Practical TELEVISION

APRIL 1967

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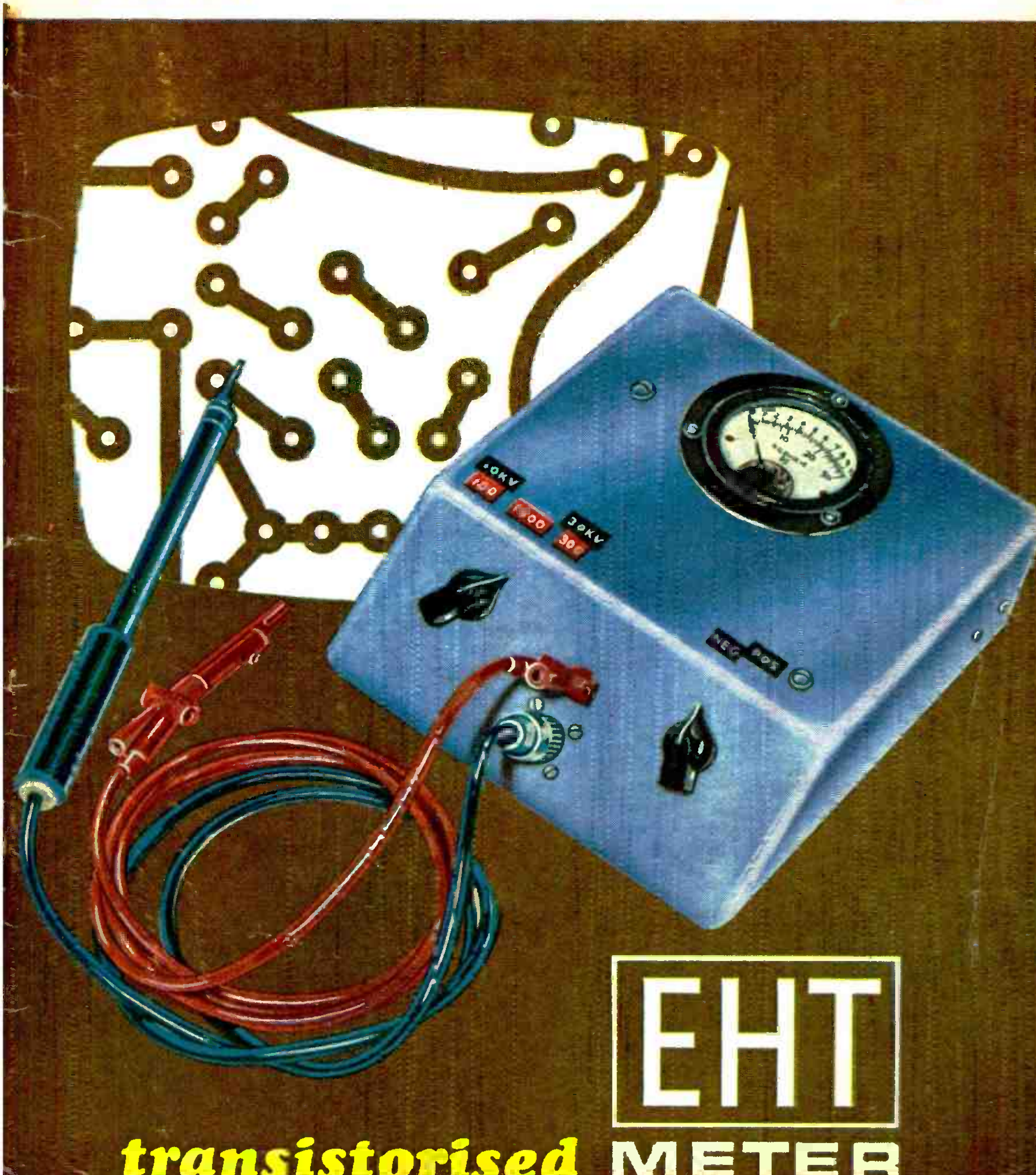

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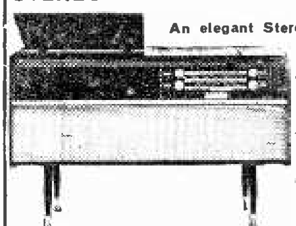

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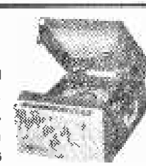

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Practical Television

SECOND THOUGHTS

THE much-delayed White Paper on Broadcasting, when it did eventually appear, bore the hallmarks of a hastily produced overnight rush job and as such came under heavy criticism.

In our February leader we complained that important questions on future television standards were left in the air. Both before and after the decision to adopt our particular 625-line parameters many voices have been raised in objection, and the system in practice has exposed these shortcomings for all to see. Yet despite the doubts, and the whispers, no word in the White Paper.

We also questioned the wisdom of restricting the colour service to BBC-2 only, for this seemed to be at grave variance with the interests of the public, the trade and industry.

Since the appearance of the White Paper and the Report from his Television Advisory Committee, the Postmaster General has obviously had second thoughts. It has now been agreed, sensibly, that both ITA and BBC-1 will also have colour outlets. These will be on 625 u.h.f. and will duplicate the respective 405 v.h.f. channels, the first stage in a complete changeover to 625 u.h.f.

This will be no overnight transformation, for although BBC-2 is to start colour later this year, the BBC-1 and ITA colour programmes may be up to three years distant. The PMG estimates that 75% coverage will be achieved by 1971, but nobody has been brave (or foolish) enough to predict a date for near 100% coverage. And yet on the despised existing v.h.f. systems we *already* have nearly 90% U.K. coverage by ITA and over 90% coverage by BBC-1! Pundits can produce arguments by the sackful about the supposed superiority of the 625-line system without altering the fact that where viewers have a choice, results are almost always far inferior on u.h.f.

Among his reasons for u.h.f.-only standardisation the PMG says: "... it will permit of the manufacture of single-standard 625-line only sets, which will be cheaper ..." Who is trying to kid whom? In comparison with the probable cost of a colour receiver any saving would be marginal only, yet a high price to pay for a dubious advantage.

Well, everyone has long been agitating for decisions. Now we have them. It may well be argued whether the TAC recommendations are good or bad. For our part we think that once again a false move has been made.

W. N. STEVENS—*Editor*.

APRIL 1967
VOL. 17 No. 7
issue 199

THIS MONTH

OUR NEXT ISSUE DATED MAY WILL BE PUBLISHED ON APRIL 21

TELETOPICS

Learning with electronic aids

COCOA, Florida—"Inquiry Modules" that use personal TV screens to link individual students with a library of information pre-recorded on video and audio tapes will be added to the Learning Centre at Brevard Junior College.

The school, which employs many new learning aids as advanced as the space technology of nearby Cape Kennedy, has ordered the new equipment from Raytheon Company of Lexington, Mass.

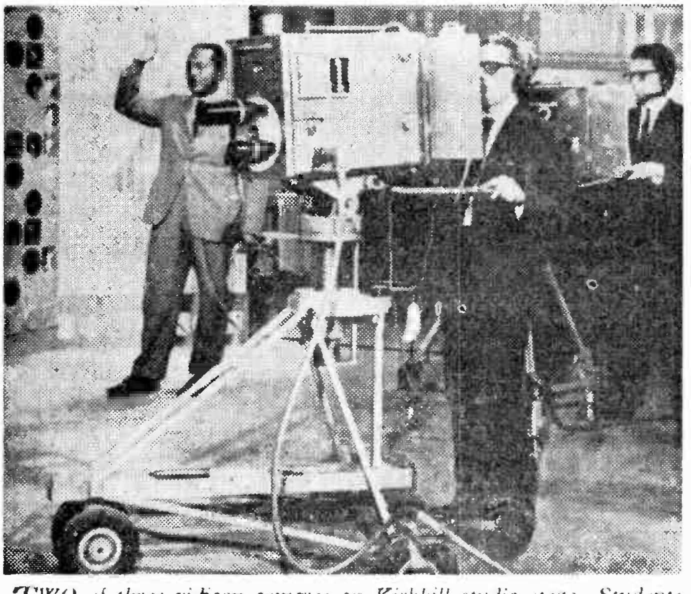
At a single booth, a student may watch educational television, closed circuit TV, video-taped TV courses and programmes, and even commercial TV. Or, he may listen to tape-recorded language lessons and other instructional materials, tape-recorded music in stereo, or f.m. radio. The student will be able to select what he wants to watch or hear. All of the college's resource materials will be available instantly by dialling the appropriate reference number. Other booths in the Learning Centre are equipped with microfilm readers and rear-screen projection cabinets for 8m.m. film and slides or film strips.

BICC TOWERS FOR TV RELAY STATIONS

BRITISH Insulated Callender's Construction Company Limited has received an order from EMI Electronics Ltd. for the supply and erection of ten 150ft. steel lattice towers. Racal Communications Ltd. have placed an order for a further 150ft. tower, bringing the total value of the contracts to nearly £40,000.

The towers will be used at Independent Television Authority relay stations for ITA v.h.f. and BBC u.h.f. television services at Llandovery (Carmarthen); Bala (Merioneth); Chesterfield (Derbyshire); Mossley, Darwen, Nelson (Lancashire); Halifax, Keighley, Skipton (Yorkshire); Whitehaven (Cumberland); Rothesay (Buteshire).

Overseas students receive TV training

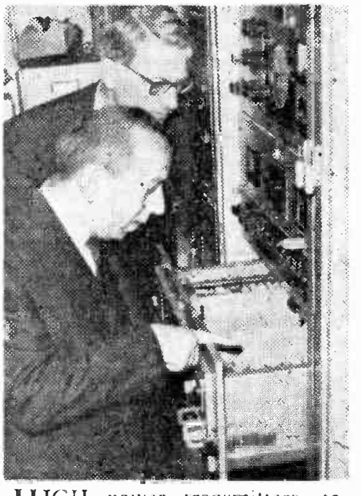


TWO of three vidicon cameras on Kirkhill studio stage. Students from abroad receiving training in the operation of TV equipment. *Full story: see Underneath the Dipole, page 323.*

Baird receivers used in Hong Kong colour TV tests

IT is announced from Hong Kong that Television Broadcast Limited will be carrying out tests of colour TV in the colony. Amongst the items ordered for this purpose is a first consignment of Baird 25in. colour receivers which will be shipped from the UK as early as May this year.

Jordan's first TV equipment completed



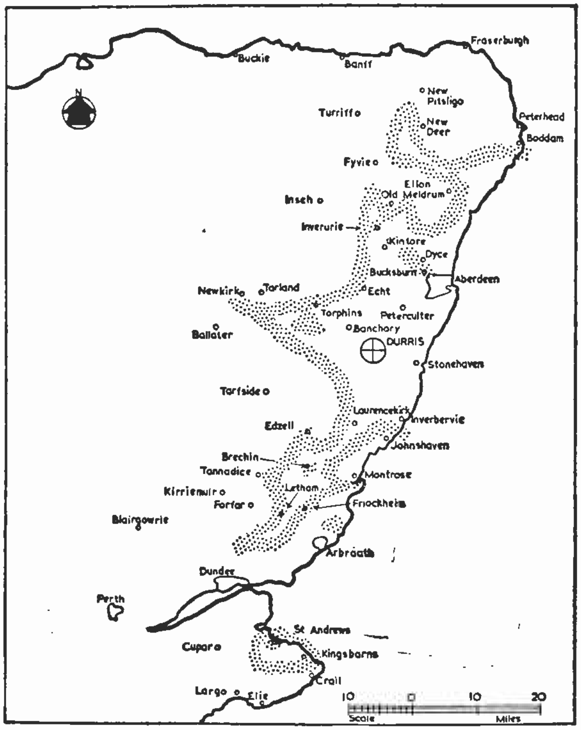
HIGH power transmitters, to provide the first TV service in Jordan, have been completed by the Marconi Company.

It is expected that the service will be on the air before the end of 1967. One transmitting station, broadcasting in band 3, will be located in Jerusalem, to give coverage of the city of Jordan and the surrounding area. The other will be on the outskirts of Amman and will broadcast in band 1. The Jordan Television Corporation studios will be in the city of Amman and programmes will be fed to Jerusalem by microwave link. The photograph shows (left) Mr. Taher Naseredin, Chief Engineer of the Jordan Television Corporation with Dr. Greiss, the Marconi man responsible for the installation examining a 10kW transmitter.

DURRIS BBC-2 TELEVISION SERVICE

This service is on Channel 28 with horizontal polarization. The vision frequency is 527·25Mc/s and the sound frequency is 533·25Mc/s. Maximum vision ERP is 500kW.

The limit of the service area is roughly indicated by the dotted band on the map. The BBC state however that this must not be interpreted as a rigid boundary and reception may be possible at many places outside it. Also, because the quality of reception on u.h.f. can vary at places only short distances apart, there are, inevitably, small pockets of poor reception within the service area which cannot be shown.



CONTRACT FOR BEDFORD BBC-1 RELAY STATION

THE BBC has placed an order with H. F. Bull & Sons Limited of Sandy, Bedfordshire, for the erection of the building for the BBC-1 television relay station which is to be built some five miles east of Bedford.

It will transmit BBC-1 on Channel 10 with horizontal polarization and is expected to come into service in the autumn. It will serve some 70,000 people in Bedford and Kempston and in the surrounding area including Willington, Cardington, Houghton Conquest, Stewartby, Wooton, Bromham, Biddenham and Renhold.

THE P.W. FILM SHOW

The annual film show, organised jointly by Mullard Ltd. and *Practical Wireless* and *Practical Television*, is to be held, as before, at Caxton Hall, Caxton Street, Westminster, London S.W.1. The date is Friday, **April 14th,** and the show will start at 7.30 p.m. prompt.

The programme will include a film *Electrons in Harness* and a topical talk on *Transistors and Television.* Refreshments will be served in the interval.

Applications for tickets—which are free—should be made now to Film Show, *Practical Wireless* and *Practical Television*, Tower House, Southampton Street, London, W.C.2. A stamped addressed envelope must be included with all applications.

IEETE ENTRY EDUCATIONAL REQUIREMENTS

THE Institution of Electrical and Electronics Technician Engineers have decided to augment the entries in the IEETE Schedule of Accepted Qualifications, as follows: (a) City and Guilds of London Institute's Telecommunication Technicians' Certificate together with at least two certificates in Supplementary Studies (Regulations 49/300). (b) City and Guilds of London Institute's Electrical Technicians' Certificate together with at least two Endorsement Certificates both in Group 'A' subjects (Regulations 57).

There follows a list of the qualificatons acceptable to the Council in satisfaction of the technical educational requirements for the election to the class of graduate:—(1) Higher National Certificate, or Higher National Diploma, in Electrical Engineering. (2) Higher National Certificate, or Higher National Diploma, in Electrical and Electronic) Engineering. (3) The ASEE Diploma in Electrical Installation Practice, or The ASEE Diploma in Electrical Maintenance Practice, or The ASEE Diploma in Industrial Electronics and Control. (4) City and Guilds of London Institute's Telecommunication Technicians' Certificate together with at least two certificates in Supplementary Studies (Regulations 49/300). (5) City and Guilds of London Institute's Final Certificate in Telecommunications Engineering (Regulations 50). (6) City and Guilds of London Institute's Final Certificate in Electrical Engineering Practice (Regulations 52). (7) City and Guilds of London Institute's Electrical Technicians' Certificate together with at least two Endorsement Certificates, both in Group 'A' subjects (Regulations 57). (8) An approved British College Associateship, or Diploma, in Electrical Engineering, gained as a result of attending a full-time, or sandwich, course in electrical or electronic engineering. (9) An approved Overseas College Associateship, Fellowship, Diploma or other award, in electrical or electronic engineering.

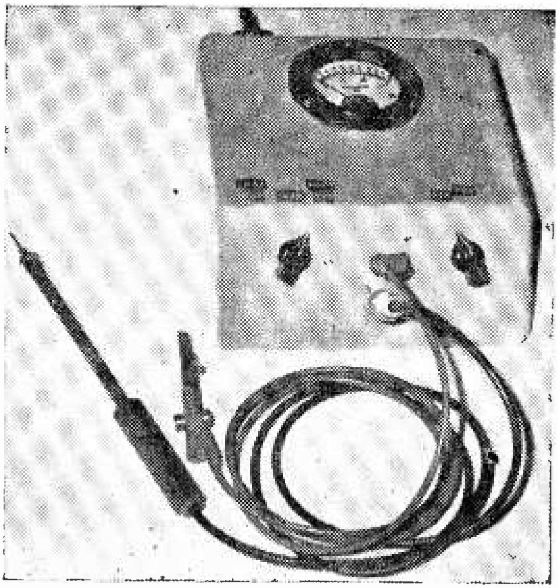
EXTRA HIGH TENSION

Positive or negative d.c. voltages can be measured with this transistorised unit, which can be operated either from the mains or from internal batteries.

This voltmeter offers an extremely high impedance to most circuits, yet employs an inexpensive meter movement.

The meter circuitry is protected against overload, polarity inversion and micro-corona damage.

The meter zero is electronically stabilised against temperature and input voltage variations, and is correct immediately upon switch on.



WHEREAS most conventional wireless and audio equipment operates with voltages below 500 volts, television receivers additionally require two higher voltages. One of these so-called e.h.t. ranges extends up to a few kilovolts, for line output stages and associated boost circuits, while the other reaches up to 30 kilovolts, for the final anodes on the picture tube. It is very useful to have a reliable meter, for accurate indications in all these voltage ranges, particularly for the two e.h.t. ranges. The current drain imposed by the meter must be limited to microamps, to avoid falsification of readings due to loading. In fact, low meter input current (i.e. high meter input impedance) is very desirable even on the lower h.t. ranges, since circuits of very high impedance and low current often have to be measured.

THE VALVE VOLTMETER

The familiar valve voltmeter (VTVM = Valve, Thermionic, Voltmeter) has long been used for making accurate voltage measurements in circuits possessing very high impedance. The principle is to apply the voltage to be measured, via a bleeder or potentiometer of extremely high resistance, to the grid of a triode valve, inserting a conventional moving coil meter in the anode circuit to measure the resulting anode current. This arrangement and its various derivatives is cheaper than a moving coil meter of extremely high current sensitivity used directly with very high series resistors in a conventional multimeter circuit. It is also more robust for portable equipment, since sturdy meters of low current sensitivity may be used. The grid circuit of a triode valve permits pure voltage control of the anode current with negligible current drain in the negative bias region, i.e. the input impedance of a VTVM can easily be made of the required extremely high magnitude.

DISADVANTAGES OF THE VTVM

The design of a practical VTVM is considerably complicated by the need to obtain zero meter readings in the anode circuit when no input voltage is applied to the grid. In the basic arrangement, this would call for a standing bias setting which is exactly at the cut-off point. In this region the mutual characteristic (anode current against grid voltage, for constant anode voltage) of any valve is rather curved and not so steep as in the region of appreciable anode current. Thus, the cut-off point is rather ill-defined, severely displaced by ageing of the valve and anode voltage fluctuations, and the early part of the meter scale would be extremely cramped.

Practical VTVM circuits employ some form of bridge circuit containing the meter. The valve is now operated at normal anode current even in the absence of an input voltage, and this current is passed through the meter in the anode circuit. A compensatory current of equal magnitude and opposite sense is also passed through the meter from another circuit branch which may take various forms not necessary to describe in detail for the purpose of this article. This arrangement will produce a linear meter scale commencing with zero deflection for zero input voltage, when the bridge circuit around the meter is properly balanced. But valve ageing and supply voltage drifts still affect the balance point, so that the

METER

by Martin L. Michaelis, M.A.

performance specifications

Range	Input Impedance	Current Drain at f.s.d.
0–100V	360kΩ per volt	3μA
0–300V	120kΩ per volt	8μA
0–1500V	24kΩ per volt	40μA
0–10kV	110kΩ per volt	9μA
0–30kV	36kΩ per volt	28μA

meter zero indication will wander; especially during the first half-hour after switching on, until all parts have reached their final temperature. A manual zero setting control is thus necessary, and frequent checks and readjustments are required.

TRANSISTORISED AMPLIFYING VOLTMETER

This brief discussion of the conventional VTVM was essential for proper understanding of the advantages of a transistorised version of the same principle of amplifying extremely small currents for indication on a low-sensitivity meter. Transistors of reputable make are not subject to ageing when run under proper operating conditions. This brings the great advantage that a meter circuit once balanced will not drift due to long-term changes of characteristics of the amplifying device. Secondly, the circuit may be arranged so that the final temperature is the initial ambient temperature. Transistors permit circuits to be used in which the control characteristic for the current amplification is essentially linear from very close to cut-off right up to full scale deflection of a meter in the output circuit. The necessary standing current for zero input is then so small that a meter bridge is not required; it being more expedient to back-off the resulting meter deflection with the mechanical zero-setting screw of the meter pointer. This means that the meter pointer will rest back against the left-hand stop below the zero-mark on the scale when the unit is switched off: a useful visual indication obviating the need for a separate pilot lamp. The low voltages required by transistors permit the use of cheap and efficient low-voltage zener diodes for stabilising the supply voltage, removing drifts of meter indication due to mains or battery voltage fluctuations.

TEMPERATURE STABILISATION

Apart from the meter movement, the only components that can have an effect on the accuracy and stability of calibration of a transistorised amplifying voltmeter are the resistors and semiconductors. Resistors of any desired degree of stability are readily available within the accuracy limits of the moving coil meter itself, so that it only remains to consider the temperature stability of the transistors. This is poor, as is well known. Without appropriate consideration of this factor in circuit design, the meter indication will depend strongly upon the ambient temperature and may be particularly erratic. Two simple tricks will completely remove most temperature effects.

Firstly, if an emitter-follower type of circuit is used, voltage gain becomes quite negligible. Such a circuit essentially involves 100% voltage negative feedback, giving unity voltage gain (the input voltage equal to the output voltage). Since current gain (i.e. impedance step-down) is what is wanted, this arrangement is quite in keeping with the function of the meter.

Now to the question of standing bias to set the small zero-current of the amplifier required to move onto the linear control range. Silicon transistors are essential for the amplifier, in order to permit the required very high input impedance in a simple circuit. These require a small threshold bias in the conduction sense before any collector current can flow. The magnitude of this threshold bias for a given collector current is extremely dependent upon temperature: values as great as 1% drift per degree Centigrade of temperature change are not uncommon.

TRANSISTORS AS CONTINUOUSLY VARIABLE NTC RESISTORS

This threshold bias drift effect, which is common to silicon and germanium transistors, is a great nuisance when designing many circuits, yet offers many rather attractive possibilities for deliberate exploitation. The actual temperature characteristic is exponential, the same as the temperature dependence of the collector current of a transistor at the normal operating point (which is indeed related to it). Now collector current increases with temperature, so that the collector to emitter voltage of a transistor drops with temperature when the collector is fed through a large fixed resistor connected to a constant voltage supply. If this collector to emitter voltage is now used as the threshold bias for the current amplifier of our meter circuit, it is clear that suitable component values can be found for which the temperature effects cancel one another.

