Servicing the Beovision 3400 Series

Part 1 **Eugene Trundle**

THE Beovision 3400 series was the second generation of hybrid colour receivers to be manufactured by the Danish setmaker Bang and Olufsen, and was one of the first wide-angle (110°) colour sets to be marketed in the UK. It used the Mullard/Philips Phase II c.r.t. system (A66-140X), the thick-neck, delta-gun tube being driven by a complex circuit using ten valves, 104 transistors, 89 diodes and one i.c. – the whole lot drawing 360W from the mains supply.

Like its predecessor, the 3400 was very much in the luxury class, with an elegant rosewood or teak cabinet and truly excellent sound and vision performance. Again like the 2600/3200 series, the chassis was engineered for optimum performance virtually regardless of cost, the result being a receiver of considerable complexity with a very large component count.

Unfortunately, this sheer weight of numbers, combined with the relatively high temperature at which the chassis runs, means that the reliability factor is rather disappointing to say the least. This situation is somewhat aggravated by the fact that the deflection and convergence circuits are unconventional in many respects, so that when trouble is experienced a bit of head scratching may be necessary.

Many of the faults that occur do not fall into the stock category. We'll describe the operation of those sections of the chassis where trouble is most likely to be encountered therefore, in addition to outlining the common faults we have come across. Space does not unfortunately permit either a full circuit or a full circuit description – these alone would fill several issues of the magazine!

Circuit Diagrams

Before we start, a few words of explanation on the arrangement of the circuit diagrams in the Bang and Olufsen service manual may be of help. To avoid a forest of lines and the confusion this could cause, B and O use a trunk system in their circuits. The circuit is in four sections, each of which has a "wire trunk" around two or more sides. When a connecting lead enters the trunk, it's given an identification, a direction and a destination. If the identification consists of a double letter, the destination is on the same diagram, and by following the direction of the

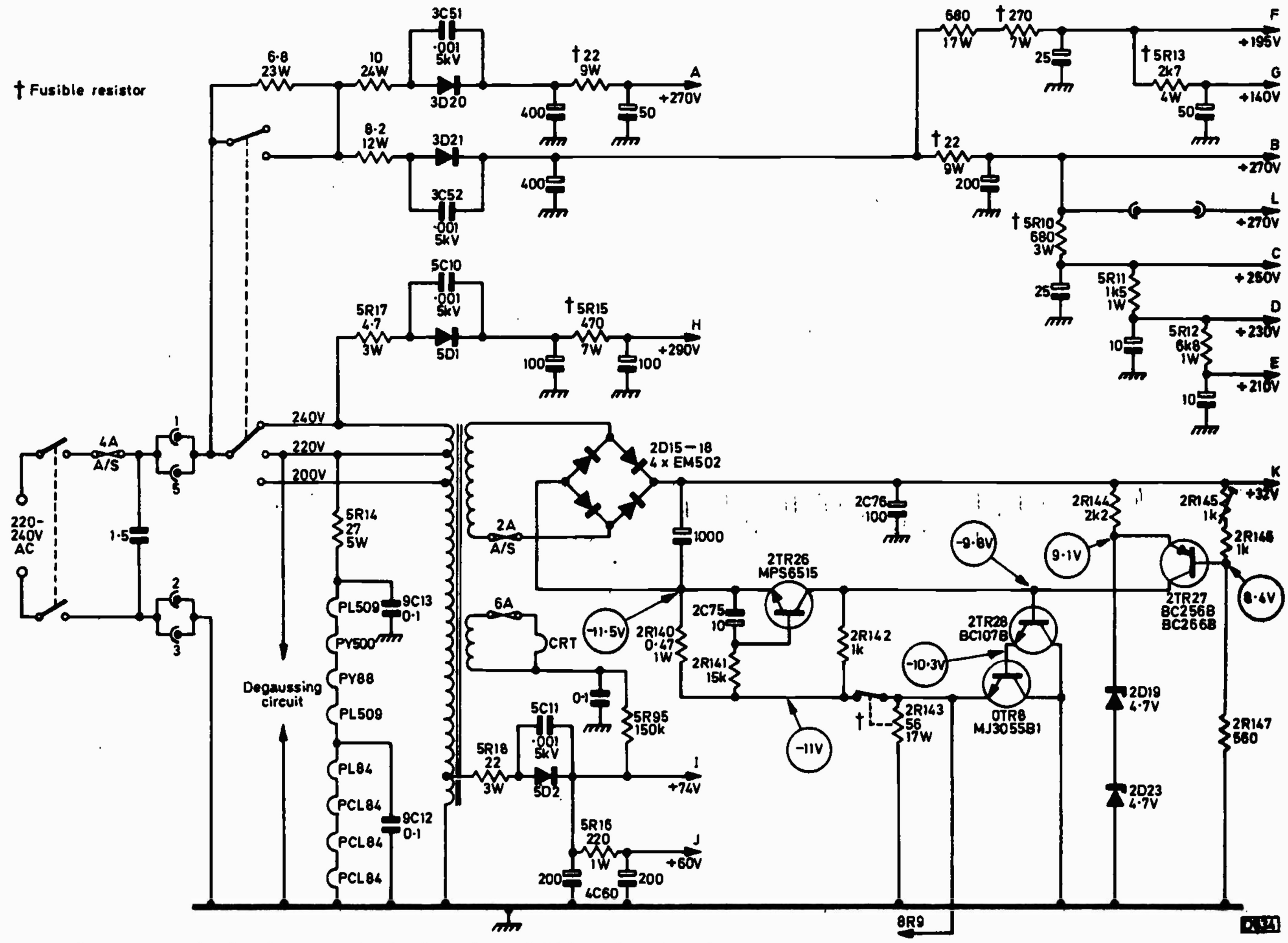

Fig. 1: Power supply circuitry used in the Beovision 3400 series chassis.

arrow you'll find it emerging from the trunk at some point. Sometimes the arrow is double-headed (diamond shaped), the connection being picked up at two points, one in each direction. If the identification consists of a single letter or symbol, a destination will be found nearby, consisting of a capital D followed by a number. This indicates which of the circuit diagrams 1–4 the lead goes to. In such cases follow the trunk in the direction of the arrow to its end. The wanted letter or symbol will be in a queue alongside an arrow marked D2, D3 or whatever. A corresponding arrow will be found on the destination diagram, again with a queue of letters to indicate the routing. Follow the new trunk, and you've arrived.

