PRACTICAL
TELEVISION

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APRIL 1969

THE PTV VIDEOSCOPE

also inside
UNDERSTANDING COLOUR FAULTS

PRACTICAL
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APRIL 1969

What Substitute?

IF WE were commercial TV advertising copywriters this would be the opportunity of a lifetime. Imagine the possibilities—"This is it, folks, the BIG one!" . . . "Practical Television now comes to you in the large economy size pack" . . . "PT uses paper whiter than white" . . . "Get the strength of our Query Service around you" . . .

There is, however, one that we'd like to borrow in all seriousness and that is "You know that Practical Television makes sense"! With the larger page size, more attractive layouts will be possible and articles will be easier to read, as will some of the larger circuit diagrams.

PT has held a unique position in the technical publication field since the bold move to launch it in the early 1930s. Since then, despite a few rough passages due to prevailing circumstances (mainly a World War), it has reflected and commented on all the major technical trends through the years. It was as up-to-date in 1934 with its constructional articles on scanning discs as it is today with the latest and authoritative articles on colour television. In beginning this new chapter in the life of PT we make one concession to our convictions. From here on we abandon c/s and kc/s etc. for Hz, kHz; we disagree with the change as a change, but the whole of industry has now swung over, as have nearly all other periodicals (some, like us, simply to avoid rocking the boat).

Finally, to return to the dreamworld of the "commercials," it would be appropriate to borrow another famous old cliche: "Look for the genuine label—Accept No Substitutes." What an idea! There *is* no substitute for PT; it is still the only magazine you can buy on the bookstalls which is devoted almost exclusively to the technical aspects of television!

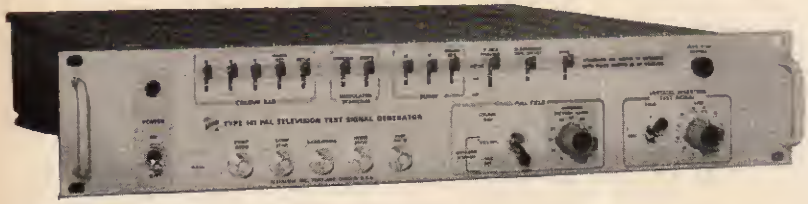
W. N. STEVENS, *Editor*.

THIS MONTH

THE NEXT ISSUE DATED MAY WILL BE PUBLISHED APRIL 18

TELETOPICS

PAL COLOUR TV TEST SIGNAL GENERATOR



Type 141 PAL TV test signal generator marketed by Tektronix UK Ltd., Beaverton House, Station Approach, Harpenden, Herts. provides high-quality TV test signals for 625-line 50Hz field standard PAL colour TV systems. Three operating modes provide PAL colour bars, a five-step staircase with fixed-average picture level and the same staircase with variable a.p.l.

The colour-bar output is a full field test signal appearing on every active line and consists of EBU 75% amplitude, 100% saturated colour bars in descending luminance order with white on the left and black on the right, PAL colour burst with four-field blanking sequence to CCIR specifications and composite sync and blanking. The staircase signal is keyed on during a selected line of the vertical blanking interval (lines 11-22 on field 1 or lines 324-335 on field 2). The last step—at white level—is double width so it can be viewed with and without subcarrier to detect clipping in the white direction.

Normal PAL colour burst is provided on the staircase and colour-bar signals. The four-field burst blanking sequence during the vertical interval may be switched out if desired. A 1MHz reference signal frequency locked to the 4·43361875MHz PAL subcarrier oscillator is provided. The accuracy of the internal subcarrier oscillator may be conveniently verified by comparing the 1MHz reference with known frequencies e.g. Droitwich 200kHz transmissions. Outputs provided on the front and rear of the instrument are: composite PAL video, composite sync, subcarrier, horizontal drive, vertical drive, burst flag and reference signals of 12·5Hz, 25Hz and 1MHz.

CCTV VIDEOTAPE RECORDER

Recently announced by Ampex International, 72 Berkeley Avenue, Reading, Berks., is the VR-5103 closed-circuit videotape recorder. It is capable of recording and playback in the US standard of 525-lines at 60Hz as well as the European standard of 625-lines at 50Hz. Working voltages are 80-140V and 190-250V. Fast forward and rewind time is 4 min. and remote control connections are provided for play, record and stop. The video frequency response is 3MHz and horizontal resolution is 300 lines.

ANOTHER MULTIBEAM

Following the introduction of their Multibeam aerials (Teletopics March 1969) J-Beam Aerials Ltd. announce the addition to the range of a smaller model, the MBM30. This consists of a Parabeam radiator and reflector with seven four-element multiple director units. The makers claim that the Parabeam radiator and reflector system with seven multiple director units has slightly superior performance to a Parabeam eighteen with little more than half the cross-boom length. The price is £3 15s.

UK COLOUR TV LICENCES

78,270 colour TV licences were taken out during 1968, the GPO announced recently. The monthly increase was about 8,000 in the final quarter of the year compared with 5,000 earlier in the year.

COLOUR TV SET SALES TOP MONO IN US

The Electronic Industries Association has produced preliminary figures for the 1968 sales of TV, radio, record and tape equipment by US manufacturers. All showed some increase over 1967 figures.

Colour TV sales had a record year with sales up from 5·22 million sets to 5·83 million. This for the first time was higher than monochrome sales. The total sales of monochrome sets advanced from 5·43 million to 5·56 million.

JAP COLOUR TV PRODUCTION

For the nine months to September 1968, Japanese statistics indicate that production of colour TV sets reached an all-time high of 1,779,131. This is a two-fold increase on the same period the previous year.

Nearly 550,000 colour sets were exported to the United States by Japan in the year ended April 1968.

MULLARD 22in. COLOUR TV TUBE

A 22in. ColourScreen television picture tube has been announced by Mullard Ltd. It is claimed to have a more rectangular and flatter faceplate than any other colour tube at present available. Coupled with the tube's push-through presentation, this makes for greater freedom in cabinet styling and viewing comfort.

LATEST ITA STATIONS

The ITA announces that the new low-power TV transmitting station at Ffestiniog, Merioneth, North Wales was officially taken into service on February 28th. The station relays the Harlech TV programme for Wales from the ITA station at Arfon.

The Ffestiniog station transmits vertically polarised signals on Channel 13, Band III. Effective maximum radiated power is 100W vision and 25W sound.

Also announced is the transmitting station at Lethanhill, Ayrshire, Scotland, which came into service on January 31st. This station relays Scottish programmes from the main ITA station at Black Hill. The Lethanhill station transmits vertically polarised signals on Channel 12, Band III. Effective radiated power (mean over the main arc) is 2kW vision.

3-D COLOUR TV?

The Japanese Toshiba Company has recently devised special lasers that can make colour images using argon and krypton gases. Their long-life makes the possibility of using these lasers for 3-D colour TV a very real one in the future of TV.

ECTT COLOUR COURSES

With over 100,000 colour TV sets in use and over one million predicted for two years' time the shortage of trained engineers is becoming quite acute and is likely to get worse. Courses run by technical colleges and the manufacturers are heavily oversubscribed and a new organisation has been formed to give intensive training to service engineers. The company is E.C.T.T. (Electronic and Colour Television Training Ltd.) of 45 Walton Road, East Molesey, Surrey.

E.C.T.T. are running a number of courses for engineers of various proficiency and a preliminary course is even run on monochrome TV for those who need to brush up their knowledge before advancing to the very much more complicated subject of colour TV. For those unable to reach their training centre correspondence courses are being run and give the same training at a very reasonable cost.

CONCORD SETBACK TV PREAMP

The first back-of-set ultra broadband preamplifier to be produced commercially has been introduced by Belling-Lee with the name Concord. Transistorised and mains-operated the new preamplifier operates on all television channels and f.m. radio in Band II.

Housed in a grey moulded case approximately—5 x 3½ x 2¼in, Concord hooks on to the back of the domestic television receiver and is easily connected.

Belling-Lee claim a signal increase of more than four times and report that performance results are very good indeed, proving particularly useful in fringe or difficult reception areas. Recommended selling price is £7 7s.

BBC HANDBOOK 1969

Now published at 7s. 6d. is the BBC Handbook for 1969. The Handbook records the activities of the BBC during 1968, including the commencement of the BBC-2 colour transmissions, and reviews the programme for 1969. Full details of the BBC organisation are included, with Station lists, transmitter service area maps, etc. The Handbook is divided into six main sections: Television; Radio; Programme Services and the Public; External Services; Engineering; Reference.

BBC-1 & ITA IN COLOUR

Entitled "What the Viewer needs to know" the ITA Engineering Information Service has issued a news sheet explaining the plans for programme duplication on u.h.f. The ITA colour/625-line service is expected to open simultaneously at Crystal Palace, Sutton Coldfield, Emley Moor and Winter Hill stations about mid-November, with Black Hill, Rowridge and Dover stations expected to come into service a few weeks later.

This ties up with Lord Hill's statement in the BBC Annual Report published recently which suggests that colour/625-line programmes on BBC-1 will start at the end of this year.

LABGEAR UHF/VHF SIGNAL STRENGTH METER

Labgear Ltd., Cromwell Road, Cambridge, announces a transistorised, battery-operated portable u.h.f./v.h.f. signal-strength meter covering all British TV channels in Bands I, III, IV and V. The chassis is anti-vibration mounted. An easy-to-read meter (25μV to 1mV) is used and a plug-in attenuator is supplied as an optional extra. There is an automatic battery cut-out when the aerial feeder is withdrawn and the unit is fully stabilised against battery voltage variation. Size is 9½ × 9½ × 3¼in. and weight 5½lb.

The unit is provided with a carrying case and shoulder strap enabling the operator to make aerial adjustments while viewing the meter reading.

INSTALLING and SERVICING COLOUR RECEIVERS

PART 7

A.G. PRIESTLEY

UNDERSTANDING COLOUR FAULTS

WHEN you first start looking at colour TV you tend to be very impressed and uncritical. Then as you begin to gain experience you see pictures that do not look quite right but you are unable to say why. The difficulty lies in the fact that we have no absolute standard for comparison, and we have no means of knowing exactly what kind of picture is being transmitted.

Test equipment is of no use to us where fairly minor faults are concerned because it will not measure the kind of colour differences which are small in themselves but important to the human eye. The only substitute is personal judgment. This takes time to acquire and is based on the stored impressions of countless pictures which looked convincingly right and of others which looked equally convincingly wrong. As time goes by the area between these two extremes gets smaller and smaller until the stage is reached where it is possible to view any receiver and pass an accurate judgment. You are then an expert, or at least partially so. You know that the colours are faulty, but you must also know what the fault is and whether it is in the transmission or inherent in the receiver, or can be cured.

Here is a list of the basic faults in a colour receiver:

(1) Unbalanced colours.
(2) Incorrect ident.
(3) PAL switch stopped.
(4) Faulty Y (luminance) signal.
} *Distorted colour*

(5) Absence of R-Y, G-Y or B-Y drives.
(6) Absence of R, G, or B drives.
(7) No colour at all.
} *Missing colour*

Tube Drive Techniques

Before discussing how to set about diagnosing the cause let us first summarise the basic facts of colour life. Each gun of the c.r.t. is driven from two separate sources; the *luminance* and *colour-difference* channels. The luminance signal provides brightness information and the colour-difference signals provide the *extra* information which turns the monochrome picture into a full colour one. Thus a colour picture is in two parts as it were, and this is why it is impossible to get correct colour unless the monochrome picture is correct also. Figure 21 illustrates how the signals are applied to the c.r.t.

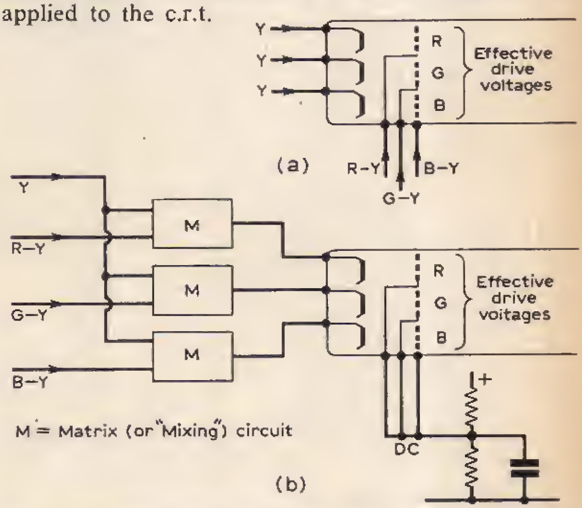


Fig. 21: Adding luminance (Y) and chrominance (R-Y. G-Y and B-Y) information to obtain a colour picture, (a) Colour-difference drive, (b) R, G, B drive.

The idea of adding extra information to a monochrome picture to turn it into a colour one is fairly straightforward, but there is an important point concerning the importance of *negative* colour-difference drive signals that deserves better understanding. Suppose we have a monochrome picture and we want to make it slightly red. All we have to do is to turn on the red gun a bit more, so the extra information could consist of a positive contribution from the R-Y colour-difference channel. So far so good, but what is happening to the other two guns?

Because the G-Y signal is obtained from mixing −(R-Y) and −(B-Y) signals in the appropriate proportions, part of any signal we apply in the R-Y channel to get our red hue will appear in the G-Y channel also but not, of course, in the B-Y one. Our red signal is therefore going to be partially spoilt by the presence of some spurious green, giving an amber colour.

In order to regain the pure red hue we originally expected it is necessary to provide a −(B-Y) signal in the B-Y channel. If this is of the correct amplitude it will appear in the G-Y channel as a signal equal and opposite to the unwanted R-Y one, and so will cancel it out. We therefore get no green output at the c.r.t. The −(B-Y) signal makes sure the blue gun is turned off by cancelling the luminance drive to the blue gun. Thus only the red gun is turned on.

So a simple matter of providing a red colour on the screen of the c.r.t. has become quite complicated. Note particularly the importance of *negative* colour-difference signals: they are just as important as the positive-going ones. The example we have just described also illustrates the principle of transmitter encoding.

An understanding of how luminance and colour-difference signals in combination drive a three-gun c.r.t. to produce a colour picture is one of the basic essentials of colour fault-finding.

First Check on Black-and-white

Before assessing a colour picture always check the monochrome picture first and make sure the grey scale is correct. Readjust it if necessary. This should be a compulsive routine procedure because small errors of grey scale will cause serious distortion to critical picture colours such as skin tones and will tend to invalidate any assessment of colour performance. This check also eliminates item (4) in our list of basic colour faults —a faulty Y signal.

Unbalanced Colour

Incorrect colour balance is probably the most common fault of all, but it may not come to your attention until the receiver develops a more obvious fault which causes the viewer to complain. Routine checking then shows that the colour performance is poor. Skies are too blue, or skin tones unconvincingly pink or green.

There are two basic causes of unbalanced colour. The first one, which is less likely, is misalignment of the decoder causing incorrect R-Y or B-Y outputs. It can be spotted immediately because any error of this kind which is sufficiently bad to cause visible colour distortion will inevitably be accompanied by venetian blinds. Blinds are symptomatic of phase or amplitude errors in the delay line matrix circuits, or phase errors in the reference carrier to the R-Y or B-Y demodulators or other forms of crosstalk between the two channels. If blinds are barely perceptible then the decoder is operating correctly.

The usual cause of poor colour balance in a picture is incorrect adjustment of the colour-difference drives to the c.r.t. The luminance drives to the cathodes of the three guns and the three first anode potentials have to be adjusted to cater for spreads in gun characteristics and different phosphor efficiencies in order to get a correct black-and-white grey scale. For the same reasons it is essential to adjust the ratios of the R-Y, G-Y, and B-Y drives in order to get correct colour balance. Furthermore since G-Y is obtained by matrixing −(R-Y) and −(B-Y) signals the matrix adjustment (where present) must be checked in addition to the G-Y amplitude adjustment. The procedure for setting up the colour-difference drives has already been described in detail earlier in this series of articles (see Part 3).

It is hard to over-emphasize the importance of correct colour drive. One hears so much about the need for good grey-scale tracking, and any errors are always so strikingly obvious, that one tends to concentrate on it to the exclusion of the equally important but rather more subtle defects of colour. Every time you see a picture which has poor colour performance but no component fault, first check the grey scale; then the colour-difference drives and G-Y matrix. Note the matrix. A small error will not produce an obvious and particular defect—just poor colour. This is especially true of skin tones. The G-Y matrix and amplitude settings are vital.

If, having carried out the adjustments, the picture is still poor colourwise, the odds are at least 20 : 1 that the cause and the cure are the same as before. Do it again. And again if needs be. If you are still not satisfied recheck the grey-scale tracking and be very critical of the highlight colour temperature. Is it illuminant C? You can only judge this in near total darkness because it will be distorted by the presence of artificial light or even daylight.

In any ordinary, competent, design of colour receiver you *must* be able to get pretty good colour if these adjustments are properly carried out.

Incorrect Ident

There are two main faults which can occur to a PAL switch mechanism. The switch will either be working in the wrong phase, or it will have stopped completely. If it is switching in the wrong phase it is obvious that the identification (or ident) process is not being carried out. This means that most colours will not merely be distorted but changed in hue in a particularly and clearly defined manner. There will not be any blinds on the picture. Once you know what to look for the diagnosis is easy. First the symptoms, then the explanation.

If you look at the standard colour-bar test pattern you will find that an ident error produces the following effects:

Correct Ident	*Wrong Ident*
White	White
Yellow	Lime green
Cyan	Magenta (red/blue)
Green	Orange red
Magenta	Mid-blue
Red	Green
Blue	Mauve-blue
Black	Black

There is no halfway house with ident: either it is correct or it is not.

The reasons for the hue changes can be seen from the vector diagrams of Fig. 22. Since the

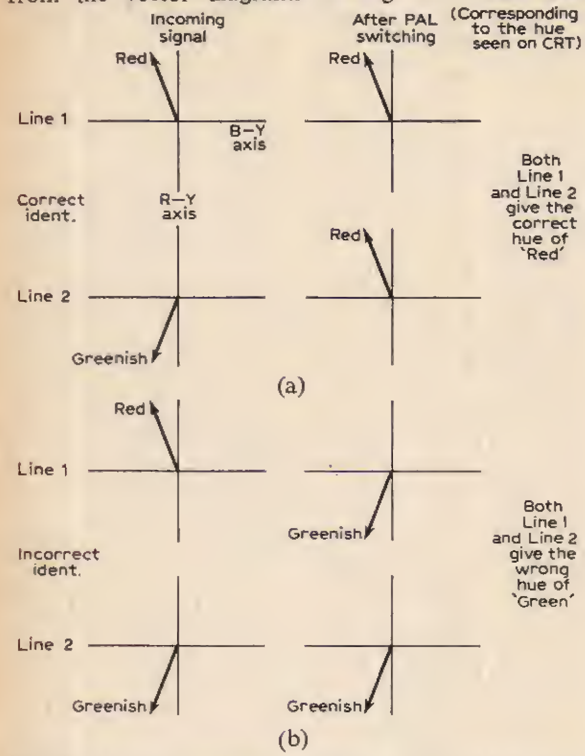


Fig. 22 : Vector diagrams showing why incorrect ident results in a hue which is the mirror image of the correct one. (a) Vectors under correct ident conditions. (b) Vectors under incorrect ident conditions. There are no blinds present on the picture when the fault is incorrect ident.

signal in the R-Y channel is being switched 180° (inverted) from line to line in sympathy with the transmission, the R-Y component of any particular hue being displayed will either be correct or inverted. The B-Y signal is not switched and so it stays the same regardless. Thus if the ident is incorrect a vector corresponding to a particular hue will be rotated about the B-Y axis to form the mirror image of the correct one.

Wrong ident means one of two things: either the ident signal is at fault, or it is not operating properly on the bistable circuit. This is obvious, perhaps, but clear thinking is the basis for all efficient fault-finding.

Tracing Ident Faults

To isolate the cause of the trouble connect a scope to the collector of the ident amplifier. This usually has a tuned circuit (at 7·8 kHz) and you will expect to see a continuous train of sinewaves of a peak-to-peak amplitude approaching twice the value of the effective h.t. rail. If the ident signal is absent or inadequate you have found the basic cause of the trouble. Connect the scope to the base of the ident transistor and see if an alternating train of trigger pulses is present. If so, the ident amplifier is faulty. If not, either there is a base-emitter short-circuit or the pulses are indeed absent, in which case you work backwards with the scope to find the fault. It cannot be far away because the a.p.c. loop is obviously in order (because colour is present on the screen of the c.r.t.) and this works off smoothed ident pulses derived from the burst demodulator.

If ident is present at the collector of the amplifier then the fault lies in the coupling to the bistable. We know that the bistable is working, from the appearance of the picture. Again, there are only a few components to check, and the comparison diode in the feed to the bistable circuit is the first candidate.

Once seen and understood ident errors are unmistakable. This is a case where a little experience turns an apparently obscure fault into an easy one.

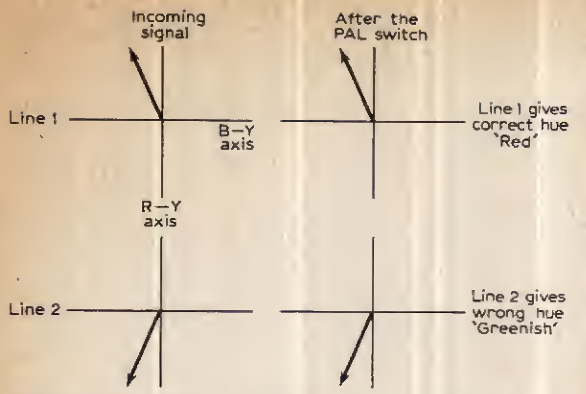
PAL Switch Stopped

It is important to be quite clear about the difference between incorrect ident and a faulty PAL switch action. Ident trouble shows up as a major change of hue of all colours except those lying on, or close to, the + and −(B-Y) axis, i.e. blues and yellows. No extra blinds are caused. If on the other hand the PAL switch stops, a major change of hue will occur to these same colours (except blues and yellows) but the hue change will be different *and serious venetian blinds will be present.* So the diagnosis is easy: hue change and no blinds—ident fault; hue change plus serious blinds—PAL switch fault.