This arrangement is essentially the same as a voltage divider consisting of a fixed resistor and an NTC (negative temperature coefficient) resistor, as familiar for temperature stabilisation of the resting current in a transistorised push-pull output stage of a pocket radio, or various waveform amplitude stabilisation circuits in television equipment. Whilst a manufacturer can get specific NTC resistor types made to order in quantity for his serial productions, the amateur constructor is

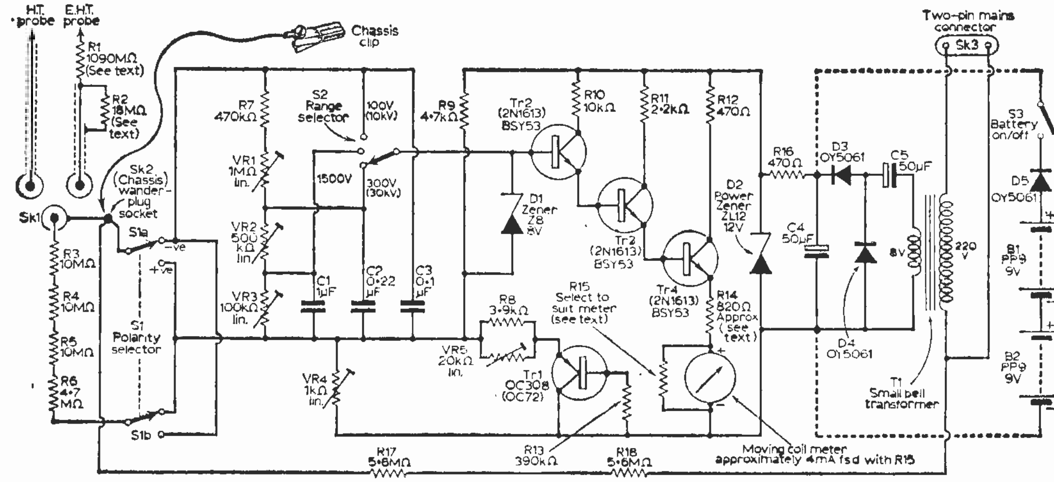


Fig. 1: Theoretical circuit diagram of the transistorised e.h.t. meter.

often unable to obtain exactly the right NTC resistor for his one-off job. Many readers will doubtless have suffered exasperation on this score. It is therefore useful to note that NTC resistors of virtually any desired nominal value and temperature exponent may be produced with a standard transistor and two carbon resistors of appropriate value. If the resistors are made preset variables the exact optimum characteristic may be set in a given circuit. The general rules are as follows. Use germanium transistors for nominal values up to some dozens of kilohms, and use silicon transistors for higher nominal values up to several Megohms. The desired nominal value is given by the sum of the fixed emitter resistor and the fixed base resistor divided by the current gain (beta) of the selected transistor, i.e. it is essentially set by selecting the base resistor. The temperature exponent is set by varying the emitter resistor and the mean operating voltage. It is hardly affected by the particular type of transistor.

The network R9, VR4, R8, VR5, Tr1, R13 shown in Fig. 1 is a practical example of this type of circuit used for temperature stabilisation. With this circuit refinement, our e.h.t meter does not require a manual zero-correction control; its indications are correct and stable immediately after switch-on and at all ambient temperatures normally encountered.

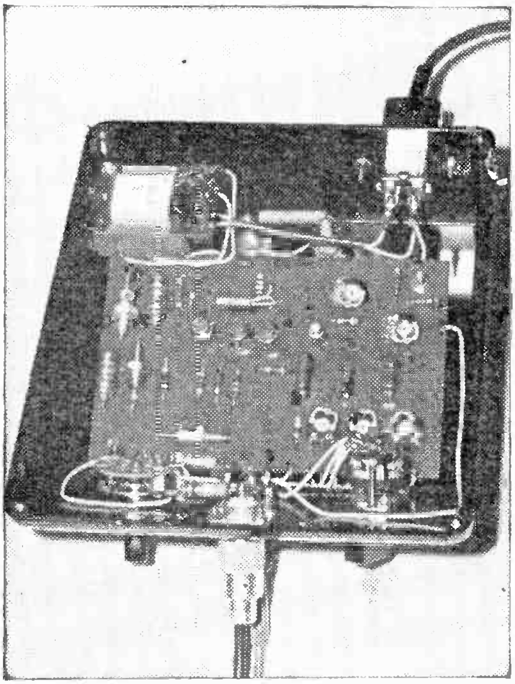
SAFETY FACTORS

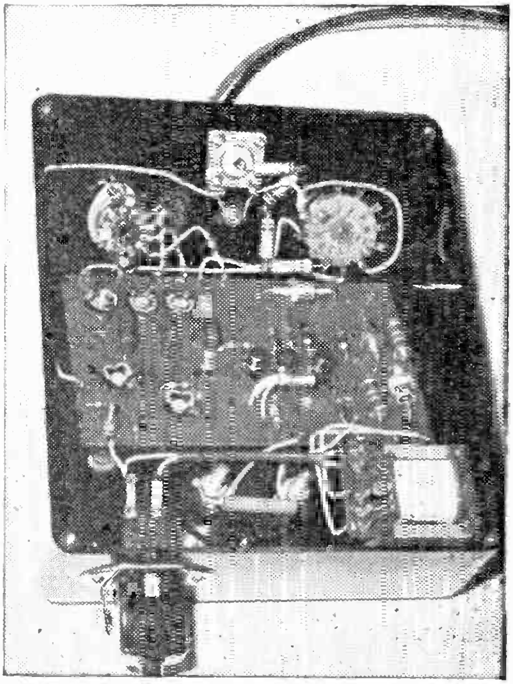
Apart from the needs to satisfy electrical requirements of high input impedance and good temperature stability, a practical amplifying meter must satisfy conditions ensuring protection of its own components and the human operator against high voltage if it is to be satisfactory for e.h.t. measurements. This raises a number of problems whose clear understanding will greatly aid the handling of e.h.t. voltages in general. It is important to realise at the outset that electric shock to a human operator is solely dependent upon the current passed through his body, irrespective of the voltage (which will adjust itself as appropriate). The current levels for the threshold of any sensation at all, and for potentially lethal effects, also depend upon the path taken through the body. Fifty microamps is normally below the level of sensation, whilst a few milliamps can sometimes prove fatal: 250 milliamps across the chest normally leads to heart flimmer followed by death in many cases, while 1 amp will result in immediate death by heart paralysis. A circuit may therefore be considered safe if the impedance between all points, which are exposed to touch and the high voltage points, is such that currents flowing when the exposed points are shorted to ground are less than 50μA. Furthermore, the resistances or other components constituting these impendances must be safely rated for the applied voltage stress, so that breakdown is unlikely.

The peak mains voltage is roughly 400 volts, so that the minimum permissible impedance between an exposed conductor and the live line is 8MΩ (or 375pF if a capacitor). For a 30kV e.h.t. line, the minimum resistance permissible between it and an exposed conductor is 600MΩ. Tuning to the protection of circuit components, matters are more involved because current, voltage stress or both can cause damage when excessive.

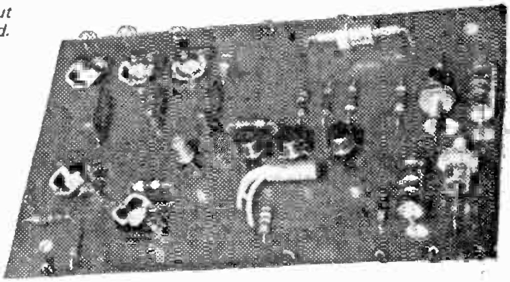
MAINS TRANSFORMER BREAKDOWN

Consider the complete theoretical circuit of our e.h.t. meter shown in Fig. 1. Disregarding R17 and R18 for the moment, it is seen that the entire circuit is floating, apart from the mains transformer primary which possesses a path to ground via the mains. The secondary must be floating, because the circuit is given a ground connection via the chassis of the equipment on test, and this may be at mains voltage in the case of a television receiver, also polarity switching via S1 precludes any other point of grounding, which would otherwise lead to short-circuits. Now suppose that the e.h.t. probe is connected-up and touched into the final anode of the picture tube, but the earth clip from the meter to the TV chassis has been forgotten or has dropped off. The insulation between the entirely floating circuit and ground





These photographs show the author's unit. Note the simple layout of components and the clean look of his printed circuit board.



will normally be many thousands of Megohms, so that a large portion of the e.h.t. voltage appears on the entire circuit in spite of the 1090MΩ series resistance of the e.h.t. probe. This is no real danger to the operator, because the voltage collapses at once if the circuit is touched. But the mains transformer will suffer. The entire voltage stress is impressed between the secondary and mains-earthed primary. Probably nothing will be noticed, since the maximum possible short-circuit current of 50μA can produce only micro-corona in the insulation of the mains transformer, which is will survive satisfactorily on several occasions. But each time the insulation will be weakened, until one day the mains voltage alone can finally break it down, causing the transformer to burn out 'for no apparent reason'.

STRESS LIMITATION

The resistors R17 and R18 are provided to avoid such breakdowns. They provide a high-resistance path to the mains as soon at the mains plug is inserted. When the chassis clip is now omitted and the e.h.t probe touches onto a final anode, R17 and R18 form a bleeder with R1 in the probe limiting the stress on the mains transformer insulation to about 300 volts which it will tolerate. With the h.t. probe connected to a maximum potential of 1·5kV, R3 to R6 still form a bleeder with R17 and R18 if the chassis connection is omitted, again limiting the stress on the mains transformer to about 350 volts. Two resistors R17 and R18 are used instead of a single 10MΩ resistor to reduce the danger of breakdown and hazard to a person touching Sk2. The value of R17 and R18 is high enough to avoid shock when touching Sk2, but it is advisable to shroud Sk1 and Sk2: use coaxial cable with good outer insulation. It is advisable to treat these parts of the circuit with the same respect as a television receiver chassis. If the mains plug of the television receiver happens to be inserted in such a way that the chassis is live, and Sk3 on the meter such that R18 goes to ground, or vice-versa, then R17 annd R18 will be connected across the mains as soon as Sk2 is connected to the TV receiver chassis. This is quite tolerable. With the other possible polarities, R17 and R18 will be shorted out via the TV receiver chassis. This is equally tolerable. It is thus unimportant which way round the meter and TV receiver mains plugs are inserted. Capacitors C1, C2 and C3 bypass any a.c. components injected by such means, so that readings remain correct in any combination.

CONTINUED NEXT MONTH

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

NEW SERIES

PART 10: More about Tuners

DIRTY contacts, selector switches and coil wafers, plus the damaged resistor that causes a lack of h.t. to the tuner unit are the most prevalent faults in the front end of the television receiver. The carefree method of sloshing a drop of switch-cleaner gaily into the little tin box can sometimes lead to trouble. More especially, if the wrong sort of preparation is used. Some switch-cleaners are excellent for dealing with contacts that have a wide surface and plenty of adjacent airspace to aid evaporation. Some tend to leave the 'carrier' lingering too long, and switching on the apparatus too soon can cause a burn and later trouble. Others attack the various plastics that are now to be found in most tuner units, and should be avoided. There are one or two, perfectly safe, especially developed for the purpose. In particular, the aerosol type, such as Multicore's 2-A-X, or the Radiospares version of a contact lubricant can be employed with confidence.

When in doubt, a drop of methylated or surgical spirit on a lint-free cloth and a little patience will clean all but the most dirt-impregnated contact surfaces. After this, a smear of lubricant such as silicone grease will prevent recurrence. The temptation to scrape or file the oxidisation from tuner contacts should be resisted. These fine surfaces depend on smooth action for their noise-free operation, and no matter how gentle your finishing, rough abrasion will always leave scratches and cause future pitting, especially to the crucial switch sections that carry h.t. The point to remember is that the tuner unit is operating at the highest frequencies, when the smallest physical discrepancy can be significant, and is also handling the smallest signal levels—which makes it the most vulnerable part of the set to unwanted noise. It must also be remembered that poor contacts in these high-frequency carrying parts of the receiver can cause other symptoms besides noise: notably a variation in signal level, and perhaps mistuning.

This is one of the chief faults of the 'cowboy' field engineer, when faced with a noisy tuner unit. First he rattles the rotor around like a football ratchet, scaring the owner out of his (or more often her) wits. Then he smears lubricating grease liberally over any moving part he can reach, or sprays the innards of the tuner with an abandon that shows the expensive aerosol tin was not purchased from his own pocket. Then—and this is the crucial point I am underlining—he switches on the set, tickles up the tuning, collects his payment and leaves.

Not surprisingly, trouble crops up again later. The process of rotating the switch unit or rapidly

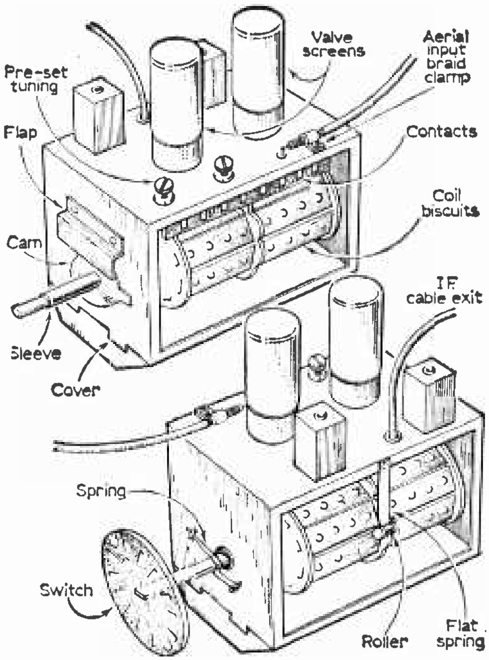


Fig. 48: Two views of old-type turret tuner, showing the trouble spots discussed in the accompanying text.

playing the press-button keys may certainly help disturb any overlay of dirt on the contacts. It does not wholly remove it, but simply displaces it temporarily. The contacts need to be tackled gently and with patience to remove the dirt completely. Next, smearing the grease on too liberally merely invites dust, and if it is laid on top of any existing tarnish or dust, can aggravate rather than cure the bad connection.

Switch-cleaner fluid, even the right type, can be laid on too generously. In doing so, our 'cowboy' may not realise he is altering slightly the electrical constants of the circuit. Remember that at the high frequencies we are concerned with, quite trivial differences in inductance and capacitance can throw a set off tune. He then retunes the set and possibly obtains good picture and sound, only to have it drift off later, when the unit has warmed up and the carrier of the switch-cleaner has fully evaporated. Make it a rule never to retune until the receiver has had a chance to warm up thoroughly, and never immediately after cleaning the contacts.

Ultimately, the best way of tackling dirty contacts is to remove the coil biscuits, printed wafers or other removable parts and tackle the contacts 'in the open'. On some tuners, this is not possible, but here it is usually easy to get at the studs and small springs that do the job. Take care not to distort these small springs; so much depends on their continued action, and a spring bent is usually a spring weakened, see Fig. 48.

With the coil biscuits removed, it is generally easier to get at the stator springs. When cleaning these, always avoid the tendency to press them back out of position. Some have quite flimsy fixing at their roots, and it is possible to dislodge certain types from the slots in the plastic where they are rooted. If possible, support the blade of such types when cleaning the contact surface. The coil biscuits themselves are easily cleaned when in the open—but don't forget to clean all the surface of the biscuit, wafer, or slider. Dirt can be trapped on the plastic and later transferred to the plated contacts, with detrimental effects.

One contact that is often overlooked during the cleaning process is the chassis return connection of the rotor arm, or switch bar. This may be, as in the case of several Philips designs, no more than a steel spring that bears against a recessed portion of the spindle. Another type depends on the pressure of the cam roller in the detents of the rotor and it is sometimes necessary to bend the flat spring slightly to increase the tension, as well as clean off the contact surfaces of the spring and cage portion of the rotor. The fact that this is partly an electrical device as well as a purely mechanical spring tends to be forgotten. From this, it follows that actual earth returns, soldered braid connections, jumper cables, screening cans, plates and the screws that secure them, must be checked—and always replaced after servicing. There is a decided temptation to leave odd screws out when reassembling an awkward tuner. Odd screws omitted may mean odd patterns on the picture at a later date.

Valve pin connections seem obvious, but are often overlooked. Pins tend to oxidise, especially where current passes. In some instances, such as the substitution of a Mazda for a Mullard valve, the actual length of the pins differs and it may be necessary to tighten contact springs, especially where these have operated without any disturbance for some time. A sharp probe inserted between the outer of the spring and the side of its hole is the best 'coaxer'. A trick some engineers use to find loose pins is to take an old valve, cut all the pins off except one, and patiently go round the base with this single probe, feeling for the slack contact that would otherwise be unnoticed. Fig. 48 summarises the trouble spots.

External switches are common with older type receivers, where separate contrast or sensitivity controls were selected, and may be used in newer sets in conjunction with the system switching. Do not omit the routine cleaning operation of these switches: always check the 'throw' of the operating bar or cable that performs the selection. An example is the G.E.C. tuner as used in the 2,000 range and the Sobell 1,000 equivalents. This type of switch fixing is mentioned especially as it embodies a trap for the unwary. When removing the tuner for servicing—the easiest method—the switch cable can be released, but the

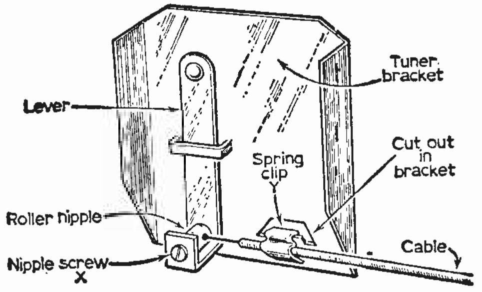


Fig. 49: System switches are often cable-operated. In some types it is important that the removal of the cable is by unhooking the clamp and releasing the nipple, but not loosening the retaining screw.

temptation is to undo the screw marked X in Fig. 49. The correct way is to disengage the cable clip Y. The advantage of this type of fixing is that its removal enables work to be done on the chassis without the tiresome bother of propping it up in a position that allows linkages to operate. The selection of channels can be made by hand and reconnection is simple, by positioning of the selector knob. For the u.h.f. unit, a similar ease of servicing applies. There is a cam on the rear of the v.h.f. tuner with two 4BA countersunk screws located on the face. Slackening these allows the cam to be turned to the appropriate v.h.f. channel position so that the u.h.f. signal can be fed to an alternative channel to the 'correct' setting, which is between 13 and 1. This is useful where 625-line reception is converted to a v.h.f. channel, as in wired relay systems. (It is also necessary to alter the h.t. tapping point at present on the left tag at rear of lower chassis, i.e. 'Local', to its adjacent tag—roughly level with the connector plug base.)

The above refers to the semi-incremental type of tuner. Other models of the G.E.C. range employ a turret type tuner and in these it is necessary to set the selector to Channel 7, then loosen the two screws on the face of the cam, rotating it to operate in the new position. The transparent disc on the back of the knob, held by two screws, can then be rotated to place the marking 'U' in the correct channel position to obscure the unused v.h.f. number.

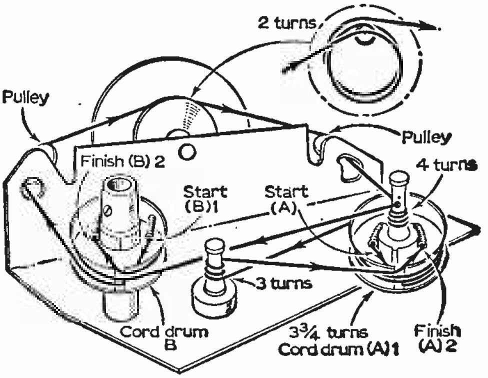


Fig. 50: An example of the fine tuner system employed for u.h.f. tuning. Exact routing of cord and freedom of pulleys is very important to avoid backlash and tuning drift.

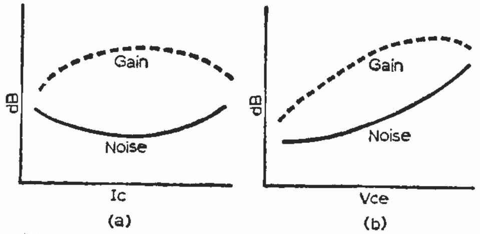


Fig. 51: Noise and gain levels vary with both collector voltage and current. Exact setting for optimum conditions in a transistor tuner can be important.

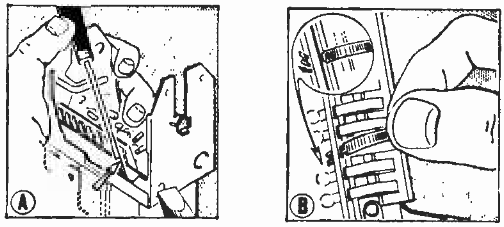


Fig. 53: Fixed spring blade contacts can be adjusted as in A and removed and replaced as in B. Correct lift (Thorn 950 tuner) at the spring tip should be between 1 and 2½mm. Working contact pressure should be about 60 grammes. Block is soldered into place and can be eased out by melting the support with a heavy-duty iron. Some care is needed when repositioning. Excessive pressure soon weakens contacts.

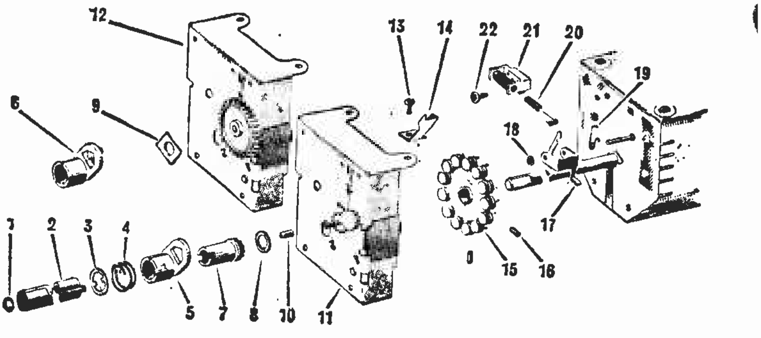
Although every manual or operating instruction leaflet will stress the point that no service should be carried out to u.h.f. tuners, it is in fact a common thing to find that the main problem is switch linkages and tuning devices. So forgive me if this is turning out to be a semi-mechanical article. To illustrate the point, Fig. 50 shows the drive cord system of the Pye 11 series, also used, with variations imposed by the different positioning of parts, in later marks and models. The catch is the winding of the cord round the pin (as shown inset) and in the exact number of turns around the drums. To renew a drive cord, always start as shown, at A1, finishing at A2, and at B1, finishing at B2. Smear the spindles of rotating parts, especially the free-running pulleys, with a little light grease, as it is important that there is no binding. When reassembling this chassis, which pivots out for servicing, and where it is necessary to remove the spring-loaded fine tuning knob, always position the selector so that the spindle flat faces upwards and the 'peak' of the cam, viewed from the rear, is at '3 o'clock'.

More complicated at first sight, but in fact much more simple ultimately, is the integrated, transistorised, v.h.f./u.h.f. tuner, such as the Cyldon IT100. The secret here is the use of tuning gang sections that tune over a limited arc —60 degrees against the more usual 180 degrees that needs geared drives, etc.—and can be operated by cam action from push-buttons. Integration has led to a much less complicated mechanical design than the switch selection system of two separate units. Tuning inductance in the u.h.f. section is by lecher wires in troughs, and conventional coils for v.h.f., with band switching coupled to the press-buttons. Five buttons select v.h.f. channels while another is used for the 470 to 854Mc/s band. Channel selection within the v.h.f. band is by depression and rotation of the inductor core spindle. Adjustable plastic ramps determine the band selection. The seventh button of the set is a common 'Off' switch, with a conventional latch-plate action, at the same time releasing the depressed button and switching the main power line. As with all other channel selector mechanisms, selection of one station automatically neutralises any other switch connection that has been made.