Where plugs and sockets are involved, they are drawn near the circuitry with which they are concerned, and assigned an identifying Roman numeral and sometimes a colour code. Plugs are indicated by solid dots for pins, while sockets are drawn with hollow rings. A plug or socket may be drawn more than once on a diagram, with different pins being used in each case. Where a D number is printed beside a plug or socket pin, it indicates the diagram from which that lead is routed via the plug and socket concerned.

Heavy black lines on the diagram enclose each printed panel or assembly, components outside these lines being mounted on the chassis metalwork. Each component has a prefix number to indicate the panel or subassembly on which it belongs, those mounted on the chassis being prefixed "0".

Chassis Arrangement

The works are arranged in similar fashion to the 2600/3200 series, with a "front chassis" containing the tuner, customer controls, i.f. stages and low-level post-detector circuitry, while the main chassis carries the power supply, signal output stages and timebases.

Signal Circuits

The front chassis and decoder are virtually identical, but updated, versions of those fitted in the 90° 2600/3200 chassis. These were comprehensively covered in the March and April 1977 issues of *Television*, by Keith Cummins. In the 3400, the troublesome 12V zener diode 4D3 (corresponding to D93 in the 2600) has been uprated to a 12·5W device which is very reliable. The high-voltage stages in the decoder, 4TR4-8, use type BF178 transistors, and the clamp diodes (3D4/5/7/8/9/10) are type BA145 in place of the EB91s of yore.

Unlike the other modifications, this latter one seems a definite step backwards since these diodes, being in the front line flashover-wise, tend to develop leaks and upset the grey-scale. The effect is usually temperature-dependent, the picture becoming more tinted as the set gets thoroughly warm. Test the reverse resistance of the diodes on the highest resistance range of the multimeter. The slightest movement of the pointer is enough to condemn a diode. If the current equivalent to the BA145, the BY206, is used as a replacement, colour imbalance can result due to the slightly different dynamic characteristic. So we prefer to replace all six diodes at once, preferably with six BY206s from the same batch. Note however that not all BY206s will do: use ones from a reputable source, e.g. Mullard. If this fails to hold the c.r.t. grids steady, leakage in the 10nF ceramic disc coupling capacitors will probably be responsible. These are 3C22/29/39.

A more subtle change has been introduced in this area due to the absence of the parallel heater chain. The colour-difference output valves are now type PCL84. This is a trap for the unwary, because ECL84s (as used in the earlier chassis) fitted in error will usually produce some kind of colour, but not for long!

Still on the valve heater theme, the 12HG7 luminance output valve's heater forms part of the dropper from the main 32V line to the 12V stabilizer zener on the front chassis. If there's a signal problem, a glance at the colour temperature of the 12HG7's heater will thus tell much about the 32V and 12V lines. This can be a time-saver.

The set-white switch is as troublesome as on the 3200, and sudden loss of luminance, video streaking or intermittent or permanent static misconvergence are the symptoms. The decoder in the 3400 has the smaller version of the chrominance delay line and, a welcome feature, component numbers printed on the panel. Apart from the odd failure of germanium diodes, reliability here is good.

Before we say goodbye to this part of the set, one or two common faults. Tuning drift and intermittency can in most instances be resolved by cleaning the tuner bandswitches. All sorts of intermittent effects can be caused by poor contact in the three noval plug/socket connections between the front chassis and the rest of the set. The mains filter capacitor and fuse are more prominent on this receiver than its predecessor – beware shocks! Finally many of the services on the front chassis and signal boards are dependent on the operation of the line timebase. It's prudent therefore to make sure that this department is working before delving into a no signal or no colour fault for instance.

The Power Supply

The power supply (see Fig. 1) is conventional for a hybrid receiver, with two main h.t. rectifiers (3D20 and 3D21) feeding eight h.t. supply lines via the usual decoupling filters. Failure of the 6·8Ω 23W surge-limiting resistor may be for internal reasons or because one of the h.t. rectifiers 3D20/21 has shorted. The mains transformer supplies 74V to the field timebase and 60V to the decoder via rectifier 5D2 from a tap on its primary winding. A fourth rectifier 5D1 furnishes a separate 290V rail to power the luminance, R–Y output and some convergence circuitry. All four rectifiers so far mentioned may be replaced by BY127s.

Many of the *RC* filter resistors in the power supply are fusible, and if one of these fails the cause will be excessive loading on its output line. A shorting PL84 sound output valve for example will spring 3R102, and delete the B–Y signal by robbing the B–Y output valve of screen grid voltage (fed via 3R102). Most of the fusible resistors feed more than one section of the receiver, so wherever two or more apparently independent faults occur simultaneously look at the fusible resistors on high.

The mains transformer has two secondaries, 6·3V feeding the c.r.t. heater via a troublesome and strange-looking 6A fuse which often goes open-circuit to give an intermittent no picture symptom, and a 35V winding which supplies the stabilized l.t. rail. The output of the bridge rectifier 2D15-18 is applied to a 1,000μF reservoir capacitor whose positive plate provides the stabilized 32V rail.

LT Regulator Circuit

Stabilization and smoothing on the active-filter principle are achieved by the insertion of 0TR8 (2N3055) between chassis and the negative bridge output. A sample of the 32V line potential is applied, "potted down", to the base of 2TR27, whose emitter is anchored to 9·1V by the zener diodes 2D19/23. The error voltage produced by 2TR27 is then passed to the base of 2TR28, amplified and applied to the series regulator transistor 0TR8. 2TR26 plays a protective role, sampling the current through 2R140. If this current is excessive, 2TR26 conducts, turning down 2TR28 and 0TR8. If the overload is very heavy, 2R143 will spring off. This is rare however.

