easy method of obtaining additional signal strength.

With the advent of colour, aerials will prove a major factor, and high gain together with careful positioning is forecast if ghosting is to be avoided and a suitable signal fed to the receiver. Ghosting might be described as annoying on black-and-white, whereas on colour it is catastrophic. One exhibitor informed that tests made so far indicated that it could well prove necessary to mount the colour aerial away from the black-and-white aerials on a separate mast or mounting. The outlook for the future appears to be bigger and better aerials and more per roof, too. ■



Ekco 23-inch monochrome receiver. This is representative in appearance of the new season's black-and-white receivers.

IDEAS FOR..... amateur TV

M. D. BENEDICT.

Part V

4. *Alignment*

Set the controls:

Target —	down (zero voltage)
Beam Current	down (maximum negative bias)
Beam focus — —	centre of range
Magnetic focus —	centre of range
Height and width control	max. scan amplitude.

Increase beam and target until some sort of image is seen, adjust magnetic focus and optical focus until a sharp image is obtained. This will be surrounded by a ring which is the target edges, so adjust scans until the target edges are just out of the picture. Magnetic focus should not need adjustment any more and all variations in beam focus should be controlled by the beam focus control. In fact, the magnetic focus is a coarse beam focus control. The target and lift should be adjusted to give a reasonable picture of about one volt peak. Increasing the amplitude with the target, the beam current should be adjusted so that it clips the peak white signals at a level of about 1·2V; reduce the level to 1V so that no clipping occurs. This allows just enough beam to be used, but not too much so that definition is lost.

Note the effect of movement in low light levels. This lag can be minimised by using the widest aperture available on the lens or by increasing the light on the scene.

If no images are present, check the amplifiers and the tube supplies. If a peculiar or unrecognisable image appears, check the scan circuits.

Testing the Circuits

1. *Head Amplifier*

Apply sawtooth across a 75Ω load and connect to the target via a 0·1 μF and a 3·3MΩ series resistor:

0·2—0·5V should be seen across a 75Ω output load.

The sawtooth should be undistorted.

2. *Processing Amplifier*

Applying line drives or mixed syncs. to the input, check with 'scope for correct square wave response—i.e., best risetime, no rounded corners but no overshoots. The "adjust on test" capacitors should be altered to achieve this. Then try sawtooth from the head amplifier and set gain for 0·7V of vision at the output. Set syncs for 0·3V. Check operation of clamps while varying sawtooth amplitude.

3. *Scans*

Connect up the scan coils to a battery with a small resistor in series scan coils. With a 'scope check that the current waveform—i.e., the voltage across the resistor, is sawtooth. Linearity may roughly be set at this point.

Check the operation of the blanking generator. The tube voltages should be checked along with the focus current.

The Viewfinder

The requirements for a viewfinder are that it produces a reasonably bright picture from the signal out of the head amplifier or the signal fed back from the c.c.u. via the cable. The scan circuits can be fed from the same generator as the Vidicon scans or from a separate generator driven by the camera line and field drives. The viewfinder to be described uses a completely separate scan circuit which is driven by the camera blanking information via a sync. separator circuit—this circuit is, in fact, a small video monitor, and may be used as such if so required. When discussing a monitor previously the idea of re-building an old television set was advised, and it was mentioned that those television sets with a damaged or tatty cabinet might be considered for re-building in to a viewfinder. The same remarks apply to the condition of the television set under consideration for a viewfinder. The normal 90° 14in. sets are quite suitable as the small tubes used for viewfinders are also 90° or thereabouts.

A favourite tube is the AW17-20, which is used in practically all studio cameras. It is a high quality 7in. diagonal rectangular tube with electrostatic focussing, the only disadvantage is that they are not easy to obtain (the B.A.T.C. might be able to assist in obtaining one). The other tubes used are the 5FP5, 5FP7 and 7BP7. All these are, unfortunately, round tubes and the P7 phosphor is a long persistence yellow phosphor giving rather smeary moving pictures unless a blue filter is used. These tubes are electro-magnetically focused and scanned and the focus assembly found on many old sets is suitable for use. The price of these tubes is from 10s. to 30s. The 5FP5 has a white trace but may be difficult to obtain.

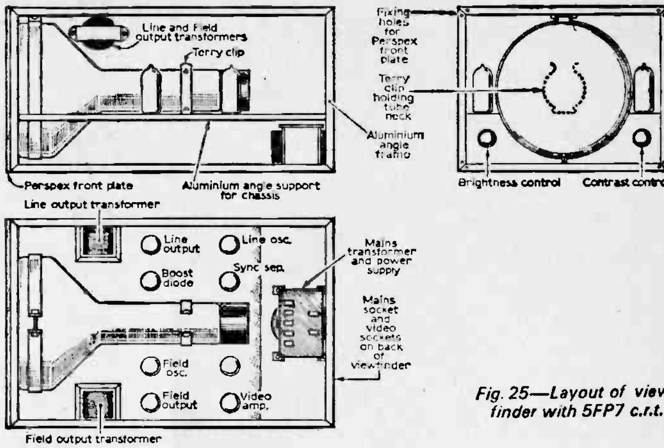


Fig. 25—Layout of viewfinder with 5FP7 c.r.t.

Construction

The layout of the viewfinder (Fig. 25) is nearly the same size as the camera and this enables it to be held on top of the camera. The frame is made up from aluminium angle with the support about a third of the way up the frame to carry the chassis. The chassis is aluminium sheet as are the sides (hinged for maintenance) and the top and back of the viewfinder. The front plate is perspex, bolted in the corners, with holes for brightness and contrast potentiometers. The back of the perspex is painted matt black to act as a mask in the areas not scanned by the raster. The perspex is edged with plastic trim (obtainable from hardware stores), as used on kitchen tables and similar furniture. Any rough edges of the camera and viewfinder could be trimmed with this provided that it does not restrict access.

One method of tube mounting is a strip of aluminium or brass bent to form a clamp holding the ridge behind the front plate of the tube, with a Terry clip to hold the tube on to the chassis. The position of the line output transformer will need careful consideration to avoid arcing to nearby components. A mains transformer will be needed, also a power supply such as that shown in the article dealing with monitor conversion. The layout of the components shown in Fig. 25 is only a guide, and it is suggested that the mains transformer is sunk into the chassis (or below it). The line and field output transformers could be mounted high on the aluminium angle as shown, leaving valuable chassis space below.

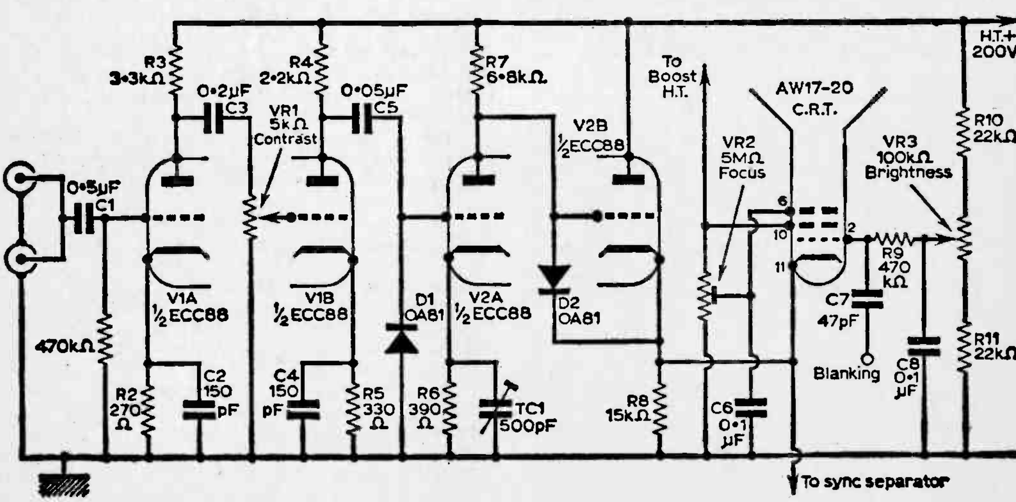


Fig. 26—Video amplifier and connections for the AW17-20 c.r.t.

A suitable video amplifier and output stage is shown in Fig. 26. This consists of three stages of amplification followed by a cathode follower. The amplifier stages all use cathode compensation for frequency response, one of the correction capacitors being adjustable as a "crispener" to aid focussing. The signal is d.c. restored at the input to the third stage with d.c. coupling to the output stage. For extended frequency response, anode chokes could well be tried but it would be necessary to experiment with this.

The use of the 5FP5, 5FP7 or 7BP7 tubes requires less line scan and a lot less e.h.t. This can be done in several ways, reduction of the screen grid voltage on the line scan output valve, or a boost voltage need not be used to supply the line output stage (this could be difficult with some circuits).

Inter-connections for the mains supply via the camera cable and the output of the head amplifier could be made by a panel mounting socket on the camera and a corresponding panel mounting plug on the viewfinder. This plug, however, would be in the way when the viewfinder is used as a monitor. Alternatively, the mains input and the video sockets could well be mounted on the back of the viewfinder and if it is found possible to make the viewfinder shorter than the camera, sockets at the front of the camera could allow a few inches of cable to connect up to the viewfinder sockets. This is, however, not very tidy.

As the viewfinder feed is from the head amplifier, the lift control has no effect, so that it may sometimes be necessary to adjust the brightness control to reset black level. For optimum sensitivity of focus, use of the "crispener" to give an edge to details, and a slight crushing of blacks may be found helpful.

The Camera Mounting

The standard lightweight television camera mounting as used in studios costs around £125. An ordinary cine pan and tilt head is not really suitable as they have no compensation for the movement of the camera's centre of gravity when tilted forward. With a lightweight cine camera this is of no importance, but with the heavier television camera, plus the weight of its viewfinder, the effect of the camera falling forwards when tilted down becomes a problem. This does not mean that a sturdy cine pan and tilt head is useless but it makes for smoother operation when some compensation is added. This can be done with some success by adding springs to the pan and tilt head as shown in Fig. 27.

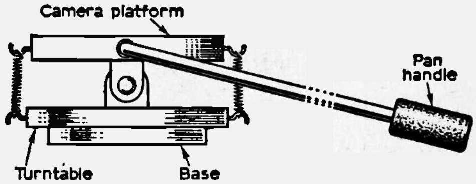
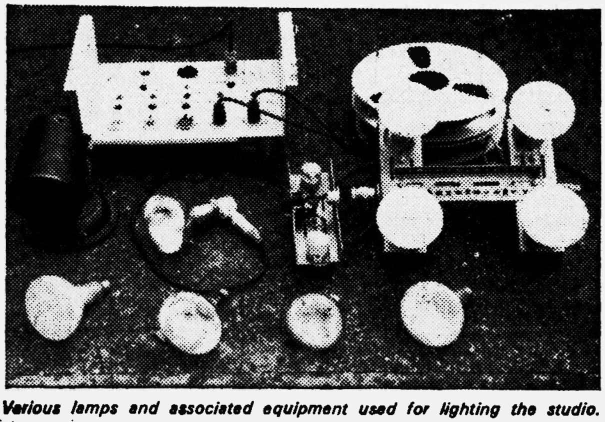


Fig. 27—Pan and tilt head assembly.

Possibly the simplest method is to tap the turntable and the camera platform and insert a suitable hook. Elastic bands should be added and the number of bands and their size adjusted to give the correct compensation, so that the camera can be tilted up and down without any tendencies to fall forwards or backwards. For neatness sake, the bands could be replaced with a spring of suitable length and rate. Heavy-duty ex-WD tripods are suitable (e.g., B44 stands) but the usual lightweight photographic tripods are too flimsy. The tripod can be mounted on a "skid" (Fig. 28) for use requiring movement. This is made up from angle metal (Dexion, Handy Angle, etc.). The wheels are castors of a suitable type—small for smooth surfaces, such as linoleum, or large ones for rough surfaces.

When mobile support is needed, for example at demonstrations or fetes, the amateur uses his ingenuity. One might well use an old pram chassis with a tripod mounted on it, or, in fact, almost anything with wheels may be pressed into use on these occasions.

Although reasonable pictures can be obtained with the usual lighting levels found in the home, the lens aperture is wide open and the target voltages rather high. This means poorer definitions and movements resulting in considerable lag and smearing. Pictures taken outside do not lag very much. This is due to the much brighter lighting hence for good pictures a fair amount of light is needed. The nominal high light level is approximately 125 foot candles with a maximum contrast ratio of about 40:1, i.e., dark parts 1/40th the level of the highlights. In photographic terms this means a scene brightness equivalent to an exposure of 1/125th of a second at F.11 using a film speed of 125 ASA. The usual photographic lamps are suitable for television use and good results can be obtained if the usual rules of lighting are observed.



Various lamps and associated equipment used for lighting the studio.

There are four basic lamp positions (Fig. 29). The main light is called the key; this is set at a slight angle to the camera, the angle being chosen largely

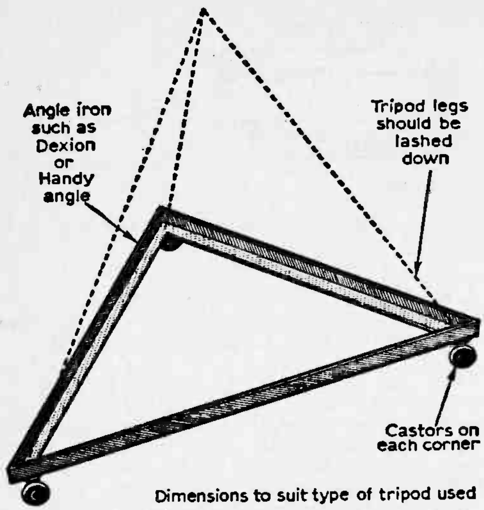


Fig. 28—'Skid' for use with a tripod.

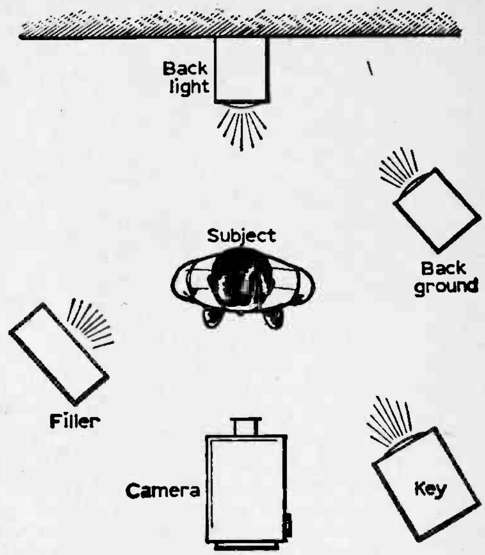


Fig. 29—Layout of studio lamps and cameras.

to reduce the nose shadow, but the key light is never mounted on the camera, or in line with it, except when unavoidable. This would ruin the modelling of the facial features and give flat and uninteresting pictures. The "filler" is a soft, diffused light and is placed on the opposite side from the key to give a balanced look by reducing the hardness of the shadows. To give "edge" to pictures and to make the subject stand out from the background, the back light is used. This shines on their hair and shoulders, making them lighter, and gives a three-dimensional effect to the pictures. Finally, the background should be illuminated. Mid-grey backgrounds are best but some form of shadow pattern adds a lot to the pictures as well as being easier on the transmission chain (less work for clamps and d.c. restorers).

The lights may be any of the usual photographic units but the author favours spotlights of the sort used in shop window displays with reflectors moulded as part of the bulb. With suitable mountings these lamps are quite cheap and need no special lamp-houses. The soft light for the filler can be any light with a shade or diffusing screen placed in front of it. Unfortunately, the lamps and their stands rather clutter up the floor space so that if it is possible lights should be suspended from above. A simple switch power distribution board to control each lamp is an advantage when setting up the lights. Any further information on lighting can be obtained from the usual books of lighting for portraiture.

Addenda

On page 502 of the August issue, Tr3 (Fig. 16) was shown as a p-n-p device. This was incorrect—the 2N706A is an n-p-n transistor. The photograph on the bottom of the same page showed a sync pulse generator. The unit was also fully transistorised despite the valve type screening can.

Part VI next month

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

CONDITIONS for July/August 1966, were reasonably satisfactory for Sporadic "E" reception, and at times was rather better than the corresponding period last year.

