The cost of this improved efficiency is interesting. Since the construction of a bowtie array is simple and relatively inexpensive, even allowing for the combining filter, the overall cost of a double stacked bowtie array is less than the cost of a single long Yagi. The wide vertical beamwidth is a further advantage, resulting in improved overall performance compared to a long Yagi. True, the latter has higher gain – but concentrated in a relatively small part of the spectrum. It's been demonstrated that weak, scattered u.h.f. signals can be quite height conscious, resulting in the signal level obtained at one height being reduced at greater or lower heights. For the true connoisseur, four such bowtie arrays can be stacked and combined using an appropriate filter. The system gain is most attractive.

Conclusion

My conclusion is that a twin (or quad) stacked bowtie system will give a better and more consistent overall performance, particularly where scattered trans-horizon signals are being sought. I'd naturally be interested in the comments of those using the different approaches discussed here – even better the observations of those who may have changed from one to the other.

Servicing the Rank Z718 Chassis

Part 1

John Coombes

THE first models to use the Z718 chassis were released in early 1975. They were fitted with an 18in. Toshiba 110° in-line gun c.r.t. Subsequent models were fitted with 20, 22 and 26in. tubes of the same type. Production began to be phased out when Rank went over to the use of the 20AX tube with the T20 chassis, which was introduced in late 1977.

Power Supply Arrangements

The Z718 chassis is capable of giving good results. It was introduced before current standards of reliability came about however. Quite a lot of faults can and do occur, though the line output transformer is fortunately reliable. One of the most common faults is no results, which can be caused by many things. To be able to deal with this sort of thing it's essential to appreciate the basic arrangement of the chassis, and to this end a simplified block diagram of the power supply, line timebase and EW modulator sections is shown in Fig. 1. As with any set, the line output stage is the heart of things. More so with this than with most solid-state chassis however, since a very simple, non-stabilised h.t. power supply circuit is used. Stabilisation of the width/e.h.t. against mains voltage variations is achieved by linking the EW modulator control circuit to the h.t. line via 4R58/4R61. Stabilisation against varying load conditions is achieved by feedback from the e.h.t. circuit to the EW modulator control circuit.

The c.r.t.'s first anode, heater, focus and e.h.t. supplies are all derived from the line output transformer which also produces, in conjunction with the EW diode modulator circuit, a 30V supply. A regulated 12V supply for the low-voltage stages is derived from this 30V rail. In early models the line oscillator was supplied from the 30V line via a constant-current circuit (4VT13 and associated components): in later sets it's supplied from the 12V rail. This means that the line oscillator requires a start-up circuit. The line driver stage also requires a start-up supply – once the set is running normally, its supply is obtained via 5R6 from the mid-point in the line output stage. Start-up supplies are provided by 4C18 and 5C3 respectively – as these capacitors charge at switch-on, the line oscillator and driver stages are provided with enough current to get them working.

Protection is provided by fuses and an overload trip. 7FS1 will blow in the event of a short in the mains input or degaussing circuit, while 7FS2 will blow in the event of a short in the h.t. circuit. 5FS2 will blow in the event of a short in the line output stage. In some sets this fuse is omitted – 7FS2 will then provide the necessary protection. If 5C3 goes short-circuit, 5FS1 will blow to protect the line driver stage – a slightly different arrangement is used in the larger screen models, in which the fusible resistor 5R25 will go open-circuit. The overload trip operates in the event of excess current flowing in the line output stage. When it operates, transistors 5VT4/5 switch on, removing the drive to the base of the line driver transistor 5VT1 and thus shutting the set down. If the fault is temporary, switching off and on again will restore normal results. The trip is intended to operate in the event of an excessive load on the 30V rail as well as a fault in the line output stage itself – a short-circuit transistor in the field output stage for example.

Circuit Features

The mains input and h.t. supply circuits are shown in Fig. 2 and the line output stage in Fig. 4. If you are handling any number of these sets it's as well to appreciate the e.h.t./tube supply arrangements as well – see Fig. 3. The rectifier circuit 5D2/5C19 produces a supply which is fed to the first anode control network via a constant-current circuit. These sets use a stick rectifier rather than a tripler, the e.h.t. current path being via this rectifier (5D4), the overwinding on the line output transformer, 5D3, 5R7, 4D16 (which is forward biased via the first anode supply) and 4R50. 4D16 provides the beam limiting action: in the event of excessive beam current this diode switches off and the c.r.t.'s grids are biased negatively. Since 4R50 senses the beam current, the voltage developed across this resistor is used to provide anti-breathing feeds to the field timebase (via 4R10) and the EW modulator control circuit (via 4R86/4R72). Rapid e.h.t. fluctuations are sensed by 5VT6, whose base is connected to the e.h.t. lead's screen – this provides a capacitive coupling. The correction signal thus obtained is fed to the EW modulator control circuit via 5C25. Forward bias for the base of 5VT6 is provided by 5R20 which is in series with the focus unit.

As Fig. 4 shows, a balanced, two-transistor line output stage circuit is used, i.e. a 900V positive-going line flyback pulse is present at the collector of 5VT2 while a 900V negative-going pulse is present at the emitter of 5VT3. The field timebase is quite complex, using a total

