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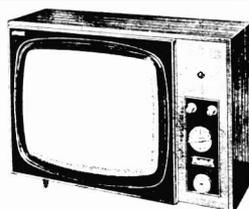
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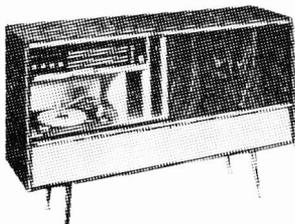
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6C9	11/-	30FL13 12/6	DL76	7/-	ECF84	7/-	EM71	14/-	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6
6C9	11/-	30FL13 12/6	DL76	7/-	ECF84	7/-	EM71	14/-	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6
6C9	11/-	30FL13 12/6	DL76	7/-	ECF84	7/-	EM71	14/-	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6	PC88	9/6
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Practical Television

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TV AND POLITICS

"Broadcasting is really too important to be left to the broadcasters and somehow we must find some new way of using radio and television to allow us to talk to one another".—Anthony Wedgwood Benn, Minister of Technology, October 18th 1968.

Readers will recognise these words as the keystone of the recent withering, and unprecedented, attack on the BBC, which was closely followed by a similar onslaught by Richard Crossman, Secretary for Social Services. Between them, these two gentlemen emitted more pompous nonsense per second than we have had the misfortune to hear in many a long year. As a result, both appeared in television interview programmes but neither, in our view, extricated themselves from their ill-conceived arguments.

Not that this is our main plank of contention, for the general public becomes immune to the strange wafflings of politicians. It is the implied innuendos behind some of the statements that cause concern. And that Mr. Benn's attack should be followed the next day by Mr. Crossman's diatribe is certainly suggestive in itself.

Mr. Benn's opening salvos were that the BBC news is comment-coloured, that they over-use a small group of "instant pundits" and that triviality and politician-baiting have encouraged contempt for those in public life. Mr. Crossman echoed the theory that the BBC is trivialising politics and he, too, is apparently against the "confrontation" type of discussion programme. This has the ring of touchy establishment figures who have come off rather worse for exposure.

The first self-contradiction comes when Mr. Benn stated that the BBC retains "a whole host" of commentators who, "being quite free to comment", carry with them some inevitable suggestion of BBC authority. With that statement he appears to demolish his whole argument! As for objecting to confrontation programmes, surely this is the meat of political presentation. If one is to discourage argument, discussion and debate on TV, one might

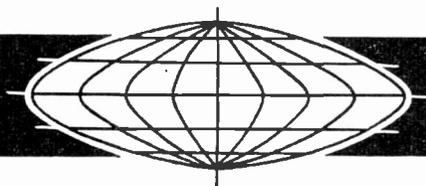
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PUBLISHED ON DECEMBER 20

TELETOPICS



LIVE TV FROM MEXICO

THE Post Office satellite earth station at Goonhilly Downs in Cornwall was Europe's receiving point for television transmissions—live and in colour—direct from the Mexico Olympic Games.

The television pictures were beamed across the Atlantic by a new earth station at Tulancingo, Mexico, to the United States National Aeronautics and Space Administration's ATS-III satellite now in orbit 22,300 miles above the equator, and received at Goonhilly, then routed by Post Office microwave links to London and fed into the British and European television networks. Conversion from the American colour system to the PAL system used in Britain and most continental countries was undertaken by the BBC.

Originally it was planned to use Goonhilly's brand new second aerial to receive the television transmissions via the first Intelsat III satellite, but the failure on September 19 of the Thor-Delta rocket carrying the satellite into orbit immediately brought into play the previously planned alternative use of ATS-III. This involved reverting to the old No. 1 aerial which was modified to work with the ATS satellite. Commissioned by the Post Office in 1962 for the first Transatlantic experiments with Telstar it has been in regular commercial use since 1965, relaying telephony and television transmissions via the Intelsat I (Early Bird) satellite.

The Mexico Olympic Games was the last major role of the aerial No. 1 installation. After the Games it was taken out of service and re-equipped to work with another Intelsat III satellite to be placed over the Indian Ocean towards the middle of next year, providing Britain with satellite communications to India and the Far East as far as Australia and Japan. Meanwhile, the new No. 2 aerial is being adapted to take over the Atlantic service, working to Intelsat I until the next Intelsat III is placed successfully in orbit.

The Post Office terminal at Goonhilly will be one of the first in the world capable of two-aerial operation and when both aerials are in service, Britain will have direct communications by satellite to all parts of the globe.

ITA TAKE EMI COLOUR EQUIPMENT

EMI Electronics have now been awarded contracts by the Independent Television Authority, valued at over £100,000, for the supply of video input equipment for the Authority's fourteen new colour television control rooms.

The switching systems are being supplied as part of the ITA re-equipment programme in preparation for their u.h.f. 625-line colour service, which they plan to bring into operation towards the end of 1969. Delivery of the first equipment is scheduled for the end of this year.

HEATHFIELD BBC-2 AERIAL

THE BBC has placed an order with Techwork (Structures) Limited, of Southampton, for the design, supply and erection of the 480ft. aerial mast for the Heathfield BBC-2 transmitting station. This new station is being built half a mile east of Cross in Hand, near Heathfield.

It is expected that Heathfield will be brought into service towards the end of 1969, on its BBC-2 channel, 52, with horizontal polarization. Later it will also transmit BBC-1 and ITV programmes on 625 lines. It will serve some quarter of a million people in East Sussex and parts of Kent.

ELECTROLUBE'S LATEST

THE latest electrical contact lubricant produced by Electrolube Limited is Electrolube 2 GA-X, a grease in aerosol form. It is for application on heavy-duty electrical contacts under the most severe temperature and weather conditions and will be particularly useful where contacts are not easily accessible and where there is a tendency for a liquid lubricant to migrate.



Completely free of silicones and hydrocarbons, 2 GA-X is safe on all known plastics, paints and rubbers. It is non-toxic, non-flammable and non-irritant. On heavy-duty contacts it will reduce resistance and arcing. It will protect electrical and electronic equipment from corrosion and condensation, improve the performance of insulators and prevent tracking in damp conditions. It removes tarnish non-chemically, by infiltration, and has no abrasive properties whatsoever. It has a temperature range of -40°C to $+200^{\circ}\text{C}$.

Price per aerosol can is 18s.

AMMANFORD RELAY STATION

THE BBC Wales relay station to serve Ammanford was brought into service on 21 October, on channel 12, with horizontal polarization.

This relay station is situated at Mynydd Betws, some two miles east-south-east of the town. It will serve Ammanford and its environs including Brynamman 2 and parts of Glanamman.

MARCONI TV AT EUROPEAN GAMES

THE Greek Amateur Athletic Association (SEGAS) has placed an order worth some £700,000 with English Electric's Marconi Company for three outside broadcast television units and a range of cameras and studio equipment to provide full television coverage of the European Games in Athens next year for the Eurovision network. A total of 14 Marconi Mark V black-and-white cameras are to be supplied. A microwave link will also be supplied by Marconi to bring the picture via a helicopter to one of the outside broadcast units.

Thirty separate sound and thirty television commentary positions will be installed to cater for all the nations competing in the European Games. Two of the outside broadcast units will be equipped with four Mark V cameras, in addition to full production facilities—the third will have five cameras and will provide the basis of the studio facilities at the new stadium.

In addition to the cameras, a range of studio control and switching equipment will be supplied, together with three Ampex video-tape recorders. One of these will be a special effects recorder capable of providing slow-motion playback facilities.

CLOSED CIRCUIT TV AND V.T.R. PACKAGE FOR INDUSTRIAL TRAINING

FOR the first time the National range of cameras, video tape recorders and accessories will be available in the U.K.

Users of CCTV have wondered why the Matsushita Electric Company had delayed the introduction of National into the U.K. Their policy has been to manufacture equipment for a particular market and only introduce it into country when an efficient technical sales and service organization could be established.

It was decided that Beulah Electronics Ltd. could provide this service in the U.K. since they had many years experience in CCTV and have an efficient spares and servicing organization.

The Beulah package contains many outstanding features and accessories include a Special Effects Unit which combines a fader and sync unit, yet only costs £150. The basic Training Package consists of: viewfinder camera with built-in 5in. monitor; tripod and dolly; monitor and V.T.R.

The equipment can only be supplied to Industrial, Commercial, Medical and Educational users as it is exempt from Purchase Tax. The package can be purchased outright or leased from the Sole U.K. Distributors: Beulah Electronics Ltd., 126 Hamilton Road, West Norwood, London, S.E.27. Telephone 01-670 6166. Telex 262415 who should be contacted for detailed brochure and full price list.

BBC RESEARCH SCHOLARSHIPS—1968

THE Engineering Division maintains six Research Scholars at United Kingdom Universities, and is awarding three Scholarships this year. The Scholarships are intended to provide the opportunity for selected honours graduates to work for a higher degree, the subject chosen for post-graduate study being within those fields of physics or engineering which have an application to sound or television broadcasting.

CAMERA TUBES SURVIVE INFERNO

ENGLISH Electric Valve Co. Ltd. TV camera tubes were the only components to survive the fire which engulfed the ATV network camera tower at the Nottingham Forest football ground on 24th August, 1968.

The tower was immediately over the central area of the fire and three cameras with two monitors and other associated equipment were totally enveloped in flames.

After the fire was extinguished, two of the 4½in. type 7295C image orthicon TV camera tubes were salvaged and returned to the EEV factory at Chelmsford. When tested, both tubes were in perfect working condition. Their performance was still as good as new, despite having been subjected to the fire. They were cleaned, fitted with new bases, then returned to ATV for further service.

Damage to the third camera was so severe that it was impossible to extract the remaining image orthicon from the distorted deflection coils.

PROWEST TAKE £¼m IN 10 MONTHS

SALES totalling £¼m, within ten months of starting have been achieved by Prowest Electronics, a shared subsidiary of Westward TV and Grampian TV.

Prowest, whose factory is at Maidenhead, specialises in advanced design video switching, mixing equipment and high performance TV monitors.

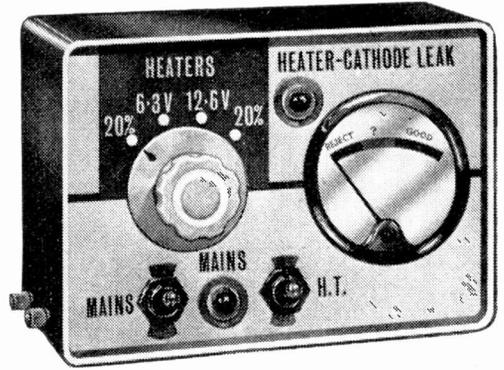
The ITA are incorporating 100 Prowest monitors at their transmitting stations for use on the new v.h.f. network and Yorkshire Television have installed 85 monitors in the studios and technical areas of their new Television Centre in Leeds. ATV have custom-built Prowest colour mixers and the BBC have bought Prowest monitors for their studios and outside broadcast vans.

GLASGOW UNIVERSITY TV STUDIO

GLASGOW University's TV centre at Southpark House, one of the largest and most professional university closed circuit television studio installations in the United Kingdom, has now been installed by EMI Electronics and is fully operational. The programme origination studio is equipped with four EMI Vidicon Camera Channels Type 201; two cameras have zoom lens systems, one a four-lens turret, and one is used in a telecine role the design of which is based on the EMI Vidicon Telecine Equipment Type 404, an important part of many broadcast studios. Other equipment installed includes a production control desk with special-effects generator, a solid-state vision mixing and switching system, an eight-channel sound mixer, a four-head video tape recorder, and full sound reproduction facilities.

C.R.T. TESTER

by I.M. REES



THE simple unit described in this article will provide basic tests on cathode-ray tubes *in situ* and establish the state of emission and the heater-cathode insulation. In addition a rejuvenation process is provided enabling many tubes which would otherwise have been written off to be rescued and the life of others extended.

Circuit Description

For simplicity the tube gun is connected into circuit as a diode using its control grid as the anode. T2 (Fig. 2) primary winding is used as an autotransformer, the 200/220V tap feeding D1. The rectified average output from D1 is fed through the metering circuit and via the limiting resistor R4 and S3 to the tube's control grid.

Meter M is set to read 0-60mA f.s.d. by means of R3. C1 has the dual function of smoothing the raw d.c. to prevent 50c/s needle vibration and damping the meter movement against flashover between grid and cathode in the tube during tests.

Heater-cathode insulation is monitored by neon indicator N2. S1a, b completely isolates the unit from the mains when switched off while neon indicator N1 functions as a mains pilot light. Switch S2a, b selects 6.3V or 12.6V for the heater and the heater boosts, catering for the majority of tubes in current use.

Construction

It is recommended that the unit is built into a wooden case to prevent any exposure to the live wiring or components. Alternatively an improvement in safety at extra cost can be made by the

inclusion of an isolation transformer to supply the h.t.

The layout is obviously non-critical but extra attention has to be paid to the phasing of the transformers T1 and T2 to ensure their that output voltages are adding. The prototype was found to poreate connected as in Fig. 2, but depending on the direction of the winding and the termination the outputs may be out-of-phase in relation to one another. Any correction can be made by reversing the primary connections of T1. The transformers used in this circuit have a high standard of insulation between primary and secondary, this being of the utmost importance if heater-cathode readings are to be of any use and must be borne in mind if alternative types are used.

The author's unit employed an ex-W.D. ammeter with its internal shunt removed leaving a basic 6mA f.s.d. moving-coil movement. An earlier model sported a 500 μ A meter but R1 was then 4.7k Ω and R2 50 Ω . Movements of greater than 6mA may require an increase in the value of R2 but it is not recommended that the value of R1 be reduced or flashover protection will be reduced.

Calibration of the meter circuit is accomplished by connecting a d.c. ammeter in series with a 5k Ω w.w. potentiometer between the B12A socket pins 2 and 11. Switch the test unit on and close S3; adjust the 5k Ω potentiometer for a suitable reading on the test ammeter (say 30mA) and set R3 for the same reading on M (mid-scale). For convenience a selected resistor can be kept at hand which will give a standardising reading of half- or full-scale deflection (390 Ω approximately for full-scale deflection). In practice the instrument calibration has moved little in its two years of use. Table 1 lists readings obtained on an earlier unit

Table 1: Current measurement readings indicating state of emission

Tube type	Good	Medium	Low	Reject
57°-90° deflection CRM173, CRM124, CRM211, AW36-80, MW43-69, etc.	20-30+ mA	10-20 mA	5-10 mA	0-5mA
110° deflection AW47-90, AW59-90, CME2302, etc.	30-50+ mA	20-30 mA	10-20 mA	0-10 mA

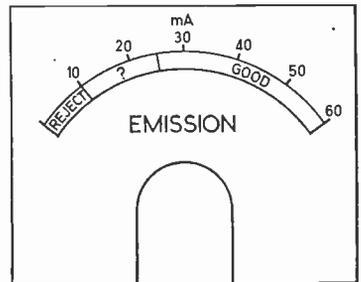


Fig. 1: Suitable meter scale for the cathode-ray tube test unit based on the readings given in Table 1.

which resulted in the meter scale of Fig. 1. Although a compromise between the 57°-90° and the 110° tube readings was required to give a practical and simple scale it has been found quite satisfactory in operation.

It is important that the two tube sockets are enclosed in a small box to prevent exposure to their live pins (see Fig. 3). At least 4ft. of cable is required between the test unit and the sockets for ease of connection to the tube under test.

Emission Tests

Emission tests are carried out by connecting the socket to the tube to be checked. With the mains switch off S2a,b is switched to the required tube voltage and S3 closed. The mains switch S1a,b is turned on with indication by pilot light N1. After a short tube warm-up period the meter will indicate the state of emission. In practice especially in tubes which have been standing for long periods without use the emission figure may be slow in reaching a maximum (this applies even with new tubes).

Flashover between grid and cathode is not uncommon in used tubes but this should clear after a few seconds. Prolonged flashover may be due to foreign matter in the grid-cathode space. This can be cleared in most cases by applying a 10μF capacitor charged to 300V between grid and cathode with the negative terminal connected to the grid.

Heater-cathode Insulation

Heater-cathode insulation is indicated by N2 which on a good tube will either remain out or glow faintly. A bold light indicates a fault. After a little practice the amount of leakage can be

estimated. As a guide a selection of resistors can be inserted between pins 1 and 2 of the B12A socket and the amount of glow noted.

Rejuvenation

If a tube has been under-run for a long period in a set the cathode tends to lose a great deal of emission due to a coke forming over the emissive surface. By over-running the heater supply and applying the normal test as outlined above this coke can be burnt off and a new surface exposed. This can be stabilised and a useful extension of tube life obtained. Tubes which have been over-run or tubes at the end of their lives can be reclaimed in some cases but the effect rarely lasts longer than a few months.

Connect unit up for normal test and note the reading. The heater switch S2a,b is then set to the appropriate 20% boost position. An increase in reading should result reaching a peak where no more improvement will result, after anything from a minute to an hour or more.

When this maximum is reached the cathode coating is stabilised by switching off the "heat" by S3 and returning the heater switch S2a, b to normal for 15 minutes. After this period the h.t. may be switched on and the new reading noted for improvement. The figure may drop slightly at first from a higher point but if rejuvenation is successful it should steady at an acceptable reading. If at first the process is unsuccessful the operation may be repeated.

It must be noted that a small risk is involved in over-running a tube's heaters. In practice I have not as yet damaged a tube by this process and dozens of rejuvenations have been carried out. Some are still giving bright sharp pictures after

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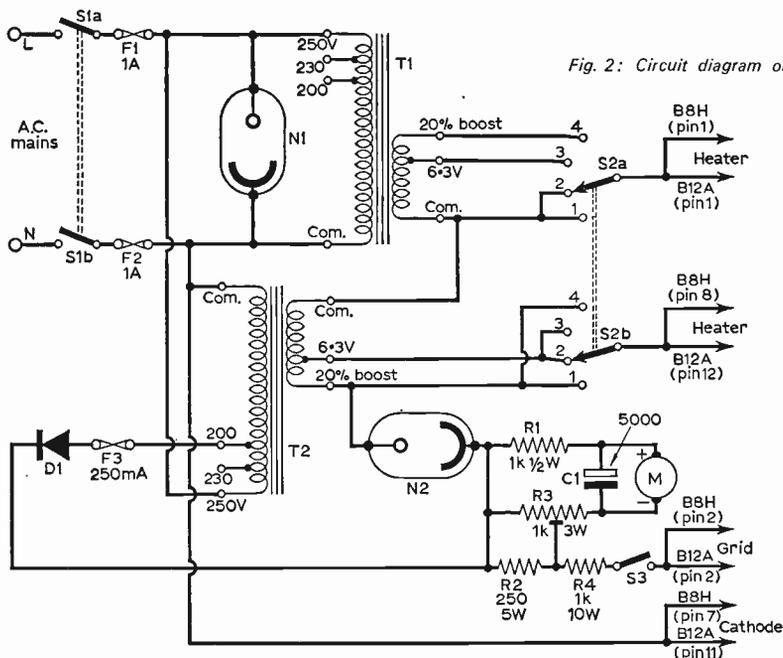


Fig. 2: Circuit diagram of the cathode-ray tube test unit.

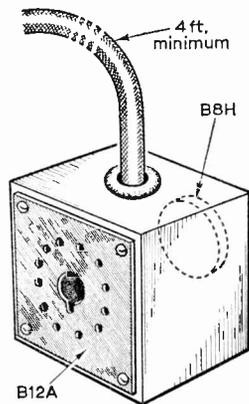


Fig. 3: Enclosure for mounting the B8H and B12A tube sockets.

TELEVISION RECEIVER TESTING

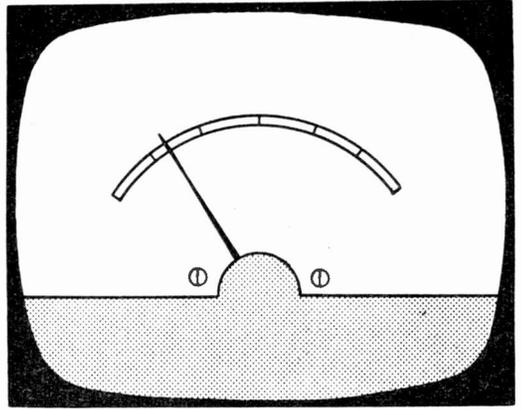
Part 6 by Gordon J. King

LINE OUTPUT STAGE TESTS

IN almost all sets nowadays (excepting some colour models) the e.h.t. voltage required for the final anode of the picture tube is derived directly from the line output stage via the line output transformer and e.h.t. rectifier valve. The basic circuit of the scheme is shown in Fig. 1. The prime function of this circuit is to cause a sawtooth current to pass through the line scan coils to deflect the electron beam in the tube horizontally. The fact that e.h.t. voltage is created is a byproduct of this primary action; but the circuit is nevertheless designed purposely to encourage the efficient production of the e.h.t. voltage without detracting unduly from the horizontal scanning action. Some compromises need to be adopted, especially in dual-standard sets, so far as the general, overall design is concerned, and the circuit is highly sensitive to efficient working, meaning that even a small shortcoming in working efficiency can result in a substantial fall in horizontal scanning power and e.h.t. voltage, showing on a picture as reduced width and impaired e.h.t. regulation.