Hue changes caused by lack of PAL switching are as follows:

Colour bars		*Hue Change*
White	stays	White
Yellow	becomes a striated	Lime/Green
Cyan	becomes a striated	Pale mauve
Green	becomes a striated	Lime green
Magenta	becomes a striated	Mauve
Red	becomes a striated	Yellowish colour
Blue	stays	Blue
Black	stays	Black

Each colour containing an R-Y component, which ought to be switched on alternate lines but is not, will consist of one line of the correct hue followed by one line of the mirror image hue as shown in the vector diagrams of Fig. 23. If you look closely you will be able to see the hue difference between consecutive lines of a field (or pairs of lines on the picture). A red hue will consist of two lines of red followed by two lines of green, and if you stand back a few feet the eye will integrate (add) these to give an overall impression of a



Alternate lines of a field are Red and Green in this example

Fig. 23: Vector diagrams showing why a stopped PAL switch causes the overall hue displayed to be the sum of the correct one plus its mirror image. The individual hues can be seen at close range and cause severe blinds.

greenish yellow. The same argument applies to all other colours in varying degrees, except +(B-Y) and −(B-Y), which contain no switched component and so remain unaffected.

If you want the simplest possible diagnostic test, here it is: red goes to green—ident fault; red goes to dirty-yellow plus blinds—PAL switch fault.

Tracing Faults in PAL Switch Circuits

Once again there are not many circuits involved in the PAL switch system of a normal design of decoder. A line pulse is fed through a pair of gating diodes to two transistors forming a bistable circuit and the square wave outputs from the two collectors are fed via two switching diodes to the primary of a coupling transformer together with the reference carrier. The switched carrier output, inverted from line to line, appears across the secondary. An oscilloscope is essential for rapid fault-finding. Check the following: (1) Are line trigger pulses present and reaching the transistors? (2) Is a square wave output present at each collector? (3) Is the square wave getting through the switching diodes? (4) Is a switched subcarrier output present at the transformer secondary? (5) Is there a reference carrier input to the switching transformer?

Somewhere along the line there will be an absence of line pulse, square wave, or reference carrier and this will isolate the cause of the trouble to a very small area of circuitry. See Fig. 24. Some notes later on in this series about tracing faults in individual circuits may come in useful when fault-finding in a bistable circuit. This may be new to many engineers, but being a go/no-go device it should not present much difficulty.

In some decoders the PAL switching is controlled directly by the ident amplifier without a bistable circuit being used; in others a ring modulator instead of a pair of switching diodes is used in the input circuit to the coupling transformer.

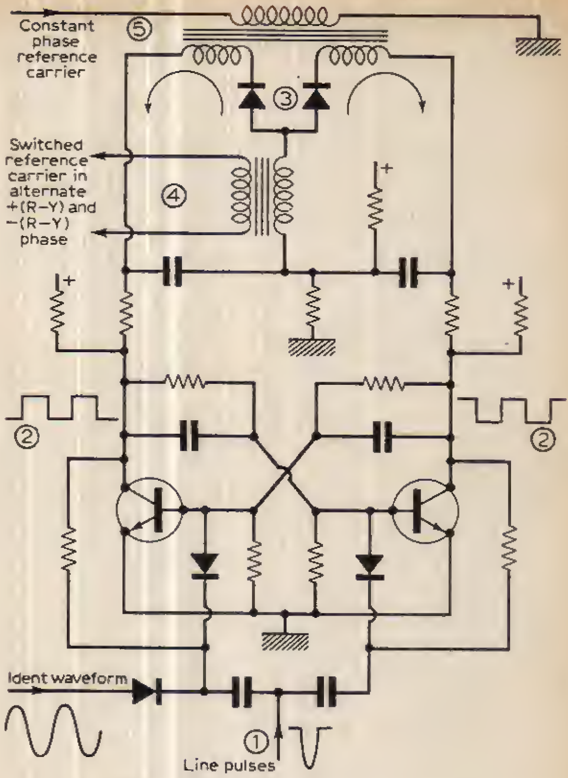


Fig. 24: A typical bistable PAL switch circuit. Five quick checks with an oscilloscope at the points shown will isolate the fault to a particular part of the circuit.

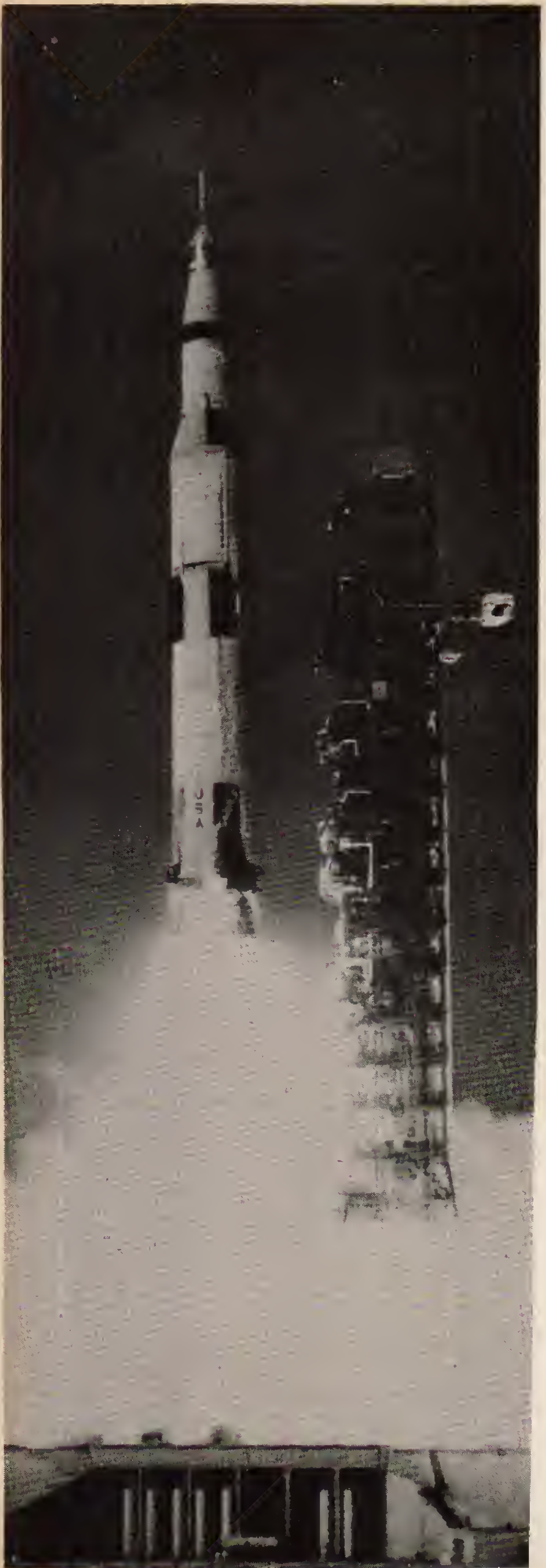
Next month we shall complete this outline of colour faults by dealing with the effects of faulty Y and colour-difference drive signals and then turn to the symptom of no colour and how best to track down quickly the cause of this trouble.

TO BE CONTINUED

Readers are invited to attend the Practical Wireless and Television Filmshow and Lecture at the Caxton Hall, Caxton Street, Westminster, London, S.W.1, on Friday, March 28th 1969 at 7.15 p.m.

The Lecture is about Colour Television and covers the setting-up procedure, dealing in detail with degaussing, purity, convergence and grey-scale tracking. The film is entitled "It's the Tube that makes the Colour" and describes the manufacture of Mullard "ColourScreen" TV picture tubes.

Free refreshments will be served during the interval and free tickets may be obtained by sending a stamped, addressed envelope to: FILM SHOW, Practical Television, IPC Magazines Limited, Tower House, Southampton Street, London W.C.2.



THROUGH the eye of an RCA 4·5lb. TV camera millions of viewers around the world journeyed with the three astronauts on their Apollo 8 flight. The miniature TV camera, the result of two years' intensive work and experimentation by RCA, is an exact duplicate of the RCA camera which sent back the live TV pictures during the Apollo 7 earth orbit mission last October.

According to the Programme Camera Manager of RCA, Richard P. Dunphy, the Apollo 8 camera is a forerunner of even smaller TV cameras which are at present being developed for use when man lands on the moon, possibly later this year.

Transmission

The output from the Apollo camera was fed into a premodulation processor where it was frequency multiplexed with telemetry and voice data. The video was then fed into an S-band omni-aerial for near-the-earth transmission or to a high-gain S-band aerial for transmission from outer space. Electronic signal processing systems were situated at Merritt Island, Florida; Corpus Christi, Texas; Goldstone, California; and Madrid, Spain. Goldstone and Madrid were the stations receiving TV from the spacecraft. Here the signals were processed and relayed to the National Aeronautics and Space Administration Manned Spacecraft Centre for release to the major TV networks of the world.

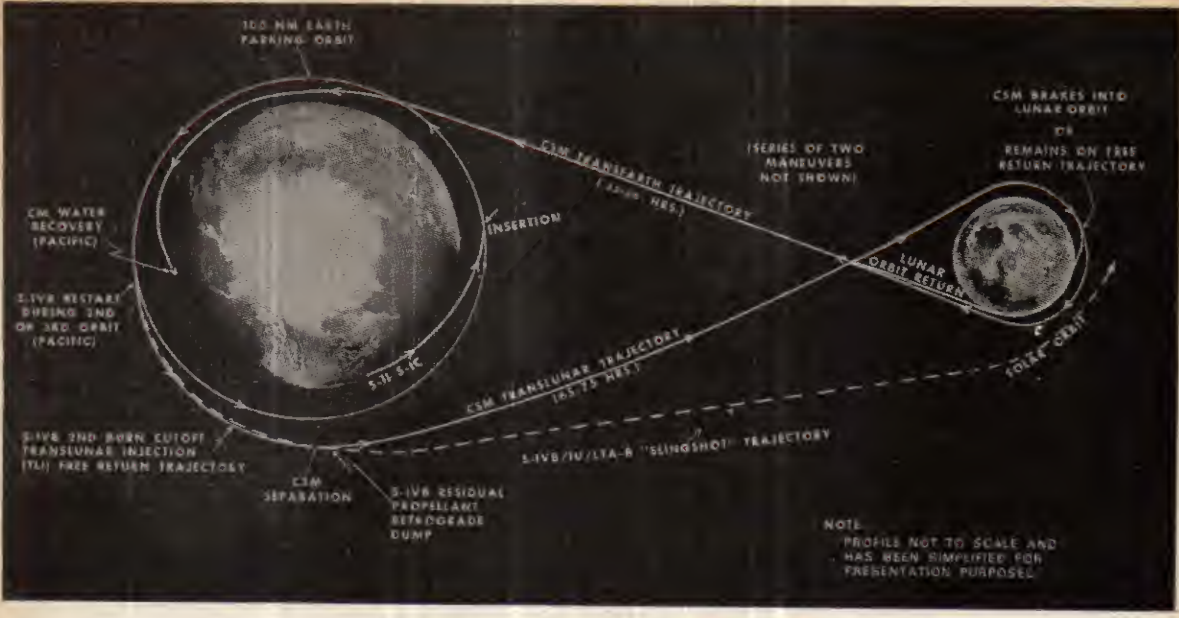
Camera

The tiny TV camera developed by RCA for N.A.S.A. uses a 160° wide-angle lens for on-board monitoring the astronauts and a 100mm. lens for viewing scenes outside the spacecraft. The use of integrated circuits enabled engineers at the RCA Space Centre in Princeton, New Jersey to make the camera some thirty times lighter and eighty-five times smaller than a standard black-and-white TV broadcast camera. And the Apollo 8 camera needs only 6W of power to operate compared with 500W needed for a studio camera.

As television viewers could see some difficulty was experienced with high light levels and stability of picture and the telephoto lens was not as simple to use as it should have been. However, considering the extremely difficult conditions under which the pictures were taken they were of very good quality.

Bandwidth

Because of the necessity to conserve weight, size and power together with the enormous distances the TV system used scanning standards different from those of normal broadcast TV. RCA developed the necessary ground station scan converters for the earth receiving stations. US commercial broadcast TV transmissions have a signal bandwidth of 4·5MHz (525-line system) but because of the spacecraft limitations Apollo's TV system was designed to operate with a 500kHz bandwith. This nine-to-



The flight trajectory of the Apollo 8 vehicle.

one reduction resulted in substantial saving in telecasting power but necessitated a field rate of 20 per second with 320 lines.

Standards Conversion

The signals received from Apollo 8 were applied to a TV display focused on to a broadcast vidicon camera and stored on the tube's photoconductive target. During each sixth broadcast field (US 60Hz field rate) the camera read out one field of video signal at the broadcast rate, the scanning beam of the camera being "gated off" during the next five broadcast scanning fields. The video signal field read out by the camera was fed to a magnetic disc recorder (a similar unit to those employed for "action replay" shots in TV sports broadcasts). The recorded broadcast-rate field then passed a read-out head and was read out five times before a new one was received from the vidicon camera and recorded. In this way conversion to the broadcast field rate for normal transmission was achieved.

Transmission Programme

In all six TV transmissions were beamed to the earth from Apollo 8. Two were transmitted en route to the moon, two from lunar orbit and the other two on the return journey to earth.

The third and the fifth television transmissions were

Here can be seen one of the technicians testing the tiny TV camera prior to the Apollo mission.

William Anders shows TV viewers his toothbrush during the first live transmission from the spacecraft on December 22 from a distance of 139,000 miles from the surface of the Earth.

This is one of the photographs that the astronauts took as they orbited the moon. The view is to the north west and includes the Gauchy Scarp in the foreground and rills in the background with the Gauchy Crater between them.

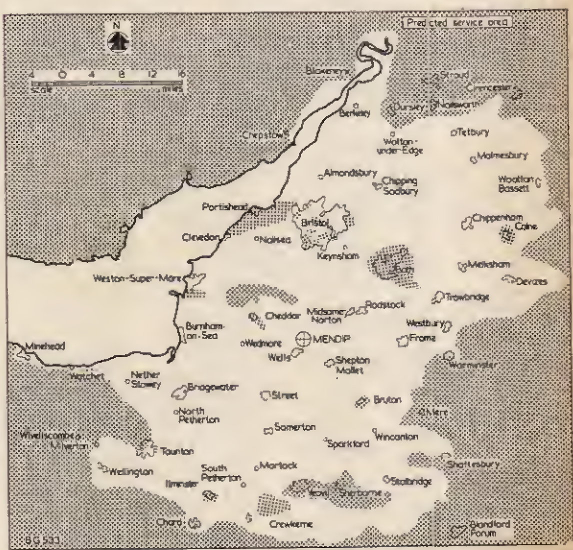
processed by the Spanish receiving station the other four being dealt with at Goldstone in California. The signals received in Spain were relayed to the Spanish earth station at Buitrago which then sent them across the Atlantic via Intelsat II F3 (Canary Bird) to Andover, Main and on to the Houston Space Centre via New York. It was the Spanish station which transmitted the pictures to Brussels for transmission over the Eurovision network.

The television camera used in Apollo 8 and the ground equipment at all locations except Corpus Christi were produced by RCA's Astro-Electronics Division. The scan converters were built under contract to N.A.S.A., the converters at Goldstone, Madrid and Merritt Island being newly delivered systems enabling N.A.S.A. to provide live TV from spacecraft for broadcast by the TV networks.

The RCA Space Centre also developed the camera systems used aboard the Ranger satellites which took the first close-up photographs of the moon's surface and the cameras on the Tiros, Essa and Nimbus weather satellites. ■

LATEST BBC-2 STATIONS

Hannington: Channel 45, horizontal polarisation.



Mendip: Channel 64, horizontal polarisation.

SERVICING television receivers

L. LAWRY-JOHNS

THORN 950 AND 960 CHASSIS

THE 950 chassis employs a very similar circuit to the 900 chassis which was the subject of a previous article in this series (see August and September 1968). However, variations to the basic chassis and differences brought about by the introduction of the semiportable models warrant further discussion.

The main electrolytic capacitor unit seems to be failing more regularly now, giving rise to various symptoms from poor sync, curved verticals, pronounced hum etc. to more obsure troubles such as weak field lock on 625 only (check the video stage carefully before changing the block however).

The block itself is on the right-hand side and has five wrap-round tags. When fitting a new unit the leads should be soldered otherwise they will almost certainly fracture if an attempt is made to rewrap them. The correct replacement capacitor will have the colours clearly marked to coincide with the leads except the chassis tag which is plain. The screening division member which is across the chassis is secured by a screw on either side and removal of this and the PY800 makes access to the smoothing block easier.

Line output stage

C98, C99 and C106 have proved troublesome, the first two causing no line scan or excessive width depending upon which fails and on what standard, whilst C106 shorts when the receiver is switched to 625 causing the timebase to cease functioning with probable damage to the v.d.r. (Z3).

An annoying effect is sometimes encountered and takes the form of a ripple on the picture according to the setting of the brilliance control. This is usually due to a fault in one of the e.h.t. rectifiers. The complete tray should be replaced. This is of course the tray which carries the three X80/150 pencil-type rectifiers.

Field timebase

Uncontrollable field roll can usually be traced to C79 (0·003μF). The working voltage of this capacitor is very important and nothing under 1,000V should be fitted.

Striations

These are vertical rulings, mainly obvious on the left side. Check W9 (OA81), the lead to tag 51 and the winding H-J on the line output transformer.

Lack of contrast

This can be due to a large number of factors but in making checks do not omit to try a replacement 30FL14 (PCF808) in the V4 position. Quite often attention is concentrated on the tuner unit and video

PRINTED BOARD SERVICING AIDS

Printed wiring between components is shown by colour-coded lines printed on the component side of the board.

White—Heaters & AC
Blue—Earth
Blue & White—Cathodes
Green—Grids & AGC
Red & Green—Screen Grids
Red & White—Anodes
Red—HT
Broken Red—Decoupled HT
Red & Blue—Boost HT

External connections to wire-wrap tags numbered to correspond with circuit diagram are also shown.

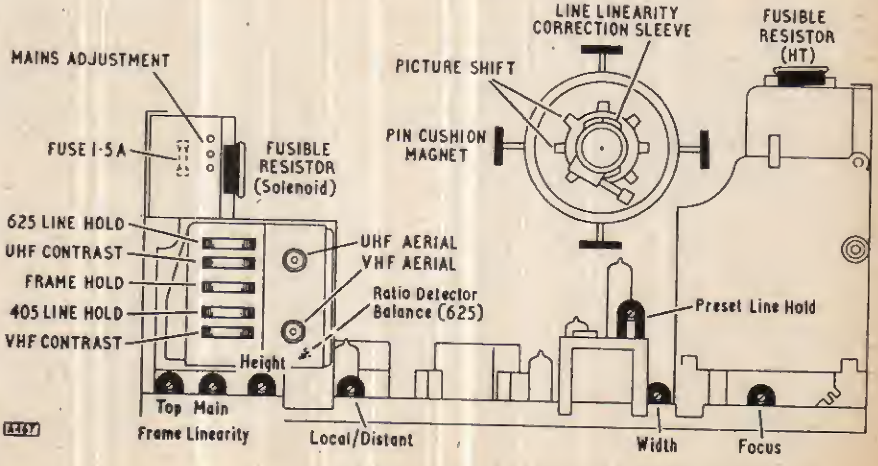


Fig. 1: Rear chassis view, showing preset adjustments.