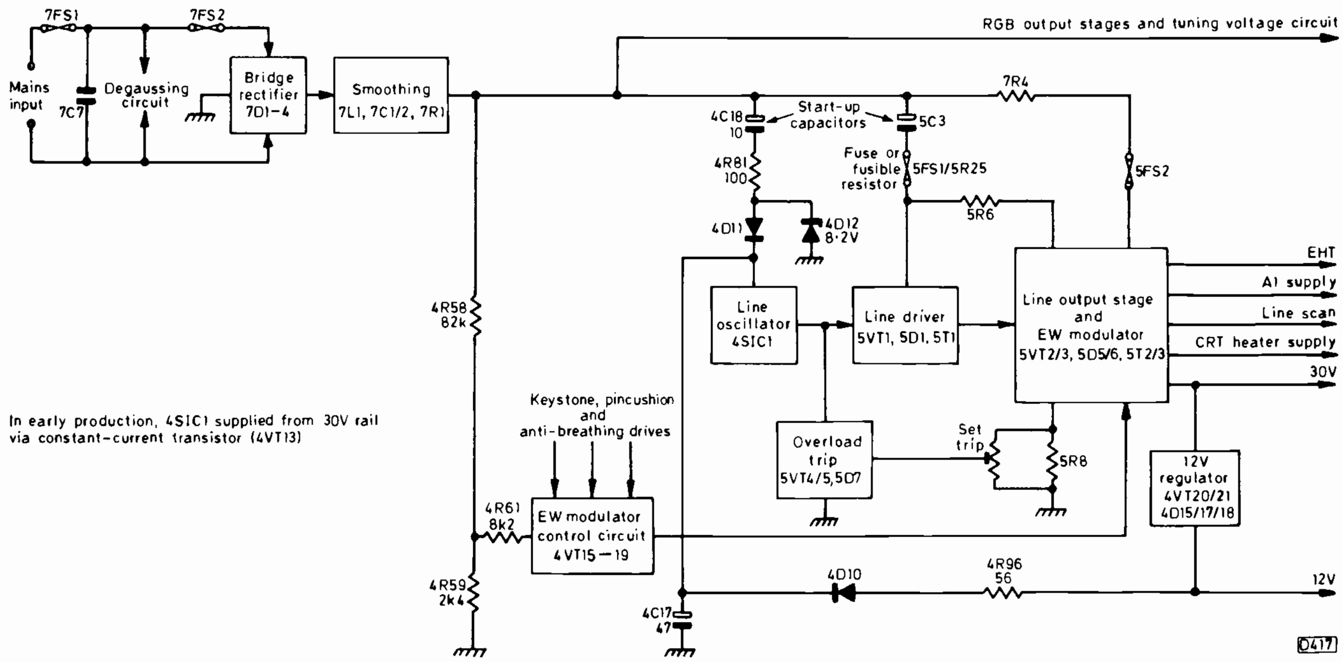

Fig. 1: General arrangement of the h.t. supply, line timebase and EW modulator circuits in the Rank Z718 chassis.

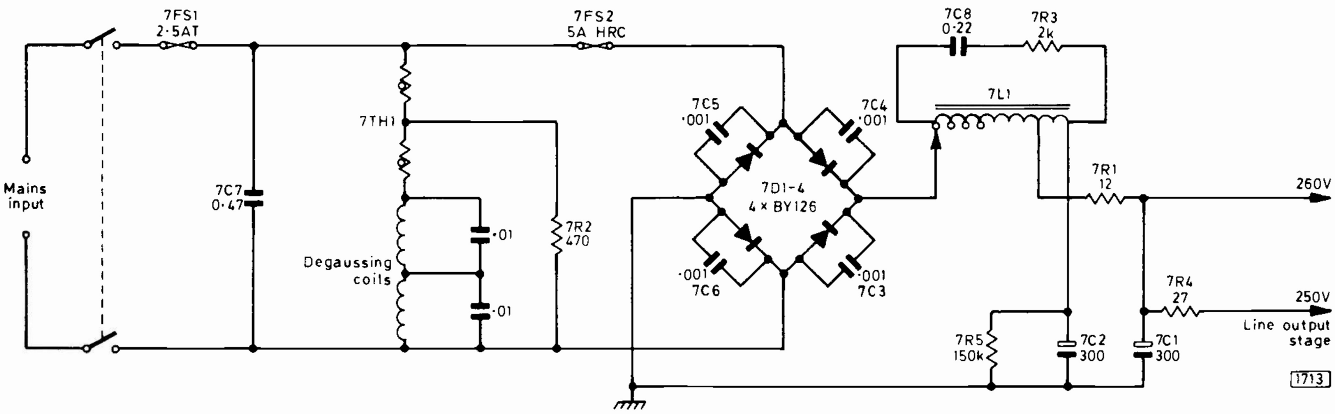

Fig. 2: The mains input, degaussing and h.t. circuits.

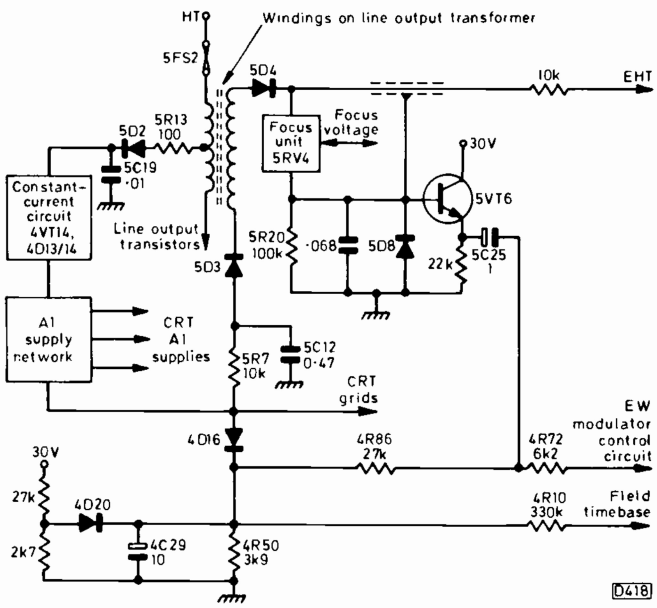

Fig. 3: The e.h.t., focus, c.r.t. first anode, grid bias, anti-breathing and beam limiting circuits.

of ten transistors: the driver/output stage circuit is of the type originally devised by RCA – with two drivers, and with one output transistor conductive during the whole of the forward scan while the other one conducts during the second part of the scan only. Since the audio output stage is fed from the 30V rail, the supply is applied via a constant-current transistor. There's a Mullard three-chip (TBA560C/TBA540/TCA800) decoder, with class A RGB output transistors. The latter share a common emitter load transistor which is used to set the black level.