Previous articles in these pages have gone into the niceties of transistor tuner design, and it is not within my brief to discuss them here. From a practical point of view, the main faults we need to consider are errors of switching and other mechanical factors. Not least among these factors is the aerial input connection itself. By now we are all familiar with the coaxial plug and socket arrangement, and the connection tends to be taken for granted. With the transistor tuners, the network of resistors that we have become accustomed to have vanished and the aerial input is fed to the bandpass circuits of (usually) a common-base r.f. stage via a small capacitor. It is more important than ever to ensure a good clean connection, no 'damp-track' across the plastic inner section of the socket, no bad joints, whiskers or other relics of careless rigging.

There is one control we need mention on the transistor tuner which is often overlooked, yet is quite important. This is the preset gain control. It is not quite the same in operation as the former sensitivity control, but is used to set the operating

Fig. 52: Exploded view of the preset fine tuning mechanism employed by Thorn in the 950 chassis. Individual parts are as follows: 1, circlip; 2 fine tuning sleeve; 3, keyed washer; 4, clutch cam spring; 5, clutch cam; 6 Radio-TV clutch cam (alternative version of receiver); 7, drive gear; 8, spacer; 9, Rad-TV spacer; 10, ferrule fixer; 11, retaining bracket and rocker arm assembly; 12, Rad-TV version of 11; 13, screw retaining; 14, cable cleat; 15, bush and cam plate assembly; 16, Allen type grub screw; 17, fine tuning lever; 18, spire clip retaining 17; 19, return spring; 20, core and grommet; 21, fine tuning coil and support assembly, with 22, retaining screw.



—continued on page 306

LETTERS TO THE EDITOR

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

ISSUES REQUIRED

SIR,—I urgently require the June, July and August 1965 issues of PRACTICAL TELEVISION. If any readers can assist, I would be grateful if they would write to me.—J. McCARTHY (24 Landcroft Road, Dulwich, London, S.E.22).

INTERPRETING SYMPTOMS

SIR,—I must point out one rather misleading statement in the otherwise excellent article by V. D. Capel under the sub-heading 'Field Slip'.

Quote: "We can now check line sync by operating the line hold control and noting whether the picture jumps into position or quickly breaks into lines in either direction. If line sync is present the search can be confined to the field coupling components between the sync separator and the field generator."

I am afraid this is not always true. Faults can arise in the video amplifier which cause a loss of low frequency amplification sufficient to produce badly distorted and weak frame sync without affecting the line lock, and surprisingly do not affect the quality of the picture to any noticeable extent; so in the case of weak or no frame sync it is not always safe to forget the signal path preceding the sync separator.—R. H. SHAW (Hayes, Middlesex).

The Author replies:

The observation of Mr. Shaw in his letter regarding the effect of the video amplifier on frame sync is quite correct. Especially will a fault in the screen grid decoupling capacitor give rise to poor frame sync.

I had a note to this effect in the rough draft of my article but somehow it got omitted in the final version. My thanks to Mr. Shaw for pointing out this omission.—*V. D. Capel*

GETTING TV TAPED

SIR,—I have read K. Royal's article on "Getting TV Taped". I am very glad to say that major recording companies do not share his views on "there being little point in taping and replaying signals above 15kc/s since they are inaudible."

Frequencies above 15kc/s may well be inaudible (except to the odd dog) but the resultant beat frequencies produced by, say, signals at 16kc/s and 18kc/s and 21kc/s are indeed audible.

Thus, for true fidelity, any recording method should be able to record and reproduce the frequencies of the high harmonics of a full orchestra.

This may sound trivial, but I was convinced of this need during a demonstration of audio equipment. The amplifying chain was equipped with a switched filter, starting at 23kc/s cut-off and going down to 12kc/s in 1kc/s steps, designed expressly to prove that the upper frequencies do indeed add "that extra something". It was quite staggering to hear the difference as the filter was taken from 23kc/s to 12kc/s. —WM. NORRIE (Richmond, Yorkshire).

The Author replies:

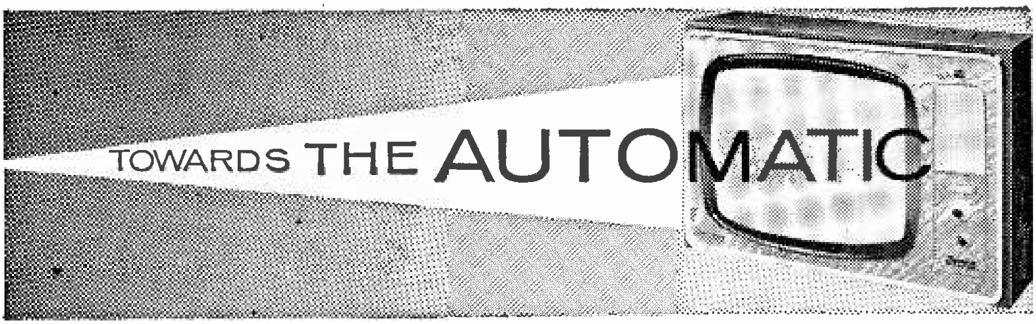
I am sorry that Mr. Norrie took to heart my very general comment concerning the top frequencies of sound recordings. This was, indeed, an arbitrary comment to highlight the wide spectrum demands of video—relative to sound!

It is true, of course, that sound much above 15kc/s is inaudible, and some people are unable to discern sounds of lower frequency, some have an auditory response coming in at about 12kc/s on a falling frequency scale. Vibrations in the air are converted by our sense of hearing to sound within the generally accepted range of 16c/s to 16,000c/s. Vibrations outside this spectrum are felt rather than heard. Strong vibrations above 16,000c/s can give rise to actual pain and below 16c/s to fear.

Mr. Norrie is a little confused about audio bandwidth, however, for the need to maintain a bandwidth extending outside the audible spectrum for high quality (i.e., hi-fi) reproduction is essential to ensure that the reproducing channel has a fast response to complex wavefronts of the programme signal which themselves are created by the overtones characterising the nature or "quality" of the reproduction (i.e., musical instrument).

The switching-in of filters, as told in Mr. Norrie's letter, has the effect of reducing the rise-time and thus "rounding off" component signals and it is this effect which is responsible for the apparent change in quality of the reproduction. Agreed, the recording device must first create signals of such sharply rising wavefronts, so the factors just expounded apply also to the recording *amplifiers*, but because these amplifiers may have responses going up to, say 25kc/s (sometimes above this frequency) this must not be assumed to indicate that overtones produced by sounding devices are all recorded, as much as we should like them to be. There are differences in "mechanism" reponsible for the conveyance of electrical signals corresponding to original air vibrations and for the translation of air vibrations *to* electrical signals and *from* electrical signals to air vibrations. But now we are getting into deep water.

I think that Mr. Norrie's original thoughts are based upon the fact that many more component signals than the mere fundamental are produced by a sounding device. The organ has the largest fundamental range extending from about 16c/s to a little over 8,000c/s. The harp is the next. A human voice has fundamentals from about 100c/s to 1,000c/s. However, the character of these sounds is provided by the harmonics or overtones extending up to 18,000c/s and sometimes beyond, but this extension often results from the sharply rising nature of the fundamental waveforms of some sounding devices, and the recording channel is required to store and reproduce these sharply rising waveforms and transients as far as is practical in the present state of the art.—*K Royal.*



TOWARDS THE AUTOMATIC

By S. GEORGE

Pt.1: STABILISED RASTERS

A NOTICEABLE trend in television design in recent years is the increasing tendency towards the self-adjusting "automatic" circuits to regulate or compensate for voltage, temperature, contrast and ageing valves, etc. In the early days the only real self-regulating device in the television receiver was the Barretter, which automatically varied its resistance to absorb variations in mains supply voltage. However, its fragile nature and its susceptibility to stray magnetic fields soon ousted it in favour of the thermistor. This similarly protected heater chains from heavy initial surges, but was less expensive, neater and stronger. In fact, they are still used for the same purpose in modern day receivers.

The advent of commercial television, with the necessity to provide good Band I/III balance plus compensation for varying signal strength in fringe areas, various automatic gain control systems for both vision and sound circuits were introduced. These have now become standardised in the present-day "mean level" system.

Other advances include: miniature thermistors to compensate for variations in the field scan coils; light sensitive cells to automatically vary contrast or brilliance setting according to ambient lighting conditions; voltage dependent resistors to stabilise height by maintaining valve generator anode voltage constant despite mains voltage variations and slight valve changes; voltage dependent resistors to stabilise width, by varying bias to the line output pentode as output either increases or decreases; and automatic frequency control of line oscillators, using discriminators to compare a sample of the saw-tooth waveform with the signal sync pulses and applying a correcting voltage to the generator triode when discrepancies occur.

There have been many other improvements in television timebase design, such as fitting VDR's across the field output transformer to reduce flyback voltages, and the inclusion of miniature chokes in the e.h.t. rectifier heater supply to reduce heater voltage on 625 to equalise that on 405.

These are not, however, true examples of automatic or servo action, which is the sensing of temperature or voltage changes and altering circuit constants to maintain a preset level.

Voltage Dependent Resistors

Voltage dependent resistors (VDR's) are ideal for sensing, since they are small, inexpensive, reliable and can withstand high voltages, while their characteristics can be tailored to the precise requirements of the designer. The resistance of VDR's decreases with increases of applied voltage but the relationship is by no means linear. As an example of typical resistive change with applied voltage, one specimen in the Mullard range drops from a resistance of 350kΩ at 1V to just about 300Ω at 35V.

To stabilise field height, the load resistor of the triode generator (usually the height control), is taken to the boost h.t. rail via another high-value resistor, with a VDR connected from their junction to chassis. The high-value resistor thus feeds both the generator triode and the VDR so that if the boost h.t. voltage rises, the increased voltage will slightly decrease the resistance of the VDR to make is pass slightly more current and thereby produce a bigger voltage drop across the common supply resistor to bring back the junction voltage to its original figure.

Naturally, the value of the common series resistor and the VDR characteristics must be carefully mated to produce the correct voltage stabilisation. A typical example, used in many Ferguson/HMV/Ultra models, is shown in Fig. 1 where the high-value resistor referred to is R3. To reduce height on change-over from 405 to 625, a 620kΩ resistor is put in parallel with the VDR to increase the current through R3 which results in the PCL85 triode anode voltage being reduced from 76V to 74V. This keeps height stabilisation within the limits of the VDR employed. With minor modifications in component values to fit in with valve oscillator characteristics, this circuit can be seen in very many dual-standard receivers, although in some models, such as those in the GEC/Sobell / McMichael range, there is no material voltage change at the PCL85 triode anode at system change-over.

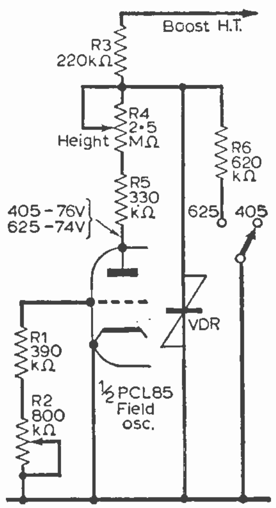


Fig. 1: Height stabilising circuit used in Ferguson/HMV/Ultra 16in. range of portables.

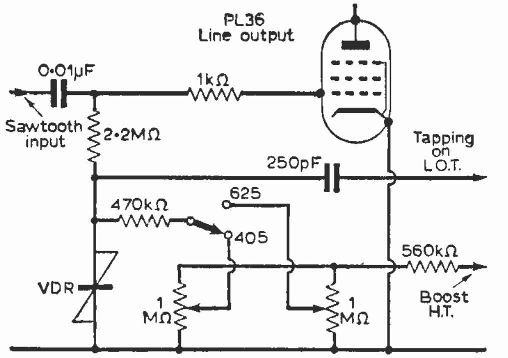


Fig. 2: Width stabilisation circuit used in many Dynatron models incorporating separate width setting potentiometers for both systems.

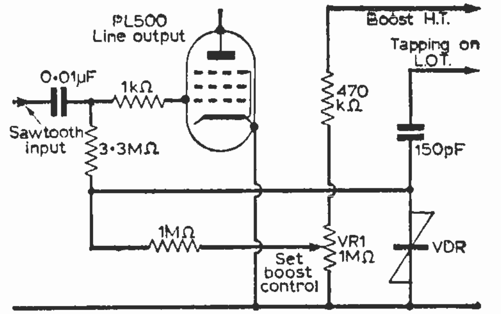


Fig. 3: GEC/Sobell/McMichael width stabilisation system. Correct picture width is obtained by setting VR1 "Set Booster Control" to give boost rail voltage of between 750–790V with full raster scan.

Height Stabilisation

Possibly the most interesting use of a VDR for stabilisation is in the grid circuit of the line output pentode to maintain constant scan width with wide variations of h.t. and ageing valve characteristics. Whereas in height stabilisation where the VDR operates as a resistor whose value decreases with increases in applied voltage, in width stabilisation circuits the VDR is arranged to function as a rectifier.

The VDR can be connected either way round to an ohmeter and will show precisely the same value of resistance. Connected to another ohmeter with different internal battery supply it will show another resistance, but it will again be the same on reversal of test leads. Thus, the VDR is not a rectifier in the true sense of the term, and a symmetric a.c. voltage applied to it would develop the same a.c. voltage across it irrespective of connection "sense". However, if an assymmetric voltage is applied to it, such as a sawtooth waveform, the VDR offers a higher resistance to the low-voltage section of the cycle than to the high-voltage portion to give a differing voltage/current ratio and thus a mean level bias. The greater the variation in the amplitude of these values, the greater the bias will be.

To stabilise line output stages, a portion of the sawtooth waveform is fed via a high working voltage capacitor to a VDR and so that a negative-going output is developed. This negative bias is then directly fed to the grid of the line output pentode so that should its output increase, a higher negative control voltage will be developed to reduce amplification.

To vary width in such stabilised systems a slightly positive voltage, tapped from a potentiometer across the h.t. rail is used to "back-off" the negative bias voltage in exactly the same way as in conventional mean level a.g.c. systems. In most cases the width control must be carefully set to manufacturer's instructions, paying attention to the boost h.t. voltage. In many GEC/Sobell receivers this control is termed "set boost" and, after setting the line linearity sleeve for optimum results, must be set to produce a boost rail voltage of ideally 770V or at least between the limits of 750-790V, or there can be risk of component or valve damage in the line output stage. Once the width has been set in this manner it is self-compensating for mains voltage variations and minor changes in valve characteristics.

Extra Control

In many of the early Thorn sets a conventional sliding-core width control was fitted as well as the potentiometer width stabiliser, so that the receivers could be re-adjusted easily after changing major line circuit components.

Line Stabilising

The various line stabilising arrangements provided by the manufacturers are all similar with the greatest diversity being shown in the arrangements to equalise width on system change-over. Some makers use the width stabiliser on both systems and rely on switching in different transformer tappings to equalise raster width, while others, such as Dynatron, who use separate 1MΩ potentiometers to equalise 405/625 scan and keep circuit power variations within system limits.

In earlier years VDR's were used for e.h.t. regulation in very many Ekco models. Such VDR's took the form of a long pencil-like element called a Metrosil and were connected from the U25 heater/cathode to chassis. The degree of focus in the older magnetically focussed tubes was greatly dependent on e.h.t. voltage, and upon the overall internal resistance of the e.h.t. line which was relatively high and caused the e.h.t. voltage to vary with the picture content. However, as the e.h.t. tended to rise during dark scenes, the resistance of the VDR would drop slightly and pass slightly more current to keep the e.h.t. constant.

Higher power line output pentodes, more efficient line transformers and higher h.t. rail voltages have greatly reduced the internal resistance of e.h.t. lines. Also the present-day self-focussing tube has helped minimise focussing variations.

AUTOMATIC CONTRAST CONTROL SYSTEMS—next month

THE WORLD OF SERVICE

Part 4: C & G/RTEB SERVICING CERTIFICATES

By G.R.Wilding

As so many readers of PRACTICAL TELEVISION are either actively engaged in the servicing industry or especially interested in the subject, we are continuing the "World of Service" series with an outline of the requirements for obtaining the C & G and Radio Trades Examination Board's joint Radio and Television Servicing Certificates. With the kind permission of the City and Guilds Institute and RTEB Secretary A. J. Kenward, we are able to reveal typical examination questions to show readers just what kind of technical knowledge is required at both intermediate and final levels. As previously mentioned in this series, the final Radio and Television Servicing Examination can only be attempted by service engineers who have passed (a) the Intermediate Radio and TV Servicing Examination or have the final Radio Servicing Certificate issued under the earlier scheme prior to 1960, and (b) can also produce evidence of being currently employed in radio and television servicing with at least one year's gainful employment in this field.

INTERMEDIATE EXAM.

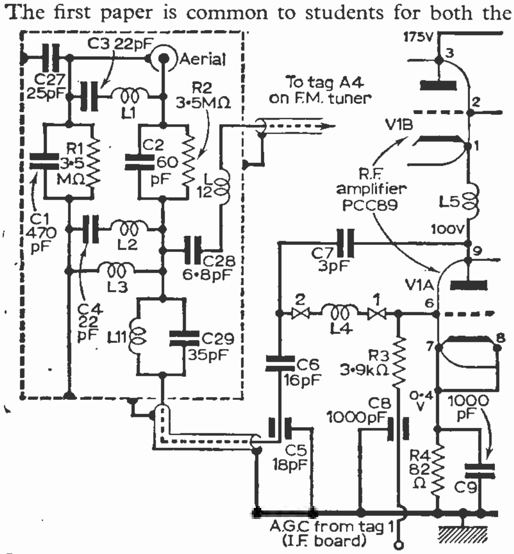
The Intermediate examination takes the form of two separate written papers, each usually comprising 7–10 questions, of which only 6 need be attempted, and for which a total of three hours is allowed. The first paper is common to students for both the Electronics Servicing Certificate and for Radio and Television Servicing, and contains mainly basic theory questions of which the following are typical examples from the 1965–66 test:

1. (a) Draw a series tuned resonant circuit and one of the parallel tuned type, clearly indicating each circuit.
   (b) Which of these circuits offers the maximum impedance at the resonant frequency?
   (c) Describe one practical use for each circuit in a radio or television receiver.
   (d) What value of inductance with a capacitance of 500pF would tune to a wavelength of 500 metres? Give the formula and show your calculations.

6. (a) Explain the following terms as applied to an alternating current:
   (i) frequency,
   (ii) amplitude,
   (iii) peak-to-peak value,
   (iv) r.m.s. value.
   (b) A 100-ohm resistor is connected in turn across the following:
   (i) A 240 volt r.m.s. a.c. supply,
   (ii) A 240 volt d.c. supply,
   (iii) A 300 volt peak a.c. supply.
   Calculate the power developed in the resistor in each case. Show all working.

7. (a) Draw the circuit (including component values) of a single-stage common-emitter voltage amplifier for use on a nine-volt supply, using
   (i) a p-n-p transistor,
   (ii) a n-p-n transistor.
   (b) In each case on the circuits above show the phase relationship of input and output waveforms.
   (c) State the purpose of each component in either (a) (i) or (a) (ii) above.

8. (a) The quality (Q factor) of a coil may be expressed by the term wL. Explain what this means in simple terms.
   (b) Explain how a coil may be constructed so as to achieve a high value of "Q".
   (c) Why in some circuits are resistors deliberately connected across tuned circuits? Where would you expect to find such circuits? State one disadvantage in their use.



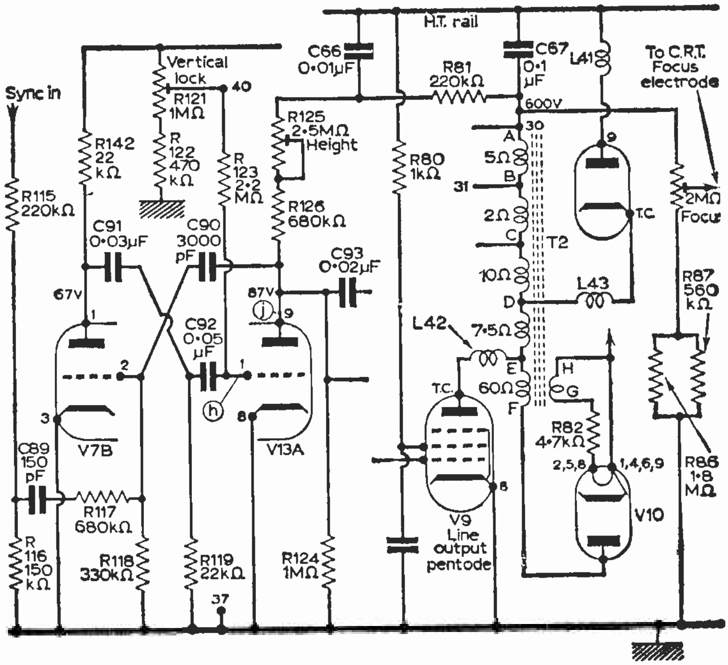
Section of the TV receiver referred to in the Final Written Examination, Question 3.

PAPER 2

The second paper is more practical in that the seven listed questions mainly relate to the circuit of a conventional 5-valve m.w./l.w. a.c./d.c. superhet appended to the paper, and invariably each year as in this instance, require examinees to identify listed components, i.e. V3, a.f. load resistor, V3 i.f. bypass, smoothing choke, or oppositely to state the function of other components, i.e. R6, C14, C28, etc. As this circuit is too large for reproduction in full in these pages, we are giving Question 5 and 6 since these do not really require diagram reference for evaluation purposes.

The intermediate examination makes reference to the complete realignment of a superhet, and it is worthwhile including a typical question (7) on this subject to show how examiners expect the sequence of realignment operations to be indicated.

5. (a) Draw a block schematic diagram representing the various stages of the receiver and title of each block.
   (b) Using the titles as heading, describe briefly the purpose of each block.
   (c) State two important advantages that the superheterodyne receiver has over a t.r.f. receiver.



Section of the TV receiver referred to in Question 4b in the Final Written Examination.

6. (a) Describe fully the operation of V2 (i.f. amplifier) stage. State what type of valve is employed in regard to its gain and control characteristics and why its cathode resistor is decoupled.
   (b) Why is a double-tuned transformer used to couple V2 to V3 (diode detector) and not a simple, inexpensive resistance/capacitance coupling?

7. Describe fully the procedure for the complete realignment of the r.f., oscillator, and i.f. circuits at typical frequencies. Tabulate your answers as follows, noting any repetitions necessary. The sequence of operations is important:

Operation	*Wavelength to which receiver is tuned*	*Signal generator frequency*	*Signal injected at*	*Component to be adjusted*
1				
2				
etc.				

FINAL EXAMINATION

First the two final written papers. These usually comprise eight to ten questions, and as before only six are to be attempted during the three hours allocated. In the 65–66 examination, seven questions on the first paper referred to the diagrams of either a 9-transistor a.m./f.m. receiver or to an a.c. mains tape recorder, but two questions, 4 and 9 were strictly confined to television and are here reproduced in full.