The circuit is very effective, reducing the ripple voltage on the 32V line to 60mV p–p. The set is very critical with regard to its l.t. voltage, and 2R145 should be set for 32V$\pm$2% across 2C76, preferably using a digital voltmeter.

When this department goes haywire, the usual result is hum on the 32V line. This modulates the sound and shows as a drifting bar on the picture. In milder form, only the chroma is affected, with the hum bar showing as a vertically drifting bar of lighter saturation. The effect is usually intermittent, and sometimes occurs only when the set has thoroughly warmed up. 2TR28 (use a BC107B) and 0TR8 are the things to go for. The fault will not always show up on an instrument test, so check them by substitution.

The rectifiers can also be responsible for hum troubles, but this is less common. The reference zener diodes 2D19/23 have been found responsible for voltage drift on the l.t. line. This shows mainly as changes in convergence and height.

Apart from 0TR8, all these components are in the middle of the field timebase panel, below the c.r.t. neck. They're a bit difficult to get at, due to the chassis angle and the tangle of the wires (there's a song there somewhere, isn't there?). Beware of solder blobs and burnt leads.

VCR Speed Conversion

G. Beard

THE playing time of Philips VCRs in the N1500 series is only an hour. This means that they are rather expensive from the tape point of view. The machines themselves can often be obtained at very reasonable prices however, making it worthwhile converting them to the 2½ hour N1700 standard. At the time of writing (January 1980) N1500s are on offer in the range £30–£70. At this sort of price the machine will almost certainly have worn or broken video heads, making it necessary to fit a new head assembly anyway. With any luck you may get some tapes thrown in.

Before starting, it's best to have the full service manual for the machine – unless you have the sort of memory that can recall the sequences in which parts fall, spring and shoot apart. The manual part number for the N1500 is 726 11066 and for the N1501 726 11502.

Initial Steps

First remove the two Phillips-headed screws on the cassette mechanism cover, then remove the four screws at the cassette opening. Next loosen (three turns) the four Phillips-head cover screws at the ends of the unit (see photo 1). Carefully raise the back of the unit, pivoting on the front edge. You will now notice that the recording level meter is attached by a strange spring with a plastic sleeve (see photo 2) on the side nearest the input leads. Manoeuvre this spring out, then lay the meter down carefully and Sellotape it to the chassis front. If you fail to take this step the meter can be broken or bitten in half by the cassette mechanism.

Put the cover, cassette cover and screws to one side. You can now see the full mechanical, electromechanical and electronic horrors you've let yourself in for.

Plug in the mains cable, which I hope you remembered to get with the machine. Connect the aerial input and output to a television receiver, push the eject button, and post a cassette in the slot, depressing it to lock. Now watch the mechanism and push the on button. If you were not looking, push the off button and try again . . .

It's probably not much use trying to play back any tapes, but just to see what sort of picture a worn out head produces switch on the TV set and tune it to the VCR's channel (approximately ch. 37). Check that the VCR buttons are tuned, and press the start button. No picture, or bands of noise, no colour and field slip probably mean that the electronics are all right. Next clean off any dirt or grease on the deck.

Now to do something constructive. You did Sellotape the level meter didn't you? – because it's now that it will fall about a bit. Stand the VCR (see photo 3) on its right-hand end (the clock end), remove the two Phillips-headed screws at the front of the bottom cover, lift up the front edge and ease from the rear clips. Six printed circuit panels are now visible. Five of the boards are on a hinged frame which is released by loosening two screws, one at the top front of the frame and one at the right-hand edge – with the machine stood on its end, that is. Swing the boards out to the extent of the retaining wire – it's best to release this to allow easier access to the mechanism. (See photo 4.)

In the middle of the chassis there's a plate (517, see Fig. 1) which is secured by three screws. Remove these and the washers.

Dismantling

Now look at the top of the chassis. Locate the capstan, and remove the rubber washer 154 (199 in the N1501 manual's exploded view – bracketed numbers hereafter refer to the N1501). Gently remove the drive belt 163 (209) from pulley assembly 219 (238) etc. (see photo 5). Note that plate 520 (522) locates over the lug on bracket 170A (217). Pull the flywheel and capstan 162 (208) etc. from bearing 155 (200). Look out for nasty greasy bits and also falling bearing plates etc. The idler wheel assembly 142 (186) is best removed for replacement (if necessary) at this point. Put the flywheel assembly aside for machining (see photo 6). The diameter of the capstan has to be reduced to 0·1312in. ($\pm$0·0001) – see Fig. 2. This is a precision job and must be done by a firm with the necessary equipment. We got A.C. Park Precision Ltd., Holland House, Burmester Road, Tooting, London SW17 (telephone 01-947 2942) to do the job.

Next for the video head drum. Remove retaining bracket 114 (166). This is accessible from the top of the chassis (see photo 7) and is held by a single screw and washer. Now go back under to head drum pulley 111 (164). With a 1·5mm.

something for the soundness of the book when we say that we only wish there was more of it – there are lots of TV byways we'd have liked the authors to have thrown light upon. The fact is however that you could write almost endlessly if you tried to take in everything. A line has to be drawn somewhere, and by and large the authors' judgement about what to include and what to leave out would be very hard to fault.

The book can be commended to readers of this magazine since it deals with practical circuitry throughout, as found in everyday commercial sets, and provides useful notes on servicing matters.