Power Supply Faults

So much for the basic features of the chassis. Now to specific faults, starting with simple power supply problems.

In the event of a dead set, start by checking at the mains on/off switch. You may find it open-circuit. Next check fuse 7FS1. If this has blown, the mains filter capacitor 7C7 could well be short-circuit. Then move over to 7FS2. If this is open-circuit, check the bridge rectifier diodes 7D1-4 and their protection capacitors 7C3-6 for shorts. The reservoir and smoothing electrolytics 7C2 and 7C1 respectively could also be shorting. If 7C1 is short-circuit, 7R1 could be open-circuit. If there's no h.t. and the fuses are intact, 7L1 could be open-circuit. In the event of 7FS2 blowing intermittently, replace the electrolytic can 7C1/2.

If the problem is a hum bar, inspect the power supply panel for cracks in the earth connections and check 7C1/2 for leakage. These capacitors can leak very badly – all down the panel and over the chassis.

If the degaussing circuit is not working, the dual thermistor 7TH1 could be dry-jointed or open-circuit – it's best to check by replacement. If there are purple patches in the corners of the screen, 7R2 could be open-circuit. This often burns a ring around itself and must be replaced with the correct type. Also check whether the degaussing coils are open-circuit.

Dead Set – Line Timebase Not Working

If the set is dead 7R1 could be open-circuit due to a fault in the line output stage. If the power supply is in order however we are faced with three possibilities: a fault in the line oscillator/driver/output stages, failure of the start-up systems to operate, or the overload trip operating.

The first step is to check for h.t. at pins 2 and 3 of plug/socket 5Z2. This will confirm that the power supply is in order. Next check 5FS1/5R25 (depending on panel – Z904 or Z904A respectively) and 5FS2. If the former is open, check 5C3 by substitution, check 5VT1/5D1/5C4/5C5 for shorts, then suspect shorted turns on the driver transformer 5T1. If 5FS2 is open-circuit, it could well be that one of the scan-correction capacitors 5C15/5C14 is short-circuit. A less likely possibility is shorted turns in the line output transformer.

If the fuses are in order, try turning the set overload trip control 5RV3 fully anticlockwise. If the set then operates normally, check the condition of the control's track and set it up correctly.

Checking through the Line Timebase

If the set still fails to work, it will be necessary to check through the line timebase. Check for a short-circuit to chassis at pin 3 of the TBA950 sync/line oscillator i.c. (4SIC1). This is it's d.c. supply pin. A low-resistance reading here could mean that 4C17 is short-circuit, or that the i.c. is defective. If a high-resistance reading is obtained, check the i.c.'s chassis connection (to pin 1). If this is in order, the i.c. could have failed or it might be receiving no supply or the start-up system might not be working. Try bridging 4C18 with a 5·6kΩ, 5W resistor as a check on the latter point. If this restores normal operation, 4C18 is probably open-circuit. If this gets the line timebase working but nothing else happens, check the EW modulator diodes 5D5/6, the 30V reservoir capacitor 5C8 and 5C24. Check also for dry-joints on pins 6 and 8 of the line output transformer or for a break on the board..

If bridging 4C18 makes no difference there could be something wrong with the power supply to the chip. Check for about 8V at pin 3. If this voltage is absent, check for h.t. at the positive side of 4C18 then check for continuity etc. at the other side – the things to check here are 4R81/4D11/4D12 plus the d.c. continuity to pin 3.

If 4SIC1 and its supplies are in order, there should be a pulse output at pin 2. These pulses should be about 1·5V peak-to-peak. If you find that they are about 8V, check for an open-circuit between pin 2 and the base of the driver transistor 5VT1 – there could be a poor connection at pin 6 of plug/socket 4Z2, or 5R23 could be at fault. Alternatively 5VT1 or its emitter diode 5D1 could be open-circuit. If on the other hand you find that pulses of about 8V are present at pin 2 of the chip when pin 6 of 4Z2 is disconnected, check for a short-circuit at the base of 5VT1. If the pulse output at pin 2 of 4SIC1 is correct, it's time to make further checks in the line driver stage.

Disconnect one end of 5R6 and connect a 5·6kΩ, 5W resistor across 5C3. If this restores normal operation, either 5C3 or 5R6 is open-circuit. Note that 5R6 is a small, carbon resistor which is intended to act as a fuse, i.e. if you find it burnt or open-circuit, suspect a fault in the line output stage – the transistors could be defective or the base balance coils 5L1/2 incorrectly set.

If the set still does not run with 5C3 bridged, check for pulses at the collector of 5VT1. No pulse output should lead to a check on 5VT1 and the associated components. If the pulse voltage is all right, disconnect 5Z1-11 to remove the h.t. from the line output stage and check for 1·6V pulses across the base and emitter of the two line output transistors. If these pulses are missing, check the transistors, the components in the base circuits and the condition/setting of the balance coils, also the line driver transformer 5T1.

In passing, if difficulty is experienced in setting up the output transistor base balance coils, i.e. if the reading jumps about or will not go low enough, the driver transformer should be replaced. The procedure is to connect a meter on the 2·5V a.c. range across 5R6 and adjust the coils for a minimum reading of about 1V.

If, with 5Z1-11 disconnected, 1·6V pulses are present at the bases of the line output transistors, check the transistors and the flyback tuning capacitors 5C9/5C10. Also check 5R8 which could be open-circuit, the continuity of the line output transformer windings and if necessary try a replacement transformer.

If the pulses at pin 2 of the TBA950 line oscillator chip are only 0·4V, check 5D1 then suspect a fault in the overload trip circuit. Check the zener diode 5D7 for being short-circuit, the values of 5R15/5R16, the setting and condition of 5RV3, 5VT4/5 and the electrolytics 5C22/5C23.

