Practical TELEVISION

AUGUST 1966

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ECC84	5/6	EK32	5/9	HN309	26/-	PCL83	8/9
ECC85	5/3	EL32	3/6	HVR2	8/9	PCL84	7/6
ECC88	8/9	EL33	6/6	HVR2A	8/9	PCL85	8/6
ECC91	3/-	EL34	9/9	KT33C	6/-	PCL86	8/6
ECC189	11/6	EL36	8/9	KT36	29/1	PEN45	7/-
ECF80	7/3	EL41	7/6	KT41	19/6	PEN45DD	
ECF82	6/3	EL42	7/9	KT44	5/-		19/6
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PY82	4/9	U404	6/-	UY85	4/9	OC44	4/9
PY83	5/6	U801	15/-	VP4	14/6	OC45	3/6
PY88	7/3	U4020	6/6	VP4B	12/-	OC65	22/6
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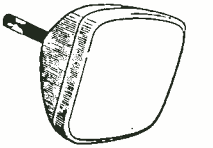

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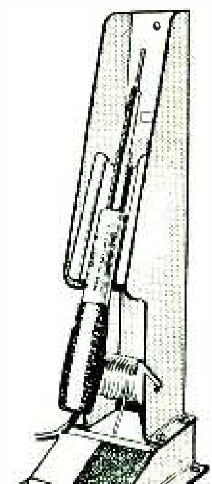

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Practical Television

AUGUST 1966
VOL. 16 No. 191

THIRD BIRTHDAY

THE patterning which appears on TV screens at certain times of the year by courtesy of Continental signal interference, due to abnormal tropospheric conditions, may be a source of discomfiture to hardened viewers but is hailed as a positively joyful phenomenon by the DX-TV hunters, who long ago realised the wisdom of the sentiment: If you can't beat 'em, join 'em.

In September 1963, P.T. also decided to join 'em. For although the number of existing enthusiasts was manifestly limited, we started a regular feature to cater for them and to stimulate others into trying their hand at this fascinating aspect of TV.

So far as we know, this was the first (and is still the only) regularly published feature for DX-TV, at least in Europe and probably in the world. To the handful of active enthusiasts in 1963, the DX-TV circle has gathered in many new participants and as we enter the fourth year the number has grown to a healthy size.

Participation does not end with sending in news to the magazine; it extends to mutual co-operation and exchanges of views and has led not only to the cementing of friendships through the mail but to personal meetings between fellow enthusiasts.

During all this time, both the magazine feature and the often heavy and voluminous correspondence from readers has been handled with unflagging energy by Charles Rafarel and this is an appropriate time to acknowledge the work of Mrs. Rafarel, a hitherto unsung heroine who has throughout displayed a tolerance at which we can only stand in amazement!

DX-TV is not, perhaps, the easiest of hobbies in which to get started and it has become clear from letters that many potential DX-ers are in need of help before taking the plunge. Therefore, starting in this issue, we begin the first of a rewritten series of articles based on those published originally three years ago, dealing with the basic principles and requirements.

We hope that these articles will successfully "convert" more readers to the cult. For DX-TV is a satisfying activity over which still lingers something of the pioneering atmosphere.

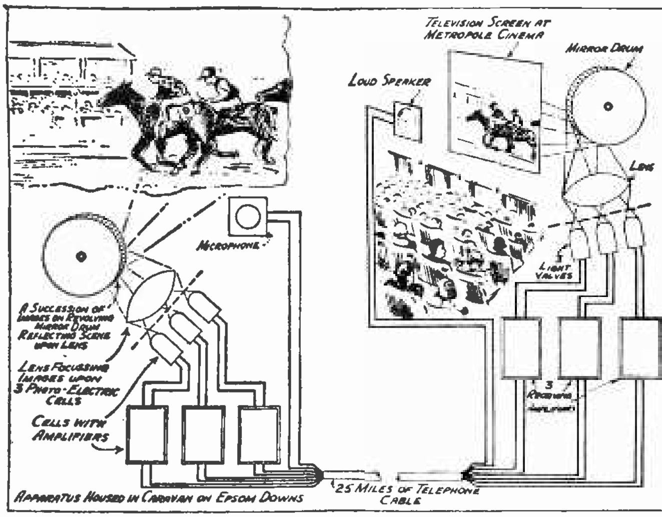
W. N. STEVENS—*Editor*

THIS MONTH

OUR NEXT ISSUE DATED SEPTEMBER WILL BE PUBLISHED ON AUG. 18th

TELETOPICS

1966 DERBY RECALLS EARLY TV TRIUMPH



NOW that the 1966 Derby is over, it is appropriate that we remember Baird's crowning success in 1931 when for the first time, scenes of the race were transmitted through BBC stations, and in 1932 were also transmitted by landline to the audience of a London cinema, where television was figuring in the normal programme throughout the week.

The *Daily Herald* (2nd June, 1932) reviewed the occasion:

"With five thousand people in the Metropole Cinema, Victoria, S.W., fifteen miles from Epsom, I watched the finish of the Derby, while thousands on the Downs saw nothing of yesterday's great race.

"It was the most thrilling demonstration of the possibilities of television yet witnessed. It made history. So distinct was the scene shown on a screen nine feet by seven feet, that the watchers forgot the race in face of the miracle that brought it before their eyes. Many of us can remember the thrill of those first 'moving pictures'. They flickered and spluttered, but out of the haze we saw men move about. Television, as we saw it yesterday, is in that stage, although the flicker is not so bad as those early films.

"We saw the horses quite distinctly as they came up the straight. April the Fifth ahead, with Dastur and Miracle close behind. We could discern the black-and-white figures of the crouching jockeys and distinguish them by the shapes of the colours they wore! As we sat in that darkened theatre, distance was annihilated. We were the first people in the world to see such a spectacle on a cinema screen. 'Marvellous!' 'Marvellous!' shouted men and women around me.

"While the excitement still raged on the Downs we were cheering Tom Walls' success, and then we came back to earth. Mr. J. L. Baird, the inventor who made the marvel possible, stepped on to the stage and received a bigger cheer than April the Fifth. He was too thrilled to say a word."

On May 25, 1966—35 years later—Baird television receivers were still in the picture—presenting all the highlights of the Derby to millions of viewers throughout Britain.

TV Trade Rejects Responsibility for Collecting Licence Revenue

CONJECTURES on steps which the Government could take to prevent TV licence dodging, brought this response from Mr. D. M. Keegan, Director of the RTRA:

"We consider it outrageous that the Post Office, having failed lamentably to enforce legislation which already exists to deter licence dodging, can even think of foisting its responsibility on to suppliers of television receivers.

"It would be a better idea, for instance, if thought was given to raising the minimum fine for licence dodging to a figure more calculated to discourage this unprincipled section of the community."

Mr. J. W. C. Robinson, M.B.E., M.A., chairman of the Radio Rentals Group, commented:

"Nobody in the television retail and rental industry condones licence evasion, but we feel that the Government's own inadequacy to act in this matter is no reason for us to be asked to set up an expensive and difficult administration to collect licence revenue on behalf of the Post Office.

"It seems incredible to me that the Postmaster - General is able easily to devise new legislation whereby the television trade is obliged to collect licence revenue while he appears unable to do anything about pirate radio stations."

NEW CHAIRMAN FOR TELEVISION SOCIETY

THE Council of the Television Society has elected Mr. John Ware, F.R.I.B.A., Dipl. Arch, London, to be chairman of council for the 1966-67 session.

Mr. Ware is now engaged as an architect in the firm, The Ware Macgregor Partnership, at Chelsea and Beckenham, specialising in work for the electronic and television industry. Recent work has been for ABC Television Ltd., Pay TV, Mullard Ltd., and Painton and Co. Ltd.

RADIO & TV SERVICING COURSES

THE London Borough of Hounslow Education Committee are holding a course of Radio and Television Servicing starting on September 26, 1966.

The course covers electron theory, magnetism, resistors, capacitors, inductors, valves and transistors. Test equipment, and fault-finding methods are also covered. This course should enable the layman to keep his radio and television-set in good repair, and prevent accidents from ignorant handling.

Enrolment dates are September 15, 16, 19, 20 and 21, from 7 to 9 p.m.

Classes are to be held at the Brentford Centre for Adult Education, Clifden Road, Brentford, and the fee is 30s. for three terms.

BBC Order Colour Cameras

ORDERS have now been placed by the BBC for colour television cameras to open their new colour service next year.

The Marconi Company has been awarded contracts for the supply of 13 of the new Mark VII colour television cameras seen in the photograph below in studio operation.

The Mark VII is one of the smallest and lightest colour cameras in production in the world, and is sufficiently stable to be operated "hands off", using only a simple control panel in the studio.

BAIRD SCHOLARSHIP AWARD

MR. J. D. Penney, B.Sc., receives the 1966 John Logie Baird Scholarship from Mr. J. C. O'Regan, Director of Radio Rentals and Baird Television, who present this award annually to the postgraduate student who most distinguishes himself in the study of some scientific aspect of television.

Mr. Penney, of London University College, will use the travelling scholarship to visit America, where he will continue research on tunnel diodes.

ABC Television Mobile-Room Unit 4

THE god Argus was said to have a thousand eyes. The new ABC Television Mobile Control Room has only six eyes, but friend Argus would be hard put to compete with it.

He would lack, for instance, the huge Taylor-Hobson zoom lenses capable of a fantastic 16:1 zoom up, almost capable of producing a portrait of a flea at 200 paces.

Inside Argus's head was muscle and sinews. Inside the new mobile unit's electronic cranium is a maze of hidden wires, the only exposed parts are the huge control panels with their glowing pattern of knobs and dials.

This completely transistorised control room can accommodate the inputs, outputs and mixing of six cameras and 45 separate microphones.

The designers have made full provision for colour and the unit can be used with NTSC or PAL with a choice of "lines" from 405 up.

The compactness of the unit can be judged from the fact that in an area 32ft. x 8ft. 2½in x 11ft. 6in., is a control room which could carry the same load as the ABC television Teddington studio 1.

Readers thinking of buying one for Christmas will need around £115,000.

Also, although the unit is fully transistorised it does draw 160 Amps from the mains.

Will the last one out *please* switch everything off.

FIELD TIMEBASE FAULTS

K. ROYAL

THE field timebase (formerly called the frame timebase) of a television receiver is responsible for the deflection of the scanning spot from the top to the bottom of the picture tube screen and its rapid return to the top to start a subsequent scanning stroke. The return stroke is termed the *flyback* or *retrace* and the time taken by this is a small fraction of the time taken by the *scanning* or *forward* stroke.

Field Waveform

This manner of scanning spot deflection is achieved by a changing magnetic field produced by a sawtooth current waveform in the field deflector coils on the tube neck. The waveform repetition frequency—which in Great Britain is 50c/s or thereabouts to match the mains supply frequency—is controlled by the field generator stage, while the coil *current* is delivered by the field output stage.

The scanning spot has to traverse the screen from top to bottom at a linear rate (i.e., constant speed) to avoid vertical distortion of the picture and the retrace has to take place within the intervals of the field scans to avoid foldover at the top of the picture. A perfect sawtooth current waveform is shown in Fig. 1, the rising trace giving the scanning stroke and the rapidly falling trace giving the retrace as shown.

In practice the waveform deviates very slightly from linear on the rising trace to combat the non-linear effect given by the scanning angle of the tube electron beam in relation to the *flat* screen of modern tubes. This deviation can be seen by adjusting the vertical linearity (form) controls for the optimum geometrical display of a test card and then monitoring the current waveform in the scanning coils on an oscilloscope. A current waveform is obtained by inserting a low-value resistor in series with the coils and then connecting the Y-input of the oscilloscope across it. The voltage waveform across this resistor is a replica of the current waveform in the coils.

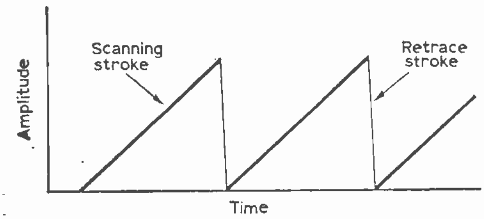


Fig. 1—A perfect, text-book sawtooth waveform on which the scanning and retrace strokes are identified.

Non-linearity

Of course if the waveform deviates considerably from a sawtooth the scanning angle/flat screen effect of the tube will be either over or under compensated and vertical non-linearity will be present on the picture. The oscillogram (photograph taken direct from the screen of an oscilloscope) in Fig. 2 reveals serious slowing down of the scanning stroke towards the conclusion of a field scan. It will be seen that the start of the scanning stroke is reasonably linear but as it progresses it becomes exponential.

Such a current waveform in the scanning coils is responsible for serious compression at the bottom of a picture as shown in Fig. 3. This test card also shows the exponential nature of the waveform, this giving rise to the gradual compression of the picture from the top to the bottom of the screen. A symptom of this kind is often caused by trouble in the negative feedback field linearising network in the output stage. If it cannot be corrected by the main or preset vertical linearity control, adjusted in relation with the height control on a test card, the circuit should be examined for change in value of a resistor or capacitor in the linearity control circuits. Sometimes a component here goes completely open-circuit, resulting in extreme expansion at the top of the picture.

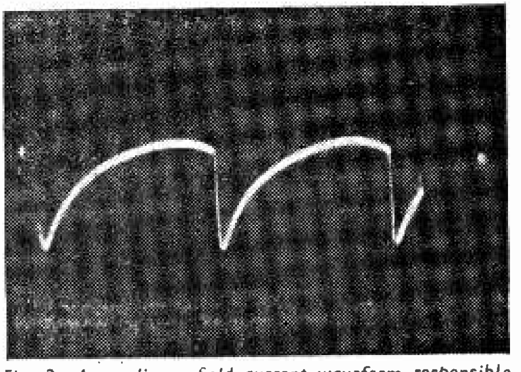


Fig. 2—A non-linear field current waveform responsible for compression at the bottom of a picture and progressive expansion towards the top.

Fig. 3 symptom can also be caused by a low-emission field output valve, the valve being able to deliver only sufficient scanning current for the first threequarters of the scanning stroke, it then being unable to produce the current needed for the latter part of the scan. When this trouble arises some degree of cure is often possible by putting the linearity controls out of adjustment, but this invariably introduces vertical distortion.

The similar symptom in Fig. 4 can be caused by the electrolytic capacitor across the cathode resistor of the field output valve going very low in value or open-circuit. Here it will be seen that the tendency is for lack of amplitude towards the top of the picture in addition to the compression at the bottom.

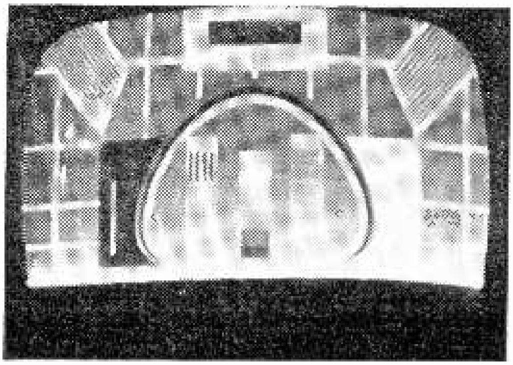


Fig. 3—Extreme bottom compression and top expansion.

Delayed Retrace

Compression at the top of the picture, as in Fig. 5, often means that the field retrace is delayed and that the picture information occurs before the retrace is fully completed. The retrace is controlled both by the field generator and the field amplifier. Thus the fault could be in either.

Mostly the trouble lies in the negative feedback linearising circuits of the output stage and a maladjusted vertical linearity control can cause the effect. It has also been known to have been caused by a fall in the insulation resistance of the field output transformer in the output valve anode

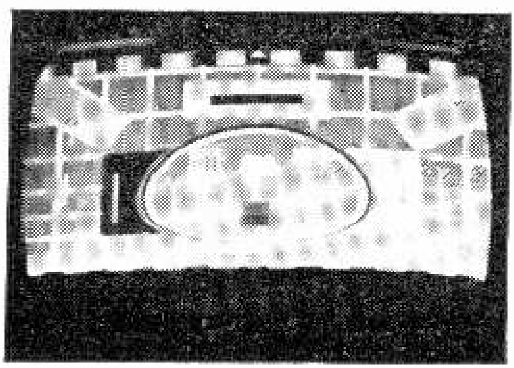


Fig. 4—Bottom compression and reduced amplitude caused by an open-circuit electrolytic capacitor on the cathode of the field output valve.

Fig. 5—This symptom is caused by a delayed field retrace.

circuit. Indeed almost anything that results in reduced bandwidth of the amplifier can be responsible, for the speed of the retrace is influenced by the bandwidth here. While the bandwidth may be adequate for the scanning stroke its impairment can seriously slow down the retrace.

The retrace in the generator stage is instigated by the switching on of a valve, this discharging a capacitor which has previously been charged through a resistor from the h.t. supply line to give the forward or scanning stroke of the drive waveform. Thus if the generator valve fails to conduct

Fig. 6—Unlocked field timebase showing the test pulses at the top of each picture section.

adequately (due to low emission, for instance) or if something varies in the charging circuit this symptom is produced. The transformer in blocking oscillator stages can also be responsible.

Nowadays the field retrace occurring in a specifically short time is more important than hitherto owing to the test pulse information transmitted by the BBC in particular during the intervals between the field scans. Even if the retrace occurs before the start of the picture information it may still be too late to miss the test pulses mentioned. When this is the case the test pulses will be displayed at the top of the picture. The pulses are displayed as a bright horizontal line, an interval, a dot, an interval and finally a second horizontal line graded in brightness, these occurring in order from the left to the right of the black interval between field scans. When they are actually displayed at the top of a picture there are often two sets of them, one above the other, since one complete picture is composed of two interlaced fields. These pulses can be seen by slipping the field (vertical) hold so that the field timebase runs either fast or slow as shown in Figs. 6 and 7. In Fig. 6 the pulses can be seen between the black horizontal band separating the two halves of the picture, while in Fig. 7 they can be seen directly above each picture section. When displayed on a properly locked picture they are somewhat similar to the lines at the top of the picture in Fig. 5 but there are only two lines of pulses. The lines in Fig. 5 result directly from the flyback as this takes place *after* the picture information has started, as already explained.

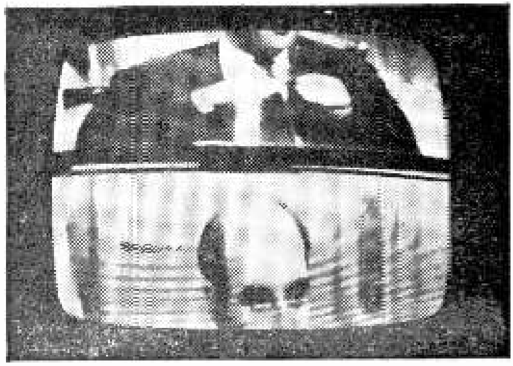


Fig. 7—With the field slipping, the test pulses can be seen in the black band separating the two halves of picture.

Speeding the Retrace

Some early sets provide a field retrace which is sufficiently fast to avoid the symptom shown in Fig. 5, yet not fast enough to clear the test pulses. The test pulses are then displayed at the top of a picture which otherwise correct. It is not often possible to solve this problem without modifying the field timebase circuits in an endeavour to secure a more speedy retrace. Some manufacturers have published details of how the field retrace in particular models can be speeded up but most of this literature is now out of print. However, by trying various resistor capacitor combinations in the generator charging network (not the time-constant controlling the repetition frequency of the generator proper but the time-constant connected to the anode of the generator, coupling to the grid of the output valve) some degree of success in establishing a faster retrace is often possible.

An interesting field timebase symptom is shown in Fig. 8. Here the field scan is reasonably linear but it is disturbed by slight expansion of lines towards the top and bottom of the picture (mostly towards the bottom in Fig. 8).

This kind of symptom indicates some form of instability towards the start and finish of the scanning stroke and it is nearly always caused by trouble in the field output valve. It is difficult to display the effect on an oscilloscope since the connection of the Y-lead often clears the trouble or modifies it. It would appear that the valve develops a fault that produces an electron oscillation (probably equivalent to the electron oscillation sometimes produced by the line output valve) in bursts along the scanning stroke, thereby causing the scanning spot to be instantaneously deflected at a greater speed.

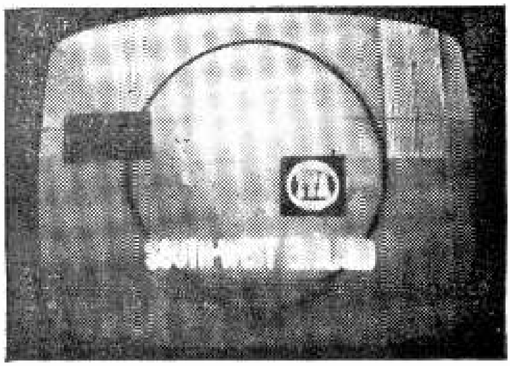


Fig. 8—The lines on this picture caused by widening of the intervals between the horizontal scanning lines result from instability in the field output valve.

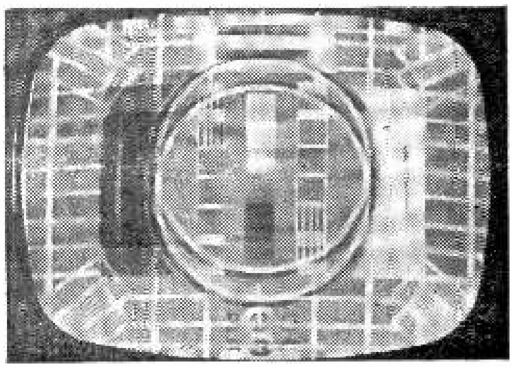


Fig. 9—Field judder caused by a faulty field generator valve.

Valve Faults

The complete cure lies in replacing the defective valve and it is not possible to establish a valve fault of this kind on a valve tester. It is thus necessary to test the suspect by replacing with a new valve or at least one definitely known to be in good condition.

Another valve fault that cannot generally be detected on a valve tester is that which produces field judder as shown in Fig. 9. The valve this time, however, is often that of the generator stage (i.e., the triode section of a triode-pentode, the pentode of which is the amplifier).

Extremely critical adjustment of the vertical hold control may temporarily clear the symptom but which, as the set warms up more, appears again.