4. (a) What is vestigial sideband modulation?
   (b) Why is a vestigial sideband modulation used for the vision carrier?
   (c) Draw to scale:
   (i) a curve to represent the band of frequencies radiated during a sound and vision transmission.
   and
   (ii) the overall response curve of a typical vision i.f. amplifier (Vision i.f. 34·65 Mc/s).
   Show the position of the sound and vision carriers and the response levels at those points relative to mid-band.

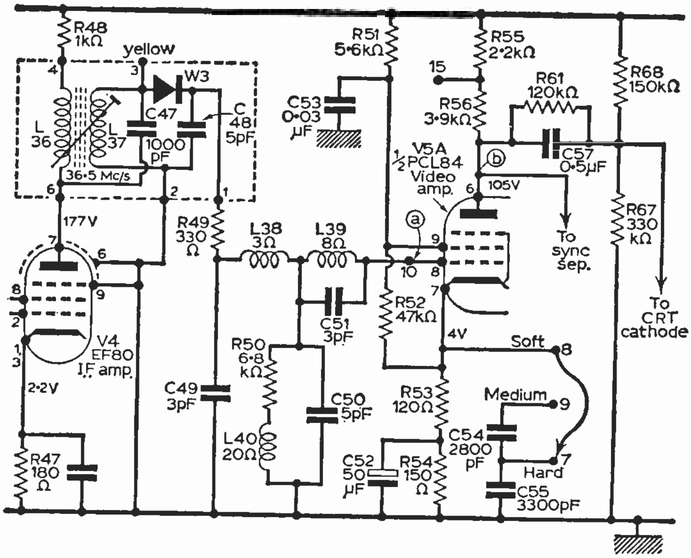
9. State the cause and describe the effects of four kinds of interference to the transmitted signal which could spoil the picture on a television receiver.
   What can be done besides using a vision noise limiter in the receiver to reduce each type of interference?

All eight questions in the second Final Paper referred exclusively to a 405 – only plus f.m. radio TV circuit appended to the question paper but as its large scale prevents complete reproduction in these pages, we are reproducing those sections of the circuit particularly referred to in the specimen queries listed.

3. (a) Explain the need for the inbuilt diplexer.
   (b) By means of a labelled block diagram show how a combined Band I/Band III TV aerial and a Band II f.m. aerial may be connected using a single downlead.
   Indicate the response curve at each connection.
   (c) If the Band I signal is of such a strength that the receiver is heavily overloaded, explain how satisfactory operation may be obtained.
   The Band II and III signal is of normal level.

4. (a) Required identification of seven components throughout the receiver.
(b) Due to a fault the raster has collapsed to a thin horizontal white line. A voltage check reveals that.
V7B anode voltage = 11V
V13A anode voltage = 16V
Suggest *one* logical next step towards diagnosing the fault. Give reasons for your answer.

7. (a) Draw the waveform to be expected on the cathode of V5A. Indicate the estimated voltage.
(b) Why is the voltage not given for V9 (Live Output Pentode) anode?
(c) A voltmeter is connected between the control grid of V5A and chassis. Explain the presence of a d.c. voltage and why the picture becomes blurred.



Relevant section of the TV receiver referred to in Question 7 in the Final Written Examination.

After these two separate written tests taken on separate days, there only remains the practical test on an actual receiver that has had several faults "planted" on it. Candidates however are judged not only by their ability to rectify the faults, but also for neat workmanship and most important, for the logical manner in which they traced the faults, as indicated by their brief written record of tests leading up to the diagnosis.

Thus the Final Examination takes three separate tests, two written and one practical, the former taking place in May each year and conducted by the City and Guilds of London Institute while the practical tests, conducted by the Radio Trades Examination Board are held several months later, but only including those candidates successful in the written examination.

Undoubtedly, possession of the Final Radio and Television Servicing Certificate (permitting membership of the SERT), is becoming increasingly important to both Service Engineers and Employers as proof of technical competence. In fact, many national employers' wage rates are now related to possession of these certificates. ■

STOCK FAULTS

—continued from page 300

conditions for the best compromise between noise and gain. Transistor gain varies with collector voltage and with collector current. With a constant collector voltage, noise is highest at low and at high collector current figures, the minimum noise position lying somewhere between. As the noise falls, the gain rises to its maximum. But if the collector current is held constant and the collector voltage varied, as the *Vce* increases so do both noise and gain—the latter with a steeper slope, i.e., more rapidly. There is thus a very important 'optimum' position for the preset gain control as noise varies in a different proportion to the signal. The reason for this control being preset and not simply optimised by the makers is that signal conditions vary greatly between fringe and service reception areas, and it is important that a transistor input stage is not overloaded; much more important than with valved stages. A.G.C. is applied to v.h.f. tuners or tuner sections, and can be either 'forward' or 'reverse'. It is perhaps a simplification to state the following, but I'll chance it and generalise: forward a.g.c. reduces the gain by causing a drop in collector voltage while reverse a.g.c. performs a similar action by reducing the collector current. Both actions have some affect on the noise figure, so the compromise setting of the gain control is needed.

U.H.F. tuners very rarely have a.g.c. applied, and for reasons that need not concern us here, forward a.g.c. in a limited manner is applied to the v.h.f. tuner. As we have stressed in previous articles, measurements should be made with reference to the manufacturer's data. Testing 'by guess' can be rather misleading on transistorised equipment—not to say downright dangerous.

Summing up the points brought out in this series of articles, we can say that many of the troubles likely to be encountered are the simple stock faults. They differ in small ways, according to the whims of the set designer, but so long as the basic possibility is remembered, chasing the tricky faults can be made easier by looking first for these 'obvious' causes. In other words, it is seldom as bad as you think! ■

uhf PROBLEMS

by GORDON J. KING

THE 625-line television system on u.h.f. has now been operative long enough to highlight many of the common reception problems. Analysis of hundreds of readers' letters received by our Query Department on the subject suggests three primary problems, roughly classified as (a) *grainy picture*, (b) *unstable u.h.f. picture* (i.e., poor line and field sync) and (c) *abnormally high level of buzz on BBC 2 sound*, with v.h.f. reception normal in all classifications.

In this article it is proposed to investigate these problems, to examine their causes and to see what can be done—if anything—to alleviate them. Firstly, however, it should be borne in mind that u.h.f. reception demands stronger signals than v.h.f. to produce comparable pictures. Secondly, out of economic necessity, certain design compromises exist in all dual-standard sets which, particularly to the purist, may be seen as shortcomings in the picture. These must be recognised as design restrictions rather than actual fault conditions or reception problems. Recent dual-standard models suffer less in this respect than earlier models.

Let us now get out teeth into the first main problem—excessive picture grain. Grainy pictures are by no means exclusive to the u.h.f. channels, but they are more prone on u.h.f. because of two factors. One, u.h.f. tuners produce more noise signal than v.h.f. ones; two, it is generally more difficult to efficiently abstract a given amount of signal energy from a passing u.h.f. wave than from a v.h.f. one. This is in some measure due to the nature of the u.h.f. signal and its propagation. As the signal frequency rises electromagnetic emission follows more closely that from sources of light. Signal propagation also becomes closer to that of light.

More Like Light Waves

The results are that u.h.f. signals are more readily reflected, refracted (bent) and attenuated with distance. This means that the 'service distance' given by a u.h.f. transmitter is less than 50 per cent of that given by a comparable v.h.f. transmitter. Thus, a dual-standard set will generally provide v.h.f. pictures of better quality than u.h.f. pictures from a co-sited transmitter. This is not usually appreciated by the non-technical viewer, and the impression given is that u.h.f 625-line pictures are inferior to v.h.f. 405 pictures.

Because of the weaker aerial signal, the noise signal produces by the u.h.f tuner tends to override the wanted signal and the noise shows as grain or 'snow' on the picture. Noise in the sound channel causes a background hiss, rather like a leaking high pressure air line or the noise made by the tyres of a car driven on a smooth, wet road.

All TV tuners produce a noise signal which appears along with the wanted signals at the i.f. output. This can be considered as an *equivalent noise signal* accompanying the wanted signals across the terminations of the aerial input, and provided this equivalent noise signal is at least 200 times below the strength of the aerial signals it will have little or no effect on the quality of the picture and sound. However, if the ratio falls below 200:1, the noise will appear on the picture and the sound.

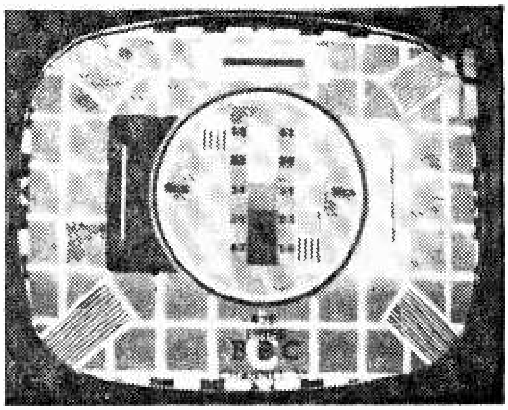


Fig. 1: Test Card C on 625-line showing a signal/noise ratio of about 100·1 (about 40dB).

A great deal of effort is put into the design of u.h.f. tuners to keep the noise signal at the lowest possible level. The first tuners—now common in dual standard sets—employed triode valves designed for low-noise working in the grounded grid mode. These tuners are thus designed for the absolute in noise performance for domestic service, which will not be improved by any amount of fiddling by the enthusiast. Indeed, one could be pretty sure that the noise performance would be impaired by unskilled tampering.

How, then, can picture grain and sound hiss be alleviated? Since, the noise of the tuner cannot be reduced, one must try to increase the strength of the aerial signal so as to get closer to the threshold signal/noise ratio of 200:1. Suppose that the equivalent noise signal is 5μV and that the u.h.f. aerial is delivering 200μV of signal to the tuner; we would have a signal/noise ratio of only 40:1 and the picture would be pretty grainy. By doubling the aerial signal, the signal/noise ratio would go up to 80:1 and a far better picture would result. The noise level would still be high, but not disconcerting. Fig. 1 shows a BBC 2 Test Card with a signal/noise ratio of about 100:1.

It is not proposed in this article to delve deeply into u.h.f. aerial systems, but it must be stressed that many poor BBC 2 pictures are the direct result of weak signals, and that these pictures could be substantially improved by spending a bit of time and money on the aerials. Sometimes it is necessary to change the aerial for one of higher gain, but in many cases the signal can often be at least doubled (improving the signal/noise ratio by at least 6dB) by experimenting with the positioning and orientation of the existing aerial.

A case recently investigated by the author in Plymouth (working from the Wenvoe transmitter) highlighted this. Here the chimney-mounted aerial gave a barely lockable picture, full of noise. The aerial was then taken from the chimney and moved around in the garden on the end of a 12ft. mast while connected to the set. In spite of the reduced height, there were positions where the signal induced into the aerial was stronger than at chimney height. Eventually, a fair picture was obtained with the aerial against the garden fence, and the signal strength here was almost three times that at the chimney site!

The use of a set-side u.h.f. amplifier (see later) further improved reception in this fringe area. It should be noted that this comparatively long-distance u.h.f. reception was possible due to the height of the receiving site above sea level—about 400ft.

The correct orientation of a high-gain aerial is very important. Up to half the available signal can be lost by the aerial being some 20 to 30 deg. off beam. Unfortunately, it is difficult to tell accurately when the aerial is 'on beam' by looking at the picture while someone else is turning the aerial. The set's vision a.g.c. tends to hold the general illumination of the picture constant, and one has to concentrate on the grain (which is difficult) so as to shout to the aerial-end operator when this diminishes.

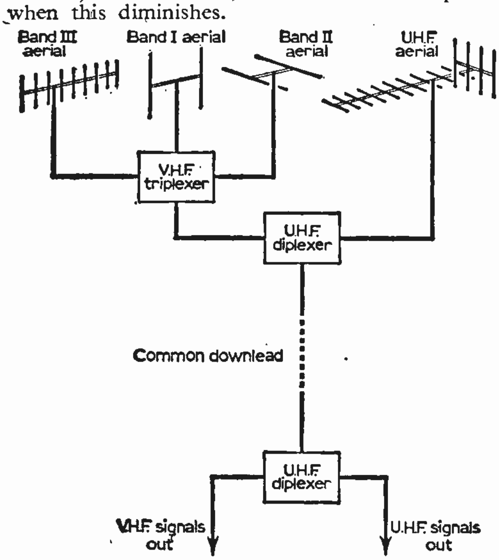


Fig. 2: While the existing v.h.f. downlead can also be arranged to carry the u.h.f. signal by the use of top and bottom u.h.f. diplexers, as shown, this technique should be avoided in areas of weak signal or where picture grain is troublesome.

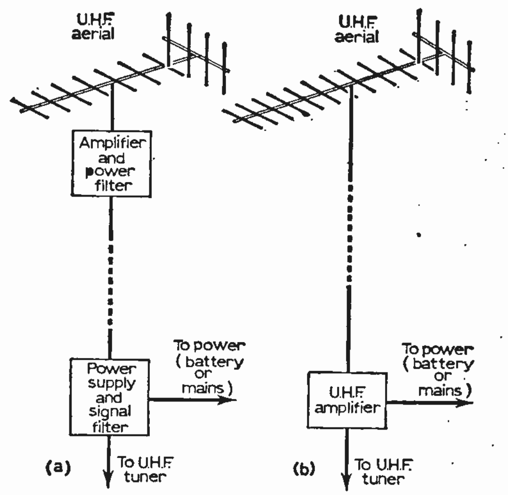


Fig. 3: A u.h.f. aerial preamplifier can be located either at the top of the downlead, near to the aerial (a), or at the bottom near to the set (b). Connection (a) requires a power filter in the amplifier and a signal filter in the power supply unit, while connection (b) does not need any filters. The amplifier can be either battery or mains powered, and in the latter case power units are available to work in series with the set's mains lead, so that the amplifier is switched on and off with the set.

An intercom system between the man at the aerial and the set watcher is extremely useful, but even better is a portable, transistorised u.h.f. signal strength meter which can be employed by the man at the aerial end. A signal variation of only a few microvolts can then immediately be observed as the aerial is turned or its location altered.

If such a luxury is not available, the next best thing is to attenuate the aerial signal or turn down the contrast (if this is possible on a weak u.h.f. signal—it depends on the nature of the set) until the picture just falls out of line and/or field lock. Any slight increase in signal strength as the aerial is adjusted will then bring the picture back into lock. This is better than trying to assess a slight reduction in picture noise.

There are hosts of u.h.f. aerials from which to make a choice, and in fringe or weak signal strength locations the correct choice of aerial is highly important. It is not only the number of elements used by the aerial that has to be taken into account, for the design of the array can also considerably affect the signal induced into the active element (i.e., dipole). Past articles have looked at aerial designs, and if there is any doubt as to the best aerial to use in a particular location, the local TV dealer, conversant with the signal field in his trading area, should be consulted.

One important aspect is that for fringe locations the multi-element 'in-line' array is often better than two separate arrays in phased and stacked formation. This may be something to do with the presence of 'scatter signal' in certain fringe districts.

In cases of excessive picture grain, where the aerial was installed with little or no experimenting or probing for signal, one can be almost certain that an improvement in signal/noise performance is possible by experimenting with the *existing* aerial along the lines suggested. If there is still insufficient signal to outweight the tuner noise signal, the use of a more efficient or higher gain aerial should be contemplated.

It should also be remembered that the tuner noise signal level increases with increase in u.h.f. channel number. At the h.f. end of Band V, for instance, the noise signal may be twice as strong as at the l.f. end of Band IV. Viewers living in fringe (lower-channel-number) reception areas are thus more fortunate than those living in weak signal areas served by a high channel number.

Keep Coupling Losses Low

Where picture grain is high, special attention should be given to the aerial downlead and to ensure that the coaxial plug is properly connected. A good quality plug must be used and the inner conductor soldered, for high contact resistance can effect both the power matching of the aerial to the tuner and the signal transference.

Really low-loss coaxial is necessary to avoid losing signal, for the cable attenuation is twice as high at u.h.f. than at high v.h.f. (i.e., in Band III). In poor reception areas the existing v.h.f. downlead should never be used, as this technique calls for two u.h.f. diplexers, one at the aerials and the other at the set, to combine the signals at the top and to split them at the bottom (see Fig. 2). Diplexers, even when very well designed, have inevitable insertion loss, attenuating the signal, and this just cannot be allowed under the conditions being discussed.

While u.h.f. tuners are designed carefully to match the downlead impedance at their inputs, a small amount of mismatch can occur over the u.h.f. bands and in the aerial system due to feeder impedance discontinuities and slight mismatch effects reflected down from the aerial end. These factors can reduce the level of aerial signal as actually 'seen' by the first receiver stage, where the equivalent noise signal is developed. Thus, the signal/noise ratio will be impaired. Often the matching can be restored to optimum on the particular channel in use by carefully adjusting the length of the downlead to the aerial socket at the set end a quarter of an inch at a time. This cannot be done using a signal strength meter as the input impedance of this will almost certainly not match that at the u.h.f. tuner's aerial socket. The downlead should thus be adjusted for the least picture noise. Where a mismatch is present, the noise will decrease as the optimum length is established for the downlead and then increase as the length is further altered. This is cyclic, from maximum to minimum noise.

Transistors Reduce Noise

Transistor u.h.f. tuners are now fitted to many dual-standard sets, and since transistors have the edge on valves from the noise aspect, these tuners produce about half as much equivalent noise signal as valved counterparts. For a given aerial signal voltage the signal/noise ratio is about twice as good (6dB better) in sets using transistor tuners.

It is generally impossible for the enthusiast to replace a valve u.h.f. tuner with a transistor one. It is, however, possible to get the low noise advantage of transistors on the u.h.f. channels by employing a transistor aerial amplifier between the aerial and the tuner aerial input socket.

At this juncture it should be mentioned that each stage of a tuner (or receiver) has its own "noise figure", and the overall noise figure due to the noise of the individual stages is given by:-

$$F_n \text{ (total)} = F_{n1} + \frac{F_{n2}-1}{P1} + \frac{F_{n3}-1}{P1 \times P2} + \dots\dots$$

where F_{n1}, F_{n2}, F_{n3}, ... are the noise figures of the first, second, third etc. stages and P1, P2 . . . are the power gains of the first, second etc. stages. The above expression reveals the importance of keeping the noise of the first stage as low as possible to maintain a low total noise output. Since the power gains of the stages following the first one will be above unity, anyway, a close approximation to the total noise is given by:-

$$F_n \text{ (total)} = F_{n1} + \frac{F_{n2}-1}{P1}$$

where the first stage noise is of the greatest import.

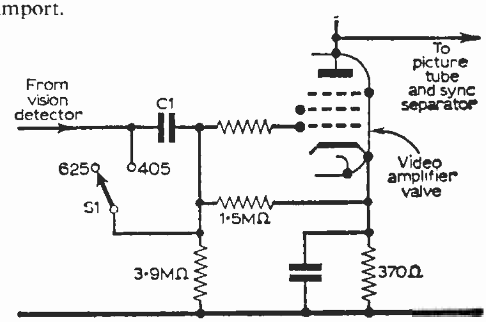


Fig. 4: Grid current in the video amplifier valve can affect the picture locking on 625-lines owing to the a.c. coupling on this standard. The relatively low grid impedance on 405-lines, due to the d.c. coupling on this standard, can often mask grid current effects (see text).

Suppose, that a u.h.f. tuner has a noise figure of 14dB and that we use a transistor amplifier in front with a power gain of 20dB and a noise figure of 6dB. The *improvement* in noise performance would then be equal to:-

$$14\text{dB (original noise)} - 6 + \frac{14-1}{20} = 7{\cdot}35\text{dB}$$

This is certainly a worthwhile improvement, roughly equivalent to doubling the aerial signal in terms of signal/noise ratio. This is with the aerial preamplifier close to the set. With the amplifier mounted close to the aerial, the improvement in *signal/noise performance* is further boosted by the first stage (i.e., preamplifier) receiving a stronger signal, since there is no downlead attenuation to take into account. However, the downlead loss between the amplifier and the tuner effectively reduces the first stage gain (P1) in the above expression.

We can now see that the noise improvement is greatest when the power gain of the amplifier is high and its noise is substantially below that of the tuner. Nevertheless, some improvement is possible even when an average u.h.f. transistor amplifier is used in conjunction with a set carrying a transistor tuner. If the amplifier is to be mounted at the top of the downlead, close to the aerial, it is usually fed with power from a small unit at the set end. This problem is avoided at the expense of a small reduction in signal/noise ratio), when it is mounted near to the set (see Fig. 3).

There are various transistors preamplifiers now available, some working from the mains and others from small batteries. Some are tuned to one particular channel and others to the local group of u.h.f. channel, over about 100Mc/s. Some mains-powered types are designed to be connected in series with the mains input to the set, so that they are switched on and off with the set.

So much for picture grain. No excuse is made for investigating this symptom in some detail, for there is no doubt that it is a major factor leading to poor u.h.f BBC-2 pictures up and down the country at the present time, and in almost all instances, some improvement is possible.

Dual-Standard Sync Troubles

Dual-standard sets also suffer from unstable pictures, due to sync troubles rather than weak aerial signal. To a large extent this is caused by the nature of the switching from one standard to the other in the video amplifier circuit. A common complaint is that the picture locks solidly on 405, but rolls and breaks up on switching to 625. It may also happen that 625-line instability of this kind occurs only after the set has been running for some time.

A common cause of this symptom lies in the video amplifier valve itself, and this may not at first be suspected because of the set's normal operation on 405 lines. Some sets, however employ the conventional d.c. coupling from the video detector to the control grid of the video amplifier valve on 405 and a.c. coupling (to avoid having to switch the biasing) on 625 and Fig. 4 shows how this is sometimes accomplished. When switched to 405, S1 (an element of the dual-standard switching) shorts out the coupling capacitor C1 between the detector and the amplifier and normal 405-line d.c. coupling is employed. In the 625-line position S1 opens the short circuit and the vision signal is then coupled through C1, giving a.c. coupling. Relatively high power, high slope video pentode valves are sometimes prone to develop a fault that gives rise to a small amount of grid current. This produces a negative voltage across the very high resistance in the amplifier grid circuit and the biasing of the valve is severely

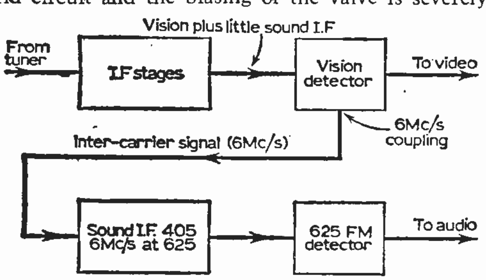


Fig. 5: The intercarrier technique employed in dual-standard sets in the 625-line condition.

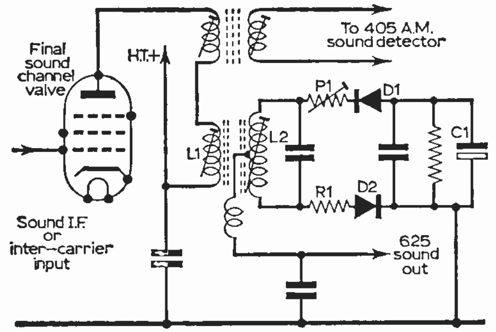


Fig. 6: Intercarrier buzz can often be reduced by carefully balancing the f.m. ratio detector by adjustment of P1.

modified, often to the extent of distorting the sync pulses passed from the anode of the amplifier to the sync separator. The pulses thus fail to be correctly developed at the sync separator output and the locking of the timebase generators is impaired.