If the pulses are normal at around 1·5V, replace 5Z1-11 and disconnect pin 8 of plug/socket 4Z2 to remove the load on the 30V supply. If the line timebase now works and the tube's heaters light up,. check for shorts across the 30V rail. Removing pin 3 of plug/socket 3Z6 will eliminate the decoder; disconnecting 4R32 will eliminate the field driver and output stages; removing the green link wire on the Z906 panel will isolate the 12V regulator.

If the line timbebase does not work with pin 8 of 4Z2 disconnected, remove the e.h.t. cap (beware of the shock risk). If the line timebase now works, the e.h.t. stick 5D4 is probably faulty – though it has been known for the tube to be defective. If the line timebase still doesn't work, check the output transistors for short-circuits, the focus unit 5RV4, the first anode supply rectifier 5D2 and its reservoir capacitor 5C19 for being short-circuit, the scan coils and for shorts generally.

This systematic check through the line timebase may seem to be a rather elaborate procedure. It helps however when a difficult case has been taken back to the workshop and a scope is used for checking. In the field one would take short cuts.

We still have some power supply line faults to consider

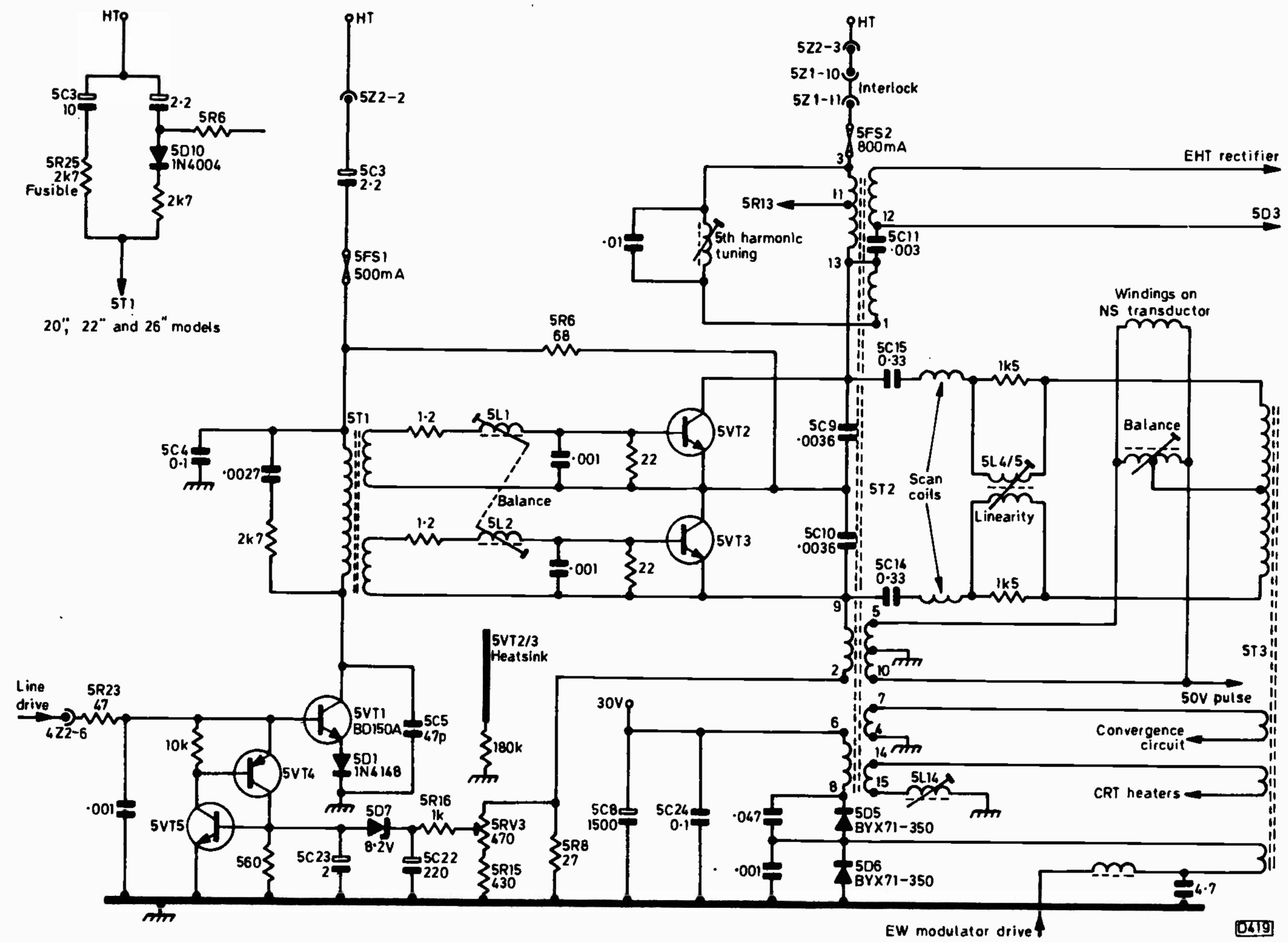

Fig. 4: The line driver and output stage circuits. The driver transistor 5VT1 is type BD150A. BU205 line output transistors were fitted in 18in. sets: larger screen models have BU208 line output transistors.

– and a couple of tips. If 5D5/6 go open-circuit, there'll be no 30V supply and the line timebase will not get started. The 8·2V zener diode 4D12 in the line oscillator start-up circuit could also have this effect if leaky. Another possibility – which in fact is quite probable – is that the 12V regulator circuit has failed. The usual suspect here is the 910Ω bias resistor 4R77, which changes value or goes open-circuit. In the earlier timebase panel, check the line oscillator chip's constant-current feed transistor 4VT13 – by replacement. It is important to use a fin type so that the heatsink can be connected – leaving this off can cause intermittent loss of sound and raster. Also check this transistor's emitter resistor 4R42 (200Ω) for open-circuit or changed value (to about 2kΩ).