The "season" started late this year, and it may continue after the usual closing time in September/Early October. One noticeable fact in the current openings is that they are somewhat "cyclic" in nature. Normally Sporadic "E" reception is largely unpredictable, excepting that the advent of thundery weather usually indicates a possible opening. But this year, from say a certain day when there was no reception at all, I have been finding that the next day or so had short weak openings, to be followed by some improvement day by day, until we had a good long duration opening of some 3 or 4 days, this only to be followed by a gradual reduction to nil again, and the cycle then repeating itself. It certainly seems at times the openings are predictable in some degree, and I would be interested to hear if other DXers have formed the same opinion.

DATES OF OPENINGS

18/7/66 Fair.	4–9/8/66 Poor.
19/7/66 Nil.	10–11/8/66 Good.
20–21/7/66 Poor.	12/8/66 Fair.
22–23/7/66 Fair.	13/8/66 Poor.
24–28/7/66 Good.	14–15/8/66 Nil.
29–30/7/66 Poor.	16/8/66 Fair.
31/7/66 Nil.	17/8/66 Nil.
1–2/8/66 Fair.	18/8/66 Poor.
3/8/66 Fairly Good.	19/8/66 Poor.

The openings were very good ones, the "star" performer was certainly J.R.T. Yugoslavia on both E3, and E4. Generally poor weather conditions, particularly in the early part of the period, were responsible for poor Tropospheric reception, but the last week of the period was generally good, for Bands I/III, and u.h.f.

NEWS

Three pieces of information for your records this month.

(1) **N.T.S. Lopik Holland** is at times using an electronic type test card somewhat similar to those used by W. Germany, seen here on 19/8/66, but I was not the first to see it.

(2) **N.T.S.** again, the u.h.f. station seen on Ch 29 is at Goes Holland and is relaying the *first* N.T.S. programmes, while that at Goes on Ch 32 relays the second programme.

(3) Two new Belgian u.h.f. stations are now in operation on Ch 40 for the B.R.T. Flemish programme, and Ch 43 for the R.T.B. French programme, both relay the Belgian Band I/III programmes, there is as yet no second chain (these stations are probably at Wavre).

Items 2, and 3, are of special interest in that the use of u.h.f. for first programme transmission may be a pointer as to future TV policy towards the use of u.h.f. rather than Bands I/III.

APPEAL TO DX-TV FRIENDS

In our series of Test Card Data sheets we are anxious to include a good photo of the Polish/Hungarian card, and the TV services have not as yet provided us with an original photo. The "off the screen" photos that we have are not really of good enough quality to print-up well in the Magazine, so if you have a good sharp photo, would you kindly lend it to us, (negative as well if possible) so that we can include it in the series. I thank you in advance for your kind co-operation.

This card is of course the one that causes all the confusion between Poland and Hungary, so if you can possibly indicate, the country of origin, we will thoroughly investigate the possibility of slight differences in the two cards.

READERS' REPORTS

A good bunch of DX reports this month, and many thanks to all who have written. Due to lack of space we will have to hold-over some reports until next time.

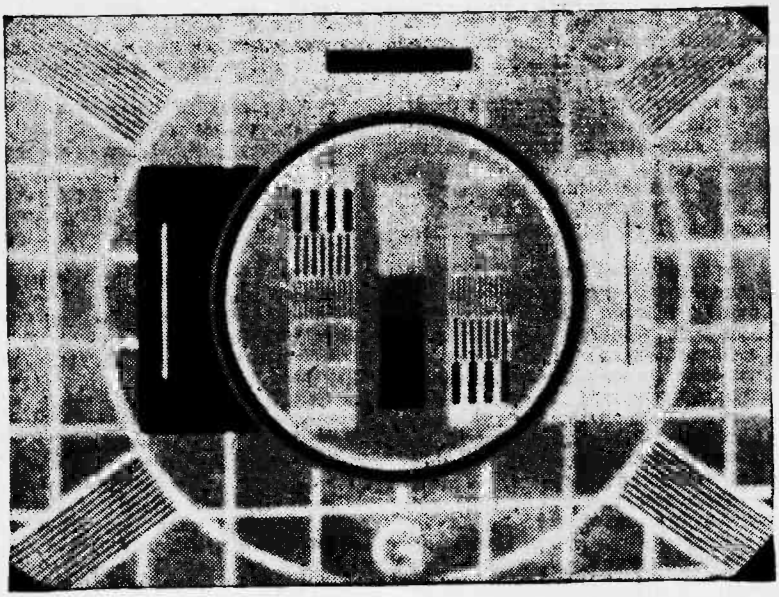
A. G. Challis (Norfolk) has reported reception of Sweden on u.h.f. Ch 43. This is an excellent u.h.f. result, and clearly shows what we can hope for. Results by him also include N.T.S. Lopik, Goes, Markelo, and Smilde.

C. J. Deaves (Harpenden) has been most active at his location, his log includes Italy, Spain, Yugoslavia, Austria, Hungary, Czechoslovakia, U.S.S.R., Norway, Sweden, Finland, Poland, Rumania, Portugal, and E. Germany, 14 countries in all! He complains bitterly about the mass of different test cards by Yugoslavia, I fully agree!

Desmond Kelly (Castlewellan, N.I.) reports that he received Poland, Hungary, U.S.S.R., Spain,

DATA PANEL-14 LUXEMBOURG

C.L.T. COMPAGNIE LUXEMBOURGEOISE DE TELEDIFFUSION



(courtesy M. Aisberg)

Test Card: as per Photo. Occasionally the card carries the letters C.L.T. at bottom.

Luxembourg operates on Ch E7, employing a 819 line positive image with a.m. sound, the sound to vision spacing is 5·5 Mc/s complying with the "E" channel system and not the French "F" system.

The power of the transmitter is 100kW on vision, and the polarization is horizontal.

The service is a "Commercial" one with advertisements at intervals.

Times—We regret that we have no precise information at the moment but a test card usually precedes the programme at about 18·30 BST.

This station has always been a difficult one to receive in Great Britain, and its reception is always a fine achievement.

Portugal, Italy, France, and Switzerland, all on one day, he must have been busy, no danger of the channel selector switches becoming dirty here!

P. Swain (Harpenden) has sent in an excellent detailed log, and I can only pick out the "star" ones, firstly T.V.E. Canary Islands E3, so he joins the select few who have got it, yes he saw the studio clock one hour behind b.s.t. The "Riga" caption was also seen, and he asks about a possible Band I transmitter here (the lists show Riga as Band III), the short answer is probably yes, a second programme being radiated in Band I.

STOP PRESS NEWS

R. Bunney claims that Telefis Eireann are using a new test card on all systems, vaguely like the E. German card with letters R.T.E. in the centre, more news and a photo as soon as possible.

CCTV FOR TEACHERS

EMI Electronics Ltd. was one of four manufacturers who recently provided complete studio facilities for a teachers' induction course in the use of television in education. The course was held at Wandsworth Technical College as one of the first stages in the setting up of the proposed Inner London Education Authority's television service.

Teachers from all parts of London, in groups of twelve, spent a week gaining first-hand practical experience of closed-circuit television equipment and of production. Each group produced an educational programme and at the end of the course the taped programmes were played back before an audience of teachers and invited guests.

405-LINE TV SOUND CIRCUITS

by G. R. Wilding

GENERALLY speaking television sound receivers require more attention than do the circuits, especially those in dual-standard audio sections of conventional radio receivers. The reasons are not hard to find. The TV sound a.m./f.m. change-over switching is quite involved, the combined detector/limiter system on 405 is far from simple and invariably uses biassed diodes while the f.m. ratio detector or more recently introduced EH90 dual-control heptode in the "locked oscillator" made. All can give trouble. Distortion, fading or lack of volume are the main complaints, with vision "buzz", over-emphasis of sibilants or poor Band I/III balance being strong runners-up.

Determining the function of many of the components, tuned circuits and traps in dual-standard sound circuits can be difficult; though a necessary task for effective fault diagnosis particularly in printed circuit receivers where component removal for test must be kept to an absolute minimum.

To take first things first and review the basic amplitude modulated detector/limiter and audio stages as used in most 405 receivers or in the 405 sections in dual-standard receivers, we must first consider a.m. interference limiters. Whereas vision limiters which reduce the effect of spot interference, are hardly ever adjusted by viewers to give any real degree of cut sound interference limiters are an absolute necessity.

In many receivers a "gate" diode forms the limiter, which blocks interference pulses. The actual bias voltage given to this diode is quite small. Often it is taken via a high value resistor, which makes it is impossible for the manufacturers to issue a figure readable with any degree of accuracy except by a valve voltmeter.

The complete 405/625 sound system of the S.T.C. VC2 series of receivers is shown in Fig. 1, where it will be seen that the biassing resistor, does not go straight to the h.t. rail as is the usual practice, but goes to the junction of the 100kΩ and 220kΩ resistors that form the anode feed to the PCL86 audio amplifier. By doing this a little negative feedback is achieved. However, the main determining factor in the limiting action of the circuit is the time constant of the C100/R114 pair since sound interference suppression operates on the time duration of the pulse and not the amplitude of the pulse as is the case with vision noise suppressors.

The duration of a car ignition pulse is only a few microseconds which, compared to the relatively slowly altering sound waveform represents a very rapid change indeed. The values of C100 and R114 are chosen so that they can follow the AF waveform, but reject a sudden sharp pulse whose duration is less than the time constant of C100/R114; since the sharp pulse has passed before the capacitor can significantly discharge through its associated resistor.

To recap, the rectified output from D3 appears across the 56kΩ load resistor R108, with R110 (8·2kΩ) acting as an r.f. filter in conjunction with C96 the 50pF decoupler. Limiter diode D4 passing a little d.c. develops a small voltage across its forward resistance so that its cathode is slightly less positive than its anode. C97, the 0·01μF a.f. feed capacitor then swings D4 anode voltage around its set figure while the cathode voltage constantly follows. On the arrival of the high amplitude short duration noise pulses, the anode voltage of D4 momentarily falls below the cathode level and fails to pass the pulse except for a small "blip". With values of 500pF and 680kΩ respectively the time constant equals 340 secs, so obviously capacitor voltage loss during the period of the pulse will be very small indeed. R109 the 470kΩ resistor feeds a.g.c. bias to the 6BW7 sound i.f. amplifier in the conventional manner. The rest of the a.f. circuit is also standard.

With only minor component variations the circuit shown in Fig. 1 is used in every duo-diode limiter/detector, although in some earlier types the diodes are not semiconductor devices.

Now to turn to the sound circuit used in most Philips receivers, which accomplishes interference limiting simply by careful choice of the component

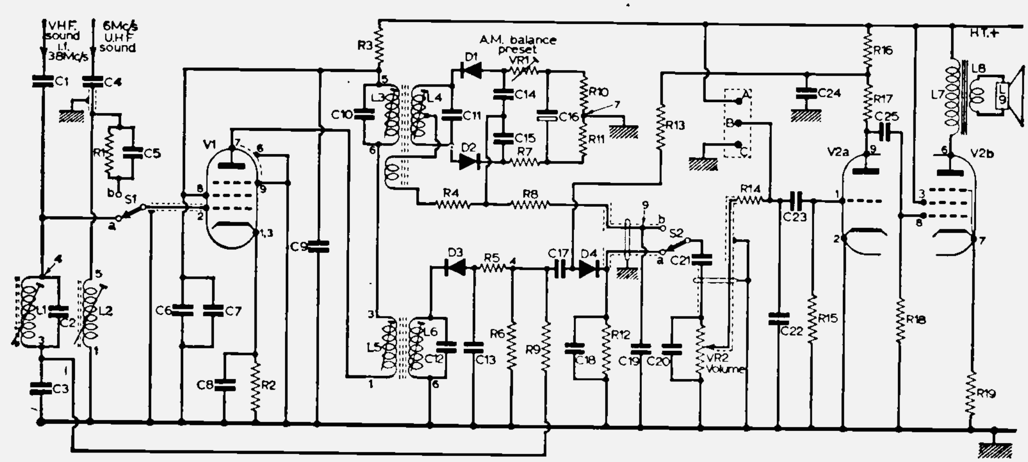


Fig. 1—Circuit diagram of the 405/625 sound system used in the STC VC2 range of receivers.

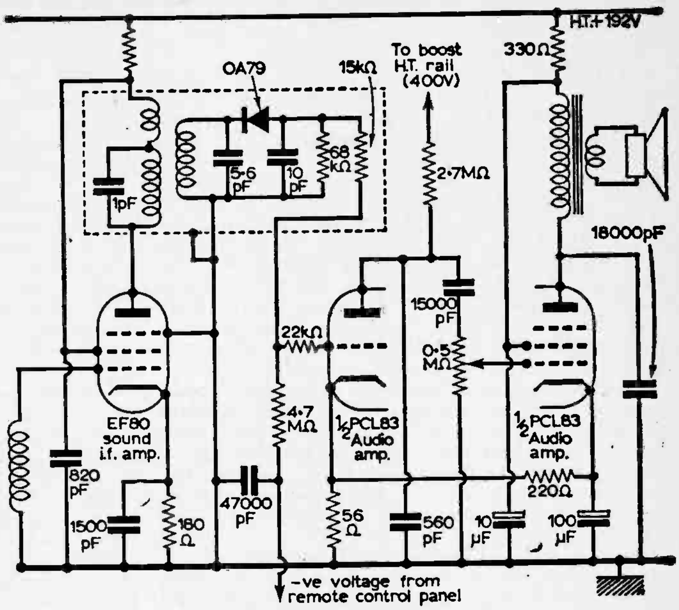


Fig. 2—Diode sound detector and triode a.f. amplifier circuit used in most Philips receivers on the 405 a.m. section.

values in the anode circuit of the triode a.f. amplifier. The same principle applies, that is the use of an a.f. load with a time constant too long to follow the short period noise pulses—in this instance a 2·7MΩ load resistor with a 560pF capacitor.

In some models Philips use one of the diodes in an EBF89 as the detector, while in others on OA79 semi-conductor, but in all instances as the a.f. triode load resistor is so high it is taken to the 450V boosted h.t. rail instead of the 192V normal h.t. rail so that the triode anode voltage can be kept to an effective value; in practice 70V.

This means that should the boosted h.t. supply fail for any reason, sound will go off as well as e.h.t. Readers confronted with such a fault might well suspect general lack of h.t. rather than a fault purely in the line output stage unless he is aware of the sound circuitry.

The basic Philips system is shown in Fig. 2 and except for taking the a.f. triode h.t. supply from the boost rail, it seems just like any other non-limiting sound circuit. However, on closer examination you will see a difference in the choice of triode anode values and that the sound i.f. bandwidth is in excess of actual audio requirements. This is for effective limiting action. The employment of a single cathode resistor common to both triode and pentode sections of the PCL83 sound valve is often seen in Philips designs and provides a simple effective way of providing a degree of negative feedback.

Excepting valves, the most common cause of 405 sound failures used to be the miniature germanium diodes, but in recent years their reliability has increased enormously and the very high value h.t. feed resistors to the limiter diodes are more troublesome. When they go open circuit, volume is reduced and when their value increases unduly, distortion on loud passages can occur, closely resembling the effect of over-loading or over-biassing valves in the audio stages.

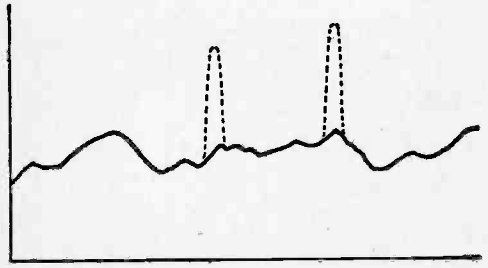


Fig. 3—Typical a.f. waveform with two random noise pulses superimposed.

With the older type of receiver fitted with a manual fine tuner, it is sometimes found that sound quality is normal each side of the optimum volume setting but is distorted at peak.

Although this may be caused by the sound channel alignment being "double-humped" or by no a.g.c. bias getting to the sound i.f. valve, this symptom can point to the limiter feed resistor.

The simplest way to check its value is to parallel a voltmeter across it on the highest possible range, say 1,000V, and note the effect produced. If volume and quality improves significantly, it indicates the resistor has gone high. Of course, if you have an ohm-meter which can measure up to 8MΩ or more, you can measure it directly.

Should volume be normal but interference appear particularly marked it may be that the limiter is not working. The most likely cause would be an open circuit or dry-jointed capacitor in the TC pair or in the case of Philips models, the 560pF triode anode decoupler.