The signal applied to the control grid of the line output valve is produced by the line generator or oscillator as it is sometimes called, and when this is viewed on the screen of an oscilloscope the display is rather like that shown on the circuit in Fig. 1, while an actual off-the-screen oscillogram of the signal taken at that point is shown in Fig. 2. This is more of a "switching waveform" than anything else, its purpose being to switch the line output valve on and off, contrary to some ideas that the waveform itself drives a sawtooth current through the primary of the line output transformer and hence through the line scan coils.

At the instant when the drive waveform starts to present its flat top to the line output valve this valve is switched on and thus passes current into the inductance of section A of the line output transformer (see Fig. 1). The current path is from chassis through the line output valve, through winding A and the booster diode to h.t. plus. The booster diode, too, is switched on or conducting at this time. During the time that the current is rising through the inductance of section A, an e.m.f. is being induced—by ordinary auto-



transformer action—in section B, the effect of which charges the boost reservoir capacitor so that the side connected to the anode of the booster diode goes negative with respect to the side connected to the top of section B of the transformer.

At the instant when the drive waveform drops swiftly from its flat top to its heavily negative-going part the line output valve switches off, causing a violent collapse of the current in section A of the transformer. This is the line retrace, the action of which induces a high amplitude pulse across section A, which is stepped up, again by autotransformer action, by the e.h.t. overwind on the line output transformer, shown as winding C on the circuit. This communicates a pulse of some 18kV or so to the anode of the e.h.t. rectifier

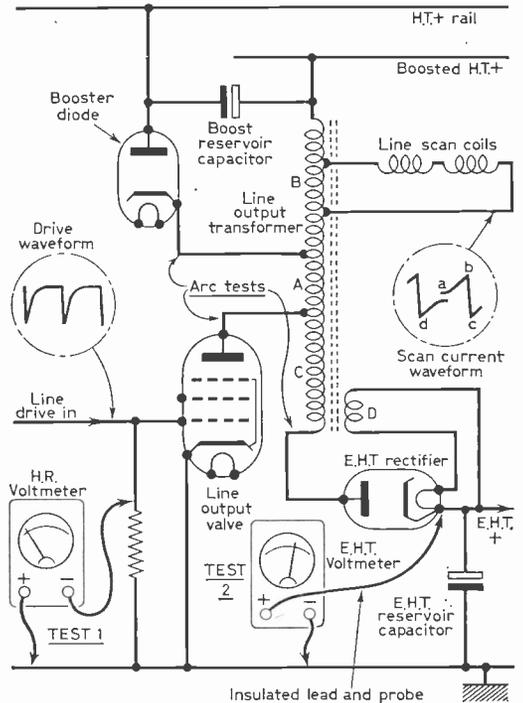


Fig. 1: Basic line output stage, showing tests.

valve, causing it to conduct and charge the e.h.t. reservoir capacitor to its peak value. Such pulses, of course, occur at line timebase frequency (10,125c/s on 405 lines and 15,625c/s on 625 lines), so the charge across the e.h.t. reservoir capacitor remains almost at peak pulse value depending on how much energy is drawn from it by the final anode of the picture tube.

It should be noted here that the e.h.t. rectifier heater winding, marked D on the circuit, substantially *steps down* the pulse potential to a suitable value for energising the rectifier heater. A not particularly uncommon fault condition consists of an unlit rectifier heater with apparently high amplitude pulse potential at the rectifier anode. This often leads incorrectly to the conclusion that the rectifier heater is open-circuit; later disproved by the condition remaining with a replacement rectifier fitted!

When the current is rising through section A and B of the line output transformer current is coupled into the line scan coils and this contributes to part a-b of the scan stroke, shown by the scan current waveform in Fig. 1. Then the line retrace (flyback) occurs, shown by b-c, at which time the booster diode is momentarily switched off because its cathode assumes a greater positive potential than its anode. This allows the line output transformer and coupled line scan coils to ring at their natural frequency, determined by their inductance in conjunction with stray capacitances. However, after the first half-cycle of ring (e.g. damped oscillation) the booster diode cathode swings less negative than its anode and the diode conducts again, thereby damping further ringing completely, but this half-cycle of oscillatory or "ringing" energy in the line output transformer windings contributes to part d-a of the line scan current. In other words, the first part of the scanning current (in the line scan coils) is provided by the energy of the controlled ring while the second part is provided by current building up through the line output valve itself.

A fair idea of this basic operation of the line output stage must be understood before sense can be made of some line timebase fault symptoms and before it is possible to apply logical testing techniques.

Various differences in detail will be observed between circuits of different sets, but the basic scheme remains fairly consistent in all sets. It is now common practice for the boosted h.t. line to feed the anode of the field generator and the first anode of the picture tube. The charge acquired by the boost capacitor remains reasonably constant during each line cycle—receiving charging pulses during the first half of the cycles and liberating energy during the second half—owing to its relatively high value (sometimes about 0.25 μ F). The charge is added in series to the ordinary h.t. line voltage thereby giving the boosted h.t. line a potential of about 500 to 800V relative to chassis, depending on the design of the set.

It is not particularly easy to make tests in the line output stage and e.h.t. section owing to the high amplitude pulse potential that exists at various points on the line output transformer, at the anodes of the line output valve and e.h.t. rectifier and the cathode of the booster diode. For example, a testmeter would have little chance of

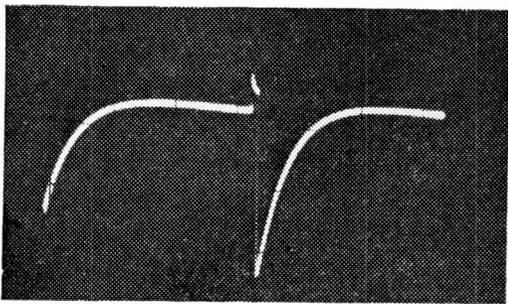


Fig. 2: Typical line drive waveform, photographed on the screen of an oscilloscope.

survival by being connected to measure the d.c. voltage at the anode of the line output valve or e.h.t. rectifier. The high amplitude pulses would have a good chance of causing a flashover within the meter movement even though the d.c. voltage is within the range of the meter. In fact any instrument, including an oscilloscope, is likely to suffer damage as the result of being thoughtlessly connected to circuits carrying pulse potentials.

One of the first tests in a suspect line output stage should be that for line drive. Most sets produce the characteristic "line whistle" when operating correctly which many people can hear on the 405-line standard and hardly any on the 625-line standard at the higher 15.625c/s. Thus lack of whistle from a set normally generating the noise could well indicate line drive failure, for the whistle is caused by magnetostrictive effects in the core of the line output transformer as the result of the changing magnetic fields derived initially from the drive signal.

However the whistle can suffer considerable attenuation by reason of a fault in the line output transformer itself or an associated component even though the line drive from the generator is normal. It is a good plan therefore to disconnect the aerial from the set—to avoid the generator from locking to the line sync signals—and then adjust the line hold control over its entire range while listening for the whistle. If it can be heard somewhere over the control's range (usually more clearly at low-frequency)—even though weaker than it is normally—then one can be sure that the generator is yielding line drive signals.

A more scientific way is to monitor the drive signal on a 'scope and obtain a waveform similar to that in Fig. 2, and then compare the signal amplitude with that stipulated in the service manual for normal working. This technique, though, is rarely within the scope of the amateur attending to his own and friends' sets.

Alternatively a high-resistance voltmeter (not less than 10,000 Ω /volt, preferably 20,000 Ω /volt or better 100,000 Ω /volt) can be connected between the control grid of the line output valve and chassis, as shown by Test 1 in Fig. 1, with the meter *negative* to grid. When the line drive is reasonably correct the grid will assume a potential of some 10 to 20V negative depending on the sensitivity of the meter and the design of the circuit. The negative voltage is produced by the grid of the valve acting rather like a diode in conjunc-

tion with the grid return resistor, thus becoming negative with positive drive cycles.

If there is definite evidence of lack of drive attention needs to be directed to the line generator and the components coupling this to the output valve. A corollary of lack of line drive is severe overheating of the line output valve, for its grid bias is effectively produced by the diode-grid rectifying action just mentioned. A typical symptom—apart from the chief symptom of no picture brought about by lack of e.h.t., boosted h.t. voltage and line scan energy—is a red hot line output valve anode and possibly a smoking line output transformer due to the heavy continuous current carried by the switched on line output valve.

If line drive is present yet the no picture symptom exists the next check should be for e.h.t. voltage (for the same symptom could be caused by picture tube failure or trouble in its biasing or electrode feed circuits). The most satisfying test for e.h.t. is to connect a suitable meter between the e.h.t. feed circuit and chassis, as shown by Test 2 in Fig. 1. This of course needs a special e.h.t. voltmeter or an e.h.t. multiplier connected to a 20,000 Ω /volt meter, the application of which is obvious.

If the e.h.t. rectifier heater is alight and the anode glowing red hot a short on the e.h.t. supply circuit should be suspected in the event of zero e.h.t. voltage. It is not particularly uncommon for the insulation on the heater winding to collapse to core or chassis, and it is not all that difficult to establish a new winding of the same number of turns as the original using the inner conductor complete with polythene insulation of a coaxial cable. The reservoir capacitor only causes trouble in older sets, for in some of these it is an actual component while in more recent models it is formed by the inner and outer conductive coatings on the flare of the tube with the glass between acting as the dielectric.

Pulse potential can be checked with an oscilloscope via a special type of high-voltage, attenuating probe. Its amplitude can then be compared with that given in the manual or design data. The service technician however usually gleans quite an accurate indication of the potential by the length of arc drawn from the pulse source to the tip of a screwdriver blade. The screwdriver must be held by a highly-insulated handle for this test to avoid burns and electric shock, and the metal blade must not be allowed to make contact with any part of the set—not even the chassis—for this could cause the line output transformer windings to overheat, badly straining them if not resulting in their immediate breakdown. Also arc tests must not be carried out in sets where a transistor line output stage or semiconductor e.h.t. rectifier is used.

The arc arises quite dramatically from a properly working circuit—without having to “earth” the screwdriver blade—via hand-capacitance and the capacitance of the screwdriver handle to the blade within, and an arc of at least $\frac{1}{4}$ in. will be obtained from the anode of the line output valve and the cathode (top cap, too) of the booster diode. Owing to the greater pulse potential at the anode of the e.h.t. rectifier—due to the e.h.t. overwind—the arc drawn from this point should be about twice the length and intensity.

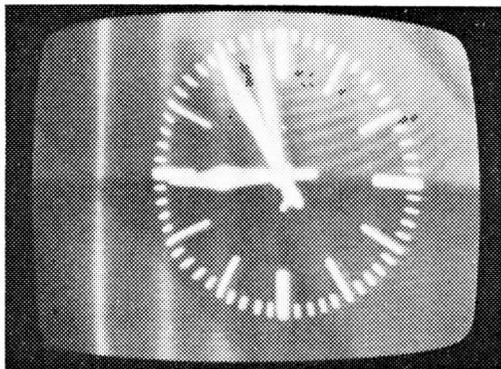


Fig. 3: Symptom of ringing in the line output stage.

If such arcs—composed of a vivid, bluish flame—can be drawn and the e.h.t. rectifier heater is alight one can be fairly certain that e.h.t. voltage is being made available for the tube final anode. If an e.h.t. voltmeter or multiplier is not to hand the spark test can be applied to the cathode or d.c. side of the e.h.t. rectifier. If the screwdriver is held as for the pulse-potential test, e.h.t. voltage will be indicated by a very thin, yellow crackling discharge between the e.h.t. point and the screwdriver blade tip. The discharge is nowhere near as vivid as that of pulse potential—it should not be—but this should not be taken to mean that the e.h.t. voltage is down relative to the pulse potential. Pulse or a.c. discharge has an entirely different character from d.c. discharge. A more violent e.h.t. (d.c.) discharge can be obtained however by “earthing” the screwdriver blade (to the metal chassis or screen) while performing the spark test. 18kV should result in an e.h.t. discharge approaching $\frac{1}{2}$ in.

Now let us consider the collective symptom of *no raster* (e.g., no screen illumination), *line drive normal* and *weak arcs* at the pulse potential points. The first move on coming up against this sort of thing should be (1) to check the e.h.t. voltage (d.c.) by meter or discharging and (2) confirm that the heater of the e.h.t. rectifier is unlit or, at most, feebly lit. The latter two are normal corollaries of the first three.

This could mean (a) faulty line output transformer, (b) faulty line output valve or booster diode (or both), (c) faulty boost reservoir capacitor, (d) shorting turns in the line scan coils, (e) faulty components associated with the line output valve, (f) low h.t. voltage or (g) faulty component associated with the line output transformer. The line output transformer cannot easily be checked—best being done by substitution—so testing initially assumes that this component is in order, discovering whether or not this is so by deduction!

First check the h.t. line voltage which, on most sets, should be no less than 200V. A lower voltage should lead to a check of the h.t. rectifier (but bear in mind that heavy conduction of the line output valve might be loading-up the h.t. supply, causing its voltage to drop a little. This would almost certainly show as the valve running abnormally hot with its anode possibly red hot). Secondly remove the top connection (cathode)

from the booster diode (switch off first!) and note any difference in conditions. If there is none, the booster capacitor is probably shorting, and replacement will cure the trouble. Thirdly disconnect one side of the line scan coils. If this restores normal pulse amplitude (vigorous discharges) shorting turns in the coils could well be responsible for the main symptom (be careful not to burn the screen by the resulting vertical, very bright line). Fourthly check the screen grid voltage on the line output pentode, for this could be abnormally low or even missing due to the screen feed resistor either increasing in value or becoming open-circuit. Finally if all these items check positively tests should be made on the components directly associated with the line output transformer, including resistors and capacitors and remembering too that shorting turns in inductors—such as the width, line linearity and third-harmonic tuning inductors, where fitted—can damp the action of the circuit sufficiently to restrict severely the pulse amplitude. If no conclusive fault is indicated and the pulse amplitude remains low (or non-existent) then—and only then—should the line output transformer come under suspicion, and in this case the best plan is to check the transformer by substitution.

The symptom on the screen (where there is not complete failure of the raster) and the temperature and appearance of the line output valve (and, sometimes, the booster diode) can often give an indication as to where the fault exists. We have already seen that a very hot valve, possibly with the anode glowing red hot, is a good indication of lack of line drive. If the screen grid is red hot lack of anode voltage is a strong possibility which should lead to checks of section A of the line output transformer (Fig. 1) and of the booster diode for emission.

If the left-hand section of the scan is considerably reduced with reduced e.h.t. voltage, the trouble could either be in the booster diode or its reservoir capacitor. If there is no change of condition when the cathode (top cap) connection is taken from the diode, the trouble would then almost certainly be caused by a fault in the reservoir capacitor.

Sometimes a low-value resistor is included in series with the e.h.t. rectifier heater to its winding on the line output transformer. This has been known to go open-circuit thereby muting the e.h.t. voltage without affecting the pulse amplitude at the a.c. points. A resistor might also be discovered between sections A and C of the line output transformer (Fig. 1) and since there is quite a lot of pulse current here this too is a vulnerable component. Its purpose is to damp the e.h.t. overwind to prevent it ringing or oscillating at a natural frequency given by the LC elements of the circuit. If a short develops across it, therefore, the picture will exhibit the ringing symptom shown in Fig. 3, where dark and light vertical bars or lines appear on the left-hand side. If the resistor goes open-circuit there will be no e.h.t. voltage.

Damping resistors are found across most inductors in the line output stage and Fig. 4 shows such a resistor across one winding of the width inductor. This is only one of the techniques in use for controlling the width of the picture. The con-

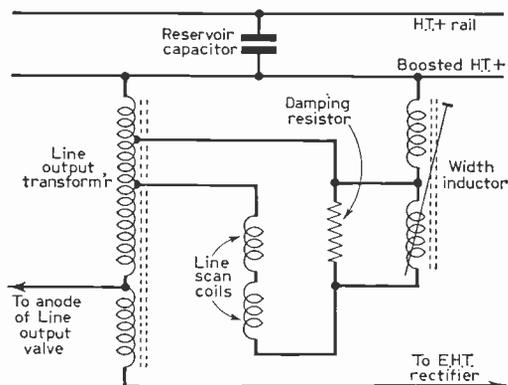


Fig. 4: Width inductor with damping resistor connected across one winding.

temporary method generally uses an inductor of some kind with an adjustable core worked by a piece of wire protruding from the former upon which the inductor is wound. The core regulates the inductance and the greater this is (with the core all in) the greater the impedance offered to the scanning coil current and the smaller the scan amplitude. A damping resistor will also be found across an inductor used for regulating the line linearity. Open-circuit shunt-type damping resistors will incite the "ringing" symptom (Fig. 3).

Line Drive Adjustment

Many sets feature a so-called line drive control. This often takes the form of a preset capacitor in series or shunt with the drive signal from the line generator. This is rather critical in adjustment, for if it is over-adjusted the line output valve could be switched on for longer periods per scan cycle than desirable. This will overheat the line output transformer and possibly lead to its failure. Under-adjustment will reduce the width of the picture and the e.h.t. (and boosted h.t.) voltage. The idea is to set the drive for a stipulated boosted h.t. voltage. If this is not known the next best thing is to turn the control up (clockwise) until



Fig. 5: The symptom of shorting turns in one half section of the line scan coils.

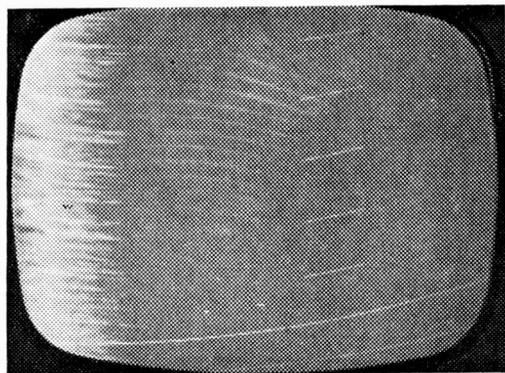


Fig. 6: Symptom of corona discharge in the line output transformer or an associated inductor prior to component breakdown.

a vertical line (not ringing) appears towards the centre of the picture. This represents "overlap" on the scan current waveform (see Fig. 1) and the correct condition is then achieved by gradually turning the preset anticlockwise until the vertical line just disappears.

Line output transformer over-running, often causing frequent breakdown, is also caused by the screen feed resistor of the line output valve decreasing in value. This symptom is accompanied by the anode of the line output valve running red hot.

Shorting Scan Coils and Corona

As already mentioned shorting turns in the line scan coils can damp the system sufficiently to prevent it working. However if only half the line scan coils (that is one half-section) develops a short the extra load is not usually sufficient to mute the action altogether. Instead the symptom shown in Fig. 5 appears on the screen.

Just prior to line output transformer (or associated inductor) breakdown discharges often occur inside the winding—sometimes visible by viewing the afflicted section in a darkened room—and a symptom similar to that shown in Fig. 6 appears on the picture. This consists of a vertical column of short, irregular lines or dashes.

Faulty Dual-standard Operation

It is not uncommon for dual-standard sets to work correctly on one line standard but fail badly line-timebasewise on the other standard. This generally points to failure of a switch section associated with the line timebase on the standard-change slider assembly or trouble in one of the switched components, like the capacitor in series with the line scan coils (the S correction capacitor) or the capacitor and/or inductor changing the third-harmonic tuning of the line output transformer from one standard to the other. If the set works perfectly correctly on one standard trouble on the other standard—from the line timebase and e.h.t. aspects, of course—is not likely to lie in the line output transformer itself but in the switched components or switch, as just mentioned.

TO BE CONTINUED

C.R.T. TESTER

—continued from page 103

two years where before they would have been discarded.

In a few cases tubes have been encountered which show reverse conditions to those of rejuvenation when on normal test, i.e. satisfactory reading at first for a few seconds followed by a slow drop in emission which is little improved by a switch to the boost position. In these circumstances it is best to remove the tube from test if a passable picture was being obtained. Tubes of this type will deteriorate rapidly in use, usually caused by a poisoning of the cathode, and there is no remedy apart from its substitution when its performance is no longer acceptable.

The most misleading result obtained with this instrument is with tubes which have partially short-circuit heaters. These receive an artificial boost on the normal voltage setting. If this is suspected as suggested by the good reading obtained compared with its performance in the set an indication of malfunction can be detected by either: (a) inserting an a.c. ammeter in the heater supply circuit of the tester to check consumption (normally 300mA), or (b) checking the operating voltage of the tube heater in the receiver if it is fitted in a series heater chain. However, after testing a few tubes it is possible to pick out a short-circuit heater from the brightness on test.

In spite of its simplicity I personally prefer to use this instrument even though a commercial unit is available in my workshop and after two years' operation its safety, speed and accuracy has paid for itself over and over again.