In the 405-line position the resistance in the grid circuit of the amplifier is considerably reduced, due to the d.c. coupling, and the grid current biasing effect is almost completely eliminated, thereby giving normal 405 locking.

The author suspects that many single-standard sets would be giving trouble in this respect if design convention had led to a.c. coupling between the detector and amplifier. Indeed, this is being proved to some extent in dual-standard receivers that use a.c. coupling on both standards. Such a receiver—the Pye 31F—was recently examined by the author for progressively failing line and field sync with increase in temperature, and tests in and around the video amplifier and sync separator failed to reveal any defective component. The latest double-pentode PFL200 valve is used in this set, with one section working as video amplifier and the other as sync separator. Normal testing failed to bring to light any trouble in the pentodes, but eventually slight grid current was measured in the video pentode's grid circuit and replacing the valve completely cured the trouble.

Intercarrier Buzz

The final condition to be examined, namely that of high level buzz on BBC 2, with BBC 1 and ITV sound normal, is also relatively common. This symptom is known generally as "intercarrier buzz".

On 625, the ordinary sound carrier (at i.f.) is not employed. Instead, an intercarrier signal is developed, which is the difference between the sound and vision frequencies. This difference is exactly 6Mc/s, and the intercarrier signal at this frequency is developed at the output of the 625-line vision detector. This is because the alignment of the i.f. stages allows the passage of a proportion of the sound signal up to the vision detector (on 405 the sound rejector eliminates the sound signal at this point—or before) and because of the non-linear function of the detector.

The intercarrier signal is thus developed across 6Mc/s tuned transformer or coupling and then fed back into the sound channel which is responsive to 6Mc/s signals as well as to the ordinary 405-line sound i.f. signals. The block diagram in Fig. 5 shows the intercarrier technique.

The sound channel fails to respond to the audible components of the vision signal because the sound is frequency-modulated and the vision is amplitude-modulated. Thus, although the sound signal at 6Mc/s contains amplitude components of the video and sync signals, there is normally no output from the 625-line f.m. sound detector.

When intercarrier buzz is present, the effect is that of a.m. vision components causing a response in the f.m. sound detector. The buzz consists mainly of harmonics of the field sync pulses and the low-frequency video components. The solution to the problems resolves first to discovering the reason why the f.m. sound channel is responsive to a.m. signal components.

Most dual-standard sets employ a fairly conventional ratio detector in the 625-line circuit, as shown in Fig. 6. This is fed from the transformer consisting of primary L1 (coupled to the anode circuit of the final valve in the sound channel) and secondary L2. D1 and D2 are the two diodes, while R1 and P1 serve to balance the two arms. In this circuit one arm can be balanced relative to the other by P1, and maximum a.m. rejection occurs under optimum conditions of balance. Unbalance will give rise to intercarrier buzz—the more unbalance, the greater the buzz level. The simple solution, then, resolves to the adjustment of P1 on a transmission for the buzz null point.

This may or may not completely cure the problem. If an annoying level of buzz remains after balancing with P1, some unbalance may be present in the coupling transformer (i.e., ratio detector transformer) or the 6Mc/s tuned circuits in the sound channel may be peaked slightly off frequency. In this event, the core in L2 should be very carefully moved one way and then the other for minimum buzz followed by a further balancing adjustment to P1, these adjustments being alternated for the least buzz. When this condition exists, and only if the buzz is still high, the cores in the 6Mc/s transformers in the sound channel should be moved a little one way and then the other to see if improvement is possible. If not, the cores should be set to their original positions. This is important.

The correct way of adjusting the 6Mc/s sound channel tuned circuits is with a crystal calibrated 6Mc/s signal generator, but few of these are yet available. It is possible to set an ordinary signal generator to 6Mc/s by beating its output signal with some intercarrier signal in the sound channel—adjusting for the dead beat point.

If these procedures still fail to rid the sound channel of buzz, a component in the f.m. detector could be defective. For instance, one of the diodes could be shorting or open-circuit or a series resistor could have gone high or low in value. Another cause of very loud buzz is open-circuit in the reservoir capacitor C1 in the circuit. If the buzz tends to decrease with P1 towards the end of its range, a diode is probably defective or the ratio detector transformer is badly misaligned.

Note that some circuits may have a pair of fixed resistors in the diode circuits, often about 1kΩ. Better balancing can often be achieved by replacing one of these with a 2kΩ preset, and then adjusting it as explained above.

Another cause of intercarrier buzz which fails completely to be removed by balancing and sound channel realignment, is misalignment in the main i.f. channel allowing too great a level of sound signal to reach the vision detector (see Fig. 5). There is no rapid way out of this trouble, since the only real cure lies in running through the alignment exercise and ensuring that the tuned circuit which lets through the 625-line sound signal is correctly adjusted to correspond with the response shaping as laid down by the designer.

It will be understood that the problems considered in this article can be caused by faults other than those explained, but the major causes of the symptoms have been dealt with here ■

COLOUR TELEVISION AS A PUBLIC SERVICE IS DUE TO BEGIN TOWARDS THE END OF THIS YEAR. FROM HERE ON, "PRACTICAL TELEVISION" WILL BE PROVIDING AUTHORITATIVE ARTICLES ON THE SUBJECT, NOT ONLY FOR THOSE WANTING A REFRESHER COURSE BUT FOR READERS MEETING COLOUR FOR THE FIRST TIME. THE DECODING CIRCUITRY NEEDS SPECIAL ATTENTION.

Decoding PAL

IN all colour television systems the original scene being televised is first analysed in terms of the amounts of the three primary colours (red, green and blue, from which all other colours can be derived by mixing) present. This is done by means of a mirror-lens filter system. Three pick-up tubes in the camera then provide outputs representing the amounts of red, green and blue in scene being scanned. A luminance signal, representing the overall brightness, is obtained by adding together the red, green and blue signals (since white light is a combination of the primary colours) in certain proportions: 0·30R + 0·59G + 0·11B, these proportions correspond to the varying sensitivity of the eye over the colour spectrum.

In all colour systems so far developed (NTSC, SECAM and PAL) the luminance signal (called the Y signal) and two colour difference signals (R−Y and B−Y) are transmitted. This is all that the receiver requires since, as the Y signal is a combination of the R, G and B signals in certain set proportions, given the R−Y and B−Y information a G−Y signal can be obtained by means of a simple matrix circuit (see later). The three-gun shadowmask colour television picture tube beams are generally modulated by feeding the Y signal to all three cathodes and the R−Y, B−Y and G−Y colour difference signals to the three control grids. In this way the tube itself acts as the final colour recovery device in the receiver since by feeding the +Y signal to each cathode and the R−Y, B−Y and G−Y signals to the grids the result is the recovery of the true R, B and G signals. The luminance signal is required to make transmissions compatible, that is receivable on black-and-white only receivers, which produce monochrome pictures from the luminance information but do not respond to the colour difference signals transmitted. Thus in all three colour television systems the transmitted waveform contains Y, R−Y and B−Y signals plus the necessary synchronisation data. In the NTSC and PAL systems the two colour difference signals, together called the chrominance or chroma signal, are transmitted on a suppressed subcarrier within the channel bandwidth by quadrature modulation, i.e. both signals are used to amplitude modulate the subcarrier but with a 90deg. phase difference between them. The PAL system as proposed for use in this country differs from the NTSC system mainly in that on alternate lines the phase of the R−Y signal is reversed (180deg. phase shift). This technique is used to reduce the effects of spurious phase changes in transmission and PAL receivers average these out over alternate lines.

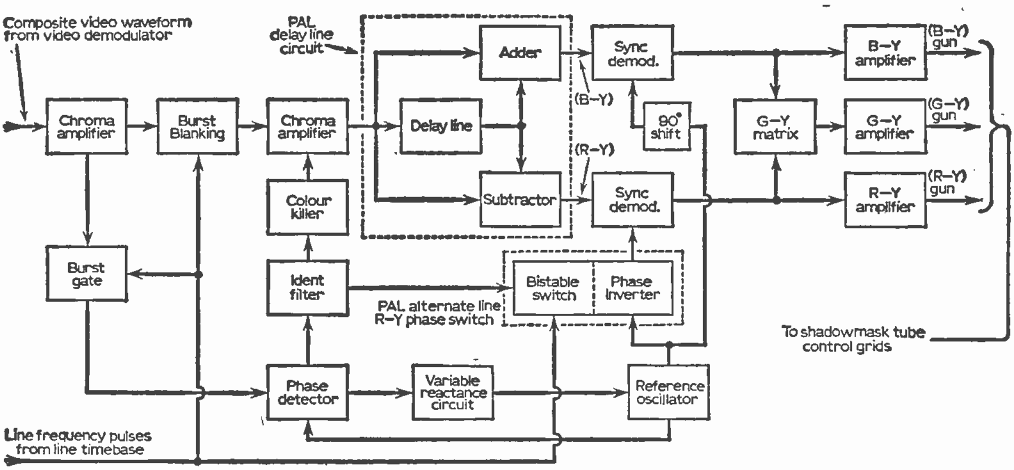
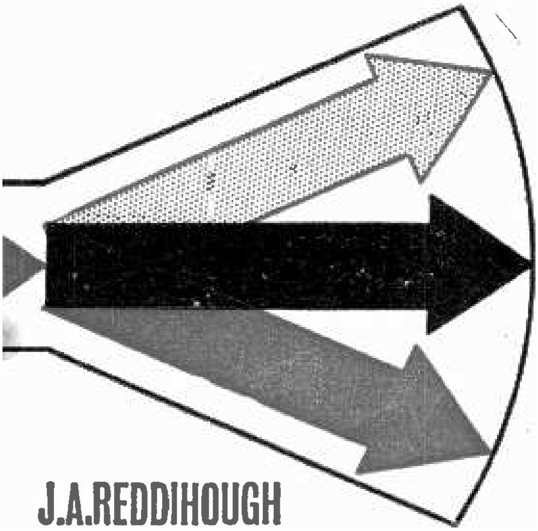


Fig. 1: Block schematic diagram of the essential features of a PAL decoder.



As the chroma information is contained within the normal channel bandwidth as used for monochrome transmission, the early stages of a colour television receiver, up to and including the vision detector, follow conventional practice. Thereafter substantial changes occur. A decoder is required to separate the R−Y and B−Y signals, establish the G−Y signals, and with in addition to this, the phase reversal of the R−Y signal on alternate lines in the PAL system the decoder is probably the most complex item we shall see in a piece of domestic receiving equipment. The luminance channel feeding the shadowmask tube cathodes follows normal video frequency amplifier practice except for the inclusion of a notch filter to provide rejection at the subcarrier frequency and a delay line to provide the very small amount of delay (about 0·4μS) needed to keep the luminance and chrominance signals in step. Further complications arise in the timebases: more scan power is required because of the thicker neck of a three-gun picture tube; a higher e.h.t. (about 25kV) is required because of the shadowmask in the tube; convergence circuits are required to maintain correct scanning of the three beams; and, as simple magnets such as are used in monochrome receivers for picture centring and pin-cushion distortion correction can not be used (they would interfere with the alignment of the three beams with the shadowmask) it is necessary to provide these features by other, more complex, techniques. In this article, however, we are concerned with the decoder as needed for the PAL system.

The essential feature of a PALD decoder are shown in block schematic form in Fig. 1. The D after PAL indicates that the decoder incorporates a delay line having a delay time of approximately 64μS (one line period for a 625-line picture). PAL decoders can be operated without this delay line but since much of the point of the PAL system is associated with the use of this delay line it would not seem reasonable to omit it. The diagram gives an idea of the complex series of operations that must be carried out to obtain the separate R−Y, B−Y and G−Y signals for the shadowmask tube. Most of the individual circuits used, however, are reasonably simple, though rather more stages than are indicated may be needed—for example a burst signal amplifier, an automatic chrominance control circuit, and so on. As shown, the input to the decoder (top left) consists of the composite video waveform taken from the video demodulator or following a stage of v.f. amplification. The input is fed to a chroma amplifier stage the bandwidth of which is tuned to pass the chroma signal (which occupies about 3—5·5Mc/s). It is then fed to burst gating and blanking circuits. The burst gate may be thought of as the sync separator for the decoder. The burst signal consists of about 10c/s of the chroma subcarrier (4·43Mc/s) transmitted during the back porch period (immediately following the line sync pulse) of the television waveform, and is used to synchronise the reference oscillator in the decoder with the chroma subcarrier. The burst gate is opened during the back porch period to allow the burst signal through by applying to it a pulse signal derived from the flyback pulse in the line output stage. A reference oscillator is required since the chroma signals are transmitted with their subcarrier suppressed so that

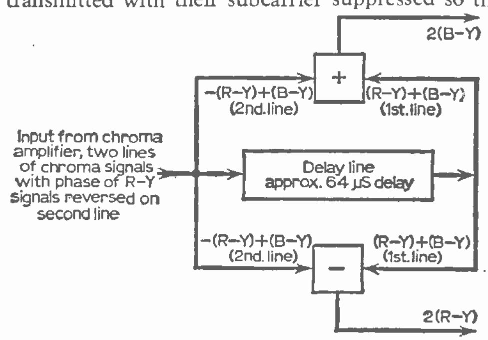
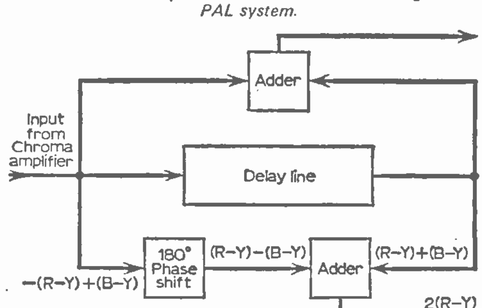


Fig. 2 (above): How the delay line circuit separates the B−Y and R−Y signals and carries out averaging over successive pairs of lines.

Fig. 3 (below): The subtracting process indicated in Fig. 2 is actually carried out by introducing a 180° phase shift then adding. The R−Y output over successive lines is ±2(R−Y) due to the alternate line phase reversal of the R−Y signal in the PAL system.



the colour demodulators in the decoder require the subcarrier frequency to be reinserted. Clearly the reference oscillator must be maintained at the same frequency and in phase with the original subcarrier oscillator, and to achieve this the burst signal is transmitted as a synchronising reference and controls the decoder reference oscillator by means of a phase detector and variable reactance control circuit which operates on similar principles to the flywheel sync circuits used in black-and-white receivers. To increase the stability of the reference generator a crystal-controlled oscillator circuit is used. The reference oscillator, as shown, feeds the two synchronous demodulators, a 90deg. phase shift network being inserted in one feed (needed because the B−Y and R−Y signals have a 90deg. phase difference between them) and an alternate line phase inverter (180deg. phase change) controlled by a bistable switch triggered at line

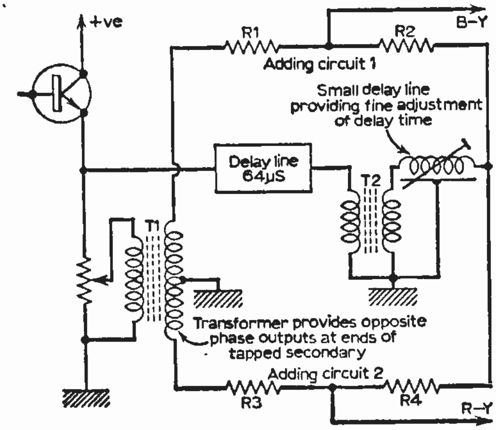


Fig. 4: Practical aspects of a PAL delay line circuit.

frequency by line flyback pulses in the other feed (needed because the R−Y signal is phase reversed on alternate lines).

Returning to the chroma signals themselves, the burst blanking circuit is included to cut off the chrominance channel during the burst period to avoid the burst signal interfering with the picture colour level. Blanking can be done by means of a diode gate circuit which is closed during the burst period by pulses from the line timebase. Following a further stage of chroma amplification the chroma signals are applied to the PAL delay line circuit, which consists of the line-period delay line plus adding and subtracting networks. By adding and subtracting two sets of chroma signals, one set taken directly from the chroma amplifier and the other via the delay line, separate B−Y and R−Y outputs are obtained. The outputs are the average taken over two lines, since the delay line delays the signals passing through it by an exact line period, and phase variations in the R−Y signal, which is phase reversed on alternate lines, cancel out.

The B−Y and R−Y signals are then detected by a pair of synchronous demodulators fed with two signals, the chroma information and the signal from the reference oscillator at the subcarrier frequency. The reference oscillator signal in effect biases the synchronous demodulators on and off so that they act as gates passing and demodulating only chroma signals in phase with the reference oscillator input to them. The 90deg. phase shift network in one of the feeds from the reference oscillator separates the reference inputs by 90deg. in phase because the B−Y and R−Y signals are originally modulated in quadrature, i.e. with 90deg. phase difference between them and this is thus essential.

The B−Y and R−Y outputs from the synchronous demodulators are fed to separate amplifiers to raise the signal to the level required to drive the shadowmask tube grids, and are also fed to a resistor matrix network which is so proportioned that by addition of the R−Y and B−Y signals it recovers the G−Y signal, which is then amplified in much the same way as the other two signals.

As the phase of the R−Y signal is reversed on alternate lines, in the decoder either the phase of the R−Y signals must be reversed on alternate lines before they are fed to the R−Y synchronous demodulator, or the reference signals fed to the R−Y synchronous demodulator must be phase reversed on alternate lines. The latter technique is used in the arrangement shown in Fig. 1 (also in Fig. 12), and it seems that this is the one that will be generally adopted in the UK.

A further complication arises, however, in that the decoder must know which of the alternate lines have been transmitted with R−Y signal phase reversal, and here we come to the ident filter. The burst signal is transmitted with a phase change on alternate lines of ±45deg. (+45deg. when R−Y is positive and −45deg. when it is −(R−Y)). This gives rise in the phase detector circuit controlling the reference oscillator to a 7·8kc/s (half line frequency) signal called the ident signal (alternate line phase reversal identification signal). This signal is amplified and used to control the triggering of the bistable switch.

The ident signal is used for one other purpose, to control a colour killer stage, which either switches *on* the chroma amplifier when colour signals are present (they are if the ident signal is being received) or switches it *off* when colour signals are not present (clearly different techniques

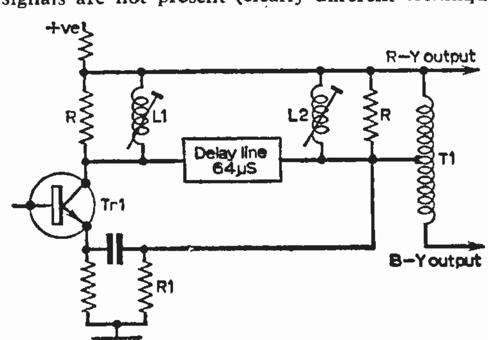


Fig. 5: Technique suggested by Mullard for adding and subtracting in conjunction with their DL1 delay line to provide separate R−Y and B−Y outputs (simplified circuit).

can be used to perform these operations). This is done to stop spurious signals entering the decoder during monochrome reception and causing colour patterning on the screen.

The functions of the various stages in Fig. 1 have now been outlined. Doubtless readers will see many articles on this subject in the coming months and it is only fair to warn them that there is as yet little standardisation in the terms that are in use to refer to the various operations necessary in a PAL decoder. Those used here have been chosen to convey as straightforwardly as possible what happens at each stage in the decoder. The following sections go in greater detail into the operation of the main stages in a PAL decoder.

DELAY LINE CIRCUIT

Figure 2 shows what happens in the delay line circuit. The input to the adder and subtractor units consists of the data from two successive lines, with the phase of the R—Y signal reversed on alternate lines. The result is that the R—Y component is cancelled out at the adder unit, whose output consists of the B—Y signal from two successive lines, whilst the B—Y component is cancelled out at the subtractor unit, whose output is the average between the R—Y signals on successive lines. Thus the averaging process between alternate lines that is a feature of the PAL system is carried out and the B—Y and R—Y signals are separated in one fairly simple operation. The operation is not quite so simple as Fig. 2 suggests, because to subtract two electrical voltages we shift the phase of one by 180deg. and then add them together. Figure 3 illustrates this operation. Note that the 180deg. phase shift may be included in the input from the chroma amplifier or in the output from the delay line to the lower adder unit.

A practical method of carrying out these operations is shown in Fig. 4. The chroma signals are taken from an emitter-follower stage and fed to the 64μS delay line and, via transformer T1, the two adding circuits. As can be seen, adding simply consists of feeding the signals from T1 and the delay line to a common point via a pair of resistors (R1, R2 add the B—Y signals and R3, R4 the R—Y signals). T1 has a centre-tapped secondary so that it produces two sets of signals in opposite phase, hence the 180deg. phase difference necessary has been introduced. A second small delay line is used to provide fine adjustment of the delay time, and this is matched to the 64μS delay line by transformer T2. Because of the alternate line phase reversal the R—Y output will be +(R—Y) and —(R—Y) on alternate lines.

A complication that arises in practice is the attenuation introduced by the delay line. A stage of amplification is used in some decoders to make up for this. An alternative approach which equalises the gain between the "delayed" and "direct" signals, suggested by Mullard, is shown in Fig. 5. Here the 64μS delay line is driven by the collector of Tr1. L1 and L2 tune the input and output of the delay line to the mid-band frequency, and the resistors marked R provide input and output matching to the delay line. T1 provides two outputs with the required 180deg. phase difference. The "direct" signal is established across R1 and fed to the centre-tap of T1, and at opposite ends of T1, R—Y and B—Y outputs are obtained.

The synchronous demodulators pass and demodulate only signals that are in phase with the reference signals fed to them from the subcarrier regenerator reference oscillator. Since a 90deg. phase shift is introduced into the feed from the reference oscillator to one of the synchronous demodulators, one demodulator will demodulate the B—Y signals and the other the R—Y signals since at the transmitter they are modulated in quadrature on to the 4·43Mc/s subcarrier (which is suppressed by using a balanced modulator). In effect, the signals from the reference oscillator are used to bias the synchronous demodulators on and off, having a switching effect so that they only pass on signals in phase with the reference oscillator waveform and do not respond to those out-of-phase with it.

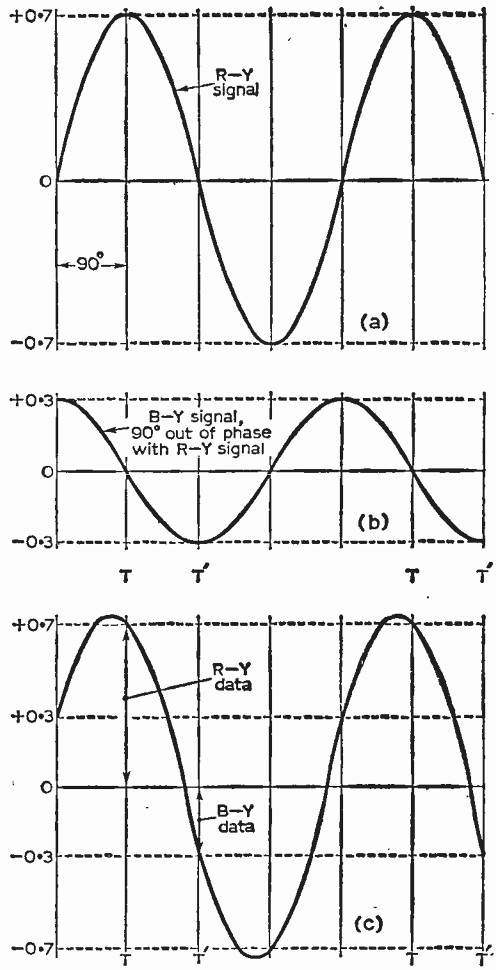


Fig. 6: The principle of synchronous demodulation.