The best way of testing the miniature diodes is to check their back to forward resistance ratio. If this is above 10:1 they can be assumed serviceable.

Weak sound is sometimes caused by open-circuit or dry-jointed fixed trimming capacitors across the sound i.f. transformers. In such cases even with the appropriate core screwed right in, the coil will tune too high. Similarly, weak and hissy sound can be caused by loss of capacity in the sound "take-off" capacitor from the anode of the common vision and sound i.f. valve to the i.f. coil in the grid of the sound i.f. pentode.

When in doubt and replacing this vital component, always check its value from the relevant Service Manual, as they can vary from 1 to 50pF.

Finally, poor sound with normal picture contrast is often caused by slight mis-setting of the tuner output i.f. coil over-favouring the vision. ■

TV TERMS AND DEFINITIONS EXPLAINED

Gordon J. King

Part VI

Horizontal Definition

The horizontal definition of a television picture is governed by the speed at which the scanning spot can change brightness as it traces out the lines of a picture from left to right across the screen. The spot brightness can almost instantaneously follow any change in bias conditions (i.e., signal) at the tube grid, but a limit is imposed by the rate at which the vision circuits themselves can respond to a brightness change signal-wise.

If the picture requires the spot to change instantaneously from black to peak white, the circuits cannot accommodate this one-hundred per cent since they cannot work in zero time. They require a finite time to change condition from the signal aspect. Thus, although the picture requires an immediate change in spot brightness, the circuits introduce a time delay.

The delay imposed in this way is related to the bandwidth of the vision channel circuits. If the bandwidth is limited due, for instance, to misalignment or trouble in the circuit, then the rate at which the spot can alter in brightness, as dictated by the original signal, is reduced. This then means that the sharp transitions between the picture components horizontally are destroyed and a blurred, unfocused effect occurs in the horizontal sense, while the lines of the raster upon which the picture is built remain in focus.

The bandwidth should not fall much below 3Mc/s on 405 lines and 4·5Mc/s on 625 lines to secure all the horizontal information that the original camera signal contains. The horizontal definition can be appraised from a Test Card, as we have already observed.

Hum Effects

Hum is the effect referred to when mains ripple (usually at 50c/s) in some way affects the sound or vision channels. The prime cause of the effects is complete or partial failure of the electrolytic reservoir or smoothing capacitors in the h.t. circuits. Partial failure may let through a little more hum than is normal for the set. This can be heard as a slight background hum in the speaker and (sometimes but not always) as a slightly dark shaded horizontal bar across the picture.

If the transmission is one that is not locked to the mains supply frequency, then the horizontal shading effect will tend slowly to drift up or down the screen, giving the picture a slow rippling effect (see also under "Asynchronous", in Part I).

Complete failure of the smoothing will almost certainly render the set useless. The hum on sound will be very loud indeed, cutting out the sound almost completely, and in many cases the line timebase will cease to work properly and only a zig-zag display of illumination will appear on the screen.

Hum can also be caused by heater/cathode shorts or leakage in the picture tube or valves (see also under "Heater/Cathode Leakage", in Part V).

A rough buzz symptom, often mistaken for mains hum on sound, can result from feedback from the field timebase circuits—the field signal somehow being coupled to the sound circuits. However, this cause can easily be proved by adjusting the vertical hold control over its entire operating range. If the buzz alters in pitch as the field generator frequency is altered, one can be certain that field timebase coupling or feedback is responsible.

Usual causes are (i) complete or partial failure of an electrolytic bypass capacitor in the field generator or amplifier h.t. supply circuit, (ii) inadvertent coupling from the field timebase circuit to the grid circuit of the audio section (this may happen after a servicing operation due to misplacement of wires in the above circuit sections) and (iii) bad design of the set or bad earthing of the volume control metal covering or screened cables to this component.

It should be noted that a similar buzz symptom can result from the vision signal getting into the sound circuits. However, this is identified by the nature of the buzz changing with changes in the picture. The trouble here can be caused by overloading or misalignment, and it is often the latter that is the main offender. One solution lies in tuning the set for the best picture quality *and then* very carefully adjusting the sound i.f. transformer cores for maximum sound consistent with minimum vision breakthrough.

Intercarrier buzz in 625-line sets can arise from poorly balanced f.m. discriminators or from the detectors in the sound channel; but here the trouble *cannot* be cured by realigning the 6Mc/s intercarrier circuits.

Hunting

This is generally the term used to describe low-frequency instability symptoms on the picture in receivers using flywheel-controlled line circuits. One effect may be that the picture oscillates slowly to and fro horizontally across the screen. Another effect is severe waviness of vertical parts of the picture.

The cause usually results from a fault in the loop circuit from the line timebase, through the control valve or electronic discriminator and reactance and back to the line oscillator. Damping circuits in the form of long time-constant filters are included in this loop to minimise the effect, but alteration in value or breakdown of an associated component can aggravate the trouble. Components particularly vulnerable are those between the discriminator and electronic reactance or line oscillator proper, depending on the nature of the circuit.

Microphony (i.e., ringing) in one of the valves of the circuit can also start the symptom going, but in this case a tap on the glass envelope of the valve with the handle of a screwdriver will stop or increase the disturbance, thereby proving a valve fault.

Incremental—Inductance Tuner

There are two basic types of television tuner for the v.h.f. channels, one using a turret or ceramic disc on which the various coils corresponding to the channels are mounted and the incremental-inductance tuner.

This latter device employs a rotary selector switch of positions equal to the number of v.h.f. channels. The elements of this switch adjust the inductance of the main coils, which are usually pre-adjusted to the highest channel, by switching in or out small increments of inductance, the value of each increment being sufficient to shift the frequency by one channel up or down, depending on which way the switch is turned.

The inductive increments are mounted between adjacent tags of the selector switches, and once the highest channel has been adjusted, the other channels automatically fall within adjustment of the fine tuning control. There are in practice one or two variations in design, especially with regard to the channel tuning and alignment.

This sort of tuner was found primarily in sets of Pye origin, and designs have been produced employing both valves and transistors.

Instability

This term implies that the stability of a circuit is impaired. Mostly, the effect is caused by an amplifier (of any type) changing into an oscillator—or, at least, approaching conditions for oscillation. For optimum results, an amplifier should be completely free of oscillatory tendencies. However, should a decoupling component fail, conditions may exist for feedback from the output of a stage to the input of the same stage or even a previous stage.

Now, should this feedback be positive that is, the output voltage arriving back to the input in-phase (with the input voltage) the loop gain of the circuit be greater than unity, changing the stage from an amplifier to an oscillator.

The oscillatory frequency will be influenced by the circuit parameters, meaning, for instance, that an i.f. amplifier will tend to generate a signal somewhere close to the intermediate frequency. This signal will *beat* with the actual signal, and a new signal of frequency equal to the difference between the frequencies of the two signals will be produced. This will fall in the passband of the amplifier and arrive at the detector along with the wanted signals. The results will be patterns on the picture and whistles on sound.

Sometimes the positive feedback is not quite sufficient to cause oscillation, but in tuned stages this will cause a rise in sensitivity at a particular frequency and thus destroy the required, flat bandpass characteristic. The set will assume a state of undue sensitivity and general tuning will be made difficult.

Faulty r.f. and i.f. valves can promote instability, as also can bad matching between circuits or failure to refit a screen after a servicing operation. In the audio stages, instability can give rise to low- and high-frequency effects from the speaker. Low-frequency instability is sometimes called *motor-boating*.

Integrator

The integrator circuit is found between the output of the sync separator and the field timebase generator. The circuit in basic form is shown in Fig. 27. In practice, it may be more complex than this or, in fact, related to other circuits, such as the differentiator (see under "Differentiator", in Part III).

The circuit is, in effect, a low-pass filter, the characteristics of which are determined by the time-

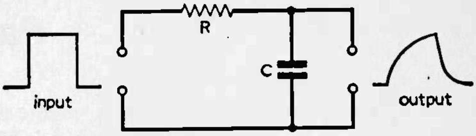


Fig. 27—Simple integrator circuit.

constant formed by R and C. In operation, the circuit works by causing very little output signal from single line sync pulses, yet a considerably larger output from the series of field sync pulses of the composite video signal.

The intervals between each field pulse of a series (usually about eight field pulses in a series) are equal in duration to the duration of a line sync pulse. Thus, each field pulse adds to the charge across C (Fig. 27), while there is little discharge through R during the intervals between the pulses. The action then, is that each field pulse adds to the charge across C so that at the conclusion of the whole series (during the field sync period) the charge across C is sufficient to trigger the field timebase and thus facilitate synchronisation. The circuit *integrates* or *adds*, hence its name.

Modern receivers use circuits of greater sophistication than that shown in basic form. Often diodes and other time-constant components are employed as a means of achieving the best possible interlace performance.

Intercarrier Sound

This a term connected essentially with the 625-line standard of television broadcasting. On the 405-line standard, the tuner and probably first i.f. stage of the receiver amplifies together both the sound and vision signals, these then being separated into their sound and vision i.f. channels.

625-line receivers and dual-standard receivers switched to the 625-line standard differ in that both the sound and vision signals are carried all the way up to the vision detector in the i.f. channel. The one i.f. channel is thus common to both sound and vision.

The sound and vision carriers on this standard are 6Mc/s apart, and the vision uses amplitude-modulation (a.m.) and the sound frequency-modulation (f.m.); as distinct from the a.m. on both sound and vision on the 405-line standard.

Now, when the two 625-line signals reach the vision detector they become effectively 'mixed' by the non-linear action of the detector. This causes a difference-signal to be produced of a frequency equal to the difference between the vision and sound carriers. This, then, is at 6Mc/s, and it is called the intercarrier sound signal. Since the sound is f.m. and the vision a.m., no modulation interaction occurs between the two signals, and the inter-carrier signal

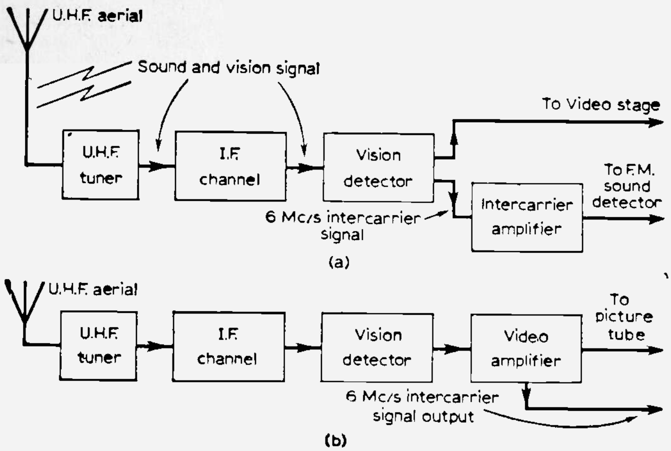


Fig. 29—The three conditions of interlace: (a) perfect: (b) line pairing: and (c) poor interlacing.

Fig. 28—Block schematic diagrams of intercarrier television receivers.

Fig. 30—Fitting an isolating transformer to cure heather/cathode leak trouble.

effectively carries the sound modulation at f.m. The vision modulation fails to influence the f.m. detector and, in any case, the a.m. is suppressed by amplitude limiting in the intercarrier channel.

Sometimes the intercarrier signal is allowed to pass through the video amplifier thus increasing its amplitude above that at the output of the detector. The two conditions are shown at (a) and (b) in Fig. 28. When (b) is used less intercarrier amplification is required than when (a) is used. The 6Mc/s intercarrier sound signal is filtered out of vision the detector or video amplifier and then channelled to a 6Mc/s amplifier, the output of which feeds the f.m. sound detector.

Interference

This is the term used to describe any form of disburbance to the picture or sound. Vision interference is either *impulsive* or *radio-frequency* (r.f.), the manifestations being white spots (grey on 625 lines) or patterns respectively. Impulsive interference results from sparking equipment, like the sparking at the brushes of an electric motor, at the contacts of a switch, in the ignition system of a motor car and so forth. R.F. interference is the direct result of a radio signal falling within the main or spurious passband of the receiver.

On sound impulsive interference causes mainly crackles from the speaker while r.f. interference causes whistles due to the beat-frequency between the sound carrier and the interfering r.f. signal.

Interlaced Scan

All broadcasting television systems use interlaced scanning. This means that a complete picture is composed of two fields (or frames) each one containing exactly half the number of lines making up a complete picture. The two fields are then arranged to appear on the screen so that the lines of one field are interlaced between the lines of the partnering field.

On the 405-line British system, for example, one complete picture is formed on the screen each one-twenty-fifth of a second. This means that each field takes one-fiftieth of a second to form, each one being composed of 202½ lines. The same field frequency is adopted on the British 625-line standard, but here, of course, there are 312½ lines to each field. The 50c/s field frequency is employed because it matches the mains supply frequency and under certain conditions it is possible to lock the field frequency at the transmitter to the mains supply frequency, giving so-called 'synchronous operation'. If the field is not locked to the mains frequency hum in the receiver can cause a ripple to run upwards or downwards on the picture (see under "Asynchronous", in Part I).

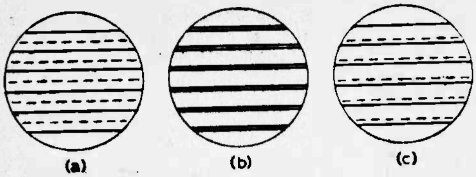
On one field the odd-numbered lines are traced out on the screen, the subsequent field then produces the even-numbered lines which are traced out between the lines of the 'odd' field. Good interlacing demands that the field timebase generator in the set is accurately synchronised to the field sync pulses, for these contain timing information as to odd and even fields.

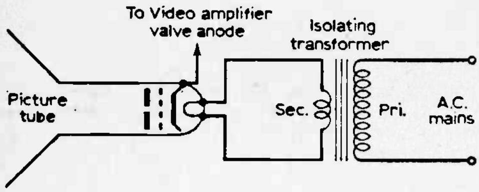
If the field synchronising is disturbed even by a small amount the interlacing can suffer badly, in extreme cases the lines of the odd and even fields overlapping each other, thereby destroying 50% of the picture information. In receivers where the interlacing is not quite correct, the lines of one field may not fall right in the centre of the space between the lines of the partnering field. This, however, is by no means as bad as 'line pairing'. The three conditions, perfect interlace, line pairing (i.e., no interlace at all) and below optimum interlace are shown respectively at (a), (b) and (c) in Fig. 29.

It is difficult to discern the condition of interlacing by looking at the whole screen. The best way to make the examination is to concentrate attention to one small portion of the screen by looking through a tube of about 2in. diameter. A small magnifying glass also helps.

Chief causes of poor or really bad interlace are (i) leakage of pulse signal from the line output stage into the field timebase circuits, as can happen due to incorrect fitting of shields round the line output stage and e.h.t. section subsequent to a servicing operation, (ii) faulty timebase valve, (iii) faulty diode in the interlace filter section (between the sync separator and the field generator sync input) and (iv) faulty field blocking oscillator transformer.

It is also necessary carefully to adjust the vertical hold control on some models for the best interlace performance as well as for the best lock. An interlace control is sometimes featured.





Ion-Trap

The ion-trap was evolved to deflect the relatively heavy ions, contributing to the electron beam in a picture tube, away from the fluorescent screen, while letting the useful electrons head unhindered towards the screen. The former contribute very little to the screen illumination, but their larger-than-electron mass soon ruins the screen, causing a dark patch to appear near the centre.

A special gun assembly is adopted in tubes featuring an ion-trap. It is set at an angle to the beam axis so that the beam would strike a plate unless deflected away to emerge from the end aperture of the gun. An external neck magnet is used for this deflection, the effect being that its field pulls the electrons of the beam back on course, but has very much less influence on the heavier ions, which are thus caused to hit the plate.

The magnet on the tube neck is called the *ion-trap magnet*, and this must be adjusted very carefully to line up the electron beam in the gun. Adjustment must always be for maximum screen brightness. Not to eliminate corner shadowing or for picture shift. The magnet can be rotated round and pushed along the tube neck to obtain optimum position.

Modern tubes rely less on the ion-trap technique, and instead use a system of aluminising over the inside of the fluorescent screen. This not only avoids the ions from damaging the fluorescent material but it also results in a brighter picture by reflecting some of the light forward, from the front of the screen (see under "Aluminised", in Part I).

Isolating Transformer

This kind of transformer has two separate windings, the primary across which the input is applied and the secondary from across which the output is taken. The term 'isolating' implies that the insulation between the primary and secondary windings is adequate for the application to which the transformer is subjected.