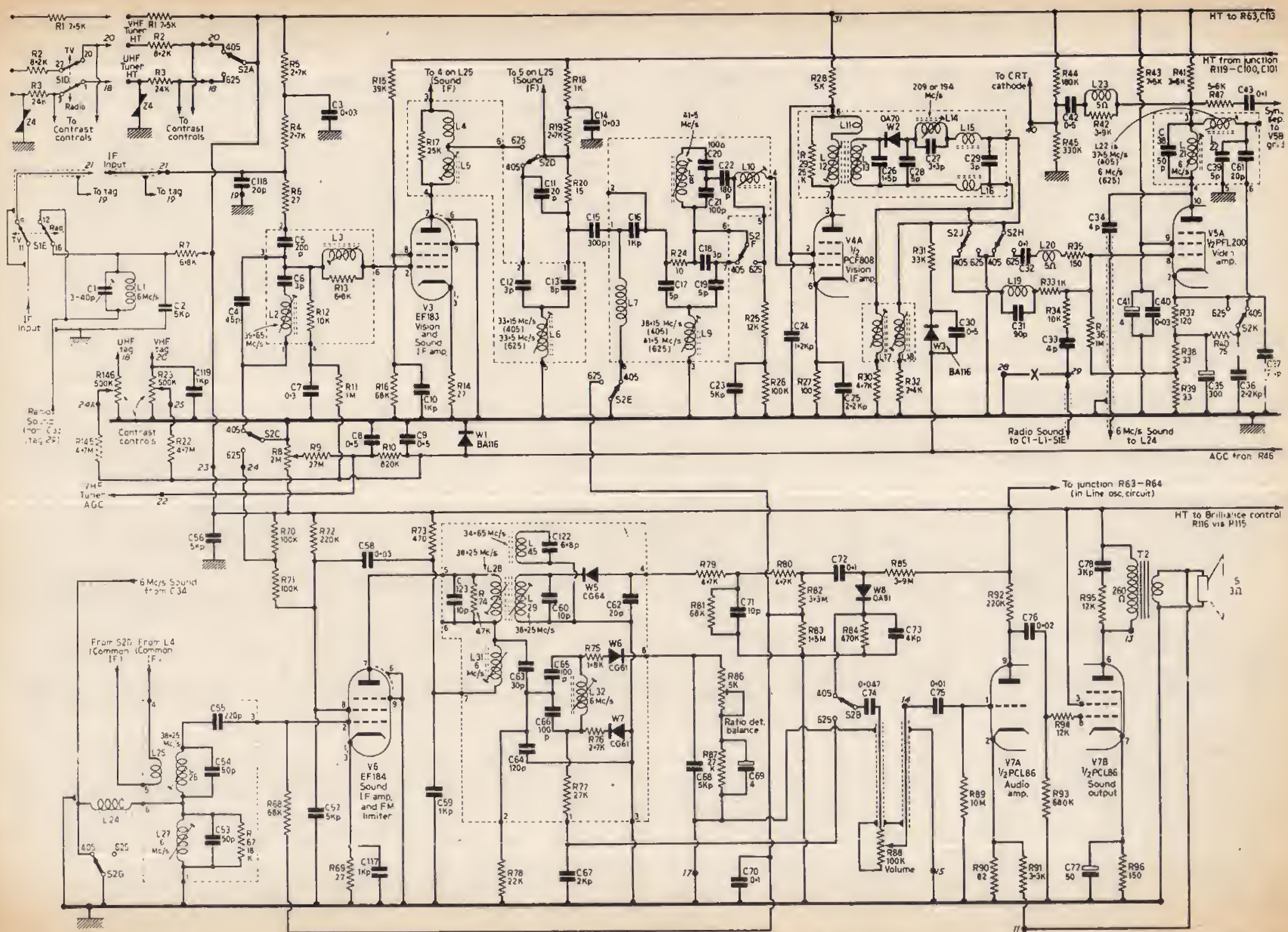


Fig. 2: Circuit diagram of the i.f., v.f. and a.f. sections of the Thorn 950 chassis. The physical layout is basically as shown in Fig. 2, page 511, in the August 1968 issue of PRACTICAL TELEVISION. *Parts of the circuit drawn in thinner lines apply to "plus radio" versions: points marked X are short-circuited on TV-only models.*

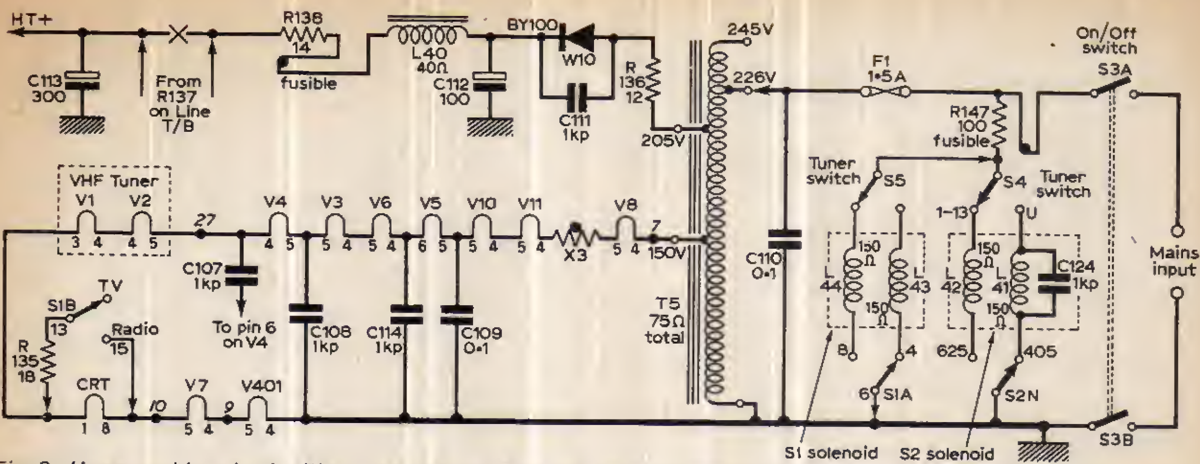


Fig. 3: Heater and h.t. circuits, Thorn 950 chassis. Note that different heater circuitry is used on the semiportable models. This will be shown next month. S1, L43 and L44 are on "plus radio" versions.

stage, the vision i.f. being neglected. So check V4 and also check R28 (5kΩ) which changes value quite regularly.

Tube faults

The majority of other common faults were outlined in the previous article including mention of low emission. We would however point out that many tubes have been condemned when in fact a check at pin 3 of the tube base would have revealed a low voltage. The supply resistor is R121 (3·9MΩ) and this is decoupled by C93 (0·1μF). C93 can become leaky or short completely, virtually shorting the tube first anode to the h.t. line.

It is far from unknown for the tubes to develop two other defects which would normally cause them to be discarded. The fact that a tube has an open-circuited heater is usually regarded with head shaking as "well, that's it." This is not necessarily so. Quite often the internal break in the heater can be welded by the application of a brief pulse from the top cap of the PL500.

We hasten to add that this operation must be very carefully carried out for several reasons. The first is the possibility of damage to the person doing the job, the second the possibility of damage to the line output transformer and the third the probability of destroying the tube heater completely.

The operation should be carried out as follows. Remove the tube base socket. Short pins 1 and 8 of the socket to preserve heater continuity. Connect a lead from pin 1 of the tube base to chassis. Allow the set to warm up. Using a very well insulated lead, touch one end to the PL500 top cap and the other to pin 8. An arc will be seen inside the tube neck. Do not repeat unless it can be proved that the heater is still open-circuit. Only the briefest of brief touches is required. By this means tube replacement may in some cases be postponed for a considerable period. In others the operation may be quite unsuccessful. This pulse application is often recommended for clearing shorts but not so often for internal welding of open-circuit electrodes.

The other common defect causes a very very dim raster to be displayed which is completely unaffected by operation of the brilliance control. This indicates an open-circuit grid. Proceed as before but join pin 7 (cathode) to chassis instead of pin 1. The pulse should now be applied to pin 2 or 6 (both grid). If successful this may not only restore full control of brilliance but also a marked increase of emission due to the disturbance of the cathode coating. Considering the alternative of discarding the tube completely, this is indeed a bonus!

Solenoid switching

The foregoing notes apply equally to the 900 and the 950 chassis. The main differences concern the system switching and in the case of the 960 semiportables the heater supply. The mechanical operation of the system switching in the 900 chassis was replaced by solenoids. In the 950 models these are mounted on the right side so that they push or pull the bar along. They are energised by the supply switch S4 on the rear of the v.h.f. tuner and de-energised by S2N on the system switch.

S4 is fed from the on/off switch via R147 (100Ω) which is there not only to limit the current through the solenoids but also to operate the cut-out in the event of a short or failure of switching in the solenoids. The cut-out is reset by joining the two wires and applying a soldering iron. Do not wrap a wire round the join as this could cause quite serious damage.

The writer has on more than one occasion found that the receiver functions perfectly well on 405 but that R147 becomes overheated and opens the cut-out when switched to 625. This has been found to be due to the orange lead to the actual solenoid being pinched under the chassis with the insulation

—continued on page 311

letters

Wake up trade!

Congratulations on your hard-hitting editorial (PRACTICAL TELEVISION—February issue).

I endorse your comments and can only hope that the trade will "wake up" in time to cash in on Colour.—**R. J. le H. Powditch** *(Electronic & Colour Television Training Limited, Surrey).*

Converting 405 sets to 625

I have read with interest the articles by K. Cummins in the January and February issues on converting 405-line sets for 625-line reception and if the steps described are taken I am sure that the end results will be first class. But I would like to mention that with the right type of receiver considerably less need be involved to achieve good BBC-2 operation, using only a u.h.f. tuner and eliminating the conversion kit. To illustrate my point I quote my own experiences.

I was particularly lucky in obtaining a second-hand Ferranti T1001 14 in. receiver for £2 10s. 0d. some time ago. After replacing the U25 e.h.t. rectifier this was in excellent working order and I found it to be extremely adaptable and versatile. It will receive BBC-2 as well as the ITV and BBC-1 programmes with little more than the addition of a u.h.f. tuner.

The circuit of the receiver is basically unchanged from when it was new some 12 years ago. The range of the line hold control had to be increased of course and this was easily done by shorting across the 270 kΩ resistor in series with it. The result is that the range now covers from 405 to 819 lines +! On one occasion I did manage to resolve a complete 819-line French picture on Channel 8 during an evening of freak reception, albeit somewhat lacking in brightness and width. However for 625-line operation it is excellent with plenty of brightness in hand, adequate width and good stability.

As regards the introduction of the u.h.f. signal to the receiver stages, the u.h.f. valve tuner needed slight modification of the oscillator section and the i.f. coil in order that the output frequency matched the lowest frequency in the v.h.f. tuner, i.e., Channel 1. When switched to this channel the output cable from the u.h.f. tuner is plugged into the aerial socket of the set and the v.h.f. tuner in effect acts as extra i.f. stages, the fine tuner being adjusted to get the best sound consistent with vision. This is done of course after the u.h.f. tuner control is adjusted to the correct channel.

Due to the fact that the sound and vision characteristics of the new standard differ from the old one it may seem surprising that anything is received at all by this means. However by a little fiddling around it is amazing what can be achieved. To resolve the sound at good strength I found that substituting the 30F5 first sound i.f. valve with an EF184 and slightly adjusting the sound i.f. coil slugs did the trick, and the fact that on u.h.f. the sound is frequency modulated does not affect the quality.

The vision section was no more difficult to adapt. The negative picture problem was very easily solved without alteration to the circuit. This set is of the type whereby the picture will turn negative by overloading if the contrast control is turned up beyond a certain point, therefore I reasoned that if a positive picture can turn negative by this means, why not vice versa? (This is of course assuming that the signal strength is sufficient to cause the set to overload, as is the case in my locality.) This in fact does happen and in practice the control has to be turned *down* some way from maximum, as does the volume control, otherwise the picture becomes unstable and the speaker resonates with a loud whistle. The vision i.f. coils were also slightly retuned as a final step to ensure that good sound and vision are

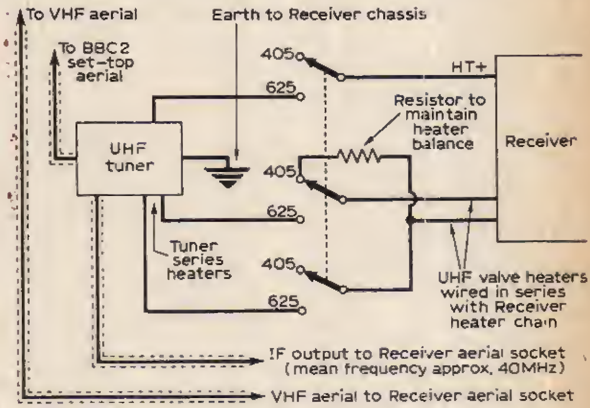


Fig. 1: Simple 405-625 power switching arrangement.

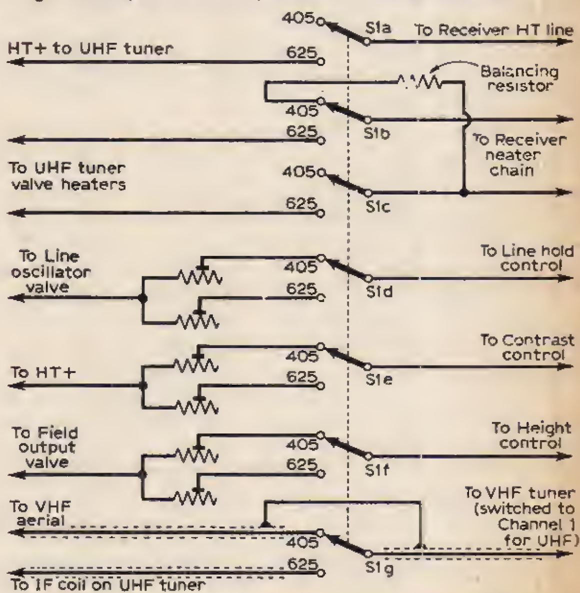


Fig. 2: Suggested system using multisection switch.

consistent with each other. Any further adjustment can be made by the v.h.f. fine-tuning knob on the receiver.

After the steps I have described were carried out I fully expected the BBC-1 and ITV reception to have suffered but apart from the tuning being more critical the quality is more or less the same as before. Of course what must help considerably is the fact that I live in a favourable locality where the signal strength of all three stations is high, being situated only about 5 miles from the Tacolneston transmitter (Channels 3 and 55) and 20 miles from Mendlesham (Channel 11).

When changing from one system to another I use a simple power switching arrangement which I have illustrated (Fig. 1), plug in either the v.h.f. aerial or the u.h.f. tuner i.f. output, whichever is needed, reset the contrast and line hold controls and for some strange reason *increase* the height for 405-lines and *reduce* it for 625-lines. I see no reason why these operations cannot be carried out simultaneously by the use of one multisection switch (Fig. 2) and a few preset resistors, but so far I have not tried this.

This set performs very well using a home-made set-top BBC-2 aerial and apart from an initial warm-up drift, which can be corrected by the v.h.f. fine tuner on the set, will give good steady results for any length of time. I have used this set successfully in this manner for nearly two years now with no trouble save for one fuse blowing and the need to replace a faulty valve in the v.h.f. tuner. When you consider the age of the set and the extra demands made upon it I feel it does credit to the "old timers" and it shows what can be done with the minimum amount of alteration and cost with the right sort of set. The cost of the set and the conversion materials amounted to less than £5.—**M. G. Jackson** *(Norfolk).*

(*We feel you have struck lucky with this chassis! For others wishing to try this conversion the Ferranti Model T1002 is the 17in. equivalent while Ekco models fitted with a similar chassis include the T326, T327, T330 and T344. Many other later Ferranti and Ekco models were fitted with similar chassis.*—TECHNICAL EDITOR.)

I am writing concerning your articles on 405 to 625 television conversion. I carried out this type of conversion on three receivers when BBC-2 started in 1964 and they are still giving good service. I feel that Mr. Cummins has made the conversion sound a bit complicated with line blanking and brightness equalisation which I have not found necessary. Also when feeding the a.f. from the 625 i.f. board to the volume control—why not leave the volume control where it is if it is already in the triode grid circuit because all you have to do on 625 is to turn the volume control down?

Regarding increase of h.t. for the line timebase again I have found this unnecessary. From my experience the heater of the e.h.t. rectifier is under-run on 625 rather than over-run causing lower e.h.t. which alters the focusing and increases the height.

My own set, a Decca DM17, has been working under these conditions for four years.

I would be willing to help anyone who wants to perform this conversion and comes up against problems.— **A. H. Rushton** *(London).*

These bands are ours !

From a report appearing in *The Engineer* for 11th October 1968 it is understood that Mr. J. R. Brinkley of STC is urging that the lower limit of the u.h.f. band allocated to business radio should be extended downward from 450 to 420MHz.

The bands from 425-429MHz and 432-450MHz are and have for many years been allocated on a shared basis to the Amateur Service and other users.

This portion of the spectrum which Mr. Brinkley wishes to annexe is extensively occupied both by communications stations and some 70 privately owned television transmitters in all parts of the United Kingdom.—**D. S. Reid** *(P.R.O. British Amateur Television Club).*

What's wrong with the trade ?

I have read your editorial (February) with interest and would like to point out the following facts: (1) There has over the past 12 months been a drastic shortage of new sets to small retailers. (2) Faulty new sets from the manufacturers have been the rule rather than the exception—at least this is my experience—and if this is so with monochrome sets I shudder to think of the colour sets.

During a recent conversation with a manufacturer's service department I was advised to leave colour alone for at least another year for the following reasons: (1) None of the manufacturers have produced a reliable set. (2) At the end of this year all will go ahead and produce single-standard models. (3) The initial cost of equipping a service department is between £600 and £1,000 and will take too long to recoup. (4) When TV engineers are paid a reasonable rate for their knowledge and work you will get good engineers to stay in the trade and not lose them to industry or other jobs.

It is time the idea that a service department is lucky to break even was disposed of and the engineer paid what his skill and experience deserve, and that a service department was admitted to be a paying proposition.

There is at present no foreseeable bonanza and the unreliability of new sets, not only colour but monochrome, make it a very hazardous business for the small man, with S.E.T., C licence, road tax, wages and all the rest. The TV business is no good to anyone other than the rental organisations who I think indulge in colour mainly for prestige.

In closing I would suggest that it is time that TV engineers had their own trade union separate from any other.—**S. G. Woodbridge** *(Middlesborough).*

VALVE & COMPONENT OVERHEATING

PART 2

G.R. WILDING

PROBABLY the most common case of valve overheating outside the line circuit is that of the field output pentode, a PL82, PL84, PCL82 or PCL83 in older receivers and a PCL85 in current models. Coincident symptoms are insufficient height with a cramped base to the raster that progressively gets worse as valve temperature becomes excessive. In most instances valve replacement will be found to work at normal temperature and cure all symptoms, but in many cases it will be found that valve failure was precipitated by a reduction in the value of the bias resistor thereby causing excessive anode current which in turn further reduced the value of the cathode resistor. Obviously unless the cathode resistor is replaced by one of correct value the new valve will be short lived and also produce the symptoms in a milder form, the extent depending on the resistor's value change.

When making voltage tests it is easy to assume that the grid coupling capacitor from the anode of the triode generator is leaky since usually a distinct positive voltage will be found on the pentode grid. However, even a new pentode running for some time grossly underbiased can develop a positive grid potential due to the liberation of gas molecules from the electrode structure making the valve slightly soft. To show that such a positive voltage has not leaked through the grid coupling capacitor, remove the valve, short the valveholder heater pins with a 50Ω resistor or wire link, then check the grid socket for positive voltage on subsequently switching on. Only extremely rarely will there be a d.c. potential present to prove the capacitor faulty.

Automatically, therefore, when the field pentode runs excessively hot check the cathode resistor for being mainly of carbon composition they reduce in value after years of service or when subject to abnormal current.

Audio & video output valves

The same reasoning applies to sound output pentodes, and to the PCL83 in particular. Whenever sound distortion occurs and this valve is running excessively hot, measure the value of the cathode resistor.

As with line output pentodes, failure of anode voltage will result in a screen current sufficiently high to make the screen grid winding glow, but as this would usually be the result of an open-circuit transformer primary winding—a very rare occurrence—it is seldom evident.

In older receivers employing an EF80 video amplifier internal short-circuits, especially from grid to screen, were quite common and generally resulted in the screen feed resistor, vision diode and video cathode resistors all being burned up. However, the PCL84 valve that generally superseded the EF80 in this stage and the PFL200 now commonly found in current dual-standard models are free from such interelectrode shorts.

Heater-cathode shorts

Cathode-heater short-circuits, particularly in valves or rectifiers with large heater voltages and placed high in the heater chain, are a common cause of the mains dropper resistor drastically overheating and of course also over-running the heaters of all the valves between the a.c. feed from this resistor and the defective valve. Furthermore, if the faulty valve has a cathode resistor, this will also be burned up.

Quite often if incorrect receiver fuses are fitted the severity of a heater circuit short-circuit will burn out a section of the dropper resistor or cause the thermistor to crack and thus disconnect the feed. Even if not burned out, a prolonged and heavy short-circuit current will invariably damage the component so that the lead-out wires make only imperfect or intermittent contact while the body of the component will crumble at the least pressure.

Heater circuit silicon rectifiers

In those receivers employing a silicon rectifier in series with the heater circuit a short-circuit in this component will cause all the valves to be grossly over-run and may continue to do so without the set user being really aware that a fault condition exists. Picture brilliance, contrast levels and volume will all be above normal but without any real defect being apparent, although in some models the excessive temperature of the sound output valve may produce sufficient distortion for the owner to complain about it.

In those Bush-Murphy models using a BY101 in this arrangement, however, it becomes impossible to use the receiver should this rectifier develop a short-circuit as uncontrolled field slip will develop. This fault indication is accomplished by feeding the screen of the sync separator from a point on the rectified heater chain (after the necessary smoothing by a *CR* combination) instead of via a dropping resistor from the h.t. rail. Should the BY101 develop a short-circuit the heater current will be pure a.c. and the voltage at the sync separator screen will then also be a.c. instead of d.c. thus constantly tripping the field timebase. When the BY101 is replaced, therefore, correct polarity must be observed, that is with anode to the a.c. feed from the dropper resistor to provide the necessary positive output from its cathode.

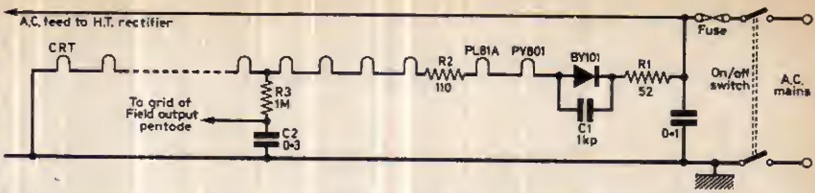


Fig. 3: Heater circuit with rectifier used in the Thorn 980 chassis. Bias for the field output pentode (30PL14) is tapped from the unidirectional (pulsed-d.c.) heater current and smoothed by R3 and C2.