COMPONENTS LIST

Capacitor:

C1 5,000 μ F 6V subminiature electrolytic

Resistors:

R1 1k Ω $\frac{1}{2}$ W 10%*
 R2 250 Ω 5W 5% wire-wound*
 R3 1k Ω 3W wire-wound preset pot
 R4 1k Ω 10W 5% wire-wound

* See text

Miscellaneous:

D1 BY100
 F1 1A
 F2 1A
 F3 250mA
 M Moving-coil 5mA f.s.d. (or see text) meter
 N1, N2 Miniature panel neons, 200-250V
 S1 D.P.S.T. light-duty toggle
 S2 D.P. four-way Yaxley break-before-make
 S3 S.P.S.T. light-duty toggle
 T1, T2 C.R.T. heater isolation and boost transformers 6-3V, 1A
 B8H and B12A tube base sockets

BAYNHAM HONRI REPORTS

PHOTOKINA • 1968

THIS vast annual event in Cologne has become larger and larger each year and has achieved great international importance. Nevertheless apart from persons professionally employed in the photographic industry in Britain the general public has the vague impression that it is wholly concerned with still photography. This may have been the case when Photokina was first started. But it has been changed and expanded over the years and now concerns many forms and uses of photography such as motion pictures, sound recording, stills in hundreds of fields, lighting, synchronised flashes, and so on. This year there were no less than 681 firms exhibiting or demonstrating equipment on stands in 14 separate halls. Some stands were of very large dimensions, practically forming photographic exhibitions of their own. Needless to say I refer to such elaborate and interesting stands as those of Kodak, Gevaert, Arriflex and Rank.

Films were mainly catered for in Hall 10 in which several British equipment manufacturers had stands. The biggest surprise was the increased use of video tape in colour (as well as black-and-white) not only for selling itself as a piece of television technical equipment but for demonstrating operational usage of wide ranges of offerings displayed on several monitors on different sites on the same stand, sometimes with six or seven colour monitors side by side. This had an enormous impact. In some cases film telecine was used as an alternative to tape, originated on either 35 or 16mm. film. Video tape using cheap helical scan machines was much in evidence everywhere in the exhibition.

The large contingent of British visitors concentrated on Hall 10, particularly on any equipment which might be concerned with colour television. BBC and ITV engineers spent hours looking at motion-picture cameras, editing machines, colour (and black-and-white) film developing machines and lighting equipment.

There were many items of equipment both for present usage and future trends: which confirmed the impressions given at the IBC Convention where such ideas were supported by lecture papers written and presented by authors from all over the world. It was gratifying to note that the new British television and film studio stages at the BBC, Yorkshire Television, the proposed new Southern Independent Television, Pinewood Studios and the ABPC stages at Elstree fulfilled all the trends and already possess accommodation for such equipment to be installed or techniques operated.

Lighting

There were several stands exhibiting lighting suitable for film, television and still studios. It was quite evident that lighting grids with various

forms of telescopes or monopoles have become popular. The French Cremer system is well advanced but expensive (agent in England, Malham Ltd.). Not all luminaires are pole-operated, but this is the trend. A number of different computer-like dimmer systems (with memory devices) were exhibited, and luminaires for small halogen bulbs. The Berkey and Malham stands were outstanding in this field.

Telescopic television lighting luminaire supports were offered by several firms. Many require lighting grids with slots in them to enable the telescopes to be rolled along the rails and, unfortunately, the gauges of these rails differ. The British gauge has settled down to 2½ in., adopted by Strand Electric, Berkey and Mole Richardson, whereas the Continental manufacturers (using circular telescopic supports) have increased to gauges of 2⅝, 2¾ and even 2⅞ in. British film studios making use of the television-type telescopic luminaire supports have all—or almost all—settled on the 2½ in. gauge and it is now too late to change to a wider gauge, though no doubt there are the I.K. Brunels of today who would like to widen the TV lighting railway gauge! However, new lighting fittings for halogen-type incandescent bulbs are becoming much lighter so the 2½ in. gauge might be right after all.

Motion-Picture Cameras

Dozens of new models of camera dollies were exhibited by different makers. Use of crystal-controlled camera motors is fine on many 16mm. cameras and even on projectors (for dubbing) but no crystal-controlled 35mm. cameras were demonstrated. Twenty-five frames per second was sometimes offered as an alternative to 24 frames per second. Nobody has yet produced a zoom lens to beat the Angenieux 10:1 zoom, available in focal length 24 to 240mm. (with an expensive periscope device) or a 25 to 250mm. zoom. The need for a 5:1 zoom, say 20mm. to 100mm., of acceptable quality was a topic of conversation by film and television cameramen and engineers, and Taylor, Taylor Hobson's name was often mentioned in the hope that this British company would offer a 5:1 zoom lens with the same quality and resolution that their single fixed-focal length lenses achieve.

Arriflex and Debrie supply cameras with torque motors to aid the take-up of film magazines. This device is especially suitable for quick starts with electronically aided 35mm. cameras such as those used for Electronic Cam and Add-a-Vision, and in this respect the Arriflex E.-Cam system is ahead. The Mitchell stand included the new reflex BNC camera—significantly within a blimp. Mitchell's are shortly embarking on a brand-new approach to a motion-picture camera but this won't be completed for another two years.

Sound

The general use of $\frac{1}{4}$ in. tape with synchronising pulses for film stage interior use (as well as for exteriors) is now becoming a normal practice. Nagra, Perfectone and Leever's Rich were exhibited, together with many other makes. Crystal control of the recorder speed so that the special synchronising cable lead is not necessary if the 35mm. camera also has a crystal-controlled drive was talked about. The latter is still in the future but it won't be long and Arriflex and Eclair have it in an advanced stage of development.

Editing Machines

There appeared to be several new makes of editing machines for both 16mm. and 35mm. use, most of them of the continuous motion table type like the Steenbeck. Some of them were fitted with a TV monitor as an alternative and one had a large colour TV monitor. The quality of the Steenbeck, Arriflex, Prevost and Keller machines is first class and is the type generally used on the Continent and for television in England. However feature-film editors in England and the USA prefer the intermittent Moviola type machines because they are quicker and easier to thread up. Continuous motion editing machines are quieter in operation and kinder to the film, however, and when film is being edited in negative form this type is essential. Rotating prisms or mirrors arrest each frame of picture; this optical method has been much improved in the last few years. Steenbeck displayed a splendid (but expensive)

editing machine with a cluster of Plumbicon colour TV cameras giving excellent quality.

Keller exhibited various 16mm. and 35mm. editing machines of new and original types including a system with interlocked sound machines coupled with electronic play-offs intended for re-recording dialogue, music and effects. These dubbing machines can reverse at four times speed in the event of a "fluff" and the section of sound which requires retake can be fitted in perfectly. The Keller play-off can also be used for reproducing on a monitor anywhere in a studio, enabling a commentary or a musical background to be recorded for subsequent editing and re-recording. It could also be conveniently used in the preparation of sound effects, with or without the British Mellotronics sound effects machine which reproduces no less than 1,260 sounds at a touch on the keyboard. This is now becoming a "must".

Other Equipment

The "hi-Spy" system of remote camera control on a telescopic mast was demonstrated by Snell Aerial Photography. This is like a boom supporting a still or movie camera up to great heights. Though more suitable for news items and television it might have uses for special shots in feature films. Snell Aerial Photography Ltd. is a London firm.

Other gadgets are improving. Many exhibitors had improvements to synchronised flashlights, some of which I think could be controlled in phase with

—continued on page 129

Practical Gift

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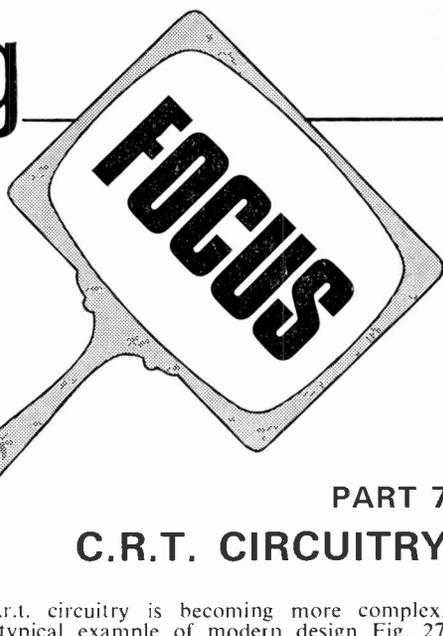
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fault finding



ILL comparatively recently c.r.t. circuitry was quite simple and generally involved a mainly resistive or direct feed from the video pentode anode to the tube cathode with the latter's grid connected to the slider of a brilliance potentiometer shunted across the h.t. rail and chassis. Cathode c.r.t. drive has almost always been employed since it means that both the video pentode and the tube can be biased well back to pass minimum current on no-signal while if for any reason video anode current ceases the screen is blacked out.

With the introduction of pentode and multi-electrode tubes cathode drive confers a further advantage, for it has a markedly improved sensi-

BY S. GEORGE

tivity over an equivalent grid drive. This arises because in somewhat similar manner to pentode valves tube beam or anode current is determined by both first anode (screen) and final anode voltage.

For grid drive the cathode potential is held constant while a positive-going grid signal increases beam current. Oppositely for cathode drive the grid potential is held constant while a negative-going cathode signal increases the beam current by lowering the instantaneous cathode potential and thus increasing the voltage between the two electrodes. With cathode drive, however, as the cathode potential is reduced thereby in effect increasing the grid voltage it also increases the first anode voltage by the same amount so that the beam current is increased by the joint raising of the grid and first anode potentials. The effect is graphically shown in Fig. 26.

To cater for dual-standard transmissions it became more convenient to employ a.c. coupling from the video pentode to the c.r.t. cathode while the resulting higher no-signal brightness level made effective line and field flyback blanking all the more necessary. A capacitor-fed video signal both increases and decreases instantaneous beam current so that a midway no-signal brilliance setting is required.

Most receivers now include some means for suppressing "switch-off" spots which can in time cause a small phosphor burn in the screen centre, while switching is sometimes incorporated to both blank the screen and stop the line output pentode working during system change.

Representative Circuits

A variation of the "high-level" contrast control system pioneered in many Pye, Ekco and Ferranti models is now being used by Bush and Murphy, so that overall the general trend of video drive

and c.r.t. circuitry is becoming more complex. As a typical example of modern design Fig. 27 shows the tube circuitry used in those Bush-Murphy receivers using a "high-level" contrast control and it will be seen that the required degree of tube drive or contrast is taken from a $10k\Omega$ potentiometer in series with a $4\mu F$ electrolytic capacitor shunted across the $3.3k\Omega$ video amplifier load resistor. Except at very low frequencies the reactance of this $4\mu F$ capacitor is small in comparison to the potentiometer. It thus serves to taper off the lower end of the frequency spectrum and also prevents direct current flowing through the control to keep its operation noise free.

Video feed is via an $0.15\mu F$ capacitor and a lead which also connects the fixed cathode bias voltage tapped from the brilliance control. This

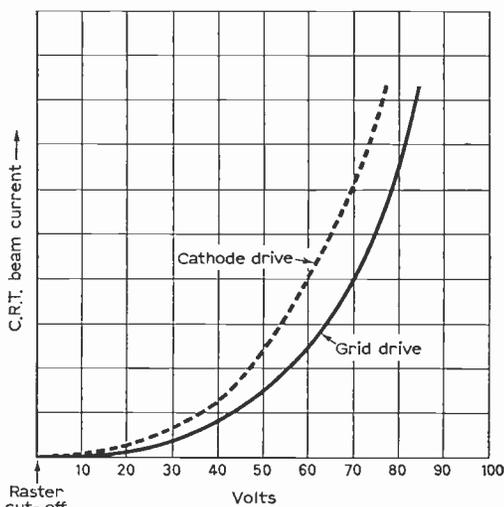


Fig. 26: Graph showing the increased sensitivity of multi-electrode tubes to cathode drive compared with grid drive.

PART 7

C.R.T. CIRCUITRY

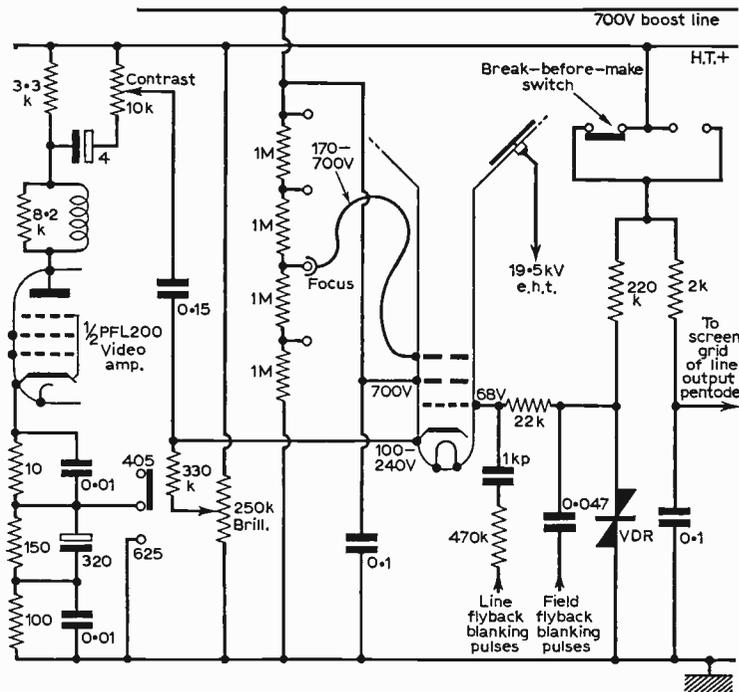


Fig. 27: Picture tube and video output stage circuits used in the Bush-Murphy models featuring high-level contrast control.

leaves the tube grid free for the injection of flyback pulses tapped from both sets of scan coils; it is maintained at a positive voltage by the potential developed across a v.d.r. at the base of a series network also feeding the line output pentode screen. Contacts in series with this feed open while the system switch is being operated and the resultant removal of h.t. from the line output valve screen grid prevents the generation of possibly damaging surges in its highly inductive anode circuit while removal of h.t. from the c.r.t. grid blanks out the screen during this brief period.

While the v.d.r. holds the tube grid voltage constant in normal use and thus maintains a fixed brilliance level its main function is to prevent the formation of "switch-off" tube spots. This is accomplished because the resistance of a v.d.r. increases with reduced applied voltage. As the h.t. voltage drops following switch-off the v.d.r.'s resistance rises so that most of the available h.t. is developed across it. This keeps the tube grid voltage highly positive, producing a heavy beam current which discharges the e.h.t. before the scan completely collapses thus dispersing the final beam current over quite a wide area of the screen.

Focus electrode potential is never very critical on modern tubes and the four-position tapping adjustment provides ample variation. Flyback blanking pulses are fed by series RC combinations to the grid from the respective line and field scan coils. In this particular model the grid voltage is 68V positive with respect to chassis and the cathode potential can be varied between 100 and 240V positive with respect to chassis by means of

the brilliance control: the net effect is that the grid is negative to cathode between 32 and 172V.

In the STC circuit shown in Fig. 28 a.c. coupling to the c.r.t. is again employed but this time the cathode voltage is kept constant from the d.c. point of view by a fixed potentiometer network across h.t. and chassis. The tube grid must therefore be taken to the brilliance control slider and in this model the control is flanked on both sides by a high-value limiting resistor. The top limiting resistor is fed from system switch contacts which again open during system switching to remove the line output valve screen grid voltage and c.r.t. grid voltage. The earthy end of the lower limiting resistor is connected to the neutral mains lead *before* the on-off switch. On switch-off, therefore, as there will be no current passing through the potentiometer or limiters, the slider potential will equal that of the h.t. rail and the sudden momentary increase in grid potential will discharge the e.h.t. before the scanning circuits fully collapse, again eliminating screen spots.

Frequency Response

An interesting feature of this design is that there is a 330 Ω decoupling resistor in series with the 4.7k Ω video amplifier load resistor, the junction of the two resistors being decoupled to chassis by a 50 μ F electrolytic capacitor. Down to medium frequencies the reactance of this capacitor is very low so that it effectively earths the top end of the load resistor. At low frequencies when its reactance becomes comparable or greater than that of the 330 Ω decoupling resistor however this no longer holds true and the effective video amplifier load is virtually the addition of these two resistors plus to some extent the d.c. resistance of the h.t. supply system. As pentode amplification is approximately equal to $g_m R_a$ i.f. amplification proportionately rises. As on the other hand the video amplifier screen grid is decoupled by only a 220pF capacitor negative feedback will assume significant proportions at a relatively high frequency. The net result is that a generally linear frequency response curve is obtained. Such measures are particularly required when a.c. video coupling is employed to compensate for the loss of gain and phase shift at the lower frequencies.

Direct Drive

In receivers employing direct drive to the c.r.t., as was generally used in earlier models, it was

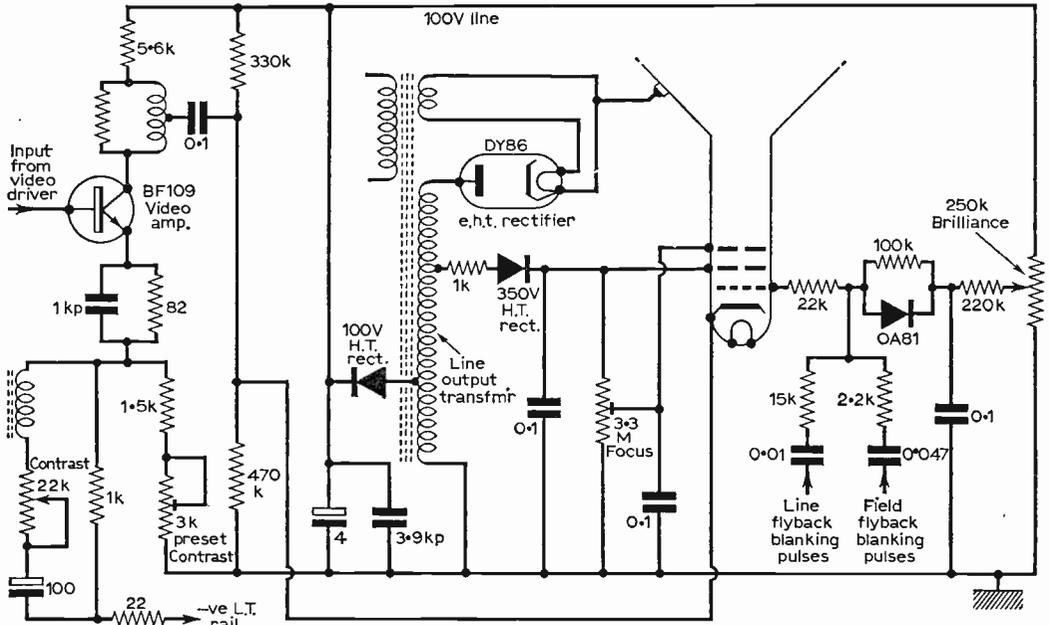


Fig. 30: Video amplifier and picture tube circuits. Perdio transistor portable model (late versions). In addition to the e.h.t. the line output transformer provides 100V and 350V h.t. supplies.

As well as absence of e.h.t. or presence of a.c. e.h.t., inability to obtain a raster can be due to absence of first anode or grid voltage. Zero first anode voltage is similar to zero screen grid voltage in a pentode valve, while zero grid voltage with normal cathode potential is equivalent to biasing the tube to the full value of the latter. This will naturally always be more than sufficient to completely cut off beam current.

A.c. e.h.t. is mentioned because some puzzling instances of blank screen with e.h.t. apparently present have been found to be caused by breakdown or ionization in the e.h.t. rectifier causing it to pass both negative and positive half-cycles. An attendant symptom with this fault is sparking at the aquadag earthing contacts due to the constant charge-discharge current to the tube capacitance.

Servicing

Blank screen: In modern receivers employing a.c. coupling to the tube the most common cause is zero first anode voltage in turn caused by a short-circuited decoupling capacitor. In older receivers and those with direct coupling a burnt out video amplifier cathode or screen feed resistor due to an internal short-circuit in the valve is fairly common. This results in the video amplifier anode voltage and therefore the tube cathode rising to the full h.t. voltage thereby cutting off the beam current.

C.R.T. internal disconnections are rare but when suspect can often be verified by gently tapping the neck near the base and noting if this results in spasmodic glimpses of picture. With e.h.t. and first anode voltage present the surest way to check a

tube is to temporarily short-circuit the grid and cathode pins when a full-brilliance raster should be obtained. If the raster fails to appear the tube has an internal disconnection. Appearance of a raster will indicate on the other hand that the cathode voltage was too high or the grid voltage too low at the maximum brilliance setting. Voltage comparison with the relevant service sheet will soon show where the fault lies, but it must be remembered that due to the high value of resistors employed voltage readings can be considerably less than those listed unless a meter of high internal resistance is used. For this reason many service manuals indicate the ohms/volt resistance of the testmeter used in their preparation. If your meter does not have a particularly high internal resistance use it on the highest range compatible with a fair needle deflection.

Blank raster: With normal sound and an a.c. coupled tube lack of screen modulation could be due to a defect anywhere back to the common vision and sound i.f. stage, but with d.c. coupling the video stage can generally be ruled out at first since failure of the video valve to pass current would black out the screen.

Undoubtedly the best move is valve substitution followed by a check of the vision detector diode, but as we are here concerned only with the video amplifier stage and c.r.t. feed check the signal path from the video amplifier grid by feeding a small a.c. voltage to this point. The simplest way of doing this is to connect a capacitor of about 0.1μF from the "live" c.r.t. heater pin to the grid. The small a.c. or "half-way" current in the case of receivers with a rectifier in the heater feed

should produce a well-defined hum-bar. If this test produces no effect there may be a short-circuit across the input to the video valve—due to a shorting solder blob or a bared lead—or the feed capacitor to the tube may be open-circuit or dry-jointed.