For example, a mains isolating transformer is sometimes used to isolate an a.c./d.c. type of set from the mains supply so that external signals, for recording, hi-fi amplification, etc., may be fed from it without the danger of external circuits and equipment becoming 'live' with respect to earth. The inter-winding insulation of such a transformer would have to withstand the full mains voltage, and this is usually given a safety margin.

Fig. 30 shows a different application for an isolating transformer. Here the transformer is set up to energise the heater of the picture tube. The tube heater is normally energised by being series-connected in the heater chain, as is well known. However, should a heater/cathode leak or short-circuit occur in the tube, a further lease of life can often be given to it by the use of a transformer connected as shown.

The ratio of a mains isolating transformer would, of course, be 1:1, since the output voltage required would be the same as the mains input voltage. It should also be rated to cater for the full power (in watts) load of the equipment, about 150 watts for an average television set.

The ratio of a picture tube isolating transformer would be such that the primary is rated to suit the mains voltage and the secondary wound to deliver the full tube heater voltage (usually 6·3v) at the required current. Moreover, the tube isolating transformer needs to have a very low capacitance between the windings and from the secondary to core to avoid the video frequencies at the tube cathode (now also at the heater due to the heater/cathode short) from being bypassed, an effect that can severely impair the picture definition.

It is usual practice to connect the primary winding to the set side of the main on/off switch, so that when the set is switched off, the tube heater is switched off too.

Sometimes the secondary is wound to provide a heater voltage boost, up to about 20%, the idea being to enhance the emission of a worn tube. Sometimes it works and a brighter picture is obtained (assuming of course, a low-emission tube), while at other times the heater quickly burns out.

Lecher Wires

This curious term in television parlance refers to the use of a length of wire within a trough or cylinder instead of the more conventional tuned circuits that are familiar with the reader. 'Trough-line' or 'tuned wire' or 'tuned line' are other meanings for the same thing.

Lecher wires are akin to half-wave dipoles, or cable stubs where at resonance the current is at maximum in the middle and the voltage at maximum at each end. The physical lengths are considerably reduced, however, by the artifice of cutting down the length at each end and then adding suitable values of capacitance in compensation.

Actually, the tuned lines used in u.h.f. valve tuners are loaded at one end by the valve electrode and circuit capacitances and at the other by a variable capacitor. The effect of changing the loading capacitance alters the tuned or resonant frequency of the wire, and thus gives a tuning range which covers the u.h.f. bands.

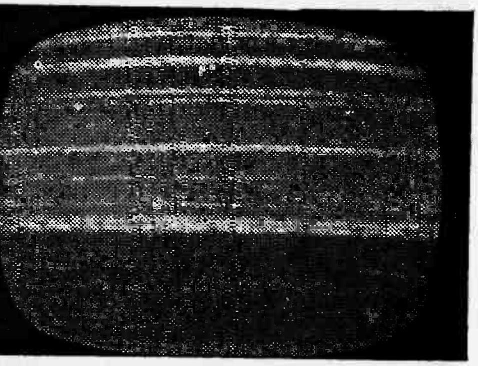
Many transistor u.h.f. tuners and amplifiers adopt so-called 'quarter-wave lines'. These, of course, are shorter than their half-wave counterparts and need to be loaded only at one end with capacitance (which is usually the transistor capacitance and that provided by the circuit and by the tuning capacitor), the other end being affectively 'earthed'.

Part VII follows next month

INTERFERENCE TESTING...

BY GORDON J. KING

1



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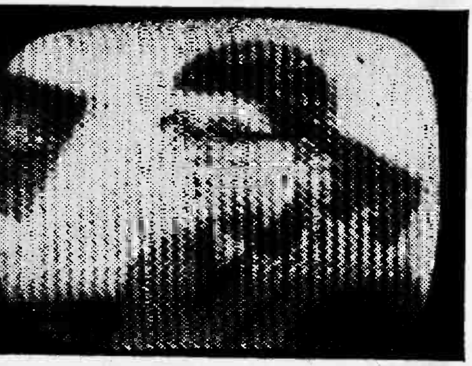

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A TELEVISION receiver is often equally as sensitive to spurious, unwanted signals—if they are allowed to get in—as it is to the wanted signals which make up the picture and produce the sound. This is due to the fact that unwanted signals have the same fundamental character as the wanted signals, making it virtually impossible for the set, once the signals arrive at the detector, to discriminate one from the other.

Over the years, circuit designers have evolved various methods to suppress unwanted signals; but when this is done a part of the wanted signal is generally impaired and the picture or sound quality suffers as a consequence. Typical in this respect, is the vision interference limiter which, if turned too far on to suppress the white spots of electrical interference (see Fig. 1) reduces the brightness of the peak white parts of the picture and lowers the general black-to-white ratio. Similarly, too much interference suppression on sound clips the high treble frequencies.

SET FILTERS

It is possible to filter out some of the unwanted signals without causing too much damage to the wanted signals, especially if they fall outside the full sideband spread of the wanted transmission. Filters to do just this are built into receivers and they constitute the various tuned rejectors in the aerial and i.f. stages. Their design is such that when adjusted correctly they let only the wanted signals pass to the detector and greatly attenuate the unwanted signals.

A filter of this kind is the adjacent channel rejector in the vision i.f. channel. This is arranged in circuit so that it either open-circuits or bypasses the carrier of the adjacent channel which, if permitted to pass to the detector, would cause a 1·5Mc/s pattern to appear across the picture similar to, though probably less severe than, the pattern shown in Fig. 2.

Another internal filter is the sound rejector in the vision strip which absorbs any sound signals that find their way into the vision channel and avoids the picture jumping in sympathy with the sound modulation.

INTERCARRIER BUZZ

On dual-standard sets switched to 625 lines, the effect is called "intercarrier buzz" and, again, can result from bad alignment of the vision i.f. stage and filter circuits. Poor balance of the f.m. sound detector and overloading due to a very strong aerial signal are other causes of the trouble. Many sets have an f.m. detector balancing adjustment which should be checked if intercarrier buzz is particularly bad and all else seems normal. Unfortunately, the compromise set design brought about by the British dual-standard requirements is an aggravating factor, about which little can be done by the viewer.

So much, then, for internal rejection to suit the normal signals fed to a receiver. But what about real, interfering signals which arrive at a set? Much depends on the nature of the interference. Take, for example, electrical interference, shown in Fig. 1. This is the kind of effect that an unsuppressed electric motor can have on the picture. On sound this kind of interference comes through as a constant cracking buzz.

CAUSES AND TIPS ON HOW TO OVERCOME EXTERNAL AND INTERNAL PROBLEMS

SIGNAL-TO-INTERFERENCE RATIO

For the interfering signal not to disturb the picture or sound, the wanted signal must be at least 200 times (46dB) as strong: This is the voltage signal-to-interference ratio. The interference in Fig. 1 is shown on a screen minus programme signal and could well represent a signal level of 10μV. This means, then, that if the set were receiving a programme signal 200 times as strong (2mV), the interference would be pushed right into the background and barely seen or, indeed, heard on sound.

To overcome interference, we must either reduce the strength of the interfering signal or increase the strength of the programme signal to obtain a good signal/interference ratio. Modern electrical equipment has to be suppressed by law. Unfortunately, this does not mean that the equipment is sufficiently suppressed to be free from interference radiation. This is virtually impossible due to economic considerations.

There are still many areas, however, where equipment suppressed to the minimum requirements by law still produces bad television interference. This often happens in towns and in screened areas where the wanted programme signals are relatively weak. The only solution to the problem here, then, is to increase the strength of wanted signal fed to the set. This often means using a fairly high gain (multi-element) aerial mounted as high as possible so as to be above the zone of maximum interference field intensity. Set-top and indoor aerials are hopeless under conditions of high local interference, even though the transmitter may not be many miles away.

FLUORESCENT LIGHT INTERFERENCE

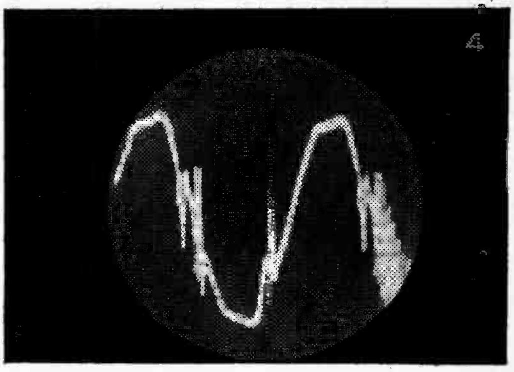
Another form of domestic interference which is now becoming widespread is shown in Fig. 3. This results from fluorescent lighting, and can be really troublesome over a distance of two or three houses if the aerial system is indoors or of poor quality.

Again, we get the characteristic horizontal bands of interference which imply that the interference is related to the mains supply frequency. The waveform in Fig. 4 gives some idea of the magnitude of fluorescent interference. This was obtained by winding a coupling of turns of wire round a fluorescent tube and connecting the other end to the Y-input of an oscilloscope with the timebase running at 25c/s. Almost two 50c/s waveforms are displayed, but the interference is caused not so much by this fundamental waveform as by the odd oscillations occurring on it. These are strongly transient and contain frequencies extending into the television spectrum.

The interference tends to worsen as the fluorescent tube ages, and oscillograms sometimes show distinct bursts of r.f. energy. Suppression components are fitted to these lights, but the minimum suppression provided is not always good enough if the wanted aerial signal is weak or if an indoor aerial (even attic type) is used.

SIMPLE SUPPRESSION

The suppression can be improved in many cases by fitting a pair of 2A v.h.f. chokes (the type used for electric motor suppression), one in series with



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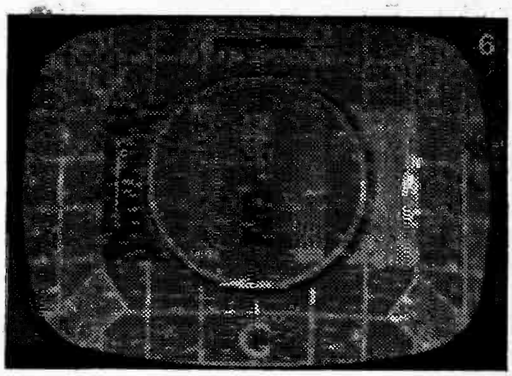

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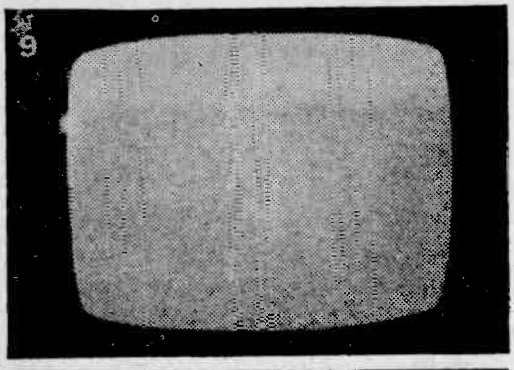


the main lead each side of the fluorescent tube. The chokes should be installed to a high electrical standard and located as close as possible to the tube ends.

At this stage it should be mentioned that any sparking electrical device will cause television interference. Thermostats, switches, sliding contacts and so forth are thus likely interference sources. The simple v.h.f. choke in series with the circuits can also help in these cases.

Electrical interference can also be generated by the set itself due to a fault. Fig. 6, for example, shows what an e.h.t. discharge looks like on a Test Card.

RANDOM DISPLAY

Since there is no synchronisation to the mains supply frequency or to the line timebase, the spots of interference appear randomly on the picture. Interference of this kind is also produced by d.c. motors, such as used in battery-powered toys, tape recorders, shavers and the like. It can also be caused by static discharges through the aerial and set when a thunderstorm is near.

When the interference arises from discharges in the a.c. (or pulse) side of the circuit. That is on the anode circuit of the e.h.t. rectifier or somewhere in the line output transformer, the effect is similar to that shown in Fig. 7. Note here that the interference takes the form of a vertical column of short, irregular horizontal lines towards one side of the screen—often the left-hand side, as shown.

The interference may also appear as a thin, vertical line down the picture, as shown in Fig. 8. This is B-K interferences caused by a faulty line output valve or booster diode (explained in the July, 1966 issue of PRACTICAL TELEVISION (Line Scan Distortion).

Another internally generated interference signal is that of *noise*. This shows on the raster or picture as grain or so-called "snow". Fig 9 shows a grain-laden raster. This was obtained by switching a dual-standard set to a u.h.f. channel on which there was no transmission. This grain effect is usually caused by *noise signals* generated by the u.h.f. tuner. V.H.F. tuners and early stages also generate noise, but a strength is usually considerably lower below that of the noise produced by u.h.f. tuners.

The noise signals result from the random movement of electrons through components and conductors, in valves and transistors, and the greater the gain or sensitivity of the early stages, the greater the noise effect. The frequency also has a bearing on noise, it being greater with frequency increase, which is why u.h.f. tuners generally produces more noise than v.h.f. ones.

SIGNAL/NOISE RATIO

Noise can be expressed as an equivalent noise signal at the input since there are two signals, the wanted programme signal and the noise signal. As with interference, the wanted signal should be at least 200 times (46dB) stronger than the interference. However, unlike interference, it is not generally possible to reduce the noise signal below the level dictated by the design of the equipment. We cannot "suppress" noise as we can interference.

This means that excessive noise can only be cleared by increasing the strength of the wanted signal, and this applies especially on the u.h.f. channels, making it necessary to use good, high-gain, lofty aerials for noise-free reception.

At this stage a word or two about aerials and preamplifiers would not go amiss. The signal/interference ratio cannot be improved by the use of such an amplifier, because both the wanted signal and the interference are amplified by the amplifier. However, a good, low-noise transistor v.h.f. or u.h.f. amplifier can improve the signal/noise ratio under certain conditions. This is generally the case when a valve tuner is used, for the lower equivalent noise figure of the transistor aerial amplifier improves the total signal/noise ratio. The amplifier may be located either close to the set or at the top of the aerial mast. The latter may show a small advantage over the former at u.h.f., but often not sufficient to warrant the complications of mast-mounting and power feeding.

R.F. INTERFERENCE

Another troublesome interference is that of "patterning". This can be caused by trouble in the set or by an external r.f. signal getting into the set from the aerial. Typical r.f. interference is given in Fig. 2, but if the r.f. signal is modulated at mains supply frequency it may take the form as shown in Fig. 10.

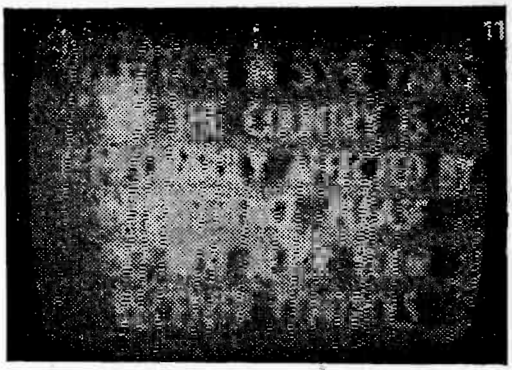
These days, such interference falls within the passband of the set, and interference of the magnitude shown in Figs. 2 and 10 would be a case in which the Post Office Interference Investigation Department would be most interested. The solution to this sort of interference lies generally in locating the source and preventing the radiation, there being little that can be done at the set end to cure it altogether.

CO-CHANNEL INTERFERENCE

Figs. 11, 12, 13 and 14 show various forms of co-channel interference. This is undoubtedly one of the major v.h.f. interference troubles of today. It arises from shared channel working, but the sharing is so arranged that maximum possible distance exists between stations of the same channel number and under normal conditions of reception the distance of the shared channel station is so far removed from the local station with the same channel number that interference is not experienced. Moreover, the plane of polarisation of the signal often differs between shared stations, further increasing mutual discrimination between them.

However, under abnormal conditions of reception v.h.f. signals are often propagated over far greater distances than is usual. This means that distant station signals are received by sets tuned to a local channel number which is shared by the distant station. The effect occurs mostly on Band I channels, though it has been known to cause trouble on Band III channels.