The tips are to check the earth link between the timebase and the line output panels – it may be open-circuit or have a high-resistance joint – and the connections on 5Z1-10/11. These latter can be dry-jointed, and another possibility is that the plastic cover has stretched, breaking the wire that links these two points. If a replacement convergence board has been fitted, you may find an incorrect plug connection.

E.H.T. but no raster occurs when the surge limiting resistor 5R13 in the c.r.t.'s first anode supply rectifier circuit goes open-circuit.

Miscellaneous Line Timebase Faults

Finally this month a few miscellaneous line timebase/line scan faults. A loud line whistle can usually be cured by replacing the line linearity coil 5L4/5. In the event of focus troubles, check pin 9 on the tube base for corrosion, the focus unit 5RV4 by replacement – ensure that the plug-in lead is connected and not broken in the socket – and finally check 12R1 (100kΩ) on the tube base. Excessive width/bent verticals can be caused by the EW modulator diodes 5D5/6. If the EW pincushion, keystone and width controls are ineffective, check 4VT19/18/17 in the EW modulator control circuit. The output transistor here (4VT19) tends to go open-circuit while 4VT18/17 go short-circuit. If necessary check the EW modulator transformer 5T3 by replacement.

Low brightness or flickering between light and dark can be a tricky fault to locate. If it's not in the decoder, check 4R47 (110kΩ) and 4R46 (240kΩ) in the constant-current circuit feeding the first anode presets. Burns around the undersides of these resistors can cause the intermittent condition.

No colour or intermittent loss of colour can also be caused by the circuits we've been considering. The output from the 12V regulator may be unstable for example (check 4VT20), or the line hold (4RV13) or line phase (4RV14) controls may be incorrectly set or faulty (check the condition of the carbon tracks). The TBA950 could be faulty, but most important check 4C24 (0·01µF) which decouples pin 13 – it can cause a momentary loss of colour on caption change or a more extended loss of colour. The tuner can also be responsible (see later).

Servicing the Rank Z718 Chassis

Part 2

John Coombes

THE field driver/output stage circuit in this chassis (see Fig. 5) is one of the most complex ever to have been used in a mass-produced receiver, so a few words on its operation may help. The basic idea of the circuit is to avoid the centre screen crossover effect that can be a problem with simple class B circuits. The circuit is certainly capable of providing a very linear field scan.

Field Driver/Output Stage Operation

The output transistors are 4VT7 and 4VT8: 4VT7 conducts throughout the scanning cycle while 4VT8 starts to conduct towards the centre of the forward scan and remains on during the second half of the scan.

The drive at the base of 4VT5 consists of a negative-going sawtooth. 4VT5/6 form an npn/pnp Darlington driver stage, producing a negative-going sawtooth across 4R25. During the first part of the scan, current flows via 4R24, the scan coupling capacitor 4C10, the NS correction circuit (transductor 5T4 and phase coil 5L11), the field scan coils, 4D3, 4VT7 and the network 4R30/4D4/4D5. The scan current falls to zero at the centre of the scan.

During the first part of the scan 4VT9, which is the driver for 4VT8, is cut off – since the conduction of 4D4/5 and 4D4/7 mean that its base and emitter voltages are the same. Towards the centre of the screen the voltage across 4R30 falls below 1·4V and 4D5 cuts off. The emitter of 4VT9 is then driven positively with respect to its base, producing a positive-going output across 4R28 to drive 4VT8. The current path reverses, with 4C10 discharging via the scan coils, 4VT8 and the other series-connected components.

At the end of the forward scan 4VT7 is driven hard on and 4VT8 is cut off (via 4VT9 which is also cut off). At this point 4C12 and the scan coils form a resonant circuit which provides the flyback action, the positive-going pulse at the junction of these items switching off diode 4D3. 4D6 clamps the voltage at the upper plate of 4C12 to the supply rail voltage. When the oscillation tries to swing negatively, 4D3 switches on again and 4VT7 takes over to produce a linear scan current flow under the control of the drive waveform. The feedback via 4R24 assists with scan linearisation.

Field Faults

Field collapse is a fairly common fault and the cause may not be in the field timebase at all – check for dry-joints on the NS transductor 5T4, which is on the line output panel. In the field timebase itself, the first things to check are the supply feed/decoupling components 4R32/4C14 and the condition of 4R30 which may be burnt or open-circuit. Then check 4D4/5/7, which often give trouble and may well be the cause of 4R30's discomfort. Make sure that they are not leaky. Check 4D6 as well. Check whether 4R33, 4R24 or 4R25 is open-circuit, then turn to the transistors. The output transistors 4VT7/8 may be short-circuit – 4VT8 short-circuit emitter-to-collector may be the cause of the overload trip operating. 4VT6