How up to date is it? Well, it doesn't cover the very latest generation of TV i.c.s, and has nothing to say on combined line output stage/power supply arrangements. We can perhaps afford to wait for something on this in a later edition. The present one takes in valve techniques as used in the final generation of hybrid receivers, discrete transistor circuitry, and the "TBA" generation of i.c.s. On the tube side, it takes us up to the PIL tube but not the 20 and 30AX. In fact it covers the sorts of sets and circuits most of us will be handling for the time being, and does so with precision and clarity.

We can recommend the book as a reference source and as an introduction for those new to TV techniques. In view of the price however you might consider it best to examine a copy before making up your mind.

J.A.R.

Servicing the Beovision 3400 Series

Part 2

Eugene Trundle

In Part 1 we looked at the signal and power supply sections of the chassis. Now on to the timebases.

The Field Timebase

The field timebase circuit (see Fig. 2) is on No. 2 panel, below the c.r.t. neck. Sync pulses from the TAA790 sync/line oscillator i.c. pass through an integrator/clipper circuit to the gate of SCS1 (BRY39), which is a conventional sawtooth oscillator. The sawtooth generated across 2C64 is amplified by 2TR4 which drives 2TR5 and by emitter-follower action feeds a sawtooth waveform into the base of 2TR3. This stage functions as a Miller integrator, converting the field sawtooth into a parabolic waveform at its collector – primarily for EW correction in the line deflection stage, but also potted down by the vertical linearity control 2R42 and mixed with the sawtooth input to 2TR4 for linearity correction. A second integrator (2R53 and 2C27) further modifies the parabola, reinjecting it into the base of 2TR4 via 2R45 for field scan correction. Feedback from the output stage is applied to the base and emitter of 2TR4, to the base of 2TR3 via 2R130 and to the base of 2TR5 via 2R49 and 2R57.

The carefully-shaped waveform thus produced passes via the inverting amplifier 2TR5 to the driver stage 2TR6. The output stage itself is a conventional complementary pair, consisting of 2TR9 as one half and the Darlington pair 2TR7/0TR1 as the other. 2D5 and 2D6 provide the offset voltage and determine the no signal current in the output stage. The supply voltage for the output stage comes from the 32V line via 2D8.

Flyback Action

So far so good, but what are 2TR8 and all those diodes for? To achieve a fast flyback at the end of the forward field scan, it's necessary to connect the "hot" end of the scan coils to a higher potential than 32V. This is achieved by 2TR8, the flyback switch, which is turned on by 2TR6 during the flyback, connecting the output stage to the 54V line. 2D8 is then reversed biased, isolating the 32V line. 2TR8 and 2D8 can thus be likened to a two-way switch, with 2TR9's collector alternately connected to 32V (scan period, 2D8 on) or 54V (flyback, 2TR8 on and 2D8 off).

Finally, 2D9. This acts as a bypass round the output stage during flyback. As we've seen, when the flyback commences, the hot end of the field scan coils suddenly rises to 54V. This appears on the negative plate of 2C38. During the forward scan period, this capacitor acquires a charge via 2D8 and 2R65 from the 32V line. The two voltages add, so that the positive plate of 2C38 rises to 54V. This brings 2D9 into conduction, diverting the stored scan coil energy from the output transistors.

To tie up the loose ends, the 54V line is derived from the I+74V supply via 2R55 and the shunt stabilizer transistor 2TR10. 2D11 clips off the flyback pulse to obtain a sawtooth for feedback and NS correction and, via the invertor 2TR11, corner convergence and EW correction.

Field Faults

We've had no trouble to date with the SCS oscillator, and only one case of a leaky and low-capacitance coupler 2C25, resulting in greatly reduced vertical scan with poor linearity. 2TR4 and the integrator 2TR3 are often suspected but seldom guilty, because when (as is usually the case) the fault is farther downstream in the timebase the distorted or absent feedback signals upset the waveforms and d.c. voltages hereabouts. If the 2TR3/4 section is in trouble, the transistors and high-value resistors are the most likely suspects.

Unfortunately, all eight transistors in the field timebase are d.c. coupled and very interdependent. This can result at worst in wholesale destruction and at best in difficult fault diagnosis.

Before continuing with the field timebase, we must emphasize that a check on the K+32V line is essential, since for correct operation it's important that this voltage is just right.

2TR5 is quite reliable, but 2TR6, 7 and 8 can be vulnerable to some faults in the output stage and should be checked if one or both of 2TR9/0TR1 are replaced. If 2D5