A very severe condition on Channel 2 is shown in Fig. 11, with the BBC's caption of explanation. Fig. 12 shows interference from a European station and Fig. 13 interference even on a powerful local signal. Fig. 14 shows how reception can be really disturbed when the local signal is weak. Notice here the line tearing aggravated by the interference. ■



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C. Rafarel

LONG DISTANCE TV RECEPTION

PART THREE OF A SHORT SERIES OF ARTICLES DEALING WITH THE BASIC ASPECTS OF DX-TV RECEPTION

WE will now deal with the conversion of British 405-line TV sets for 625/819-line Continental picture reception. On 625-lines various Continental TV systems employ either positive-or negative-going signals for the image, so for full coverage a converted TV set should be able to deal with either method.

First a little advice on the choice of receivers for possible conversion. It is best to use a set with a tuner of the incremental type for Bands I/III, as opposed to the more usual turret type, since the use of the latter type will present certain difficulties in calibration of the various Continental TV channels which lie between the British "B" channels. Turrets will also have the inconvenience of needing continual adjustment to the slugs in the tuner oscillator coil for different stations.

The incremental type of tuner permits continuous tuning over the whole of Bands I/III, without any untuneable gaps. This type of tuner is fitted among others to the older types of TV set in the Bush range (i.e. TV53, 62, 63, and 66) and this range of receivers convert very effectively for Continental picture reception, and would be my first choice for beginners.

Sound Channel reception will not be possible with the simple conversions described below, but once the excitement of DX pictures has been experienced it will be more than enough to encourage beginners in further efforts in the more complicated techniques required for reception of the sound channel, which can be either a.m. or f.m., at various sound-to-vision frequency spacing.

Most of Europe employs 625-line negative transmission as opposed to the BBC/ITA 405-line positive system in Bands I/III. We must therefore rearrange our video detector diode so that it can deal with a negative-going signal instead of a positive one, i.e. the detector has to be inverted (coupled in the reverse direction). If we want positive-going images as well (as for BBC/ITA, French and Belgian TV) we must make this reversal of the diode detector switchable so that we can choose either system.

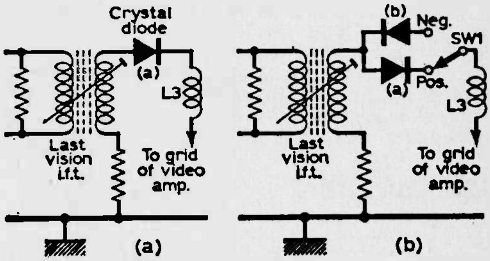


Fig. 2—Switchable diode detector (diodes).

Most British 405-line sets employ either the circuit shown in Fig. 1 with an EB91 valve, or that in Fig. 2 with a crystal diode. These are the basic circuits, and some slight variations will be found in different makes of set.

These two circuits do not cover all British 405-line sets for there are many variations, as for example, in the filter choke circuits L1, L2, and L3, and in various resistor and capacitor values.

After reference to the service sheet of your own receiver you should be able to carry out the modifications on the lines shown, but if you have any difficulty in applying the modifications to your own case, send the service sheet or circuit of your set to the author c/o "PRACTICAL TELEVISION", on loan for further advice.

This is not quite the whole story for effective DX reception. Further modifications are needed in respect of the amount of bias on the video amplifier valve when handling negative-going images, the line speed control and the picture width particularly on the French 819 line system). Details of the further modifications will be given next month.

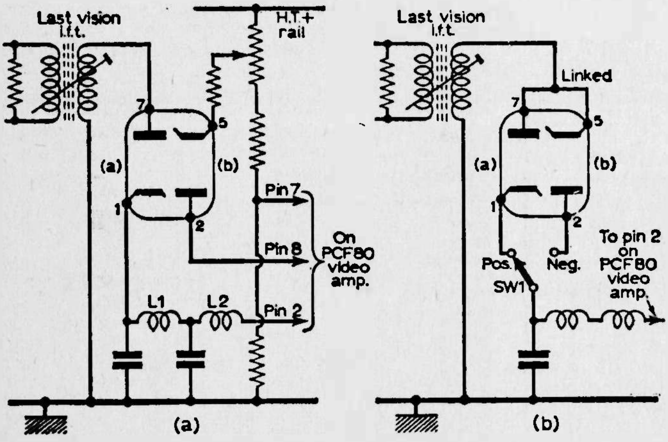


Fig. 1—Switchable diode detector (valves).

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

NEW SERIES

PART 4. Sync Separators

PREVIOUS articles in this series have included references to synchronising faults, and it has been stressed that poor locking or triggering of the line and field timebases may have causes quite remote from the synchronising separator stage itself.

There has recently been some attention given to the video stages of valve and transistor receivers, when the point was raised again and again that a "clean" signal is vital to preserve the sync pulses.

In this article we shall concentrate on the sync separator stage itself But first, a few words about what the stage does, why it is necessary and how certain faults can affect its performance.

BASIC FUNCTION

The fundamental task of this stage is to split the picture signal from the keying pulses, then separate the latter into a shape and magnitude suitable to trigger the timebases. The triggering of the receiver circuits has to be exactly in step with the timebases of the camera at the transmitting end.

A waveform is transmitted with the polarity of the sync pulses opposite to that of the video signal which gives the picture information. With reference to a given level of the overall waveform, the video information may be "positive-going" while the synchronising information is "negative-going". This is the case with the 405-line system used for Bands I and III transmissions in this country.

Change-over to the 625-line system, used for BBC-2, involves, among other things, a change of this polarity, so that the video is negative-going and the sync positive-going. Although this may seem a minor factor, simply involving a reversal of detecting methods, there is one significant difference that must be considered: the sync pulses are now transmitted at maximum transmitter power.

This affects the coupling from the video amplifier to the sync separator, the method of triggering the timebases, and the way in which a reference voltage for a.g.c. purposes can be derived.

In the original article on sync separator troubles in the *Stock Faults* series (Part 5, PRACTICAL TELEVISION, September, 1964), nearly half the available space had to be given to an explanation of the principles of sync separation. Rather than repeat this information, Figs. 13 and 14 can be used to summarise such basic facts as we need. The skeleton circuit is typical of the common saturated pentode sync separator used widely by most manufacturers.

TYPICAL CIRCUIT

From the anode of the video amplifier, V1, the composite signal (lower part of Fig. 14a), is applied via R1, C1 to the grid of the sync separator V2. The polarity of this signal (inverted by the video amplifier) makes the sync portion of the waveform positive-going, as shown in Fig. 14. This causes a grid current to flow in V2 and produces a negative bias across R2.

The amount of the bias depends on the d.c. component of the signal; R5 is used to take off this control voltage for the a.g.c. circuits. Although the d.c. component of the signal appears to be lost, being blocked by C1, it is actually restored by the rectifying action of the grid-cathode circuit of V2, and R2 becomes the load resistor of this diode.

The bias, dependent on signal strength, is arranged so that only the sync pulses cause anode current to flow. Fig. 14a shows the slope of the valve characteristic and the pulses of anode current thus produced.

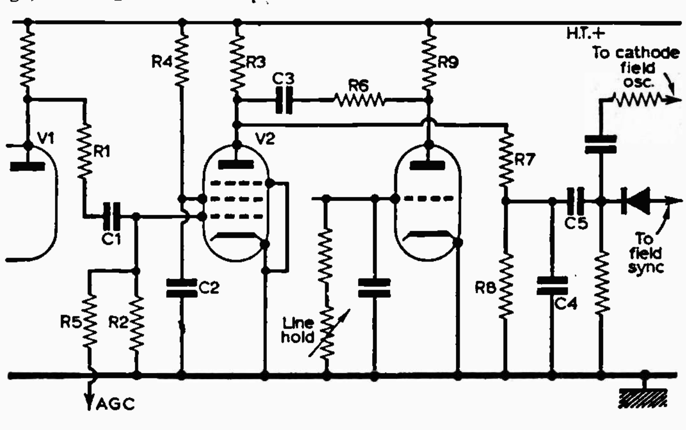


Fig. 13—Skeleton circuit of typica synchronising separator stage.

SHORT GRID BASE

A high value of R4 ensures a low screen grid voltage, making the valve operate with a short grid base, giving a sharp cut-off as shown. Screen grid voltages of sync separators may be as low as 35 volts, and are usually quite critical. For this reason, we must check the operating conditions if there is evidence of picture content interfering with the sync pulses.

An oscilloscope quickly reveals this sort of fault as a roughness on the tops of the sync pulses. The leading edge of the sync pulse must be sharp and "clean", hence our insistence that the signal from the video amplifier is unimpaired. It is a waste of time chasing around the sync and timebase circuits if the waveform has been distorted in or before the video amplifier.

There is another vital component that can affect these conditions—the coupling capacitor, C1. From Fig. 14a we can see that the grid of V2 is at zero potential during the sync pulse, giving a pulse of anode current (and thus producing a negative-going anode voltage because the drop across R3 increases). But the bias charge across C1 cuts off the valve between the pulses.

Hence, this component must withstand both the d.c. which is practically full h.t. and the full swing of signal peaks, which can result in a very high instantaneous potential. The rating of coupling capacitors should be high enough to allow for peaks, thus, be careful with replacements.

TIME CONSTANT

The exact choice of R1, C1 is determined by other factors, such as noise clipping and the preservation of clean front and back porches of the waveform (the short period between signal waveform and sync pulse leading and trailing edges, when the signal is at black level). Indiscriminate swopping of components in an attempt to cure a "touchy sync" fault is seen to be ill-judged.

From V2, the separated sync pulses are now fed to the timebases. There are many ways of doing this, and the simple skeleton circuit of Fig. 13 only gives an indication of the method. Here, the important factor is the difference in duration of the line and field pulses.

Whereas the field pulses, of 40μS duration, have little effect on the differentiator circuits of the line synchronising section, it is important that the 9μS pulses that trigger off the line circuits do not affect the field synchronisation.

Field pulses occur each 1/50th of a second and are integrated during the field sync period to form one larger pulse. From the anode of V2, an attenuator consisting of R7, R8 reduces the pulses to a low level and C4 charges until the voltage across it reaches the required level to trigger off the field oscillator. This means that a series of consecutive small charges are applied, and the line pulses which come at half line intervals during the field pulse period, would contribute to this charging effect unless they were filtered out.

To do this, D1 comes into action. Its rectifying action limits the output so that the line pulses, producing an output above the limiter setting, have no effect on the charge across C4. The d.c. component is blocked off by C5.

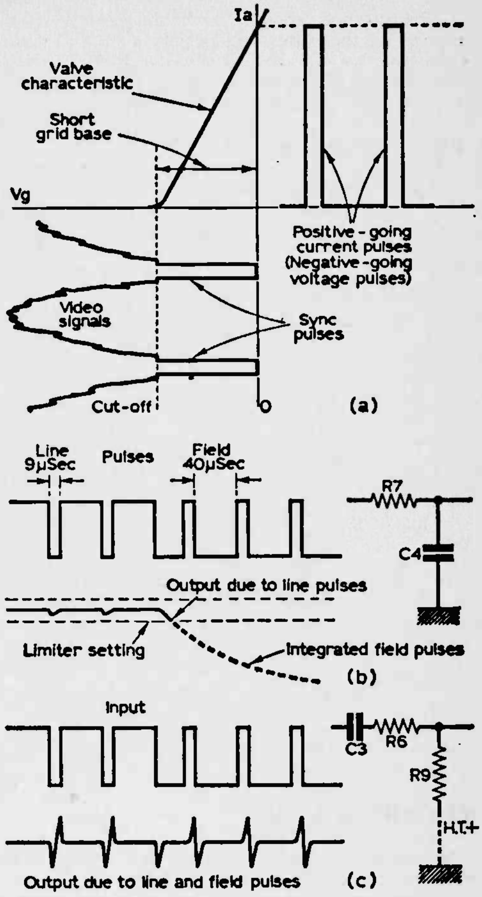


Fig. 14—What happens to the waveforms. (a) the composite signal is applied to a short grid base stage so that sync pulses cause conduction while video information cuts the valve off (positive-going sync negative-going video). (b) longer field pulses are integrated to form one larger pulse and limiter setting renders smaller line pulses ineffective. (c) passing the total sync signal through a differentiating circuit produces short steep pulses at leading and trailing edges.

RANDOM TRIGGERING

From this, we can see that the field sync diode needs to be good, to prevent random triggering, and the blocking capacitor must not be leaky, or a false lock could occur because of wrong operating conditions. A change in integrator values is not so likely, but the charge capacitor must not be overlooked as a possible cause of "no field sync".

As stated, the field pulses have little effect on line sync, and, in fact, the whole of the sync signal is fed to the line differentiator circuit, with the leading and trailing edges of all sync pulses producing steep pulses as shown in Fig. 14c. The pulses arriving at half-line intervals during the field period are so far out of time with the line synchronisation that they have no effect.

The method shown, with pulses fed from V2 anode to the line oscillator via a differentiator consisting of C3 and R9 (with R6 acting as an isolating resistor to prevent over-coupling), is used by several designers.

REVERSE POLARITY

We have already noted (and at present must take this statement for granted) that the sync signal is virtually the same for both 405 and 625-line systems, except that the polarity is reversed.

System switching takes care of this, but the grid potential of the sync separator is not suitable for mean-level a.g.c. as used in many 405-line-only sets, and a method of augmenting the a.g.c. during 625-line operation has to be found.

Although this is a subject for another article, it must be noted here that the clamping and delay circuits of the a.g.c. line, altered by system switching, can affect the sync separator by the shunting impedance at the grid, when a fault occurs.

This should not be overlooked, and the possibility of poor a.g.c. decoupling affecting the sync by setting up a kind of "feedback loop" may give obscure symptoms. Similarly, the coupling to the sync separator may be altered by the system switching This is partly to maintain constant levels, and partly to eliminate interference, which has a greater effect on the maximum amplitude sync pulses during 625-line operation.

It is perhaps fortunate that the system is used at higher carrier frequencies, in the u.h.f. band, where this kind of impulsive interference is less likely to be picked up.

FLYWHEEL SYNC

However, negative modulation, on 625-lines, means that flywheel sync for the line circuits is practically imperative. We have already looked at some line sync circuits, and now it is worth considering the front end of these, the sync coupling.

Flywheel sync circuits may not seem quite the same as those we may have met on earlier receivers. Some of them, notably the S.T.C. technique, appear very simple, consisting of little more than a couple of diodes and a few components, none of them being particularly critical.

As this type is used by K-B, R.G.D. and Regentone, in some early Pye and Ekco models, and with variations by Ferguson, H.M.V., Ultra and some GEC-Sobell sets, plus an upside-down version by Alba, such simplicity may be fortunate.

Certainly, from experience, the author would say that the most frequent trouble with these is the discriminator, and changing the pair of diodes very often effects a cure.

BASIC CIRCUIT

The basic circuit of this type is given at Fig. 15, where V1 is the line oscillator, D1, D2 the discriminator diodes, and typical component values may be as shown. Negative-going sync pulses from the sync separator are fed to the cathodes of the discriminator and a sawtooth waveform from the line oscillator output is coupled back via the 3,000pF capacitor to the anode of D1, which is connected via the flywheel long time-constant circuit to the grid of V1. The 150pF capacitor serves to couple this waveform at half strength to the junction point.

Negative sync pulses cause the diodes to conduct equally and when the sync pulses are correct; i.e., in the middle of the flyback, the control voltage is zero.

When the timebase runs slow, the flyback is late, sync pulses occur when D1 conducts and D2 is "off" and a negative voltage is applied to the grid of the oscillator.

When the timebase is fast, sync pulses arrive with D2 conducting and D1 "off" and a positive voltage slows down the oscillator. This is a considerably simplified explanation which omits the details of discriminator action, but which serves to point out the possible weak spots; i.e., the diodes themselves, upon whom the balanced action depends, and the time constant components which determine both the lock-in range and the pull-in range of flywheel circuits.

BUSH-MURPHY CIRCUIT

A more complicated circuit which needs some attention to the pull-in range occasionally is the Bush-Murphy flywheel-sync circuit. The sync is again fed to the coupled cathodes of the diode pair, but equal and opposite sawtooth waveforms from the line output transformer are applied to the anodes.

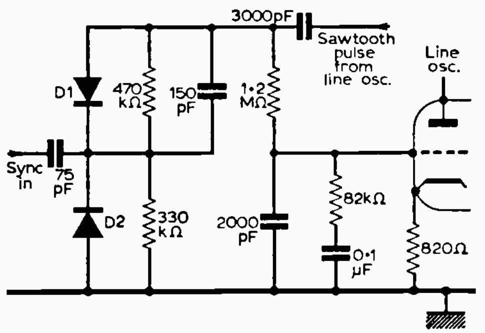


Fig. 15—Basic STC discriminator circuit used in many different models.