It is often found that the symptom can be cleared permanently by reducing the field amplitude—height. Of course this is no solution to the problem, for a properly locked full scan demands a valve change.

Generator stage valve trouble can also affect the vertical hold control. In this instance the hold control may have to be positioned hard clockwise or anticlockwise against one of its stops to stop the picture from jerking upwards or rolling downwards. The former symptom is shown in Fig. 10 and the latter in Fig. 11. These indicate respectively the field generator frequency being a little too fast and a little too slow. As the picture rolls downwards and the broad, dark horizontal band separates the two halves, so field flyback lines flick across the screen as Fig. 11 shows.

If this happens with the hold control at the end of its range, and adjustment within the control's range only worsens the symptom, one can be sure that either the generator valve or a component associated with the repetition frequency of the generator is defective. If the locking point is very close to the end of travel of the hold control the picture will tend more to jump intermittently rather than roll steadily. The steady roll effect may indicate lack of field sync pulses or their attenuation.

Lack of Field Sync

For instance, if the field sync pulses are removed altogether from the generator the picture will roll smoothly upwards or downwards, tending to steady when the hold control is critically adjusted for a repetition frequency of 50c/s. Should this be possible to attain within the range of the control the fault is definitely lack of sync pulse signal. In this event attention should be directed to the field sync circuit which is connected from the sync separator valve (in all sets) to the sync input of the field generator stage. In some models, however, the sync pulses are fed to the generator through a diode circuit network whose job it is to shape the field pulses to facilitate the accuracy of timing of the field generator and thus to enhance the interlace performance.

It often happens that this diode (which is generally a small metal rectifier or semiconductor type) fails and thus ceases to pass the pulses to the generator or it may attenuate the pulses. A defective component in the associated network can have the same effect. However, one can be fairly sure that sync pulses are present if the picture has a tendency to jerk into intermittent lock when the hold control is near the correct locking point (which, as already mentioned, may be when the control is up against one of its stops). If one gets the impression that correct lock would occur were it possible to turn the control beyond its stop then, assuming the field generator valve is in good order (as proved by changing), an alteration in value of a component associated with the field hold control should be suspected. High-value resistors connected directly to the control often have a habit of changing in value, causing the symptom.

Indeed a component change of this nature may be sufficiently extensive to cause the generator to operate at half the correct repetition frequency (i.e., 25c/s instead of 50c/s). The symptom in this case is the display of two half-sections of the picture in perfect lock. Owing to the slower timebase speed flicker is troublesome and a low-frequency buzz can often be heard from the field output transformer. It will be noticed that Fig. 12 symptom differs from that in Fig. 11 in that the former is devoid of flyback lines as the picture remains under the control of the sync pulses even at half-timebase speed. ■

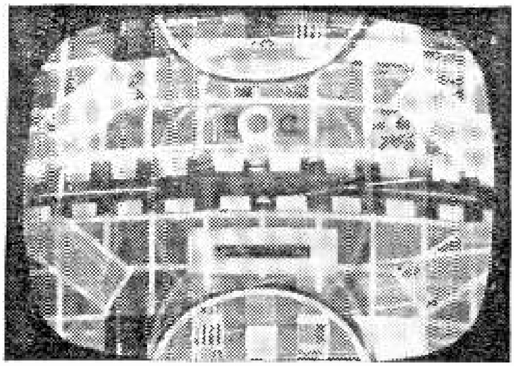


Fig. 10—Field timebase running too fast.

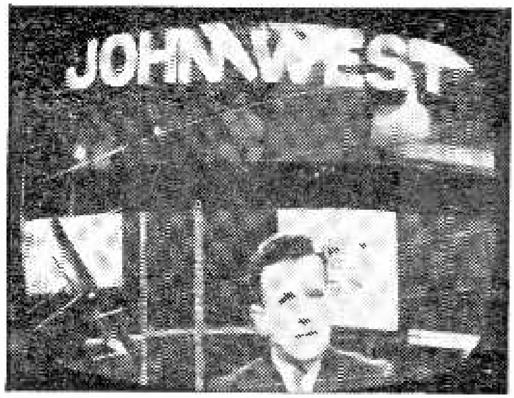


Fig. 11—Rolling field caused by lack of sync pulses. Note the flyback lines.

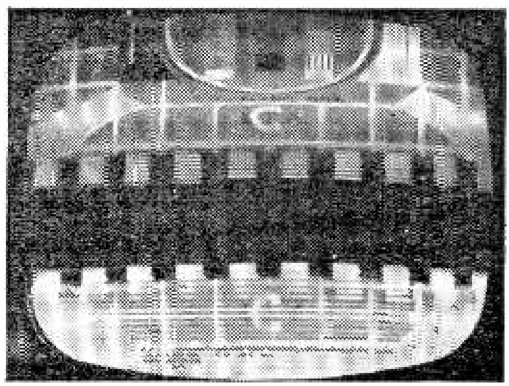


Fig. 12—Field timebase running at half speed. Here there are no flyback lines.

MORE ABOUT VIDEO CIRCUITS by G. R. Wilding

ALTHOUGH there is not so much scope for experiment in television, compared with other fields, a lot of fun can be had playing around with the video circuits of a 405-line television receiver. In this article we discuss the video amplifier stage—that is, the section from the cathode of the video detector to the cathode of the picture tube.

The main function of this part of the circuit is to provide a drive of about 30 volts to lift the raster from its no-signal near black state to peak white. The amplifier must, therefore, have a high amplification factor and remain fairly linear from zero frequency to 3Mc/s. In practice this is often achieved with a single pentode valve, which makes it easy to maintain d.c. coupling into the valve grid and from the anode of the video valve to the picture tube.

To enable the stage to cope with such a wide range of frequencies, resistance/capacitance coupling is usually employed, but suitably modified to maintain gain at the higher frequencies. The gain of a resistance/capacitance coupled stage can be worked out from the formula

$$A = \frac{\mu \times R^{L}}{R^{A} + R^{L}}$$

where A is the stage gain, μ is the amplification factor of the valve, R^{L} is the load resistance and R^{A} is the a.c. resistance of the valve. This formula is only suitable for low frequencies as the reactance at the anode falls as frequency is increased (due to the stray capacitance) and the effective value of the anode load resistor is reduced.

Gain versus Bandwidth

The gain of the stage will thus progressively deteriorate with increases of frequency once the shunt reactance becomes comparable with the load resistance, resulting in the higher Test Card gratings and fine detail being reproduced with less contrast than the low frequency signals.

This stray shunt capacitance across the video load resistor is caused by the capacitive effect of the load resistor, the anode to chassis capacity of the valve, the stray capacitance of the valve-holder and wiring, the input capacity of the picture tube and the input capacity of the sync separator valve. While efforts are made to minimise this capacitance often it is around 25pF.

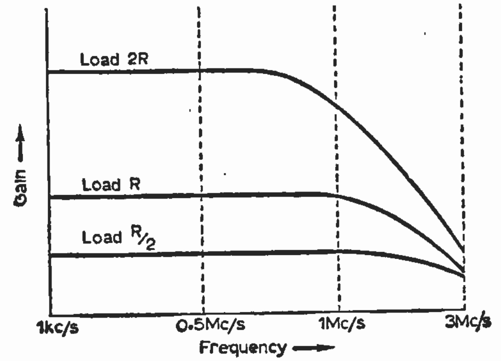


Fig. 1—This graph shows how the overall response of a video stage can be changed by varying the value of the resistive loads.

This leaves two courses open to the designer wanting to linearise the gain over the frequency range: reduce the value of the anode load resistor from the conventional high value (for good gain) to one comparable with the circuit capacitive reactance at the highest frequency to be handled; or to incorporate some inductance to broadly tune (using the stray capacitance) the video anode circuit and thus boost the falling response curve at the top end. This permits the use of a higher value load resistor to achieve greater overall gain, but care must be exercised to prevent undue resonance at any one frequency which will cause "overshoot" or "ringing".

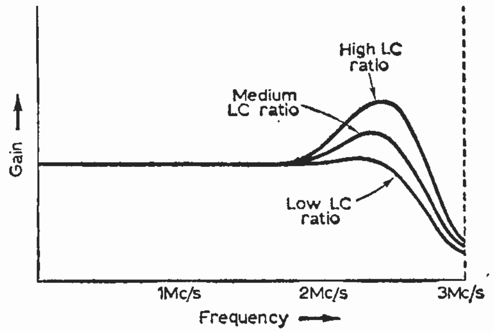


Fig. 2—Additional inductance tuned to resonate with the stray circuit capacitance can be used to peak the h.f. end of the band.

In practice both systems are used, depending on the level of signal strength at the video detector, the amplification factor of the valve employed, the sensitivity of the picture tube and the type of video stage (single pentode or triode/pentode cathode-follower).

Simple resistive loads (4·9 to 6·8kΩ) are used as in many Pye, Invicta, GEC, Sobell and McMichael receivers and give excellent frequency responses. When used with series or parallel "peaking" coils, as in many Philips receivers, the anode load resistors may be appreciably higher in value. For instance, in the Philips 19TG121 and 23G121A series, the anode circuit of the PL83 video amplifier has no less than six resistors and two chokes in a series/parallel arrangement.

Reducing Stray Capacitance

Cathode-follower circuits are increasing in popularity and are used in many Murphy and Bush models and also in some Decca dual-standard receivers.

The great advantage of a cathode-follower (often a PCF80 with the pentode section directly coupled to the triode) over a single pentode is that the triode section, which has less than unity gain, frees the pentode section from most of the circuit capacitance, making it possible to use much higher value load resistors in the pentode section.

Changing the Characteristics

To reduce amplification at the lower frequencies it is standard practice to insert a frequency conscious negative feedback loop. One method of doing this is to reduce the value of the cathode by-pass capacitor. Generally the reactance of any decoupling capacitor should be no greater than 1/10 of the value of the resistor it decouples, at the lowest frequency handled. Thus, instead of using a very high value electrolytic, a capacitor value is chosen which offers negligible impedance to the medium and high video frequencies, but has a high reactance to the very low frequencies so that full negative feedback is developed across the cathode resistor.

Another method is to feed the picture tube via a series/parallel RC combination. This can be done in several ways. A popular method is to feed the video output to the top of two series resistors; the tube feed coming from the junction, and the other end going to chassis. This then forms a simple fixed potential divider with the amount of signal going to the tube being set by the ratio $\frac{R2}{R1 + R2}$ where R1 and R2 are the top and bottom sections respectively. A capacitor can be paralleled across R1, whose reactance to medium and high frequencies is extremely small, so that the full video output at the higher frequencies is fed to the tube. At low frequencies the capacitor is not effective and the tube input is thus reduced to the fixed potential divider ratio.

Decoupling a resistive h.t. feed to the screen grid of the video amplifier is another method used to limit gain at the low frequencies. Voltage variations produced at the screen grid are in phase with those at the anode when the decoupling is perfect. When the decoupling is not perfect, phase change takes place between the screen grid and anode voltage variations which reduce the anode signal voltage and thus the overall amplification. Again by choosing a decoupling capacitor to offer high reactance to very low frequencies but negligible reactance to other frequencies, the response curve can be straightened.

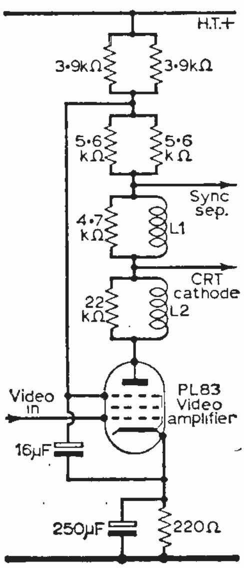


Fig. 3—Integral anode load and screen supply circuit as used in many Philips receivers to provide high-gain, linear amplification from d.c. to 6 Mc/s. Peaking coils are used to boost the h.f. response and selective negative feedback to reduce amplification at the low frequencies.

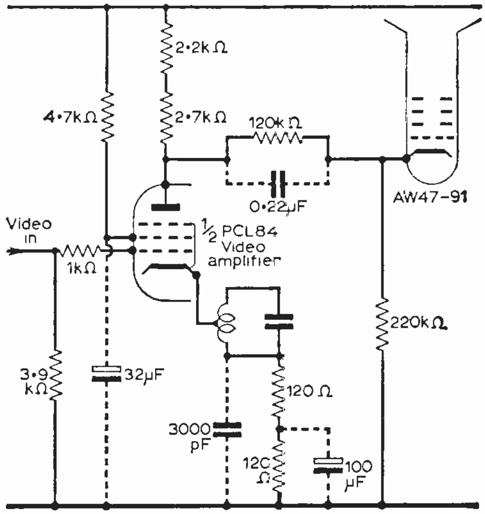


Fig. 4—The components shown connected by dotted leads will reduce the effect of negative feedback at the medium and high frequencies and thus increase gain in the upper part of the spectrum. The circuit shown is used in the Sobell ST196 receiver.

Reverse Biassing

As well as maintaining linear gain/frequency characteristics in the video stage, the input-output characteristics must be fairly linear so that small and large input voltages receive the same amount of amplification. With a conventional r.f. or a.f. amplifier handling an a.c. waveform this is easy to arrange by biassing the valve to the centre of the straight part of its characteristic, but it is a different matter to accommodate the positive-going d.c. output from a vision detector, as it is necessary to reverse bias the video pentode to prevent its grid going positive on peak white signals.

This results in going off the straight part of the valve's characteristic, and as the c.r.t. must also be well biassed back to almost black on no-signal; some curvature of the voltage input/screen luminance characteristic is unavoidable at low input levels. It is for this reason that the two darkest squares on the Test Card are so much more difficult to separate than the two lightest squares, unless the brilliance level is brought up excessively which results in "milky" blacks.

While most video pentodes rely on a small resistor in the cathode lead to provide this bias, many receivers additionally have a "bleeder" resistor from the h.t. rail to the cathode of the video amplifier to increase and stabilise the voltage developed across it, making it less dependent on the valve's instantaneous anode current.

Bearing in mind all these factors, therefore, it becomes the most instructive and informative way to appreciate video circuit functioning by varying the value of these various components and noting the effect on resolution, tonal gradation and signal handling capacity.

Check the Carbon Resistors

It is doubtful if you will be able to improve on *overall* stage performance, but as carbon-type resistors are used in most positions to eliminate inductive effects and are subject to stringent service, it will almost certainly be found that one or more will have substantially changed in value. Their replacement will often bring about a distinct improvement.

Summing Up

To summarise the main points:

1—An increase in video and detector load resistor values will increase gain at the lower and middle frequencies.

2—An increase in the value of the cathode bias resistors, or a decrease in a h.t. to cathode "bleeder" network will enable the valve to accommodate a bigger grid swing but can cause inadequate amplification of the sync. pulses and further deteriorate picture gradation.

3—An increase in the value of the capacitor-shunted resistor feeding the tube from the video anode will effect low frequency gain and the d.c. contrast level.

4—Increasing cathode and screen decouplers of electrolytic values reduces the negative feedback at the low and middle frequencies.

5—Increasing cathode decouplers of picofarad values will reduce the negative feedback at high video frequencies.

Picture Quality Control

Incidentally, by replacing a picofarad fixed decoupler shunted across a bias resistor, with a variable type of slightly higher maximum value, it is possible to improve the resolution by critically adjusting the amount of feedback to suit reception conditions. In fact, such trimmers or "picture quality controls" were once widely used on many makes of receiver.

Finally, for DX'ers or those residing in very weak service areas who may find it necessary to slightly restrict the bandwidth of the i.f. stages to improve gain, may find it equally advantageous to match the restriction in h.f. response with higher load resistors. ■

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

NEW SERIES

PART 2. More Field Faults

A MULTITUDE of troubles can have their origin in common faults. These are prevalent on some models, practically non-existent on others. Sometimes one wonders why certain makers have designs that require such frequent resetting of hold controls, while others seldom need adjustment. An example of the latter is the Baird series, such as the 640 and companion models, where the makers are so confident that the hold controls are presets, not normally accessible to the owner. No wonder so many of these bread-and-butter models are put out on rental.

On some other sets control failure is far too frequent and the height or field linearity control is a common offender, usually because it carries both a standing d.c. current and the peaky field pulses as well. Certain of the Decca models, the DM45, 36, 55, etc., and the Ekco 368, 377, 380 series had this trouble. The symptoms were often elusive and tests would appear to clear the trouble, often for days at a time, when the fault was in its early stages. Many a service engineer has had frustrating callbacks to these sets for "touchy hold", "intermittent field collapse" or "jitter" before the root cause became evident. And it was usually the variable resistor.

INTERLACE DIODE

Another common cause of "jitter" in many different sets has been the interlace diode. Some details of this little joker's place in the circuitry have already been given and we need not expand on the subject except to say that models such as the Bush TV80 and 90 range had this problem, as did some of the Ekco receivers, notably the 407, and the Cossor 945 and the printed circuit version, the 948. Depending on whether the diode developed a high back-to-front ratio, went open or short circuit, the symptoms would vary. In the last instance, as the boost line is not regulated particularly well, one effect was to reduce field stability and brightness at the same time!

In general one can check the interlace circuit by putting the field slightly out of lock, when the jitter or bounce will lessen. It is often possible to achieve a firm half-speed picture when a steady lock is out of the question; but who wants to watch performers with legs growing out of their heads? If no replacement diode is available there are several ways of getting over the problem. One is to borrow a similar diode from another part of the circuit, preferably a sound interference limiter. Don't borrow the a.g.c. clamp diode as this component can also cause poor synchronisation and aggravate the fault—but more about this at another time.

In the S.T.C. chassis, such as the VC3, commonly used in the K-B VV05, and others in the "Challenge" range, made for the multiple stores and mail order groups (and none the worse for that), the problem was overcome with a simple

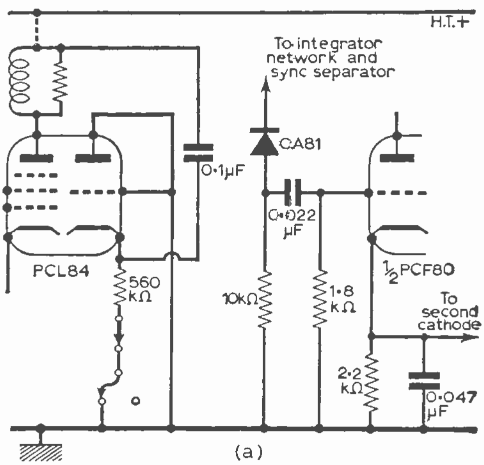
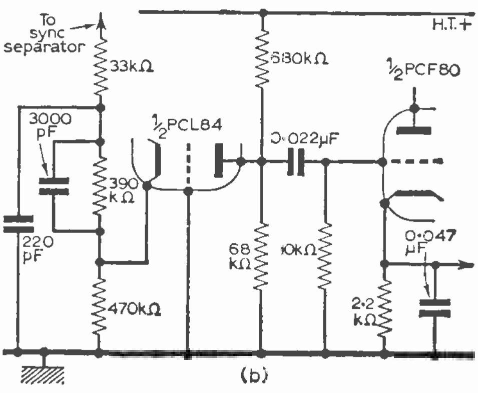


Fig. 4a (above)—Conversion of vision interference limiter triode to diode for frame sync coupling, as in (b), below.



modification. A PCL84 is used as video output and part interference limiter. By disconnecting the limiting feed component and using the triode section as a diode the interlace trouble was immediately overcome. Another shot fired in the valve *v* semiconductor battle! This change is incorporated in later chassis.

We have already mentioned the adverse effect of a poor smoothing capacitor. On some sets this is worse than others (Sobell 279, Regentone 193, Alba 655, for example) and on some, such as the Decca DM4, 45, 36, etc., where extra smoothing is employed and a multiple electrolytic used for regulating different sections of the circuit, interaction between the sections is a very real danger. Field buzz due to field pulses modulating the sound, or apparent sound-on-vision which turns out on close inspection to be field modulation of the video circuits, can be caused by this trouble. First make sure that the common earth return of the combined electrolytic is secure. Check for dry joints; then, if the trouble persists, isolate the sections with temporary substitute components. Luckily we are able to get quite small capacitors of high rating nowadays, so finding a site for three separate items in place of one is not difficult.

TAG STRIP BURNOUT

A fault that does not hit the technical headlines very often but which can be the very devil when it occurs is a burnout of the paxolin tag strip, valve base or printed circuit board in and around the field circuit. The burned tag, or intermittent arc across paxolin to chassis, was one fault that caused intermittent field collapse in older models such as the Murphy 230, the Alba 324, 644, 724, etc. Sometimes a cure can be effected by slipping a piece of new insulant between the bottom of the tag strip and the chassis but more often it is better to remove the connections from the tag and use a new anchor site. Small tag strips, three, four or five way, are readily obtainable from spares factors for a few pence. A convenient mounting hole can usually be found.

BURNED FOIL

The burned foil problem is much more annoying. In its later stages, such as when the video section of some of the Regentone, RGD and Argosy sets burns out, as well as the offending components, a whole section of the surrounding circuit quite literally goes up in smoke. The only cure is to scrape away the charred remains, wire back to a safe portion and use "conventional" connecting methods. Something similar used to happen to a number of G.E.C. receivers, whose vertically mounted printed panels were interconnected by valve base sockets and plugs. The fault begins with arcing between adjacent current carrying pins of different potential and a track is burned, carbonising, presenting a partial short-circuit which passes more current, burns more ad infinitum or until the fuse blows. (I told you not to use that silver paper!)

Change in value of components can occur under similar conditions, especially those mounted near the field output valve, which handles a lot of power and runs quite hot. One receiver in which this trouble happens is the Philco 1035, where the offending components are mounted near the PCL85 valve. Lack of height can be caused by the field flyback suppression capacitor which connects the cathode of the triode blocking oscillator valve to the grid of the c.r.t., developing a leak when hot. Often this trouble crops up after several components have been affected and misleading results can be obtained when tests are made. For example, immediate replacement of this 0·015µF capacitor may bring up the field to an excessive amount and the next point to check is the adjacent feedback capacitor from anode of PCL85 pentode section to the linearity network. This is a 0·005µF component. After replacing this we find we have a field within controllable limits but cramped at the bottom despite adjustment. Yes, that's right, look around the valve base—most likely the cause is the cathode resistor, 390Ω. The decoupling capacitor, which could also be the culprit but in this instance seldom is, is mounted vertically beside the valve and is a 500µF electrolytic. This is one case where sequential fault finding can be rather frustrating as the cure of one fault uncovers another.