Video stages are basically simple and when they completely fail to operate can usually be quickly put right. Remember however that a short-circuit across the video cathode resistor of a 405-only receiver will usually result in an *almost* complete loss of vision since being unbiased the positive-going input will just attract grid current and produce little effect on anode current.

Limited brilliance control: This most generally takes the form of inability to completely kill the raster rather than inability to obtain full raster brightness and though it might appear to be simply due to value change in a resistor associated with the brilliance control network this is very rarely the case. In almost all instances the effect is due to interelectrode leakage in the tube. If the leak is from the first anode to another lower-voltage electrode or to an earthy point the resulting increased drain on the boost h.t. rail often becomes apparent through inability to secure full height.

Poor tonal range: This fault is usually most apparent on 405 giving a "soot-and-whitewash" picture due to the video amplifier valve being over-biased and operating too close to current cut-off. The most common cause is not an increased value cathode bias resistor as might be supposed but a *reduced* value stabilising resistor connected from h.t. to the valve's cathode.

This fault also results in impaired amplification of the low-amplitude 405 sync pulses which in turn can produce two simultaneous symptoms, (a) weak sync lock and (b) insufficient a.g.c. due to reduced negative voltage being developed at the sync separator grid.

Raster shading: Raster brightness level gradually decreasing from one side to the other irrespective of brilliance control setting is almost always due to inadequate decoupling of the boost h.t. feed to the first anode. Shunting each suspect capacitor in turn will soon show up the culprit.

Hum-bars: Hum-bars usually originate in stages prior to the video amplifier. The most frequent cause is heater-cathode leakage in a signal-amplifying valve, but on occasions ineffective h.t. smoothing may be the cause. Valve substitution and shunting suspect capacitors is the quickest way of localising the cause.

Transistor Circuits

Except in the Thorn fully solid-state colour television chassis transistor video stages are mainly employed in the battery/mains type of portable made by Philips, Sony and Perdio. Basically, the circuitry is similar to valve technique but because these receivers can be operated from 12V batteries the power supply for the video amplifier

has to be derived from the line output stage for there to be sufficient voltage swing across the video stage load resistor to drive the c.r.t. from cut-off to full brilliance and provide the sync pulse amplitude.

As well as providing the boost h.t. for the tube first anode and focus electrodes the transistor line output stage must also supply a comparatively high voltage for the brilliance control so that it can adequately vary the tube grid voltage to set the required no-signal brightness level. The video stage, c.r.t. supplies and line output stage are therefore closely integrated so that a fault in one subcircuit can produce effects in another.

As an example of how the various tube h.t. supplies are derived Fig. 30 shows the basic circuitry used in the Perdio Portarama 3. The e.h.t. winding feeding the DY86 e.h.t. rectifier has two tappings near its earthy end, one providing a 100V supply and the other a 350V supply. The former supplies the BF109 video output transistor and the 0.25M Ω brilliance control while the latter voltage is used for the tube first anode and focus electrodes. Flyback blanking is applied to the tube grid with the video drive supplied from the junction of a fixed potentiometer to the cathode.

As is general practice with transistor video output stages the gain or contrast control consists of a variable resistor in the emitter lead which varies the negative feedback and the general circuit constants.

Transistor Servicing

The causes of blank screen in valved receivers generally have the same effect with transistor receivers save that with direct coupling failure of collector current due to an open-circuit emitter resistor or complete absence of forward bias for any reason can raise the tube cathode voltage to an excessive figure.

General servicing technique remains the same but as transistors can easily be damaged by transient pulses or even by drawing excessive arcs from nearby high voltage points the following precautions must be followed. (a) Do not bridge capacitors, especially those in power circuits, while the set is switched on. (b) Always use a test prod to avoid inadvertently shorting adjacent printed circuit wiring or earthing voltage-carrying points. (c) Isolate signal tracers and injectors with a small-value capacitor. (d) Use a heatsink and minimise soldering time when replacing semiconductors of any type.

TO BE CONTINUED

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PART 14 M. D. BENEDICT
COLOUR BROADCASTING—3

OUTSIDE broadcasts are probably the most spectacular source of colour programmes. When a broadcasting organisation considers colour equipment an outside broadcast unit is a very attractive idea in terms of value for money since o.b. equipment can always be used in a studio as well as elsewhere but studio equipment is confined to studio productions. At present the BBC uses three colour o.b. vehicles and ATV uses one as do several of the independent studios in particular Intertel. Most of these units are equipped with the Philips three-tube camera since this was the first Plumbicon colour camera available; because of its great sensitivity, ruggedness and light weight it is greatly appreciated.

Camera control units for this camera are somewhat bulkier than for image-orthicon c.c.u.s and space within a vehicle needs to be used more carefully or conditions are cramped. Basic facilities are similar to the ordinary outside broadcast vehicle units—three to four cameras are the normal complement. As in a studio two colour monitors are used with a third for the engineers. It is normal to have one racks operator for two monochrome cameras but as lighting on o.b.s is not under control this necessitates considerable adjustment of controls. O.B. use thus requires an operator for each camera.

Coding and handling equipment follows studio practice and the BBC units are equipped with natlock facilities. Colour hand-held cameras are becoming available as are equivalents to most facilities found in monochrome working such as remote cameras and video disc recorders featuring instant replay with "freeze frame."

Filters are often used on o.b.s to correct for colour temperature effects or changes of lighting due to clouds passing over the sun. Mixed natural and artificial light has to be carefully controlled by filters as with filming. However, with television any errors can be seen and corrected immediately.

Colour operation is much more costly than black-and-white, particularly capital expenditure. Cameras cost about £25,000 (a monochrome broadcast-quality image-orthicon camera costs £10,000). A colour studio or mobile control room costs around £300,000 to equip and once equipped a considerable amount of familiarisation is

required to convert from black-and-white techniques (both technical and production). BBC personnel undergo various courses, the technicians working on a short residential course at the BBC's training college in Worcestershire whilst production staff have familiarisation courses of demonstrations and a practice production in the experimental colour Studio H.

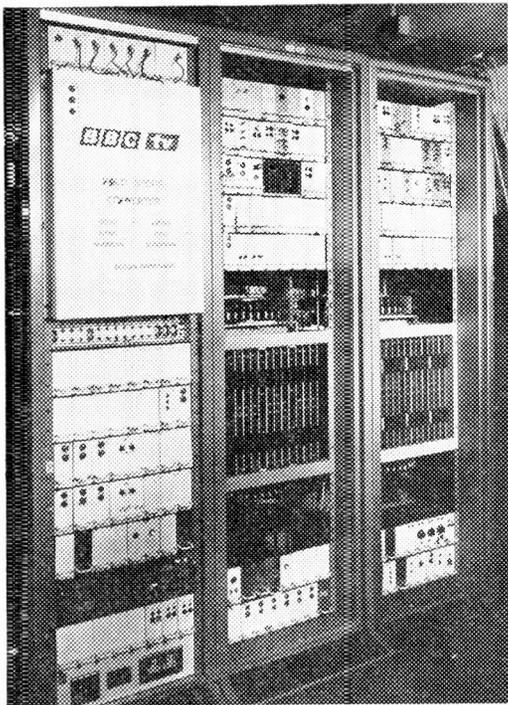
Intertel, a company offering outside broadcast facilities, foresaw the demand for colour and equipped two units, one with elderly Marconi image-orthicon channels and the second with Philips cameras. Several of the commercial companies, particularly Rediffusion, recorded shows in the studio simultaneously on 525-line NTSC using Intertel facilities and on 405 lines using studio cameras. Monochrome cameras (with a neutral-density filter to reduce the light considerably) and colour cameras worked alongside each other and the results were very similar. Home viewers saw the 405 version whilst the 525-line recording was exported to the USA. In this way all production personnel gained a lot of colour experience without the considerable cost of operating their own equipment. Technicians too learnt much from their Intertel colleagues.

ABC, who pioneered much of the SECAM system, and ATV bought colour equipment, ABC TV Marconi Mark VIII cameras and ATV a m.c.r. with Philips cameras, using these facilities to record shows for the American market and recoup some of their expenses.

Colour Equipment Line up

In operation colour equipment takes more people much longer to line up. Camera operators set up each tube and its channel to give optimum quality before checking registration. Naturally four-tube and "contours out of green" cameras are less affected by poor registration but since the effects of poor registration are less obvious it becomes somewhat harder to get it exactly correct. Colour balance is checked by setting the gains and black levels for each channel before pointing the camera at a special chart with a grey scale in order to check that the mid-greys are balanced. Correct gamma correction is essential to achieve this balance or tracking of each colour right through from black to white. In order to give a reference an illuminated opaque screen, often with a neutral-density filter, is placed near to the colour monitor used to balance pictures. Eyes tend to adapt to a given colour temperature of reference white and considerable errors of judgement may occur if the operator has been viewing under low-wattage tungsten lighting, for example.

Studio equipment, like modern monochrome equipment, needs occasional checking of gains, etc., but most of the extra equipment for colour can be set up using an oscilloscope or a vectoroscope. PAL is considerably easier to handle than NTSC and its coder is set up using an oscilloscope only. In most studios distribution amplifiers are each set to 0, 6 or 15dB gain and any losses between amplifiers are added to bring the total loss up to these figures. Handling colour requires very accurate amplifiers but the design and quality of such amplifiers is of the highest standard so that it is now practical to build an amplifier of a given gain using a lot of feedback to stabilise the gain.



BBC field store converter for converting colour pictures between the US 525-line, 60c/s NTSC standard, and the 625-line, 50c/s PAL standard used in the UK. The electronic equivalent to a high-speed rotary switch is in the centre of the two right-hand cabinets. BBC photo.

Encoded signals can be handled without any adjustment of such amplifiers.

Lighting is usually a tedious process both for black-and-white and colour. More care is needed when planning a colour production and a higher light level is used, about twice that of a monochrome studio. Cameramen have a slightly larger camera to manoeuvre and of course they are working in brighter lighting levels. Practically all studios are air conditioned so it is not appreciably hotter in a colour studio in spite of the extra lights. In general it is the engineers who work harder for colour television.

Programme Production

In drama particularly it is necessary for everyone to know what is happening a lot earlier than is normal in black-and-white practice. Corners cannot be cut in the same manner and everybody must plan ahead much more otherwise too much time will be wasted. Probably the hardest job falls to the designer who decides on the sets and their arrangement and selects props. Colour television exaggerates the amount of colour in a picture and if a drab sordid slum interior is called for little or no colour must be allowed on the set otherwise it will start to appear colourful and gay thus ruining the impression of drabness that the director requires. One phrase which sums up the designer's approach is "the best colour is least colour" and this applies to ward-

robe design as well. More care and taste are required of the designer and wardrobe staff when colour television is used but comparatively little of the normal monochrome practice needs to be altered. Make-up also needs to be more careful and subtle as any slight tendency away from a good skin tone tends to be exaggerated by the camera. Six o'clock shadow and the ruddy glow that alcohol brings are two examples of this.

Producers and directors preparing a programme for the screen need to change plans as work progresses in order to cope with snags as they arise. Good colour, much more than good black-and-white, depends upon co-operation between all personnel planning the programme so a much tighter liaison is required with all changes detailed so that any further snags can be sorted out before the production reaches the studio floor.

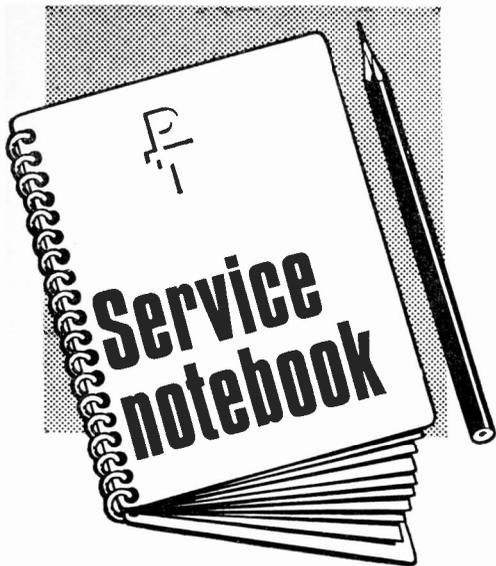
All the small delays will add up and until experience in colour working is achieved it will not be possible to break the rules as much as in ordinary black-and-white productions. Studio time is always precious and with technical line up taking a lot longer and the many other complications of colour this time is in even greater demand. American experience was not encouraging since when colour started in the States it was very limited and producers went all out for the most complex productions of colourful spectacles and made the colour a key feature of a production. Technically colour equipment was far harder to handle and as a result of all these problems on top of what would have been complex and difficult monochrome production colour television got a reputation for being very difficult. Unfortunately the impact of these productions was largely lost as only a fraction of the viewers had colour receivers.

In spite of this the BBC is trying to maintain its productivity in terms of studio time and man hours. BBC-2 is almost entirely colour and when the black-and-white studios are re-equipped for colour productions BBC-1 may start being recorded in colour. Wisely the BBC are treating colour as "hi-fi" television, colour adding realism. Approaching colour in this way ensures that good as colour programmes undoubtedly are they are still interesting for the viewer receiving them in black-and-white. At all stages the producer must bear in mind that the majority of his audience cannot afford to view in colour yet.

Following through this bold approach to colour television the BBC introduced colour as a complete service rather than the odd programme. Other organisations are following this idea, Yorkshire Television installing only colour equipment in their new studio centre even though their colour transmissions are some time away.

Colour television in this country seems to be following the opposite course to America. Three rules are becoming apparent: first no loss of productivity can be allowed by the introduction of colour; secondly colour must not become the reason for a programme and any colour programme must be attractive in monochrome; and finally as all types of programmes are suitable for colour as many as is technically possible are transmitted in colour.

TO BE CONTINUED



by G. R. WILDING

WE were called to a four-year-old Ferguson 19in. set the other day which the owner complained sometimes had sound-on-vision and at other times vision-on-sound. As anticipated we found that the preset tuner settings were varying due to the mechanism simply working loose, although to the owner it seemed that the entire unit was faulty. In this and many similar models made by the Thorn group—HMV, Marconi and Ultra—a simple and reliable mechanical system is used (see Fig. 1). A thick circular plate is fitted to the extended tuner shaft and round the edge are mounted a series of adjustable nylon screws, one for each channel, which can press on a spring plate mounted on the tuner to operate a miniature variable capacitor across the local oscillator circuit. As the tuner shaft is rotated the varying extent to which the nylon screws protrude from the plate varies the setting of the push-bar.

In this particular model, however, and as frequently occurs after some years of service, the circular plate had simply worked loose and needed resecuring with an Allen Key into the sole grub screw. This grub screw is hard to see unless you first remove a thin retaining disc from the main plate, and it is usually necessary to remove the complete tuner from the cabinet. However this is a simple matter and only involves removing the knobs and four large securing nuts. After securing the circular plate it only remains to reset the nylon screws, in most models by a rear-mounted, spring-loaded plunger which can engage with a toothed head to the nylon screws.

The vital point to watch is that the circular plate is secured closely to its original position to ensure that the nylon screws are able both to depress the push-bar to its fullest extent and permit it to rise to its full height. There are tens of thousands of models with these preset v.h.f. tuners, and once you know the drill it is easy to transform what at first sight may seem a big job into a minor adjustment.

Weak Field Hold

A modern dual-standard KB receiver had weak field lock but normal line lock. Our first move was naturally to replace the PCL85 field oscillator output valve, but this produced no improvement. Our next move was not to replace the sync separator but the video amplifier since experience tends to indicate that this would be the more probable of the two, and doubly so in this particular model in which the triode section of the PCL84 video output valve is employed as an amplifier of the field sync pulses. On replacement field locking was found to be perfect but whether it was due to a defective pentode or triode section of the PCL84 was impossible to determine.

Sync separator valves rarely give trouble since during most of their working life they are virtually cut-off while having a low screen grid voltage they do not pass a high anode current even when driven hard on by the positive-going sync pulses. We tend to replace these valves first when there is a complete or near complete failure of sync on both timebases.

If changing all suspect valves fails to cure weak field lock in older receivers we then check any germanium diode interlace filters, while if there is only weak line hold in receivers with flywheel sync we similarly check the discriminator diodes. Indeed in some Bush/Murphy flywheel sync models defective diodes have been known to completely prevent the line oscillator working. All this is not to be taken as a condemnation of miniature diodes for nowadays they are extremely reliable, but following the system of testing all those components which could possibly be at fault but can be tested in situ it pays to try them first.

While the main requirement is that they have a high reverse/forward resistance ratio, with discriminator diodes they should have sensibly equal values on forward conductance. Naturally when first fitted the diodes' forward resistance will be

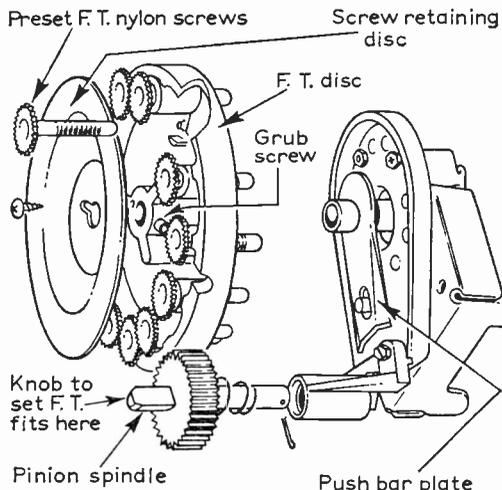


Fig. 1. Preset line tuner mechanism used in many Thorn models.

within close limits so that any undue variation between the two will indicate a change and merit the component's replacement. Ideally in flywheel sync circuits replace both.

Occasionally we get seemingly freak causes of weak field sync—for instance in some recent Thorn group models poor field locking on u.h.f. only can be caused by a defective EF184 vision i.f. amplifier. On u.h.f. the sync pulses rise to 100% of the carrier and can run a faulty valve into grid current and/or saturation thereby clipping the peak pulse amplitude.

Impaired h.t. smoothing can also make field hold weak, while I can recall many other Regentone/R.G.D./Defiant receivers whose i.f. slugs sometimes shifted after years of use to result in a restricted bandwidth with slight ringing that mis-shaped the comparatively long time-constant field sync pulses and impaired locking. Customers usually failed to notice the gradual decline in resolution and only complained when the field hold got 'edgy'.

I have also known the actual preset potentiometers cause impaired locking by developing a leakage from track to metal casing due to carbon dust inside the control or to an over-liberal application of cleaning fluid not meant for this purpose, i.e. petrol or lighter fuel.

In earlier models using blocking oscillators, transformers with impaired winding insulation to core often produced weak locking, and this must also be regarded as a possibility in transistor receivers that use this type of timebase oscillator rather than the multivibrator generally used in valved receivers today.

TV AND POLITICS

—continued from page 99

as well abandon home, club and pub discussions and, to do the job properly, dispose of the Opposition in parliament.

Mr. Benn continued: "Important subjects are skimmed, important discussions are telescoped and conflicts are artificially sharpened." To this Mr. Crossman demanded long "undocored" transmissions of Parliamentary proceedings, lasting at least one hour. Firstly, what is important? To an apiarist, beekeeping is important. And who is to select which proceedings to broadcast? Do the party in power select the best times for their "instant pundits" to shine, or pick sessions most likely to show them in a good light? Who, then, would be guilty of doctoring?

Mr. Crossman in particular was acid about the programme times given to "trivial and unimportant" subjects. If, he argued, wrestlers get 60 minutes a week, why not politicians? There is a quick answer to this one. Broadcasting organisations carry out intensive viewer research and by and large the box provides what most people want. A search through both BBC and ITA handbooks failed to reveal any figures on party political broadcasts but it does not require a research expert to know that the ratings are very low indeed. And even so, most viewers only regard them as an interval to brew up coffee.

A curious remark from Mr. Benn was that:

"If the BBC, which does not depend on advertising, follows a programme policy that is indistinguishable from ITV, which does, then people might well ask what is the case for having a licence fee and a public corporation anyway." People might also ask that if, as suggested, the two organisations follow identical policies, why is it that Mr. Benn mounts a slashing attack on the BBC yet says nothing about ITA! They might conclude that it is the BBC itself, rather than their policies, for which Mr. Benn is gunning.

This might also gather weight in view of the display of sour grapes evident in the view that "With the exception of the Government itself there is scarcely any other body in Britain enjoying as much power as the BBC." And does this not bear out a one-time statement from the speaker that there is an "overwhelming technical case for a monolithic broadcasting organisation?"

The episode may simply be a storm in a teacup but as neither politicians nor broadcasters we of Practical Television feel a little alarmed and despondent at the possible implications. Both Mr. Benn and Mr. Crossman were at great pains to stress that they were expressing their personal views but it seems odd that two Ministers should virtually simultaneously make attacks on roughly the same lines. It seems odder that no official views have been forthcoming. One could well ask if there is any connection between all this and the deteriorating relations between the Prime Minister and the BBC and, to be even more cynical, the recent appointment of Miss Judith Hart as Propaganda Minister (or should we say Paymaster-General?).