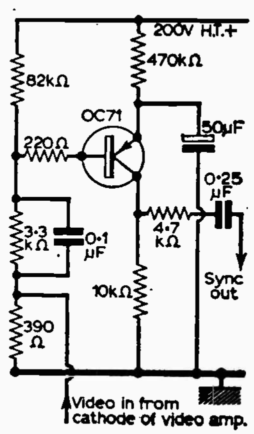


Fig. 16—Pye introduced a transistor sync separator stage as early as 1961 in their V700 and V830 models.

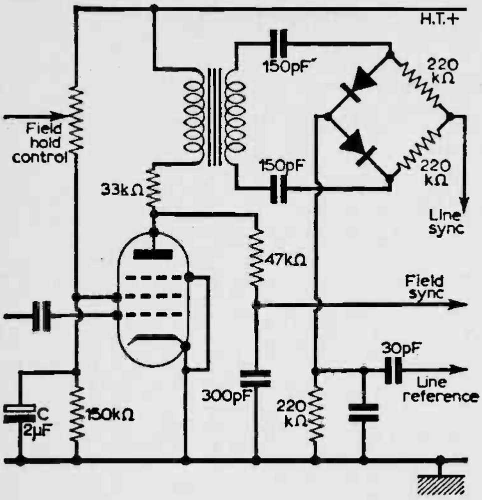


Fig. 17—Sync separator stage of Ekco T344F, using a 6F23 pentode.

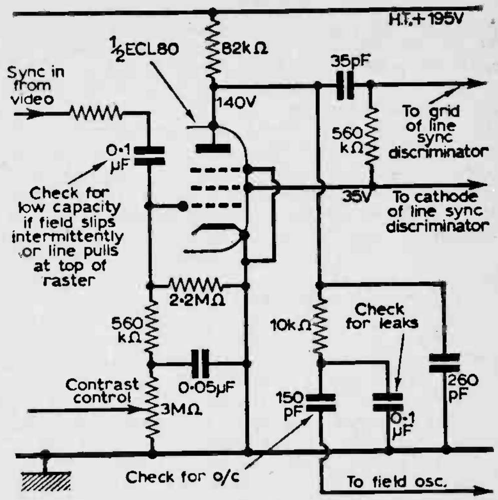


Fig. 18—Unusual regulation method for G2 voltage employed by Decca in the DM35 range.

The voltages are arranged so that a seesaw change is apparent at the junction, with the saw-tooth waveforms equal only twice during a cycle, at the middle of the forward stroke and again at the middle of the flyback.

When the sync pulse arrives, the voltage across a 2MΩ output load is equal and opposite at the ends and zero at the centre tap. But the centre tap is made variable, and applied to the grid of the triode line oscillator, giving some adjustment to the pull-in range to allow for variation in component tolerance spread.

The trouble is that slight off-setting temporarily cures faults in the coupling circuit, and by the time the control is hard over at one end and still failing to lock, we have a difficult problem to unravel, unless we remember to recentre the preset and *then* go about our fault-finding. A small point, but it has caught many a good mechanic.

As a footnote to this—some late circuits use tapped fixed resistors instead of a preset. Check that these balance within their tolerance before looking deeper.

COMMON CAUSES

All of this discussion has been general—but sync separator faults are as different as the individual circuits, at first sight, until we realise that the reasons for poor sync boil down to a few common failures, and the ensuing examples may make this clear.

Fig. 17 looks a straightforward kind of s/sep circuit, with a saturated pentode feeding a line flywheel oscillator via a coupling transformer and a diode bridge and the field oscillator via a simple integrator.

But a closer look reveals that the all-important screen-grid voltage is maintained at low level by a potentiometer circuit, of which the top arm is actually the field hold control, and the bottom half a heavily decoupled fixed resistor.

Where a carbon-track potentiometer is in a series-fed circuit, carrying h.t. current, there is a possible risk of a "hot-spot" at the slider, and also at the end rivets that secure the contacts to the track. Effectively, the resistor goes "high". This can also happen with some kinds of wire-wound pot.

In this instance, the screen-grid volts reduce from their nominal 25 and sync is impaired. Line sync troubles in this circuit sometimes originate with a high resistance joint on the primary side of the coupling transformer, and sometimes with a poor chassis return on the mounting of this item.

The decoupling capacitor C is another possible cause of trouble which should not be overlooked. In many cases, where the screen feed is a conventional series fixed resistor, a 0·1μF capacitor may be used, and a short-circuit at this point will cause the resistor to overheat.

SERIES RESISTOR

Replacing the resistor temporarily cures the fault, but if the screen voltage is lower than specified, suspect the capacitor of having developed a leak. A case in point is the Bush TV128, where the line sync is usually the first to be affected. As the screen voltage is already quite low—around 10 volts—the fault may not be obvious.

Another Bush model with voltage trouble is the TV78, whose anode resistor goes high, usually impairing field sync first. On the TV135 the h.t. rectifier is a likely suspect when the sync begins to get touchy.

Another culprit is the Murphy 410, and other similar models, where field sync is affected by the 180kΩ screen feed resistor going "high". And on another older model, the Ferguson 506T, a separate sync separator is used for field scan and when the 220kΩ series resistor in the integrator circuit goes high, field sync goes haywire.

Still on the subject of screen voltage, a look at the Decca DM35 circuit (Fig. 18) reveals an unusual method of regulation. G2 is coupled to the cathode of the triode section of the line sync discriminator. There are several fault possibilities in this circuit, noted on the diagram, among which the 0·1μF sync coupling capacitor is perhaps the most prevalent.

Field sync troubles, however, can be caused by the potentiometers in the appropriate circuits, and have already received our attention.

Another old-timer, the Ultra V815, used to suffer a cogging effect when the sync coupling capacitor grew leaky, and as this was more evident on a stronger signal, the symptoms could be confusing.

LEAKY SYNC CAPACITORS

Some Philips circuits, notably the Stella ST5721, have an 18pF sync coupling capacitor, and a leak at this point tends to affect the line oscillator first. Everything really depends on the relationship between the sync waveforms and the oscillator input—hence our earlier remark that sync faults are as individual as the different circuits.

The GEC BT455 and 456 range use a pair of coupling capacitors, and the 0·047μF lower section may short-circuit, affecting the field while the line still locks. This can cause fruitless searches in the wrong stage.

In similar models, video conditions drastically affect field sync and the 100μF cathode bypass of the video amplifier is a prime suspect. The GEC BT448 was a case in point, and the Cossor 948 suffered from poor i.f. and a.g.c. decoupling which caused touchy sync. Changing the sync separator valve sometimes appeared successful, but the fault could recur.

A further example is the Pilot P60, where a cogwheel effect can be temporarily cured by substitution of the sync separator. The real cause of the trouble is usually in the cathode circuit of the video amplifier, where the 330Ω resistor has possibly risen in value.

The perplexing thing about this is that resolution appears unimpaired and the frequency gratings on the Test Card show up nicely—until one looks a little closer and realises that the high frequency component is supplied by ringing—and not exactly helped by the fault!

FAULTY SYNC COUPLING

As a general note, line sync is most likely to suffer when the sync coupling is incorrect. Intermittent tearing, especially at the top of the picture; i.e., during the field period, and the cogwheel effect, can result from these sync input troubles.

Similarly, where a separate field sync section is employed, touchy hold rather than complete loss may be due to the coupling. The Sobell T175 was prone to such trouble when the 3,000pF gate coupler went open-circuit, and the gate diode was another component which upset the field circuit when it changed characteristics, through ageing, overheating or damage.

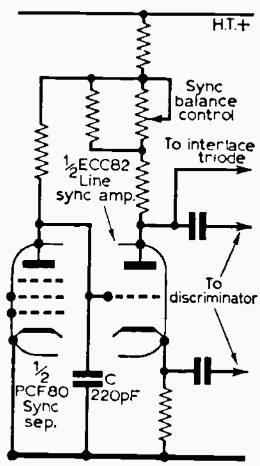


Fig. 19—Deceptively simple sync separator stage of Pye 17 and 21 groups of receivers with direct coupling from sync separator anode to line sync amplifier grid.

The Pye CTL58F suffered from poor line hold which looked at first like a flywheel sync fault but which usually turned out to be the 1,000pF sync coupling to the discriminator. And still on Pye circuits, Fig. 19 illustrates an odd method of coupling used in the 17 and 21 series of receivers.

The anode of the sync separator is directly coupled to the grid of the line sync amplifier. Decoupling capacitor (C in diagram) goes short-circuit or leaky and the sync is lost.

The problem is that any work on this circuit necessitates a complete setting up of the sync balance control. Space prevents a complete description, but this will be furnished if any reader should require the information.

To be continued

LETTERS TO THE EDITOR

ISSUES OF P.T.V.

SIR,—In the July issue a Mr. Brody from Stratford requires the April/October, 1965 issues of PRACTICAL TELEVISION. I can supply him from June to October, if any other readers can make up the remainder.—W. READ (17 Holderness House, Champion Hill, London, S.E.5).

VALVE INFORMATION

SIR,—On page 519 PRACTICAL TELEVISION August issue, two readers seek information on the following valves. I think that I can help. The first reader, Mr. P. Winterbottom: CV131—9D6, EF92, W77. CV140—6AL5, D77, EB91, DD6. CV4015—9D6 etc. C.R.T. VCR112—(CV1112) made for the R.A.F. Commercial equivalent is a V1026 (Ferranti or Mazda ?).

Second reader, Mr. F. R. Kew: VX3188's. This could be Tungsram frequency changer, if so, two valves of different bases can be had. B7 base or side contact CT8. Failing this, it could be Continental International Octal base which reads—50mA a.c./d.c. gas full wave rectifier.—W. RITCHIE (Glasgow).

THANK YOU LETTER

SIR,—In the August issue of PRACTICAL TELEVISION you were kind enough to publish a request for me for a copy of the September issue of P.TV. I received a copy from a reader the next day and subsequently received copies from six other readers. To all these readers I am very grateful, and as one good turn deserves another, I shall be glad to send my spare copies to any readers who need them.—R. C. J. WILKINS (Flat 1, 6 Medina Terrace, Hove 3. Sussex).

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

UNDER NEATH

THE DIPOLE

BEAUTY is but skin deep. At least, that's what they say. In this day and age, featherbedded against anxiety by a Welfare State, spurred on by pep pills and relaxed by reefers, the faces of teenagers of today should be free from wrinkles and fresh as daisies.

There should be no need for these lovely teenagers to look like the careworn middle-aged twentyites with sooty eyelashes, rings under the eyes, permanently pouting mouths and wobbly-nobbly knees. That's what they look like on many television plays, especially those from BBC, thanks to poor lighting, poor makeup, unattractive clothes and, worst of all, the adoption of ugly deportment and strange unnatural attitudes.

I'm sorry for these teenagers who so often speak as they dress—in a slovenly manner. However, these are the great days of the anti-heroines as well as the long haired, lean and scruffy kings of the coffee bar in television spectaculars.

The Sloane Square Effect

"Pseudo-withit" television directors, for instance, persuade ambitious young actresses to strike the off-beat poses seen in adverts in women's magazines. Bags under the eyes (normally adopted by Cabinet Ministers!) are extra embellishments created by the strong overhead television studio lighting, which cannot be avoided if long-shots are being picked up at the same time as close-ups. If some of the lamps were lowered down into the correct position for close-ups, the backs of the lamps would be revealed in the picture by the long-shot camera.

Experienced film studio lighting directors are able to take the wrinkles out of faces by diffused front lighting lamps (called 'bashers') usually fitted to the front of the cameras. Strong side lighting, wide angle close-ups, high level "kicker light" and multiple shadows break the rules of good portraiture.

Medals (With Bars) to BBC Engineers

The contribution to the favourable public image of the BBC has come largely from the engineering side. Every few weeks there is something new; some new technique, some new inventions and their harvest of patents. For instance, they have two entirely different computer equipments, which convert the live or taped television pictures from 625 to 405 lines (or vice versa) on 50 cycles or for conversion of either to 525 lines on 60 cycles (for American and Japanese TV market). More recently, there has been the new method of driving slow motion pictures (or freezing individual frames) by means of a magnetic disc which picks up the 4-track output from the individual quadrature magnetic heads of a VTR machine.

The Soccer World Cup was a wonderful opportunity to exhibit this latest BBC engineering gimmick for which they can add a bar to the row of medals they have continued to collect since the days of their first Chief Engineer, the late Captain P. P. Eckersley. It was "Eck" who laid the foundation for BBC's progressive engineering policy. But it was also "Eck" who condemned the first OB microphone sound mixer in the early days, at Savoy Hill, when he first saw a (then) elaborate 4-channel equipment embellished with various meters and attentuators for this and that, with associated switches and knobs. "Cut all that out!" he said to the youthful Iconos. "All the OB department needs is a switch marked ON and OFF!"

S-S-S-S-SH-SH! It can now be revealed that ICONOS was at Savoy Hill, privileged to work in the British Broadcasting *Company's* ranks under Captain Eckersley and also Captain H. J. Round, of Marconi's.

No medals for BBC Play Department

The Programme side of the BBC lacks the dedicated single-mindedness of the engineers. For me their programmes are sometimes very very good, but when they are bad, they are horrid! No wonder some of the directors and scriptwriters are crazy mixed-up kids with curls in the middle of their foreheads!

too many bbc television plays lack style polish story line shape continuity technical polish and punctuation smooth presentation is mutilated by producers directors cutters and editors in their aim to abolish the time scale conventions of television and film-making grammar flashbacks ends of sequences and other natural curtains which have been the traditional basis of theatrical play construction confuse viewers who cannot or will not turn mental somersaults at the behest of avant garde playwrights.

The above paragraph lacks punctuation. It is confusing like the non-continuity of the BBC play THE HORROR OF DARKNESS.

I will repeat the above paragraph this time with commas (quick fadeouts) semi-colons (wipes) inverted commas (process shots) and full stops (flash backs and long fadeouts). In other words, with punctuation which straightens out grammatical turbulence.

Too many BBC television plays lack style, polish, story line, shape, continuity, technical polish and punctuation. Smooth presentation is mutilated by producers, directors, *cutters and editors in their aim to abolish the time scale conventions of television and film-making grammar. Flashbacks, ends of sequences or other natural "curtains" which have been the traditional basis of theatrical play construction confuse viewers who cannot or* **will not,** *turn mental somersaults at the behest of avant garde playwrights.*

THE HORRORS OF DARKNESS by John Hopkins was a typical example of a BBC play, not so bad as some but bad enough to inspire a mass switch over to ITV during the 70 long minutes it was on the screen. It had an unpleasant theme, lacked story continuity or a time scale, and persisted in flashbacks. It flipped continuously and unnecessarily from close-up to close-up, was lit in much too low a key for TV sets, especially those receivers which have the usual Automatic Gain Control and are without the Mothersole circuit, which portrays light and dark scenes correctly, and is a black level correction. But I don't think it was the lighting man's fault. I noticed a credit for a video-tape editor. I can only suppose that he carried out his cutting in yoga fashion, standing on his head, with a blunt instrument to sever the recorded video-tape! There are certain canons of construction which good playwrights observe for theatre, films and TV plays. Cannons to the right of them! Cannons to the left of them! Someone has blundered! Was it the producer, James McTaggart or the director Tony Page who sent the wrong message in their disastrous despatch to viewers?

By the way, the "best buy" in TV sets selected by "Which" was one of the few models which incorporates a black level correction circuit, the winner being a Bush TV 135U.

I've Been Framed

They come in three main sizes: 15 second, 30 second and 60 second. They are brash and soothing; witty and silly; with actors or drawings; but always with "voice over", a term referring to commentaries, dubbed dialogue, Greek choruses or soliloquies. They are TV commercials — the source of revenue for all television programmes alternate to the licence-supported BBC.

Every young viewer knows his favourite ad. Production of these advertising filmlets has become an industry of its own, utilising studio space or exterior locations. Their brief flashes provide many actors with a steady income and have become a mainstay for the film technicians — director, cameraman, makeup man, art director *et al.*

The immense cost of some of these clips bears no relation to their length. Their success or failure is mainly in the scissors of the film editor. For a 15-second commercial, a film unit and perhaps a dozen actors and extras go on location 30 miles into the country—the 15-second script takes half a day to film and the editor laboriously assembles it, with captions, frame by frame, and eventually adds music, effects and commentary.