Quite the opposite happens with a number of the Philips receivers where simultaneous faults can have their origin in common causes. A look at the circuit soon shows why. To take a common example: the Stella 1049 range, coming a little more up to date. Complaint may be "no field and no sound". Before jumping too quickly toward the set consider that the coincidence is unlikely, a common fault is more on the cards.

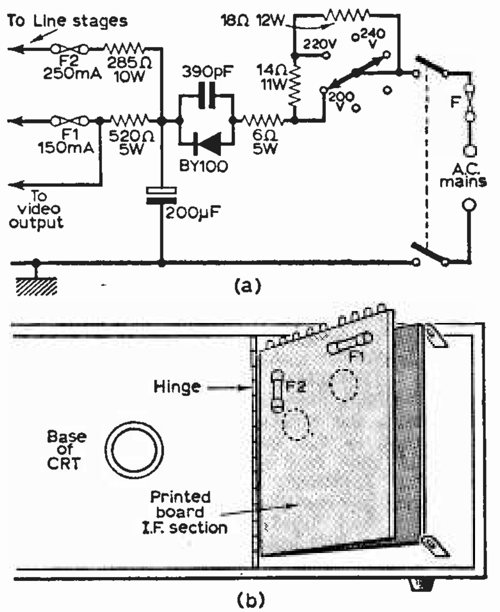


Fig. 5—Separation of h.t. lines can produce confusing symptoms. H.T. supply circuit used in many Philips models is shown (a), with physical position of fuses (b).

And the usual common link between these two sections is an h.t. rail. As Fig. 5 shows this is indeed the case and not only is there a separate h.t. line for the line stages and another for the rest of the set, but there is, moreover, a subsidiary line for the video output stage. While we are considering this, if we are not too careful, the thin white line will have burned an irrevocable line across the face of the tube, for a secondary symptom is that the brightness control has no effect. My point is that these faults can be caused by one small and simple common factor and could even be the failure of a fuse. The fuses in the h.t. lines are both located on the hinged i.f. printed panel. The horizontal fuse is the one in which we are at present interested and also the 520Ω 10W smoothing resistor in series with it.

When dealing with sets of this nature it is always wise to make several tests of various functions to isolate a possible common cause. As an example, a careful investigation, even before the back was removed, would reveal that only the line stages worked, that neither the sound output stage nor the field output stage were in operation, and that the brightness control was useless, leading attention immediately to the separate h.t. line. Under alternative conditions no line output *and no sound* make the other fuse the most likely starting point for our tests. But we shall return to these points later.

While still concerned with this type of receiver, with its numerous cross-links of cable and plug-socket connectors, we must never overlook the possibility of poor contacts. One fault that has cropped up a few times is an intermittently unstable field hold, the picture tending to "hover" now and again. Before going too deeply into the circuitry check the clean contact efficiency of the conversion joint beside the ECL80 sync separator. Field pulses are taken from the anode of the ECL80 via this link. There are a number of these links, put in to facilitate conversion from 405-only to dual-standard operation.

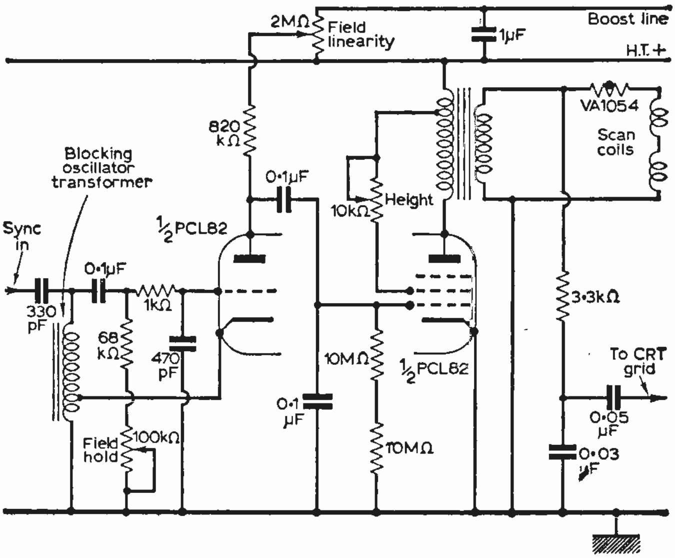


Fig. 6—Typical Pye circuit, as used in Invicta 538. Note anode feed to oscillator triode, use of variable pentode screen voltage to control height, and varistor in scan coil circuit.

O/C SCAN COILS

Another point which has arisen fairly often is that of open-circuited scan coils. For someone who has not had occasion to trace around Philips circuits a few times the physical layout can be a bit of a nightmare. But if there is the least possibility of a suspicion of scan coil failure on, for example, the Philips TG100 series and its many variations, the quickest way to test is to lift off the left-hand connection and check for continuity to the adjacent tag. Unfortunately there is no easy cure except replacement (itself no mean task on a couple of the models). A quick check is to apply a low d.c. to the disconnected scan coil winding, when the white line across the screen should jump if the coils are in order. This is a fair test also for shorted turns, which will damp the movement considerably, and a clue can often be gained by spot checks of this nature where no instrument we are likely to possess can help us.

"WIRING BOGEY"

One particular field trouble in this series, typical models being the TG121A range, is also caused by the "wiring bogey". In this case an open-circuited earth return link from the common tag which carries leads from the field output transformer, the scan coils and, surprisingly, the heater chain. This can, unfortunately, put a high a.c. voltage across the field output transformer primary and the result usually is that the valveholder of the PCL85 arcs across between the anode pin 6 and the adjacent heater pin 5. Once this has happened replacement of the valveholder is needed, but before switching on check the heater chain continuity and the earth return of the field output transformer windings.

We have already mentioned the "cover-up" fault where misleading symptoms can confuse us the first time we meet them. It is as well to bear in mind that most circuits employ an oscillator h.t. feed from the boost line and often the height control is also in series with this feed. It is surprising to find that the boost line can drop quite a bit before the raster disappears and, as the height is impaired, the picture looks more brilliant than it would with a full raster. A case in point is the Philips 1768U where the boost line can drop to almost that of the h.t. when a 0·018µF capacitor between h.t. and boost line develops a leak. The first apparent symptom is an inability to obtain

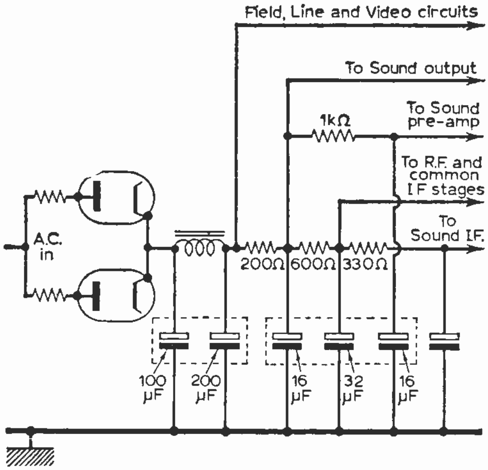


Fig. 7—Another example of division of h.t. supply lines (Decca DM35), which can be complicated by the use of common multiple electrolytic capacitors. Poor earth returns or development of leaks causes circuit interaction.

sufficient height. Later on the line speed will vary and the sound become distorted as these circuits, too, depend on the boost voltage.

In some Pye, Pam and Invicta models this tendency is also to be noted. For example, in the Pye 310S almost similar symptoms occur when a 0·05μF leaks and drags the boost line down to 300V or less. In this model the height control, a 1MΩ variable resistor in series with the oscillator anode feed, may develop a "hot spot", again robbing the oscillator anode of its voltage. In other similar models a rather peculiar train of events has the same result—inter-electrode short-circuits in the cathode ray tube, especially grid to first anode or first anode to (earthed) supports or cathode returned points. The overall effect is a reduction in boost voltage and this is easily proved by removing the tube connection and noting its effect on the raster. The Invicta 538, the 146 and the Pye V200 evinced these symptoms. This could be misleading with the 538 as the field tended to creep up from the bottom rather than shrink uniformly. No use looking for cathode bypass electrolytic of the output valve on this model, for there isn't one! The PCL82 cathode is returned straight to deck. The reason for the slightly different behaviour is the way the field linearity control is between boost and h.t. lines with the tapped point feeding the oscillator anode, whereas the height control varies G2 voltage.

WRONG VOLTAGE

These internal c.r.t. shorts and leaks occasionally show up when a set is run on the wrong voltage, so attention should be paid to the mains voltage setting and—particularly if the set has been purchased second hand with an unknown repair history—the mains dropper should be checked. It is possible to clear these shorts and leaks in many cases, but the "bludgeon method" should be a last resort and discussion does not come within the scope of this article.

It will be noted that this range, in common with many other receivers built in the last five or six years, has a varistor in series with the scan coils to maintain regularity of scan with warming up. An open circuit here will produce the thin white line and the quick test is a short-circuit across it. In fact the short-circuit can be left on until one can conveniently lay in another VA1054, with no harm done except to one's patience.

Other models in the Pye range used very different field circuits, with pulse shapers and interlace networks, in all of which the same kind of faults discussed earlier occur. The Pam 600 is a case in point with its ECC82 multivibrator, triode section of the PCF80 sync separator as pulse shaper and PL84 output pentode. Here the pair of synchronising diodes are a prime suspect for field jitter and the 0·015μF capacitor decoupling the boost line for field "creep". And as a final note on this business of "judder" never overlook the possibility of field output transformer primary breakdown to core.

INCREASE HEIGHT

This fault is common to a number of sets besides some of the models discussed and the test is to slowly increase the height. If the field stays steady *and linear* at mid to two-thirds height, then judders at full height, suspect the transformer. If it begins to judder early and does not increase linearly, suspect one of the feedback capacitors.

to be continued

Workshop Data

by J. D. Benson

SERVICE has often been called the "poor-relation" of the radio and television trade. Almost 40 years' experience has proved that this is a misnomer, provided that certain conditions are adhered to. The most important condition for determining that service work is profitable is that the service engineer has a full understanding of the equipment that he has been called upon to repair. Equally important is the ability of the engineer to know where information can be found, since it is almost impossible for the average individual to memorise *all* the data that is applicable to the wide subject of servicing.

Technical Library

In the writer's opinion, the most valuable adjunct to workshop equipment is its library of technical data. Service data, for radio and television, falls roughly under three headings, i.e. data and circuitry as supplied by this and similar journals, manufacturers' data sheets and handbooks for radio and television receivers (including grams., etc.), component specifications (manufacturers') and text books dealing with standard practice.

The most important factor connected with service data is that it can be quickly found when required. This immediately suggests that filing or storing must be carried out in a methodical manner and maintained in that order if valuable time is to be saved. Standard filing cabinets are expensive and are not always ideal for storing service sheets. Since the number of individual service sheets can run into many hundreds, adequate space is required. In the writer's case, multi-compartment storage racks were used, the service sheets being stored in hundreds. Shelving divided into compartments can be equally useful.

Having decided on the method of storing, the next most important step is to provide a means of locating the desired information quickly. A sturdy, hard-backed ledger should be acquired, indexed if possible, but if not it should be divided into sections, alphabetically, and each date sheet entered under the equipment makers name and model in one column, and the data sheet number prominently written in another column. If the data sheets are stored in hundreds, and the compartments duly labelled, it is but a few seconds' work to find what is wanted.

Manufacturers' data is generally supplied in book form and is generally much more bulky than data sheets. Compartments can again be used, each individual compartment being labelled with the manufacturer's name. An important factor, if this method of storing is used, is to supply each compartment with a typed list of the receiver models, to which is added a number which is in turn printed on each data book. By using this method, much time is saved.

Component and text books can be kept on a book shelf with a typed description of the contents stuck on the spine of each book if not already titled. Workshop instrument data and circuits should be carefully filed, a box file is admirable, since this can be kept with component data and is always to hand when required.

Data Sheet Protection

Data sheets and service books used at the bench are liable to be subjected to rather hard treatment. Manufacturers' data books are rather better equipped to cope with rough handling by reason of the fact that they are generally produced with strong covers. Data sheets, on the other hand, are very prone to tearing and should be protected by thin sheets of perspex or celluloid hinged by drilling and inserting rings of 16 or 18 gauge wire. This simple device not only renders the circuitry more readable, on both sides, but also greatly extends its useful life.

Service data is the life blood of the service engineer and should therefore be treated with the utmost respect. In the writer's workshop it was the job of the more junior apprentice to locate the service data for receivers entering the workshop for repair. The service sheet or book was attached to each receiver in readiness for the service engineer. Each completed receiver was accompanied by the relevant service data to the soak test bench and when OK'd, the service data was collected by an apprentice and filed. With a system like this, or similar, complete control is kept over service literature and endless time saved.

Domestic Appliances

With the steady increase in the types of electrical domestic appliances the service engineer is called upon to investigate and repair an ever widening range of electrical devices. Wherever possible, operating particulars should be acquired and a library built up as in the case of radio and television. It has been found best to keep the two libraries separate and in different parts of the workshop in order to avoid confusion. By planning and putting into practice the methods suggested in this article, service can be elevated from the position of the "poor relation" to a healthy income earner. And finally, if a book, recording all the difficult and time wasting faults that are met with from time to time in radio and television, is kept, it will be found a most useful addition to the workshop library. ■

UNDERNEATH

THE DIPOLE

VIDEO tape recording was first introduced in the USA about nine years ago. A glance at the journal of the American Society of Motion Picture and Television Engineers, dated May 1949, takes one back to the days before video tape when television was almost a cottage "hand-made" industry; when programmes were networked "live" in the USA within very small geographical regions, at the same time as Britain was contemplating the initial problems of inter-city co-axial lines networking all over Britain. Simultaneously, both countries were straining to develop improved methods of recording television programmes on motion picture film, with the USA being faced with the complications of vision recording 60 fields on 24 film frames per second, while Britain started off by coping with 50 fields of vision on 25 film frames by suppressing the interlace—a coarse but effective method, good enough for items of historic importance. In the USA the necessity of recording important television programmes was not only to enable historic events to be replayed years later, but merely delayed for an hour or two later than Eastern standard time. This was the main reason for the feverish search for different types of television recording, suitable for immediate replay. Ultra-fast high quality film processing, thermoplastic and magnetic tape recording were competing with both Ampex and RCA standardising on a compatible system which is now used for black-and-white video tape recording. The quality of the taped picture in black-and-white has reached a very high standard, far ahead of the less reliable (but sometimes very good) film telerecording from TV cameras. Feverish efforts are currently being made to attain acceptable colour quality on video tape—but the world market for colour VTR is relatively small, and both black-and-white and colour film in 16 and 35mm gauges will be in demand for a long time.

Automation

The automation of television camera operation for remote control has been used for several years and is a valuable tool in many factory processes. This applies particularly to those processes which have themselves to be manipulated at a distance, for safety. The TV monitor screen enables the operator to watch his handiwork and if necessary, record the result on film or video tape. Medical usage in a number of hospitals of closed-circuit television for observation, for operations and X-ray work, also for dentistry, is being continuously improved both for monitor viewing of the transmitter picture or of a VTR of it.

Remote control of cameras in television studios is, however, mainly restricted to single-camera set-ups in newsreaders or interview studios, located some distance from the control room. Here, an engineer is able to remotely control pan and tilt, focus and zoom of the camera, thus giving a more interesting presentation of a scene compared with the fixed camera set-up. Further developments have been carried out which have led to the application of memory systems for the instant return of adjustments to their precise rehearsal positions, at the touch of a button.

DC or AC for Lighting?

Automation in the manipulation of studio lighting is another side of production techniques which has progressed at great speed during the last two or three years. Film studios have depended for a long time upon direct current, to enable carbon arcs to be used. The carbon arc is noisy, dirty, heavy and expensive, requires constant attention and trimming—but gives an excellent light of great whiteness and hard, crisp shadows. High intensity carbon arcs are often mixed with tungsten bulbs for spot or flood lights by the lighting cameraman, who usually calls for filters to be fitted to the arcs, to bring the colour temperature down to about 3,200°K. This gives the slight yellowish tinge to the arcs, to match them up with the tungstens when colour photography is being shot. In television studios, alternating current is preferred, as it readily enables efficient dimming to be applied to the tungsten lighting.

The Strand Electric Company has progressed in a few years from their heavy slate theatrical Grandmaster switchboards, through saturable reactor TV dimmer boards, electromechanically controlled resistances (with memory circuits) to the latest variations of silicon semiconductors and computer "programming" of light changes.

Their latest model is called the "Instant Dimmer Memory System" in which programming can be prerecorded. Thorn Electrics Limited have also entered the studio lighting control equipment field using similar techniques, incorporating thyristor-type dimmers and the use of silicon semiconductors for stability. On the Continent and in America other makers have evolved lighting control systems along the same lines. Whether the art of lighting actors and settings calls for the complete mechanisation of techniques remains a matter of opinion.

Colour Balance

The most important part of any scene is not the scenery, but the face of the actor or actress. If the heroine's can be more beautiful or the villain's more horrific (if the story requires it to be so), attention has to be paid to the facial make-up appropriate to the type of illumination, as well as the basic factors of portraiture, modelling, "kicker" and filler-light. The make-up artiste and the lighting man have to remember the effect of the greenish-violet light from a mercury vapour lamp or an enclosed arc, the bluish-white of a high-intensity carbon arc or the yellowish tinge of the tungsten filament bulb. The earliest theatrical lighting progressed from candles to gas jets in the footlights; to lime lights which were silvery-white spotlights behind lenses (made by burning a mixture of oxygen and coal-gas on a lime cone). All of these different types of lighting, for stage, film or television, have their own particular effect upon the cosmetics required, their colours, their shadowing and their texture.

The Materials of Make-up

"Give me a room where the walls are wet, and the bricks are red . . ." With this cry the "actor laddies" would take care of their make-up requirements for the week! In the days of the serio-comic and the tragedian—the eras of Macready and Grimaldi, brickdust scraped from the walls of their humble dressing rooms would suffice for most make-ups. For more involved character make-ups, an actor would mix lard with it to make a base. Stage make-up is meant to accentuate the features so that eyes and mouths are distinct and apparent from the most distant parts of the theatre's auditorium. Whilst the old time actor would use his brickdust scrapings, so the "minstrel men" would "black up" with burnt cork.

Contrary to what most people believe—burnt cork is not made by putting a match to a cork, and then rubbing the scorched portion on the face! In fact, it is necessary to collect a large number of corks—Eugene Stratton, the music-hall star of many years ago, favoured champagne corks—and make a small bonfire of them! The ashes are floated on a basin of water—until they become waterlogged—they are then removed from the basin, the water squeezed out through the fingers, and the residual paste stored in a jam jar for use next time you want to sing "Swannee River".

But today, make-up comes in all types, in tubes or "pancake" as well as the popular sticks of greasepaint that sell in thousands to operatic and dramatic societies up and down the country. Make-up is readily available to create horrific effects or improve appearances.

Commercials: their value

When you think of spectacular film productions like "Cleopatra", "My Fair Lady" or "The Sound of Music" you may (or may not) think about their enormous costs, which start accruing from the purchase (at a terrific price) of the sound film rights of the original story, the play or even the silent film, you take a breath. Then add the payments made to one or more (almost certainly, more) scenario writers, one or more (definitely more) high-bracket pay-packeted stars, directors, producers and technicians, plus sumptuous settings, shatteringly loud musical backgrounds, then the total cost will be colossal—and is often a worthwhile investment, yielding rentals which go on and on for years. The films are long in footage but the price per foot is often not so much greater than that of a thirty-second television commercial. Individual items of this important interpolation in all ITA programmes average only 46·8 feet in length but receive the same care and attention per frame as a lengthy classic of the cinema. This arises because of the astonishing trick effects of many kinds, cartoon animation, puppetry, star acts and TV personalities which are crowded into the limited time, for which the advertising agents (on behalf of their clients) pay high rates for 15, 30 or 60-second time slots varying the rate according to the time of day. Peak viewing times ("A" times) between 7 pm and 10.30 pm are naturally the most expensive.

Like the spectacular investments in spectacular films, television advertising has proved to be worth its high cost, and the trick photography has justified the planning and thought given to every single film frame. The very nature of advertising films has caused special emphasis to be placed on photographic trick work, with the surrounding "plot" dominated by the product advertised. One of the leading experts in this field, Mr. D. C. R. MacDonald says that trick techniques quickly gain the attention of the audience and can be used to demonstrate and analyse the product being advertised. For instance, in a film advertising car tyres a shot of a car going along a road would be routine and commonplace. If, however, at one point, the car body and chassis magically disappears, leaving only the driver and tyres moving along, the shot would be intriguing and would concentrate audience attention on the advertised product.

Colour Somersaults

Mr. Wedgwood Benn is a talented Postmaster-General, the only one who can do a double somersault and juggle from TV line standard to line standard and remain an acrobat (technically known as the bearer) who can provide support (by way of extortionate taxation) for heavyweight Chancellor Callaghan and his featherweight tax adviser, Mr. Kaldor. Lord Hill has made a good case for colour to be made available to the ITV companies, by allowing it to be transmitted on 405 line band 3 transmission. The over-over-overtaxed ITV companies, now faced with payroll tax, deserve a little consideration. This is a good practical suggestion; one which will reach the maximum population in the shortest time, even allowing that the present BBC-2 transmitters on UHF have been in operation in many regions for many months. This step—colour on 405 as well as 625 lines—and an alternative that the BBC-2 channel be shared with the ITV by alteration on different days, have been mentioned several times in the pages of this journal. Lew Grade, managing director of Associated Television Network, is going ahead with colour films for television for exporting to the United States and elsewhere. Will the P.M.G. prevent these colour films from being transmitted in colour?

Iconos

LONG DISTANCE TV RECEPTION

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

THIS short series is, in fact, a condensed re-issue of the basic principles of DX-TV published in *Practical Television* from September, 1963, onwards. The original editions are now out of print, and as we have been receiving many questions asking what DX-TV is all about, here are the basic details again.

TV reception falls into four categories, dependent on the mode of signal propagation:

(1) **Local Reception.** Distances up to approx. 50 miles, dependent on the height of the transmitting and receiving aerials. This is not exclusively "line of sight" as some bending of the signal occurs near the earth's surface, and around obstructions.