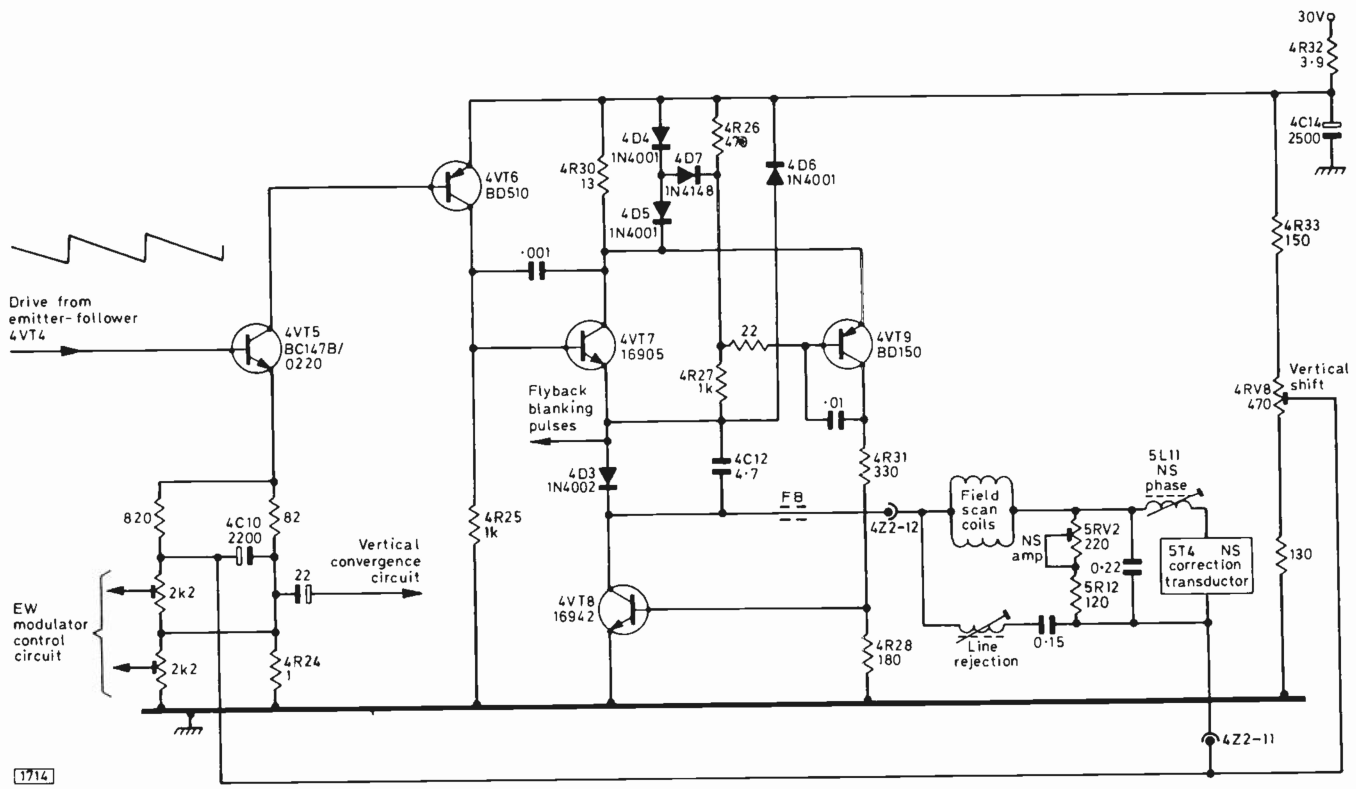

Fig. 5: Field driver and output stage circuits. In 20-26in. models 5RV2 is 470Ω and 5R12 200Ω.

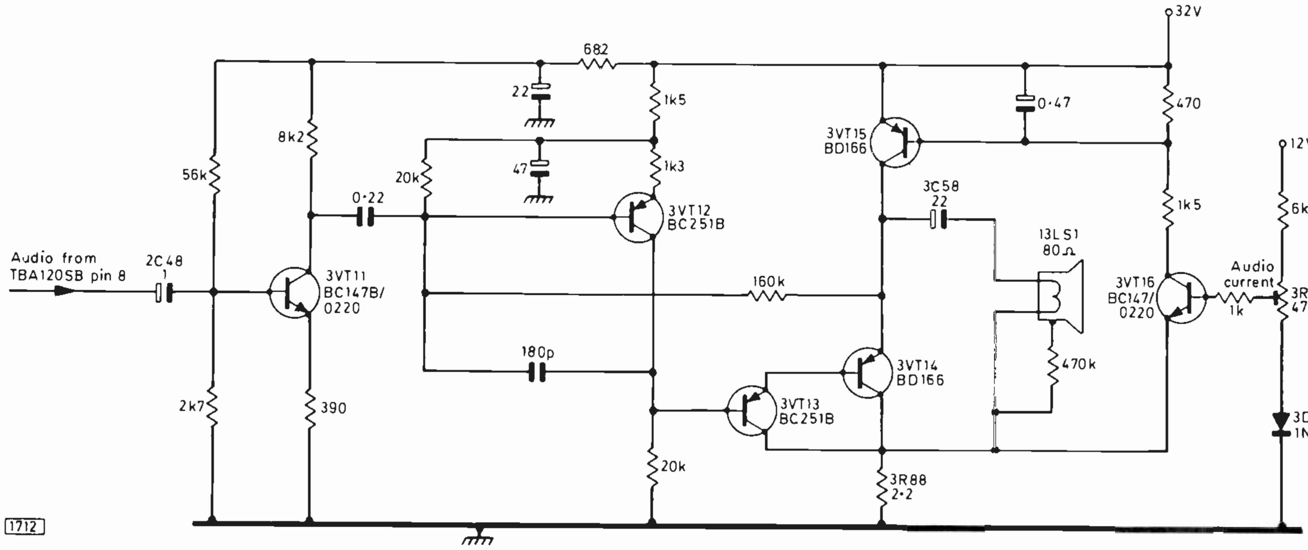

Fig. 6: The audio circuit.

may be short- or open-circuit while 4VT5 may be open-circuit. Make sure that 4VT8's emitter connection is good. Another possibility is 4C10 open-circuit.

Less likely possibilities are the linearity transistors 4VT3 (BC158) and/or 4VT4 (BC148) – they tend to go short-circuit – and open-circuit field scan coils. Also check pins 11 and 12 of plug/socket 4Z2 for dry-joints.

Lack of height is another fault whose cause can lie in the line rather than the field timebase – check the setting of the fifth harmonic tuning coil 5L3. This is done with a scope – couple the probe loosely to the focus adjustment access hole and tune for minimum ringing at minimum brightness. This should be consistent with minimum change of raster size as the brightness control setting is varied. The usual cause of lack of height in the field timebase is 4R9 which is in series with the height control. This resistor was 2·7MΩ in earlier sets and was subsequently changed to 470kΩ. Use this latter value in all cases.