Field output stage bias

In the Thorn 980 series of portable models a BY101 is placed in the heater chain (see Fig. 3) to reduce heat dissipation inside the cabinet, but this time with connections reversed to give a negative rectified output. Polarity is reversed to provide a negative bias for the pentode section of the 30PL14 field output valve without the need to include a resistor in the valve's cathode lead. This has two advantages. First there is a worthwhile gain in effective anode h.t. since any bias developed across a cathode resistor must be deducted from the available h.t., while secondly the absence of a cathode resistor and decoupling capacitor ensures that there can be no negative feedback loss from this point. Should the BY101 go short-circuit in these models absence of bias plus the simultaneous injection of a small a.c. voltage to the pentode grid would immediately result in reduced height and bad linearity to instigate a service call.

It must not be assumed that BY100s or BY101s often break down in this heater circuit usage, but the possibility must always be considered.

Mains dropper safety precautions

A point worth noting in these Thorn portable receivers is that the mains dropper resistor is split into two sections, one of 52Ω in the conventional position and the other of 110Ω placed immediately after the first two valve heaters (the usual boost rectifier and the line output pentode). Of all valves these two are most likely to develop a heater-cathode short-circuit and by placing them after the heater circuit BY101 any short-circuit current would be limited only by the rectifier's forward resistance plus the 52Ω resistor in its cathode lead. Such a heavy current would blow the fuse with more certainty than if the 110Ω section was also included in the feed to these two heaters and at the same time this latter resistor is completely protected from possible damage unless other valves lower in the heater chain break down.

Hybrid receivers

In hybrid receivers where the transistor power supply is developed across a resistor or resistive network at the earthy end of the heater circuit a short in the BY101 would raise this transistor l.t. supply although since the resistance of the valve heaters would be raised by the excessive current they would absorb the greater proportion of the excess voltage. The effect would be much more serious if the resistor across which the transistor l.t. supply developed went open-circuit, for then almost the full mains voltage would be developed across the resistor and thus also across the transistors. Fortunately the electrolytics shunted across the transistor l.t. rail and chassis are of low working voltage and would certainly break down under the greatly increased voltage thus virtually short-circuiting the l.t. rail.

HT shorts

When surge limiters moderately overheat with only a small reduction in rectified h.t. voltage the almost certain cause is a partial short-circuit across the h.t. rail. This could be due to a variety of causes It could be an internal short-circuit in a valve, with the shorting electrode fed via a medium-value resistor from the h.t. rail, a short-circuit decoupler similarly resistive fed from h.t., or a shorting solder blob in a printed circuit receiver. The first move is to look for charred or discoloured resistors: this will generally reveal the defect quicker than meter tests.

When the surge limiter gets red hot, implying that the short-circuit is directly across the h.t. rail before or just after the series smoothing choke, it is essential to locate the cause with the set switched off to avoid permanent damage to the rectifier. The surge limiter will need replacement anyway otherwise it is sure to go open-circuit within a short time. The first move is to determine whether the short-circuit is greatest on the rectifier or set side of the smoothing choke. If greatest at the rectifier end the only possibility is that the reservoir capacitor is defective, but if as usually occurs the short-circuit

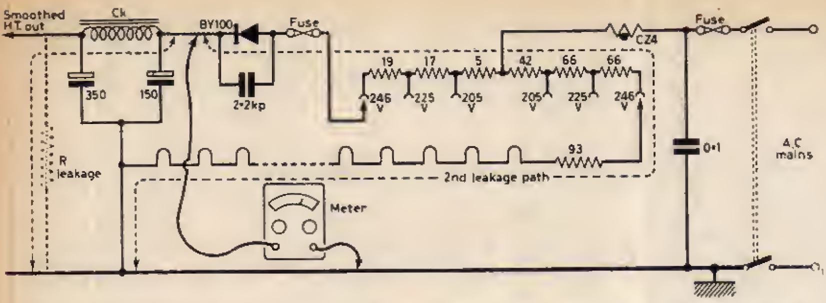


Fig. 4: Typical heater and h.t. power supply circuits. When testing for leakage across the h.t. rail and chassis remember that if the ohmmeter applies a negative potential to the BY100 cathode this will be forward biased and conductivity will be measured through the BY100 and heater chain as well as through any leakage.

is on the smoothed end there are many possibilities.

One of the main smoothing capacitors may be short-circuit but as electrolytic failures are rare look for charred resistors, but this time of low value and feeding h.t. circuits. It is possible for the winding of the smoothing choke or the primaries of the sound or field output transformers to short-circuit to core, but these possibilities are also rare. Instances do, however, occur, usually shown up by melting wax caused by the overheated winding.

Some internal valve short-circuits can put almost a "full" short-circuit across the h.t. rail, but to do so the electrodes concerned must be connected via low-value feeds to h.t. and chassis respectively. This usually implies an i.f. pentode or field or sound output valve, for in all these instances the anodes are connected via the low d.c. resistance of a transformer's primary winding to the h.t. rail—plus a low-value decoupling resistor in the case of an i.f. pentode —screen-feed resistors are all low while the cathodes terminate at chassis via the usual low-value bias resistor. The best method of locating a defective valve is simply to connect an ohmmeter across the h.t. rail and chassis and note if removing any valve "possibles" removes the short-circuit.

When tracing short-circuits in receivers with BY100 type rectifiers, however, it becomes easy to make incorrect assumptions. For instance if the polarity of the ohmmeter battery is such that on applying the test-prods across the h.t. rail and chassis the rectifier is forward biased current will pass through the rectifier and will also flow through the valve heater chain (see Fig. 4). This means that with the ohmmeter applied one way round it could indicate a value of well under 1kΩ across the h.t. rail and chassis when really it is measuring the resistance of the heater circuit plus the forward resistance of the BY100. To further complicate matters and cause confusion on removal of any valve this reading will revert to the true leakage across the h.t. rail since the heater chain will then be broken. One could easily form the impression therefore that there was an internal short-circuit in the valve removed. This could not of course happen with a valve h.t. rectifier, but to eliminate this very real possibility always reverse the meter leads for highest reading, or better still leave any one valve out or remove the c.r.t. base connector to break the heater chain.

Before leaving the subject of defective valves remember that an incorrect type or two transposed valves while not imposing any "cold" measurable short-circuit may take so much current when the set is switched on that it becomes equivalent to a heavy load. This can lead to a great deal of time-consuming work, so always check that the right valves are in the right places in receivers that may have received unsuccessful service attention.

When tracing shorts in a printed-circuit model where the fault may lie along one of several printed "leads" isolate each suspect in turn by cutting across the print with a sharp knife. If found free of fault, continuity can easily be restored by a small bridging blob of solder.

Short-circuits that blow the fuse immediately on switching on are often due to the insulation of the older type of finned h.t. rectifier breaking down to the central mounting rod. Other possibilities are a defective double-pole mains on/off switch or the r.f. bypass capacitor shunted directly across the mains input. If this capacitor is found defective remember that the replacement must be of at least 500V and preferably 750V a.c. working voltage rating to withstand the peak voltage inputs and surges.

Replacing surge limiters

After replacing surge limiters which may have gone open-circuit through length of service it sometimes appears that the set is taking excessive h.t. current, the replacement resistor running hot or even smoking. Most new wire-wound resistors give off a certain amount of smoke at first, and in most cases it will be found that the set is only taking normal current, but quite often the wattage of the replacement resistor is insufficient or the resistance excessive.

The value of surge limiters is closely related to the value of the reservoir capacitor and the type of rectifier so that the correct value should be obtained from the relevant service manual rather than just fitting whatever low-value resistor is to hand. For example in many dual-standard KB/RGD receivers the tapped surge-limiter resistor has sections of 5Ω, 17Ω and 19Ω but all too often in service work we come across open-circuited sections in these and other receivers shunted by the widely used 25Ω or 50Ω resistor. This results in reduced h.t. and e.h.t. and although while the set is new it does not have a very great effect it becomes very apparent in older receivers with tubes past their best.

On the other hand of course nothing prejudices the life of a rectifier whether valve or silicon as much as reducing the value of surge limiters below the manufacturer's recommended figures. ■

PRACTICAL AERIAL DESIGN PART 2

A. J. WHITTAKER

THIS month we shall describe the construction of a television aerial for Bands I and III. It may be used as a loft aerial or outside. The author has constructed this aerial system, comprising a dipole with reflector for Band I and a Yagi for the reception of Band III. The two are linked by a twin-wire feeder the length of which is arranged so that on Band I it matches the dipole at about 75Ω, the other end of the wire offering a high impedance to the Yagi which is tuned to Band III (by the length of the various elements). When the aerial receives a Band III transmission the feeder acts as a high impedance at both ends. Thus it is not necessary to employ a diplexer or filter unit. More about these in a later article. The aerial is located in the loft and a good signal is obtained from Tacolneston (Norwich), which has a vision frequency 56·75 MHz, the dipole being cut for a frequency of 55 MHz, and from the Band III transmitter at Mendlesham, which has a vision frequency of 204·75 MHz, the dipole here being cut for a frequency of 203 MHz.

The Band I aerial rods are made from ½ in. copper tube fastened by U-clamps to the wood boom. Figure 1 shows the constructional details. The length of the dipole is calculated from the formula $468/f$, where f is the channel frequency in MHz, giving an answer in feet. This formula gives the length of the dipole taking into account the difference in the velocity of electromagnetic waves travelling along a wire to those in free space (i.e. the velocity factor). The dipole is separated in the centre by about 1 in., but this is not critical.

The Band III dipole, reflector and director elements are made of ¾in. copper tube fastened to the boom by U-clamps. The various lengths of the elements are worked out from the previously given formula. Bending the folded dipole may be done by filling the tube with sand or by using a bending spring. The fold is best formed by bending around a 2 in. radius, a little help being given by judicious use of a blow lamp to soften the copper at the bend. The constructional details are given in Fig. 2.

Adding a reflector to a dipole improves the forward gain by about 4 to 5 dB. Adding directors increases this by approximately ½dB per element and also improves the bandwidth. These are typical figures which will vary with the frequency and hence with the design of the aerial system.

Fig. 2 also shows the method of fixing the ends of the dipole on the boom and the attachment of the feeder and connecting line. Lengths of the various elements for the Yagi aerial (channel 11) are:

- R (reflector) length $=\lambda/2=27{\cdot}6$ in.
- D (folded dipole) length $=27{\cdot}6$ in.
  Length of dipole end to end $=55{\cdot}2$ in.
- $l1$ (director) length $=0{\cdot}43\lambda=24$ in.
- $l2$ (director) length $=23{\cdot}5$ in.
- $l3$ (director) length $=23$ in.

The length of the twin feeder connecting the Band I and III aerials is 14 ft. (75Ω unscreened). The boom is of wood, length 60 in., cross-section 3 by 1½ in.

TV AERIAL FEEDERS

Concentric feeders are used to connect the aerial system to the receiver. A concentric feeder is one in which the centre conductor is entirely enclosed by the outer conductor which is a screening copper

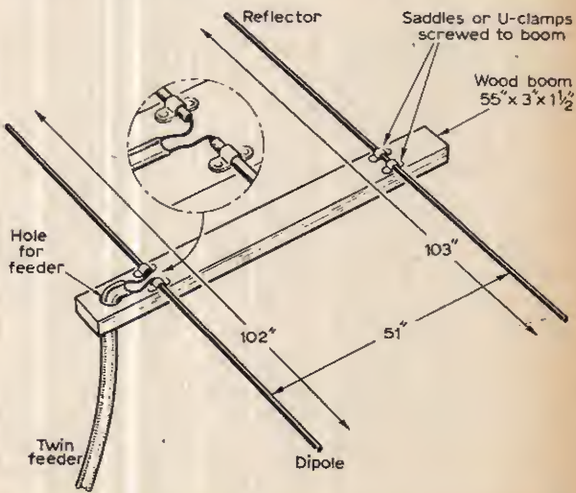


Fig. 1: The Band I aerial comprises a dipole plus reflector.

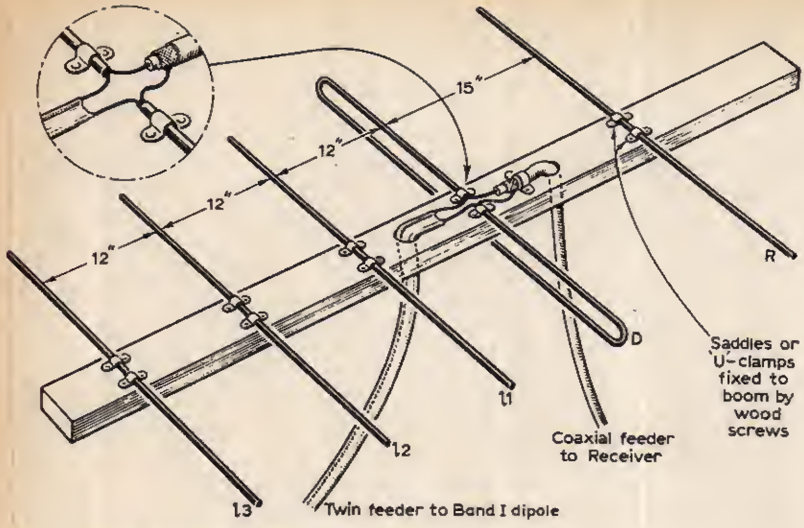


Fig. 2: Constructional details of the Band III Yagi aerial.

braid covered by a plastic sheath, a practical example being the well-known coaxial cable. This may be single screened wire or twin screened, but the latter is seldom used nowadays for domestic installations. Fig. 3 shows a section of these feeders.

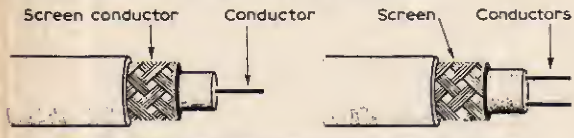


Fig. 3: Single and twin screened coaxial cables.

A transmission line is composed of inductance L and capacitance C per unit length all along the length of the wire (see Fig. 4). Matters must be so arranged that the reactive components L and C of the line cancel, so that the line becomes effectively a pure resistance. To bring about these conditions we must arrange that a certain value of load across the end of the line causes it to resonate. In this condition the L and C components cancel.

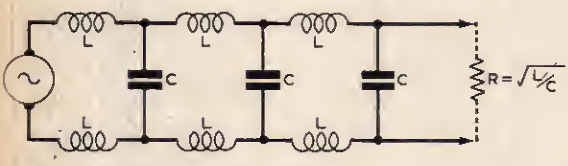


Fig. 4: Equivalent circuit of a transmission line.

It can be shown mathematically that $\sqrt{L/C}$ must be the value of the terminating resistance to produce the condition of resonance in the transmission line or feeder in order to make it into a line of pure resistance. The signal will then travel from the aerial to the receiver with the minimum of impedance. $\sqrt{L/C}$ for domestic coaxial feeder is typically 75Ω. If we had a resistance of a very much smaller value than this at the receiver end the signal would be reflected and standing waves would be present on the feeder. A similar set of conditions occurs if the receiver end is of a higher resistance than $\sqrt{L/C}$ or is open-circuited.

At the aerial end the system should be resistive at the frequency of the transmission and should remain so over a band of channels relating to the particular band for which the aerial system is designed.

The effect of feeder mismatch is not terribly serious if the length is less than 100 ft. If the feeder is longer than this degrading of the picture quality may occur due to blurring of the image (i.e., the picture appears out of focus). As the length increases the effect of mismatch may cause ghosting (i.e. a ghost image appears to the right of the main image).

For single-channel operation in Bands I and III aerials require a bandwidth of typically 5 MHz for the 405-line transmissions. Bandwidth requirements of the u.h.f. channels are more critical. Individual u.h.f. channels are 8 MHz wide and the four channels allotted for each area will cover a total bandwidth of 88 MHz. The agreed variation in gain should not be greater than 3 dB over the band. Front-to-back pickup should be 16 dB with minimum side pickup. More about u.h.f. aerials next month.

The characteristic or surge impedance of the concentric feeder is given by the formula $138 \log b/a$ (see Fig. 5). This is typically 75Ω but other impedances are available depending upon the design of the cable and the termination required. For instance a λ/4 Marconi aerial would require a 40Ω feeder.

All forms of dipole aerial are essentially balanced systems with respect to earth. Thus it is theoretically necessary for the feeder to be balanced in this way as well. The single core coaxial feeder is an unbalanced feeder because the screen is usually earthed at the receiver end. There are available balanced twin-core feeders but nowadays it is the practice to do the job the hard way and use single core feeders. The unbalanced cable works satisfactorily when connected to a dipole or Yagi aerial

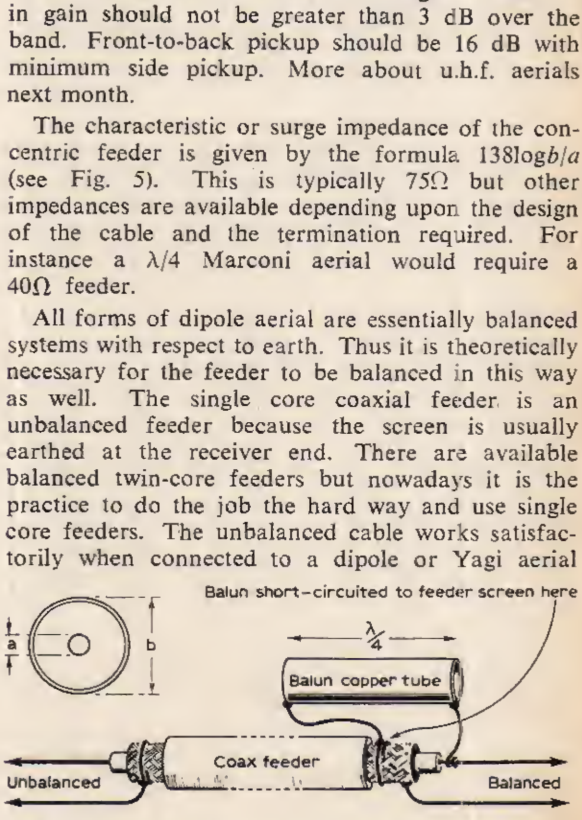


Fig. 5 (above left): Concentric feeder characteristics.
Fig. 6 (below): Construction of a simple BALUN.

on Bands I and III (there seems to be some argument and speculation about this problem amongst aerial manufacturers), but with colour television it may well prove essential for the feeder to be correctly balanced and terminated to avoid deterioration of picture quality.

A device for balancing a coaxial feeder is known as a BALUN (from BALance to UNbalance). This may be simply made up as shown in Fig. 6, using a quarter wavelength piece of copper tube. The $\frac{1}{4}$-wave matching tube presents a high impedance which prevents the waves from travelling over the surface. Its performance and bandwidth depend upon the frequency.

ATTENUATORS

In areas of high signal strength it may be necessary to attach some form of attenuator to the feeder to cut down the signal input to the receiver. This must not upset the feeder termination. Figure 7 shows how this may be done. The simple T-network of resistances forms an attenuator for reducing signal strength at the input terminals of the receiver. If we assume the feeder to be 75Ω, the aerial input at the receiver to be 75Ω, and N is the factor of attenuation, then

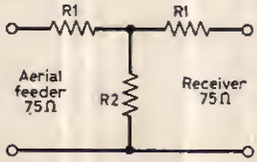


Fig. 7: Simple T-network attenuator.

$$R1 = 75\left(\frac{N-1}{N+1}\right) \text{ and}$$

$$R2 = 75\left(\frac{2N}{(N+1)(N-1)}\right)$$

If we wish to cut the signal down 20 times (i.e. 20log 20 = −26dB), then $N=20$ so that

$$R1 = 75\left(\frac{19}{21}\right) = 68\Omega \text{ and}$$

$$R2 = 75\left(\frac{40}{21\times19}\right) = 7{\cdot}8\Omega.$$

The resistors should be of the $\frac{1}{4}$-watt, 10% high-stability type and selected from the standard values available. This will give R1 68Ω and R2 7·5Ω.

In conclusion one final note on the simple aerials used on Bands I and III. These are basically resonant-type aerials in that the optimum performance is obtained at one frequency (i.e. the frequency of the transmitter the aerial is tuned to). The subject of bandwidth arises when one considers how far away from this centre frequency one may deviate before an unacceptable degrading in performance takes place. Aerial bandwidth may be defined as that frequency range over which the impedance, gain and directivity fall off to an acceptable extent.

TO BE CONTINUED

SERVICING TV RECEIVERS

—*continued from page 303*

punctured. Other causes of non-operation are an open-circuited blue lead and a split solenoid, or merely that the moulded cam on the rear of the switch spindle is loose and is not rotating with the spindle to operate the S4 switch.