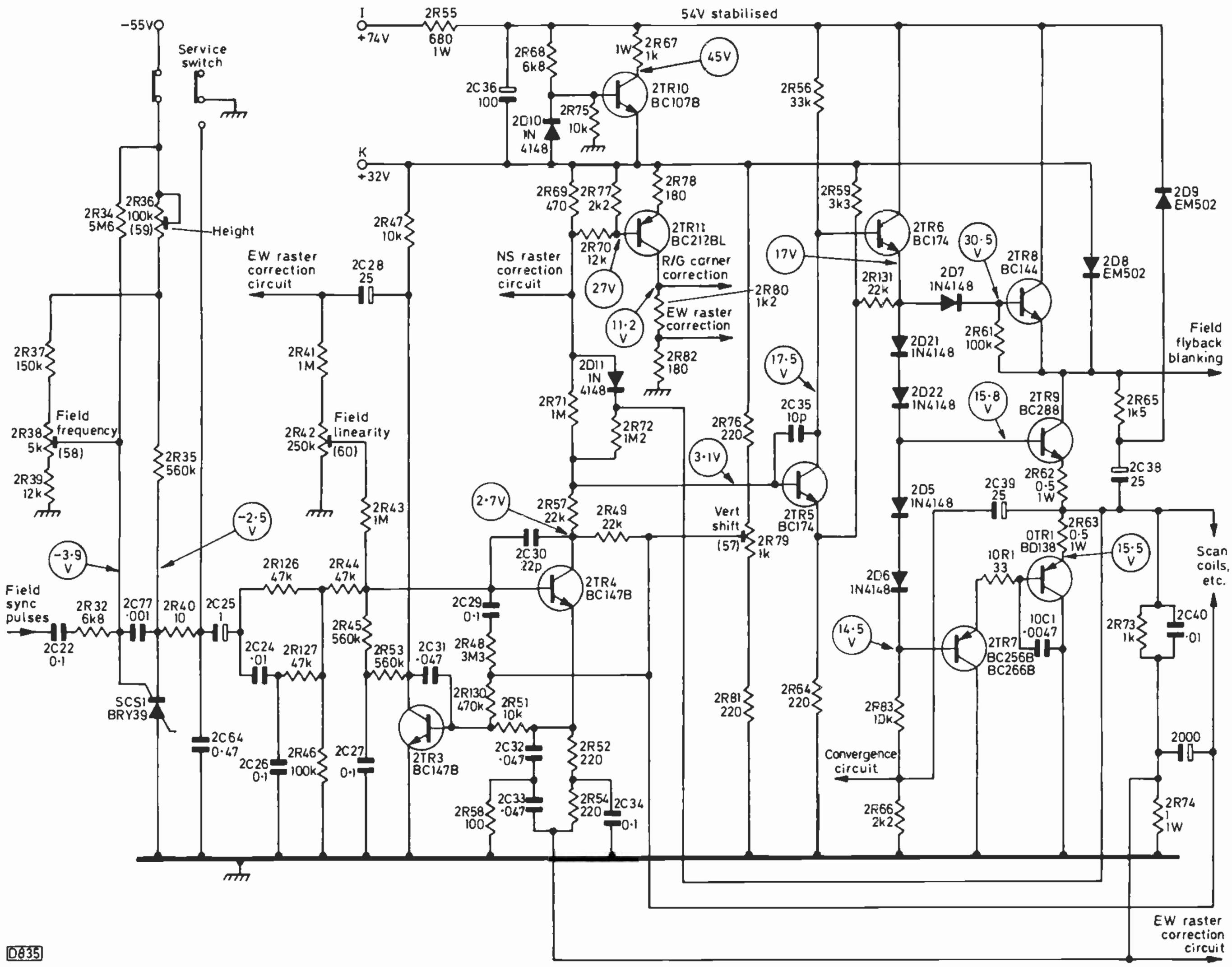

Fig. 2: The field timebase circuit used in the Beovision 3400 chassis.

and or 2D6 go leaky or short-circuit, crossover distortion occurs with a cramping of the scanning lines halfway down the scan, giving the impression of a brighter horizontal line through the middle of the picture.

Most of the problems in the field timebase centre around 0TR1 and 2TR9. A common symptom is field collapse, with 2R62 and 2R63 overheating. This will be due to these two transistors having gone leaky or short-circuit. It's important to replace them with the correct types, BD138 and BC288, making sure that 0TR1's collector is isolated from chassis, and also checking their close neighbours 2TR6, 7 and 8 for any ill-effects.

If height or linearity problems occur, a very rough rule of thumb is that the two transistors below the mid-point – 2TR7 and 0TR1 – handle the second half of the scan (bottom of the picture) while the two above are more likely to be responsible for faults in the upper half of the picture. The mid-point voltage should be just half the 32V supply line voltage, and this is a good guide to the health of the timebase.

Failure of the flyback switch 2TR8 will affect the top of the picture, the symptoms varying from severe top foldover to imposition of teletext on the picture. Faults here usually upset the voltage on the 54V line, but make sure the I+74V supply is present and correct before getting too involved with 2TR8!

Repeated failure of the output pair may be due to a gremlin in 2TR7, a faulty 2D9, or excessive voltage on the K+32V rail. On one memorable occasion, sudden and unpredictable failure of 0TR1 and 2TR9 was traced to intermittent leakage in the polystyrene anti-parasitic capacitor 10C1.

Spitz und Sparken

There are a lot of volts in the 3400 chassis, and now that we're moving on to the high-power stages a word of warning, based on bitter finger-sizzling, cuss-shouting experience, is appropriate. We've already mentioned the shock hazards on the front chassis. The main chassis bristles with them. There's a very prominent 10W resistor alongside the 12HG7 on the left of the c.r.t. neck, with a cool 290V on its end. Blown fuses mean no discharge path for reservoir capacitors: when you switch off and get hold of the fuse to replace it, you'll probably emerge from the set in a mighty hurry. The e.h.t. generator cannot muster quite the 7mA of the 3200 series, but should be treated with as much caution – like most valve receivers, there's no discharge path for the e.h.t. voltage held in the capacitance of the c.r.t. glass, and the charge is retained long after the set has been switched off. The unusual colour coding of the conductors in the mains lead can often mean that the chassis is live to earth or the aerial socket – check it with a neon or meter before starting work.

NEXT MONTH: THE LINE TIMEBASE

Servicing the Beovision 3400 Series

Part 3

Eugene Trundle

The Line Timebase

Almost the whole of the right-hand side of the main chassis is given over to line scanning and e.h.t. generation. Basically there are two output stages, the main generator which provides the e.h.t. and half the horizontal deflection power, and an auxiliary generator which furnishes the remaining 50% of the deflection power. It works in what might be described as quasi-push-pull with the main generator – see Fig. 3.

The presence of two output stages allows liberties to be taken with the e.h.t. regulation, based on the "50% fiddle factor". What this means is that if the e.h.t. falls at high beam current due to poor regulation, picture ballooning can be avoided by reducing the deflection current by half as much, percentage wise, as the e.h.t. voltage drop. For example, if the e.h.t. falls by 10%, and the deflection current by 5%, then provided the vertical amplitude and focus voltage track these variations nobody will be any the wiser – unless he's looking at an e.h.t. voltmeter. This compensation idea is exploited to a lesser extent in most solid-state receivers, where a so-called anti-breathing resistor is inserted in series with the h.t. feed to the line output stage.