Seeing that he feels so passionately about the matter it is another oddity that Mr. Benn made no public protest while he occupied the office more appropriately concerned—Postmaster-General. Or perhaps Mr. Benn thinks he still is PMG. At least we have had no word from the present incumbent of that office!

Perhaps the best summary to all this is the opinion of Mr. Christopher Mayhew MP who said: "The greatest enemies of free serious political television are not the broadcasters but the political leaders." In other words:

Politics is really too important to be left to the politicians.

W. N. STEVENS—Editor

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To mark the 21st anniversary of the advent of the transistor, a special feature simply explaining solid state physics in relation to transistors, diodes and other common semiconductor devices.

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all in the JANUARY issue.
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USING LENSES

IT is an odd paradox that many constructors of CCTV equipment have more difficulty with the lens systems (considered an easy part of A-level physics) than with the electronics (considered too difficult and specialised for A-level physics), and this is almost entirely due to a lack of appreciation of how lenses work. Since lenses are essential parts of television transmission equipment, being involved in projection, cameras, and beam splitting, some account of their operation seems desirable.

REFRACTION

Light is a v.h.f. radiation of frequency around 600 million Mc/s. At such a frequency the normal methods of generating microwaves which serve us well up to a few thousand Mc/s are useless and we depend on the oscillation of electrons within atoms to generate light; such oscillations become suitable when substances are heated, when electric currents are passed through gases, or when certain chemical reactions occur. Though we may appear to be at some disadvantage in generating this frequency we are all equipped to receive it by our eyes; we can also use devices which convert the energy of light into electron movement (photocells).

Experience of radio waves shows that the higher the frequency of the wave the more nearly its path approaches a straight line, and this is true for light; the amount of deviation from a straight line path is so small that it was not discovered until fairly late in the history of physics. In free space, as for any other v.h.f. radiation, the speed of light is 300,000,000 metres per second (about 186,000 miles per second). It is a good antidote to 20th century superiority to think that this speed was first measured in 1676 by the astronomer Römer, using nothing more than a clock and a telescope. We today with all our modern equipment have devised new methods but not superior thought on the subject.

When any electromagnetic wave, radio or light, passes from free space to some denser medium (glass etc.) its speed becomes less. It is for this reason that the speed of a waveform in a cable is always given as less than the speed in free space and the lengths of TV aerials are slightly shorter than the half-wavelength they would be in free space. Also because of this the direction of a beam of light must change when it passes from air (almost free space) to glass (a denser medium) unless it hits at 90°. Fig. 1 shows why

this should be so: to slow down, the wavepeaks must crowd closer together, but unless new light is to be generated the wavepeaks in glass must touch the wavepeaks in air at the surface of the glass. The only way of achieving this is to bend the beam, the process called refraction.

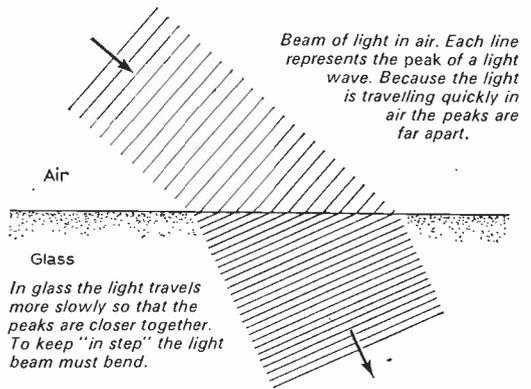
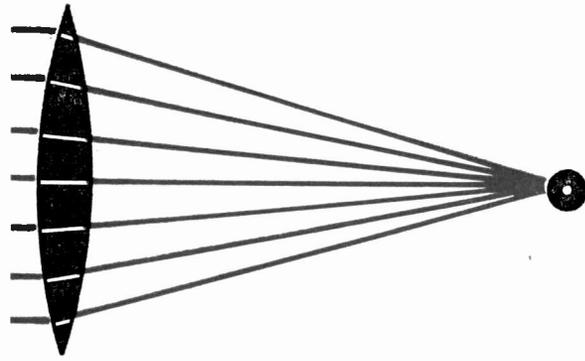


Fig. 1: The process of refraction.

The refraction of a beam of light at a glass surface is shown in Fig. 2. The relation $\sin i/\sin r$ is known as the refractive index of the glass and measures the amount of refraction which is experienced by a beam travelling from air to glass. If we reverse the direction of the beam, the path is the same.

PRISMS

Prisms use this principle of refraction to alter the direction of a beam of light (Fig. 3). Light travelling from air to glass is refracted farther from the surface; when the same beam of light leaves the prism it is reflected more towards the surface; and because of the shape of the prism these two refractions do not leave the beam travelling in the same direction (as would a glass block) but deflected in another path. Prisms can therefore be used to make cameras "look sideways", and, given suitable angles, even backwards. A 90° prism (Fig. 4) is particularly useful in this way as it enables the light paths, as shown, to be reflected at either 90° or 360° to the original path. This effect is due to *total internal reflection*. When a ray of light in glass is



refracted into air the angle in air is always closer to the surface of the glass. As the angle of a ray in glass is brought closer to the surface a point is reached where the angle in air becomes zero (the ray then runs along the surface of the glass) and at even closer angles within the glass the ray reflects back inside the glass without entering the air. This happens at an angle between ray and glass of anything less than 55° (approximately, depending on the type of glass), and this angle is called the *critical angle*. In a 90° prism, the light coming in at 90° to the surface hits the glass of the next face at 45° and is therefore reflected.

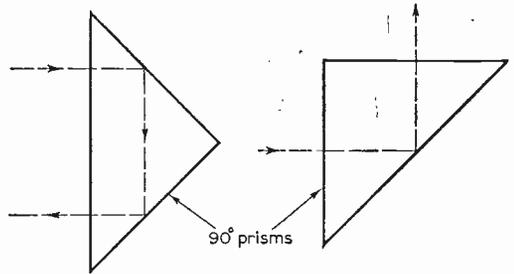


Fig. 4: Uses of 90° prisms.

LENSES

A lens may be looked on as a set of joined up prisms (for microwaves lenses can be made of large prisms—of suitable material, usually ferrite—joined up) all acting on the light (Fig. 5). The line drawn centrally through the lens at right angles to the lens surface is called the *axis*, and in a thin lens all rays of light which arrive on a path parallel to the axis pass through one point after they have been refracted in the lens. This point is on the axis, and is called the *focus* (Fig. 6). The distance from the centre of the lens to the focus is called the *focal length*. In a thin lens the portion of lens round the centre has little lens effect since the sides are approximately parallel to each other, and any ray of light going through the centre can be drawn straight through since it is hardly deviated at all.

We can now show how an image is formed by a lens. If we imagine light beams leaving any point on an object held in front of a lens, and if the effect of the lens is to make these beams come together again, then the point where they

come together is the *image* of the point on the object which they left, since to the eye rays will seem to come from there in the same way as they would come from a real object. There are two types of image: real images, formed when real beams of light intersect and which can be shown on a screen; and virtual images which only appear to come from a point, cannot be shown on a screen, and can only be seen by the eye. The image formed by a slide-projector is a real image; the image in a mirror is a virtual image since it appears to be behind the mirror though no image can actually be there since no light passes right through the mirror. For our purposes virtual images are of no interest and we shall concentrate on real images made by the biconvex type of lens shown in Fig. 7.

Fig. 7 shows how the position of an image may be found by drawing to scale. The object is placed on the axis, so that its image must also

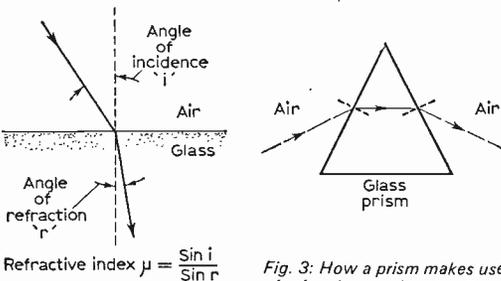


Fig. 2: Refractive index.

Fig. 3: How a prism makes use of refraction to alter the direction of a beam of light.

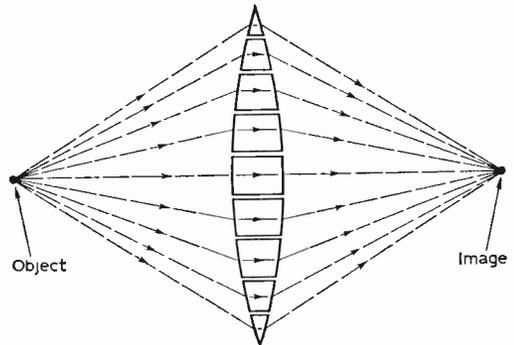


Fig. 5: The lens as a set of prisms.

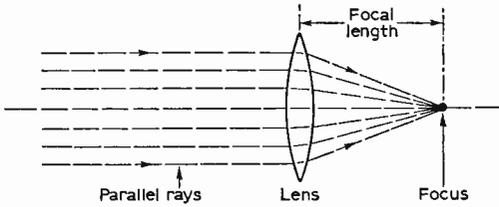


Fig. 6: How a lens provides focusing.

be placed on the axis; and two rays are drawn from the other end. One ray is drawn parallel to the axis, and, by the first rule, must be refracted through the opposite focus. The second ray is drawn straight through the centre of the lens, and is not deviated. Where the rays meet is the *image* of the object. In all cases where a single convex lens is used to form a *real image* the image is inverted.

Fig. 7 also shows the symbols used in calculating the distance of object and image from the lens. The distance of the object from the centre of the lens is *u*, from the centre of the lens to the image is *v*, and from the centre of the lens to the focus is *f*. If a real image is to be shown the object must not be nearer to the lens than the focus on the object side (the front focus) and we can use the formula

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

(Remember that *f* is measured to the focus on the *image* side—the back focus.) This formula should be easy to remember as it has the same form as the resistor formula

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

for resistors in parallel.

To save work we can rearrange this formula to read:

$$f = \frac{u \times v}{u + v}; u = \frac{v \times f}{v - f}; v = \frac{u \times f}{u - f}$$

so that we can find whichever quantity we want.

USING THE LENS FORMULA

Strictly speaking the lens formula holds true only for thin lenses and not for the thick compound lenses used in most modern optical work. For most purposes, however, the formula can be used with most lenses provided they are not of specialised construction (very long focus telephotolenses or very short focus lenses). If the focal length is known the positions of the object

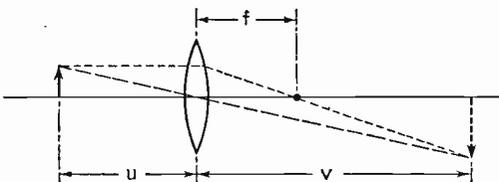


Fig. 7: How a lens forms an image.

and image can be found using the same tables as are used for resistors in parallel. It is therefore easy to work out how far a lens must be placed from a vidicon in a CCTV camera or from a slide in a slide-scanner; first, however, the focal length of the lens must be measured.

MEASURING FOCAL LENGTH

A crude method of measuring focal length is to set up a piece of white sheet and focus on to it the image of some objects at a considerable distance (100 feet or so). The image of trees or buildings seen through a window is ideal (remember that the image is upside down). In this condition the distance from lens to sheet is approximately the focal length.

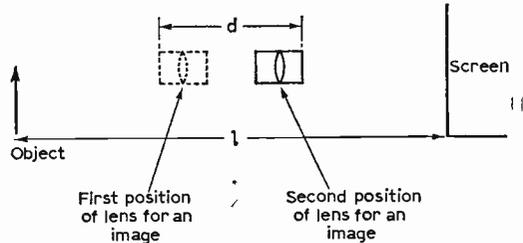


Fig. 8: A method of measuring focal length.

In some cases the lens is not accessible and the method shown in Fig. 8 is used. A screen and an object are set up (the object should preferably be a lamp bulb with a pin against its surface to focus on to) at a distance apart which must be at least four times the focal length. Since we do not know the focal length we must set up the object and screen at some distance (say 4 feet) and try to obtain an image of the object on the screen using the lens. If no image can be obtained the distance between the object and screen must be increased.

When the distance between the object and screen is more than four times the focal length two positions of the lens are found which give a focused image. One position gives a magnified image and one gives what might be called a "minified" image. The distance which the lens has to be shifted from one image to another can then be used to find the focal length of the lens from the formula

$$f = \frac{(l^2 - d^2)}{4 \times l}$$

where *d* is the distance shifted and *l* is the length between the object and screen. The distance which the lens has been moved can be measured even if the lens is set inside a tube because measurements can be taken from one end of the tube; either end as long as the same end is used consistently in one experiment.

COMBINATION OF LENSES

When lenses are placed together the resultant lens combination has a different focal length from either of the single lenses. When the lenses

are touching, the focal length of the combination is given by

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

where f_1 and f_2 are the focal length of the single lenses and f is the focal length of the compound lens, measured from the point at which the lenses touch.

When the lenses are not touching the formula is more complicated

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{x}{f_1 \times f_2}$$

where x is the distance between the lenses and the other letters are as before. If x is small however (up to 1/5 of f_1 or f_2) the quantity $x/(f_1 \times f_2)$ is negligible and need not be used; i.e., the lenses can be treated as if they were in contact. The focal length of the combination is measured from between the lenses and for practical purposes half way between is an adequate approximation if the focal lengths are not too different.

LENS APERTURES

The system of quoting lens apertures as f numbers is familiar to most amateur photographers but understood by few. The simple theory of lenses assumes that rays close to the axis are used and even with more complex lenses the best quality images are obtained when only the rays close to the axis are used. For this reason a lens may be fitted with an iris or with fixed limiting apertures so that not all its diameter is used. The size of the aperture is usually expressed as a fraction of the focal length of the lens, because the same aperture in inches on lenses of different focal lengths would let through different amounts of light. Thus an aperture of $f/8$ means an aperture of 1/8 of focal length, an aperture of $f/11$ is 1/11 of the focal length and so on. The larger the number quoted the smaller aperture, since it is that fraction of the focal length. Long focal length lenses must have high value f numbers or be enormous in diameter; conversely short focal length lenses can be of reasonable size for very low f numbers and lenses of $f/1.9$ can be easily obtained for vidicon cameras.

The amount of light which a given aperture lets through depends on the square of the aperture size, and so on the square of the f number. An aperture of $f/8$ lets through 1/64 of the light of an $f/1$ aperture; an $f/11$ aperture lets through 1/121 of an $f/1$ aperture; and as the ratio $f/8:f/11$ is approximately 2/1 the $f/8$ aperture lets through twice as much light as an $f/11$ one. In modern cameras the f numbers are arranged in a sequence so that each step down of f number doubles the amount of light passing through the lens.

The choice and use of lenses in amateur TV is often rather haphazard; it is hoped that this article has cleared away some misunderstandings and helped to define some of the dimensions associated with lenses. ■

NEXT MONTH IN

Practical TELEVISION

INSTRUMENT C.R.T.s

The requirements of an oscilloscope tube differ widely from those of the well-known receiver picture tube. This article provides a detailed technical account of instrument c.r.t.s including such sophisticated types as multi-gun and multi-trace tubes. Design improvements in recent years are described, giving at the same time an insight into the associated equipment. How bandwidths of 1,500 Mc/s and over are achieved is explained.

TV RECEIVER TESTING

The next part in this series describes basic fault diagnosis techniques in the timebase generator stages and also how to check the operation of the field output stage.

CONVERTING 405-ONLY SETS to 625-LINE OPERATION

Remarkably good conversions of 405-only receivers for 625-line operation are possible using readily available surplus u.h.f. tuners and i.f. panels. This article, the first of two, provides detailed guidance on the problems involved and the best approach to adopt.

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INSTALLING and SERVICING

COLOUR RECEIVERS

PART 3

P. G. ALFRED

WHEN good purity and convergence have been obtained the next adjustment to be carried out, or at least checked, is grey-scale tracking. The aim is to achieve highlight areas of a pure white corresponding to illuminant C and dark grey areas of a completely neutral hue with no hint of spurious colour. If these two conditions are satisfied the half tones in between will also be correct, unless some peculiar and uncommon fault exists.

These adjustments should always be carried out in near total darkness in order to prevent the highlight colour from being distorted by ambient light which is not illuminant C. It is also necessary to kill the colour.

Once again it will be found that minor differences exist between the various makes of receiver, and so the service manual should be consulted. BRC receivers use RGB instead of separate luminance and colour-difference drives, and the relevant instructions must be followed scrupulously.

Grey-scale Tracking Adjustment

However, if we ignore the special case of RGB drive the grey-scale adjustment is really quite simple. It is usually best carried out on a blank noise-free raster, although it can also be done on any picture with a true black area. With the brightness control set to the middle of its range, or such other conditions as are described in the appropriate manual, turn off the B and G guns. Switches are usually provided for this purpose, but if not connect a 100k Ω resistor by means of clips between the grids of the c.r.t. and chassis. Now turn the red gun first anode preset control up until a red raster is visible. Then turn it down slowly until on very careful inspection it is just possible (and only just) to see a faint red glow at some convenient part of the raster or on the black area of the picture. Switch off red and carry out the same adjustment to green, and then repeat for blue. Tune in a monochrome picture and look carefully at the dark grey tones. By inspection adjust *any two* of the three first anode preset controls to get pure dark grey tones. (This prevents the first anode voltages from being set at the wrong drive level.)

To adjust the highlights to illuminant C either tune in a monochrome picture (colour picture with colour killed is also suitable) which has a large highlight area, or better still use a cross-hatch generator of a type which will also provide a bright blank raster. The latter is greatly to be preferred.

Now comes the tricky part. The red drive to the red gun cathode is usually fixed, but controls are provided for setting the levels of the G and B drives to their respective cathodes so that

R+G+B gives a pure white. These have to be adjusted to suit the phosphor efficiencies of each tube. The problem is—what is illuminant C? As a vague generalisation it is a completely neutral, slightly warm, white. If you look at the highlights in near total darkness and decide that they look slightly coloured, however slightly, then they are not illuminant C.

In view of the fundamental importance of correct grey-scale adjustments if good colour performance is to be obtained it is suggested that service workshops will find it well worthwhile to invest in a standard source of illuminant C. This can conveniently be made from a low-wattage colour-matching fluorescent tube to B.S. 1853 as will be described when we come to discuss workshop equipment. If the highlight colour is compared against this source it becomes a comparatively simple matter to achieve an adequate match. The picture illuminant may not be exactly C but it should be close enough to give a good colour picture.

Having adjusted the highlight end of the drive range it is now necessary to check the dark grey tones again. If an adjustment is needed, use the same *two* controls as before. You should now have a good grey scale, and a monochrome picture will look truly black-and-white.

Colour-difference Drive Controls

Correct purity, convergence and grey-scale tracking are essential if a good monochrome picture is to be obtained. There is no short cut, no trick of the trade, nothing that can be done to retrieve the situation if any of these three adjustments have been badly carried out, because they also form the basis of a good colour picture. But even when they are correctly set the colours can still be wrong. This will happen if the colour-difference drives to the grids of the c.r.t. are not in the correct relative proportions.

If the drives are badly in error the fact will be obvious on most types of colour picture, and certainly on a colour-bar test pattern such as that transmitted by the BBC. Let us consider each bar in turn. The first bar is white, and good purity and grey scale will ensure that it is illuminant C. Next comes yellow, and a common fault is that it appears as a "lime" yellow instead of a pure "butter" yellow. Occasionally it looks old gold—i.e. too much red. Cyan, the next bar, is a greenish blue, and one becomes accustomed to finding it looking a dirty colour—i.e. too much green—or rather ostentatiously blue. The green bar is hard to judge: it usually appears too dark or too bright, but it needs experience to assess it correctly. Magenta is easy. If it appears predominantly red, or blue,

then it is wrong. The red and blue bars seldom show any errors unless they are too bright or too dim.

On ordinary pictures skies can look too blue, and trees can appear too green, but these errors do not usually spoil the entertainment. Look for the pastel colours instead (areas of low saturation) and particularly skin tones or the stonework of old buildings. Errors here are important because the brain behind the eye is quick to register a protest.

If you decide that the colour-difference drives are not correct there is a simple adjustment technique that rarely fails to make a very worthwhile improvement. It needs a proper colour-bar test pattern (not a rainbow pattern), a simple oscilloscope, near total darkness, and a few minutes for doing it.

First check the grey-scale tracking to make sure the highlights are illuminant C. Now with a properly adjusted colour-bar test pattern of normal contrast, brightness and saturation switch off the B and G guns. Referring to Fig. 17(a), adjust the saturation and if necessary the contrast until the four red bars indicated are all of equal brightness. Switch off R, switch on B and adjust the B-Y colour-difference gain control so that the four blue bars are all of equal brightness. Switch off B and switch on G. Connect a scope to the green gun grid and adjust for a clear display. Turn the G-Y matrix (mixing) control until the waveform is as shown in Fig. 17(b). Now adjust the G-Y gain control

until the four green bars are of equal brightness, and the job is done. You should now have the best colour performance of which the receiver is capable.

Special Notes: (1) Some receivers have an R-Y gain control instead of a B-Y control. In this case set up the reference level on blue first and then adjust the R-Y gain for equality of the three red blocks. Adjust the G-Y matrix and gain as already described. (2) Some receivers have no drive controls for service use, and so this valuable series of adjustments cannot be carried out. (3) Always adjust the G-Y matrix control before doing the G-Y gain setting.