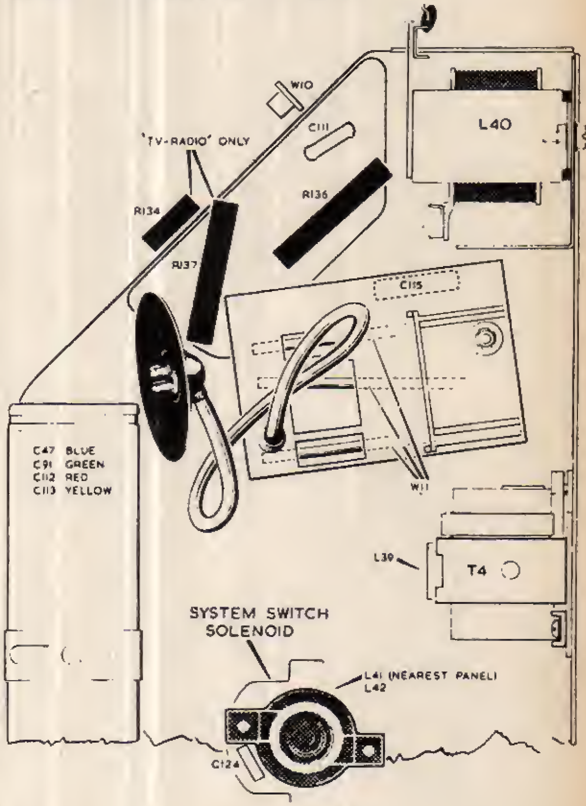


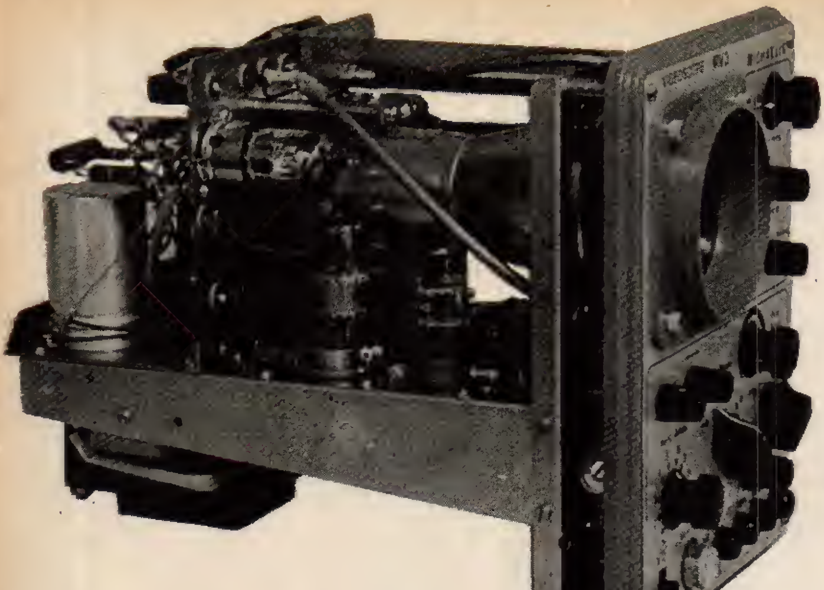
Fig. 4: Right-hand side panel, 950 chassis, showing the position of the system switch solenoid.

In the case of the semiportables, which use the "960" chassis, the solenoid is on the left side and operates the push bar at an angle. With this system the solenoid may chatter continuously if the side lever is not engaging. A visual inspection will show this immediately although a description of the operation may not clarify what happens so easily.

Checks for inoperative solenoids

In short therefore if the solenoids are not working check the supply to the tuner switch and make sure these contacts are being operated by the plastic cam. If there is no supply to this point, check R147 which may be open. Note: if the cut-out is open (not the resistor), the set will not operate at all. If the supply is going through S4 correctly, check the leads to the solenoid and check the solenoids to make sure they are intact.

CONTINUES NEXT MONTH



THE F

VIDE

MARTI

A CONVENTIONAL oscilloscope is used to display the relationship between two variables in the familiar graphic form. In most practical cases in the course of television servicing and experiments one of the variables is time marked out by the horizontal X-deflection of the spot on a c.r.t. screen and the second variable is the voltage waveform to be examined, marked out by the simultaneous vertical Y-deflection.

The timebase for the X-deflection is normally traced with a suitable waveform derived from an internal sawtooth oscillator. Its waveform and the Y-deflection waveform to be examined are normally both periodic, possessing respective *steady* frequencies. Only if these respective frequencies bear a simple whole-number ratio relationship to each other is it possible to obtain a stationary display on the c.r.t. screen, because otherwise successive traces drawn during successive strokes of the timebase will not coincide in position on the screen. If the discrepancy is only slight the display will appear to wander slowly, but if it is large we obtain a jumble covering the entire width of the display without being able to discern any waveform.

In principle it would be possible to adjust the fine frequency control of the timebase until the display comes to a standstill, but this alone is not sufficient because it is too critical. We require some further device which forces a more positive lock, i.e. which gives a small range, not a mere point of the timebase fine control range, within which the display becomes stationary. This is effected by a process called synchronisation. We deliberately set the timebase oscillator running slightly too slow and then apply a portion of the Y-deflection voltage to give the timebase a jolt once each cycle, thus automatically speeding it up the correct amount to effect a rigid lock. This process is self-stabilising because the jolt automatically increases if the timebase gets more out of step, and vice versa, within reasonable limits.

The foregoing brief discussion has made it clear that the basic oscilloscope requires a cathode-ray tube with power supplies, a sawtooth oscillator as timebase, a pair of high-level voltage amplifiers to produce the large voltages required at the c.r.t. electrodes in order to move the spot through adequate horizontal and vertical distances on the screen, and a synchronisation amplifier to apply *suitably distorted* fractions of the Y-deflection signal to lock the timebase into step. The oscilloscope described in the present article possesses all these features.

PERIODIC WAVEFORMS

The great majority of waveforms encountered in television work, and certainly all waveforms encountered in receiver servicing, are periodic, i.e. they possess fixed steady frequencies, usually the line or the field frequency of the particular television standard. The described synchronised free-running timebase is always satisfactory for displaying stationary pictures of such waveforms.

It may become inconvenient if the waveform to be displayed consists of very sharp periodic pulses with nothing in between. The timebase must always run at the signal frequency or a sub-multiple thereof, because a harmonic of the signal frequency would produce multiple stationary traces, ultimately a complete raster as intended deliberately for displaying TV pictures. Thus for displaying a waveform on an oscilloscope with a synchronised timebase at least one period of the signal waveform must appear across the screen. Now if the signal waveform consists of only a very narrow pulse in each otherwise blank period clearly the synchronised timebase will

TV SCOPE MV3

. MICHAELIS, M.A.

inevitably give a very small and cramped trace of this pulse at one edge of the c.r.t. screen. In order to examine the pulse in greater detail we must magnify its display. This is possible only by using a different type of timebase which is not free running. It is triggered off to start a single run across the screen whenever a pulse arrives so that the speed of the run across the screen may be adjusted to any convenient value to suit the duration of the pulse, irrespective of the pulse repetition frequency. When the single run is finished the timebase flies back to the start and then waits until the arrival of the next signal pulse fires it once again.

TRIGGERED MODE

In this *triggered* mode of operating a timebase synchronisation is obviously inherent because if the timebase starts one run coincident with the arrival of each signal pulse the successive traces must coincide in position on the c.r.t. screen. Furthermore it now does not matter if the signal pulses cease to arrive with a steady frequency but appear in arbitrarily fluctuating sequence. The display with a triggered timebase is still rigidly stationary whilst a synchronised timebase would be quite unable to resolve such non-periodic waveforms.

In considering the design of the Videoscope MV3 careful thought was given to the question whether or not to incorporate a triggered timebase function. The criterion is the extent to which such a function will be required in the course of work with television equipment. Let us examine the problem from this angle. The only pulses of significance for servicing receiver and CCTV equipment are the line and field pulses, their porches and the colour sync burst. All these are of adequate width in relation to the line or field period to permit the display of the necessary detail for servicing purposes using a synchronised timebase, and the latter is always usable because all these waveforms are periodic. For a wide range of ordinary TV design work and experimenting we may assume the same situation.

On the other hand more exacting work and professional monitoring may well demand triggered displays. It may be necessary to examine pulse detail on test-pattern waveforms, or even to single-out test waveform lines transmitted by some stations between the field sync pulse and the start of the picture frame during normal transmission hours (for example this is common practice for networking purposes with the German Free Berlin TV microwave link to the German Federal Republic). Even these applications are still not concerned with non-periodic waveforms for which a triggered timebase is imperative.

Non-periodic waveforms are rarely encountered in television work but there are some instances and these may even involve amateur work or the science education field. The most obvious example is the oscilloscopic display of pulses from Geiger counters and other types of detectors for nuclear radiation and X-rays. These pulses do have a statistical mean frequency but the sequence is always quite irregular and only a triggered timebase can give a stationary display.

An important television raster principle often employed for examining nuclear radiation and X-rays is to cause each pulse to trigger a single timebase run at a vertical level on the c.r.t. screen corres-

★ components list

Capacitors:

C1	39pF C
C2	12pF* C
C3	0·1μF M500
C4	50μF 125V E
C5	1200pF C
C6	0·1μF M250
C7	0·047μF M250
C8	220pF C
C9	150pF* C
C10	0·1μF M500
C11	1μF 350V E
C12	0·1μF M500
C13	0·1μF M500
C14	25μF 15V E
C15	1μF M100
C16	100pF C
C17	10pF C
C18	22pF C
C19	0·047μF M250
C20	50μF 125V E
C21	47pF C
C22	470pF C
C23	4700pF C
C24	0·047μF M250
C25	0·47μF M250
C26	10pF C
C27	3pF* C
C28	0·68μF M250
C29	10pF C
C30	1μF M500
C31	0·02μF M250
C32	560pF* C
C33	2000pF C
C34	470pF* C
C35	0·1μF M500
C36	2200pF C
C37	0·047μF 1kV paper
C38	0·22μF M500
C39	1μF M250
C40	8μF 500V E
C41	32 + 32μF 500V EC
C42	32 + 32μF 500V EC
C43	8μF 500V E
C44	50μF 125V E
C45	200μF 35V E
C46	33pF* C
C47	18pF* C

C = 500V ceramic
E = tubular electrolytic
EC = can-type electrolytic
M = microfoil or small paper. Following number is working voltage

TC1 2-6pF
TC2 4-20pF
Ceramic trimmers

Resistors:

R1	9·1M Ω	R30	100 Ω	R59	470k Ω
R2	1·1M Ω	R31	120k Ω	R60	100 Ω
R3	1·1M Ω	R32	120k Ω	R61	220k Ω
R4	100 Ω	R33	2·2M Ω	R62	220k Ω
R5	2·2M Ω	R34	100 Ω	R63	220 Ω
R6	680 Ω	R35	27k Ω 1W	R64	1k Ω
R7	12k Ω 1W	R36	27k Ω 1W	R65	150 Ω
R8	270 Ω	R37	470k Ω 1W	R66	6·8k Ω 1W
R9	100 Ω	R38	120k Ω	R67	4·7k Ω 1W
R10	6·8k Ω 1W	R39	120k Ω	R68	100 Ω
R11	220 Ω	R40	1M Ω	R69	1M Ω
R12	100 Ω	R41	51k Ω	R70	4·7k Ω
R13	100 Ω	R42	33k Ω 2W	R71	100k Ω
R14	2·2M Ω	R43	33k Ω 1W	R72	100 Ω 1W*
R15	2·2M Ω	R44	10k Ω	R73	560 Ω 1W
R16	100 Ω	R45	27k Ω	R74	1·5k Ω 5W W.W.
R17	220 Ω	R46	27k Ω	R75	6·8k Ω 5W W.W.
R18	220 Ω	R47	1M Ω	R76	470 Ω 1W
R19	4·7k Ω 2W*	R48	2·7k Ω	R77	10k Ω 1W
R20	2·2k Ω 1W	R49	47k Ω	R78	8·2k Ω 1W
R21	5·6k Ω 2W	R50	10k Ω	R79	120k Ω
R22	100 Ω	R51	100k Ω	R80	27k Ω
R23	100 Ω	R52	5·6k Ω 1W	R81	120k Ω
R24	5·6k Ω 2W	R53	1M Ω		
R25	220k Ω	R54	1M Ω		
R26	270k Ω 1W	R55	8·2k Ω		
R27	51k Ω	R56	820 Ω		
R28	100k Ω	R57	100k Ω		
R29	2·2M Ω	R58	4·7k Ω 2W		

All 10% ½W carbon unless otherwise stated

* see text

Variable Resistors:

VR1	1k Ω lin.
VR2	2·5k Ω lin.
VR3	5k Ω lin.
VR4	250k Ω lin.
VR5	100k Ω lin. with d.p. mains switch
VR6	25k Ω lin.
VR7	250k Ω lin.
VR8	100k Ω lin.
VR9	1k Ω lin.
VR10	2·5M Ω lin.
VR11	250k Ω log.
VR12	500 Ω lin.
VR13	100k Ω lin.

VR1, 8, 9, 12 and 13 presets

Valves:

V1	EC92
V2	EF184
V3	ECC88
V4	ECC85
V5	ECC81
V6	ECC85
V7	DG7-32

Semiconductors:

D1	250V p.i.v. silicon diode capacitance $\leq$ 3pF
D2-D4	100V p.i.v. silicon diodes capacitance $\leq$ 3pF
D5	100V, 500mW zener
D6, D7	as D1
D8, D9	Silicon h.t. rectifiers, 0·5A, 1kV p.i.v.
D10	Silicon h.t. rectifier, 250mA, 1kV p.i.v.
D11-D14	Silicon l.t. rectifiers or bridge unit, 60V a.c., 25mA
D15	24V, 500mW zener
Tr1-Tr3	Silicon npn > 30V rating with ß at least 20. BSY53, 2N1613, etc.

Miscellaneous:

F1	1A medium-delay
LP1	Miniature neon pilot lamp
P1	Coaxial socket
P2-P4	Shrouded banana sockets
P5	3-pin mains plug
RLY1	15k Ω relay, 5mA snap-in, 2 changeover contacts (adapt any more sensitive relay with appropriate shunt and series resistors)
S1	SPDT slide switch
S2	2-pole 5-way rotary
S3	1-pole 5-way rotary
S4	DPDT slide switch
S5	with VR5
T1	Mains transformer. 350-0-350V 80mA, 6·3V 0·5A, 6·3V 3A, 60V 10mA or nearest equivalent. Add 60V winding or modify existing fourth winding or use small separate transformer (see text).

Material for cabinet, fittings for c.r.t., printed circuit board, wire, solder, etc.

ponding to the amplitude of the pulse. Many types of nuclear radiation detectors deliver pulses whose mean rate of arrival is proportional to the intensity of radiation and whose individual amplitudes are proportional to the photon energy (colour) of the radiation. It is thus clear that a triggered television raster produced from these pulses in the manner just described will possess bright bands at vertical levels

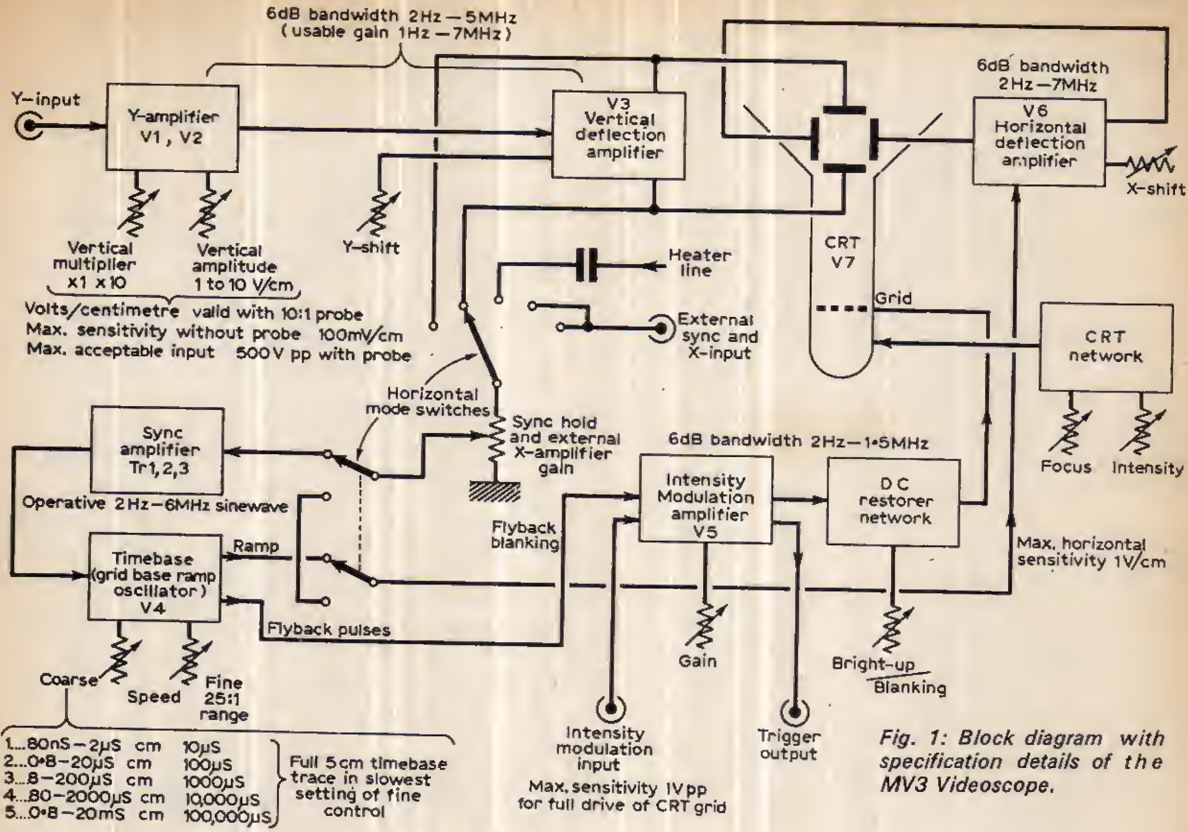


Fig. 1: Block diagram with specification details of the MV3 Videoscope.

corresponding to preferred photon emission energies in the studied radiation, and dark bands elsewhere. This effect is produced directly without any need for intensity modulation at the grid of the c.r.t. because the different brightness levels are produced by the relative probabilities of the timebase run falling at each level of the raster. This type of television raster is known as a *spectrum raster*, because the form and information content are identical to those of an optical spectrum produced from a visual light source with a glass prism. A spectrum raster display on an oscilloscope can be produced with quite simple circuits and thus constitutes a useful and interesting project for amateur experiments and scientific education.

AUXILIARY MODULES

It was decided to incorporate only a synchronised timebase in the Videoscope MV3 since this suffices for the great majority of ordinary television work and the reader not wishing to go beyond such work will welcome a basic oscilloscope of minimum complexity and cost. However it was fully appreciated that many readers will already require or will be enticed by the foregoing discussion to take up the more special kinds of experiments requiring a triggered timebase. The Videoscope MV3 has therefore been prepared so that the necessary auxiliary modules can be connected externally without modification of the basic instrument. A triggered timebase unit incorporating a delay generator and another unit incorporating a detector for nuclear radiation and all auxiliary circuitry to display the spectrum raster are at present being designed specially for the Videoscope MV3.

EXTRA FACILITIES

In the present article we shall just outline the preparatory facilities incorporated in the Videoscope MV3 in order to be able to connect these and many other adapter units. These additions must be simple and as far as possible of general appeal for other purposes since otherwise it is unjust to burden the reader desiring only a basic instrument with their expense. Two facilities are actually needed.

The first is a means for switching off the internal synchronised timebase and feeding any desired external signal to the horizontal deflection amplifier. This is a common feature of most modern oscilloscopes and very useful for all manner of ordinary purposes such as phase and frequency comparisons of two voltage waveforms by way of Lissajous figures, display of magnetic hysteresis curves or any other examination of a function of two variables neither of which is time. To save components the same input socket and gain control serve for the sync amplifier and the external horizontal signal input, since the one is obviously never needed when the other is in use.

The second facility required is a means for intensity modulation with an external signal applied to

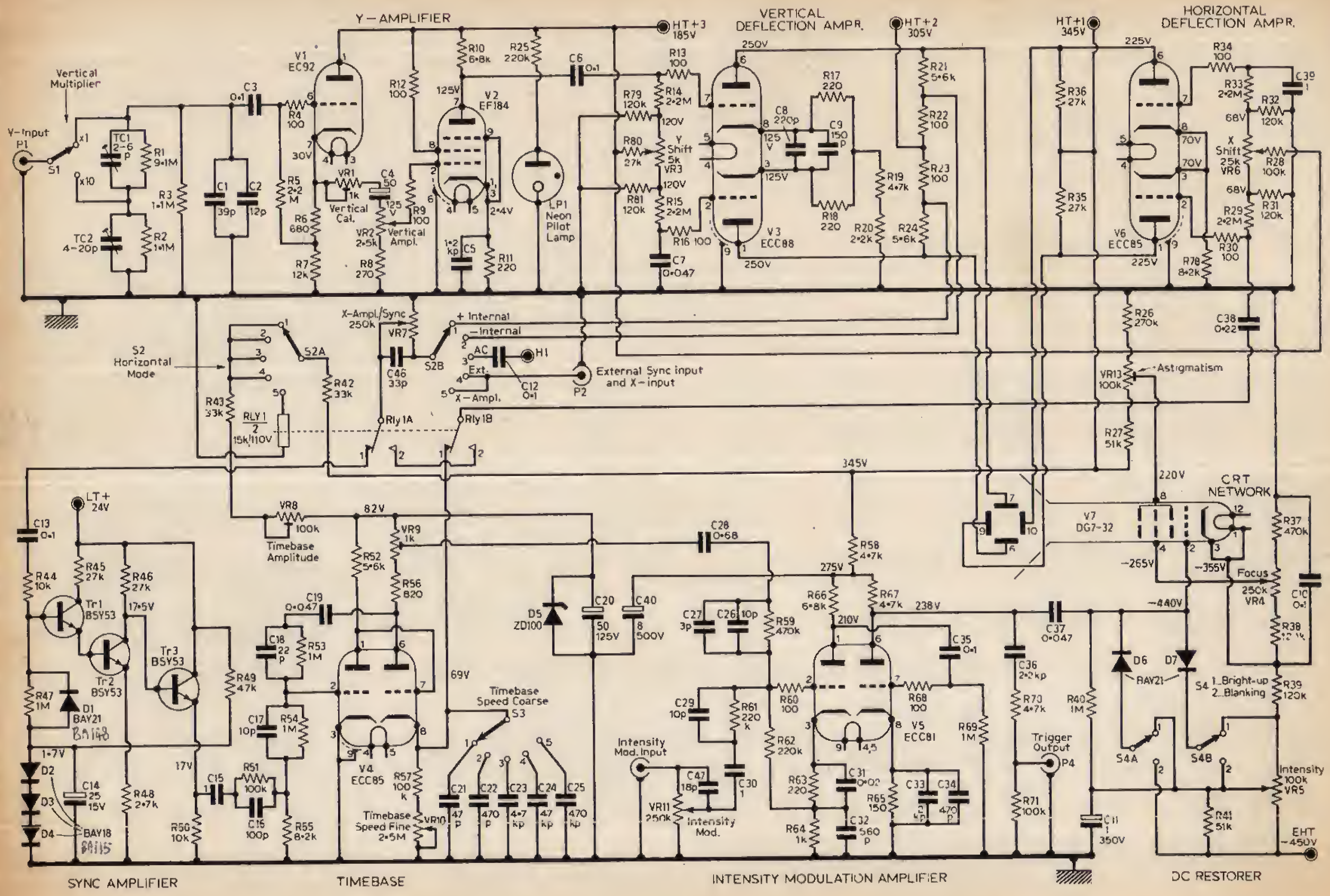


Fig. 2: Circuit diagram of the Videoscope MV3. The circuit of the associated power supply system will be included next month.

the c.r.t. grid after suitable amplification. This calls for a considerable number of components since it requires a third signal amplifier and a d.c. restorer and clamping system at the output for proper relation to the static intensity control. Being an unusual feature for ordinary oscilloscopes it is necessary to justify its inclusion by further applications of general appeal. The obvious solution, and the one which has been taken, is to design the Videoscope MV3 so that it can be used to display ordinary TV pictures, e.g. as viewfinder for a CCTV camera. The necessary waveforms will be available from the camera with at most a few auxiliary components needed according to its particular circuitry.