Synchronous demodulators thus "sample" the chroma signals applied to them when they are "on". The principle will be clearer by examining Fig. 6. Here (a) and (b) show separate R—Y and B—Y subcarrier waveforms in quadrature (90deg. apart in phase). 0·7 and 0·3 are roughly the proportions in which the R—Y B—Y signals are transmitted (these proportions are derived from the Y signal composition mentioned in the opening paragraph of this article). It will be seen that at 90deg. time intervals, i.e. T, T′, one waveform is at maximum and the other at zero. Consequently if the synchronous demodulators sample the waveform at these times, at time T one would open and sample the R−Y signal and at T′ the other would open and sample the B−Y signal, both being opened and closed by reference waveforms at the same frequency and phase as the subcarriers. In (c) a single carrier is used for the R−Y and B−Y data, the phases of (a) and (b) having been added. This is the results of quadrature modulation the carrier. Again, if the synchronous demodulators open at times T and T′, they will sample the R−Y and B−Y data (which, as shown, will be in the correct proportions) provided that they are controlled by reference waveforms having the correct phase and frequency characteristics.

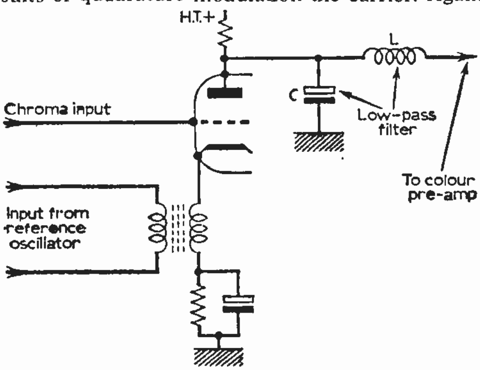


Fig. 7a: A simple synchronous demodulator circuit using a triode valve. A low-pass filter and subcarrier rejector are included in the output circuit.

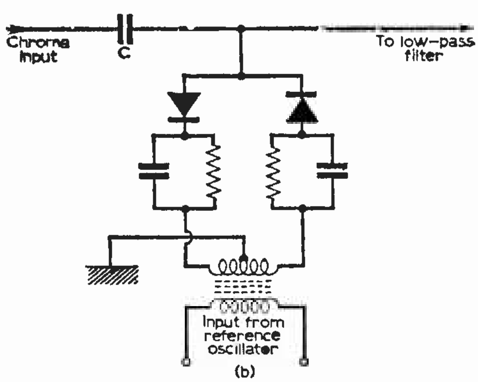


Fig. 7b: Synchronous demodulator using two diodes.

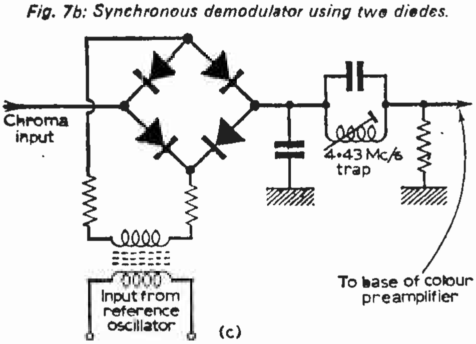


Fig. 7c: Semiconductor bridge demodulator.

DESIGN APPROACH

There are a number of approaches to synchronous demodulators design. Some synchronous demodulators operate on an averaging principle: the reference signal establishes, in conjunction with a filter, an average output which then varies in accordance with the samples of chroma signal. With this system, chroma signals in phase with the reference signal augment the output (since the sampling frequency is faster than the rate at which colour changes take place, the "average" faithfully follows the data originally modulated on to the subcarrier). This technique is used with the triode type of synchronous demodulator shown in Fig. 7 (a)—a type of synchronous demodulator that has been much used in American NTSC receivers. The reference signal is fed to the cathode and the chroma signal to the grid. Biasing the cathode in this way switches the triode on and off so that it is opened periodically (at 4·43Mc/s) to sample the chroma waveform. The phase of the reference waveform is such that the output is applied to the colour amplifier via a low pass filter (L, C), which removes the h.f. component and leaves an output that is the varying average of the chroma samples.

Semiconductor diode circuits will, however, undoubtedly be used for U.K. PAL receivers, and two arrangements that have been used are shown in Fig. 7 (b) and (c). A pair of diodes is used in the arrangement shown in (b), whilst (c) illustrates a diode bridge demodulator. Both circuits are again based on the principle of sampling the chroma input under the control of the input from the reference oscillator. The arrangement with two diodes operates in conjunction with capacitor C. The demodulator is switched on and off by the reference signal: when it switches on at the sampling time, the charge on C follows the chroma signal voltage, thus making available at the output at each sampling period the chroma information then present. Again this type of circuit operates in conjunction with a filter.

The bridge circuit is biased off by the reference signal until the sampling period arrives when it is opened and demodulates the chroma signal which is passed via a 4·43Mc/s trap to the colour preamplifier.

G—Y MATRIX

All that is needed to obtain the G−Y signal is a simple resistance network of the type shown in Fig. 8. The R−Y and B−Y signals are added in the same manner as with the PAL delay line network described earlier. The values of the resistors in this case must be selected so that the R−Y and B−Y signals are added in the correct proportions. A pre-set balance adjustment may, as shown, be incorporated for setting-up purposes. As the Y signal is approximately $0{\cdot}3R + 0{\cdot}6G + 0{\cdot}1B$, $(G-Y) \triangleq -0{\cdot}5\ R-Y-0{\cdot}2\ (B-Y)$.

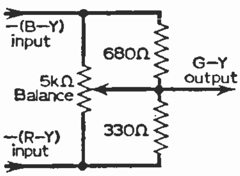
The derivation of this formula is somewhat complicated: those wishing to follow it through will find it in standard textbooks on colour television.

Matrixing may be done in the cathode or emitter circuits of B−Y and R−Y preamplifiers. a complication that arises in practice is maintaining the correct phase relationship between the three signals. On the basis of the above formula, assume (Fig. 9) that we have −(B−Y) and −(R−Y) signals at the bases of the colour preamplifiers Tr1 and Tr2. If these are the usual common-emitters stages then at the collectors we will have +(B−Y) and +(R−Y) signals and at the emitters −(B−Y) and −(R−Y) signals to give us the +(G−Y) signal at the junction of the G−Y matrix R1, R2. Clearly Tr3 must be operated in a different mode to Tr1 and Tr2 in order to keep the three signals in the same phase relationship. As shown this can be simply effected by using a common-base G−Y preamplifier (or grounded-grid stage if valves are used.) As the efficiencies of the three different types of phosphor used on the shadowmask tube screen differ, the outputs of the three colour preamplifiers are pre-set at different average levels.

COLOUR OUTPUT STAGES

It seems likely that valves will be used in the immediate future for the colour output stages since the peak-to-peak grid drive voltages required for the shadowmask tube are appreciable —about 183V peak-to-peak for the R grid, 163V peak-to-peak for the B grid and 85V peak-to-peak for the G grid. A simple pentode output stage is shown in Fig. 10. The only feature that calls for comment is the need for a clamp. The output is clamped during the line flyback period by the triode clamp (diodes and transistors have been used in other designs) to which pulses from the line output stage are fed for this purpose.

Fig. 8 (right): Resistor matrix network for establishing the G−Y signal from −(B−Y) and −(R−Y) inputs—see text.



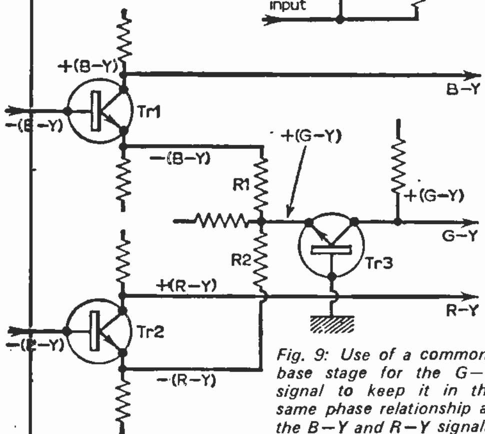


Fig. 9: Use of a common-base stage for the G−Y signal to keep it in the same phase relationship as the B−Y and R−Y signals.

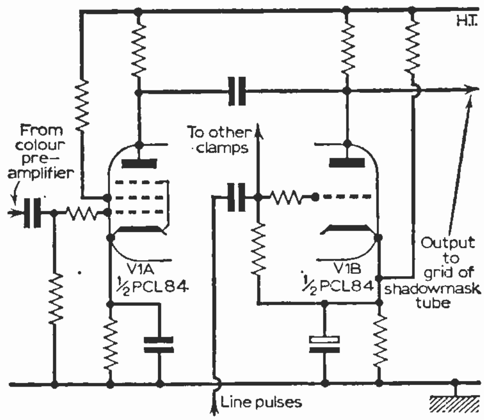


Fig. 10: Pentode colour output stage with triode clamp to clamp the output during the line flyback period to the correct zero value.

This measure is necessary to obtain the correct zero value so that true colour picture backgrounds are produced. The peak-to-peak drive voltages required are less if the luminance and colour signals are fed to the shadowmask tube cathodes, and designs using transistor output stages for this technique have been published. However, for this system more elaborate matrixing circuits are required since in the techniques assumed in this article the tube itself acts as the final matrix to provide true R, G and B signals in the manner outlined in the second paragraph of this article.

A simplified circuit showing a probable scheme is shown in Fig. 11. A crystal-controlled oscillator provides the 4·43Mc/s reference signal required by the synchronous demodulators, a buffer stage being included to stabilise the load on the oscillator. The burst signal used to synchronise the oscillator is fed to a phase detector circuit to which the reference oscillator waveform is also applied, the system working on the same principle as flywheel line sync circuits. The control potential developed is fed to a d.c. amplifier which controls a variable capacitance diode (i.e. variable reactance) in the oscillator circuit. The ident signal which appears at the output of the phase detector is also amplified by the d.c. amplifier, being taken from its collector and applied to a high-Q tuned amplifier circuit before being used for the purposes previously outlined. How it may be employed to fulfil these purposes is described later.

PAL SWITCHING

The arrangements required for the 90deg. phase shift in the feed from the reference oscillator to the B−Y synchronous demodulator and the 180deg. phase change on alternate lines in the feed from the reference oscillator to the R−Y synchronous demodulator are shown in Fig. 12. The reference signal to the B−Y synchronous demodulator is fed through a 90deg. phase shift network—there are a number of possible ways of obtaining this 90deg. shift—and then taken to the demodulator via transformer T2. The reference signal for the R−Y synchronous demodulator is fed via transformers T1 and T3. T1 has two

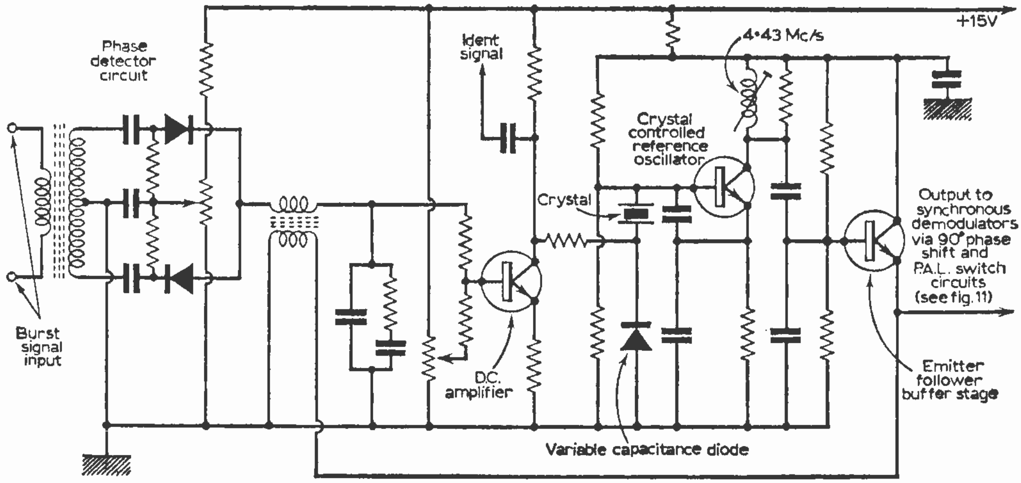
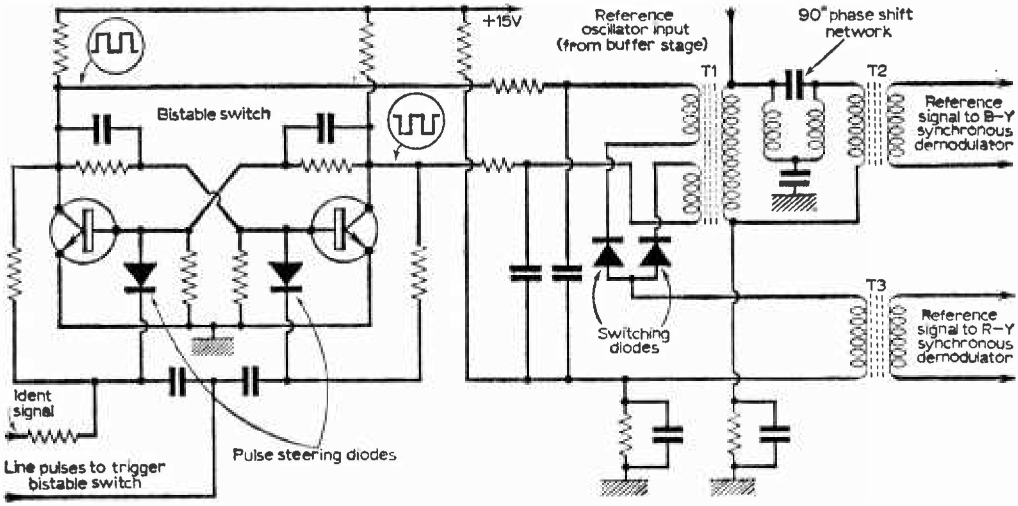


Fig. 11 (above): Simplified circuit of a crystal reference oscillator with phase detector and control circuits.

Fig. 12 (below): PAL switch, using a bistable switch circuit and pair of switching diodes to reverse the phase of the reference signal to the R – Y synchronous demodulator on alternate lines.



secondary windings wound with opposite phase relationships to the primary, and the reference signal is taken from one or other of these winding on alternate lines, thus giving the required 180deg. alternate line phase change. The two switching diodes are switched on and off on alternate lines, the R – Y synchronous demodulator taking its reference signal via whichever switching diode is on. The switching diodes are switched on and off by the bistable switch which is triggered on and off at line frequency by a series of pulses from the line timebase in conjunction with the ident signal which synchronises the bistable line switching with the line phase alternation of the transmitted signal.

The bistable switch is a member of the multivibrator family of circuits. It differs from the astable multivibrator used in television timebase circuits in having two stable states—hence the name bistable—either one transistor conducting and the other cut off or vice versa. This state of affairs is achieved by using resistance cross-couplings instead of the time constant RC cross-couplings of the astable multivibrator (the capacitors shown in parallel with the coupling resistors are included to speed-up the switching action from one stable state to the other to make the output waveform squarer). Two pulse steering diodes in the line pulse input circuit to the bistable switch ensure that the pulse is applied to the base of the non-conducting transistors to trigger it into conduction (this is achieved by forward biasing the diode to the "off" transistor and reverse biasing the diode to the "on" transistor, the biasing depend-

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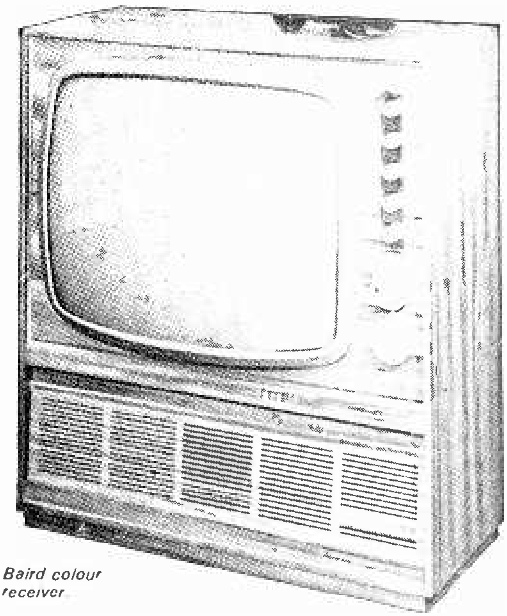
COLOUR TV AT 35s A WEEK



Baird colour receiver

BEING shown at this year's "Daily Mail" Ideal Home Exhibition (Olympia, March 7 to April 1) is the Radio Rentals Baird colour television. The exhibitors have created a display stand incorporating a television studio which relays colour to the actual sets being offered to the public later this year. This demonstration of colour television shows the advances that have been made over the past year since the Government gave the go-ahead for colour television on BBC-2 625-lines to commence before the end of 1967.

The Baird colour receivers, available from Radio Rentals branches, are expected to cost £285. However, the television trade estimates that 80% of colour sets will be rented. Prices have not yet been firmly fixed as conditions such as purchase tax, etc., may change before the receivers can be installed. Radio Rentals state that the rental charge will be 35s. per week. *Radio Rentals, Seymour Mews House, Wigmore Street, London. W.1.*

BELLING-LEE AERIAL DEPOTS

THE establishment of a system of local depots has assisted Belling-Lee Aerials with the maintenance of a rapid delivery service during the winter season.

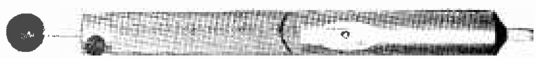
The depots were installed as part of an intensive effort to establish a fast delivery service in areas not quickly within reach of the Liverpool factory and the North London Branch Office.

Depots are located in Beith, Ayrshire, Bristol and Eastleigh Nr. Southampton. A depot is also planned in the Birmingham area.

SOLDER REMOVER

SURPLUS or unwanted solder can now be speedily removed with the Henri Picard & Frere Ltd. de-soldering suction pump.

Suction is created by a powerfully sprung piston which is released by pressure on a button catch. The solder is sucked through a pointed nozzle and is ejected on the return of the piston. *Henry Picard & Frere Ltd., 34/35 Furnival Street, London, E.C.4.*



De-soldering suction pump.

TWO NEW STELLA TELEVISIONS

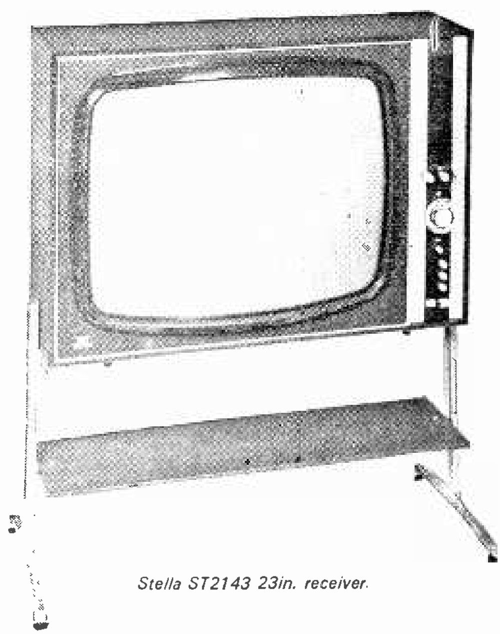
TWO new receivers now join the Stella Corinthian range. They are models ST2143, a 23in. receiver with a recommended price of 75 guineas and model ST2059, the 19in. version, having a recommended price of 67 guineas. They replace models ST2133 and ST2094.

Both receivers have similar specifications, the only difference being a smaller cabinet for the 19in. model. Bands 1, 3, 4 and 5 are covered.

Cabinets are styled in dark Sapele veneer finished in satin polyester. The front screen surround panel is in black polystyrene while the control and front facing speaker panel is in contrasting black and silver.

Metal stands with a wood shelf to match the cabinet of the receiver are available as optional extras.

Photograph shows the 23in. model ST2143. *Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.*



Stella ST2143 23in. receiver.

Servicing TELEVISION Receivers

No. 133 - MURPHY V470, V480, V490, V500 and associated models

by L. Lawry-Johns

All these models were released early in 1960; the V470 is a portable receiver. The 17in. receivers are fitted with Mazda CME1705 picture tubes, while the 21in. models have CME2104's. Some of the early V480's were, however, fitted with a CME-2101 picture tube. Another variation in this series is that some V470's have flywheel sync (WA).

The basic circuit has 15 valves (16 in the 470-WA) plus a metal rectifier and a couple of diodes (four in the 470WA). These receivers are designed to operate from a.c./d.c. mains, 200 to 250V: the mains adjuster is a circular device, rotated to the desired setting by slackening an insulated nut at the centre. It is essential for this to be correctly set, not only for the correct voltage, but because unless it is correctly located, the receiver will not function at all. This has been the reason for many unnecessary service calls, and readers are advised to check this before taking more involved checks to locate the cause of non-operation. Also remember that on 200-210V d.c. supply setting, the rectifier is out of circuit and it is therefore vital that correct mains polarity be verified. To further emphasise this, as it is important, when the setting is made for 200-210V d.c. mains, one side of the mains is direct to the chassis—this must be negative—and the other direct to the smoothing choke. Failure to observe this will result in the 500mA h.t. fuse, F2, blowing; capacitor C86 (200μF) becomes a dead short when the polarity is reversed.