(Reception available at all times in Bands I/III, and u.h.f.)

(2) **Tropospheric Reception.** Distances 50—750 miles approx. Under certain atmospheric conditions, and the best period is the autumn, or still air, and particularly during fog, the air tends to become "stratified" into layers of different density, and the signal when passing from one layer into another becomes "refracted" and "bent down" to reach us again at distances far in excess of those mentioned above.

Hot days followed by cold evenings, in the absence of wind, will produce the required conditions, and the best period is the autumn, or even later (November—January) under foggy conditions, but reception is possible throughout the year.

The characteristics of "tropospheric" signals are long duration and slow fading, and they are applicable to Bands I/III and u.h.f.

(3) **Sporadic E.** Distances 500—2,000 miles.

For DXers this is, of course, the "star" turn as it brings in the really long-distance pictures, but it is, in fact, easier to receive than the Tropospheric reception noted above.

Propagation is by reflection instead of the Tropospheric refraction, and this reflection takes place from clouds of ionised gas that float at random in the upper atmosphere, particularly at certain times of the year, and which act as mirrors reflecting the transmitted signal back to the earth's surface over great distances.

Because the reflecting surface moves, and its efficiency as a mirror changes frequently, the signal that we receive from it is somewhat erratic in both intensity and duration, hence the name used, "Sporadic".

These reflecting clouds are present to some degree at all periods of the year, but the best times are usually between May and September, particularly during unsettled and thundery weather.

The characteristics of reception are very strong signals at times, but of variable duration from a few seconds only up to several hours for any one station received, coupled with fast fading.

A further aspect is of possible rapid changes in "skip-distance". For example, U.S.S.R. may be being received, but if there is a change in the position of the reflecting surface, this will fade-out, only to be replaced on our screens by, say, a Polish signal. This in its turn may vanish, and be replaced by Czechoslovakia. While this can be infuriating at times, it does enable us to log many stations and countries all operating on the same channel.

Basically, Sporadic E applies to Bands I and II (U.S.S.R. and Italy), but possible reception at the l.f. end of Band III is now under investigation.

(4) **F2 Layer Propagation.**

There is a further reflecting surface even higher above the earth's surface, known as the F2 layer. This is only really active on or near the sun-spot maximum, due next 1967/68/69, but this medium can produce very long-distance reception even up to 12,000 miles.

The next Beginners' Guide will give details of European TV standards, etc., and then we will deal with aerials and TV sets for use in DX work.

AKAI VIDEO RECORDER

To be released in a few months by Pullin Photographic Ltd., 11 Aintree Road, Perivale, Greenford, Middlesex, is the Akai model VX-1100 video tape recorder. It uses $\frac{1}{4}$-in. magnetic tape from 7 or $10\frac{1}{2}$-in. reels.

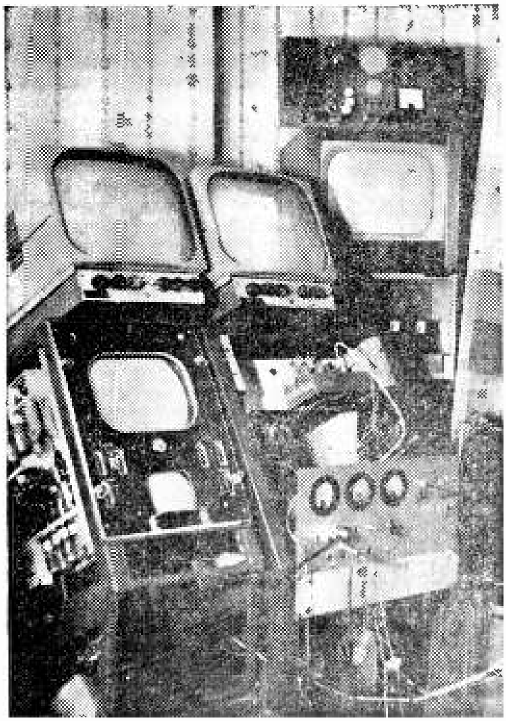
Tape speed is 30 i.p.s. which is the slowest to be used in a domestic recorder. Playing time is 50 minutes on both tracks from a 7,200ft. tape. It incorporates completely transistorised circuits and has two VU meters. The recording is longitudinal special modulation system, using cross field bias head. Power supply is 100—240V 50 and 60 c/s. Signal to noise ratio is more than 34dB. TV input and output, 1·4Vpp sync-negative 75Ω. Audio input and output line, 600Ω. Mic. 20kΩ. Dimensions are $17\frac{2}{3} \times 10\frac{1}{3} \times 16\frac{2}{3}$in. Weight is 45 lb. and the price is expected to be between £250 and £300.

IDEAS FOR.....

amateur TV

M. D. BENEDICT.

Part III



THE circuit (Fig. 9a) is simple but it has one major disadvantage. It is an earthed grid amplifier with a signal applied on the cathode. This has the effect of offering a low input impedance, so in fact this is arranged to be 75Ω and act as a termination. If the set works well on r.f. signal then the other half of the ECC81 could well be used as a cathode follower to provide a video output from the vision detector as shown in Fig. 9b. The gain should be set up for 1V at the output and h.f. corrector trimmer adjusted to give a good response on the test card. This is quite useful, for a modern u.h.f. set can easily be adjusted to tune the amateur 430Mc/s band. The termination effect of this circuit will be explained next month.

Cables and Termination

When a pulse is sent down a coaxial cable and it reaches the end an echo or reflection occurs and this will appear on the signal as the familiar positive or negative echo or ghost. If, however, the cable has no end no echo occurs! This "endless" cable is obtained by adding "termination" to the end of the cable. The termination is of the same value as the effective impedance of the cable. This is usually 75Ω for most coaxial cables. This means that a cable must only be terminated at one point, the far end; so any other apparatus "end" by the cable is "bridged" across the line as in Fig 10. Therefore a separate termination is added across the end of the cable. Alternatively some apparatus has a low input impedance, so this is arranged to be 75Ω and no extra termination is needed. This piece of apparatus is always placed on the end of the cable.

D.C. Restoration

The outputs of the amplifiers shown are coupled through a capacitor to the next stage so that the d.c. component of the signal is lost. This has the familiar effect of allowing the blacks of titles or credits, for example, to appear grey. The video output stage may also be coupled to the tube through a capacitor alone. The d.c. can be restored by adding a diode as shown in Fig. 11. This conducts during the synchronising pulses and restores the potential at the bottom of syncs. to earth. If a different potential is required the existing bias supply could well be adopted.

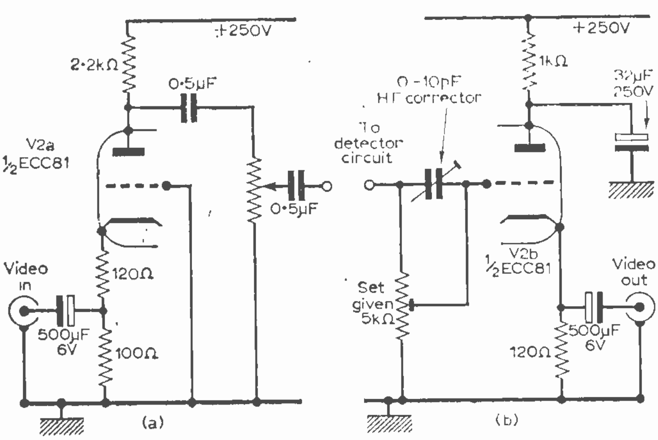


Fig. 9(a) Earthed grid amplifier and 9(b) Cathode follower.

Power Supply

To isolate the set from the mains a double-wound transformer is required so a circuit of the form shown in Fig. 12 can be added. The valves of the set can be rewired in a parallel circuit. The series type valves—those with a set prefix — PCC84, PL81, etc. (those with an 0·3A heater) are replaced with the 6·3V heater

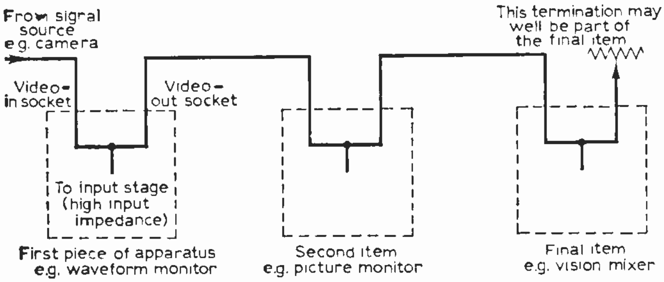


Fig. 10—Showing method of "linking" the coaxial cable between units. Note that cable terminated at one end only.

focus. The scan coils move the beam across the target in the usual manner.

The target is laid down on the inner surface of the optically flat end of the glass tube. It is a transparently thin layer of tin backed by antimony trisulphide which has the property of changing its resistance according to the light falling on it. Thus a highlight on the target causes the resistance to drop and the potential of the rear surface of the antimony trisulphide layer to rise up towards the potential of the target bias. When the beam scans the highlight point the beam current restores the rear surface to its original potential and this results in a flow of current through the load resistor. This flow is proportional to the change in resistance of the target at any one point or, in other words, the light falling on that point. The bias supplied to the target also controls the current flow and hence the signal level out, so acts as a gain control.

The beam current is controlled by the grid bias of the electron gun and is kept as low as possible to reduce beam size and so increase definition. The beam is cut off during flyback and this gives a consistent black level for a clamp to stabilise.

equivalent—those have a prefix E—ECC84, EL81, etc. If it is impracticable to rebuild the power supply, a good isolating transformer would be necessary.

As the layout of these various circuits will largely depend on the set chosen and the condition of that set, no specific layout can be recommended, except to keep leads reasonably short. If, however, the r.f. side of the chosen set does not work then it is a good idea to remove the r.f. and i.f. components. This will leave space on the chassis and will lighten the load on the power supply.

We will now deal with the circuits and layout of a Vidicon camera. In next month's article the mechanical construction will be dealt with, as well as test and alignment procedure. The article dealing with the Telecine Channel will also contain details of certain modifications and improvements which are not strictly necessary for a simple camera, but these can be incorporated at a later date.

The principle of the Vidicon camera is quite simple. The electron gun at one end of a glass tube one inch in diameter by about six inches long, fires a stream of electrons down this tube (see Fig. 13). These electrons are focused by the focus coils which surround the tube, the point of focus varying with the speed of the electron beam. This is controlled by the potential of the wall anode—hence the control of beam

A General Description

The output of the tube is very low (current about 0·2μA) and of high impedance. The head

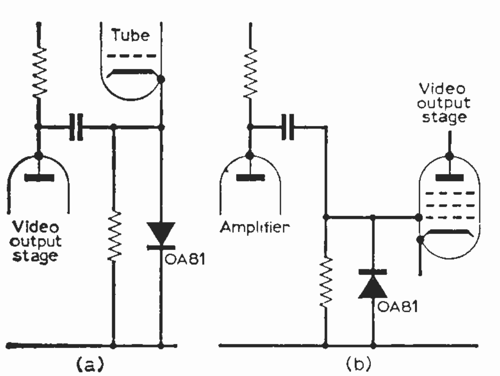


Fig. 11(a)—D.C. restoration at the c.r.t. cathode and 11(b) grid of the video detector.

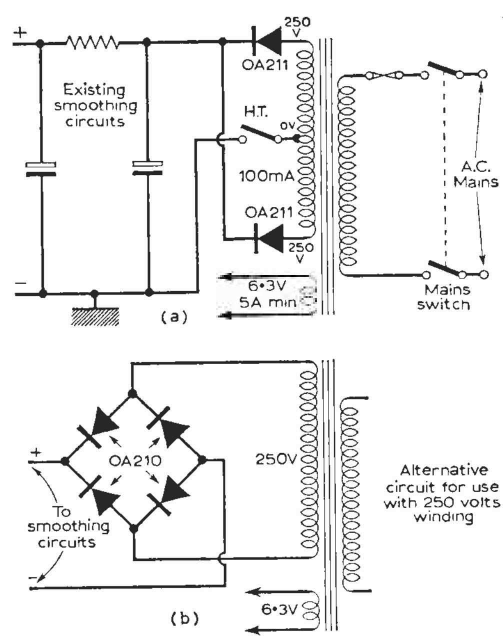


Fig. 12(a)—Power supply for parallel heater and 12(b) alternative cct.

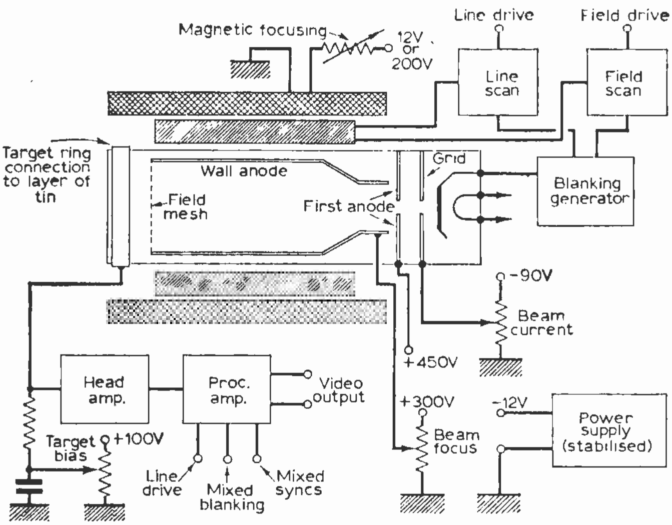


Fig. 13—The vidicon camera tube and associated circuitry.

amplifier is used to reduce this impedance to approximately 75 ohms. The head amplifier also corrects for losses at high frequency due to stray capacity across the high (for video) value of Vidicon load resistor. This amplifier is connected to the processing amplifier (this can be at either end of the camera cable, and will be discussed later) corrects the signal from the head amplifier and adds blanking and sync pulses and feeds two outputs.

The sync generators are driven by line and field drive and supply scan current to the tube scan coils. The drives also supply the blanking generators which cut off the vidicon cathode during flyback. Power supplies give the several high voltages required for the tube as well as a 12 volt stabilised supply. The focus current is supplied by a 12 volt supply for a low impedance coil or from a 250 volt supply for a medium impedance coil.

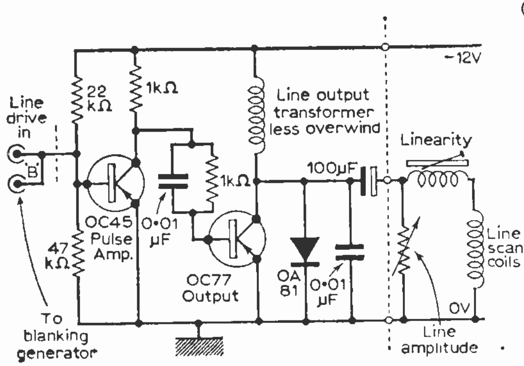


Fig. 14—The line scan circuit.

Scan Circuits

These are both built on to one piece of Veroboard about 3 x 4in. The edges of the Veroboard are supported by aluminium angle and the contacts are made by a 10-way edge contact plug with socket mounted on the camera base. No layout troubles have been found with this circuit and there should be enough room for the addition of shift circuits (to be described in the modifications for Telecine use). This plug has enough contacts for the external mounting of shift and amplitude controls; the frame linearity is a "skeleton" pre-set potentiometer mounted on the Veroboard.

Line Scan Circuit (Fig. 14)

A pulse amplifier drives the output stage which has two inductive loads. The first load is, in fact, a valve line output transformer without the e.h.t. overwind and most types of transformers seem successful as this is not a critical component. The second part of the load is formed by the scan coils and a magnetic type linearity corrector from a valve line scan circuit found in many 7—10 year-old Pye (and similar) sets.

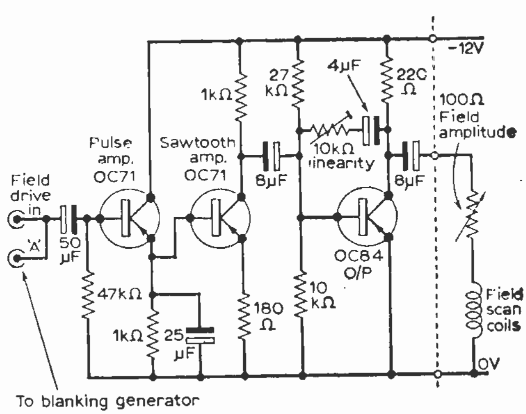


Fig. 15—The field scan circuit.

The Field Scan (Fig. 15)

Here the pulses are amplified and integrated to give a sawtooth, which is amplified and fed to the output stage. Variable feed-back is used to adjust linearity.

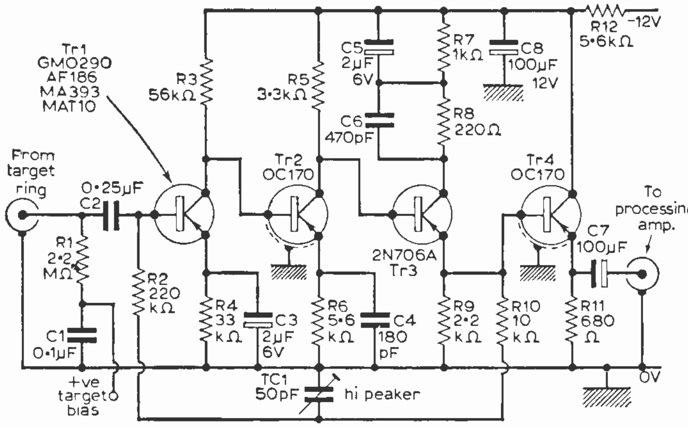


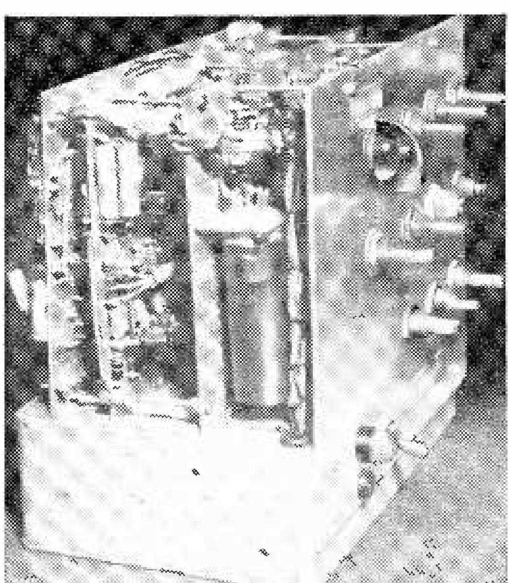
Fig. 16—The head amplifier circuit.

Processing Amplifier (Fig. 18)

The signal from the head amplifier has come via a camera cable which may be short or long depending on the type of camera to be built. (See next month's article where this point is discussed further). Hence the cable impedance is matched with a 75 ohm combination of resistor and gain potentiometer. The gain control feeds an amplifier, the emitter of which is decoupled by a capacitor of a value which is to be determined on test. An emitter follower is next and this produces a low impedance output for a clamp to act. This is an OC44 which, when conducting during line drive, stabilises the black level of the signal during flyback, the output of the tube being cut off by blanking applied to the cathode. This is not mixed blanking which is now fed in at the emitter of the next stage and all the signals during this blanking period are cut off by the diode. This cleans up the signal by removing all spikes due to the clamp and line scan induction. All signals below a d.c. level controlled by a lift emitter follower and its bias potentiometer are also removed by the diode. Then another video amplifier stage with an adjustable emitter capacitor from which the video signal is applied to the output stage where sync, pulses are added. One can obtain two isolated outputs provided very high gain transistors are used.

The Head Amplifier (Fig. 16)

This is about the only circuit where layout is important (Fig. 16). It is built into a small die-cast Eddystone box. The input from the co-ax socket is fed to a 3-stage high gain amplifier; the input impedance is controlled by negative feedback. H.F. correction for the not inconsiderable stray capacitances is provided by the low value emitter capacitors on the second and third stages, one of which is made adjustable and is used to peak up the h.f. response of the complete channel. These amplifier stages feed the output stage, an emitter follower to match the camera cable impedance.



Photograph shows fully interlaced strobe pulse generator for 405/625 line operation, using valves built by the author.

Construction of Circuit Boards

Each unit is built on Veroboard. Line and field scan circuits can be built on to one piece of Veroboard about 3 x 4in., and the processing amplifier on a similar-sized piece. The line output stage inductance (old line output transformer) will probably be mounted on the camera and not the Veroboard as it is likely to be too heavy. Room should be left on the scan board for two extra stages if the camera is to be used in a Telecine channel. The edges of the Veroboard should be supported by a bracket and the connections made by a 10-way plug and socket, as used on computer boards and similar applications. The socket is fixed to the board mounting bracket and the plug soldered direct to the required strip of copper on the Veroboard, if this is possible, otherwise wire jumpers are quite satisfactory.

The processing amplifier is similar but the lift control is mounted externally.

The head amplifier layout is shown in detail in Fig. 17. The input co-ax socket is fixed to the Eddystone box. One of the fixing bolts is also used to support the Veroboard. This is a six strip by 15 holes, i.e. about 1 x 2½in. The mounting of small components perpendicularly to the board is used as in small transistor radios. Several bits of the strips are removed to reduce stray capacity. Connections for the target bias, earth, and −12 volts are made via

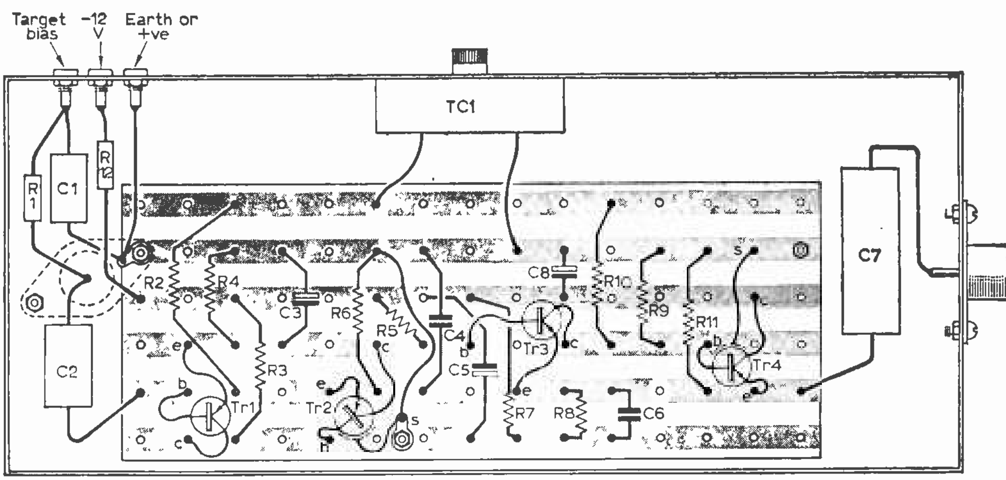


Fig. 17—Veroboard layout of the head amplifier.