When viewing film through a moviola it is possible to differentiate between each frame, and there are 25 in a second on television. Editors are accustomed to jump cuts, but viewers are not; and a 15-second commercial can undersell the product if it leaves you confused and cross-eyed! A sequence which may seem smooth and acceptable to a film editor who has looked at it a dozen or more times on an editing machine. But to a viewer seeing the same clip on TV for the first time, it may be merely an irritant.

The best and the most satisfactory television commercials are those which follow the basic rules of correct timing of the cuts, which ought to be easy to both ears and eyes. There are not enough film editors who appreciate these techniques. Many a good idea for a commercial has been ruined in the film cutting room. On the other hand, many a poor idea has achieved success through its treatment by the film editor.

A considerable campaign is being waged by a chocolate company in the London tubes, by adding satirical sub-titles to early movie stills. No doubt, this idea has been modified for use in TV commercials by now, as there are millions of feet of film which is available *almost* gratis, from film libraries, compared with sending the usual huge film unit which is considered essential in this day of high productivity (!). One man to one job and hang the expenses!

Cut and Print!

A "stock shot" has nothing to do with farming—nor does the alternative phrase "library shot" indicate that a ·45 revolver has has been fired in the library! They both describe a piece of film, often only 3 or 4 feet long which is obtained from the TV company's own archives, or from the library vaults of IT News or film companies.

BBC have their own film storage vaults. All film libraries are immaculately documented, card indexed, described as to the "story" covered, ownership, whether negative print, magnetic sound or optical sound track available. Cross reference of the card index systems are broken down to divide for instance, "shipwrecks" into sinkings, rough seas, breeches buoy, ship fire, ship aground or on rocks, etc, etc. Obviously for films for the cinema or for TV, these 35 and 16mm films are valuable inserts for dramatic or documentary TV subjects. This may save not only time but the expense of sending a film unit to the Arctic to photograph Eskimo igloos or to an H-bomb test.

TV organisations all over the world have accumulated huge footages of all the national events together with many other filmed features for future use. To minimise the use of vault space, they store it mainly on 16mm film. Countless air, sea or land crashes of all types, panoramic views of New York, aircraft, tigers, earthquakes, Hongkong streets and police station "blue lamps" are as carefully indexed as the shipwrecks; all are available instantly for a TV play or quiz programme.

If a regional television company for instance, has no suitable stock shot available for the director, they are hired from film libraries at agreed prices per foot.

Iconos

'COGGING'

— PULLING ON WHITES —

by S. George

COGGING, or to give the defect its fuller title, "pulling on whites", is a most annoying fault and often difficult to pin-point.

The term cogging of course derives from its effect on the Test Card circle, which becomes transposed to a perfect cog-wheel.

Basically the fault is due to late starting of the line scan whenever there is a bright termination on the right hand side of the picture, and it is the series of black and white rectangles on the right hand edge of the Test Card, obligingly fitted by the BBC and ITA, that produces the cogging action, as inspection will reveal.

This delay in turn is caused by mis-shaping or virtual disappearance of the sync pulse front porch by mis-alignment, video stage or sync separator trouble.

This 2nd porch is to enable the line pulses to all uniformly commence from a common level, i.e. the black level so that perfectly regular timebase firing can occur.

When black or near black picture content precedes this porch, there is no difficulty in the video signal dropping to this point before the sync pulse, but when a high level bright signal is transmitted right at the end of the line scan, any delay in dropping to black level can delay the triggering of the line timebase resulting in the succeeding lines apparently being displaced to the left.

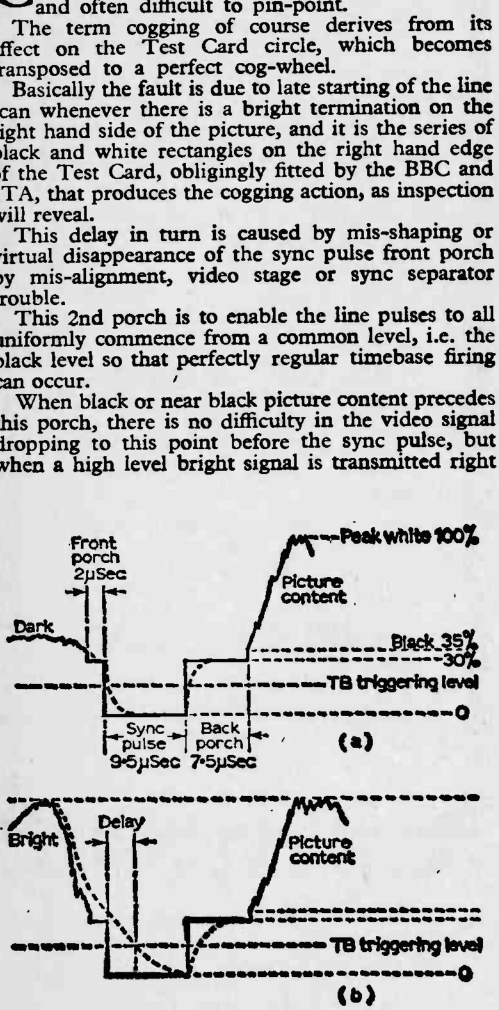


Fig. 1—(a) Detail of 405-line sync pulse transmitted, and waveform of typical "cogging" receiver when dark scene terminates line scan.

(b) Showing gross distortion of pulse and elimination of front porch when bright scene terminates line scan. Note difference on timebase triggering points.

Misalignment

As stated, misalignment or a video or sync separator fault can introduce this delay. However, when investigating faults of this nature a video stage with restricted high frequency response can produce almost the same visual effect as misalignment and it is often extremely difficult to be sure which is the root cause.

The guiding rules to eliminate the latter must be, freedom from sound-on-vision, freedom from vision-on-sound, ample volume, non-critical fine tuner setting, and good Band I/III balance.

If the defect suddenly appeared, it is highly unlikely that alignment is at fault, although some of the latest dual-standard receivers are very critical on front-end adjustment. This is particularly to be watched for on push-button and pre-tuned models where the viewer has no direct means of simply and directly checking fine tuning.

We have known more than one instance of alleged line generator trouble purely due to slightly incorrect tuner settings resulting in "pulling on whites" on Band III. However, the possibility of an undamped peaky i.f. stage (due to a dry-jointed resistor) or a slightly unstable valve (due to an o/c decoupler) must always be kept in mind.

C.R.T. Failure

The commonest cause of "pulling on whites" some years ago was leaky heater/cathode insulation in the c.r.t., so loading the video stage with excess capacity that it could not instantaneously drop to "black level" output when bright scenes terminated the line information. The front porch was grossly distorted or eliminated while the picture content trailed into the sync pulse as shown in Fig 1b.

Due to manufacturing and design improvements this type of c.r.t. failure is very rare indeed, and the most likely of cogging, trimming excluded, is probably an increase in the value of a video load or cathode resistor, producing the same effect as an increase in video circuit capacity by raising the R/C time constant.

Thus to maintain an adequate frequency response with the unavoidable circuit capacitance, a designer may have to limit the video load resistor to 6·2kΩ. If this resistor materially rises in value, the frequency response curve inevitably falls off just as if circuit capacitance was increased.

As a practical illustration, if a meter test prod is applied to the cathode of a c.r.t., definition will deteriorate while tendency to pull on whites will become most evident. Similarly if an excessive value cathode by-pass capacitor is fitted when making replacements after a video burn-up, and when values are hard to read, "cogging" symptoms can appear. Of course if the vision detector load resistor increases materially in value again these symptoms will appear, but due to it passing little current, unlike the video anode load resistor, this possibility is very rare.

Faulty Sync Separator

When it appears that the sync separator itself may be at fault, the most probable cause will be the high value, often up to 1·5MΩ, grid resistor having increased beyond permissible limits. Application of a voltmeter on a high range, so that its internal resistance equals this figure, and placed across the suspect while the set is working, will invariably remove the symptoms completely if this is so.

In modern receivers employing mean level a.g.c. with the negative control voltage tapped off from the sync separator grid, it is possible for a defective component in the a.g.c. system to inhibit correct clipping action, and this must always be considered.

Finally, even a perfect receiver can often exhibit signs of severe "cogging" due purely to bad aerial siting and reflections. Often such cases though highly objectionable on the Test Card, give little cause for complaint on average programmes.

The peak white and black castellated edge is of course the reason, and the only cure is careful aerial re-direction which in many instances need only be quite small and well within the swing of the mounting brackets. ■

Servicing TELEVISION Receivers

No. 127. S.T.C. VC2 and VC3 chassis, K-B XV60, WV90, WV75, KV001, KV101, KV002, KV400A and KT405A; RGD RV202, RV302 and 627. Regentone TV402, 404, 501 and 502.

By L. Lawry-Johns

THESE chassis are very similar and differ in details which do not really affect general servicing. An earlier VC1 chassis may be found in some models. Receivers using this basic chassis include the models XV60, WV90, WV75, KV001, KV101, KV002, KT400A and KT405A; RGD RV202, RV302 and also the earlier 627. Regentone models are the TV402, 404, 501 and 502. The models are either 19 or 23 in., and use AW 47-13W and AW59-13W respectively.

Tuners

Designed for dual standard operation, the u.h.f. tuner may or may not be found fitted. The power supply for the u.h.f. tuner is derived from the v.h.f. tuner and the i.f. output of the u.h.f. tuner is applied to the v.h.f. tuner for amplification by the mixer section of the frequency changer whether the v.h.f. tuner is of the rotary or push button type. On the subject of the v.h.f. tuner it is pointed out that different valves are used in the rotary tuner, usually PCC189 and PCF86, to those shown in our diagram of the push button type. Some rotary tuners, however, use a PC97 and a PCF805.

Circuit Description

The circuitry is simple and straightforward. Most of the troubles encountered are due to valve failure and do not cause much trouble but more of this later. The output of the v.h.f. tuner is applied to a common i.f. stage shown as V5 EF183 on the diagram. For 405 operation the sound i.f.

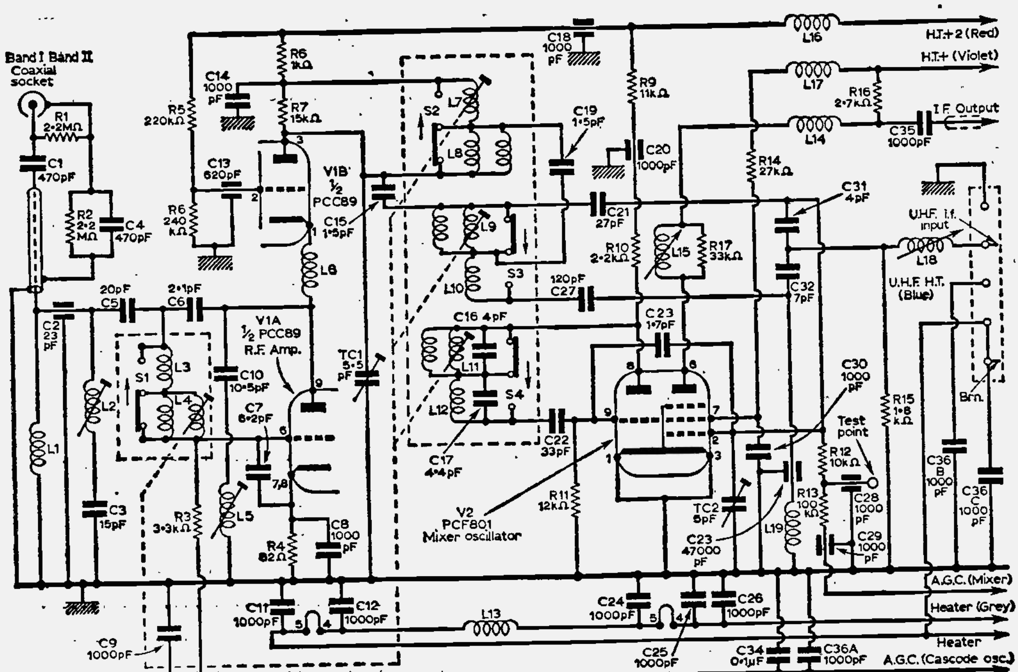


Fig. 1—The dual-standard tuner unit

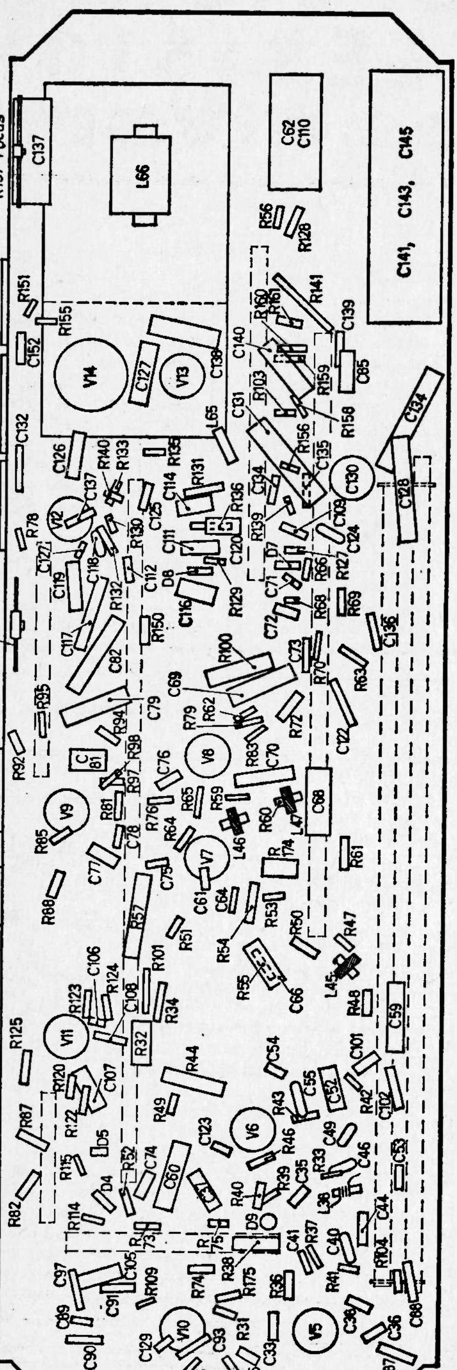


Fig. 2—Under-chassis view showing layout of components.

is extracted from the V5 anode by C38 and is applied via S1 to the V10 control grid (6BW7). The sound i.f. at the anode of V10 is passed to the D3 (GEX13) sound demodulator (405), thence to the limiter D4 (GD9) on to S4 and the volume control to the a.f. stage, which is the triode section of V11 PCL86, and finally via C108 to the output section of this valve.

The f.m. signals of the 625 standard are taken from the V10 anode and are suitably detected by the D1-D2 circuit (both diodes OA79) before being handed on to the switch S4. The inter-carrier sound i.f. of the 625 signal is extracted from the anode of the video amplifier V7 PCL84. Thus a fault in the vision i.f. stage V6 EF184 or in the vision detector or video circuits can cause a loss of sound on the 625 standard; the symptoms thus being described as "no vision signals on any channel, no sound on BBC-2 but normal sound on BBC-1 and ITV".

Usually this complaint can be rectified by replacement of the PCL84 but of course there are times when it cannot! The triode section of the PCL84 functions as the field sync amplifier whilst the V8 PCF80 functions as a sync separator (pentode) and part field oscillator (triode). V9 PCL85 functions as the other half of the field oscillator and the field output. V12 a PCF802 is the line oscillator. V14 the line output and V13 the efficiency diode PY801. The valve V14 may be a PL36, 30P19 or a PL302. The e.h.t. rectifier is a DY86.

H.T. Supplies

The h.t. rectifier is a BY100 silicon diode. The VC2 chassis uses a choke-capacitor h.t. smoothing circuit consisting of a 150μF reservoir, a fairly large choke and a 350μF reservoir, a 75Ω resistor with a 200μF, a further 75Ω and a 250μF main smoother. The second 75Ω is shorted out for 225V and 205V working thereby putting the 200μF and 250μF in parallel. Our diagram shows the latter circuit (VC3). The VC2 also varies by having the 13Ω surge resistor before the 1A fuse instead of after it. This should be remembered when testing for mains at the fuse holder. The heater circuit is the same in both chassis.