Because the main generator supplies all the e.h.t. and 50% of the deflection power it needn't be stabilized against mains voltage variations appearing on the h.t. line – provided the "fiddle factor" requirement is met. There is however a VDR circuit to ensure that the stage operates reasonably efficiently and to keep the e.h.t. above 20kV at maximum beam current. VDR 6R6 is the stabilizer, working in conventional fashion from pulses from the e.h.t. transformer, with the "set boost" control 8R5 referred via 8R3 and 8R4 to the +270V h.t. line instead of the boost line.

Various means of reducing dissipation in this stage are employed, such as running the suppressor grid at +32V and shaping the line drive waveform to match the e.h.t. current demand, feedback for this purpose coming via the step-up transformer 9L3.

The focus voltage is obtained by rectifying the flyback pulse at the pentode's anode, with the reservoir capacitor 13C1 returned to a pulse output tap on the e.h.t. transformer to secure the correct focus voltage/e.h.t. tracking. The d.c. voltage tapped from the slider of the focus potentiometer 8R1 has a great big parabola (also from the e.h.t. transformer) superimposed on it so that focus is not lost towards the picture edges.

Returning to the e.h.t. transformer itself, the final anode voltage for the tube is derived via the GY501 from an overwinding on the transformer, with (unusually for a half-wave valve rectifier circuit) 5th harmonic tuning. This has the effect of improving the e.h.t. regulation at the expense of calling for a higher peak voltage in the primary circuit. E.H.T. regulation is also effected by 6D1, which samples the beam current flowing through the overwinding and regulates the PL509 accordingly. 6D1, sensing the e.h.t. current as it does, is also used for beam current limiting – a negative potential being built up in 6C5 as tube current increases. This is passed via a two-stage amplifier to the luminance output valve.

There are several additional secondary windings on the e.h.t. transformer. Windings 8-9 and 10-11 feed the line scan coils. Secondary 4-5-6-7 provides pulse feeds to various other parts of the receiver, primarily the decoder and CDA clamps, and a –200V line for the brightness control network and silent warm-up circuit. The same line furnishes the collector voltage for the auxiliary generator stabilizer. Winding 1-2-3, with rectifiers 8D1 and 8D2, provides "floating" balanced outputs of +20V and –20V. These lines are fairly heavily loaded by the corner convergence and NS raster correction output amplifiers, each of which uses a complementary-symmetry transistor pair. We'll come back to them.

The auxiliary generator consists of a PL509 and PY88 driving a second output transformer whose secondary winding drives a sawtooth current through the line scan coils to reinforce the scanning power provided by the main generator. Tertiary windings cater for corner convergence and a conventional d.c. horizontal shift circuit. Once again anode dissipation in the PL509 is kept down by operating the suppressor grid at +32V. Full stabilisation of this stage is required, and because EW correction is also applied here a transistor amplifier is used to control the PL509's control grid voltage.

The flyback pulses appearing at point 9 on the scan transformer are applied to the width control 6R24 via 8R24 and 8R25. The potted-down pulses are rectified by 6D4 and applied to the base of transistor 6TR1. The emitter of this device is held at a fixed voltage by zener diode 6D3. As a result, the conduction of the transistor varies, its collector voltage being a function of the flyback pulse amplitude. Line drive pulses coming via 9C10 are clamped to this potential by 9D1. Thus stabilisation is achieved. The B+270V line is sampled via 6R23 to compensate for h.t. voltage variations.

A parabolic waveform at field rate, adjustable by 6R29 and 6R26 (amplitude and tilt), is applied to the emitter of 6TR1. Due to the presence of 6R20, the zener diode stabilization at this point is not very "stiff", while the network 6C8/6R19 at the base of the transistor has a time-contant such that its base is effectively grounded for the relatively fast EW correction waveform applied to its emitter. Thus 6TR1 works in the common-emitter mode as a d.c. loop amplifier to provide stabilization and in the common-base mode as an EW correction amplifier.

To optimise the e.h.t. deflection power tracking, 6R15 links the control circuits for the two output stages. The gain of 6TR1 (common-base mode) increases with frequency, due to the time-constant in its base circuit, and this helps to compensate for the effect of short-term e.h.t. current demands such as a bright vertical bar on a dark background.

There's no doubt that a goodly percentage of the problems that assail the 3400 chassis are in the stages just described. We've never had trouble with the line oscillator or driver stages, so we'll come straight to the most usual symptom – no results and a blown 400mA fuse at the top of the e.h.t./deflection valve board.

If the fuse has blown gently, you might be lucky and find that the trouble is no more than an overload due to excessive brightness and contrast. This is not surprising, as the current in the fuse is 410mA with everything going flat out – or more if the beam limiter preset is over advanced. Adjust control no. 31 (beside the G-drive preset on the

CDA/luminance panel) for 0·75V across test points b4 at the top of board no. 6. If the trouble is recurrent, we fit a 500mA fuse in this position.

What is more likely is that failure of the fuse was caused by a heavily-damped main generator, with nearly one ampere being drawn. A burnt focus control may be at the root of this, betrayed by an evil smell. Much more common however is shorting turns in the e.h.t. transformer 8014039, curable only by replacement. Before condemning the transformer, it's prudent to confirm that drive is present at the grids (pins 1 and 8) of the PL509s. The screened leads taking the line drive to the panel sometimes short, although this is not as common as it was on the 2600/3200. If there's any suspicion of intermittent line drive, 2C15 (0·001μF) and 2C16 (470pF) in the driver stage should be replaced, though we have yet to experience this.

We find that fitting a 250Ω 10W resistor in series with the lower 400mA fuse, fitting PL519 valves in place of the PL509s, and reducing the e.h.t. by 10% increases the reliability of the scan/e.h.t. department.

The lower fuse fails less often than the upper one. When it blows violently for no apparent reason, hinge up the screened valve panel assembly, remove the screening can, and examine the print land connected to pin 3 of the PY88. This is in close proximity to the earthed sprite clip which secures the screening can, and intermittent arcing often occurs here: grind away the corner of the sprite clip, or trim back the print land, to cure this one.