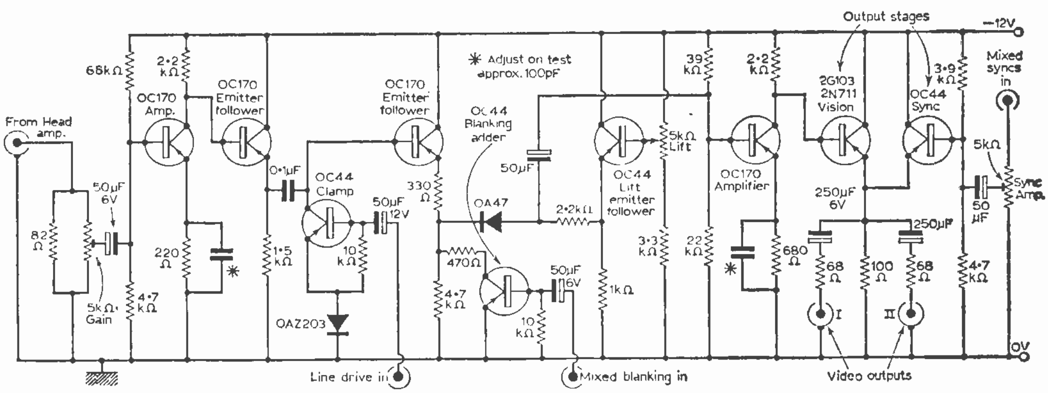


Fig. 18—Circuit of the processing amplifier.

feedthrough capacitors or similar connectors. The adjustable capacitor C4 is mounted on the case. The 0·1 and 0·25μF capacitors are miniature 100 volt working types as used in computers, but several types of components are small enough for use. All other capacitors are miniature electrolytic or miniature polystyrene components. The resistors are all miniature $\frac{1}{8}$ or $\frac{1}{4}$ watt components; the vidicon load resistor should be a high stability, low noise type.

The power supply is best assembled roughly in position in the camera (or c.c.u.) when the other major components have been assembled. However, the mains transformers should be as far away as possible from the scan coils. The blanking generator is built on a piece of Veroboard and has even been mounted on a tube base in one version of the camera. The board can be mounted in any spare space in the camera.

These amplifiers and generators can be built up now, and using the test waveform generator a rough check of their operation can be made.

Next month details of the mains power supplies will be given, also further information on the camera, including the mechanical construction and layout of the two versions of this camera.

Part IV next month

PRACTICAL TELEVISION INDEX

The index to Volume 15 of PRACTICAL TELEVISION is obtainable from the Post Sales Department, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.
The price is 1s. 6d. inclusive of postage.

BUYING a used TV receiver

By J. CHAPMAN

THERE are thousands of second-hand (trade-in) television receivers on the market at the moment. These range in price from a few shillings for the type of set that "went when we traded it in" to fifty pounds or so for one of last year's "slim-line" models. Obviously you take a risk buying a trade-in, but is there any risk with the cheap sets when you consider the cost of present-day servicing? You can often get many months' use out of an old set before anything goes wrong. Then it is often only a valve, which can be replaced at little cost. If it is beyond the owner's capabilities and he has to throw it away, little has been lost: especially when you consider the depreciation of a new receiver. You cannot, however, hide the fact that an old set is what it is and you cannot expect too much from such a buy.

HOW TO GO ABOUT IT

There are many things you could look at when buying a used television receiver, but most traders who handle these are not all that bothered if they sell you one or not. If you ask too many questions, the retailer may throw you out of the shop or wrap the set round your ears. One must remember that they are in business to sell new sets and selling a "trade-in" means the loss of a "proper" sale.

Some traders will not give you a working demonstration and are quick to tell you the old story "it was working when we traded it in". Unless you are buying one for bits, it is advisable to go to another dealer if you get this sort of treatment.

If you are lucky enough to get a working demonstration, do not expect too much. It is advisable, if you live in a reasonable signal area, to ask the salesman to run the set off a simple aerial as some retail shops have large arrays which capture a lot more signal than the normal domestic array.

Readers with a little technical knowledge can often improve the performance of a used receiver at little cost. A few tips on this subject appear in the accompanying article "and how to improve it".

POINTS TO WATCH

There are almost as many different types of used television receivers as there are motor cars. It is, thus, impossible to comment on particular receivers, but the layman may well find the following points of interest.

Receivers having no channel switches or push-buttons are, of course, only suitable for receiving BBC-1 transmissions. They are at least ten years old and can be obtained for a few shillings.

The early BBC-1/ITV receivers which were produced in the mid-fifties can be identified by the old-fashioned 2- to 5-channel tuners. Most of these receivers perform well, but it should be remembered that they are nearing the end of their usful working life and that the tuners are not so reliable as the modern turret types. Anything above five pounds is too much for a receiver of this type.

Receivers with turret tuners covering all the BBC-1 and ITV channels were introduced in the late fifties. These are easily recognisable by the channel numbering on the tuner switch (often 1 to 13) and can be picked up for a few pounds.

It is difficult to identify receivers produced between the late fifties and early sixties as the external design did not change very much until the slim-line receivers came on to the market. One would be silly to try and put a price on these receivers as they are often sold on their appearance, but one should be careful not to assume that receivers with a switch marked 405/625 are suitable for receiving the BBC's second programme.

CONVERTIBLE RECEIVERS

In anticipation of BBC-2 some manufacturers began producing what they called "convertible" receivers a few years ahead of the first transmissions. All of these are convertible, but at a price. The manufacturers' conversion kits vary in cost up to £20 and the labour charges involved in the conversion can equal that amount. This is because some of the receivers require new i.f. amplifiers, extensive changes to the line and field timebases, additional switching linkage and ancillary components. All convertible receivers require u.h.f. tuners and on the later convertibles that is all that is necessary to make them fully dual-standard. On the later convertible models (or "switchable" types as they are sometimes referred to) it is a simple matter to fit the extra tuner, as on the majority of sets sockets are provided to simplify the internal connections.

If you cannot trust the dealer, either have him fit a tuner and show you the results (this will probably cost you) or find another trader. Most traders are honest and some actually guarantee their second-hand sets.

TEST CARD CHECK

It is often best to buy a second-hand receiver during the week as the trader has more time and you have a chance to see it working during a trade

Continued at foot of next column

. . . and how to IMPROVE it

By W. HENRY

AFTER acquiring an old television receiver, it is advisable to run the rule over it before putting it into service if you want to get the best out of it. One of the first things that ought to be checked is the fuses—see the line-drawing which shows the position of the main components in a typical old receiver. If the fuses (1) are bridged with ordinary wire, or with silver paper, replace it with a fuse of the correct value. Better still, measure the current consumption before doing so, to ensure that the previous expedient was not caused by excessive drain or surges.

Also look for flashes and sparks in the line output and boost diode valves as they warm up, and especially in the rectifier valve, if one is fitted. If the rectifier (9) is defective, it often pays to disconnect the base, leaving only the heaters in circuit, and replace the valve with a silicon diode. BY100 diodes are suitable and are quite cheap. You will, however, need an additional surge limiter, of between 12 and 25 ohms, to compensate for the increased efficiency of the semiconductor device, and a 1,000 pf capacitor, rated at least 500 volts d.c. working, across the diode to protect it. A delay fuse could profitably be included in the h.t. line to give further protection.

Next, have a look at the mains dropper resistor (2). Cowboy field engineers have a nasty habit of bridging burned-out sections to keep a set going; especially those who earn any sort of bonus. Other, more meticulous, field engineers, may have fitted wire-wound components to bridge the gap, but check the values as they are often incorrect. Mains dropper sections, covering a very wide range of values, are available through most dealers (Radiospares). They are made in such a way that a substitute mains dropper can be assembled and mounted on a piece of threaded rod, which can be firmly clamped to a chassis point to help heat conduction. It should be positioned to achieve maximum ventilation and in a position unlikely to produce a hot air stream over vulnerable sections of the set. Often an improvement on the original design can be made by remounting the mains dropper in a different position. A piece of tinplate, bent to shape and firmly clamped to the chassis, makes a nice thermal shunt. It should be about an inch from the body of the dropper, and not touching any woodwork or components, nor butting against the back cover when replaced.

CHECK WITH THE RIGHT VOLTAGES

Having got the right voltages in the right places, and remembering to calculate wattages when replacing power sections, we can test the set again. And here, we may have a disappointment. If the set has been over-run in the past for any length of time, it is likely that the efficiency of some of the valves may be down. The most likely sufferers are the hard-working types, such as the video amplifier (3), the line output valve (4), boost diode (5) and field output valve (6). You may also find the tuner valves will no longer come up to scratch, but not to worry, tackle the job systematically and an improvement will be effected.

LACK OF WIDTH AND HEIGHT

If, with correct h.t. and heater voltages, there is a lack of width and height, it is possible that the boost voltage is down. This can be caused by a weakening boost diode, or possibly a line output valve being under-driven. Lack of width which is also associated with cramping towards the right-hand side indicates the boost diode itself is the culprit. But before getting too despondent, take a look at the screen feed resistor to the line output valve. These often fail and should be replaced by wirewound components. The usual value is between 2 and 3kΩ with a minimum rating of 2 watts.

On many receivers, the drive to the line output valve is critical. If the line oscillator (8) is not

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test transmission. You can then check the bandwidth of the receiver by the resolution of the gratings in the centre of the test card picture. Also you can see (and hear) if there is any sound on vision or vice versa.

If the alignment is not all it should be—giving poor resolution or sound on vision, etc.—leave the set alone if you cannot do the re-alignment yourself, as it may be an expensive job to have it done professionally. Also, you may find some of the coil slugs and formers jammed or damaged.

TUNERS

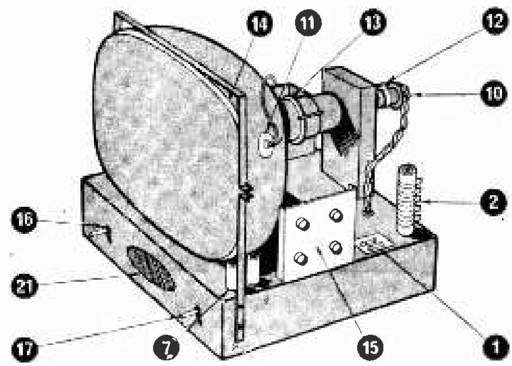
It is advisable to check that the v.h.f. tuner (and the u.h.f. one if fitted) is satisfactory, switching from one channel to another and checking that there is no degradation of picture when returning to the original channel. In most locations, the picture brightness levels of BBC-1 and ITV should be similar. ■

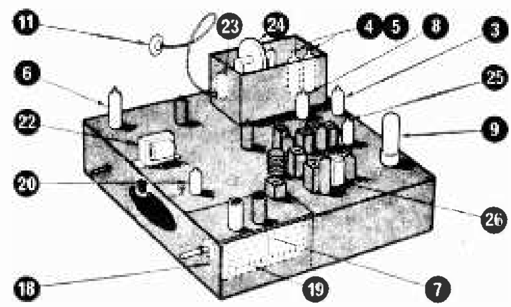
delivering a big enough pulse, the width will be affected; ECC82 and PCF80 combinations are particularly troublesome in this respect. The former may be the only one of its type, and a new valve will be required, while the PCF80 usually has several counterparts throughout the set. The frequency changer PCF80 can generally be changed with the line oscillator to prove this fault. In other cases the line oscillator may be a part of a double triode whose second section is either a frame sync pulse shaper or an inverter stage. Again, a temporary swop should prove the fault. One should be careful not to be side-tracked by other faults that change-over may produce.

FAULTY SIGNAL CIRCUITS

Having obtained a raster that is filling the screen and is variable by adjustment of the different controls, we may turn our attention to the signal circuits. If the set was indeed working, as the salesman said, we should expect some sound and perhaps a weak picture. These are generally the conditions under which an exchange is made, often under the misguided impression that a weak picture denotes tube failure. So let us tackle the tube (10) problem first.

1. Fuses.
2. Mains dropper resistor
3. Video amplifier
4. Line output
5. Boost diode
6. Field output
7. R.F. amplifier
8. Line oscillator
9. Rectifier
10. Cathode ray tube
11. Final Anode (e.h.t.) connector
12. Ion trap
13. Scan coils
14. Tube clamp
15. Preset controls
16. Manual controls
17. Tuner control
18. Fine tuner cam
19. Turret contacts
20. Sound output
21. Loudspeaker
22. Field output transformer
23. E.H.T. rectifier
24. Line output transformer
25. Valve screens
26. Tuned circuits





TUBE FAULTS

If an a.c. voltmeter is available, the tube heater can be tested. A common cause of discard is a partially short-circuited heater, giving less than the rated voltage at the correct current, and consequently, less than the required cathode heating. The reason for this low voltage is that the current through the heater chain, other things being correct, will be normal, and the reduced resistance of the damaged heater develops less power. If the tube is fed from an isolating transformer, with the voltage the heater requires, the cathode will perk up again and a good raster should be obtained. Although the radio retailer would not consider such a repair worth his while, *Practical Television* readers are at liberty to experiment. The cost of a suitable heater transformer is negligible in comparison with that of a new, or even a re-gunned tube, and if it is not a success the transformer will always be a useful standby for a number of other experiments.

If the problem is simply low emission, one can resort to boosting the heater voltage to effect a temporary repair. The author knows of several "temporary" repairs, done five or more years ago which are still going strong! The possibility of over-running the tube exists, but as it was probably beyond redemption anyway, what is there to lose? The method for clearing grid-cathode leaks, which usually cause uncontrollable brilliance even with the grid feed disconnected, is to flash the leak away by applying e.h.t. Extreme care must be exercised as one can easily have an accident.

To obtain the best conditions, all the connections to the base of the tube should be removed, except for the heater. Then the cathode is connected to chassis and a well-insulated flylead is attached to the final anode connector (11) ready for connection to the grid pin. Switch on the set, allow it to warm up until you can hear the line oscillating strongly, then apply the hot end of the insulated lead to the grid pin. A couple of seconds should be enough. Keep one hand in your pocket as you do this, and even if a shock (which is more of a burn from e.h.t., and, because of the high impedance source, not especially harmful) is suffered, it will not pass through the body. Flashes within the gun of the tube may be observed, especially if the leak was caused by a flaked cathode coating or old gettering. Repeat this once or twice, and in the majority of cases the leak will have cleared.

continued next month.

Servicing TELEVISION Receivers

Regentone 192 & R.G.D. 619

by L. Lawry-Johns

THESE models were produced for the 1961 season and featured a push-button tuner unit, 19in. tube, forward facing loudspeaker and in the case of the 619 a photocell contrast circuit to alter the gain according to the ambient lighting conditions.

A further R.G.D. model, the 621C, was a console with the same chassis and slightly larger (7 x 4in.) loudspeaker. The circuit is quite simple, employing 13 valves and a few diodes. It has proved fairly trouble free except, perhaps, for the tuner unit which had its share of minor defects.

Dismantling

Remove the rear cover screws and lay the receiver face down on a soft surface. Pull off the control knobs and take off the slide clips which secure the top of the escutcheon and lift this away from the cabinet. The screws which hold the control panel and tuner can then be removed. Disconnect the loudspeaker leads and photocell (if fitted), remove the four nuts; two top two bottom. Remove chassis carefully. The tube is an AW47/90 with a closed loop linearity sleeve on the neck which, of course, is free to slide in and out of the deflection coils once the

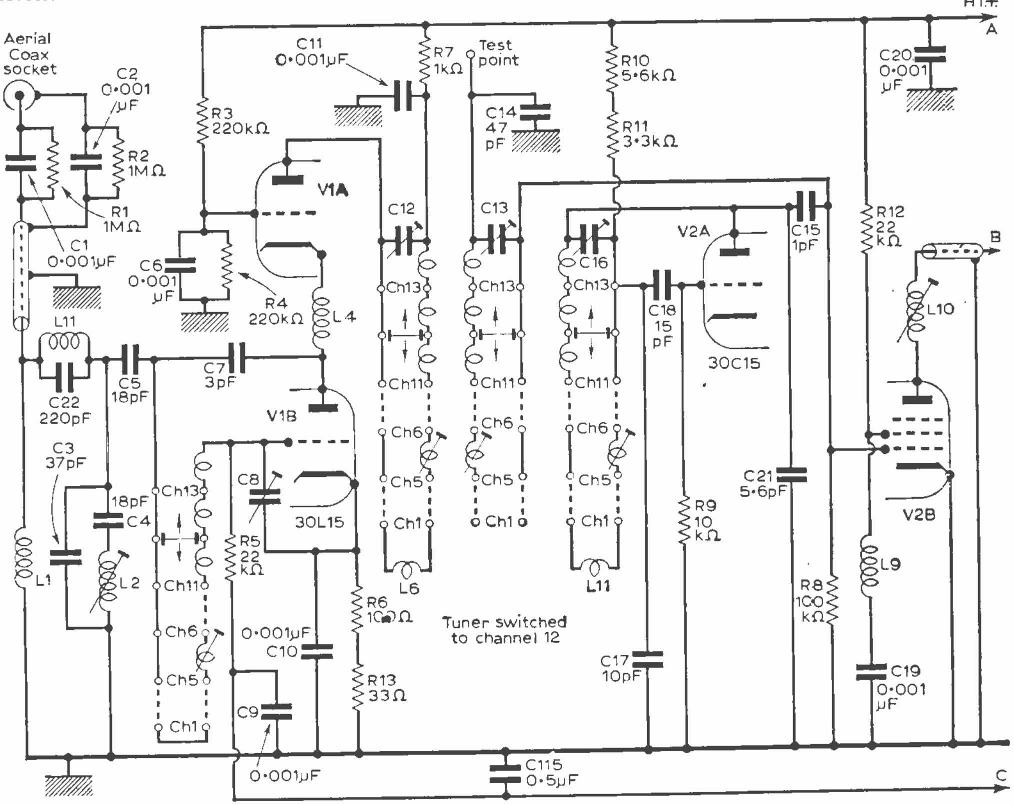


Fig. 1—Circuit of the r.f. tuner unit.

clamp is slackened in order to effect control of line linearity and to an extent the width. The sleeve must not be pushed too far in under the coils or overheating will occur. The gap in the loop must be kept to one side.

Channel Selection

Expose tuner and open lid by lifting the thick black wire outward. The lid swings back to expose the contact studs and plastic slides which carry the spring leafs. The front two slides should be used for channels 1 to 5 and the rear two for channels 6 to 13. These slides are numbered to correspond with the push-buttons. Before opening the lid release any depressed button by applying slight pressure to one of the others. To change channels raise the side plastic retaining arms and remove the slide on the channel not required. Place it into the desired position (as marked). Ensure it is properly located to engage the button slide. Close down retainers, close lid and secure with black clip.

Press the chosen button, carefully prise off the name-plate on the button to expose the fine tuner screw. Adjust screw for maximum sound and optimum picture resolution. Depress and release buttons several times to see that the contacts are holding and making properly. The contact studs must be kept free of tarnish to ensure proper contact.

HT Rectifier

Rectification is by a pair of silicon diodes which, when replacement becomes necessary, can be replaced by a single diode such as the BY100 or equivalent. When the 1·5A fuse is found to be blown these diodes should be the first item to be checked for shorts. Using an ohmeter the rectifiers should register a low forward and high reverse resistance. The 0·1μF capacitor, C118 should not escape attention in such a check. A replacement must be of adequate voltage rating clearly marked 250V a.c. or more. A capacitor of less than 750V d.c. rating is not suitable. The presence of this capacitor is essential to absorb mains transient surges and protect the diode(s). This type of fault will not blow the 500mA h.t. fuse as it occurs later in the circuit, after the electrolytics. Therefore when the 500mA is blown the fault can be looked for in the receiver circuit rather than in the power pack.

Line Timebase

The line timebase valves are one half of the ECC82 V7, the PL36 V8 and the PY800 V9. The usual trouble causing a failure of line timebase operation is a gassed PL36 caused by a cracked glass envelope. This usually splits neatly around the base of the glass where it joins the plastic. It goes without saying that there will be no visible heater glow in the PL36 when this happens.

Other causes of line timebase failure can usually be traced to a faulty ECC82, o.c. width selector resistor section or a defective 0·25μF boost line capacitor (C60) which may be open circuited or shorted.

If the line timebase is functioning as evidenced by normal line whistle and correct voltages but there is no illumination on the screen at all, the EY86 will most probably be at fault with an o.c. heater. When the timebase whistle is strained or very subdued note the effect of removing the EY86 or taking off its top cap. A sudden return to normality with sparks from the top cap to the top of the EY86 (if still fitted) indicates that this valve is shorted and is overloading the timebase. If, however, the EY86 lights normally the fault should be looked for in another part of the circuit particularly in the first anode supply to the tube base where C119, 0·02μF may be found shorted. Note that if C71 (0·2μF) is shorted the effect will be a dark picture rather than no picture at all since this capacitor is returned to the h.t. line not to chassis as is C119.