The reason for carrying out these adjustments visually instead of apportioning the drives in accordance with the transmitter "weighting" factors is to tailor the three colour-difference drives to match the phosphor efficiencies of each particular c.r.t. Obviously if a tube is changed it will be necessary to readjust the drives to match the new set of phosphors if the best possible colour picture is to be obtained.

Installation in the Home

When you install a colour receiver in somebody's private house you have two duties to perform: one technical and one psychological. Let us discuss psychology first.

A man who spends £300 or more (net of income tax) or the equivalent rental charge on a piece of domestic equipment gets his enjoyment in two ways. In the first place he enjoys the colour programmes because colour is novel and because it also greatly enhances the entertainment value of the picture. Secondly, and of comparable importance, he enjoys having a colour receiver because it is a status symbol—one up on the Joneses—or (a much healthier state of affairs) he gets a quiet sense of pleasure from having something valuable, different, of technical interest, and aesthetically pleasing. A whole range of hidden emotions comes into play. Whatever these are, good or bad, he has undoubtedly given the matter quite a lot of thought, and for he and his family the day you wheel in this exciting new toy is quite an occasion. So a casual couldn't-care-less attitude simply will not do. Even if you make a good job of the installation some of the fun will have been lost for ever. A friendly, competent approach, a little sense of the importance of the occasion, and you will have not only an extra cup of tea but also a fund of goodwill that is the pride of any responsible engineer and an important asset to any business.

Installation Procedure

The first point to check is the aerial installation. It is bad policy to feed an expensive receiver from an inadequate aerial, especially when a high-gain, highly directional u.h.f. one only costs about £1 more than a cheap and cheerful affair. In fringe areas particularly make sure that the coaxial cable is a good-quality, low-loss type, and try to get a signal of at least 500µV.

The next problem is choosing a position for the receiver. This is usually dictated by the layout of the furniture, but try to insist on it being

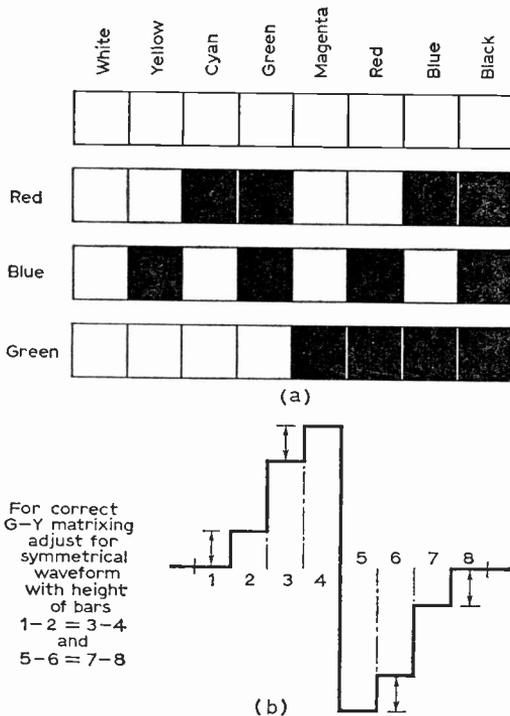


Fig. 17: Adjusting the colour-difference drive ratios.

placed with its back at least partly towards the windows so that the light does not fall directly on the screen. Other possible hazards are radiators, under-floor electric heating and fluorescent tubes, all of which can occasionally affect the purity or cause interference.

Having placed the receiver in position it is not uncommon to find that the only power point is down the other end of the room or else is so antiquated as to border on the dangerous! In most cases a temporary arrangement can be made that is adequately safe, but it is important to make sure that it is quickly replaced by a proper installation and not left by default until someone gets hurt. Any trailing leads should be secured so that they cannot be accidentally kicked.

It is good practice to give the receiver time to warm up before giving it a final check, so having switched on and made sure that a picture is present start tidying up any odds and ends. You may have used a wooden box for resting the receiver on whilst the legs were being assembled, and there is bound to be a carton or a large piece of felt used to protect the cabinet in transit. There will also be some bits on the carpet, so pick them up. It pleases the housewife!

At this point the question of safety arises again. You will probably make the odd trip out to the van to put away some spare gear or to fetch a piece of coaxial cable. Make it a point of basic technique always to ensure that the unattended receiver is either *switched off and disconnected or that the backplate is firmly in place*. Check also any testgear that you have been using. One day a child will walk into the room in your absence and start fingering this fascinating new object that has suddenly appeared. Tragedy can strike in an instant.

If the receiver has been properly checked in the workshop it is unlikely to need much attention. However it has been bumped and shaken about in the earth's magnetic field, so the purity may be imperfect. Make it a point of routine to degauss the screen of the c.r.t. with a portable degaussing coil, and then check the purity. It is not always possible to make the room dark enough to do this by just looking at the picture, and it is often helpful to use a magnifying glass for inspecting the phosphor dot triads at the centre of the screen and the outer edges. This sort of care does not pass unnoticed by the customer.

Now plug in a crosshatch pattern from a portable generator and check the convergence on both 625 and 405 lines. In many cases it will be quite satisfactory, but occasionally a touch is needed to the static convergence magnets. The dynamic convergence should not need adjustment.

Grey-scale tracking is stable for long periods in a well designed receiver and in any case it is difficult to set it as accurately at a customer's house as in the darkness of a workshop. Check that it has not been changed by accidental movement of a control, and do not try to readjust it without good reason. Remember that the highlight colour will not look the same in artificial light as it does in darkness or daylight.

To complete the process give the picture a careful check for general black-and-white performance on both systems, and inspect a colour picture on 625 lines. Make sure that all the

controls, both customer and external preset, are correctly adjusted for a normal picture, and that the hold controls are at the middle of their pull-in range.

Always try to time your call so that an off-air colour transmission will be available for testing the receiver, and for demonstrating to the customer. If this cannot be done, the only alternative is to use a colour bar or rainbow pattern generator. It is clearly not very satisfactory to install a receiver with no means of knowing whether the colour circuits are working properly and without being able to adjust the controls to give a normal colour picture.

An important part of the complete installation procedure is to make sure that the customer understands how to operate the receiver correctly and confidently. Note the "confidently"! Ten minutes spent upon showing him (or her) how to use the controls and standing by whilst he practises using each of them in turn will save many a service call.

You must assess each customer's mentality and ability. How much are you going to tell him? Are you going to keep it simple, or is he capable of understanding a fairly complete description? Only you can judge. After he has learnt to adjust a good picture on each channel it is always worth making the point about colour saturation. Nearly everyone starts off by turning up too much colour and getting a glorious technicolour effect. It is very impressive, but what a pity to distort the colours when a much more pleasing picture can be obtained by turning down the saturation control.

The other basic point concerns the lighting. Any luminous colour picture will be degraded by the presence of ambient light: it is inherent in the physics of the process. Explain this to the customer and point out that he will always get a better picture under subdued lighting conditions. There is no need to sit in the dark, indeed it is better not to, but try to keep direct light away from the screen. Careful siting of table lamps or standard lamps will often produce a very satisfactory compromise, and a cosy fireside atmosphere as well.

It is usually a good idea to make a return call 2-4 weeks after the original installation. Perhaps some managers will think that they cannot afford to—service calls are expensive. And yet—perhaps they can. A service call made at your own convenience may well avoid one at a time much less convenient. And even if a call was not really necessary anyway the goodwill generated is the biggest single asset of your business. People want *service*, and if *you* provide it they will come to you for all their needs. Indeed they will refuse to go anywhere else.

The purpose of this return call is to make sure that the customer has no problems and to take the opportunity of checking the performance of the receiver. A certain amount of ageing takes place during the first few weeks—a settling down process—and if purity, convergence and grey-scale tracking are checked and if necessary reset the receiver will remain correctly adjusted for very long periods without further attention.

TO BE CONTINUED

THE TRU-MATCH AERIAL

DAVID CAMERON

THE conventional u.h.f. aerial is based on the Yagi and an agreed performance exists. The gain must remain within 3dB over the band (maximum variation 1dB over any one channel), the directivity must not undergo violent changes over the band and the impedance presented to the feeder must remain 75Ω resistive. The dipole, being a resonant device, is in consequence resistive at one frequency only on either side of which a reactive component appears. The useful bandwidth of a dipole could therefore be defined in terms of the band over which the impedance remains substantially resistive.

Many expedients have been used to make a successful wideband Yagi; the Trucolour range, introduced by Antiference Ltd., represents the latest attack on the problem. Two well-known rules are observed: (1) Aerial elements that are "fat" (with respect to their length) exhibit a resistive impedance over a wider band than "thin" elements. (2) A folded dipole has a wider bandwidth than a single dipole and its impedance can be optimised to any required value.

Building on these, the Trucolour range includes the following patented features: (a) The properties of the fat element are featured in the driven half of the dipole, which is unusually fat (equivalent to 18 inches on Band 1) and is thus resistive over an unusually wide band. (b) The wideband dipole has its frequency range increased by the Tru-match principle (see later). The element nearest the dipole is the second half of the Tru-match pair. The combination of these elements introduces frequency compensation whereby the impedance at the dipole feed-point remains substantially resistive over a wider range than that of the dipole alone. (c) Directivity and gain are obtained in the usual Yagi fashion, by using parasitic elements. The Tru-match element, however, proves to be an excellent means of coupling the dipole into the array, previously a difficult problem.

By such means, the gain variation is very much less than the agreed industry standard over a frequency band in excess of 100Mc/s and compared with existing aerials with the same number of elements the gain is increased. The front-to-back ratio is much higher than the agreed minimum values and the polar diagrams show low values of side lobe amplitude and very little variation over the band.

When impedance variations are encountered over a frequency band the appearance of any reactive components can become aggravated by the use of a balun. The makers claim that the Trucolour range provides such a close 75Ω resistive match to the feeder that a balun would not

improve the performance and is therefore unnecessary.

DIPOLE ELEMENTS

When the dipole elements are relatively *thin* compared to the wavelength, the changes in the reactive component of the dipole impedance are rapid and of large magnitude, often reaching kilohms. It is this reactive component which restricts the dipole bandwidth when considered from an impedance aspect, because the characteristic impedance of the feeder connected to the drive terminals of the aerial is purely resistive. The presence of reactance in the aerial's impedance results in a higher standing wave ratio (mismatch) than that which would be introduced by a purely resistive impedance of the same magnitude.

A purely resistive impedance of 100Ω , for example, operated into a resistive load of 75Ω would result in a s.w.r. of 1.33:1 which is tolerable. However, an impedance of 100Ω comprising equal parts of resistance and reactance (70.71Ω for both R and X) would result in an unacceptable s.w.r. of about 2.6:1.

Should the impedance, regardless of magnitude, be totally reactive, the s.w.r. would be infinite if operated into a resistive load and reflection would be complete. Therefore if these reactance swings can be reduced, lower s.w.r. values will be obtained.

Variation in reactance is much less rapid for *thick* conductors so that for wideband operation conductors of large cross-section offer great advantages over thin ones. The cross-sectional size will be related to wavelength and at the very short wavelengths of the u.h.f. bands a very low wavelength/diameter ratio is more easily achieved. Reducing the wavelength/diameter ratio can be likened to reducing the Q factor of a conventional LC tuned circuit except that a lower Q indicates lower efficiency whereas a lower wavelength/diameter ratio means a slight reduction in radiation resistance and self-resistance. More significant is the considerable reduction in reactive magnitudes and variation when operating off-resonance—all-important when considering broadband working.

TRU-MATCH PRINCIPLE

The Tru-match principle utilises the reactive components present in the complex impedance of dipoles when operating off their true resonant frequency. Two dipoles are used, a parasitic

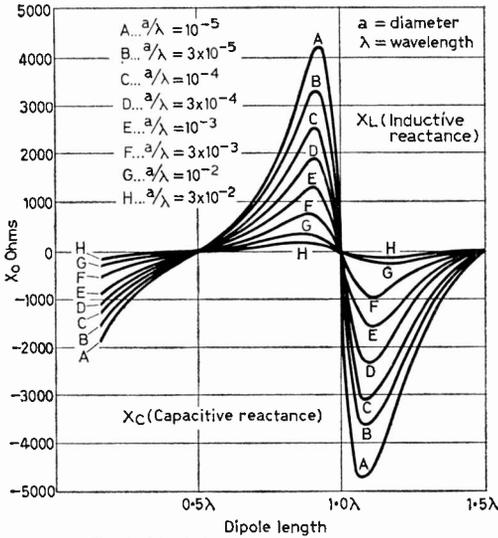


Fig. 1: Dipole impedance characteristics.

element proximity-coupled to the driven element. The dipoles are tuned to different frequencies and when it is required to raise the resistive impedance at a certain frequency the driven dipole is made longer and the parasitic dipole shorter than a normal halfwave dipole for that frequency.

The individual reactances of the dipoles (the longer one inductive, the shorter one capacitive) being tuned to be equal will consequently cancel out (see Fig. 1). The resultant impedance will be resistive, the magnitude dependent on the ratio of the dipole lengths (the spacing factor and the conductor diameters, both relative to the wavelength, must be taken into account). By this method a large range of impedances (including complex ones) can be obtained, limited only by the degree of reactances that can be obtained on dipoles of near-zero length (capacitive) and near-fullwave length (inductive).

It follows that the system can also be used for reducing the impedance. The driven dipole would then be shorter than the conventional halfwave element and the parasitic dipole would be inductive and therefore longer than the driven element.

A feature of the system is that at frequencies immediately below centre resonance the impedance is slightly inductive and at frequencies immediately above centre resonance slightly capacitive. However at frequencies further removed from the centre the reactances revert to the orthodox (capacitive at the low and inductive at the high frequencies). This means that there are three resistive impedance points, the frequency spacing between them being governed by the ratio of the long to short dipole lengths. In this way the resistive bandwidth of the dipole system is increased.

The Tru-match system also provides a means of impedance adjustment or correction. Aerials can be tuned in the first instance for maximum performance as a function of phasing, gain and directivity throughout the structure, and this is

the primary function of the principle as applied to Tru-match dipoles.

For a given diameter of conductor, the wavelength/diameter ratio will be lower on the u.h.f. than at the longer wavelengths of the v.h.f. bands, with consequent reduction in reactance amplitude. Therefore a form of folded dipole is used as the active element to present a higher resistive impedance than a normal straight dipole. Thus the degree of impedance "lift" required from the principle can be advantageously reduced because as with all frequency-conscious matching systems the bandwidth will be inversely proportional to the ratio of impedance transformation.

The primary driven element is the broad limb to which the feeder is attached. The secondary (capacitive) dipole is mounted between the driven element and the main director chain. In this way it also operates as a coupling-in element, particularly at the h.f. end of the design bandwidth. The off-set folded dipole design provides two spacing factors to the coupling-in element, giving improved performance at both low and high frequencies.

The author is indebted to the Research Department of Antiference Limited for providing information on which this article is based.

PHOTOKINA—1968

—continued from page 110

motion-picture camera shutters. This would be of special interest to television production companies that use film—which means all of them.

There is now much activity in the design of new colour processors for 16mm. and 35mm. films, for cinema and TV. The demand for taped colour television features to be transferred from tape to film will increase, with Technicolor's Vidronics system in the lead. There were several firms exhibiting processing equipment for developing colour negative and also reversal colour positive prints for both 16mm. and 35mm. film. The array of Arriflex machines was most impressive and the British Photomec system attracted much attention and received praise for its design and workmanship. Another British colour processing machine, the Lawley, was exhibited by Newman and Guardia. This was available in module form so that developing tanks could be rearranged or even bypassed to deal with different makes and emulsions of negative and reversal colour film.

First-class processing machines of a type used in several British film laboratories were shown by the French Debie company who also exhibited their well-known cameras. These included a very advanced timed film camera suitable for recording the growth of a plant, with exposures every few hours or days. This kind of thing used to be done with Heath Robinson type equipment with exposures made and timed with wierd and wonderful water tanks, W.C. cisterns, pulleys and weights. In these days the electronics men take over and their push-button circuitry takes charge, including flash illumination!

DX TV

A MONTHLY FEATURE
FOR DX ENTHUSIASTS

by Charles Rafarel

AS I have been on holiday in Bulgaria and Turkey for nearly four weeks I cannot give a full personal assessment on the current DX conditions. However I have a very good idea of what has been happening thanks to Maurice Opie who acted as "stand-in" during my absence. From his reports it seems that there have been a few SpE openings after all, even at this rather late part of the season. Nothing very spectacular, of course, but at least something to look at whilst we wait until we get some Tropospherics in November.

This is the joint current log for M. Opie and myself. The period is from 6/9/68 to 17/10/68. M. Opie's log covers 6/9/68 to 30/9/68; 1/10/68 to 17/10/68 is covered by both of us.

- 7/9/68 Sweden E2.
- 9/9/68 Czechoslovakia R1, W. German E2 and E4.
- 10/9/68 W. German E4.
- 11/9/68 USSR R1.
- 15/9/68 USSR R1.
- 17/9/68 Czechoslovakia R1.
- 18/9/68 Poland or Hungry R1.
- 22/9/68 Poland R1.
- 24/9/68 Hungary R1, Spain E2, E3 and E4 (two test cards E4).
- 28/9/68 Austria E2a, Poland or Hungary R1.
- 1/10/68 Czechoslovakia R1.
- 7/10/68 Czechoslovakia R1.
- 15/10/68 Poland R1, Hungary R1 and Yugoslavia E3.

The Trops have produced little in the way of results. There was, however, one startling opening on 4/10/68 when M. Opie had Spain on E2, E3 and E4 as steady tropospheric signals.

In Bulgaria we have reason to believe that the following transmitters are now in service in Band I: Russe Ch.R1 5kW, Varna Ch.R1 5kW, and Plovdiv Ch.R2 ?kW (experimental). I stayed in Plovdiv for one night and tried to contact the PTT bureau but alas they were closed after 6p.m. when I arrived and opened too late the next day when I was en route early for Istanbul. I did, however, note the presence of a number of Band I aeriels, so something is already happening. Next season we can look forward to the chance of a "new" country: until now Bulgarian TV has been exclusively in Band III.

In Austria the second chain u.h.f. is growing rapidly. I saw a veritable forest of aeriels everywhere this year. The latest station is Wachberg-Wettra Ch.58 100kW Hor.

In Hungary Budapest power is now up to 150kW from 30kW and Pecs R2 up to 2kW from 1kW. Every little helps: it has been received here at 1kW. Tokaj is down to 2kW from 20kW, not so good for Band II DXers.

In Holland Den Helder E10 has now closed down. This one has been reported in the past by East Anglia DXers.

New USSR transmitters include Archangelsk R1 ?kW, Saratov R1 ?kW, Piatagorsk R2 10kW, Vorkuta R3 25kW, Magnetogorsk R3 10kW, Blagovescensk R3 25kW, Sverlovsk R3 5kW and Orenberg-Penza R4 ?kW. A nice list of new ones which will present even more problems of identification: if only we could have test cards which carry legible station identification! I fear this cannot be as many cards originate in main TV centres and not individual transmitters.

Without passing comment on the merits or otherwise of pirate TV transmitters, I understand that the following are projected: A 625-colour station, presumably u.h.f., to be installed in a Super Constellation aircraft flying at 15,000ft. in a certain pattern six miles off-shore (this system has already been used effectively by the Americans over Vietnam); it is hoped that transmissions will commence in mid-1969. It is also rumoured that an ex-USA destroyer with TV transmitter is to anchor six miles off Gt. Yarmouth soon; as yet we have no details of Channels, power, etc.

My own enquiries in Greece indicate that there is still no project for a TV service there but I was amazed to see quite a number of high and efficient aerial arrays in the Thessalonika area optimistically pointing towards Yugoslavia some 60 miles away. This might encourage the Greek authorities to contemplate a TV service of their own.

We have heard a rumour that F. Smales, of Pontefract, Yorks., has had a staggering success with USA F2 reception of an East coast transmitter. I hope to give fuller news soon.

R. Bunney reports transatlantic paging stations being active once again. He now has a new RF25 converted receiver and has been logging K1Y 508 Orlando and a New Hampshire, USA, station between 35 and 40 Mc/s. This could mean business soon for USA DX/TV.

We have a good log from another new DXer, D. Glover of Solihull, Warwickshire. It's nice to hear from the Midlands: we do not get many reports from this area but from this excellent one it cannot be due to local conditions, so what about it Midland DXers?

D. Glover says that it has been quite a good season for him with reception of France F7, Spain E2 and E3 and also 2nd chain, Portugal F2 and F3, Sweden E2 and E3, Finland E2 (TV1 and TV2), Italy IA, Norway E2 and F3, Poland R1, Hungary R1, USSR R1 and Swiss E2. In all a very nice lot.

THE 'LYNX' CCTV CAMERA

W. STIRLING

THE Pye Lynx, which is the most widely used CCTV camera in this country, is a well-tested design of considerable interest to anyone building or modifying a vidicon camera. The Lynx is completely transistorised, weighs only 9lb, and consumes only 13 watts; but it provides pictures of full professional standard for CCTV use.