In the event of field jitter, check that the field hold control 4RV1 (470kΩ) is set correctly in the centre of its track. If this is all right, check the safety resistor 4R33 in the vertical shift circuit. The metal rings at the ends of this resistor tend to crack – they can be soldered as a temporary measure, but replacement is the correct course. Later resistors are wirewound ones, eliminating the problem.

A fault which occasionally occurs is a bright line two inches from the top of the screen with incorrect pincushion correction at the top. The usual cause is the pincushion amplitude control 5RV2 (on the line output panel) going open-circuit or burning up. Its value is 220Ω or 470Ω depending on screen size. Also check 5R12 which is in series with it and sometimes goes open-circuit.

The field convergence circuit has a driver (4VT10) and class B output stage (4VT11/12). The usual cause of field convergence faults is the pnp output transistor 4VT12 (BD510) going short-circuit. As a result, the bias resistor 4R39 (56Ω) will burn. If 4VT12 is in order but 4R39 is cooking, the npn transistor 4VT11 (BD509) is probably open-circuit.

Sync Faults

In the event of loss of sync it's worth starting by checking the adjustment of the field and line hold controls (4RV1 and 4RV13 respectively). The next suspect is the sync separator/line oscillator i.c. 4SIC1 (TBA950). If this proves to be in order the fault is almost certainly over on the i.f. strip, where replacement of the TCA270Q demodulator i.c (2SIC1) will usually restore normal operation. 2SIC1 can also be responsible for poor field sync only.

First Anode Presets

We've now covered all the usual timebase faults. The first anode presets 4R10/1/2 are mounted on the timebase panel and can be responsible for too much or too little of one colour – due to dirt on the tracks or changed values respectively. They were 10MΩ in early models and 2·2MΩ in later versions, with changed value resistors in the associated network.

Audio Output Stage

Moving over to the signals side of the set, the only power handling section is the audio output stage, which is again a little unusual (see Fig. 6). The Darlington pair 3VT13/14 provide the output, driving the loudspeaker via the coupling capacitor 3C58. 3VT15 provides a constant-current supply, its base being driven by 3VT16 which senses the voltage across 3R88, with 3RV9 setting the standing current.

Sound Faults

In the event of no sound, first check 3VT15 and 3VT16. If these are in order, check 3VT16, the speaker 13LS1 (80Ω), 3C58 and 3R88. The connection to the negative side of 3C58 can break if the panel has had much handling, giving rise to intermittent sound. Possible causes of loss of sound on the i.f. panel are the coupling capacitor 2C48, the intercarrier sound chip 2SIC2 (TBA120SB) and the latter's supply feed/decoupling components 2R25 (100Ω) and 2C45 (100μF).

For sound distortion, first check whether 3RV9 can be set for a reading of 0·44V across 3R88. If this cannot be set correctly, suspect 3VT14/15/16, 3R88, and 3RV9 (check the condition of its carbon track). Displacement of the loudspeaker's cone is another cause of distortion.

Servicing the Rank Z718 Chassis

Part 3

John Coombes

IN this final instalment we'll be dealing with faults in the signals sections of the receiver.

The Decoder

The decoder is of the Mullard three-chip type – TBA560C, TBA540 and TCA800. The latter i.c. is followed by RGB driver and output stages, all direct coupled. Fig. 7 shows the driver and output circuits: the output stages operate under class A conditions, and negative feedback is applied to the bases of the emitter-follower drivers via resistors 3R60/1/2 to keep the black level constant. 3VT10 forms a common emitter load for the output transistors and provides a convenient method of setting the black level. There are one or two "extras" in the earlier part of the decoder. First a blanking pulse amplifier stage (3VT2). Secondly a timing circuit for the burst gating/black-level clamping pulses (3L12 etc.). And finally an overload circuit which reduces the contrast via pin 2 of the TBA560C i.c. in the event of an excessive output at pins 3, 5 or 7 of the TCA800 i.c. Diodes 3D8/9/10 conduct in the event of excessive RGB output signals, driving the base of one transistor in a differential amplifier circuit (3VT17/18) linked to pin 2 of the TBA560C.

For ease of reference we'll list the various faults and their usual causes.

No luminance: The usual cause is the luminance delay line 3DL1 going open-circuit. The TBA560C i.c. can also be responsible for this fault. Check by substitution – this is easy as all the i.c.s plug in.

Loss of one colour: First check whether the relevant output transistor is open-circuit. Other things to check are: the driver transistors; the drive presets 3RV6/7/8 (the tracks tend to give rise to intermittent faults); and the TCA800 i.c. by substitution.

If any further difficulty is experienced, check the first anode presets on the timebase panel. If faulty, make sure that the modified 2·2MΩ type is fitted in each position. Associated modifications that must be carried out are as follows: change 4R48 to 430kΩ and make sure that 4R44 and 4R45 are 510kΩ and 560kΩ respectively and are fitted between the collector of the constant-current transistor 4VT14 and the junction of 4D16/4R48.

Bright red/green/blue raster: Check whether the relevant output transistor is short-circuit or its load resistor 3R69/70/71 is open-circuit. This latter check is easy: switch off and touch the resistors lightly – a cool one is suspect. If necessary check the relevant driver transistor, the TCA800 i.c. and the condition of the first anode presets – careful movement of the relevant control will generally prove the point.

Floating colours: First check the TBA540 i.c. by replacement, then if necessary the 4·43MHz crystal (3XTL1). Occasional culprits are the chroma delay line and the reference oscillator frequency trimmer 3C35.

Bright raster (no picture) with flyback lines: Check whether 3R55 (120kΩ) in the line pulse feed to pin 8 of the TCA800 i.c. is open-circuit. Under this condition the voltage at 3TP2 will fall to about 0·5V.