A fine tuner is not provided, the channels are

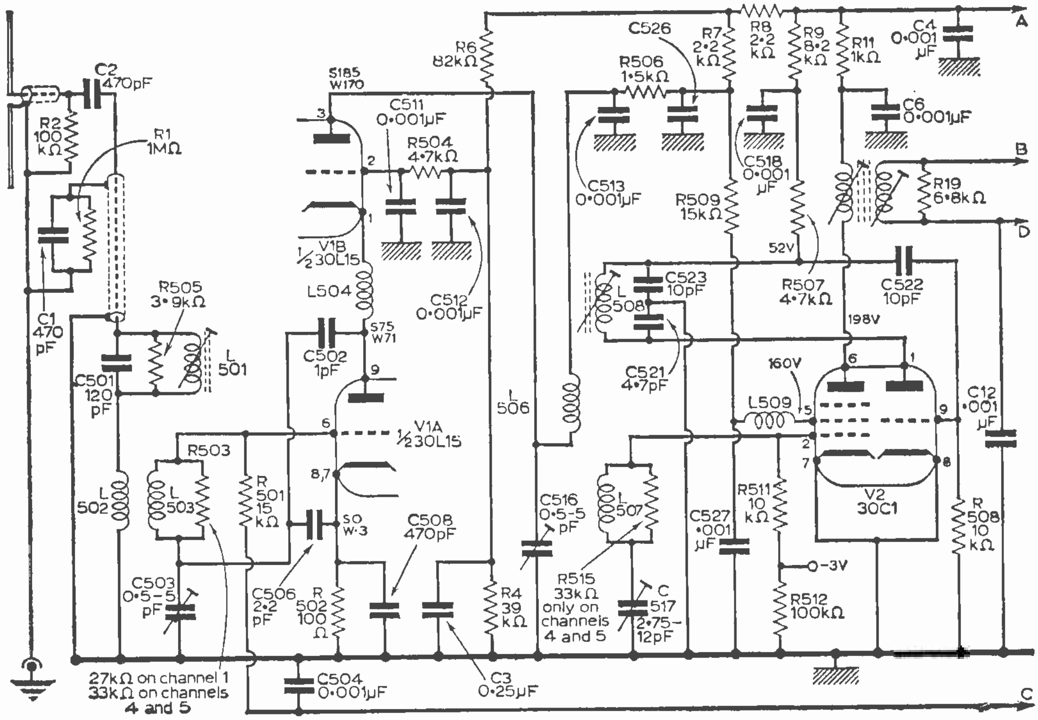


Fig. 1: Tuner circuit of the V470.

selected in the usual way; the coils being in a turret, but tuning can only be carried out by adjusting the oscillator coil cores. This operation is carried out by inserting a non-metallic tool through the hole at the bottom, under the tuner unit, setting the core for maximum sound consistent with freedom from sound on vision effects. Do not turn the channel selector (i.e. rotate the turret) unil the tool has been withdrawn.

Should the receiver be in use in areas of high signal strength, some cross-modulation may occur. This takes the form of vision buzz on sound, and sound interference with the picture. In such cases remove the cover from the middle of the back of the cabinet and move the Local-Distant switch to the right—Local. The switch to the right of the Local-Distant switch is the interference limiter S3. The purpose of this is to damp the video output to reduce the white level of interfering pulses. It should be kept in the off position unless ignition interference is severe.

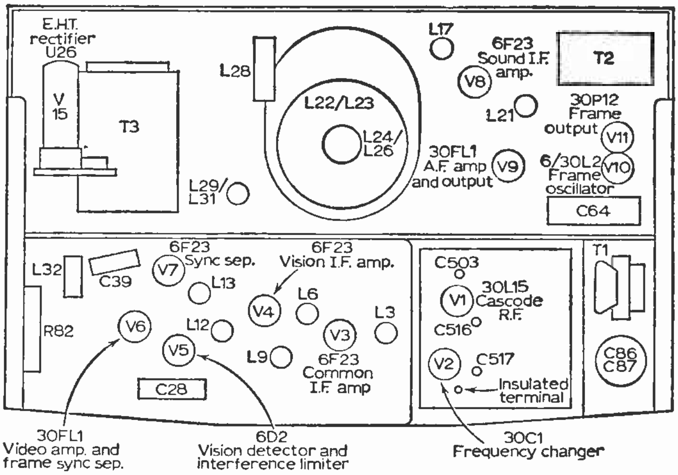


Fig. 2: View from the front of the V470 chassis.

The tuner unit

One of the most common faults is that of weak Band III. The 30L15 is the first valve to suspect if the aerial is known to be good. A weak valve in this position (V1) will give rise to a weak and grainy picture. If the picture is weak but not grainy, i.e. the picture lacks clear black and white definition, check V6 (30FL1) the video amplifier and field pulse shaper. Also check R38 (68kΩ) and R33 (10kΩ). A weak tube will tend to give fuzzy outlines to the picture with a silky effect to the whites—i.e., the whites tend to have a pearly appearance, the effect worsening as the brilliance or contrast controls are advanced.

CONTINUED NEXT MONTH

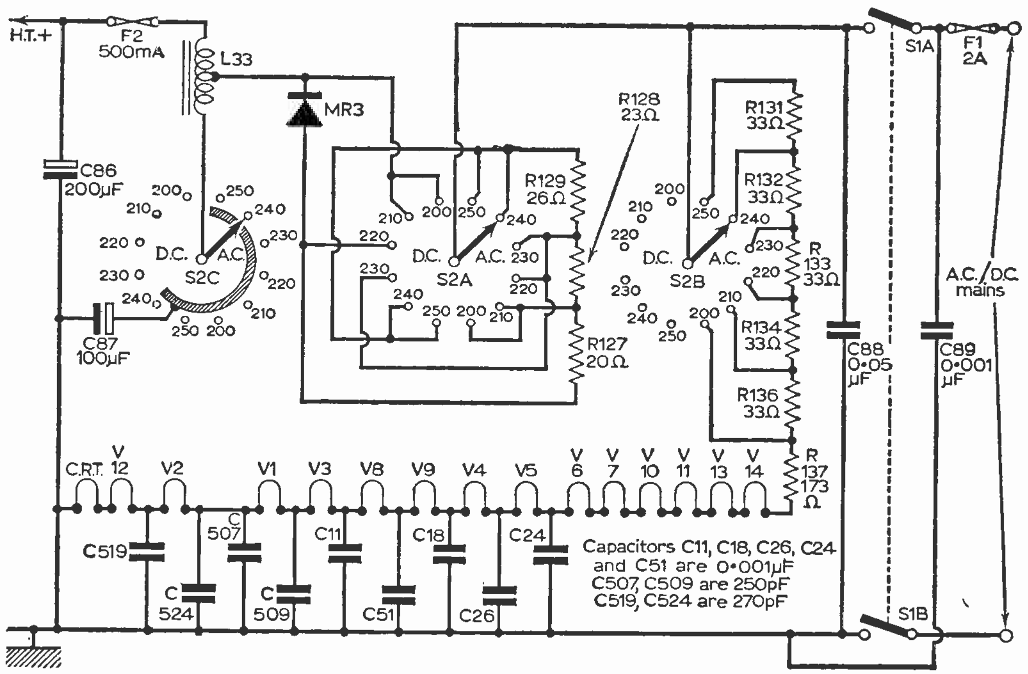


Fig. 3: Power supply circuitry for the V470 chassis.

UNDERNEATH THE DIPOLE

EXPORT—or die!' seems to be the exhortation of the Government, whipping up Productivity. Both BBC and ITA are doing their bit in this field, earning millons of dollars, drachmas, ducats and deutschmarks by exporting a growing volume of drama, comedy, documentary and newsreel items to all parts of the world. It all flows out in many forms, shapes and sizes—35mm. film, 16mm. film, video-tape at 525 lines 60 fields, 625 and 405 lines on 50 fields—together with a miscellaneous collection of transfers from the original recorded medium to another. And thereby hangs the difference in the final technical quality of both sound and picture when it is reproduced on the customer's telecine equipment—far, far, far away, in foreign lands.

Colour exports

At present the world market for colour for television is limited to U.S.A. and Japan, But it will not be long before the demands rapidly increase, coincident with the starting of colour programmes on BBC-2 followed by ITA-2. The outlook for colour TV here is slightly more encouraging thanks to trade and pubilc criticism, including that from the Editor in our February issue· Not withstanding the Goverment's initial discouragement of colour on ITA's 405-line service, and subsequent second thoughts on its use of 625-line colour, many of the independent TV companies have been actively preparing for live, taped and filmed colour. Already a few of the companies are producing colour film series which are achieving export successes equal to (or even better than) the BBC film exports. Take the case of ATV, whose studio stages at Boreham Wood are fully occupied with TV taped plays and serials. This company's exports increase month by month, expanded by the leasing of film studio stages on four or five series, all shot on 35mm. film in colour. Quality of colour on these films in first class both on cinema screens and on monitors fed from both Cintel twin lens flying spot telecine and from vidcon telecines.

Results on the average domestic colour television set in America have to be seen to be believed. The reports I have read are variable and contradictory and it appears that any kind of colour however bad, is preferred, compared with the old-fashioned black-and-white! Within the next month or so Iconos will be at the 50th Anniversary Conference of the Society of Motion Picture Engineers in New York, USA. No doubt, he will see the many lively colour channels he can tweak on the knobs of the console-type supa-charged 25in. jobs.

Sagging sagas?

Our old friend the TAM-ratings assure us that the television sagas are not sagging· 'Peyton Place' continues to attract a huge audience, who follow minutely the plots, counter-plots and sub-plots in that T-bone size slice of American life today. The astonishing thing about the presentation in Britain of this type of continuing serial is that the various ITV major and regional areas show different episodes in the same week—so that if you are a fringe viewer of two overlapping regions, it is possible to see episodes that occur up to two years apart.

BBC-2 with a great fanfare of trumpets introduced Britain's answer to 'Peyton Place'—John Galsworthy's 'Forsyte Saga' with a hand-picked cast of brilliant actors and actresses, headed by Kenneth More who shows what a good actor he is, besides being a star. The two terms are not synonymous by any means. David Gile's direction gets to the heart of things—and this serial alone is worth a BBC-2 aerial, and a hope that a signal is coming through strong and clear. I will be writing more about 'Forsyte Saga' in future issues.

Show stopper or starter?

In the early days of post-war television, BBC only, from time to time the cameras would enter a—wait for it—real theatre and bring the West End 'Who's for Tennis' shows to the provinces. An invited audience would applaud a trucated scene or two; the matinee idol's forehead would indeed show 405 lines, and at least a minute of 'curtain calls', curtains rising and decending, and static curtains would fill our 9in. or 12in. screens. A good expert would prop up a show for a few more weeks—but more often it was a part of the death throes of a play.

Excerpts from shows continue—but there is greater subtlety in the direction of a television version today—and now we have the announcement from Rediffusion that they are to show a series of 'Excerpts from the Shows'. I hope that this will include visits to many of the larger Provincial Companies, who have earned an enviable reputation for the English Theatre. Bristol Old Vic and Nottingham for example. With this in mind, should not every theatre, whether civic or private enterprise, have inlets for all the paraphernalia of TV—so that it is easier to record 'on stage', and that viewers can realise that actors don't move from teleprompter to teleprompter—from Camera 1 to Camera 2.

"Let's make a TV show"

Everyone has their own ideas of the ideal TV show—but have they? Is not the essence of television the gift of actuality?—

seeing it as it happens whether it is a national celebration or a unique concert or recital. Surely the problem is as tricky as selecting those ten gramophone records for 'Desert Island Discs' which is such a perennial favourite on the radio. But how much of television is memorable—as a great film or show, a sporting event or a shock scoop can remain in one's memory for ever? This must be one of the tests of whether television is a separate art-form, or is merely a domestic extension of the theatre. Perhaps it will be more memorable in colour? This is what the makers of colour commercials hope for: impact.

Teach-ins

The British theatre has the Royal Academy of Dramatic Art, the Central School of Speech Training, the London Academy of Music and Dramatic Art, etc. as its training schools, together with its repertory companies for teaching, training and developing the abilities of would-be actors. Repertory theatres play their part, too, not only for planting the elements of acting but also of the other important contributions of lighting, scene painting and stage management. Schools for film production have not made very much progress in Britain, though the London Polytechnic has a fine course on Kinematography, editing, light- and associated aspects—all likely to be outdated by the techniques of television aids now available for cinema film production.

One of the most advanced television training schools in the world is at the Thomson Foundation College, Glasgow, which has unique facilities for the technical instruction of students as television cameramen, directors, scriptwriters, floor managers, vision mixers, etc. Film work is also dealt with, including photography, processing and editing. There is a well-equipped studio, qualified instructors and a syllabus far in advance of any other in the world.

The Thomson Foundation is a residential college, open to students from any part of the world, provided they are sponsored by a recognised broadcasting organisation and that their fluency in English is sufficient to understand technical instruction in this language. Guy Bloomer, the Principal, has had considerable experience in major and regional television organisations.

It was founded by Lord Thomson primarily for the promotion of education in the underdeveloped countries. It was long ago realised in UNESCO that this can only be made *speedily* possible by the use of mass media in modern communications—by newspapers, radio, television and films.

C.O.I.

The Central Office of Information is well aware of the vital importance of modern methods of communication mentioned above, but also the importance of enhancing British prestige abroad and stimulating a greater demand for British goods in overseas markets. C.O.I.'s own departments for sponsoring items for the world's sound radio, television and cinemas, which demonstrate Britain's industrial achievements and the British way of life (excluding "X" scenes from Royal Court Theatre productions!) are distributed to underdeveloped, half-developed and fully developed countries. Their Booklet "Let the World See Your Flims" indicates the go-ahead attitude of the C.O.I. In it, the four important points are mentioned which makers of industrial films must watch:

(a) Direct advertising or a heavy sales approach and promotional treatment must be avoided.
(b) Avoid lip sync dialogue which present certain difficulties when dubbing into a foreign language.
(c) If there are incidental voices, they should be put on the music—or on separate tracks, not on the commentary track.
(e) Most useful running times for such subjects are 13 or 27 minutes.

These points all seem logical. It won't be long, however, before C.O.I. are presented with a new problem for 35mm. release prints when single track magnetic striped sound film prints are made available for export. This will enable prints to be sent abroad with commentary or dialogue in the language of the country concerned. On return to Britain, the magnetic sound can be erased and recorded in the language of the next country to which it is being sent. This saves the cost of a new print—always provided it hasn't been scratched or otherwise damaged.

Jungle drums

All of these factors are important in enabling governments and peoples to understand each other, even if they're thousands of miles apart. The days of jungle drums and coconuts (horses hooves) are over in these days of Mellotron magnetic sound effects; at least, that is what you might think. But, you can bet dollars to doughnuts, that the jungle drum is still used for seashore sounds by swinging the lead shot on its skin!

Confessions and impressions

Kosygin has come and gone—and as usual there has been the TV coverage—State visit, camera angles for the use of—they are all there, the shots of the crowds, the airport welcome, but one thing is missing and what a loss it is—there is no longer Richard Dimbleby. He was a unique personality and television has lost so much with his death.

Religious programmes have a certain style about them too—there are the Betjeman tours of empty churches which echo to his footsteps—there are the varied denominational services with the cutaway shots to cherubs on the ceiling or hands on bibles—there are the cheery and homely congregations singing hyms Ancient and Modern, their well-scrubbed faces glistening in the TV lights and their well-polished boots the bane of the lighting man.

But this is television—just as the mellower-styled "Avengers", "Twenty-Four Hours" and "Watch with Mother" fulfil a purpose!

A new-style TV programme will enter the TAM-rating race; will it be Yorkshire Relish (piquante!) or Yorkshire Pudding (nourishing!) and which of the seventeen competing syndicates will win the ITA franchise?

Iconos

What to do when the  blows...

V.D.CAPEL

A quick examination of a 'dead' receiver frequently reveals a blown fuse. The question is what has caused it to blow and how can the trouble be located? The first thing to do is to identify which fuse has blown. Fuse arrangements vary, but generally there are two in the mains input circuit. A third fuse might well be in the h.t. supply line and any subsequent ones would be feeding h.t. sub-circuits such as the line output stage. There are exceptions to this, for example it may be found that only one leg of the mains supply is fused with a second fuse in the h.t. rail. The value of the fuse is a good indication of its function. Ratings from 1·5A to 3A are commonly used in the mains side, whereas 250mA to 850mA are usual for h.t. fuses. One must be careful not to be misled by an incorrect value which may have been fitted previously.

Having identified the fuse that has blown, check for measurable short-circuits or leaks with an ohmmeter. If it is the h.t. fuse, take a reading from the h.t. line to chassis. This should be around 20,000Ω and anything much below this figure should be treated with suspicion. If either or both of the mains fuses have blown, replace them and take a 'cold' reading across the mains plug. A reading of several hundred ohms is to be expected since the heater chain is in circuit. The chain can be broken at its lowest point by removing the base connector from the c.r.t. whereupon the reading should indicate several kilo-ohms if a metal rectifier is used, or infinity if a valve rectifier is fitted. Should a low reading persist, then the trouble must be traced by isolating the various circuits concerned.

Heater cathode shorts

First check for a heater/cathode leak in one of the valves. Elimination or confirmation of this possibility can be made by breaking the chain at its highest point by removing the valve rectifier if fitted, or the boost diode. If the reading remains the fault is elsewhere, but if it persists a heater/cathode leak is the most likely cause. In this case, the best course is to replace the boost or valve rectifier and then remove each valve successively down the chain, until the faulty valve itself is reached. When it is removed the reading will disappear as before but on removing the one below it the reading will remain. This procedure is illustrated in Fig 1. As can be seen from this illustration the mains dropper is in series with the top end of the heater chain. This affords a useful aid in diagnosis: if the resistance of the leak as measured across the mains input is greater than the value of the mains dropper, then possibly it is on the heater side of the dropper and could be due to a heater/cathode leak. If the leak is lower than the mains dropper then it must be on the supply side of this component. In such a case the fault could lie with the rectifier, the switch or the associated wiring. Rectifiers, both metal and valve, are frequent causes of fuse blowing but rarely give any measurable reading when cold.

So far, we have been concerned only with cold-chassis tests—purely resistance checks without the presence of high voltages. Sometimes these will produce nothing as high voltage or 'normal' heat is necessary to cause the trouble to show. Heater/cathode leaks often occur only when the valve is warmed up: metal rectifiers often develop a leak only in the presence of high voltage. Similarly the valve rectifiers will often only flash over when hot and also when a voltage appears across them. If a cold chassis test fails to reveal anything, then the only thing to do is to replace the fuse, disconnect a suspect component or part of circuitry and switch on.

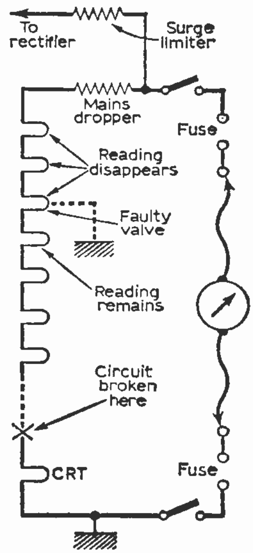


Fig. 1: Testing for heater/cathode leaks with an ohmmeter.

Diagnosis of the fault the 'hot' way may require the expenditure of several fuses. A good way to start is to disconnect the supply lead to the rectifier. As the heaters light up watch for any signs that any of them are over bright as this indicates a heater/cathode short somewhere. Should this happen, remove the last bright one down the chain and have it checked in a valve tester, or if a replacement is to hand, try a substitution test. Note that the trouble could be the next one down the chain as it may have a heater/cathode leak on the high side of its heater which would not effect its own heater current.

Should the fuse blow immediately upon switching on, then the switch is the likely culprit. If nothing happens upon switching on and the valves light up normally then let the set run in this condition for a few moments to ensure that the valves reach their normal operating temperature. Then if nothing happens, reconnect the supply to the rectifier. When switching on again visually check a valve rectifier for internal flash-over. Should the rectifier be of the metal type and the fuse blows immediately then almost certainly it will be the cause of the trouble. Another possibility, though less likely, is a defective reservoir or smoothing capacitor.

Many sets incorporate a small paper capacitor across the mains input circuit to stop r.f. getting on to the mains. This is a likely suspect and should be disconnected during the testing procedure. Fuse blowing on reconnection will give the obvious indication.

Surge faults

Now to the problem cases where the fuse does not blow with everything connected. Sometimes a momentary surge may occur in the set causing a fuse to blow but without any definite fault being present. This may be due to a small flake of cathode material falling from the cathode of the rectifier and just touching the anode as it drops to the bottom of the glass envelope. Such a condition may not recur. However, a surge could also occur if the set was switched on after being switched off for only a few moments. In such cases nothing more need be done other than replace the fuse.

There may be other cases however where the fuse may go periodically: again there may be no actual fault. When switching on the initial current may be much heavier than when the set is running normally. The valve heaters are cold and in this condition they have a much lower resistance (hence, will pass more current) and if a metal rectifier is used this will immediately conduct and allow the reservoir and smoothing capacitors to charge up at the time the heater current is at its heaviest. This initial surge is responsible for many fuses blowing where there is no real defect. The answer is to fit anti-surge type fuses.

Replacing fuses with a higher rating is normally frowned upon, but under some circumstances may be justified. Especially if the original rating was on the low side. Some manufacturers actually recommended this as a modification.

Intermittent faults

Periodic fuse blowing may not be due to a temporary surge, but the result of an intermittent fault; particularly if the fuse blew sometime after switching on. Often after such an occurrence no fault can be found when tests are made and the set works perfectly for another protracted period. In such a case the only thing that can be done is to disconnect the various feeds from the mains input and wire in a cartridge fuse

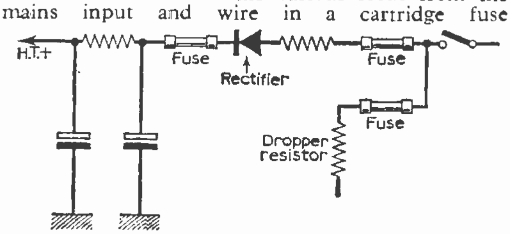


Fig. 2: Adding extra fuses is a useful way of locating a faulty section of circuitry.

temporarily. The general idea is shown in Fig. 2; one fuse can be put in the lead to the rectifier, another to the mains dropper and valve heater chain, and one in the h.t. side of the rectifier to the smoothing and reservoir capacitors. The rating should be below that of the fitted mains fuses so that when the fault occurs one of these will blow first. Now one has to wait for something to happen! When it does, the blown fuse will indicate which part of the circuit contains the fault. Should the mains fuse blow in one of these 'hook-ups', it indicates the fault lies between the mains fuse and the distribution point of these auxiliary fuses—usually the on/off switch. ■

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

THERE was no significant change in DX conditions for the period 23/1/66 to 23/2/67, and the sad story of generally poor reception continues. It has been another depressing session. There has, however, been a very slight improvement in respect of tropospheric propagation in Band III, and u.h.f.

First of all, a short run-down of Sporadic E activity. There have been a few openings, but not nearly as many as we would like. Those noted below were recorded by R. Bunney and myself (also see "Readers' Reports").

2/2/67 Sweden Horby E2, Switzerland Bantiger E2.

9/2/67 Sweden Horby E2.

17/2/67 Spain TVE Zaragossa/Alicante E3.

The Tropospherics were best from 2/2/67 to 10/2/67, with France, Cherbourg F12, Rouen F10, Lille F8a, Brest F8, Niort F7, Le Havre F7, and Rennes F5, all well received on Band III.

U.H.F. over the same period gave Lille Ch.21, Brest Ch.21, Nantes Ch.29, and Metz Luttanges Ch.34, from France, and Brussels Wavre Ch.43 from Belgium, the last two being new ones here.

NEWS

R. Bunney comes up with the latest news from Turkey. At present there is only a 50 watt experimental station at Istanbul Technical University operating on Ch. E4, but there are big new projects in hand, and these should all be good "possibles" for us via Sporadic E propagation. The following stations are planned to go into service between 1968 and 1972.

Ankara E3. 100kW. Izmir E3. 100kW.
Istanbul E4. 100kW. Bursa E2. 60kW.
Adana Ch. E4. 30kW. Kanya Ch. E10. 30kW.

A little further afield, and notwithstanding denials in some quarters, Pakistan appears to be operating in Band I after all, with Karachi E4, 30kW, Islamabad E4, 30kW, and a proposed station for Peshawar E3 by December 1967.

AURORAL REFLECTION

We have already dealt with Sporadic E, Tropospheric, F2 layer reflections, and Meteor Shower propagation, so now a few notes on a further method, Auroral reflection.