A feature of this camera is the automatic sensitivity control, which adjusts the bias on the target of the vidicon automatically to compensate for light variations so that the output signal is of constant amplitude. This is a feature which is of great value in many CCTV applications, particularly when the camera is remotely controlled. The range of the automatic sensitivity control in the Lynx is 300:1. The video output is 1.4V peak-to-peak with white positive, suitable for connection to a video monitor.

In any CCTV camera the most difficult parts of the circuitry are the video amplifier and the scan amplifiers. The video amplifier used has a bandwidth of 5Mc/s, with preset peaking controls to adjust the ratio of h.f. to l.f. gain, the gain is such that a 1V p-p output is obtained from a signal current input of 0.2µA p-p.

The camera can be scanned at 525 or 625 lines, 50 or 60 fields and 405 line scanning is possible if five components are altered.

Video Amplifier

A total of 8 transistors is used (see Fig. 1), of which one forms a clamping circuit operated by the mixed sync pulses. R1 is the vidicon target load, 180kΩ, requiring a high input impedance at the first transistor and some correction for loss of high frequency caused by the effect of target

capacitance across the 180kΩ resistor. Tr1 is a 2S733 npn silicon transistor operated at low current for the best possible noise figure, and as an emitter-follower to obtain a fairly high input impedance. Tr2 is an AF117 voltage amplifier of high gain, the gain being varied by altering the bias on the base through the gain control R8. Note that the emitter resistor is decoupled by C6 for low frequencies and by C5 for high frequencies. Tr2 is RC coupled to Tr3, another emitter-follower (AF117) which provides a low output impedance for feeding the clamp transistor Tr4 (OC45).

Clamp Circuit

The base of Tr4 is fed with negative-going pulses from the sync mixer and each pulse drives Tr4 into conduction. When Tr4 conducts its emitter and collector are at practically the same voltage so that C10 charges up to the voltage set by the potentiometer R16 ("set-up"). C10 can discharge only through the base of Tr5 and the time constant is such that the voltage on C10 hardly changes between two sync pulses. In this way the signal is set to a definite d.c. level at each sync pulse and the loss of d.c. and low frequency a.c. signals in the capacitor coupling of the previous stages is compensated.

H.F. Peaking

Since this clamping has restored the d.c. level the following stages are direct-coupled to preserve the d.c. level and further clamping is therefore not required. The two transistors Tr5 and Tr6 (AF117) form a direct-coupled pair which incor-

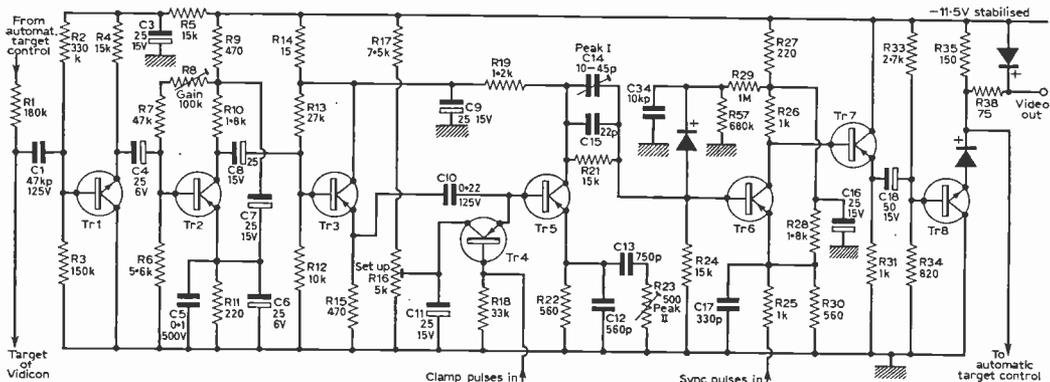


Fig. 1: Circuit diagram of the video amplifier used in the Pye Lynx CCTV camera.

porates the high-frequency peaking necessitated by the h.f. losses at the input. The base circuit of Tr5 forms the load for the clamp capacitor, as already described, and its emitter circuit is used for peaking. The emitter resistor is bypassed by a 560pF capacitor for h.f. peaking and also by a network of a 750pF capacitor and a 500Ω resistor in series. This resistor R23 fixes the amount of peaking voltage required at the middle video frequencies. In addition to this the coupling to the next stage consists of a resistor and two capacitors in parallel, one capacitor (C14) being adjustable to peak the highest video frequencies.

C14 also has the effect of differentiating the signal, however, and at its maximum setting can cause differentiated pulses to extend beyond black level. This in turn causes considerable synchronisation trouble on the monitor unless such peaks are clipped before the sync pulses are added to the video signal. The diode connected between the base of Tr6 and the network in its collector circuit acts as a clipper for such video pulses.

Sync Mixing

Tr6 acts as an inverter, peaker and also mixes in the sync pulses. The 330pF capacitor in parallel with the 560Ω resistor in the emitter act as a third stage of high-frequency peaking, the sync pulses being fed in via the 1kΩ resistor. Negative-going sync pulses at the emitter are amplified as negative-going pulses at the collector, while negative-going video signals at the base are amplified as positive-going video signals at the collector. In this way a composite video waveform is obtained at the collector.

Video Output Stage

Finally the complete video signal is fed to the output stage, a pnp plus npn emitter-follower adjusted to 75Ω output impedance by R38. Two diodes, one in series with the video output and one in parallel, are used to protect the video output stage against any voltage surges on the video line caused by connection to the monitor, etc.

Setting up

In use the gain control is set to give the standard video output of 1V peak-to-peak and the set-up control is set so that the sync pulse amplitude is 0.4V peak-to-peak. The peaking trimmers are

set up on a test pattern, C14 for minimum streaking and R21 for best sharpness with tolerable ringing.

Vertical Output Stage

The vertical output stage (Fig. 2) uses a compound emitter-follower (two OC81 transistors) passing a current of about 18mA. This drives the scan coils through a 250μF coupling capacitor, the earthy side of the scan coils being used to provide feedback to the previous Miller timebase stage for linearising the scan.

Horizontal Output Stage

The horizontal output stage (Fig. 3) is fed from an emitter-follower Tr22 (NKT223) which acts as a buffer stage feeding positive pulses to the base of the output transistor Tr23 (NKT227). The

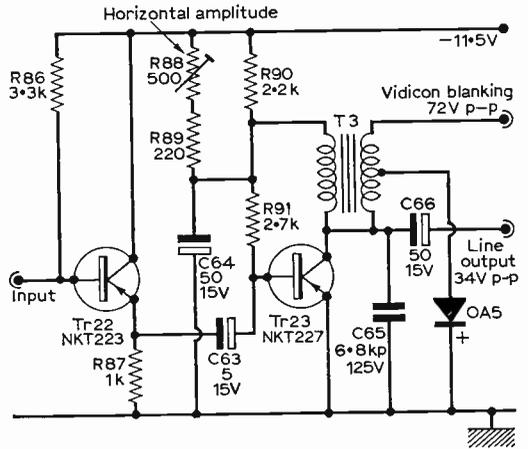


Fig. 3: The horizontal output stage

arrival of a positive pulse cuts off Tr23 so starting the flyback and causing the usual surge of voltage across the deflector coils. The OA5 diode connected to earth from the tap in the secondary of the scan transformer acts as an efficiency diode and conducts during the positive flyback peak, charging the coupling capacitor C66 negative. The output transformer is also tapped to provide a negative blanking pulse for the control grid of the vidicon during flyback. At the end of the flyback the output transistor is turned on again and current in the output transformer and scan coils increases linearly to provide the scan. The scan amplitude is adjusted by varying the resistance between the transformer and the 11.5V negative line. Flyback duration is determined by capacitor C65 which tunes the transformer and scan coils to the third harmonic of the scan frequency.

Acknowledgement

The writer gratefully wishes to acknowledge the help of Pye H.D.T. Ltd. in the preparation of this article.

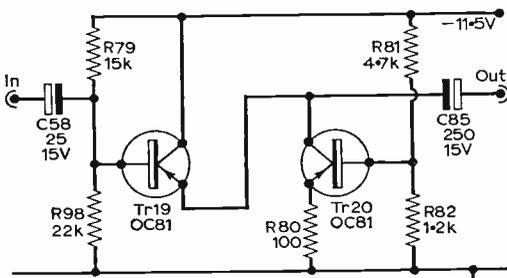
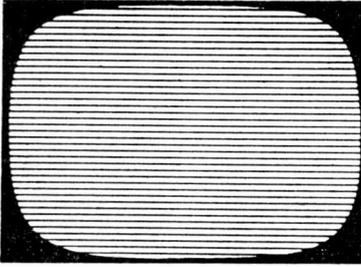


Fig. 2: The vertical output stage.



Servicing TELEVISION Receivers

No. 152 PHILIPS 19TG164A Series

by L. Lawry-Johns

WITH certain reservations these notes can be used to help in the servicing of quite a large group of models in the Corsor, Philips, Stella and Peto Scott ranges. All are dual-standard models with either 19in. or 23in. tubes. Some have transistorised tuner units for u.h.f. reception and these include the 19TG158A, 19TG164A and 23TG164A Philips, and also the Stella ST2029A and Corsor CT1974A.

Similar models with valved u.h.f. tuners include the Philips 19TG154A, 19TG156A and 23TG156A, with the Stella ST2123A, ST2113A, ST1093A, ST1099A and ST2149A. The earlier Philips 19TG152A, 21TG153A, Peto Scott TV350 and many Corsor models are basically similar but differ considerably in detail. This article and the diagrams essentially concern the first mentioned models, with u.h.f. tuner of the transistorised type.

To protect the fairly fragile printed panels from possible damage due to over-heating resistors, in many cases these components are soldered to stand-off tags in such a way that over-heating

will cause the solder to melt and the resistor to drop out of the circuit. Specifically these are R200, R201, R201A, R223, R254, R255, R436 and R437. These resistors are of the Dubilier BTA 1W type and are presented to the underside of the tags for soldering, not wrapped round. This feature should be remembered when dealing with faults concerning inoperative tuner units, field timebase and sound output. Quite often the resistor will be found in the bottom of the cabinet where it has fallen, quite suitable for reconnection to its tags once the cause of the fault has been removed. For example a no sound condition will reveal R223 (390Ω) missing from its tags. In this case the PCL83 should be replaced before the set is switched on after the resistor has been refitted (if the resistor is still in good condition of course). If the resistor again overheats with a new PCL83 check C228 which could be leaky; although this is not usual. Similar remarks could be used concerning the field timebase where the PCL85 would be the valve and R436-R437 the drop-off resistors, the symptom here being a

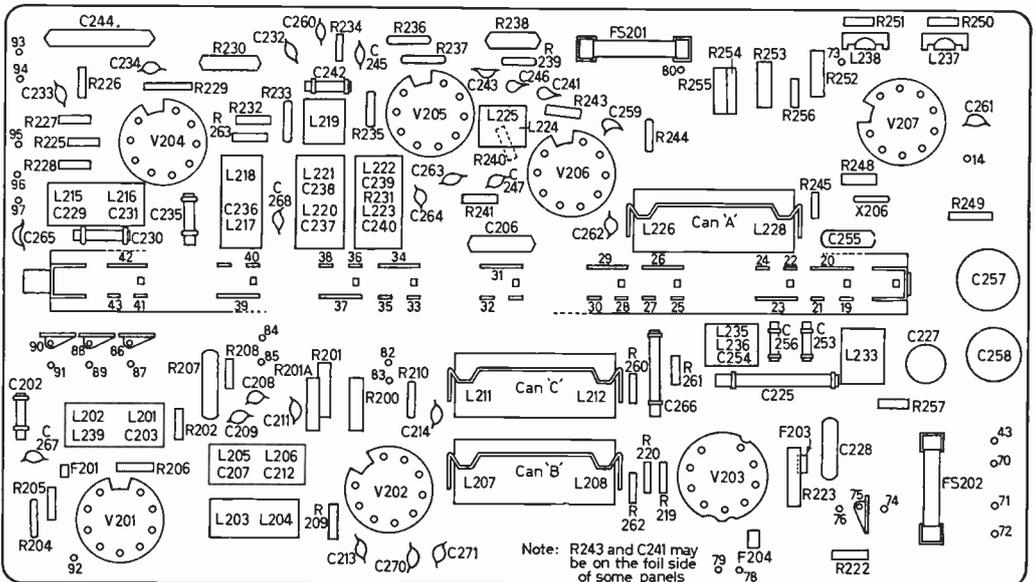


Fig. 1: Layout of the i.f. printed panel, viewed from the component side.

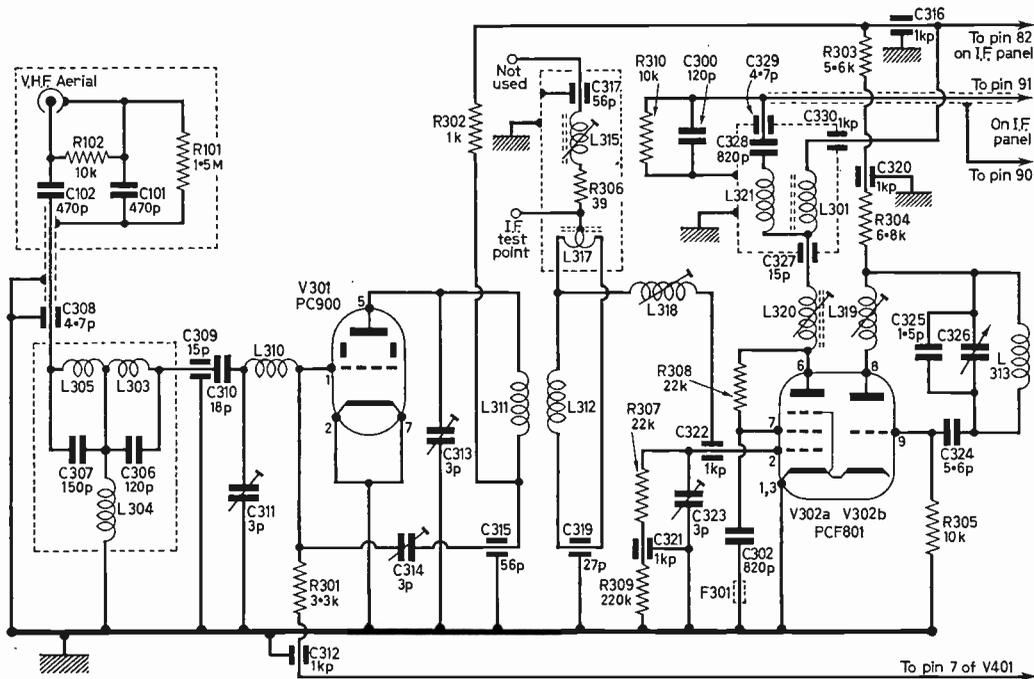


Fig. 2. Circuit diagram of the v.h.f. tuner unit

narrow white line across the centre of the screen denoting field collapse.

Fuses

Another feature well worth bearing in mind is the location and purpose of each of the three fuses.

FS100 is the mains supply fuse, rated at 1.5A. It is located near the mains input. This will fail in the event of an overload in the heater circuit, h.t. rectifier-smoothing circuit or in the video circuit, the latter being less likely due to the presence of series resistors of the drop-off variety R254-R255, and also R118 (500Ω). Therefore if FS100 fails it is fair to investigate the rectifier circuit first.

However, there are two other h.t. fuses concerned only with the h.t.1 and h.t.2 circuits. Both are located on the i.f. panel. FS202 is in the top corner and this is mainly concerned with the line timebase and the sound output stage, both potential fuse-blowing circuits. This is the fuse which is most likely to fail resulting in no sound or picture although the valve heaters are all glowing (except the e.h.t. rectifier of course) and h.t. is present at several points, the h.t.2 and h.t.3 lines still being very much alive. FS202 is rated at 250mA and a slight spit inside the PY800 or PL36 will often cause it to fail.

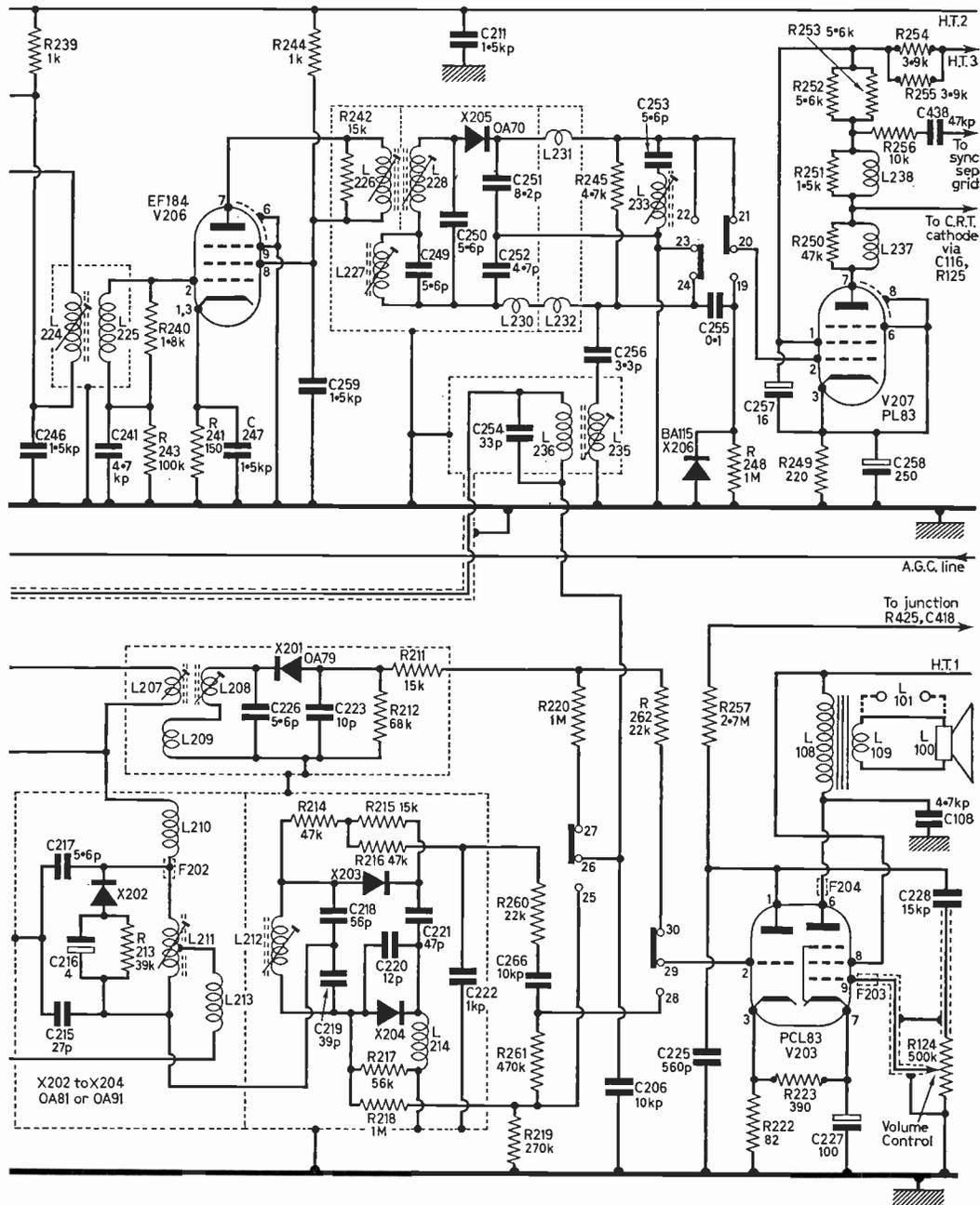
FS201 is in the h.t.2 supply line which is to the i.f. stages, tuner units and field timebase. This fuse is halfway down the side of the panel and is rated at 150mA.

Common Faults

One fault which will almost certainly be encountered concerns Bands I and III only and therefore can be located in the v.h.f. tuner. The symptoms are inability to tune properly, the fine tuner having very limited or no effect. The cause of the trouble is associated with the plastic core of the fine tuning capacitor C326. This is a small plastic shaft carrying a band of metal. As the shaft is moved in and out of C326 the metal band varies the capacitance.

Two things can happen, both equally likely. The shaft can break leaving the rest of the core inside the C326 sleeve, or the band of metal can become loose. It is the actual break which causes most trouble. The slug end in C326 comes out easily enough but the shaft is often difficult to unscrew or push out from the brass carrier which is part of the swivel-arm assembly. A 1/16 in. Allen key will sometimes do the trick particularly if heated first and then rotated to unscrew the plastic shaft end.

To remove the turret to provide better access, remove the front end circlip and take off the sprocket drive assembly, remove brass plates front and rear, ease the turret out noting how the roller arm springs down. With the turret out, release the fine spring on the lever arm and rotate the arm. Unscrew the broken shaft. Rotate the arm back to its operating position so that the new core can be fitted. The new core will have no proper thread on it, this being made when the core is screwed into the sleeve. To facilitate cutting the thread the end may be lightly greased and the



stages, Philips 19TG164A series of receivers.

to fit it on each desired channel so that the fine tuner is fully operative.

Line hold

If the line will not lock with the control at one end, change over the two ECC82 valves and try again. If necessary fit another ECC82 in the

V404 position and check R420 330kΩ if the trouble is on 405 only.