Line Hold

When the hold control is at the end of its travel and the picture still cannot be locked or is still a

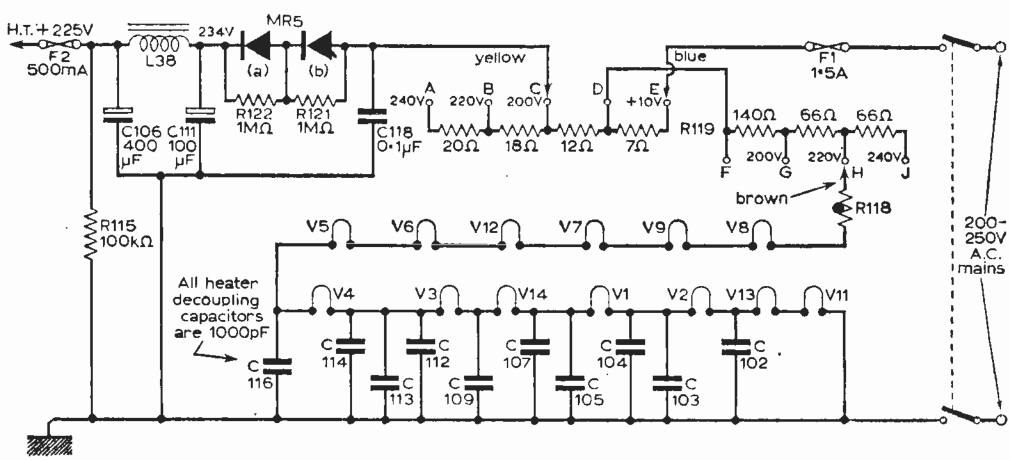


Fig. 2—The power supply and heater chain.

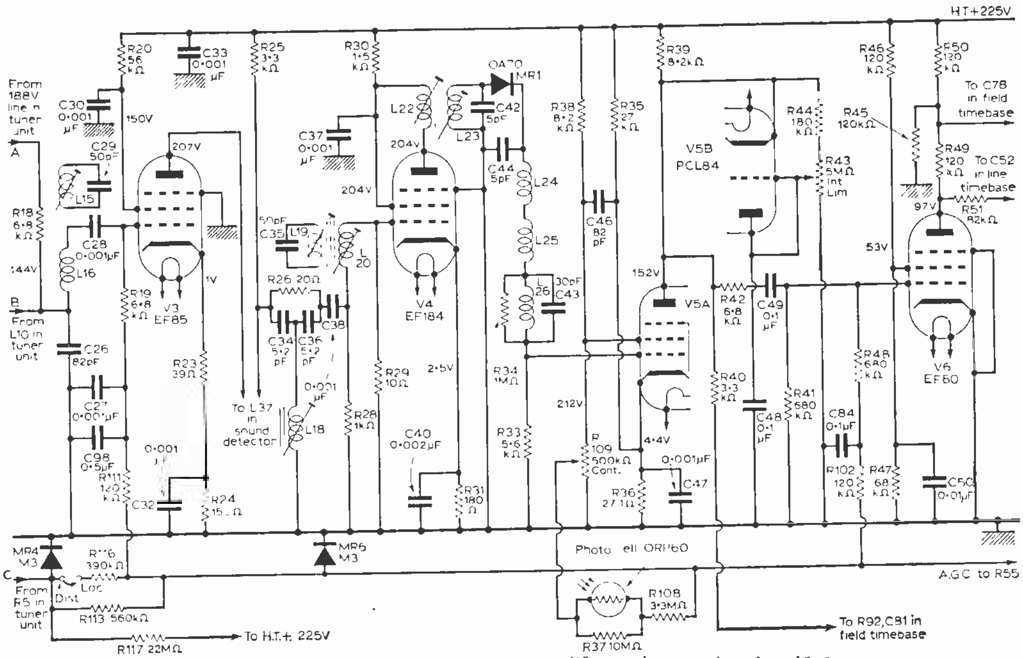


Fig. 3—Vision i.f. video detector, video amplifier and sync separator stages.

mass of lines check the ECC82 by replacement then check R53 (270kΩ). R59 is also not to be ignored but lack of width should first direct attention to this. It doesn't change value very often however.

Field Troubles

Perhaps the most common field timebase trouble is bottom compression with the top tending to be comparatively extended. Items to check are V12, PCL85, C67 (100µF), R65 (390Ω) and C69 (0·01µF).

Lack of height; that is an even loss top and bottom, is rarely due to any of the above items. Attention should immediately be directed to R76 (1·5MΩ), R84 (470kΩ) and C77 (0·01µF).

continued next month

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500 school teachers see colour television

THE tremendous interest aroused in colour television by the Government's decision to allow the BBC to transmit in less than 18 months' time had a focal point in Swindon the other week.

Rentaset Wired Services Division, a member of the Radio Rentals Group, and long established in the area, presented a series of colour television demonstrations to education authorities, at the company's Shrivenham Road studios.

The demonstrations were produced by technicians from Baird Television who travelled from Bradford with their equipment to show how advanced is Britain in the development of colour television.

Heads of universities, colleges and schools from all over the country and members of their teaching staff attended, as did chief education officers and senior executive officers from a large number of cities and towns.

Each session commenced with an introduction to the black and white system. The guests were then taken to Headlands School, where they watched a colour broadcast Relay System (installed and operated by the Rentaset Wired Services Division) of a series of lectures taking place in the studio at Shrivenham Road.

NEW CHAIRMAN OF RIC.

Sir Jules Thorn, chairman of Thorn Electrical Industries and president of the British Radio Equipment Manufacturers' Association, has been elected chairman of the Radio Industry Council.

The RIC which co-ordinates the interests of the domestic consumer products sector of the electronics industry has as its constituent members: B.R.E.M.A., Radio and Electronic Component Manufacturers' Federation, British Radio Valve Manufacturers' Association and the Electronic Valve and Semi-Conductor Manufacturers' Association.

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

THE Sporadic E season has really opened at last, and what an opening it has been! Everyone must have been well satisfied, even those who were despairing over the effective conversions of their sets must know by now that all is well!

CONDITIONS (PERIOD 18/5/66 TO 18/6/66)

The first big opening here was on 18/5/66, and since then things have been really "buzzing", hardly a day without Sporadic E results. All the old faithfuls have been coming in well at times, and in my own area the only missing ones have been Denmark and Rumania, but these have been received elsewhere.

The list of dates and countries will be omitted this month because stations have been too numerous to note in detail, and I have quite a lot of news and readers' reports for you.

NEWS

(1) Test Card "D" is now being used by Coimbra Portugal. Many of us have seen it, and **Albert Davies,** of Crawley, has a letter from R.T.P. confirming this but saying that the use may be only temporary.

(2) Rumania. A. Davies has seen a new type of Test Card on Bucharest Ch R2. This has a small centre circle, about the size of the U.S.S.R. one but with a picture in the middle, and the words "Televiziune Rumani" inside the circle. The circle is enclosed in a dark oval with flattened ends, and the card has four corner circles like the Russian one, together with various contrast wedges.

We hope to have a suitable photograph from Albert for inclusion in a later edition. Since the original report Bucharest R2 has been seen radiating the card shown in Data Panel No. 7 in the March, 1966, issue, so the new card may be another temporary one.

BIG NEWS!

(3) Santa Cruz de Teneriffe, Canary Islands, has been received by **Mr. Roper,** of Torpoint, and myself on Ch E3, so one of the "exotics" recently mentioned has become possible.

On 14/6/66 from 14.30 onwards, Mr. Roper saw a T.V.E. Test Card on top of the regular T.V.E. programme being received at that time. This second T.V.E. card was later followed by a clock (one hour *behind* B.S.T.) then the usual T.V.E. opening caption (mast and globe) was seen and subsequent programmes, although Spanish, were not the same as from Spain itself.

During the afternoon of 14/6/66 I too saw two *different* Spanish language programmes on Ch E3, as well as R.T.P. Portugal at times, so I feel that there can be no doubt that we received the Canary Islands.

(4) Yugoslavia J.R.T. The use of Test Cards and Test Patterns has been somewhat of a problem this year, but from observations by myself and A. Davies the following conclusions have been reached, based on reception on 11/6/66, following caption identification of a preceeding programme:

The Marconi Resolution Card No. 1 (like Eire) was seen on Ch E3 as a Sporadic E signal, and this was floating with the Polish/Belgian type card, both of these are used by Yugoslavia.

On Ch E4 there were two "floating" Sporadic E Black and White Check-board patterns (like N.T.S. Holland) and these, too, are known to be used by J.R.T.

It would appear that at least four Yugoslavian stations were coming in under exceptional conditions of propagation in the direction of Yugoslavia, and that the four are:

(1) Kapaonik E3.
(2) Kum E3.
(3) Labistica E4.
(4) Sliema E4.

While it is admitted that this is not conclusive proof it would certainly seem that at least four Yugoslavian stations were involved.

(5) Sporadic E skip distances. I feel that we must revise our ideas about minimum distance for Sporadic E skip. This was estimated at approximately 500 miles and under this reception was not practical.

However, on 20/5/66, **R. Bunney,** myself and others received E3, Liège-Ougrée, Belgium, as a Sporadic E signal, and he is only approximately 300 miles from that station, even a little nearer than I am, and some other readers are only a little further away! So what is the minimum distance going to be in the future?

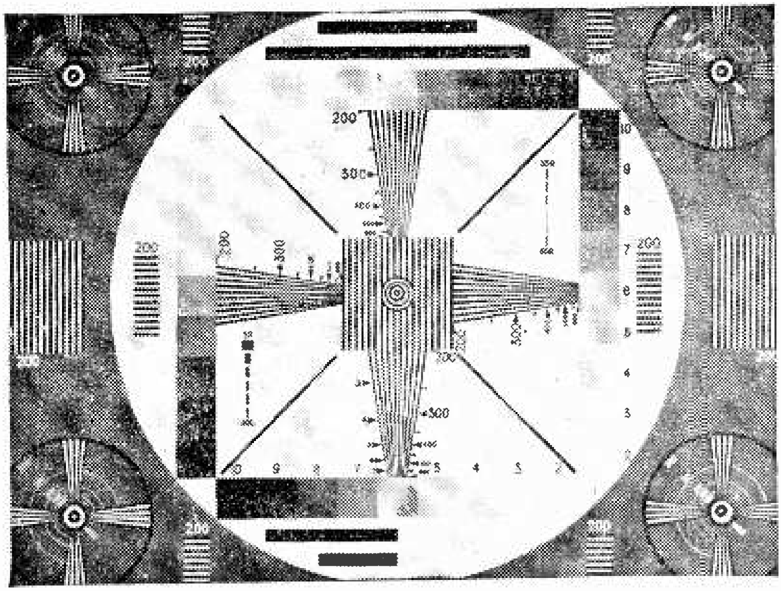
READERS' REPORTS

J. Beswell, of London, reports reception of Spain E2, E3 and E4, France F2 and F4, Italy IA, Portugal E3, Yugoslavia E3, Hungary R1, Switzerland E2 (with "Z" not 2 on card "Z"= Zurich), and Denmark E5. On u.h.f. Holland, Goes, Ch 32.

C. Marston, of Harrogate, has joined our ranks with Belgium E3, Switzerland E3, and E4, France

DATA PANEL-12

HOLLAND N.T.S.



(courtesy M Aisberg)

Test Card—As photograph above for Bands I/III and u.h.f. (marked "2"). A black and white check-board pattern is also radiated by both chains at times.

Channels—NTS operates in Band I on Lopik Ch E4. NTS operates in Band III on Goes (E7), Markelo (E7), Smilde (E6) and Roermond (E5). The UHF second chain uses Markelo (Ch 54), Goes (Ch 32), Roermond (Ch 31) and Lopik (Ch 27).

All the above have been well received in UK, except for Goes Ch E7, which is a rare one.

Times—Test Card times are normally late afternoon for Bands I/III but from 0900 for u.h.f. Programme times normally start late by our standards at approx. 1930 and finish early (around 2230-2300 B.S.T.).

NTS programmes are often sponsored by various religious groups and the initials of these (AVRO, KRO) can be seen on captions.

F2 and F4, Spain E3, Czechoslovakia R1 and R2, Sweden E3, Norway E3 and E2, West Germany E2, Poland R1, Rumania R2, and Italy IA. An excellent start.

A. G. Challis, of White House, Southwood Road, Beighton, near Acle, Norfolk, is doing well with his new S.T.C. export set with France and Holland in the U.H.F. "bag," and Denmark E7 as a good Tropospheric. He kindly offers free his "old" converted Bush TV 53 to anyone who needs it if they will collect it from him, so deserving cases please apply to the above address!

J. Cribbon, of Athlone, Eire, has been active with reception of Czechoslovakia, U.S.S.R., Switzerland, Austria, West Germany, Spain, Italy, Portugal, Belgium, Holland, Poland, and Finland, so he did well during the recent good conditions.

We are always delighted to have your reports, particularly those noting new type Test Cards, etc., as this helps considerably in the identification of other readers' problem stations.

DISTURBANCE TESTING

by V. D. Capel

A LIMITATION of which many amateur constructors and experimenters will be keenly aware, is that imposed by the lack of expensive test equipment. With it the professional can rapidly diagnose and trace faults while the home experimenter has to try hit-or-miss methods. There are ways and means whereby this deficiency can be minimised so long as a multirange testmeter is at hand. A meter that will read voltages and resistance is essential, while current ranges are also useful.

Disturbance Testing

The basic method of fault diagnosis without test equipment is known as disturbance testing. In essence it consists of injecting suitable signals into various points, such signals being obtained from local improvised sources which mostly are very simple.

Many readers will be familiar with the placing of a finger via a screwdriver blade or some other convenient conductor on to the grid pin of a sound valve. The resulting hum tells us that the valve is working. This is a simple illustration of the method. The hum is the result of a.c. mains fields that are picked up by the conductor and the body, and as the mains frequency is in the audio range it proves a suitable and convenient source of signals to check a.f. circuits. Disturbance testing carries this principle further.

Let us assume that we are confronted with a receiver (TV or radio) that has no sound. We should, as with all fault diagnosis, adopt a systematic method of working. This can be done by starting at the loudspeaker and working backward, eliminating stage by stage until the defective stage is located. Firstly, listen carefully for residual mains hum. If present, this will absolve those two components and their wiring from blame. Again we are using a local signal source, the a.c. ripple on the h.t. line, but in this case we do not need to inject it because it is already present.

No Noise

If there is no noise at all the speaker or transformer could be faulty, but the trouble could be due to other causes. Lack of h.t. or an o/c output valve heater would be other possibilities, so an h.t. check should be made on both sides of the output transformer primary, and a visual check on the valve heater. Should there be no voltage on the anode side of the transformer primary, then the winding is most likely o/c, but if there is, listen for crackling in the loudspeaker when the measurement is being made. This will be due to changes in the current drawn by the meter through the primary as the test prod is touched on the terminal. If no sound results then, switch off, switch the meter to the lowest resistance range and apply the test leads across the transformer primary. The internal meter battery should cause enough disturbance to make a pronounced noise in the speaker. If it does not, look at the actual reading, there may be a dead short which could be caused by a shunted tone capacitor. If there is still no clue, try across the actual speaker. With radios do not forget to check speaker muting switches.

If there is noise in the speaker by either of these tests, the finger on the grid of the output valve will reveal whether or not the output stage is working. If it is not, voltage and resistance tests will locate the precise reason. This is why a testmeter is so necessary, disturbance testing will often localise the trouble to one stage, and from then on the meter is required to indentify the defective component.

Healthy Hum

Should there be a healthy hum from the output stage we can move back to the a.f. amplifier. Here again hum can be injected into the grid circuit by the same means. In this case, a rough check on the gain of the a.f. stage can be made by comparing the volume of the hum with that produced on the grid of the output valve. It should, of course, be much greater, if it is about the same or even perhaps, less, then a fault is present which is greatly reducing the gain of the a.f. stage. A low emission valve or the anode load resistor gone high in value are frequent and most likely causes of this.

We can inject hum right back to the a.f. side of the detector. This will give a check on the coupling and i.f. filtering components. Remember, however, to keep the volume control at maximum as otherwise a misleading result may be obtained. Another pitfall which may be encountered is when applying this method to battery radio sets. In this case, there may not be any a.c. hum fields around, especially if the job is being done away from any mains wiring. In such case no hum will be heard even though the a.f. and output stage may be in order.

Sound Detector

The detector itself will, in most cases, either be a valve diode such as the EB91 or a germanium diode. The former can easily be checked by changing it over with the vision detector. The germanium diode is more prone to trouble than the valve, its favourite trick is to go short-circuit. Its effectiveness can be checked by measuring its resistance and then measuring again with the meter leads reversed. There should be a big difference between the two, one reading very high, on many cheaper meters the reading will be infinity, and the other quite low. One end of the diode should be disconnected first to remove the shunting effects of the last i.f. coil and the a.f. grid circuit.

Passing back now to the i.f. stages it may be thought that an r.f. signal generator would be essential for localising faults here. Hum injection obviously will not work as a.f. signals would not get past the tuned i.f. coils or the detector. The answer, however, is just as simple, merely scatching the anode pins with the test prod of the meter! The random frequencies produced are by nature of their generation spiky in waveform (the meter must, of course, be switched to a suitable range), and as most theorists know, such waveforms are rich in harmonics. These harmonics can and do extend into the r.f. range and some will fall within the frequency pass-band of the i.f. tuned circuits. These will therefore be amplified, detected and pass through the a.f. amplifier to give a crackling or scratching noise in the loudspeaker. So, what seems on the surface to be a crude method is found to have a sound theoretical basis!

Warning

One word of warning, however, scratching any h.t. point will produce such frequencies which can get into a later point in the receiver via radiation from the meter lead. Thus the speaker noise can be produced even though the i.f. circuit being tested may be dead. To avoid being misled by this, use the test prod on another nearby h.t. point such as the h.t. side of the i.f. transformer or the screen grid pin of the valve as well. A comparison can then be made between this and the effect produced on the anode pin. The noise produced by scratching the anode pin should be much greater if the circuit is functioning. If there is little or no difference then a fault must exist. Proceeding back to previous i.f. stages, we can use the same method and the disturbance should in most cases get louder as we go further back and there is more gain between our injection point and the loudspeaker. This, however, is not always the case as various other circuit factors can influence the result.

The grid circuits of the stages can also be brought in by scratching the grid pin with the meter set on the ohms range, the same principle applying as before. Before doing so though, take a voltage reading on the grid first. An internal leak in the valve could put h.t. on the grid pin, or if the receiver was unstable a large a.v.c. voltage may be present. In either case the meter could be damaged if such voltages were applied with it switched to ohms.

Tuner Fault

If either the tuner or the common i.f. were at fault, then there would be no vision as well as no sound, so investigation of these would have been indicated from the start. Should this be the case, then the common i.f. would be the first to be checked and the same methods used. A short cut here would be to trace the screened lead leaving the tuner for the i.f. panel and then use the test prod on the terminal to which the centre conductor is connected. First, the meter is switched to a voltage range in case h.t. should be present at this point, and then to resistance. A healthy noise produced by this will point to the tuner as being the source of the trouble.

Most tuners are not too easy to get inside for testing especially if all the coils are in place in the turret. Usually there is a test point which is connected to the grid circuit of the mixer, so a quick check can be made on this, thus localising the trouble to either mixer or r.f. stage. If a disturbance can be produced right back to the aerial socket, the oscillator is very likely at fault and the oscillator anode load is a common cause of trouble.

Supposing we have a set in which the sound is present but there is no vision. Disturbance testing likewise can be employed to ferret out the offending stage. Assuming that there is a raster on the screen, we first make a check on the video stage. This may be an output pentode or it could be a pentode directly coupled to a cathode follower. In either case we can test the complete stage at one go by applying the test prod to the grid of the pentode with the meter switched to ohms. There is no need for a scratching action here as the stage will handle d.c., and we are putting the d.c. potential of the meter battery on to the grid. If the prod has a negative voltage on it, the anode current through the valve will drop and its anode voltage rise. As this is directly coupled to the tube cathode, it will rise relative to the grid voltage. Hence there will be a drop in the brilliance of the raster. If, to complete the check, we reverse the meter leads so that a positive potential is now applied to the control grid, we will observe an increase in the brightness of the raster. Should there be no noticeable difference, then a fault exists in the video stage.

Video Detector Stage

The detector is the next candidate if the video stage seems to be in order. It can be tested in the same way as the sound detector. Sometimes with both sound and vision detectors, if they are of the germanium diode type, they are often mounted inside the can of the final vision i.f. transformer. Some cans slip off quite easily, but others do not. In some cases then, it may be quicker to miss the detector and go straight back to the last i.f stage. If disturbances at the anode there produce results, then it can be assumed that the detector is working. If no results are forthcoming then we shall have to go back to the detector to check.

When investigating the vision i.f.s the same method of scratching the anode pin can be used, but of course the effect is visual, not audible. Usually the disturbance appears as white spots over the screen similar to car ignition interference. It is advisable therefore to turn the brightness down so that the raster is just visible, whereupon the spots will be clearly seen. The same point applies too about comparing the result with that obtained by scratching a near h.t. point. Just as with the sound circuits, interference pulses can be radiated and picked up by later vision stages, thereby misleading. Also the spots should be brighter and more prolific the further back one goes, although, as with the sound i.f. circuits, this does not always apply.

The technique of testing without the use of elaborate instruments can be also used when

—continued on page 519

TV TERMS AND DEFINITIONS EXPLAINED

Gordon J. King

Part V

Gated A.G.C. Systems

A.G.C. stands for *automatic gain control*. This is fully dealt with in Part II of this series. Gated a.g.c., however, means that a switched gating circuit is interposed between the video signal circuit and the a.g.c. rectifier so that the a.g.c. potential is derived only from the black level parts of the video signal. In that way the gain characteristics of the vision channel are completely unaffected by changes in actual picture signal.

Gradation Squares

These are found on test cards and their purpose is to permit assessment of the contrast performance of a receiver's vision channel. On test card "C", for instance, they are placed in the centre of the circle. The top and bottom squares correspond to peak white and black level respectively and the intermediate squares correspond to light grey, middle grey and dark grey.

Theoretically a receiver should be adjusted for the best overall contrast by first removing the aerial plug from the set and then turning down the contrast control. Next the brightness control should be adjusted so that illumination (raster) is *just* visible on the screen. Finally the aerial should be connected and the contrast control slowly advanced until the gradation squares resolve in correct contrast ratio. Too great a setting of contrast will tend to cause the black and dark grey squares to resolve both as black with no (or very little) contrast difference between them. In practice, however, it is generally necessary to make final contrast adjustments with the brightness control in accordance with the ambient illumination of the viewing room. Too much brightness should be avoided as it encourages defocusing on whites, especially if the tube is a bit weak; it also reduces the contrast ratio between the white and light grey squares.