Internal arcing in any of the four valves can cause random fuse-blowing.

Two odd faults to conclude this section. A half-size picture with bizarre geometry is the result when the auxiliary generator stops. Horizontal black lines at odd times and random spacings are sometimes caused by sparking in the spark-gap on the focus electrode (pin 9) of the c.r.t. Usually an audible "snicking" noise is produced, and the spark can be seen in darkness.

NS Raster Correction

To compensate for pincushion distortion at the top and bottom of the raster, the 3400 uses a current generator in series with the field scan coils. See Fig. 4.

The waveform required is known as a butterfly from its appearance on the scope. It's generated by mixing line and field-rate waveforms in diodes 5D5/6, the shape of the modulation envelope being controlled by the amplitude and balance controls 5R25 and 5R22 and the tuned circuit 5L1/5C20, which is resonant at about 12·5kHz. A further line-rate component is added via 5C24 from the top and bottom correction phase controls 5R34 and 5R33. These controls are set to correct any tilt on the top and bottom horizontals of the raster.

The complete correction waveform is amplified in the power amplifier 5TR1/2/3 and 0TR4/5 whose output is applied via 5C26 (10μF) to the primary of the NS output transformer 12L1. The secondary of the transformer is tuned to resonance at line rate and its second harmonic by the network 12C1/2 and 12L2. The network is in series with the field scan coils, so that the vertical scanning current is suitably modulated to compensate for NS pincushion distortion.

If the NS correction department is not working properly, the result is either S-shaped top and bottom edges to the raster, or simply severe pincushion distortion at the top and bottom. If the latter symptom is accompanied by a very snowy picture, switch off before resistors 8R6 and 8R7 burn out, because the NS output stage 0TR4/5 will probably be drawing a heavy current.

One of the rectifiers 8D1, 8D2 may have shorted, but it's more likely that the trouble is due to the transistors themselves or the 470pF anti-parasitic capacitors (15C1/2) associated with them. If 8D1 or 8D2 have to be replaced, use type MR854. Less commonly 5TR2 or 5TR3 are responsible, and the latter pair should be checked for consequential damage whenever 0TR4 or 0TR5 are found faulty. The 33Ω stopper resistors (15R1/2) in the base leads to the output transistors sometimes swell up and burst as a result of faulty transistors or polystyrene capacitors.

The 5mH coil 5L1 is very fragile, and can go open-circuit to upset the NS correction. Just as common is failure of the tuning capacitor 12C1 (0·047μF) across the NS output transformer's secondary winding. This capacitor passes a lot of ripple current, and many types are not suited to life here. We find that the 630V polycarbonate type marketed by RS Components lasts well.

If difficulty is experienced in setting up the geometry (and it can be made very good), ensure that the yoke is square on the c.r.t. This should be when the pip on the deflection yoke is lined up with the moulded line on the c.r.t. flare.

Convergence

Despite the complexity of the convergence arrangements (corner convergence is achieved by injecting a differential current into the line deflection circuit), troubles are not very common and many of them are "one-offs". We'll summarize the few stock faults that we've encountered without embarking on circuit descriptions.

The push-pull horizontal convergence output stages are fairly reliable – they work under less duress than the field and NS power amplifiers, and the odd failure is easily traced with a meter.The usual fault is an open-circuit base-emitter junction, causing red or green horizontal misconvergence. Sudden or intermittent loss of convergence at screen centre will very often be due to a wire coming adrift from the convergence yoke, or poor contact in the service switch by the 12HG7 valve. All the components prefixed 7 on the circuit diagram are in the pull-out convergence box, in which we've had random failures of the BC147 transistors, each time betrayed by incorrect electrode voltages. If the scope has to be called in, it will probably be to trace an open-circuit 10μF or 25μF capacitor in the vertical convergence section – on most occasions 7C14 or 7C15.

When adjusting the convergence, be careful not to break off the fragile white plastic knobs, and bear in mind that some of the corner convergence controls are located on panel no. 5 above the c.r.t. neck. If they don't do much, the chances are that someone has switched off the corner convergence at switch 5S1 on the same panel.

Hardware

We've had a few cases of faulty loudspeakers. Like the wound components, the luminance output valve and many other parts, they must come from the manufacturer's UK service department as they are rather special.

The Philips c.r.t.s fitted to these receivers seem to go down relatively quickly, with the symptoms of poor grey-scale and soft focusing. While they'll soldier on for a long time in this condition, the performance capabilities of the electronics in the set justify replacing the tube. Rebuilt tubes are readily available, and seem to last longer than the originals if obtained from a good firm. Installing a replacement is no joke however, because the cabinet fits the