Lack of width

The PL36 is usually responsible for inadequate width but the PY800 should not be ignored as these seem to lose emission quite regularly.

TO BE CONTINUED

UNDER NEATH the dipole

IN these days "window dressing" of every kind calls for colour: in female (and male) dress, décor, in journalistic print and picture, in advertising, in the cinemas and television. The pen was said to be mightier than the sword; but much more potent is the still or moving photographic picture, particularly when in colour and on television or in the cinemas.

Good taste in the use of colour is just as important for dress as it was in the cautious days of city gents' black suits, grey waistcoats, pin-stripe trousers, top hats and all. Those were the days when "grey scales" were virtually applied to personal taste, long before films and television. This is the day and age of colour, which in advertising is recognised as the loudest and brightest magnet of all. It commands respect from advertising experts and competitive business men. Its flexible use can go beyond the limits of accurate colour reproduction of a landscape or a human face; colour separation between actors and backgrounds and the tricks of the producer with colour temperature changes can enhance the atmosphere of a drama. The BBC has made wonderful progress in its use of colour television, spurred on no doubt by the stiff competition it will have in due course from ITV colour television programmes.

Competition

Real progress in any technological objective is hastened greatly by war—and by strong industrial (or artistic) competition. Many of us remember the earliest days of public television when the BBC used to fill up pauses with a picture of goldfish swimming around a glass bowl. Sometimes we looked at them for 10 minutes at a time, the sedative effect no doubt being highly efficacious. This was before the BBC was faced with competition from commercial television, instigated by the advertising world and founded under the jurisdiction of the Independent Television Authority. Then it was that the wise decision was made to put all actual transmitters under the control of the ITA instead of (as in the USA and elsewhere) allowing transmitting equipment to be run by each individual company. Programme presentation and studios for each area were allocated with care to different programme contractors and immediate competition between them and, collectively, with BBC increased rapidly over the years. It is this same kind of competition which has now led to the very high standard of colour television, easily the best in the world, as

transmitted by the BBC. The delayed decision to adopt the PAL system of colour transmission and to licence ITA and ITV companies to go into the u.h.f. 625-line standard, first in black-and-white and later in colour, were both wise and logical. It is probable that if the ITV competition in colour had not appeared on the horizon the BBC would not have achieved the magnificent progress they have already made. A big factor has been the continuous contact between the technical heads of BBC and ITA plus some boffins on the technical committees of the Independent Television Companies Association and on the receiving end the British Radio Equipment Manufacturers Association. If all this hadn't happened we would still have laboured under the potential phase distortion troubles that haunt the NTSC system.

Advertisers' influence

Once again pressure from the advertising world has speeded up technical developments and may well provide the commercial TV companies with even bigger revenues. For the advertising experts know full well that colour commercials have about twice the impact of black-and-white commercials and will carry with them a kind of "star cachet" even when seen on black-and-white receivers. This in turn has encouraged further technical and creative refinements in colour television by the BBC and in the preparatory work now in hand by ITV companies. This applies particularly to special effects, travelling matte, superimpositions, slow motion, inlay, overlay, titles and other magical electronic legerdemain.

Video tape progress

The time has now come to reconsider the use of video tape as an originating medium for colour television programmes. The snags of the differing international line-standards have been largely overcome by the new all-electronic BBC standards converters, and also the latest film development which has been achieved by Technicolor and is named Vidtronic.

Starting at a TV studio with a production being made with three or four colour television cameras, vision mixed and video taped in the usual manner, the tape is sent to Technicolor for transfer. The Vidtronic system now makes use of a very high-quality video-tape play-off machine for separating electronically the video-tape signal into its three colour components for reproduction on three high-quality monitors. These are again separately photographed on to three film colour-separation negatives which are in turn combined in the dye imbibition processing facilities which have always been the unique basis of the Technicolor system. These three dye-transfer printing facilities are used separately on to each release print film, either in 16mm. or 35mm. It has always puzzled me how Technicolor has achieved such miraculously good colour results on film. Now they have extended the originating media to include video tape I am even more astonished. These remarks are made after seeing the Vidtronic results myself, which were particularly good on 35mm. film, seen via telecine on colour monitors.

The world before your eyes

Explorers and naturalists originally reported with descriptions and drawings of their finds, from the days of Capt. Cook to (I presume) Mr. Livingstone. Since that time the camera has brought back from safaris in the wide open spaces visual information, at first by the heavy and clumsy field camera and the wet-plate process (involving a portable dark room on the spot). During the American Civil War, and even during the Boer War, such primitive necessities were unavoidable if a picture was to be secured and even processed *under fire*.

Cherry Kearton was the first explorer to use a hand-held motion-picture camera for photographing lions, tigers and other big game in wildest Africa. This was the compressed-air driven Aero-scope camera designed by a Polish scientist Proziński and made in London by Newman Sinclair. Later on Martin Johnson (USA), Capt. Frank Hurley (UK) and Armand and Michaela Denis (France) covered the same kind of safari. BBC film units armed with 11mm. film cameras and sound equipment of the most sophisticated types are capturing the most amazing sights (in colour) and sound (on tape) in many parts of the world.

The South American scene has been superbly covered by BBC's South and West area film unit in the *Big D Ranch* series in which the activities of Stanley Brock, naturalist and animal collector, were very professionally photographed and narrated. *Hunting for Giants* was one of the best safari films I have seen, involving photographic reports on how to catch jaguars, harpy eagles, jabiro storks and giant armadillos. But the most exciting sequence in this beautifully photographed episode of *Big D Ranch* concerned Stanley Brock's capture of an anaconda, a 22ft. long snake, the largest type in the world. The capture was made partly under water and took several minutes to accomplish. Viewers who saw this on colour television must have sat on the edge of their chairs, enthralled by the real-life drama and the skill of the white hunter. I imagine that the cameraman must have held his breath with agony as he heard the film ticking away to the end of a long 16mm. film roll. Fortunately there was enough film, and it was in the can. It was in one uncut shot and not "cooked up" by ingenious editing. If this is the high standard of safari production we may expect in the future the ITV companies will have to pull up their socks. Anglia Television are the most experienced and advanced in this field.

In all the excitement of recalling for you this anaconda capture I have so far overlooked mention of the excellent synchronised sound which played such an important part of the scene. When Stanley Brock was climbing up a tree looking for a stork's nest, he spoke towards the cameraman on the ground—he was his own narrator. Suddenly he pulled out a small cine camera and started photographing the nest, at which point close-ups were cut in, with his commentary over, as in the long shots taken from the ground. This revealed a technique I had not seen before and added yet more excitement and reality to the presentation.

Thus the directional mike, the sound of which was synchronised possibly with crystal control together with high-quality long-focus zoom lenses, made contributions to this demonstration of technical virtuosity. To achieve such shots equipment has to be extremely sophisticated, not to say exotic. And the director and his team have to know how to use it.

Technical get-togethers

Such film production series as *Big D Ranch*, specially shot by the BBC for the BBC colour TV programmes, together with the growing number of foreign TV organisation customers, must surely be as successful commercially as they are artistically. These small BBC production units using 16mm. reflex cameras, synchronised ¼ in. tape recorders and other glamorous technical aids can teach many an experienced cinema-film production team a thing or two. Strangely enough there are top veteran film cameramen who are willing and eager to learn hints and tips from the BBC. As a matter of fact only a few weeks ago the BBC invited members of the British Society of Cinematographers to the BBC Television Centre at Shepherd's Bush to see and hear about what goes on there, in debate with leading BBC engineers.

Following this delegates from 20 countries, representing about 45 different organisations, are now due to visit BBC Television Centre, to which will be added a number of delegates from ITV companies. All will of course be asked to listen to the technical triumphs—and the failures—which occurred in the steady progress in colour television. This civilised approach to the exchange of knowledge, facts on experience and hopes for the future is not altogether new in films and television.

Dual-purpose stages

The Pinewood Studios last year invited a technical committee of the Independent Television Companies Association to a lunch at that studio and placed its famous panelled board room at their disposal for a meeting of all the ITV companies' chief engineers. Many BBC engineers have also visited its famous film production stages, its workshops and open-air lot. All of them have seen the new J and K dual-purpose stages, suitable for film for the cinema or for television, with or without television aids, or for speedy conversion to live or taped TV production. So successful have these dual-purpose stages been that another two stages, L and M, are to be built to be ready by May 1969. These new stages will be based partly on the dual-purpose pair that have been so successful. TV lighting grids, now accented by cinema-film lighting cameramen, will be fitted together with many other new devices favoured by television engineers and directors. The exchange of technical knowledge is a civilised approach, even between rivals.

Iconsos

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MW36/24		CRM123	CME1903	C14GM	C19/16A	4/15G	172K		
MW31/74		CRM124	CME2101	C14HM	C19/10AD	5/2	173K		
MW31/16	Twin Panel Types	CRM141	CME2104	C14JM	C19AH	5/2T	212K		
MW43/80	A47-13W	CRM142	CME2301	C14LM	C19AK	5/3	7102A		
MW36/44	A59-16W	CRM143	CME2302	C14PM	C21/1A	5/3T	7201A		
MW53/80	A59-13W	CRM144	CME2303	C171A	C217A	14KPA	7203A		
MW53/20		CRM153		C174A	C21AA	17ARP4	7204A		
MW43/43		CRM171	Twin Panel Types	C175A	C21HM	17ASP4	7401A		
AW59-91		CRM172		C177A	C21KM	17AP4	7405A		
AW59-90		CRM173		C17AA	C21NM	21CJP4	7406A		
AW53-89		CRM211	CME1906	C17AF	C21SM	SE14/70	7501A		
AW53-28		CRM212	CME2306	C17BM	C21YM	SE17/70	7502A		
AW53-80		CME141		C17FM	C23-7A		7503A		
AW47-91		CME1402		C17GM	C23-TA		7504A		
AW47-90		CME1702		C17HM	C23AG		7601A		
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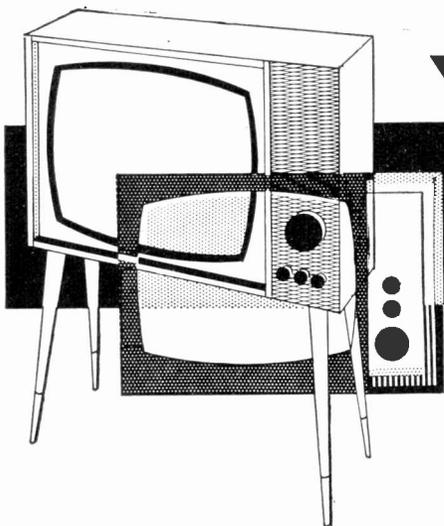
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Your Problems Solved

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

ULTRA 6618

The fault started with the picture reducing in size by about 2 in. all round and the controls had no effect. Then I noticed that the brilliance control when turned up caused the picture to blow up and disappear. I assumed from this that the tube was faulty and obtained one from one of your advertisers. However on fitting this I find the fault remains with one difference, the field is now extended beyond the tube edges and cannot be altered with the controls.

I am given to understand that this set employs a Thorn chassis. I wonder if you could give me the number of it so that I may purchase a circuit diagram.—F. Tollerton (Lancashire).
The Thorn 850 chassis is fitted in the 6618. The line output valve is a PL36, PL302 or 30P19. Change this and check the 6-30L2 (ECC804).

BUSH TV135

When the set has been on for a few minutes the action of turning up the volume control causes the sound to go right off, but it returns a second or two later. Then as time passes the maximum volume obtainable steadily falls until after 1-2 hours the sound is barely audible. At this point when the control is now turned fully up the sound will go off altogether and stay off, but turning it back—anticlockwise—just a little will bring some of the sound on again. Switching the set off cures all these troubles for a little while; then it starts all over again.

The aerial I am using is the communal type which is piped into my home. This system converts the frequency of the BBC-2 signal so that it may be received, along with the BBC-1 and ITV programmes, with a v.h.f. tuner. As the sound on BBC-2 comes through clearly and loudly at all times and exhibits none of the peculiarities described above when the other two programmes are switched in, the tuner is evidently free from blame. So is the sound output valve and volume control, otherwise I would have irregular sound on BBC-2.

It would appear that the trouble lies somewhere between the volume control and the switch con-

tacts which separate the 405 and 625 sound channels since only 405 is affected. It has been suggested to me that the fault may be in the 405 a.g.c. circuit which may not be used on 625. But to confuse matters further I have found that when I alter the settings of the brightness, contrast and line hold controls it momentarily affects the sound, and when done quickly will cause the sound to go right off for a second.—S. T. Parry (Glamorgan).

The part of the circuit which is likely to be at fault is the sound noise limiter. This consists of a diode (BA115), two 2.2M Ω resistors, a 1M Ω resistor and two 0.03 μ F capacitors. Check these.

HMV 2623

The picture breaks up immediately on switching on. Adjustment of the line hold control will hold the picture steady temporarily but after a few minutes the picture breaks up again and further adjustment is necessary. The line hold control is very critical and a light touch will affect the quality of the picture.—L. Owen (Sussex).

We would advise you to check the sync separator components and the sync feed to the line oscillator. If necessary check the video amplifier components, particularly the cathode capacitors.

BUSH TV85

This set has four push-buttons and is tuned to the Isle of Wight. Would you please tell me how to adjust the tuner to get Westward and Wenvoe.

If I push the button in so far on BBC-1 I get a good picture, and if I push the button on ITV right in and hold it I get a good picture. But letting them click into their proper positions the picture is faint and the sound goes off.—E. Willmott (Dorset).

To select any BBC station push in the BBC button and then pull it out until it engages the tuning spindle or spline. Rotate the button to obtain the required station and gently push back to the original position. Repeat with the ITV buttons.

MURPHY V873

Recently on this receiver the field started to slip after being switched on for about half an hour. On attempting to adjust the field hold, within a matter of seconds, the field and line collapsed into a horizontal line at the centre of the tube, the picture being about 1½ in. high.—S. Mallory (Glamorgan).

We would advise you to check the 10kΩ 1W anode load resistor to the PCF80 video amplifier valve, which is to be found at the top of the i.f. strip. This resistor frequently changes in value due to inadequate wattage rating.

PHILIPS 19TG173A

The picture on this model is losing height top and bottom at the rate of an eighth of an inch per day. Controls are at their limits.—E. A. Cross (Dorset).

We would advise you to check the resistors associated with the height control. These are a 1.5MΩ from the boost line and a 1.2MΩ to pin one of the PCL85. Also check the 22kpf capacitor which decouples the 1.5MΩ and height control junction as this could be leaky.

McMICHAEL M72T

Could you state whether it is possible to fit a u.h.f. tuner to this receiver?—B. Wilson (Lincolnshire).

There is no satisfactory way of converting this set to the 625 standard. Whilst it is possible to fit an i.f. panel and u.h.f. tuner, the line output stage presents problems.

FERRANTI 20T4

This set gives an excellent picture but no sound. Could you tell me where the audio output valves are situated?—A. Norris (Dunbartonshire).

On the right-hand side of the main chassis there are a number of electrolytic capacitor cans. Between these are two valves—an EB91 and an ECL80. The latter is the audio output valve. Check these valves and the h.t. to pin 6 of the ECL80. Also check the nearest EF80 to the ECL80 (on the i.f. plate) and associated components.

PHILIPS 1768U

This set has a blank screen with no raster. The spark from the e.h.t. lead is strong and there is a timebase whistle, but this seems to vary in tone.

On replacing the EY86, the set works for a few weeks and then a broad wavy line comes across the centre of the screen, then the whole screen goes blank again. All this time, the sound remains good.—J. Fell (Dudley, Worcestershire).

Your remarks suggest that the line timebase fails, but if the whistle remains when the screen goes blank the output or booster section is more likely to be responsible. In the first instance, check the condition of the line output valve and the booster diode (in the e.h.t. box). The latter possibly fails when hot.

BUSH TV125RU

After switching on and the picture appearing, it gradually gets darker (in about three or four minutes). The brightness control has to be turned up to its maximum then the brightness remains stable. If the brightness control is left at maximum the next time the set is switched on the picture appears far too bright and the control has to be turned down, but after a few minutes has to be gradually turned back to maximum.—J. Smith (Essex).

You should check the tube base voltages. That at pin six should vary with the brilliance control from 60-120V (maximum brilliance). Pin seven should record about 190V. Pin three should be steady at about 690V and any drop here should be reflected as loss of height.

Therefore we would suggest you check the video stage PCF80 and the brilliance network.

RGD/REGENTONE TV403

When the brilliance is full on I can only get a contrasty picture with contrast fully adjusted. I have replaced the h.t. rectifiers, line output valve and boost diode, also e.h.t. rectifier, but the trouble has not cleared.—J. Stock (Gloucester).

The trouble is due to low first anode voltage (c.r.t. base pin 3). Check the resistors in this circuit and if necessary check the focus control (2MΩ). Shunt the 4.7MΩ (yellow-mauve-green) resistor with a similar value to increase the first anode voltage if necessary.

DECCA DM4C

The fault takes the form of four frames behind a Venetian-blind effect which no amount of control adjustment can resolve. All controls appear to be working normally and most of the valves have been tested and found to be in order. This fault is on BBC-1 but no picture of any sort can be obtained on ITV. Sound on both channels is excellent.—S. G. Rowan (N. Ireland).

We are not certain of the effect on the screen. You mention "four frames", but we can hardly think that this is possible. It is likely though that the line generator is running at the wrong speed, causing the break-up effect. For four frames to appear fieldwise the field generator would have to run at about 12c/s. which would give incredibly bad flicker!

GEC 2019

I am having trouble with the picture. When I switch on the picture is normal but after a few minutes there is a black band at the bottom of the screen about 1 in. wide. Please could you advise me how to put the trouble right.—L. E. Dabb (S. Wales).

This is a symptom of a worn field timebase valve. If possible have this checked by a dealer and replace if below 70% down when hot. Alternatively check by substitution. Make sure that the vertical controls, including linearity and height, are adjusted after the set is properly warmed up.

FERGUSON 3619

I can get good vision and good sound but not together. Can you inform me how to overcome this trouble?—P. Croft (Kent).

This is the basic symptom of misalignment of the dual-standard i.f. strip on the 625 standard. Special equipment is required for realignment and is a job best undertaken by a skilled technician. However, the trouble can also be aggravated by a weak u.h.f. aerial signal. If possible check the set on a friend's aerial to prove this possibility.

SOBELL ST283DS-T

The field timebase will not open out to cover the entire depth of the tube with the height control fully turned up. On switching on there is about $\frac{1}{2}$ in. gap at top and bottom which increases as the set warms up to about 2 in. on either side. Also there is occasional loss of hold for a few seconds at odd intervals then it locks again. The line timebase is all right and the fault occurs on all stations. The following remedies have been tried without success:

PCL85 field output and oscillator valve changed; sync separator valve changed; video amplifier changed; PY33 rectifier changed; thermistor in series with scan coils replaced; anode and grid capacitors in the field timebase have been disconnected and tested for shorts but only on an ohmmeter. No resistors appear to be burnt out.

The voltages on the anode, screen and cathode of the field output valve are nearly as recommended by the makers.—D. Fisher (Essex).

We suggest you change the 560k Ω resistor from the height control to pin 1 of the PCL85. If this is not effective check the 270k Ω resistor in series with the 0.1 μ F capacitor.

QUERIES COUPON

This coupon is available until DECEMBER 20 1968, and must accompany all Queries sent in accordance with the notice on page 139.

PRACTICAL TELEVISION, DECEMBER 1968

TEST CASE -73

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

? AN experimenter noticed the same symptom on a number of sets of five-years-old or more vintage. It took the form of a cyclic pulsating or "breathing" of the picture essentially in the field (vertical) dimension mostly on the local BBC-1 channel. In some cases the vertical scan could be seen to expand and contract at the slow rate of about once per second (or a little less) by at least a quarter of an inch. On sets with slightly reduced width the vertical edges of the picture were seen to be S-shaped, and it was noticed that this curvature effect was also pulsating in sympathy with the picture.

Thinking that he had come up against a fault common to all these older models the experimenter commenced to investigate the field timebase circuits where he concluded the cause of the symptom must be. Indeed on changing the field timebase oscillator of one set the symptom cleared completely, on another it was reduced a little, but on the remainder it was just as severe as ever with new field timebase valves. The other parts in the field timebase were carefully checked and some replaced but the symptom could not be cleared.

What had this experimenter overlooked—and what, indeed, is the cause of this symptom which,

as the experimenter discovered, is not uncommon on the older type of set? See next month's PRACTICAL TELEVISION for the solution to this problem and for a further item in the Test Case series.

SOLUTION TO TEST CASE 72
Page 92 (last month)

The arcing described last month from the base of the EY86 in an Alba Model T655 was not so much a d.c. discharge—which would give a characteristic yellow, thin crackling type of spark—as an a.c. one, a rather violent, bluish spark. This suggested that the fault was possibly in the e.h.t. rectifier valve itself—letting through some line pulse potential—but replacing the valve had no alleviating effect at all! Attention was then directed to the e.h.t. feed circuit to the tube final anode, and by running the set in a darkened room small discharge sparks could be seen on the external conductive coating of the picture tube in proximity to the earthing spring. The tension of this spring was increased to secure improved earthing and the symptom completely disappeared.

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