Incorrect biasing of the video amplifier valve or trouble in the picture tube can badly disturb the contrast ratio, particularly towards the dark grey and black end of the contrast scale, causing the dark grey (and sometimes the middle grey) squares to resolve almost as black.

Grid Current

In ordinary valve amplifier stages the control grid is given a negative potential. This is called *grid bias*. A valve in good condition so biased cannot pass grid current. Should the valve grid swing positive though, the grid will tend to act something like an anode and attract electrons from the cathode into it. The current so arising is called *grid current* and its very nature tends to decrease the input impedance of the stage in addition to badly distorting the signal waveform.

An amplifier stage running into grid current is in trouble indeed. Usual causes are poor insulation of grid coupling capacitor (resulting in the grid going positive), incorrect biasing and trouble in the valve itself. Some stages of a television receiver are supposed to pass grid current and these are the synchronising and timebase stages. For instance, quite a lot of grid current flows in the line output valve due to the line drive waveform. This can be detected with a sensitive voltmeter connected across the control grid resistor. The voltage measured is the volts drop across the grid resistor due to the grid current flowing into it. This in fact represents a good test for line drive. A very small indication or no reading at all on the grid (negative relative to chassis) would imply a lack of drive from the line timebase generator.

Such a test demands a very sensitive voltmeter of not less than 20,000Ω/V. A meter of lower sensitivity could badly damp the grid circuit because, due to the small grid voltage developed, the voltmeter may have to be set to a relatively low voltage range to secure a reasonable needle deflection.

Grid Emission

This describes a condition where the control grid of a thermionic device itself emits electrons and acts something like a cathode. This condition may sometimes arise from particles of cathode material adhering to the grid electrode. As the temperature of the grid increases due to normal operation of the valve or tube, so electrons—in small quantity—are emitted by the grid.

The effect is that the grid goes a little negative (similar to the effect of grid current). In a valve stage this can upset the operating conditions, while in a picture tube it can result in an extra back-biasing effect counter to the bias controlled by the brightness potentiometer. In extreme cases the screen illumination is impaired, even at full setting of the brightness control.

Grid Leakage

Sometimes a leak develops to the grid of a valve from an electrode carrying a high positive potential. This makes the grid go a little positive in counter to the negative potential supplied by the biasing network. In an audio amplifier stage sound distortion results, while in an i.f. or r.f. stage the trouble can disturb the a.g.c. system and manual control of contrast, since the positive voltage is reflected back into the a.g.c. and contrast control circuits.

In a picture tube the trouble often makes it impossible to turn the screen illumination to zero, even with the brightness control fully retarded. From the picture tube aspect both grid leakage and grid emission conditions can sometimes be corrected by "sparking" the grid electrode to the high pulse voltage present on the anode of the line output valve.

The procedure is as follows: First remove the base connector from the picture tube and join the tags on the base corresponding to the heater via an external circuit comprising a 5W wire-wound resistor of about 22Ω for a 6·3V 0·3A tube heater. This completes the heater continuity in the set without straining the heaters left in circuit. Next connect the cathode pin of the tube to receiver chassis (or the h.t. negative line) and take a heavily insulated lead from the anode of the line output valve (top cap) and remove about ¼in. of insulation at the end of the lead. The set should then be switched on and allowed to warm up and finally the uninsulated conductor at the end of the anode connected lead should be very carefully "flashed" across the grid pin of the tube, after which the set should be switched off and restored to normal.

In a large proportion of cases of this kind handled by the author the grid effect has been so deleted without undue damage to the tube itself. In some instances it has been discovered that the apparent emission of the tube is a little impaired after the process, but this may be better than not being able to use the tube at all!

It is not worth attempting the exercise on a faulty valve.

Group Area Channels

Each local u.h.f. reception area is allotted four channel numbers, often embracing a frequency spectrum of 88Mc/s. At the time of writing only one channel of the four in any group is in use and this for BBC-2. Eventually all the four channels will be active carrying both monochrome and colour signals. The *group area channels* correspond to the four u.h.f. channels of a local reception *area*. For instance, the four channels of the main London area are 23, 26, 30 and 33, with channel 33 currently carrying BBC-2 transmissions.

Half-wave Dipole

This is fully explained under the heading "Aerials" in Part I of this series.

Harmonics

A harmonic is a multiple of a fundamental frequency. For instance, a fundamental frequency of, say, 2,500c/s has second and third, etc., harmonics at frequencies of 5,000 and 7,500c/s, etc. A pure signal is a sine wave, while a square wave, which is sometimes produced by the time-base circuits and by video signals, is composed of a fundamental sine wave plus a series of odd-numbered harmonics. Provided the amplitude and the phase relationships of the harmonics are correct, the more odd-numbered harmonics added, the closer becomes the resultant waveform to a square or (more accurate) rectangular wave.

A sawtooth waveform—also produced by time-bases—is developed by the addition of a series of both even and odd numbered harmonics in correct amplitude and phase relationship.

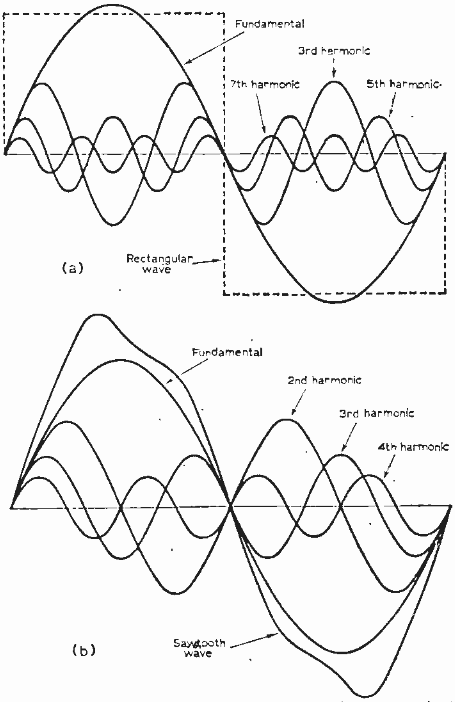


Fig. 21—Showing at (a) how a rectangular wave is produced by the addition of odd harmonics and (b) the formation of a triangular or sawtooth wave by the addition of both odd and even harmonics.

The diagrams at (a) and (b) in Fig. 21 show respectively the formation of rectangular and sawtooth waveforms due to the addition of sine-wave harmonics of the fundamental frequency. Harmonics are created by non-linearity in amplifying circuits and by other factors of circuit design. A pure sine wave, of course, is devoid of all harmonic components, but when a pure sine wave is passed through electronic equipment some degree of distortion results and this can be considered as the addition of harmonic components. A small amount of distortion means that the amplitude of the added harmonic components is small.

Owing to the harmonic component make-up of video signals (resulting in the rectangular, sawtooth and transient nature of the signal) the vision circuits have to have a bandwidth sufficiently wide to pass the harmonic components without undue attenuation. A narrow passband will restrict the higher order harmonic components and thus distort the characteristic nature of the video signals, thereby impairing the definition of the picture and the synchronising action of the timebase circuits.

The generation of harmonic components in the r.f. and i.f. stages of a receiver can cause pattern interference effects. For example, harmonics are often produced in the sound and vision detector circuits and if they are allowed to get back into the early stages of the set they might beat with the wanted signals and cause whistles on sound and patterns on picture. Harmonic suppression artifices are adopted and detector stage screening is not uncommon in early receivers. Small h.f. and v.h.f. chokes are sometimes employed to "stop" the unwanted harmonics while allowing unrestricted passage of the lower frequency wanted signals.

Since it is extremely difficult to produce a pure sine wave signal in the local oscillator, such circuits at the front end of receivers and in tuners often produce harmonics of the fundamental oscillator frequency. These harmonics can heterodyne with out-of-band signals picked up by the aerial and give rise to an interfering signal at intermediate frequency. These interference signals can cause patterns on vision and whistles on sound.

Heart-shaped Polar Diagram

A polar diagram is a "contour" drawing revealing the sensitivity of an aerial or microphone at points all round it. A vertically mounted dipole aerial, for instance, picks up signal equally at right-angles all round it. When mounted horizontally, however, maximum pick-up occurs at each side of the aerial, with minimum pick-up at either end. This gives the well-known "figure-of-eight" polar diagram.

The heart-shaped polar diagram is obtained by the use of a reflector behind the dipole, the effect

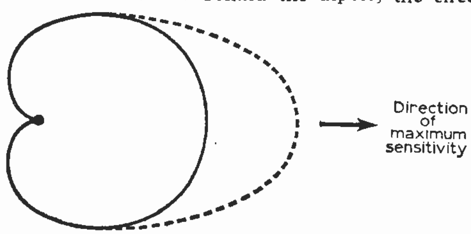


Fig. 22—A heart-shaped polar diagram. The broken-line shows emphasis due to directors in addition to a reflector on an aerial system.

being exaggerated by the use of directors in front of the dipole. Fig. 22 depicts the heart-shaped polar diagram due in full line to a reflector only and in broken line to a reflector *plus* directors. More information on this subject can be obtained under the heading "Aerials" in Part I of this series.

Heater Circuit

This circuit is often specifically referred to in television work. In early sets the heaters of all the valves and the picture tube were connected in parallel across a low-voltage, high-current winding on a mains transformer. Nowadays, however, all the heaters are connected in series. The current required to energise them is thus equal to the current of just one heater alone but the voltage required is the sum of the voltages of all the heaters.

The current is obtained by interposing a series resistor of relatively high wattage rating between the heater chain and the mains supply. The resistor—called a *mains dropper*—is of a value which across it is developed the difference between the mains voltage and the series heater chain voltage when the current flowing is equal to that required by the heaters. The heater chain or circuit may also include a thermistor (to avoid high current surges when first switching on and the heaters are cold) and r.f. bypass capacitors and chokes.

Heater/Cathode Leakage

This term refers to poor insulation between the heater and cathode of a valve or picture tube.

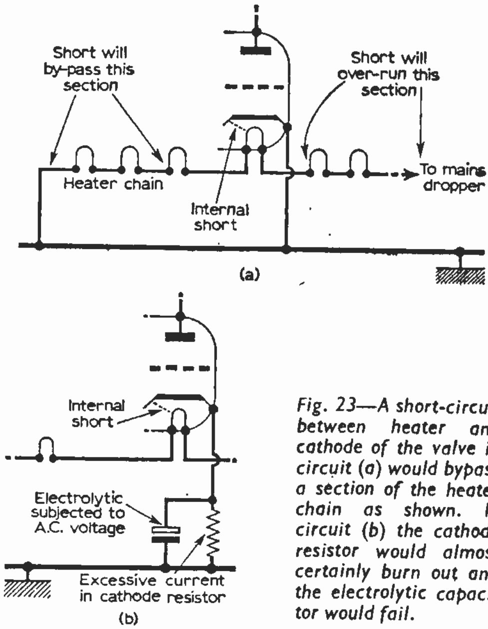


Fig. 23—A short-circuit between heater and cathode of the valve in circuit (a) would bypass a section of the heater chain as shown. In circuit (b) the cathode resistor would almost certainly burn out and the electrolytic capacitor would fail.

Only rarely does the insulation between these two electrodes collapse completely, shorting them out altogether. When this does happen, though, a section of the heater chain (in sets featuring a series connected heater system) is likely to be shorted out, causing the heaters of the valves remaining in circuit to be severely over-run. This is revealed by a section of valves being unlit, the remainder glowing two or three times as bright as they should, depending on the exact whereabouts in the heater circuit is the valve with the short-circuit between heater and cathode.

Fig. 23a shows how a heater/cathode short will bypass a section of the heater chain when the cathode of the faulty valve is connected direct to chassis. Often, however, a cathode resistor is present in the circuit as shown in Fig. 23b, and if this is not too great a value it will soon reveal the trouble by smoking badly, sometimes becoming red hot and fracturing, thereby cutting off the short-circuit current.

If there happens to be an electrolytic capacitor across the resistor the a.c. voltage at the valve cathode will result in an a.c. path through the capacitor, with consequent overheating and possible explosion. The capacitor would, of course, take the full short-circuit current should the cathode resistor go open-circuit.

Poor insulation, as distinct from a definite short, does not usually affect the heater chain current. It can nevertheless introduce hum into a sound or vision amplifier stage from the heater circuit to the cathode. In the picture tube the trouble can produce the symptom of uncontrollable brightness owing to the short or leakage effectively putting the tube cathode at zero h.t. potential. This tube grid then remains positive with respect to cathode at all settings of the brightness control. This condition results in heavy beam current and full raster brightness. There is usually no picture because the short bypasses this to chassis or else greatly disturbs the operating conditions of the video amplifier valve, the anode of which is in d.c. connection with the tube cathode in many sets.

Heptode Sync Separator

The more common type of sync separator circuits (see later under "Sync Separator") employ an under-run pentode valve arranged in such a manner that the limiting action of the valve suppresses the actual picture signal yet allows the sync pulses of the composite video waveform to produce current pulses in the anode (and sometimes screen grid) circuit. These are translated in terms of voltage pulses across the load resistor and then fed, via filter systems, to the appropriate timebase generators.

A more effective circuit using a triode-heptode valve has been derived for 625-line receivers. The heptode section is used for separating the sync pulses from the composite signal, while the triode section may be used as a pulse clipper or interlace filter.

One of the problems associated with the negative-going picture signal of the 625-line standard is that any interference pulses rise from the waveform in the positive direction and can thus be mistaken by the timebases as sync pulses. This problem is resolved in the line circuit by the use of a flywheel-controlled line generator, but this still leaves the field generator vulnerable. This is where the heptode sync separator comes in.

Fig. 24 shows how the interference pulses rise in the same direction as the sync pulses on a 625-line signal. And Fig. 25 shows the basic circuit of the heptode sync separator. From this it will be seen that the third grid of the valve is connected much like the signal grid of a conventional pentode sync separator valve. It is to this grid that the composite signal from the video amplifier is fed.

The first grid of the heptode, however, is arranged to receive only an inverted (negative-going) replica of the interference pulse present on the video signal proper at the third grid. Thus, on receiving opposite pulses on two of its grids, the interference is cancelled by the action of the valve.

Positive-going interference pushes the ordinary kind of sync separator much harder into grid-current than do the sync pulses themselves. The interference thus tends to charge the coupling capacitor to an abnormally high value, an effect that holds the stage at anode current cut-off, even during the sync pulse periods if the interference is strong enough. The stage is thus blocked and the sync is affected until the high charge is exhausted.

The heptode sync separator eliminates this trouble to a large extent. It will be seen that a positive bias is applied to the first grid from a potential-divider across the h.t. supply. This is adjusted to maintain a little grid current during normal video signals on the one hand yet to allow the negative-going gating interference pulse to pull the valve out of grid current on the other. The actual interference gating pulses are derived from a form of frequency-selective network; an example is shown in Fig. 26.

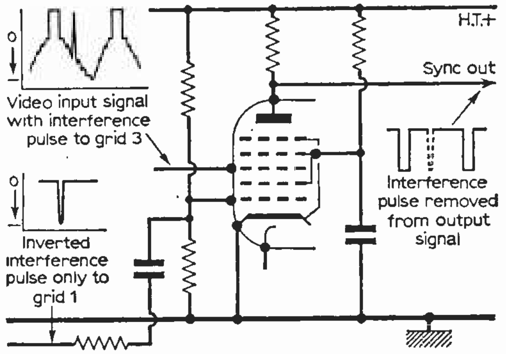


Fig. 25—Basic circuit of the heptode interference-cancelling sync separator.

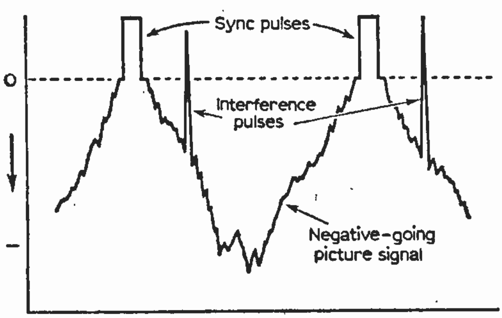


Fig. 24—Showing how pulses of interference appear on the video waveform and rise in the same direction as the sync pulses on 625-line signals with negative-going picture modulation.

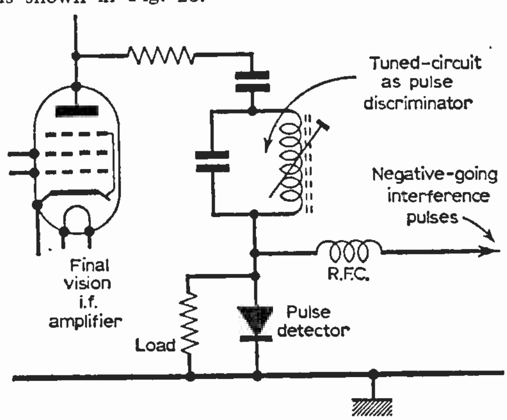


Fig. 26—Showing how the triggering interference pulses for the heptode circuit in Fig. 25 may be obtained from a tuned circuit discriminator and pulse detector, fed from the final vision i.f. amplifier anode circuit.

Part 6 follows next month

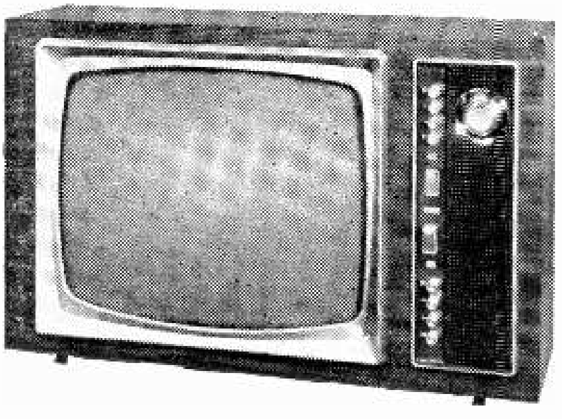
TRADE NEWS • TRADE NEWS • TRADE NEWS TRADE NEWS • TRADE NEWS • TRADE NEWS

NEW RECEIVERS FROM BUSH

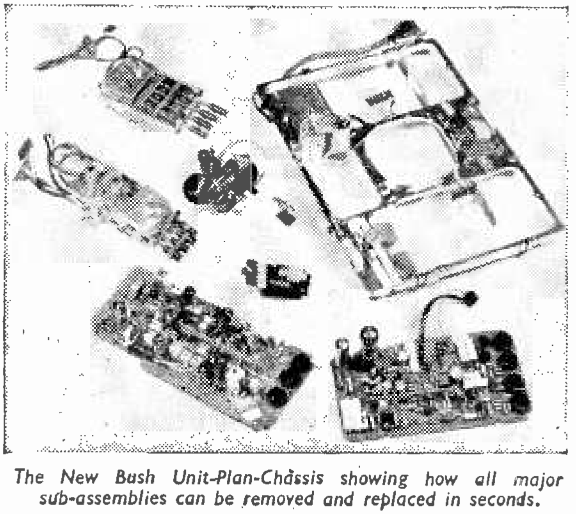
ANNOUNCED this week are two completely new Bush TV receivers—the 19in. Green Label TV141U, priced at 68 guineas, and the 23in. Red Label TV148U, at 77 guineas. Both are available without u.h.f. tuners at 6 guineas less.

"Unit-Plan-Chassis" are employed. This is a completely new development, using the well-tried elements of the earlier successful Bush design in an ingeniously simple modular construction.

The Unit-Plan principle allows for *every* major assembly to be unplugged and replaced by the field engineer. Two screws are removed to reveal the works of the new Bush TV141 and 148. Just two more screws retain the chassis which can be hinged back to give access to every component and connection.



The Bush 19in. Green Label TV141.



The New Bush Unit-Plan-Chassis showing how all major sub-assemblies can be removed and replaced in seconds.

U.H.F. DISTRIBUTION AMPLIFIER

FROM Wolsey Electronics, a division of A.B. Metal Products Ltd., Dinas Rhondda, Glamorgan, comes a two-stage single channel distribution amplifier, model LD44. It runs directly from the mains supply, the power unit supplying 27V a.c. to the transistorised amplifier.

Two UY004B transistors are used. Input and output impedances are 75Ω; gain is 20dB; noise factor 9dB; and maximum output 150mV. Coverage is any requested channel. Dimensions are $7\frac{1}{4}$ x $4\frac{1}{2}$ x $2\frac{1}{4}$in. and the unit weighs 3lbs. Finish is in red and grey.

Two further models are in the process of being finalised. One gives 40dB gain, the other is very similar but will have six outlets.

COMPANY NAME CHANGE

TO bring the company name into line with its product range, the name of Standard Telephones and Cables (Transistors) Limited has been changed to S.T.C. Semiconductors Limited.

The company is the newly formed subsidiary of S.T.C. in which the semiconductor operations at Footscray, Kent, and Harlow, Essex, are now consolidated. Its product range covers transistors, integrated circuits, signal diodes, silicon rectifiers, Zener diodes and thyristors.

RADIO AND TV DELIVERIES CONTINUE TO FALL

MANUFACTURERS' home disposal of radio and television receivers to the trade during April 1966 follows the downward trend shown in the first quarter of this year, according to the Economic and Statistical Department of the British Radio Equipment Manufacturers' Association.

Television deliveries for April this year were 107,000 compared with 122,000 last year and 162,000 in the same month of 1964. Radio receivers were 114,000 compared with 169,000 in April 1965 and 191,000 in 1964.

Radiograms were also lower at 11,000 for April 1966 compared with 18,000 in 1965 and 21,000 in 1964.

These estimates are net figures of deliveries by manufacturers to the home market on firm and other accounts, including those to specialist rental and relay companies.

MINI SOLDERING IRON

RAWLPLUG CO. LTD., Rawlplug House, 147 London Road, Kingston, Surrey, are marketing a miniature soldering iron for light use. It is priced at 19s. 6d. and heats up in two minutes. It has a cork handle which makes it safe to be laid down flat on the bench top.

Disturbance Testing

—continued from page 513

trouble-shooting in the frame or field circuits as they now are called. This applies to cases where there is a complete or almost complete lack of field scan. A word of caution here, when testing with a set in this condition, be sure to turn the brilliance down until the horizontal line in the centre of the screen is just visible. If the brilliance is too high, a black line will be burnt permanently across the screen as many users have found to their cost!