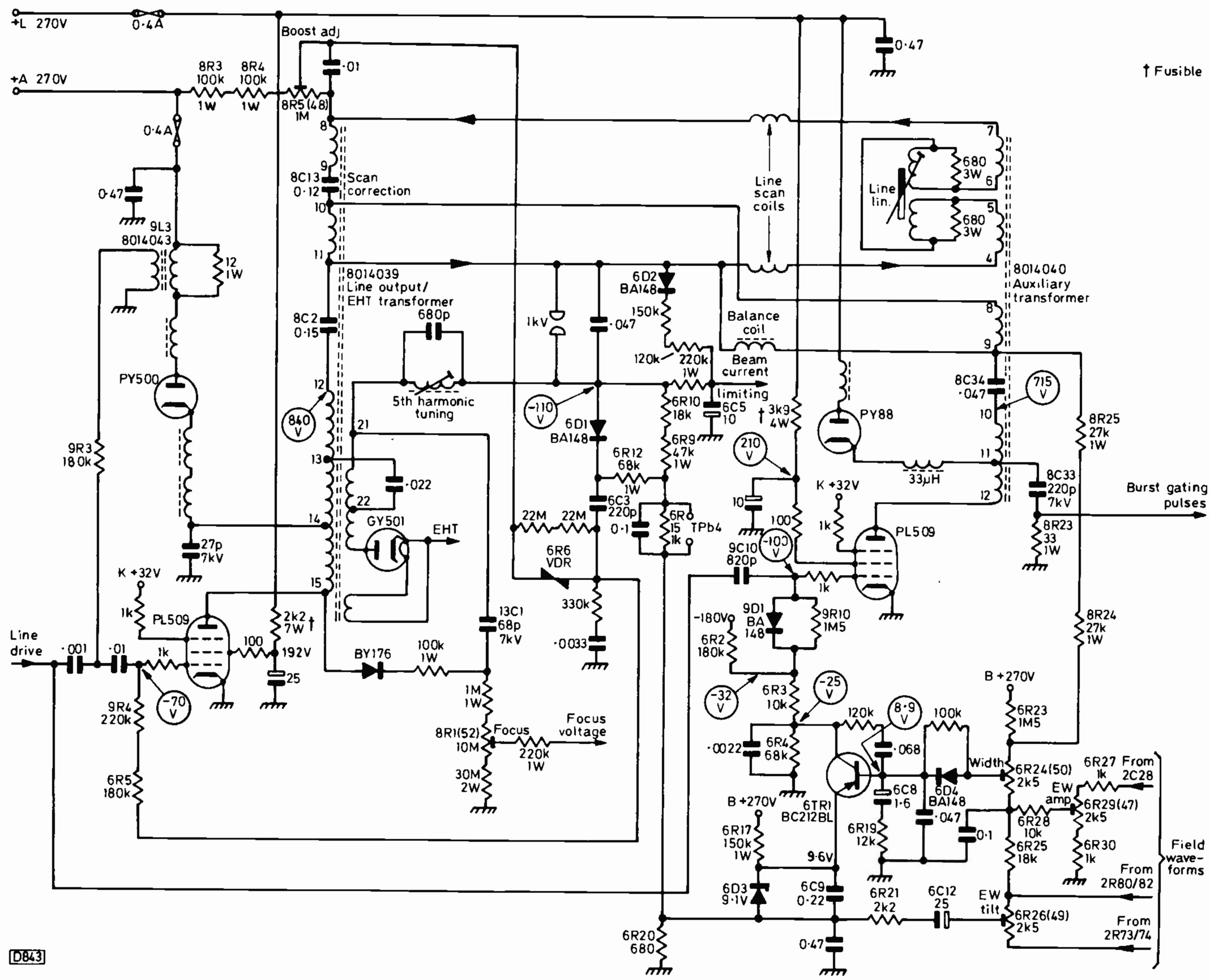

Fig. 3: Simplified circuit of the "double" line output stage used in the 3400 chassis. The voltage across 6C5 should be −1·1V.

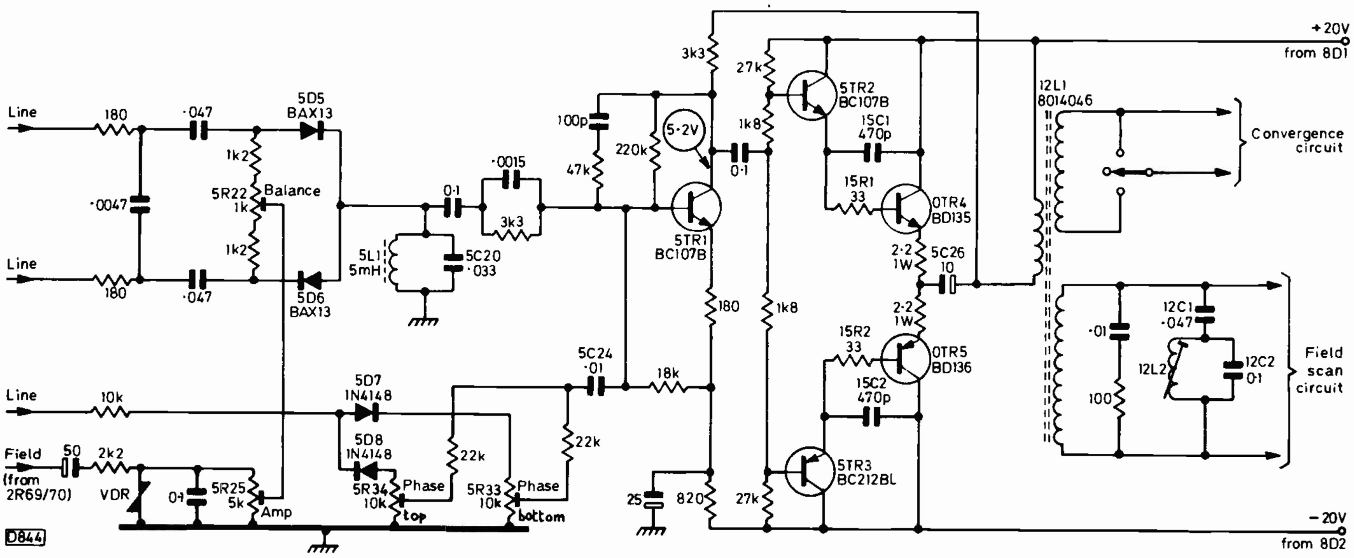

Fig. 4: The NS raster correction circuit, which gives rise to a fair number of the faults on these sets.

c.r.t. like a glove – remove the wooden wedge inside the top of the cabinet, and have the sticking-plaster ready for the odd skinned knuckle!

Purity adjustment on this type of c.r.t. is more critical than with the 90° type. Care is necessary to achieve good purity, though we've always managed without a microscope. High beam current can cause overheating of the shadowmask, leading to the quaintly-named phenomenon of hot-bulge, in which a pink patch appears on a white object if it's large and lingering. Correct setting of the beam limiter and, if necessary, readjustment of the purity will go a long way to alleviate this problem.■