Fault Conditions

These receivers do not give much trouble apart from the usual v.h.f. tuner unit faults of poor contacts which are easily recognised if not sometimes so easily remedied. Perhaps the most common fault condition is that caused by an open circuit valve heater, i.e. all valves fail to heat up and therefore there is no sign of life from the set except that h.t. can be recorded at all points where it may be expected but, of course, being much higher than normal due to the lack of loading.

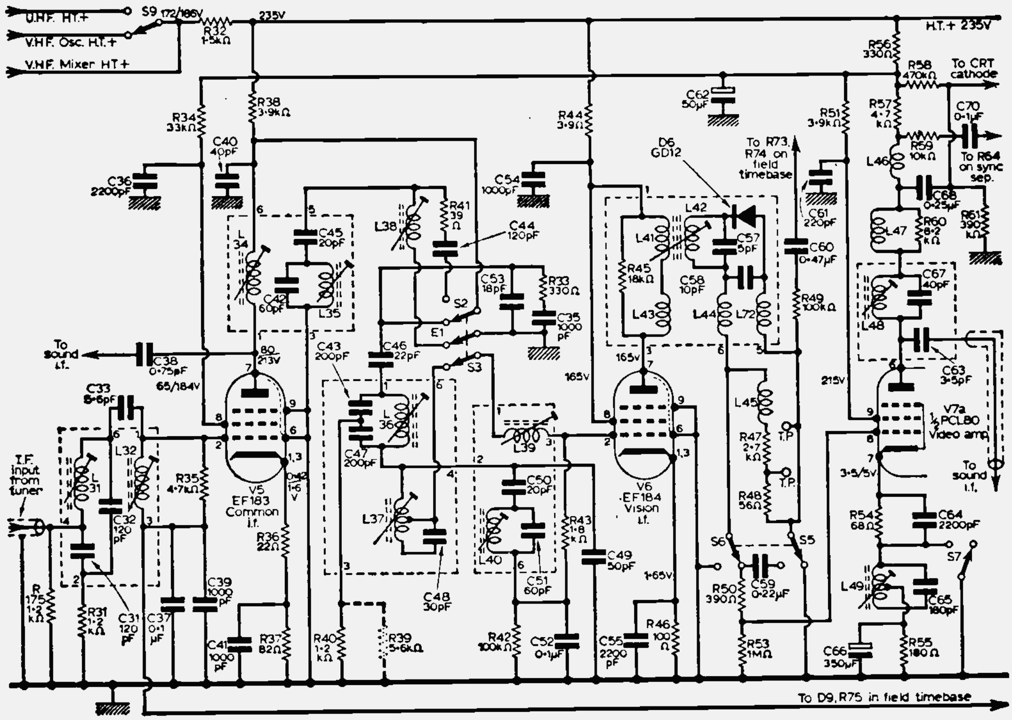


Fig. 3—Circuit of the i.f. unit.

No trouble should be experienced in locating the break in the heater circuit. First ensure the mains supply is at the tags of the dropper R170-172 on the left centre. Across to the front right R166 main heater dropper thence through the VA1026 (R164) and on to the PY801 base pin 5, on to pin 4 then PL36 pins 2 and 7 and along the heater chain thereafter all pins 4 and 5 up to the tube heater pins 8 and 1 to chassis. Quite often the EF184 or EF183 heater will be found open, sometimes the PCF80 although any heater could be at fault.

No Picture, Sound O.K.

Switch to 405 and listen for the line whistle. If very weak or absent check the PL36 (V14). Quite often this will show no heater glow although all other heaters glow normally. This is due to a fractured envelope and care should be used when removing the valve as the glass can fracture further under pressure.

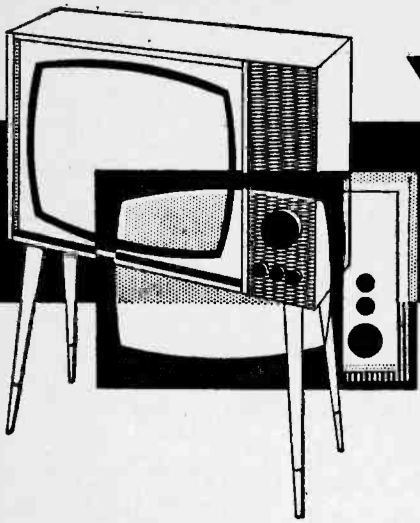
This, of course, is quite straightforward but the fact that the PL36 (or equivalent) may be normally heated does not absolve it from responsibility as this valve often loses emission quite suddenly. A new valve will often restore normal conditions without further testing.

The correct operating conditions for the PL36 are 200V at pin 4 and up to 60V line drive at pin 5. We say "up to" as the presence of the meter used causes the actual voltage to fall according to the resistance of the meter. The line drive is held fairly steady by the v.d.r. but this has little use if R142 1·8MΩ rises too much in value. This defect can cause the PL36 to be overbiased and the circuit to fail. If the valve is in order but the pin 4 voltage is well over 200V—say up to the h.t. line voltage (230V) this is the condition which should be suspected now assuming the line drive is correct but there is no e.h.t., the PL36 is in order; check the boost line voltage which will probably be found not a lot higher than 200V. If this is so check C134 0·1µF 750V. If the boost voltage is very low—say below 100V, check the PY801 which may be of low emission.

If there is no voltage at all check at pin 9 of the PY801 as L65 could be open circuit.

If the circuit functions but there is no voltage at the side of the tube check the DY86 which will probably have an open circuited heater. If the line whistle is strained remove the DY86 and note the difference as this could be internally shorted; removing the top cap or the c.r.t. connecter has the same effect as removing the valve. If there is no line whistle at all check the PCF802 and associated components.

To be continued



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 page 44 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

COMBINED AERIAL SYSTEM

I have recently moved into this area, where I have erected a combined BBC/ITV aerial. The BBC reception is good whilst ITV (London) is very weak. Originally I tried the aerial erected in the loft in the horizontal position and received the Midland ITV satisfactorily. Since I have fitted this on the chimney I can receive ITV London but no Midlands. Can I fit an ITV aerial in the loft and couple by a diplexer box to the other aerial array.—E. J. Jones (Wokingham, Berks.)

The horizontally polarized ITV signal you received is Membury (Berks.) channel 12. There is no point in fitting a diplexer if you want to receive channel 9 as well, since this signal would come from the combined aerial which would have to be fed into the BBC (Band 1) section of the diplexer. It would be better to use a splitter. Check your tuner valves also.

HMV 1847

Is it possible to change the e.h.t. rectifier inside the line output transformer can.—E. J. Michtell (Bideford, N. Devon).

It is necessary to replace the complete transformer assembly which includes the e.h.t. rectifier, as the rectifier is sealed within the transformer can, which is oil filled.

BEETHOVEN B77

There is no type number on the c.r.t. Could you give me the type number? Also, the picture will not focus. The height is O.K. as soon as the set is switched on but after 10 to 15 minutes this is reduced by ½in. Also it is impossible to obtain field linearity.—M. S. Gellard, (Richmond, Surrey).

The c.r.t. is a Mullard MW36–24 and is magnetically focused. The inability to focus may be bound up with the lack of height in which case you should check the boost line voltage, R70–C70, etc. Also check the ECL80 field linearity components, including in this C54–C57.

GEC BT455

The set gives a good picture when first switched on, but after about 6 minutes or so the picture darkens abruptly as though the brilliance was suddenly switched off. Adjustment of the brilliance and contrast controls brings a slight improvement. The line output valve PL500 and the PCF802 have been replaced but the fault remains.—R. Haslam (London, S.W.17).

This symptom is probably caused by a change in value of a capacitor in the vision i.f. strip, putting the circuits out of alignment. This could be a very difficult fault to locate, and virtually impossible without instruments set up for alignment response tests and going round each tuned circuit in turn in an endeavour to locate the faults. On the other hand, the trouble could be caused by a poor soldered connection on a tuned circuit (i.e. i.f. transformer etc.) or even bad valve seating in its holder.

PHILIPS 1768U

The first indication of trouble was a reduction of picture width to approximately half size. A check was made and it was found that h.t. was normal but the boost line voltage was low. The set worked in the above-mentioned condition for some months and then finally lost both picture and sound. The a.c. voltage now reads 150V and all power supply components and valves have been checked and found to be in order. On further investigation it was found that the total current drawn by the output line valve was some 200mA. The line whistle varies when the hold control is adjusted.—A. J. Richards (Rochester, Kent).

If the line output valve is definitely receiving line drive (and this would appear to be the case since the line whistle is audible), then the trouble can only be in the anode loading of the valve, and shorting turns in the line output transformer would be a possibility. Check the line boost circuit including capacitors and connections to the line output transformer.

BUSH TV177

There is severe ghosting on this receiver and it is much worse on ITV. I am 12 miles from Winter Hill and the aerial is loft mounted.—H. Ashworth (Bury, Lancs.)

A cause of ghosting, assuming that the set is correctly aligned and working properly, results from the main signal being reflected from nearby hills, large buildings, etc. so that the receiving area picks up the main signal plus smaller signals which are reflected a fraction of a second later than the main signal. The only cure lies in experimenting with the aerial system, probably increasing the gain and directivity and orientating for maximum discrimination between the main signal and the reflected ones.

EKCO T284

The picture becomes "negative" when fully tuned in, particularly on channel 5 which is stronger than ITV channel 10. When slightly off tune, a normal picture is received but the sound signal is then down. I have changed the video amplifier (30FL1), without any effect. On changing V7—vision a.g.c. rectifier and sound limiter (6D2), the sound disappears as the set warms up. The same effect occurs when I interchange V7 with the other 6D2.—D. J. James (Swansea, Glam.)

The trouble would appear to be associated with the a.g.c. diode and vision limiter valve 30L2. Check this valve and associated components.

EKCO TC286/1

With the set switched to vision, the following valves U191, 30P4, 30P12 and 30FL1 all appear to be alight. The EB91 and 6/30L2 are not alight but all the heaters are O.K. New valves have been tried in these positions without improvement.—W. J. Norris (Chorley, Lancs.)

We suggest you try changing V14 (EB91 or 6D2) which probably has a heater cathode short. Also check V12 (30FL1).

ULTRA VT9/17

The picture suddenly disappeared whilst viewing. The U25 and 20P4 were replaced. It was possible to bring a picture back by applying a small voltage across the heater leads of the U25. The smaller resistor in series with these leads was shorted out and now after a considerable warm up period the picture appears but is very dim and occupies a small area of the screen. From time to time it was noticed that the U801 flashed brilliantly then settled down normally.—K. Aldred (Mansfield, Notts.)

The trouble here is with the low h.t. voltage due to a fault in the U801 rectifier or associated smoothing and/or surge limiting resistors in its anodes (one of these may be open circuit) or failure of a component in the line timebase. If the line output valve and booster diode are normal, as well as the h.t. voltage, check the components in the line timebase/booster circuits.

MARCONI 4614

I am experiencing distortion of sound on 625 only. Occasionally crackling is heard and distortion clears momentarily (few seconds) then more crackling and distortion returns. Have checked the audio section by feeding a gramophone pick-up through the circuit and all appears O.K. Have also changed both diodes in the ratio detector circuit.—J. Fielding (Billington, Lancs.)

Since 405 sound is O.K., it can be assumed that audio stages are in order and that the trouble lies either in the f.m. detector or in the alignment of the intercarrier 6Mc/s channel. Check the resistors in the ratio detector circuit and if these are O.K., suspect alteration in frequency of the intercarrier channel. This may be caused by a poor soldered connection on a capacitor across a 6Mc/s tuned circuit.

K-B STARDUST

On switching on, the sound comes through normally but the picture begins to jump up and down accompanied by a crackling noise. After a few minutes it settles down and is O.K. Now when I switch on the sound is still O.K. but the picture is very weak—in fact I cannot make out anything at all except for a few faint lines across the screen. The brilliance and contrast controls make no difference. I have changed PL36, ECC81, PCF80 and PCL84 without improvement.—G. E. Gower (Larkhall, Lanarkshire).

The symptoms point to a c.r.t. defect and we suggest you check the voltages at the base of the tube. If the control grid voltage does not vary as you adjust the brilliance control check for shorted capacitors, etc. The fault could well be due to an open circuit electrode inside the c.r.t.

COSSOR 148

The trouble is that the picture tends to pull over to the left, also on the test card I get a cog wheel effect. Originally the picture was also rolling upwards. I have changed the 6AB8 without any improvement.—J. Gladman (Highbury, N.5.)

Check aerial to ensure that unwanted reflected signals (promoting "ghosts") are not causing the "pulling". Check the video amplifier (8A8–PCF80) circuit resistors which sometimes change value and the sync coupling capacitor (0·1μF) connected to pin 9 of the ECL80 sync separator.

RGD 610

ITV is very good but BBC is very poor indeed. I have tried tuning the oscillator core but neither sound nor vision improve.—C. W. Richards (Madeley, Salop.)

We presume the BBC section of the aerial is in order and has been tested. Dismantle the BBC coils from the tuner and examine for fractures and/or disconnections.

BUSH TU85

I have fitted a BY100 rectifier across the h.t. metal rectifier which was giving low output and have a satisfactorily correct small picture. I wired a 25Ω resistor in series with the a.c. input and included a 0·005μF capacitor across the rectifier. However, I have no data regarding the h.t. value and was wondering whether this was now likely to be excessive.—J. Halfpenny (Birmingham 19).

The h.t. will be almost exactly correct with the circuit you describe and there is no need for concern.

PYE 17/S

Is it possible to fit a larger tube to this chassis such as a 23in. and wha modifications are necessary, if any?—B. G. Seaton (Dagenham. Essex).

To avoid really extensive alterations you should adhere to the same deflection angle for the larger tube which must therefore be a 21in. and not a 23in. If the c.r.t. fitted is a 90° AW43-80 (17in.) a suitable larger tube would be an AW53-80 with no modifications necessary. Where the existing tube is a MW43/80 your replacement would be a MW53/80.

TEST CASE -47

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.

Having moved into a new house fitted up with an attic-type TV aerial which gave good BBC and ITV pictures, an "experimenter" soon discovered that on BBC a curious type of interference occurred intermittently from dusk. The interference is depicted in the accompanying "telephoto", and as can be seen is composed of two horizontal bands, spaced by about a quarter picture height, the bands themselves resembling very fine white/grey dots, rather like grain or "snow" due to a weak picture signal.

What is the most likely cause of this interference, why is it present only on BBC-1 and not on ITV and what is the best way to trace and cure it?

See next month's PRACTICAL TELEVISION *for the answer to this problem along with a further item in the Test Case series.*

SOLUTION TO TEST CASE 46
Page 572 (last month)

The "watery" vertical line effect illustrated last month is symptomatic of interference generation by the line timebase. The vertical line is, in fact, created by a disturbance in the timebase at exactly the same instant on each line scan, the composite effect being the building up of a vertical, thin line.

The effect is often caused by the generation of transient switching pulses in the line amplifier when the line drive changes over from that provided by the booster diode to that provided by the line amplifier proper. Almost half the line scan is endowed by reclaimed energy passed by way of the conducting booster diode. After this energy has all been used, the booster diode switches off and the line output valve switches on.

Mostly, however, switching transients are suppressed by modern circuit techniques, but the sudden surge can cause the output valve to develop a form of electron oscillation which lasts for only a very small fraction of a second during each scan. This can cause the trouble. A test for this can be made by holding a small, powerful magnet close to the envelope of the line output valve when, if the symptom is affected or disappears, the valve should be replaced. An early cure for the trouble was to clamp an ion trap magnet round the valve envelope. Indeed, some sets came complete with a magnet fitted on this valve!

Switching transients can often be caused by wiring small r.f. chokes in series with the top-cap connections of the booster diode and line output valve.

This interference is sometimes radiated from one house to a neighbour's house, and a curious thing about it is that it may not be displayed on the set responsible for it, only on a neighbour's set!

If the interference is radiated and the affected set is tuned to the alternative 405-line channel while the offending set is tuned to the other channel, the line drifts from side to side across the screen, rather like the windscreen wiper of a car, and for this reason it is given the name "windscreen wiper interference".

QUERIES COUPON

This coupon is available until OCTOBER 20th, 1966, and must accompany all Queries sent in accordance with the notice on page 41.

PRACTICAL TELEVISION, OCTOBER, 1966

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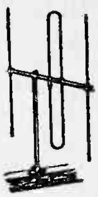

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