The test prod applied to the control grid of the output valve with the meter switched to ohms should make the line kick either up or down the screen. Again, it is necessary to try for a voltage reading first as if the field generator is working a considerable negative voltage will be present on the output valve grid. If the result of this test is inconclusive, or if it is required to asses the performance of the receiver without actually repairing the field fault a scan can be obtained by injecting an a.c. voltage into the grid. This can conveniently be derived from the heater supply. A capacitor of any value around $0{\cdot}01\mu F$ to $0{\cdot}05\mu F$ can be connected from one of the heater pins to the grid. The waveform will be a sine instead of a saw-tooth, but the frequency—50 cycles—will be the same. The result will be therefore, a locked picture, but badly non-linear. It will be sufficient, however, to see if the vision circuits are working and whether the vision gain is up to standard as well as the video response. Should the fault lie in the output stage, then of course there will be no scan. Should this be so, the output transformer and scan coils can be tested by scratching the meter probe on the output valve anode pin with the meter switched to a high d.c. voltage range. The horizontal line should kick slightly. The current drawn by the meter through the transformer primary winding will be only small in comparison with the normal scanning current so the amount the line is deflected may not be sufficient to give a definite indication. An alternative method is to connect a capacitor—the same as used for the grid to heater would do—from anode to chassis. The charging current through this component should give a clearly visible deflection.

Not Foolproof

Disturbance testing is, of course, not foolproof, also it has definite limitations; it cannot distinguish off tune circuits in the receiver section through missing or loose cores or open-circuit shunt capacitors. It cannot trace speed or linearity faults in the field, or faults in the line circuits. Non-theless, it can run to earth many commonly encountered faults quickly. It is often used by professional engineers as a quick check and when working in the field. For the home experimenter with the minimum of instruments it can be very valuable. Experience will improve the individual's ability to know what to expect and to accurately assess the results. A good plan is to try out the various tests on a working receiver so that the necessary familiarity will be achieved. ■

READERS' LETTERS

CAN ANYONE HELP?

SIR,—Can anyone please tell me the specification of c.r.t. VCR112 or suggest a source of information on this tube? This tube has electrostatic deflection and it would seem from an external examination that one pair of deflector plates has terminals on the side of the tube. The base has seven contact sockets and there are a further three on the side of the tube.

Also can anyone please tell me the civilian equivalents of CV131, CV4015, CV140?—P. WINTERBOTTOM (Flat 1, 2 Victoria Road, Poulton-le-Fylde, Lancashire).

SIR,—I should be very grateful if any reader could sell or loan me a copy of PRACTICAL TELEVISION for September, 1964, containing structural details of an aerial amplifier (booster) for u.h.f.—R. C. J. WILKINS (Flat 1, 6 Medina Terrace, Hove 3, Sussex).

SIR,—I am very interested in constructing the Olympic II transistor TV receiver and, as no back issues are available for April to October inclusive, I should be extremely grateful if you could prevail upon my fellow-constructors to sell or loan these copies to me. I guarantee to reply to all correspondents who communicate with me. —L. H. SHEPHERD (3 Derwent Avenue, Newcastle-on-Tyne 5).

BOWTIE AERIAL

SIR,—Many thanks for the u.h.f. Bowtie Aerial design published in the January issue of PRACTICAL TELEVISION. It is picking up low-power signals with great success.—J. A. ROWE (Sheffield 5).

ANYONE ANY GEN?

SIR,—I am unable to get any information about two valves I salvaged from a piece of ex-Government equipment. They are both VX3188s. Has anyone any gen?—F. R. KEW, A.M.I.E.E. (155 Grey Street, North Shields, Northumberland).

SIR,—I would be very grateful to obtain copies of the following issues of PRACTICAL TELEVISION, as I require them to complete my collection. They are: January, February and June 1964 and April 1965.

I am willing to pay a good price for these copies including any expenses that are incurred.—JAMES COLE (37 Chapter Road, London, S.E.17).

TELETOPICS

SIR,—I would like to congratulate you on the "Teletopics" feature of this magazine. It is from these pages that the man-in-the-street gains a knowledge of what is "going on" in the television industry—information that is not often published in the National Press. Long live PRACTICAL TELEVISION and "Teletopics".—RICHARD COLLINS (Leytonstone, E.11).

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

BOOK REVIEWS

Colour TV Servicing Guide
By Robert G. Middleton, published by Foulsham-Sams Technical Books Ltd., 112 pp., $11\frac{1}{8}$in. x $8\frac{5}{8}$in., price 28s.

TV Servicing Guide
By Leslie D. Deane and Calvin C. Young Jnr., published by Foulsham-Sams Technical Books Ltd., 124 pp., $11\frac{1}{8}$in. x $8\frac{5}{8}$in., price 22s.

IT is perhaps unfortunate that this pair of Guides has the appearance of a superior kind of children's comic annual, and doubly deterrent that their size prevents their being fitted in the average bookshelf. Page size, not thickness, for the lavish style of layout, double-column presentation and method of showing circuits and photographs proves that the same material could have been incorporatsd in more conventional format.

Actually, the text is solid and informative in both books, though the photographs, mainly of oscilloscope and c.r.t. displays, still have that vitiated look common to American publications. This is a pity, for the TV Servicing Guide relies heavily on photographs for illustration of fault symptoms. The book is really a collection of symptoms and their treatment, divided into twelve chapters, taking the receiver stage by stage. On pages 4 and 5 there appears an excellent sectional layout of typical TV circuitry, making a block diagram, with the sections detailed within the block. This alone could justify the dimensions of the pages.

The approach may deter the learner: Chapter 1 plunges straight in, and before the bottom of the first column the reader is up to his eyes in a.g.c. (And, incidentally, how does one "adjust the a.g.c." in the way described without a spares box full of components and an ever ready solder gun?)

The change in British standards now brings American publications more into line, and in fact, the Guide is applicable in most details. Many of the symptoms can be directly related to our own dual-standard receivers. There are still a few minor pitfalls, which even the indefatigable Mr. Oliver has not noted in his quite superfluous introductory preface. An example is the colour-coding of a germanium diode—the opposite to our own usage.

The Colour Guide, by that stalwart of USA writers, Mr. Middleton, is a well-written book, amply illustrated with sectional diagrams, scope trace and raster photographs, and some informative colour pictures. It assumes a prior knowledge of the black-and-white receiver, and of servicing and general theory. An occasional small misprint and the transatlantic tendency to omit periods from abbreviations make harder reading for the British reader, although i.f., previously an embarrassing if, is now i-f.

Nevertheless, it is necessary for the student to start *somewhere*, and this book is extremely easy to assimilate. A good knowledge of the fundamentals of colour transmission can be gained, and sufficient working knowledge of receiver circuits to enable the intelligent reader to adapt his knowledge to current systems.

The book is divided into eight sections, with the symptoms grouped wherever possible, chapters taking the form of "general discussion, common symptom and tests and summing up" that makes both for conformity and easy reference.—*H.W.H.*

TV Troubleshooters Reference Handbook
By Stuart Hoberman, published by Foulsham-Sams Technical Books Ltd., 128 pp., $8\frac{3}{4}$in. x $5\frac{1}{2}$in., price 24s. TVH-1.

TV Diagnosis and Repair
By the PF Reporter Editorial Staff, published by Foulsham-Sams Technical Books Ltd., 96 pp., $8\frac{3}{4}$in. x $5\frac{1}{2}$in., price 13s. 6d. TDR-1.

Bench Servicing Made Easy
By Robert G. Middleton, published by Foulsham-Sams Technical Books Ltd., 160 pp., $8\frac{3}{4}$in. x $5\frac{1}{2}$in., price 24s. BSE-1.

Know Your Signal Generators
By Robert G. Middleton, published by Foulsham-Sams Technical Books Ltd., 144 pp., $8\frac{3}{4}$in. x $5\frac{1}{2}$in., price 20s. KOG-1.

Know Your Square-Wave and Pulse Generators
By Robert G. Middleton, published by Foulsham-Sams Technical Books Ltd., 144 pp., $8\frac{3}{4}$in. x $5\frac{1}{2}$in., price 21s. KOP-1.

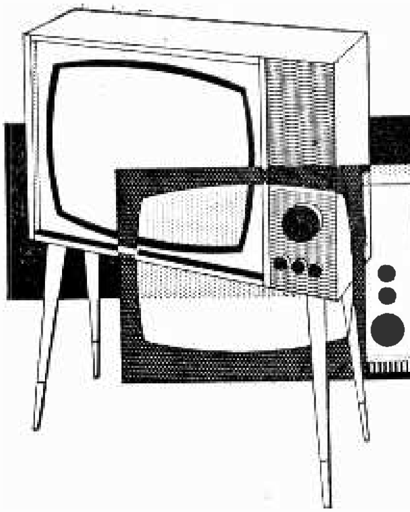
A NAP hand of service specials. And like many a nap hand, something of a mixed assortment. TV is trumps: three of the five books deal with this subject, from different angles. Two of them have a direct approach, TVH-1 dividing the typical circuit into sections and attacking faults from a practical point of view. There is an absolute minimum of theory. TDR-1 has more emphasis on diagnosis, is profusely illustrated and draws heavily on actual American production circuits. The third of this group cheats a little in its title, for BSE-1 is actually a run-down on TV servicing techniques. Although covering much of the same ground as the other two, it contains a number of hints on the use of instruments, particularly the oscilloscope. Although the jacket illustration and blurb make its concentration on TV techniques obvious, it might have been better had the title also made this clear.

The other two books, by the same author as BSE-1, are "wild" cards in the nap hand, and KOG-1 is undoubtedly an ace. Whereas most American books have whole areas of inapt matter for the British reader, this collection of 7 chapters on the design, limitations and application of one vital type of instrument is wholly applicable.

Pads and filters, damping methods and actual hook-ups for different tests are taken for granted. The reader who finds it necessary to buy these books for reference is likely to need this advice as much as the details of generator accuracy, calibration and usage.

One point of criticism that must be made is the out-datedness of much of the material of the first three of this batch of books. Even allowing for unavoidable publishing time-lags, there could have been some recent revision which brought the transistor circuits nearer the present, gave some mention of modern line output stage techniques and at least a passing look at alternative systems, especially as regards the colour receiver, which features largely in any American publication.

May we also ask why it is necessary to retain the Foulsham-Sams gimmick of a special preface for "the English Reader"? Apart from giving Mr. Oliver something to do, this pre-preface serves little purpose. Translation is hardly needed today. In the areas where it would most be appreciated, i.e. standards and modulation systems, only a passing reference is given. In the first three of these books particularly, W. Oliver (G3XT) finds it hard to justify the out-datedness and refers us lamely to maker's literature for transistor information.—*H.W.H.*



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 524 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

ENGLISH ELECTRIC 16T11D

This set with no aerial gives a normal blank raster. On BBC when an aerial is connected, the sound increases but the vision disappears (with all controls fully turned up, only a jumble of dots and dashes is faintly visible). On ITV, a picture of adequate contrast and brightness can be obtained, but with a similar effect to "worms" and dots with a faint patterning which appears to be interference.

Apart from the above, there is a buzzing noise which is not constant but cuts in and out, and varies with the setting of the sensitivity, line hold and contrast controls. The line hold in particular greatly increases this noise, which is also clearly audible through the speaker.

All valves have been checked except both EY51, PL82 and PL83. A "V" type room aerial is being used.—I. Fraser (Ewell, Surrey).

Check the electrolytic capacitors and decoupling capacitors of the i.f. strip. Realign the i.f. coil cores if necessary.

FERGUSON 3608

I have a strong line whistle which can be altered in pitch by the line hold but there is no e.h.t. and the EY86 does not light up.

I have replaced the line output transformer and the boost capacitors but with no luck, also checked by substitution all the valves associated with the circuit. There is a slight blueing of the PL36. —J. W. Scott (Wimbledon, S.W.19).

We presume the EY86 has no internal short and the PY81 (or PY801) is in order.

We would suggest you check the grid circuit of the PL36 (30P19), especially the 2·2MΩ and 1·8MΩ resistors.

FERGUSON 506T

The field has collapsed so that the picture is about $3\frac{1}{2}$in. wide in the centre of the screen, the width is O.K. but what picture there is, is split —i.e. the top at the bottom and the bottom at the top. I have had the PY33, PCL82, ECC82, PY81, PL81 and the EY86 checked and they are all in order. The height control only works when the picture is made a couple of inches narrower. A couple of days before the field collapsed. On moving the height control to narrow the picture there seemed to be another part picture just out of step with the main picture. Also, when changing channels, it was difficult to get a picture without twisting the channel switch backwards and forwards—W. H. Smith (Liverpool 7).

Check the height control (2MΩ) and the 2·2MΩ resistor in series with the hold control to pin 1 of the PCL82. Check the associated capacitors if necessary. Clean tuner disc studs.

BUSH T98C

I want to take a lead from my TV to my recorder (Vortexion). Can I take this direct from the speaker terminals or do I need an isolation transformer for safety.—N. Bonie (London, W.10).

Provided a three pin plug is used for the appliances and it can be verified that neither chassis is "live" there is no reason why a pair of leads cannot be taken from the TV loudspeaker tags to the tape recorder input.

K-B ROYAL STAR QVP20

I would be obliged if you would let me know if there is a width adjustment in this set. The picture is now $\frac{1}{2}$in. less than it should be in width and I am unable to locate a width control.

Also could you let me know how to centre the picture, which is slightly low. After warming up, the height increases by about a half to 1in. Is there anything I can do about this?—Reader (Swansea).

The width control is a sleeve on the tube neck which, when the clamp is released, can be withdrawn from the deflection coils (if it isn't stuck fast) to increase the width. Check PL81 line output valve. Check field oscillator-output PCL82.

The shift magnets are immediately behind the deflection coils.

PETO SCOTT 1416T

I bought the above set secondhand and it had a number of faults on it which I have cleared up but I am left with two faults which I cannot solve.

Fault A.—Lack of brilliance.

Brilliance very poor when set first looked at. I changed V17 (video output) with the result that the brilliance was a bit better but still far from normal. Next the h.t. was checked. This proved to be normal, VR9 and R131 proved to be the values indicated on the circuit diagram, also R132 was checked and proved to be normal. Shorting grid and cathode of tube to each other produces normal brilliance as does shorting across R131.

Fault B.—Lack of height.

Every effort to remedy this fault has failed, the raster is only about 4in. high, V18, V19 have been changed, all voltages are the same as in the circuit diagram where indicated. I would like to point out that although the height is low the width is O.K. and the raster is not distorted.—R. Keeling (Leyton, London, E10).

If the screen is illuminated with the brightness control turned towards maximum, then a picture lacking in brightness could be caused by (i) low video drive (check signal and video amplifier circuits) or (ii) low emission picture tube, especially if the illumination is by this adjustment below normal. Shorting grid and cathode, of course, kills tube bias and will brighten the raster abnormally.

Lack of height should lead to a check of the resistors connected between the anode of the field oscillation and h.t. line. An increase in value here can cause the trouble, as also can low boost volts. If all the small components check okay, suspect field output transformer.

DECCA DM45

I would be very pleased to receive your advice regarding fault that has developed on my set. Loss of height and lines crowded at bottom. I have checked voltages and the following are low:—Valve 6 (a) PCL84, Valve 7 (a) ECL80, the boost voltage at junction of L19 and C59 is 600 (Wireless and Electrical Trader). —B. Winch (Isleworth, Middlesex).

The voltages on the valves mentioned are influenced by the sensitivity of the voltmeter. A meter with lower sensitivity than that used for the specification voltage will read low. This is normal. The setting of the field timebase controls and presets will also affect the voltages. Cramping at the bottom of the picture should lead to a check of the field output valve and of the electrolytic capacitor on the cathode of the valve.

ALBA T655

I have recently experienced trouble with no screen illumination or sound. I checked the e.h.t. lead and it is possible to get a good spark from the lead to the chassis. The brilliance control and line timebase are O.K. I have changed the following valves: PY32, EF85, EY86, PL81, PCC84, PCF80 and the screen resistor on the PL81. Checked the voltages at the valve base on tube and obtained readings on all of these. There is crackling with the movement of the volume control, which seems to indicate that the sound output is working.—M. Andrews (Langley, Oldbury, Worcs.).

Since both sound and vision are affected, it would seem that the symptoms have a common cause. However, you say that the screen also fails to light. This alters the situation somewhat, for one would be led to believe that, perhaps, the h.t. supply circuits have been disturbed. Check the h.t. supply to the tube electrodes and to the sound stages. Also make sure that the aerial is delivering a good input signal and that the set is correctly tuned to the local channel. Of course, there could be two faults, one in the picture tube and the other in the sound channel, but this is unlikely under ordinary conditions of failure.

GEC 7401A

There is no picture and the e.h.t. rectifier valve, EY86, fails to light up.

The sound is also absent except for a whistle when the sensitivity control is at max.

The EY86 has been changed with two others and has made no difference. The barrater glows for a few seconds when set is switched on and then appears to go out, although the glass is always hot.

Can you explain briefly the function of the barrater please as I cannot trace this on the Service Sheet.—J. Hawkins (Bootle 20, Lancs.).

It would help with the symptoms mentioned to know exactly how they occurred, as it seems likely that two faults are present in the set. One lies in the e.h.t. section, and the effects appear to point to shorting turns in the line output transformer or lack of line drive to the line output valve. The other is in the sound circuits (probably), but trouble in the tuner or common i.f. stages could be responsible. We would have said that h.t. failure was most likely for both effects, but this is discounted by your comment concerning the whistle, which implies that h.t. must be present! The barrater regulates the current in the series connected valve and tube heaters.

REGENTONE 197

The set works perfectly on 405 lines but on 625 there is no picture and only crackling as it is tuned. This is with a good antenna.

It seems to me from the way the circuitry is arranged, that the trouble must be in the u.h.f. tuner. Naturally, I can't touch this, as I understand that with some makes you cannot change the valves without re-aligning it.

Are there any checks that I can do to isolate the trouble or will I have to return the whole tuner unit to the makers ?—P. Galvin (Liverpool, 18).

The trouble you describe is fairly common and usually responds to a change of PC86 valve on the tuner. Check PC88 if necessary.

DECCA DM22/C

The field has a tendency to slip in a downward direction after set has been on for about 20 minutes. This fault can be corrected by the frame hold control. It will hold for a while then slip again, until pot. has reached max. then two halves of field are received.

Have tried several good ECL80's and a change of PCL82 but no improvement—tried moving VR8 (interlace). On checking ECL80 anode voltage, it is down to 12 volts, which can be restored to 30 volts when removing C97 0·02µF capacitor. Renewed 330Ω and 500µF on cathode of PCL82. H.T. voltage about 190.—G. Harris (Canvey Island).

The PCL82, part field oscillator and field amplifier, could well be causing the trouble mentioned. If possible, test this valve by substitution before delving too deeply into the field circuits. The voltage on the triode anode of the ECL80 will be very low as it is fed through a 3·3MΩ resistor. Of course, when the coupling capacitor is removed, the stage conditions are altered. Hence the reason for the voltage change.

DEFIANT 4109

Five minutes after switching on the above set it went completely dead. I checked house supply, main fuse on set and on-off switch—these were all serviceable. I would be most obliged if you could give information concerning this failure, not being very conversant with defects of this kind; also could you tell me the year this model was manufactured?—D. P. R'che (Gosport, Hants.).

Check the mains supply along the tags of the upper right side mains dropper. If present at all tags continue test through thermistor to the PY81 heater thence along heater chain, 30P4, 30FL1, etc., until the break is found. We are unable to say the year of manufacture of this model.

QUERIES COUPON

This coupon is available until AUGUST 23rd, 1966, and must accompany all Queries sent in accordance with the notice on page 521.

PRACTICAL TELEVISION, AUGUST, 1966

TEST CASE -45

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.

? *On the Bush TV128 being investigated by an experimenter, the sound remained normal while the brightness of the picture increased gradually until the brightness control was eventually unable to reduce the brightness adequately for a picture of correct contrast. At this stage, the picture was too bright even with the control turned fully anti-clockwise.*

A check was made of the brightness control circuit and the feed to the grid of the picture tube. There appeared to be no fault in this circuit and replacement of the resistors in the brightness control and tube grid circuit failed to cure the trouble.

What section of the circuit had the experimenter overlooked, and what tests could have been made to establish the location of the trouble?

The solution to this problem will be given in next month's issue of PRACTICAL TELEVISION, *along with a further item in the Test Case series.*

SOLUTION TO TEST CASE 44
Page 477 (last month)

As a means of monitoring system response, the BBC have for several years been radiating a test pulse signal during actual transmissions. So that this signal will not interfere with the pictures, it is arranged to occur when the composite video signal falls to black level; that is, during the period between fields.

A convenient period is during the field pulse periods. At these times the picture signal proper falls to black level and a series of field pulses occur that, after processing by the receiver, serve to synchronise the field timebase and lock the picture vertically. Before the picture signal recommences, after the field pulses, the signal remains at black level for a number of lines, and it is during this time that the test pulses are radiated.

The enthusiast of Test Case 44 scope testing, discovered these test pulses on his trace of the field period, as shown last month. The effect that these pulses have on the screen of a TV set can only normally be seen by reducing the vertical amplitude (height) control or by unlocking very slightly the vertical hold control so that in either case the period between fields is made visible.

At the top of the picture the test pulses can then be seen in the form of bright horizontal lines and dots. Some sets which have a slow field retrace, due to a fault or design characteristic, display these pulses at the top of the pictures on BBC-1, even with the height and vertical hold controls correctly adjusted.

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MISCELLANEOUS

CONVERT ANY TV SET into an Oscilloscope. Instructions and diagrams 12/6. REDMOND, 42 Dean Close, Portslade, Sussex.

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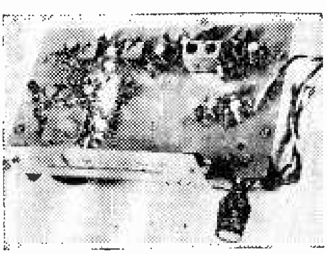

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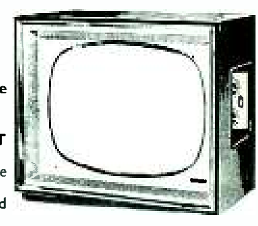

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