INTENSITY MODULATION

Whenever a triggered timebase is used, irrespective of whether it is internal or external, it is necessary to use an intensity-modulation circuit because the spot will be waiting most of the time between trigger pulses and would burn the screen if not held cut off then. The static intensity control must be set beyond cut-off when using a triggered timebase which generates the necessary bright-up pulses for the duration of each triggered stroke. Thus if the triggered timebase adapter is an external unit we require external access to the c.r.t. grid via a suitable amplifier.

FLY BACK BLANKING

Apart from its necessity for triggered timebase operation and its usefulness for CCTV-viewfinder picture display, the intensity-modulation amplifier can also be used for flyback blanking and time spotting. Flyback blanking is desirable but not essential when using a synchronised timebase. Provided the timebase oscillator is designed so that the flyback is much faster than the forward stroke the flyback will leave a much fainter trace than the wanted forward stroke. This is because the trace brightness for a given beam voltage and current is always inversely proportional to the instantaneous writing speed. For the same reason an ordinary display of an accurate squarewave voltage shows faint flanks but bright roofs.

When the forward stroke and flyback times become comparably long, and this is unavoidable at some of the higher speed settings in a simple circuit, the equally bright flyback trace can confuse the display by virtue of the resulting foldback. There is no distortion as such, so that if the flyback only can be blanked out by applying a suitable signal to the c.r.t. grid at the right times there is no objection at all to running a timebase oscillator under conditions where the flyback is sometimes as long as the forward stroke.

Most simple timebase circuits do not deliver a sufficiently accurate squarewave pulse during the flyback of the sawtooth so that direct application of the distorted pulse actually present at some point of most customary timebase oscillator circuits will either blank or restore the trace too early or too late so that not all the flyback is blanked or part of the wanted trace is lost. Some pulse shaping is thus necessary and the easiest way is to overdrive an amplifier with the distorted waveform. Overdriving any amplifier of sufficient gain with any arbitrary waveform always produces accurate square pulses.

A better way to convert any arbitrary waveform into a squarewave is to use a voltage-controlled bistable multivibrator known as a Schmitt trigger circuit, and this is the means adopted for the purpose in comprehensive professional oscilloscopes. But in the interests of the simplicity of our Videoscope MV3 it was decided to drive the intensity modulation amplifier heavily with the distorted blanking pulses from the timebase rather than to add still more components for a Schmitt trigger stage. Although this adopted solution does not give quite perfect flyback blanking at the highest speeds of all, it does give fully adequate blanking. Consequently it is permissible to run the timebase right up to the point where the flyback is comparable to the forward stroke so that this design has been able to manage with fewer coarse ranges (thus a simpler switch) and broader fine ranges (greatly simplifying practical operation).

DC RESTORATION AND CLAMPING

Whenever intensity modulation is applied to a c.r.t. it is necessary to define the white and black potentials in a manner independent of the relative times spent by the actual waveform at these levels or in between them. If this is omitted the static intensity control of a TV receiver will have to be reset continuously according to the highlight-to-shadow area ratio, or the static intensity control of an oscilloscope employing flyback blanking will have to be reset in conjunction with every change of timebase speed.

The customary method of defining the black and white potentials in an unambiguous manner is to use a diode to clamp a particular level of the waveform to the slider potential of the static intensity control. This is in effect a process of waveform rectification to obtain a d.c. voltage representing the correct mean brightness of the display and then adding this d.c. voltage and the waveform to the static brightness control potential.

POLARITY

Let us consider the required polarity of this process for the various applications of intensity modulation discussed in connection with the Videoscope MV3. For flyback blanking we desire the static intensity control to determine the trace brightness in a manner independent of the forward stroke to flyback ratio. Thus if we are going to apply negative blanking pulses to the c.r.t. grid during flyback the blanking waveform must be clamped so that its positive intervals are at the potential of the slider of the static intensity control. We achieve this by coupling the waveform capacitively to the c.r.t. grid to block any previous d.c. potential it may carry, and then connect a diode across the grid leak between the grid and the intensity control slider so that the cathode is at this slider potential.

For time-spotting we require the same polarity. Time-spotting consists of marking the trace with equal intervals of time by feeding very narrow negative pulses of known frequency to the c.r.t. grid. This produces very short black gaps in the trace.

This polarity of d.c. restoration is known as positive-limit clamping, or negative d.c. restoration. The converse, called negative-limit clamping or positive d.c. restoration, is appropriate for the bright-up function associated with operating a triggered timebase or displaying a TV picture. It is realised simply by reversing the diode. Evidently we must be able to connect the diode in either polarity at the grid of the c.r.t. in the Videoscope MV3. As the self-capacitance of a switch to effect this directly with a single diode would restrict the signal bandwidth unduly, remembering that we also desire to be able to handle television video waveforms, two diodes have been used with one end of each connected permanently to the c.r.t. grid.

The switch is employed to connect the respectively required diode to the intensity control slider and the other one to the appropriate end of the intensity control track to hold it cut off. In this manner the very low barrier-layer capacitance of the diodes is always in series with the much larger switch capacitance so that the capacitive loading of the c.r.t. grid is essentially removed.

This arrangement fulfils yet another vital function in that the diode not being used for clamping functions as limiter to prevent any dynamic excursion from exceeding the range of the static intensity control. Thus it is impossible to overdrive the c.r.t. by running it into grid current, a condition of operation expressly forbidden by the manufacturers.

This completes our general discussion of oscilloscope features required for television work and how these have been taken into account in the design of the Videoscope MV3. Apart from the special accessory units under preparation all standard universal accessories such as electronic switches for displaying two signals simultaneously may be connected to the Videoscope MV3 just as successfully as to any other oscilloscope. Next month we will commence with the circuit description and constructional details, including bandwidth and general performance considerations. Some years ago we published a first videoscope in this journal, and later some modifications, thus the present new design is the third generation and hence the designation MV3 in which the letters stand for the author and for videoscope. The present design essentially incorporates the same features as its nominal ancestors but with improved performance in keeping with further developments and in particular the need for a greater bandwidth which has arisen with the advent of colour television.

CONTINUED NEXT MONTH

TELEVISION RECEIVER TESTING

Part 10 by Gordon J. King

FLYWHEEL-SYNC CIRCUITS

GENERAL testing in the synchronising circuits was covered in Part 5 (October, 1968) and as was then promised this article deals essentially with tests in the more involved flywheel-controlled line circuits. Tests in this area have purposely been held over until now—subsequent to our dealing with ordinary sync and timebase testing—because flywheel-sync, as it is called for short, requires a different kind of line generator in most cases from that used in direct-sync systems, the sync, control and generator stages all being integrated, so to speak.

Parts 5, 6 and 7 revealed that in direct-sync systems shaped pulses derived from the received sync signals are fed direct to the generators to trigger them at exactly the right instant for correct field and line locking. This sort of sync is always used in the field timebase, and there are still quite a few sets which employ it in the line timebase. However, in the line timebase it has the major shortcoming that excessive noise carried by the line sync pulses, especially when the aerial is failing to yield a sufficiently strong signal and in areas of high impulsive interference, tends to trigger the line generator a very small fraction of a second before or after the firing point for optimum lock. This might not break up the lock completely but it can produce ragged vertical edges to the picture content due to the firing point hovering at random around the correct point.

Flywheel-sync is found in some quite early sets; but in these it was not always as successful as it should have been and this led some technicians to remove it in favour of the then more reliable direct-sync method. It subsequently lost favour with some manufacturers for a while, but with the advent of the dual-standard set (and colour sets) it came back again—this time more reliably! And now the vast majority of sets use it, either on both line standards or on 625 lines only. It will also be present in the latest breed of single-standard 625-line only models—monochrome and colour—so it is just as well to get some idea of how best to test it!

It is noteworthy that the negative-going video modulation of the 625-line standard produces positive-going interference pulses, rising up in the same direction as the sync pulses themselves, and in the direct-sync system these can be mistaken for sync pulses, as shown in Fig. 1. Flywheel-sync

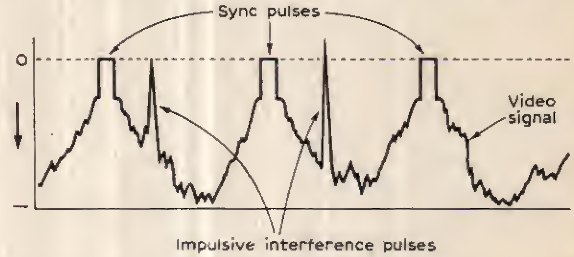


Fig. 1: How interference pulses can rise in the direction of the sync pulses on 625 and disturb the sync performance.

combats this in the line timebase, while in the field timebase—where the interference can cause vertical judder or rolling—special interference cancellation circuits are used; moreover, in the line timebase the disturbance is more noticeable on the 625 standard owing to the higher scanning speed and energy, which is why some dual-standard models run direct-sync on the 405 standard and flywheel-sync on the 625 standard.

The basic flywheel-sync scheme is shown in block schematic form in Fig. 2. Here the line sync pulses from the sync separator are fed via the differentiator network to a phase discriminator along with line pulses from the line timebase itself. The phase

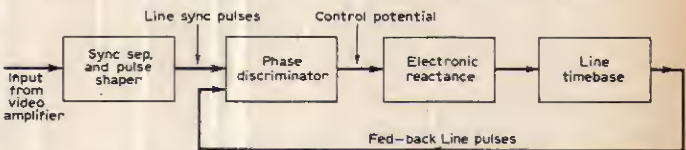


Fig. 2: Block diagram of the basic flywheel-controlled line sync system.

discriminator is something like a discriminator type f.m. detector, in which the two signals it receives are compared one with the other in terms of frequency and phase. When the pulses are coincident in these characteristics the discriminator is balanced and it produces no control output. In this type of circuit the line timebase frequency is controlled by an electronic reactance connected in parallel with the frequency-sensitive elements (not uncommonly an ordinary tuned circuit composed of inductance and capacitance). The electronic reactance is often a valve arranged so that to the oscillatory signal it looks either like capacitive or inductive reactance—mostly the former—whose value can be altered simply by changing the grid bias. Thus since it is connected across the line generator the speed of the generator can be adjusted by varying the bias to the valve about a nominal standing value.

The circuit is adjusted initially so that the line speed is correct when the discriminator is balanced—that is when the fed-back line pulses match those

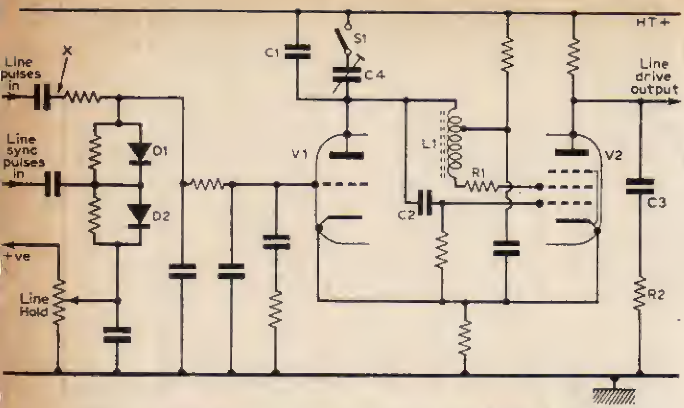


Fig. 3: Flywheel sync circuit controlling a sinewave oscillator. Point "x" shows where a sync on/off switch can be connected.

derived from the line sync pulses—and under this condition the picture locks linewise within the raster. Now should the frequency of the line generator tend to wander up or down from its correct frequency the discriminator will produce a plus or minus voltage which is fed to the electronic reactance in such a manner as to correct the line frequency. Once the fed-back line pulses and the sync pulses coincide again in frequency and phase the discriminator is brought back into the balanced state.

This arrangement eliminates the ragged vertical edges to picture content and renders the set less sensitive to impulsive interference because the circuit feeding the control potential from the discriminator to the electronic reactance is relatively slow-operating. This means that it has a long time-constant and is thus unaffected by fast-occurring pulses of interference. Moreover, once an average value of control potential has been established a flywheel effect is achieved by the long time-constant; in fact in a well-designed and adjusted circuit it is possible for the generator to free-wheel in line lock for several lines if the line sync pulses happen to fail, which is certainly a feat that the direct-sync system is unable to perform.

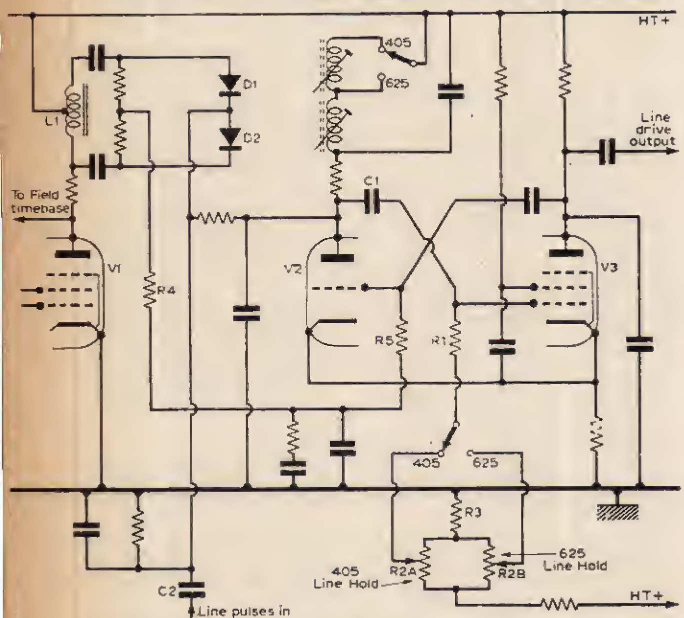


Fig. 4: Flywheel sync circuit controlling a multivibrator line generator. The waveforms in Fig. 9 show the signals at the inputs to diodes D1 and D2 under balanced conditions.

This type of flywheel circuit is shown in Fig. 3, where diodes D1 and D2 with the associated components form the discriminator, V1 is the reactance valve and V2 the oscillator valve proper. The pentode valve is caused to oscillate at the frequency set by L1 and C1 due to positive feedback from its screen grid to its control grid via C2 and R1. The resulting signal is of sinewave form, but is shaped by C3 and R2 to a form suitable for driving the line output stage.

S1 is the standards change switch which when closed introduces C4 in parallel with C1, thereby reducing the frequency of the oscillator. The switch is closed in the 405-line position, and since C4 is a preset the line speed can be set accurately for 405-line lock after the line hold control itself (in the diode circuit) has been set for correct 625-line operation with S1 open.

It will be seen that V1 is effectively in parallel with L1 and its capacitor(s), and since this is the reactance valve the oscillator frequency can be made to vary by altering its grid bias, as already explained. The line hold control is connected across a voltage source and since its slider eventually feeds the grid of V1 altering the control changes the grid bias and hence the generator frequency. This control is of course adjusted to establish the correct line lock when the circuit is receiving both sync and fed-back line pulses. If the frequency or phase of the fed-back pulses wanders a d.c. control output is produced by the discriminator diodes, and because this potential is directly communicated to the grid of V1 the frequency/phase of the oscillator is modified accordingly and is pulled back into step with the sync pulses.

A slightly different arrangement is shown in Fig. 4. Here the generator is a multivibrator composed of V2 and V3, whose repetition frequency is governed to some extent by the time-constant of C1 in series with R1, R2 and R3, R2 being adjustable for line lock setting. In addition to the ordinary anode load resistor, the sync separator valve V1 is loaded by inductor L1 across which the line sync pulses are developed and fed to the discriminator diodes D1 and D2.

The discriminator also receives line pulses direct via C2 and as before accurate synchronising is achieved when the frequency and phase of the line pulses match those of the sync pulses. This is in effect because the potential at the junction of the two resistors across the two diodes is at a zero reference under synchronous conditions. In this circuit, when the frequency wanders from the sync pulse reference the resulting control potential is

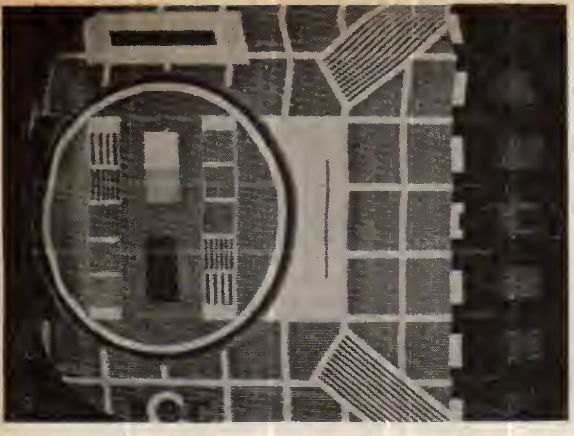


Fig. 5: How incorrect flywheel sync phasing can displace the picture in the raster.

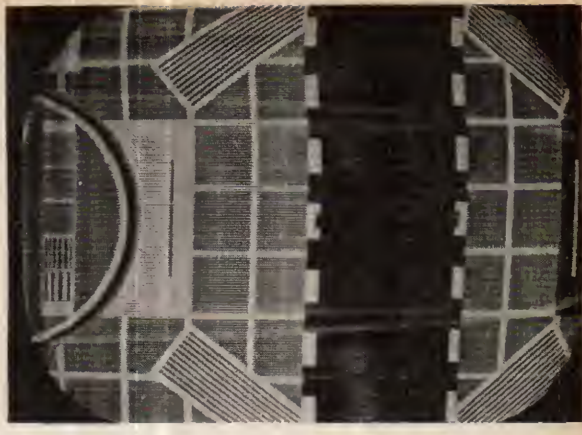


Fig. 6: In this example the phasing error, and hence the displacement, is more severe.

fed to the grid of the first multivibrator valve V2 via R4 and R5 instead of to a reactance valve. The overall effect is the same however because the change in potential at V2 grid changes the multivibrator frequency, increasing or decreasing it from that set by the hold control depending on whether the control potential is positive or negative—that is whether the generator is tending to run slow or fast.

The circuit in Fig. 4 has separate line hold (lock) controls for the two standards, this being achieved simply by switching from one to the other on line change. There is also the added feature of the tuned circuit in the anode of the first multivibrator valve (V2). This rings at the appropriate line frequency (10,125Hz on 405 and 15,625Hz on 625), the correct ringing frequency being established by core tuning. On the 405 standard both inductors are in series, while on 625 the top one is switched out leaving only that connected nearest to the valve's anode in circuit. This ringing effect helps with the flywheel action.

In both circuits the long time-constant referred to earlier is established by the components feeding the control potential to the reactance valve (Fig. 3) or the multivibrator (Fig. 4) and if these go wrong or change significantly in value unusual hunting effects will appear on the picture giving a sort of curvature effect to the verticals.

However before we get too deeply involved with testing techniques it is instructive to consider one or two fault symptoms. It is possible with flywheel circuits for the repetition frequency of the generator to be matched with that of the line sync pulses yet the phase to be displaced by several degrees. When this happens the whole picture, while remaining in line lock, is displaced *within the raster* to the left or right, as shown by the photo in Fig. 5. An even more severe phase displacement is shown in Fig. 6, while much smaller displacements are shown in Figs. 7 and 8.