Unfortunately the very spectacular sight of Aurora is very seldom seen in the South of England, although it is not unknown. I recall when I lived in the North being vastly impressed with seeing some displays in "glorious technicolour", although at that time I did not realize that it could have its practical uses as well!

Aurora is a direct result of sun-spot activity causing electro-magnetic disturbances in the E, F and D layers of the upper atmosphere, and these are most pronounced during early-mid April and early-mid October each year.

The times of Auroral activity are fairly clearly defined, their being two daily "peaks" around 16.30 GMT and 24.00 GMT, with a gradual build-up over the preceding two to two and a half hours and a drop in activity between the two periods.

The best direction for reception is the east-west line, and reflections take place at right angles off the *vertical* Auroral reflecting layer, in a lateral propagation direction.

As before, Band I is most subject to this type of reflection, but cases *have* been known to have taken place in Band III. In Band I, distances up up to about 750 miles can be expected, but openings can be cyclic with skip starting at 750 miles, reducing to 250 miles for more local DX then opening again to the 750-mile limit.

TV reception is likely to be similar to that expected from F2 layer reception, with characteristic "smearing" of the image due to multi-path reception of the signal.

I must confess that I have never personally been able to attribute any DX reception in my southern area to this type of propagation, and it may well be that I am too far south. Northern DXers, however, may well find it possible. The next opening date is this month, so I hope to have some reports in due course. Aerials to the east, please, for best results!

READERS' REPORT

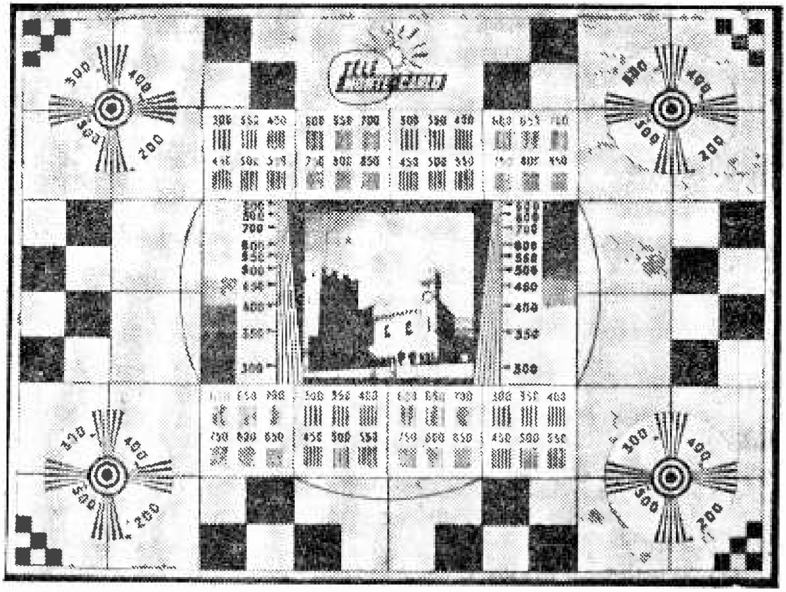
R. Roper of Torpoint has received Divis N.I. u.h.f. Ch. 27. He does have a good water path, so it may be more difficult in other areas, but it is a nice catch for him, in addition to u.h.f. France, Rennes and Troyes.

D. Bowers Saltash includes the following in his report for January 1967, under winter conditions, and he points out that his results do indicate that there was some activity after all. An analysis of the log shows that many of the signals were of very short duration only (two minutes or less), and other DXers feeling disheartened should remember this point. Reception of this type demands considerable patience, with attention firmly on the screen, and time available during the day to keep vigil; not all of us can manage this. Here is the log for January 1967, with January 10th as the best day:—

Germany E4, Italy IB, Norway E4, Austria E4, Holland E4, USSR R2, Poland R2, Czechoslovakia R2, Sweden E4, and Spain E4. It is interesting to note that reception was towards the h.f. end of Band 1. In winter I, too, have noted this phenomenon.

DATA PANEL-20

MONTE CARLO, MONACO



Test Card: As photograph above.

Channels: Band III only on Ch. F10 Monte Carlo (Mt. Agel), 50kW horizontal polarisation.

Band I: Some station lists show a transmitter on Ch. F2 but this is not active. It is said that ORTF France raised objections to this channel being used and the station closed down some years ago.

Reception: Tele Monte Carlo on F10 has never been received in the U.K. to our knowledge, but it has been received in Western Belgium, and so it must rank as a distinct possibility, if a rare one.

Data Panel Series: The publication of Data Panel No 20 completes the present series which covered some 23 European countries. We will, however, keep the list up to date from time to time by publishing new test cards as they come into service and by giving details of other countries that become possible to receive in the U.K.

DECODING PAL

—continued from page 318

ing on the potentials at the bases and collectors of the transistors—note the resistors connected between the transistor collectors and the "cathode" sides of the steering diodes). The bistable switch provides two square-wave outputs of opposite polarity at line frequency to switch the switching diodes on and off.

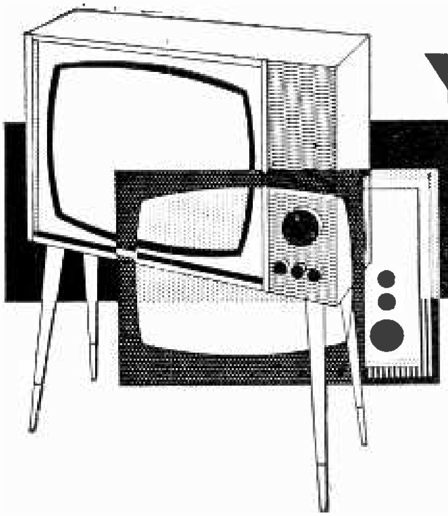
USING THE IDENT SIGNAL

The ident signal, which is at half line frequency, can be used to control the triggering of the bistable switch by using it as a variable bias signal to block triggering pulses arriving at one of the steering diodes on alternate lines. In this way the bistable switching is synchronised with the alternate line phase reversal of the transmitted R—Y signal. Once the switching has been established with the correct timing no further action is required, though the ident signal is still present and thus overcomes the possibility of false triggering because of noise pulses.

For colour killing the ident signal can be used after rectification and smoothing as the base bias for a chroma amplifier stage, the base bias thus being removed in the absence of the ident signal so that the chroma amplifier is then inoperative.

CONCLUSION

We have now covered the main features of a PAL decoder and outline the basic techniques used. It is only fair to add that considerable variation in detail will probably emerge as practical designs reach the production stage. It is hoped, however, that this article will have indicated to the reader how the decoder goes about the basic operations necessary in order to produce from PAL transmissions the three separate colour-difference signals required by the shadowmask colour picture tube. ■



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

EMERSON E429440

When this set is switched on, the picture comes up a little ahead of the sound. The sound always used to come on before the picture and was quite loud. Now when it comes, it is very quiet and gradually over about an hour strengthens. No matter how long the set is on, the sound will not go any higher than is desirable in a small room although the volume is fully up. The picture is extremely good.—J. S. Kelly (Liverpool, 18).

It would seem that the i.f. sound channel is drifting and needs checking for alignment or that one or more of the valves in the sound channel is low emission and that the emission gradually improves as the set warms up. It would pay to have the valves checked by a dealer with a good valve tester and replace any in the sound channel which are low.

ULTRA 1781

Ten to fifteen seconds after switching on, a small spot appears on the centre of the screen. This then opens up into a straight vertical line 6in. high and $\frac{1}{8}$in. wide. This then suddenly opens out until it reaches full height of the tube, but only about 8–10in. wide. The sound and the picture are unobtainable.—J. Moore (Reading, Berkshire).

We would advise you to check the h.t. voltage and replace the rectifier if necessary. Check the heater current. If these points are in order, check the line output valve and the tuner unit valves etc.

PHILIPS 197G/120

This set lacks e.h.t. and the sound is very poor. —A. Thomas (Bristol, 4).

Lack of e.h.t. voltage could be caused by trouble almost enywhere in the line timebase or in the e.h.t. circuits. Shorting turns in the line output transformer is a possibility. Low sound could mean a weak aerial signal, misalignment of the sound channel, low h.t. voltage, faulty sound valve—almost anything in the sound channel!

MURPHY V240A

The picture and sound are excellent when working but sometimes at intervals of about three minutes I have to keep on re-setting the horizontal hold as the picture suddenly pulls to the left of the screen and disappears into lines.

On other occasions, the picture suddenly goes bright and disappears and you can just see the shadows of the pictures on the screen. In both cases, just a touch of the horizontal hold adjuster restores the picture.

Sometimes the set will work for about half an hour but nearly every time there is a programme change, the horizontal hold requires adjustment.—J. Humber (Pembroke Dock).

This set appears to have a faulty line oscillator or discriminator valve. These are 20L1 and 20D2 just between the line output "cage" and the mains resistor. Check these valves by substitution, and if no improvement results, a systematic check of their associated components is indicated.

HMV 1890

This set has a violent hum on the sound. The picture is perfect. Having an old PCL82 with a short on pin 6 to pin 7, I put this in the set and this regained sound and improved things slightly. Could the cause of the trouble be the $400+100+16\mu$F electrolytic smoothing capacitor?—J. Brettle (Cradley Heath, Staffordshire).

It seems unlikely that the electrolytic capacitor is the cause of the trouble. By inserting a valve with pins 6 and 7 shorted you cut out the screen feed, effectively converting the stage to triode operation and if this temporarily regained the sound we would rather think that the $1M\Omega$ feedback resistor from the pentode anode of the PCL82 to the triode anode has been open-circuited.

If you wish to change the electrolytic capacitor, you may find difficulty in obtaining the specific component for this out-of-date model, and perhaps it would be better to fit a standard $400+100\mu$F, 350V wkg. as available from several sources and add a separate 16μF tubular electrolytic.

PHILIPS 19TG158A

I receive BBC-1 on Channel 2 and ITV North on Channel 9. I can also pick up an excellent picture in sound on Channel 8 (ITV Midlands). I want to be able to receive other ITV channels. On Channel 11, I can pick up good sound from ITV Wales but the picture is very poor with "snowstorms", rolling picture and pulling to the side.—S. T. Green (Macclesfield, Cheshire).

As you are well aware, reception of stations outside your service area will require specially aligned aerials tuned to the correct channels, and probably a good deal of site experimentation.

Several articles on TV-DX work have appeared in these pages, and from the remarks of our contributors, we can see that the problem of "out of area" reception is a very ticklish one. You are already doing well to pick up Welsh ITV and your description of symptoms simply indicates that there is a weak signal. You may improve it by aerial alignment, but may have to fit an extra aerial with greater gain and narrower bandwidth to reduce the noise, and perhaps follow this with a masthead booster, as your set is not a particularly powerful "front-end" model for this work.

EKCO T221

The trouble here is no vision and no raster. The sound is perfect. The U25 develops a blue flame inside as the line whistle comes in, then the centre metal becomes a red glow. This has been replaced but the trouble persists. Several other valves have been replaced with new ones and the ion trap magnet has been moved around without success. A blue spark can be obtained from the c.r.t. cap.—B. Finch (Lowestoft, Suffolk).

You may possibly have a faulty c.r.t. but we would also advise you to check the e.h.t. capacitor as well. This can easily be done by disconnecting it and taking the e.h.t. lead straight to the c.r.t. It is quite safe to run the receiver in this state if a satisfactory picture results.

STELLA ST2029A

The sound and vision on Channel 10 are only receivable at position 9. The sound and volume are both perfect and on Channel 10 there is no trace of a signal. The vision on Channel 2 is still OK at position 2 but the sound is distorted by a strong hum and the sound of Channel 2 is now receivable at position 1 which was not possible before. I have changed the tuner valves —PC900 and PCF801—but this made no difference. An inspection of the tuner shows nothing mechanically wrong and all the printed wafers seem to be in order. The fine tuner is also OK.—B. Welch (Ramsgate, Kent).

The trouble is certainly caused by a drift in the tuner, and the components around the oscillator section of the frequency changer should be suspected. The drift in frequency appears to be related to both channels in use, although, of course, the effect would be greater on the higher frequency Band 3 channel.

PHILIPS 1756U

I require a line output transformer for this model and have been offered one from a Philips 1748U. Could you tell me if this will be suitable and if not could it be modified to work satisfactorily?—F. Webster (Slough, Buckinghamshire).

The line output transformer you have been offered is not likely to be suitable for the Philips 1756U. This particular model was quite individual and used a very distinctive line output transformer. You can recognise it by its large black screening can held on by a central wingnut and the anti-corona shields that guard the connections of the EY51, which in this model is mounted across the top of the transformer.

BUSH TV24C

On switching on the picture is very good but after about 20 minutes "snow" begins to appear and worsen until on dark scenes no detail can be seen.—P. Holmes (Uppingham, Rutland).

The effect can be caused by a faulty h.t. feed resistor to one of the EF80 valve bases. If the effect is worse on ITV, check the PCC84 valve on the tuner unit. It may be necessary to check the e.h.t. connection and lead from the EY51 to the side (or top) of the tube.

PYE V430A

I would like to convert this set to receive BBC-2 and find that I can obtain a Philips 625 conversion kit at a very reasonable price. Before I buy this kit I would like to know if there are any snags I might run into.—R. Gould (Ilford, Essex).

We regret that we have no experience of fitting the converter you mention to the Pye V430A in order to receive BBC-2. Since the V430A was not intended to receive 625 lines, we would envisage that you would have difficulties particularly in the line output stage.

GEC 2000DST

In order to locate the front panel oscillator trimmer more easily I want to remove the band change knob which has around it the 405 tuning ring. I imagine they are pull-off fits, but I want to be sure as they do not respond easily to a steady pull.—H. Leslie (Wimborne, Dorset).

There have been a number of structural and styling variations on this range of chassis, but in general, the channel selector knob arrangement was similar in them all. The knob should pull off but invariably it is a tight fit.

Perhaps the best method is a piece of flat linen tape about ½in. wide looped under the knob. This is then pulled off with a straight and steady pressure. This spreads the pressure against the underside of the flange and prevents the splitting of the inner portion that usually occurs when one tries to remove by prising off with a screwdriver blade.

Beware of the fine tuner control. On several models, this cannot pull off, having an internal flange and the support panel must be released from inside. This is a bit tricky until you successfully locate the four 4BA cheesehead screws, after which it is plain sailing

CHANNEL 6 AERIAL

Would you please tell me the dimensions for making a five-element aerial for Channel 6.—P. Richards (Tadworth, Surrey).

The dimensions required are: folded dipole 31·5in. overall; reflector 33in. and the four directors respectively from the dipole 29·5in., 29in., 28·5in. and 28in. Reflector/dipole spacing 17·1in. and dipole/director and director/director spacings, 8·7in.

BUSH TV62

The sound is alright but the EY86 will not light up and there is no picture. I have had PL81, PY81 tested and found OK.—T. Brimelow, (St. Helens, Lancashire).

Check the line drive to the PL81 control grid (pin 2). If absent the PL81 will overheat in which case check the ECC82. If the ECC82 is working check the 0·1μF boost line capacitor (junction of 100kΩ etc.) and the line deflection coil connections etc.

RGD 610FM

The picture is stretching at the left-hand side and leaving 3in. blank at the right-hand side, otherwise it is quite clear and the sound is good. I have fitted a new line output transformer, new BY100 and new voltage dropper.—J. Medhurst (Rochdale).

There is a sleeve adjustment on the tube neck beneath the scanning coils for correcting line linearity on most versions of this set. Some improvement might be possible by moving this sleeve in or out of the coils, along the neck. Otherwise check the line output valve and booster diode.

PHILIPS 9148

The picture will remain stable for about an hour or so after switch-on, but then sections of it start pulling to the left especially during a dark scene. On some nights the fault seems worse than others. This happens on both channels.—H. Nutley (Brierley Hill, Staffordshire).

This symptom could be caused by an inter-electrode leak in the picture tube, as the tube warms up. It can also be caused by trouble in the video amplifier or sync separator. It would seem that a valve is responsible (or something affected by temperature) since the symptom occurs only after an hour's operation.

MURPHY V320

On this set the 30P19 burns out in about two weeks. The cathode appears red hot. Disconnecting the screen from the valve, there is no voltage: reconnecting, the voltage returns.—D. Smith (Westbury, Wiltshire).

Your trouble could be within the line output transformer, or it could be due to the fact that you are using 30P19 valves. The V320 was originally designed to take a 30P4, and we believe that a limited run of 30P4's (specially coded "MR") are still available to perform this function.

EKCO T205

I recently brought this set to Bristol from Dorset. It worked quite well in Dorset—presumably North Hessary Tor—but I can get no results in this area. Could you say if any adjustments have to be made to bring in the local BBC channel.

The T205 can be tuned to any BBC-1 channel quite easily by adjusting the four coloured trimmers at the back of the set near the aerial panel. The yellow one is local oscillator and should be adjusted for maximum sound, the green one is aerial and should be adjusted for maximum picture whilst the red and black are bandpass r.f.'s which should be adjusted for the best compromise between good sound and good picture.

PETO SCOTT 1964

When first switched on, the picture starts very dark, then gradually increases in brightness for about half an hour. After this, the set then settles down. This fault only occurs on BBC-2.—H. Watkins (Birmingham, 14).

If the fade-on effect occurs only on BBC-2 and not on the v.h.f. channels, it could be caused by (a) drift in the u.h.f. tuner (b) drift in the alignment of the 625 standard i.f. channel (c) fault in the video amplifier valve (which shows up when switched to the 625 standard). There are other possibilities, but those given above should be the first to be investigated.

FERRANTI T1023

The picture is poor but the chief fault is horizontal lines across the screen.—H. Haffern (Belfast, N. Ireland).

The horizontal lines, if dark, could well be caused by co-channel interference due to your aerial picking up not only the wanted station but also the signals from a distant station sharing the same channel number. If this is the cause, you should concentrate on improving your aerial system, arranging for greater discrimination between the wanted and interfering signals.

MURPHY V250

I have replaced the CRM171 with a type 43/69 c.r.t. I have connected the coating to the chassis and dispensed with the original e.h.t. capacitor. The raster brilliance is not up to expectations. Do I have to make any alterations to the tube connections?—J. Bartley (Rhyl).

You may possibly have installed a faulty new c.r.t. but we advise you to check your ion trap magnet first. Regarding the e.h.t. rectifier, this is sealed within the oil-filled line output transformer and is not readily replaceable. If available, a new transformer complete is the method of curing trouble.

BUSH T57

The sound is good but the picture has narrowed both sides.—C. Freeman (Worcester).

We would advise you to check the ECC82 and PL81 valves.

BUSH TV138R

I am disappointed with the sound quality from this set. Is it possible to connect an external speaker or amplifier to the speaker leads in the set or would this upset operation of same. —A. Heald (Southport).

It is quite in order to use an extension speaker (3Ω) with this set but you must ensure that the chassis of the television is never at mains potential (live) by using a 3-pin mains plug correctly wired. Check the metal work and the loudspeaker with a neon to prove it is not live.

REGENTONE 194

Firstly, the dropping resistor broke down and I got it going again with a 20Ω resistor wired across the break. Now the picture goes somewhat negative and is covered with white dots. The sound, after about a minute, almost goes off and stays that way.—J. Lee (Hull).

It is possible, if the set was normal prior to the resistor replacement, that too much or too little heater current is being applied to the valves. Check the voltage across the tube and valve heaters to determine this. Too low voltage means insufficient heater chain current and would cause a negative picture. This would indicate the wrong value dropper resistor.

DECCA DM4

I wonder if the two rectifier valves PY82 could be replaced with a silicon rectifier.—L. Greig (London, N.8).

It is a good idea to replace the paired rectifiers of the Decca DM4 with a silicon diode, as poor h.t. was one of the faults which caused many of the problems with this receiver.

You should use a BY100 with a series 25 Ω 5W resistor, connecting one end of the resistor to the anode of the BY100, the other end of the resistor to the linked anodes of the PY82 valves. Then disconnect the lead from the reservoir capacitor to the PY82 cathodes, take it to the cathode of the BY100 (cathode is the lead that joins to the outer casing). Leave the valve heaters in circuit to maintain correct heater drop, but do not connect across the h.t. line, as the usual fault with these valves, horizontally mounted, was flashover.

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This coupon is available until APRIL 21st, 1967, and must accompany all Queries sent in accordance with the notice on page 328.

PRACTICAL TELEVISION, APRIL 1967

TEST CASE -53

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.

? *The trouble on a six-year-old Decca was generally low performance, which one might expect for a set of such age. The width was a little down, the picture definition not too good (though not particularly bad!) and in particular the field lock was very weak and critical.*

Thus, excepting the field lock trouble, the set was behaving reasonably normal for its vintage. Tests were thus made of the sync separator and components from the sync separator to the field timebase generator and all appeared well. No improvement at all could be obtained on the lock.

What vital factor was overlooked? 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 52

Page 284 (last month)

The clue to this problem was in the first sentence of last month's Test Case. Namely, implying that the trouble occurred after repairs in the power supply input circuit.

Actually, the repair constitued replacing the volume control and mains on/off switch. In many receivers the on/off switch is arranged in such a manner that the tube control grid is connected to the set side of the pole of the on/off switch (a double-pole switch always being used) returned to chassis.

Thus, when the set is switched off the grid is caused to go positive relative to the cathode, an effect which speedily discharges the e.h.t. reservoir capacitor by a momentarily high beam current, thereby eliminating the lingering spot effect in the centre of the tube.

Examination to the switch wiring revealed that the tube grid wire was inadvertently connected to the 'live' pole of the switch so that when the set was on, a.c. ripple was applied direct to the grid—an effect, which would most certainly result in a severe hum bar.

Rearranging the switch wiring so that the grid wire was connected to the 'earthy' pole cured the trouble.

This problem highlights the need to make absolutely sure of all connections on the four tags of the on/off switch when replacing the volume control.

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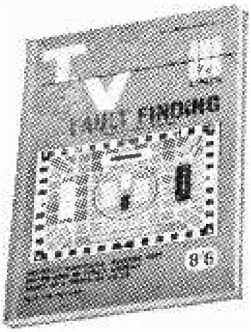

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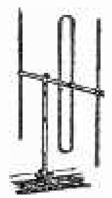

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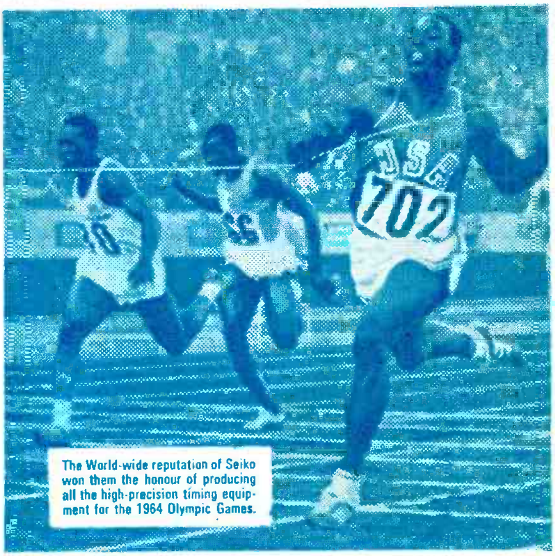
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