Some systems incorporate a special circuit for adjusting the phase of the oscillator independently of the frequency, and some of the early sinewave sys-

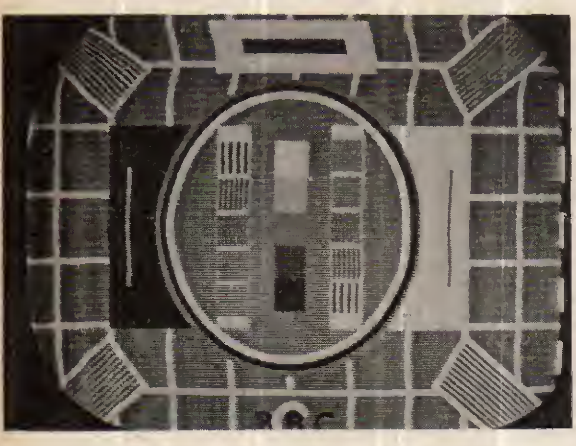


Fig. 7: The displacement here is to the extent of a cut-off on the left-hand side of the picture only.

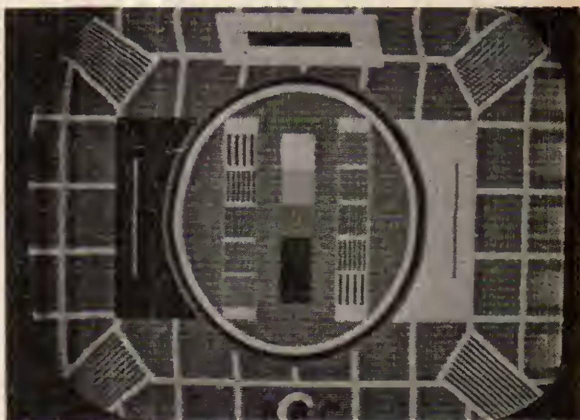


Fig. 8: Very slight phase error shows as part of the left-hand side oblongs being sliced off. Such an error can be caused by unbalance in the phase discriminator circuit.

tems are of this kind. The idea is first to set the frequency for the best possible and most consistent line lock, irrespective of how the picture is displaced in the raster, and then adjust the phasing preset to bring the picture to the middle of the raster, avoiding the cut-off effect shown in Figs. 7 and 8.

At this juncture the best way of adjusting the actual frequency must be emphasised. There is little point in swinging the line lock control over its range until the line pulls into lock, for it is possible to secure a temporary lock when the setting is far from accurate, and this soon shows up by the line flicking out of lock again on a change of scene or camera. The plan is to very carefully adjust the control until the picture continues to remain in lock or jump immediately into lock after pulling out the aerial plug and putting it back again. If this action necessitates resetting the lock control, then its original setting was wrong. To avoid having to test each time by removing and reinserting the aerial plug many sets feature a so-called push-and-twiddle control (these are also present on the latest colour models —the BRC range, for instance) which is designed to disconnect the line sync input when pushed in. The rotating part of the control is the ordinary line lock, and once the sync has been disconnected by pushing the control in a very sensitive setting of this control is possible, the line just about locking (vaguely) when the setting is correct, at which point the knob is released to reconnect the sync thereby establishing a really solid lock which is unaffected by changes in picture content or interference and which occurs immediately the set warms up after a period of inaction.

(a)—above *(b)—below*

Fig. 9: Equal but opposite phase sync pulses are fed to the two flywheel sync discriminator diodes.

Fig. 10: Hum in a flywheel-sync circuit. This is not uncommonly caused by a heater-cathode leak in an associated valve.

If the picture phasing is in error after the correct locking position has been established the phasing preset (if fitted) should be adjusted to correct this, returning afterwards to the line lock to ensure that this is still optimised. If on the other hand it is impossible to lock the picture—albeit vaguely—and there is a tendency for the picture to come into lock when the control is turned hard in one direction, then the oscillator tuning must be corrected. When the circuit is like that in Fig. 3 the plan is to set the line hold control to range centre and adjust the oscillator tuning (the core in L1 in this case) until the conditions as just mentioned are obtained. When the set has no means of line sync disconnection it sometimes pays to connect a simple toggle switch in series with the line sync pulse input to the discriminator if this is possible (at the point marked X in Fig. 3).

Sets without a preset phasing adjustment should automatically phase correctly when the generator frequency is set correctly. If this fails to happen, however, check any preset inductors present. If the picture remains well displaced within the raster it could mean that one of the discriminator diodes is faulty or even that one of the resistors or capacitors in the discriminator circuit is faulty. A fair degree of balance is essential for the circuit to work properly. Where a definite component fault exists the most likely culprit is one of the discriminator diodes.

Technicians or enthusiasts in possession of a reasonable oscilloscope can check the diode circuit for balance by monitoring the signals at the inputs of the two diodes and comparing the two displays. For correct working they should match each other closely, but will, of course, be of opposite phase as shown in Fig. 9, where (a) is the signal on one diode and (b) that on its partner.

Circuits using reactance valves can cause quite a bit of trouble if the valve is a little faulty. For instance hum due to heater-cathode leakage can give the symptom shown in Fig. 10.

NEXT MONTH: SOUND FAULTS

DX TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

CHARLES RAFAREL

BECAUSE of the revised layout of the magazine the deadline for this issue has had to be brought forward so that only a short period can be reviewed. I was hoping that sufficient time would have elapsed for a significant improvement in DX to have taken place but alas the terrible conditions of the last period still persist. However there seems to have been at least some marginal improvement.

Once again this is a combined report for M. Opie and myself of reception in the Bournemouth area for 13/1/69 to 31/1/69. SpE first:

- 22/1/69 Czechoslovakia R1, USSR R1 and East Germany E4.
- 23/1/69 Czechoslovakia R1.
- 24/1/69 West Germany E2.
- 25/1/69 Czechoslovakia R1.
- 26/1/69 West Germany E4.
- 28/1/69 Czechoslovakia R1.

There was even one reasonably good day for the Trops on 25/1/69 with France F2, F8, F8a, F10 and F12 all coming in quite well. This opening however, as is now usual, did not develop or last very long, and u.h.f. at this time was dud.

Regarding F2 the USSR Forward Scatter Network in the 35-40MHz band was once again active on the 15th, 18th and 21st January, but for what exact reason is not yet apparent.

Returning to the magnificent reception by F. Smales of Pontefract of WGR Buffalo Ch.A2, I have a letter from an old DX friend in the States, F. Dombrowski of Milwaukee. His local station relays WGR and I quote what he says: "During commercials for a WGR furniture store the huge letters WGR are shown behind the announcer exactly as described in the January issue!" The operative word is huge; that I think explains why Frank could read them in spite of multi-path F2 images—other TV stations please copy!

F. Dombrowski is an active member of an American club "The World-wide TV-FM-DX Association", which as its title indicates is exclusively concerned with TV and f.m. DX. A monthly bulletin is published for interested DXers and the annual subscription here is 30s. ($3.50) by International Money Order. A specimen copy can be had for two International Reply Coupons (30 cents). Write to Mr. F. Dombrowski Junior, P.O. Box 5001, Harbor Station, Milwaukee, Wis. 53204.

His general comments on DX this year in the Northern part of the States are of interest. For SpE he says 1968 was the worst ever for him, just like our experiences over here, but farther south things have been much better, as we recently reported. The Trops were poor as well, with openings restricted to a maximum of 500 miles, whereas a year ago the distances were up to 700 miles. Up to 1963 he logged 300 stations so his future scope is of necessity somewhat limited and he suggests that the future lies with u.h.f. DX.

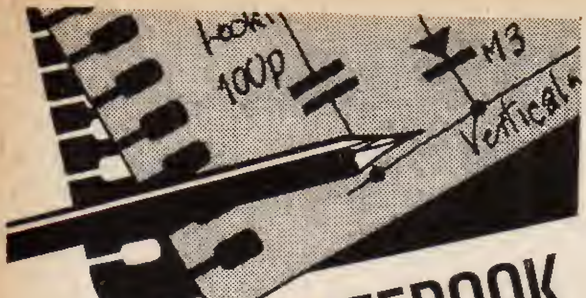
My sincere wish for DXers everywhere is that 1969 will be better than 1968. So let us get ready now by overhauling the equipment. I have already started by fitting a new c.r.t. to the old Siera Belgian TV, extracting a couple of u.h.f. (now redundant) tuners, a c.r.t. over-run transformer and a mass of small components put in at various times for now obscure reasons! In fact I have nearly enough spares to make up another set! The old set is performing better than ever now that it has been returned to more or less the maker's original intentions; I suppose that under poor conditions one can get a bit too clever in trying to push up the gain.

R. Bunney tells us that on Iceland TV there are now in addition to the original Band III station two low-power relays in Band I: Hvalfjördur Ch.E2, 0.05kW; and Skalafell Ch.E4, 0.05kW. Although these are very low-power stations there is one advantage in that if an opening occurs over the Atlantic they are the only ones that could come in, so we might just be lucky. For the Test Card please see data sheet No. 23.

I have been checking through ORTF's latest list of low-power relays for 1st chain, and I hope to give more news soon when a second list including u.h.f. is published. The list to hand covers North Eastern France and it is worth noting that Boulogne I Mt Lambert is operating on Ch.F4 horizontal at 40W. I remember this one from a long time ago. It could prove a possible for DXers in the Dover/Folkestone areas, as a "new" one.

Since our report in the last issue of the very good log of Bruce Thomas of Castleford we have heard direct from him (the earlier information came from F. Smales). We now have the complete log for the Trop opening of 13/12/68 and in addition to the list we have already given he had Denmark Zeeland E6 and West Jutland E10 and West Germany Langenberg E9 in Band III, and on u.h.f. West Germany Dortmund Ch.25, Hamburg Ch.40 and France Lille Ch.21. I make his total now 29 stations in seven countries which is very commendable indeed.

D. Bowers of Saltash found some quite good SpE openings in December 1968 with East Germany E4, West Germany E4 (SWF and NDR), Czechoslovakia R2, USSR R2, Holland E4, Belgium E3, Spain E4, Norway E4, Sweden E4 and France F2 and F4.



SERVICE NOTEBOOK

G. R. WILDING

MANY BBC-2 faults that seem to be caused by u.h.f. tuner misalignment or a defective component switched in on 625 are due only to a faulty valve or to an over-advanced sensitivity control. For instance, we were recently called to see a Marconiphone 23in. model which the owner said had intolerable hum on BBC-2 but was all right on the other stations. The hum turned out to be vision buzz as anticipated but despite the most careful adjustment of the fine-tuning control it could not be eradicated.

There was no separate u.h.f. sensitivity control for user adjustment so we switched off and examined the interior for a preset. The only sensitivity adjustment was a chassis-mounted local-distance potentiometer in operation on 405 only. On reference to the manual it was suggested that if signal strength was sufficient to cause cross-modulation on 625 an aerial attenuator should be used.

However although signal strength was adequate in this particular instance it wasn't excessive and of course the set had originally worked perfectly from the same aerial. There seemed a strong possibility therefore that some drift had occurred in the u.h.f. tuner.

On switching on again BBC-2 reception was perfect but within a few minutes the vision buzz returned and gradually built up to an intolerable level. This was obviously caused by the effects of heat so we immediately replaced the PC86 r.f. amplifier and found that this completely cured the symptoms. The valve was probably passing some grid current when hot thus dampening the input circuit and altering the overall response curve.

In another example after replacing an open-circuit mains dropper resistor in a modern Bush Model TV166U we found perfect v.h.f. reception but on u.h.f. the line hold was extremely edgy and the raster edges wavered about.

The owner did not have a separate u.h.f. aerial but merely transferred the v.h.f. aerial to the u.h.f. input when required and thought the weak line hold on BBC-2 was due to not having the correct aerial. In point of fact the output from the v.h.f. aerial was more than adequate and on reducing u.h.f. contrast and slightly readjusting the push-button fine tuner the resolution of the finest gratings was outstanding, but the wavering and edgy line hold persisted although not to the same extent. We then replaced the PCF80 line oscillator and obtained perfect line lock.

Finally we must mention that in some Thorn receivers (Ferguson, Marconiphone, Ultra, HMV) poor field hold on u.h.f. with normal field hold on v.h.f. has been due to a weak vision i.f. amplifier.

On u.h.f. sync pulses occupy from 77% to 100% of carrier amplitude while on v.h.f. they rise from zero to 30%. Thus if a valve is slightly soft or has low emission the high amplitude u.h.f. sync pulses can be clipped or limited to impair their timebase triggering action.

Timebase Squegging

We had a very unusual fault in a modern Ultra 19in. model recently. The complaint was normal sound, no picture, the latter being due to no e.h.t. Inspection showed both the line output pentode and boost diode to be without h.t. through an open-circuit fusible resistor.

As there was no measurable h.t. short-circuit present we lightly resoldered the resistor clip and switched on. We then obtained wildly erratic line scans, some wide, some narrow and pulsating or oscillating about once per second. It was almost the timebase equivalent of a.f. motor-boating and if speaker hum level had been high or the set not so new we might have suspected an open-circuit main smoothing capacitor.

Although not expecting it to cure the trouble we replaced both the 30FL14 line oscillator and PL500 line output pentode "just in case" (no matter how remote the possibility, it always pays to check-replace valves when investigating unusual faults before getting involved with circuit tests).

Results were exactly as before. We then put our meter test prod to the line output valve grid to check if line drive was similarly erratic and were immediately rewarded with an almost normal if slightly smaller raster but which still pulsated slowly. On reducing the meter's voltage range the pulsations completely stopped, leaving a stable raster. Clearly the grid had been floating, that is not returned to the chassis till the meter was applied.

In this particular model there were several suspects (see Fig. 1), a 470Ω grid stopper, 2·2MΩ grid leak and a v.d.r. or even the 1·8MΩ resistor leading to the slider of the width control potentiometer. All were really rather improbable suspects since grid circuit resistors seldom go open-circuit. But the fact remained

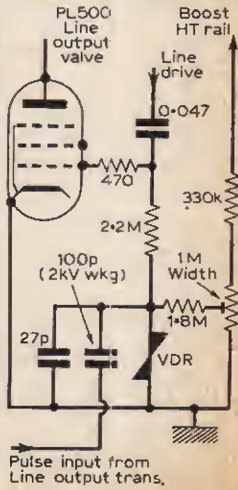


Fig. 1: Line output valve grid circuit.

that there was no continuity from the line output valve grid to chassis.

We found the cause to be the v.d.r. becoming unsoldered from the printed panel. We often find high-wattage resistors becoming unsoldered from panels when subject to extreme overload, but in this instance as the set operated almost normally with the meter from grid pin to chassis and indicating a small negative voltage it was difficult to see why the v.d.r. had heated up.

However, on resoldering the v.d.r. back into position, although we obtained an excellent raster, it started to heat up and we found that no less than 500V developed across it. The only real possibility then was that the 100pF 2kV capacitor feeding a pulse from the line output transformer to the v.d.r. was leaky.

This proved to be the case, and on replacing this capacitor, and also the v.d.r. as it appeared to be somewhat damaged by the potential applied to it, we obtained a full size, perfect raster.

Philips T-Vette

One of these excellent 11 in. portables was brought in for service with the complaint of insufficient width on both systems. This receiver, similarly to other small portables, can be operated from the mains or a 12V battery, and our first move on plugging into the mains was to check the l.t. supply voltage. Normally it should be 11V, regulated by a three transistor plus zener diode arrangement so that despite mains voltage variations or the gradually falling voltage from a battery the l.t. rail voltage remains constant.

The measured l.t. voltage in this receiver was only just over 9V, so lack of width was purely due to low l.t. In this model there is a preset potentiometer (supply adjust) which can vary the bias applied to a voltage-sensing transistor, associated with the zener diode, whose output in turn controls the base potential of another transistor emitter-coupled to an AD149 power transistor connected in series from l.t. +ve to the l.t. rail. The greater the forward bias applied to this last transistor, as determined by the setting of the supply-adjust control or by a regulating voltage from the transistor/zener diode combination, the greater its conductance and the smaller the potential developed across it. Once the l.t. rail voltage is set at 11V by the preset control variations in mains or battery supply are automatically compensated by the regulator circuit.

To ensure that the receiver was not taking excessive l.t. current and thereby over-running the regulating circuit we removed the l.t. fuse and connected an ammeter across the clips to check consumption. Normally it should be 1·3A on v.h.f. and 1·5A on u.h.f., but in our example it was just under 1A on both systems, so obviously the fault was in the l.t. supply system.

Adjustment of the preset control had negligible effect on the rail voltage and although it varied the collector potential of the associated transistor, this seemed to produce no material voltage changes at the intermediary or power transistors.

We then compared voltages with those in the service manual and immediately found a major discrepancy. The collector voltage of the intermediary transistor, termed the feedback amplifier, was over 15V whereas it should be 5·25V on v.h.f. and 5·5V on u.h.f. The emitter of this transistor is directly and solely connected to the base of the power transistor or regulator.

The resistors were all as specified so we next made the usual ohm checks from base to emitter and base to collector on both these transistors. However, the associated resistors were of so low value and the general circuitry such that the readings we obtained were meaningless and it became necessary to isolate them from the circuit.

Always following the line of easiest checks first, we found that the big power AD149 transistor was very accessible while the intermediary AC128 was mounted on a small printed panel and its removal and replacement would entail delicate soldering.

On removing the two base and emitter leads from the AD149 we found a low base-emitter resistance with meter test-prods one way round but a high value when reversed—the normal results.

However the base-collector junction was found to be open-circuit with the test-prods connected both ways, so obviously this transistor was the cause of the low l.t.

With the power transistor's collector-base junction open-circuit the receiver l.t. could only pass through a resistive network from supply to l.t. rail and there was no current path through the regulator.

An excessive voltage drop therefore occurred across the latter thus reducing the rail voltage. The high intermediary transistor's collector voltage returned to normal when we replaced the AD149, while the l.t. voltage rose to 11·8V which we could then reduce with the preset control.

When testing transistors in this simple but quite reliable manner a reverse-forward resistance ratio of at least 25 : 1 should be found, but, of course, with high-power transistors the reverse resistance reading will be less than that for small-power types.

Probably the two most useful attributes of a test-meter when servicing transistor receivers are an accurate low-range ohms scale and fine, sharp pointed prods. Resistor values can be so low that average ohms ranges will not indicate with certainty whether or not a short-circuit exists across them. This particularly applies to power supply and regulator circuits, where, as in this Philips model, resistors of 12, 10 and even 0·75Ω are employed.

Finally, in all transistor service work check and recheck all possibilities to eliminate unnecessary transistor and component removal. In so many cases the greater proportion of time spent on transistor TV service work is in replacing perfect items.

TO BE CONTINUED

UNDERNEATH THE DIPOLE

A CAPTION that should always be kept in readiness on BBC-2 is *PLEASE DO NOT ADJUST YOUR RECEIVERS*. Warnings of this type have long been useful to viewers on BBC-1 and ITV's main and regional transmissions. They most frequently concern interference from foreign transmitters and other distortions beyond the control of the engineers of the studio or television transmitters concerned—or to faults in the GPO lines and links between them. Rarely are the station's engineers to be blamed.

However quite a different situation has arisen on colour television, largely due to the amazing improvement in the colour quality of BBC-2 transmissions during the past few months. But this technical excellence is not consistently good and when BBC-2's colour is poor, oversaturated, distorted and out of alignment it is often so bad that viewers blame their sets and telephone their hire-maintenance service company demanding immediate service. Skilled television service engineers (with the right instruments) are worth their salt and added up all over the country can cost their employers hundreds of pounds in wasted time following for instance the transmission of poor colour film prints or video tapes or fourth-generation duplicates of ghastly colour studio work.

These nasty colours are mostly of foreign origin and are passable when seen in black-and-white. The American show *Rowan and Martin's Laugh-In* for instance is a crisp, slick and wisecracking show, and visually acceptable in black-and-white. In colour however the stars usually have faces as red as irascible lobsters (dipped in pyrosoda). Seen in colour the supporting cast resembles misaligned cartoon supplements in American newspapers. In the USA they don't seem to mind such distortion and viewers revel in the strange hippy trend of powerful chromological hues that bear little relation to real life.

The colour quality of the preceding BBC programme may have been excellent in every way: those programmes recently videotape recorded at the BBC Television Centre have benefited by the enormous strides which have been made not only in electronic equipment but through close collaboration in stage lighting and portraiture, make-up, décor and wardrobe. Together these contributions achieve an art which conceals art, a worthy objective.

To reassure tenderfoot colour viewers, especially those with very new colour sets, the BBC should give advance notice of filmed or taped colour programmes that are below par (as seen on monitors during rehearsal) as follows: *THE COLOUR OF THE NEXT PROGRAMME IS BELOW STANDARD FOR REASONS BEYOND OUR CONTROL. PLEASE DON'T TWEAK YOUR SETS!*

As we go to press I have just heard that BBC-2 has made successful protests about the sour colour and some of the parochial Los Angeles jokes in the *Laugh-In* programme.

RINGING THE CHANGES

It will not be long before there will be three colour TV channels in operation in Britain, BBC-2 plus BBC-1 and the fourteen Independent Television Companies. In some rather privileged "high places" (on hills) it may be possible to pick up two or three different ITV channels in addition to the BBC colour transmissions. High outside aerials and low-loss downleads are usually necessary in any case, and in some sites it may be advantageous to twist the aerial on its mast by remote control towards the required signal.

There may well be differences in colour balance between the ITV transmissions and those from the BBC. For everyone's sake it is hoped that all TV studios in Britain work to the same colour balance to ensure that the faces of the actors don't change from a ruddy sunburn on a BBC channel to an ashen pallor on a colour ITV station! I have seen 11 different styles of colour balance from 11 television stations on a hotel room receiver in America. Skin texture is the most important single common factor. The present BBC-2 colour test card (child and doll) is a splendid setting-up signal for *all* stations to use.

WORLD MARKET FOR COLOUR AND MONOCHROME

Transferring colour video tape to high-quality 35mm. colour or monochrome film for the world market has been accomplished by Technicolor on their Vidtronics system shortly to be reported in PRACTICAL TELEVISION, and the different taste in colour by different nations can be dealt with in the colour grading of the film print required. The USA prefers a bold, warm, optimistic colour balance whereas Japan likes a much paler effect such as is readily obtained with shadowless fluorescent-tube studio lighting. The Continent of Europe seems to favour a low-key chiaroscuro of shadows, the taste becoming more gloomy in Scandinavian countries. The lighting experts of the BBC colour television centre each have their own particular styles but all are nearer to my own particular liking for portraiture. This is soft low-contrast lighting which flatters even the most beautiful female face and emphasises the type of character to be portrayed.

Strand Electric's "Cosmetic" lighting may help with this approach to theatre stage lighting too, which has suffered by the temporary abandonment of the most useful tool of the lot (when properly used), the footlights. The filler light is just as important as the keylight and the kicker light puts the emphasis in the right place just as imaginative colour separation between foreground actors and a busy backcloth can make the actors stand right out in a stereoscopic manner.

BALLET IN COLOUR

Ballet combines dancing with music, drama, mime, décor, wardrobe and colour. Dancing and music are the controlling factors but colour influences every one of them. From the very start of public television in 1936 viewers have seen snatches of ballet in monochrome and, more recently, in colour. However good it was in black-and-white on 405 lines, the transition of ballet to colour and to 625 lines has made a tremendous advance.

The transmission of *The Sleeping Beauty* from the stage of the Royal Opera House, Covent Garden, beautifully performed by the Royal Ballet Company, was a delight for sore eyes. Antionette Sibley and Tony Dowell as Princess Aurora and Prince Florimand respectively were "backed" by a corps de ballet with delicately coloured dresses which looked charming in colour TV against magnificent scenery. Immaculately presented with superb lighting and valuable guidance by a pleasant young link man to introduce each act the whole lengthy programme was intensely satisfying. It had twice the impact of a monochrome picture.

I look forward to colour outside broadcasts from another gracious London theatre the Coliseum, which has been restored to the original Matcham auditorium designs. Brilliant productions (in the English language) are now being presented there of new and recent operas in addition to long standing classics. Spectacular and dramatic productions include *The Force of Destiny*, a new version of Verdi's great work which includes big battle scenes, duels, choirs of 86 persons and field guns (with ammunition by Strand Electric) and brought from the audience at the opening night 19 curtains and a standing ovation. A pity it wasn't colour taped by the BBC. The magnificent lighting and technical knowhow of Charles Bristow and John Wyckham played an important part in the enormous success of Stephen Arlen's ambitious production.

The delicate shades of colour in ballet and opera show up best when the three colour separations and their combinations are restored with consistent accuracy, such as is now achieved with the new Rank-Bush-Murphy and Plessey colour receiver integrated circuits. This development was first revealed by Bernard Rogers, Head of Bush TV Research, at the International Broadcasting Convention last October. Further details and a demonstration have just been given by him at a British Kinematograph, Sound and Television Society meeting. Described by many as a system which will take the worry out of set maintenance, it will soon be in demand by other set manufacturers.

NEWS AND COLOUR

So far I have been dealing this month with some of the better and finer things (and pious hopes) about colour television, to which I am now, needless to say, devoted. The newsreel cameramen at home and abroad have to make the best of any news story they can cover on colour motion-picture film. The newsreel cameraman is a pictorial journalist who has first to get his story, then to relate it (with or without sound) so that it can be cut together speedily, lending itself to commentary, when required. Eastman Kodak or Gaevachrome are the film stocks mainly used for TV news coverage in Britain with 16mm. colour-reversal negative.

With the widest variety of lighting conditions the news cameraman may film the laying of the foundation stone of a concrete monstrosity of a theatre building one day and be involved in militant student warfare on the next. How on earth is it possible to secure film that will cut together without startling colour balance changes? This is one of the things to which Independent Television News attempted to find an answer when representatives of 14 ITV companies attended a conference in February.

Under the Chairmanship of Cyril Moorhead of Independent Television News a common objective was sought as regards type of colour film stock, processing, magnetic striped sound usage, lighting, synchronising and still photo coverage. A tall order this, especially as comparisons with recent BBC achievements have to be expected. There is a long queue of ITV orders for the Cintel flying-spot colour telecine, which includes the BBC's T.A.R.I.F. correction device. The ITV companies each have their own individual ways of working in their local news operations and some of the best work in black-and-white has been networked from smaller regions such as Border and Westward. There are bound to be differences in style and proficiency but competition should keep them all on their toes.

Certain rules for filming which date back to the days of Cecil M. Hepworth and orthochromatic film stock (which was insensitive to the colour red) and to portraiture still apply though we are now in the age of colour: (a) Try to film the face of your subject against a mid-tone background and not against the sky or a white background. (b) Expose for the shadows and let the high lights take care of themselves. (c) Avoid profiles if possible. (d) Save footage. If your story can be joined together by merely removing the camera stops between shots you're doing fine. (e) Make sure the camera is steady and securely mounted.

These are ancient rules. We must now add that quick pans, quick zooms, and gimmicky shots should be used sparingly; hand-held cameras do not *have* to shake; camera-film gates must be kept clean; and footage saved is useful—get the story with minimum footage or the film editor will have extra cutting to do.

Television journalism concerns the film cameraman more than anyone else. He is a showman as well as a journalist and cameraman and must bring back the story in a showman-like way. I remember an occasion at Westward Television Plymouth when at 5.25 p.m. (17.25 to you) a cameraman drove in with his day's work. "A factory fire has just started on the other side of the railway bridge" he said handing in the film magazine of his day's work. "I'm going back to cover it." He was back at the factory within a minute of the fire brigade. Ten minutes later he was back at Westward with the story in another camera magazine—and the film processing department had the solution ready and warmed up for development. At 18.05 precisely the *Westward News and Diary* was on the air and behind the title was a sky-shot with smoke which panned downwards to firemen directing hoses on the seat of the fire—a furniture store. More shots followed, all cutting together beautifully and commented on by the announcer. That's professional newsreel work, that is!

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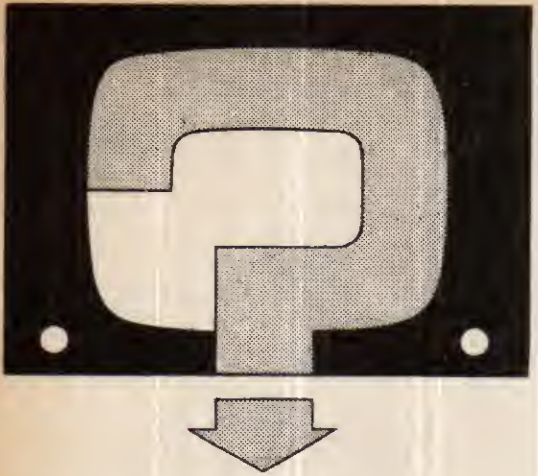

YOUR PROBLEMS SOLVED

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply service data or provide instructions for modifying 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 331 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

PHILCO 1090

I have put two new PCF80 valves in the tuner and the third one is now on its way out. I keep on having to retune the fine tuner every five or ten minutes.—L. Knibb (Northampton).

We doubt if the PCF80 valves did fail. It is far more likely that a resistor has changed value. Particularly check the 6·8kΩ oscillator anode load.

SOBELL T279

There is no sound or vision on Channel 9, no sound on f.m. and a weak signal in the form of grey and black lines accompanied by a rushing sound on Channel 1.

Channel 9 and f.m. failed first leaving me with just Channel 1 which was perfect for two months, then the picture suddenly began to go very bright, returned to normal for a few minutes then disappeared altogether.—J. James (Essex).

The fault is due to a resistor in the tuner changing value or going o/c altogether. If you remove the tuner unit cover, you will see the resistor across the PCF80 valve base. The correct value of this component is 10kΩ 1W.

GEC BT2748

The above mentioned television set has given good service in the past. However after an evening's viewing on switching the set on the following day there was no sound, vision or raster. All the valves and the tube heaters were alight.

There was complete lack of e.h.t. and the line whistle could not be obtained.—I. Sullivan (Middlesex).

This is the symptom of voltage failure. Check on the h.t. line with a voltmeter. Zero voltage should lead to a check of the rectifier, fuse and a.c. feed to the rectifier. Low voltage could indicate a short or leak on the line due for instance to a failing electrolytic smoothing capacitor or an electrical leak in a transformer.

REGENTONE 194

On switching on, the picture rolls upwards. After adjusting the vertical hold about three or four times, it remains steady. The PCL85 valve is in good order.—J. Hugo (Co. Durham).

If the fault is not one of a weak field sync, check the resistors and capacitors associated with the hold control and pin 2 of the PCL85.

PHILCO 1091

Could you please state the correct resistor values for R10 and R14. They measured about 1kΩ each but were marked brown black brown. I replaced these as I was looking for a fault i.e. no vision and no sound. I finally discovered there was no earth connection between the receiver panel and the timebase chassis.

Connecting a wire to these restored vision and sound but there is vision-on-sound interference which has made me wonder if the above two resistors were correct after all.—J. Etherington (Surrey).

Resistors R10 and R14 are both 1kΩ in value. The vision-on-sound may be due to excessive signal input or incorrect sound i.f. alignment.

HMV 2633

I am shortly moving from Manchester to an industrial area in Berkshire where piped BBC-2 is available. This comes on Channel 4 Band I. I would be grateful if you could tell me what modifications will be necessary to enable my set to function on the above arrangements.—J. A. Somers (Berkshire).

The modifications are quite simple. Disconnect the lead from tag board connector E. Connect a shorting link between tags E and F. This allows the switching to take place whilst still maintaining the h.t. to the v.h.f. tuner.

Replace the "U" biscuit in the v.h.f. tuner with the Channel 4 biscuit.

KB WV09

Some months ago this set developed uncontrollable picture roll which was traced by a service engineer to an interelectrode short in the EF184. Shortly afterwards the picture lost detail on white and the picture depth decreased at top and bottom. There are also two faint white lines about half the picture depth apart, which slowly roll down the picture: Changing the PCL85 does not improve it. When either of the faint lines is in a position half way down the screen there is no appreciable difference in either half of the picture. I am wondering whether the trouble is in the interlace, and if so how to tackle it. The picture is not sharply focused.

Another trouble that developed after servicing was the picture came on after about half a minute as usual but was faint and takes about 20 minutes to attain full brilliance. There is plenty of brilliance then and the tube appears to be in good condition.—R. Bottomley (Somerset).

Some of the loss of brilliance and focus may be due to the focus control changing value. It should be 2MΩ. Check the 0·1μF decoupling the boost supply to the height control, and the resistors 100kΩ and 1MΩ.

Check the electrolytic capacitors, especially that associated with the field output stage.

BUSH TV75

Although this set it fairly old the picture was a good one till I lost control over the brightness. On switching the set on with the brightness control fully down the picture comes on with too much brightness and the field flyback lines are visible. When the contrast is turned down the picture goes grey. All the valves are good so could this be a fault in the tube or the resistance network.—K. Hickman (Coventry).

It is possible that there is a grid-to-cathode leakage in the tube. Quite often connecting pin 2 directly to chassis with pin 11 connected to h.t. will clear the short. Check the brilliance network from pin 2 and the brilliance to chassis if necessary.

KB KV001

The trouble is vision on both ITV and BBC. It started about four weeks ago with a dark spot in the middle area of the screen. This could be removed by setting the contrast control full over to the left side and the brightness knob in a certain position. As time passed the picture took longer from cold to appear and over the period it grew worse until now there is no picture at all.—W. A. Lysamore (Devon).

First listen for the line timebase whistle. If this is present check that e.h.t. is reaching the DY86 (DY87) right side e.h.t. rectifier.

If it is check this valve and the 2·7Ω heater circuit resistor in the valve base socket.

PYE 830A

Occasionally I get a double picture with about one inch overlap. I can correct this by adjusting the vertical hold, but it doesn't stay put for long and is very critical. I have changed this pot and also the valves in the line section but still no result.—W. E. Hicks (Birmingham).

We advise you to check the PCL85 valve V13 for your trouble, and if this does not produce a cure check the 50μF electrolytic capacitor across one end of the small transistor sync panel mounted above the main chassis. This component may be given as C47 on your printed panel.

KB 1192

This receiver developed severe sound distortion. I have tested the PCL86 and this is in perfect working order.

I have also found on this set that the fine tuner tends to alter its setting but can be put right again with a quick twist of the channel changer.—K. L. Kirkley (Newcastle-upon-Tyne).

Check the bias resistor of the PCL86 (120Ω). Then check the 8·2MΩ load resistor of the sound noise limiter diode (D7). Clean the turret contacts and ensure the valves have a good contact in their bases.

PHILIPS 1768U-07

The fault is that the line hold control will not correct line hold. By disconnecting the lead from the interference limiter control the fault is cured. What is the cause of this fault and its remedy?—J. Din (Bristol).

Vision interference limiting on this model is achieved by making use of the suppressor grid of the video output valve. In your case the vision interference limiter is tending to attenuate or distort the line sync pulses in the video stage prior to their application to the sync separator. The trouble lies in the limiting circuit so check the components in the video output valve suppressor grid circuit.

EKCO T418

I am experiencing sound-on-vision on BBC-1 only. Could you also advise me as to the correct core to adjust to eliminate ringing.—E. Britton (Middlesex).

Ringing accompanied by sound-on-vision interference is symptomatic of misalignment of the vision i.f. channel, possibly the sound rejectors. This adjustment cannot successfully be handled without the alignment instructions and suitable test equipment—signal generator and video output meter at least. Those skilled at the art however can often eliminate sound-on-vision by tuning for the best vision and then carefully adjusting the sound rejector in the vision i.f. strip for minimum sound on the picture; this though cannot generally be recommended.

PYE TV15

The trouble started with loss of raster when the brightness control was turned up. In moving it to my work room I dropped the set. After replacing the broken valves and making three repairs to the printed circuit I find that sound is satisfactory on both BBC-1 and ITV but can get no raster at all. The PCL84 video amplifier has been renewed while the PL36, PY800 and the EY87 have been tested and found all right. The usual tests for e.h.t. reveal bags of spark at the EY87 anode, but hardly anything at the tube. I have no means of reading the voltages obtainable. In passing I should mention that a DY86 inserted in the EY87 holder by mistake results in a clear picture but does not fill the tube width to its fullest.—J. Thompson (Lancashire).

Our manual gives the e.h.t. rectifier V18 as a DY87. We advise you to try one of these in the holder before proceeding.

The width controls R104 and R105 are on the top of the timebase panel, and other causes of low width are a defective PL36 or a leaky coupler 0·01μF C87.

SOBELL TP710

There is a gap of about 2½in. each side of the picture. Everything else is OK.—B. David (Aberdare).

Check the line output valve and replace if necessary. Check the h.t. voltage and if this is lower than specified, change the h.t. rectifier.

EKCO T433

The picture has shrunk in size 1in. top and bottom and ½in. on the left side of the tube. I have had new valves (PY800, 30P19) but they have not made any difference. There is also a white line ½in. from the top of picture and 4in. long each side of picture. —H. Robinson (Lancashire).

The reduced picture size should lead first to a check of the h.t. line voltage. If this is much below 210V attention should be directed to the h.t. rectifier and, if you are sure that this valve is in order, to the connections and components on its anode and cathode. If the voltage is about normal or a little high suspect low emission of the line output valve or booster diode. Also if necessary check the boost reservoir capacitor. When you have achieved the correct picture size, the lines—due to test pulses—at the top of the picture will probably disappear.

QUERIES COUPON

This coupon is available until April 18, 1969, and must accompany all Queries sent in accordance with the notice on page 329.

PRACTICAL TELEVISION, APRIL 1969

TEST CASE 77

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.

? *A Philips colour set Model G25K was said by its owner sometimes to give "green" pictures instead of pictures in full colour—yet at other times the picture was said to be perfect. Checking the set on Test Card F at the customer's home failed to reveal the symptom, the picture of a child with a blackboard being perfectly coloured in the centre circle.*

The main adjustments of the set were carefully checked, but no fault could be found. The set was then switched off and allowed to cool off, after which it was switched on again. Sure enough this time the coloured information in the Test Card had a greenish predominance. The switch-off, switch-on process was repeated and it was found that the picture was just as likely to appear "green" as in perfect hue. Exactly the same effect could be obtained by changing from a monochrome to a colour-encoded transmission and back again (monochrome always being normal however) or by disconnecting and reconnecting the aerial alternately.

What was the most likely cause of this symptom? *See next month's* PRACTICAL TELEVISION *for a further item in the Test Case series.*

SOLUTION TO TEST CASE 76
Page 283 (last month)

The Bush TV141 in last month's Test Case is the type with a line timebase stabilising device in the form of a voltage-dependent resistor (v.d.r.). This is connected to a tapping on the line output transformer and thus receives line pulses to which it gives a d.c. reference and hence a d.c. voltage across a load resistor in the line output valve control grid circuit. The d.c. voltage decreases when the load on the line output stage is high and increases when the load lightens, and in this way adjusts the stage bias to suit the load conditions—a sort of line output stage a.g.c.

Examination around this section showed that the v.d.r. had failed in such a way that the grid bias was reduced on the line output valve, causing it to pass an excessive cathode current. This in fact was found to be almost 200mA against the normal 140mA for a correctly operating and adjusted stage. The heavy current in the primary of the line output transformer caused its overheating and subsequent failure.

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Thank you very much. Vernon T. Randle,
Dallas, Texas.

Extract of letter from Mr. Wendell C. Ward, Texas, U.S.A. *Sept., 1968*

I have recently read through Mr. Briggs' book "A to Z in Audio" and found it most interesting. It's refreshing to find a man who can write about what could be a dry subject with enthusiasm and humor.

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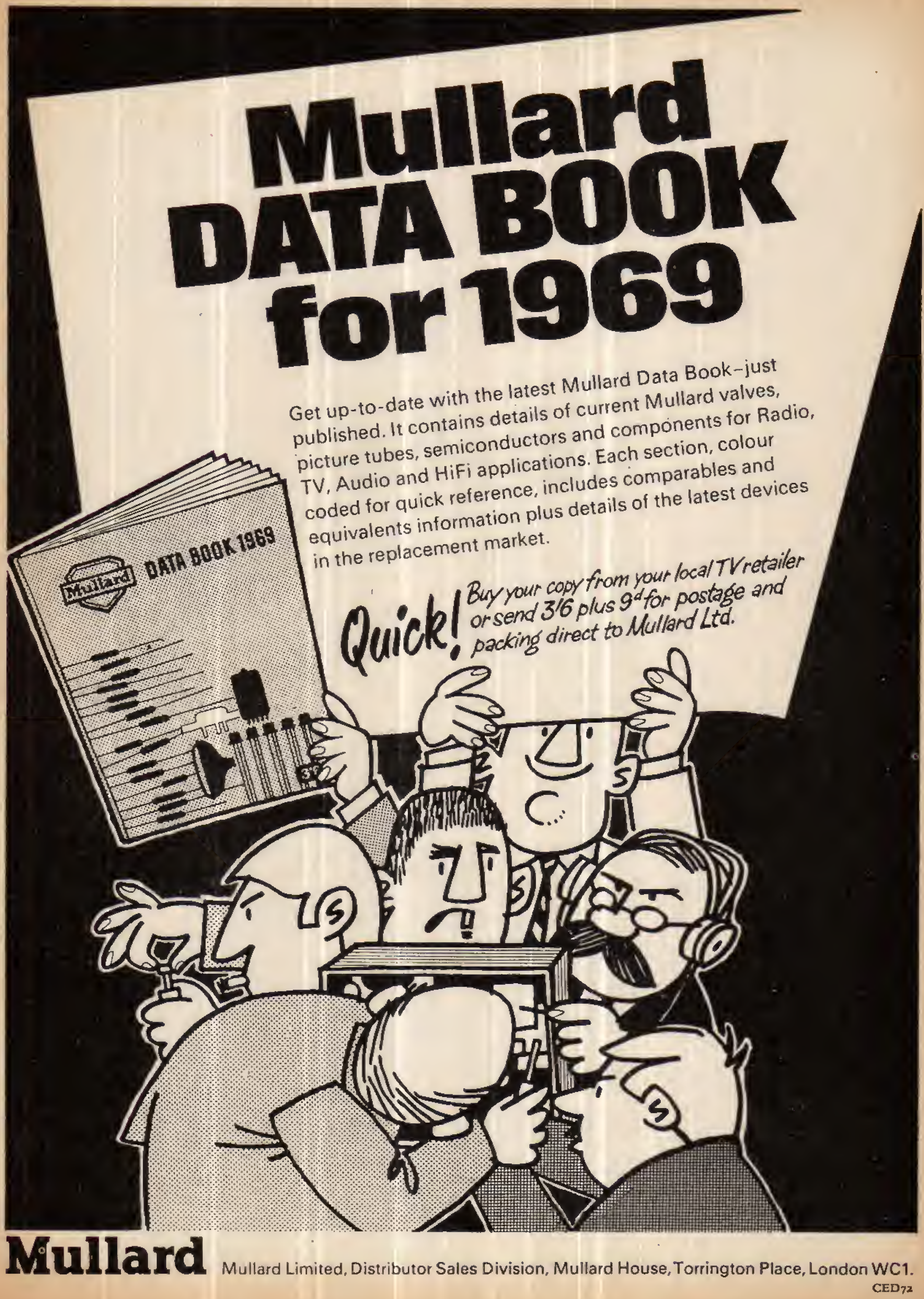
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