Flyback lines at low brightness level: Ensure that the black-level preset 3RV13 is not set too high and check the condition of its track. If necessary check 3VT10 for being short-circuit.

Bright raster: Check the diodes 3D5/6/7 in the burst gate/clamp pulse timing circuit for being short-circuit.

Intermittent loss of brightness: Check the preset brightness control 3RV11. Then if necessary check 4R46/7 on the timebase panel (see Part 1).

Blank raster: Check the TBA560C i.c. by substitution. The TCA270Q i.c. in the i.f. strip and the tuner unit can also be responsible for this fault.

Black zigzag shading at the top of the picture: This is a strange fault when you first encounter it. The cause is the diode (3D1) in the field flyback pulse feed going short-circuit. It's type BA317.

No colour or intermittent loss of colour: A clue is given by measuring the voltage at 3TP2 (TBA540 pin 9, TCA800 pin 14, and, via 3R42, TBA560C pin 14). A normal reading is about 1V. If the reading is 2·5V the colour-killer is operating – it can be overridden by pulling out link 3LK2. If the voltage is 4V there's no burst signal. This condition can be obtained by shorting together 3TP3/4 – so that the set a.c.c. control 3RV2 can be adjusted (for 4V at 3TP2). If the reading is 6·5V there's a mis-ident condition – the burst swings but the bistable is out of step.

When confronted with the no colour condition you will usually find that the voltage at 3TP2 is 4V. This may vary according to the particular cause of the fault. As a first step check all three i.c.s by substitution, which is easy enough to do. Make sure that the pins aren't bent or turned over when removing/refitting the i.c.s as this may induce another fault. And don't push too hard as this can cause dry-joints on the print side or even cracks in the panel/print.

Other things to check are the chroma delay line which may be open-circuit and the set a.c.c. control 3RV2 which is sometimes responsible for intermittent loss of colour – this can sometimes be detected when setting up the control, i.e. a variation in the voltage at 3TP2 is obtained instead of 4V.

In stubborn cases check the following items: The 4·43MHz crystal (3XTL1) which may be open-circuit. Capacitors 3C12 (0·1μF), 3C24 (10μF), 3C28 (220pF), 3C36 (0·33μF) and 3C40 (0·33μF) for shorts. These defects will produce a reading of 4V at 3TP2. If 3C22 (22μF) is short-circuit the reading at 3TP2 will be 1V. If 3C27 (2·2μF) is short-circuit the reading at 3TP2 will be 3·5V.

Finally note that the cause of the fault may lie on the timebase board (see final paragraph of Part 1) or in the tuner (see later).

IF Strip

The main source of trouble in the i.f. strip is the TCA270Q vision demodulator i.c. In the event of a blank raster check this i.c. by substitution or by checking the

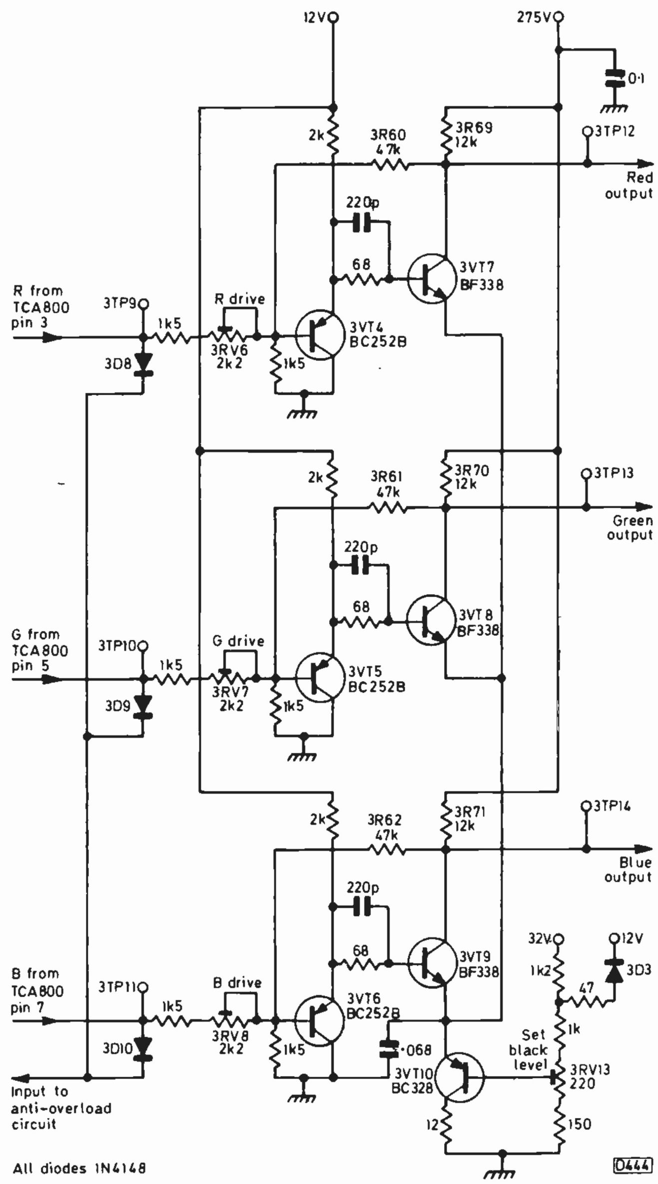

Fig. 7: The RGB driver and output stage circuits. 3VT10 forms a common emitter load for the output transistors.

voltages very carefully. This fault can also be caused by the i.f. strip l.t. feed components – check whether 2R4 (10Ω) is open-circuit or 2C13 (100μF) short-circuit. The TCA270Q i.c. can also be responsible for poor field sync or, on occasions, loss of sync.

There are three transistors in the i.f. strip. Any of them can go open-circuit, but it's usually 2VT2 (BF198) that's at fault. The result is a very snowy picture or no picture at all, just grain. These faults can also be due to the tuner or the aerial system of course. Voltage checks on the transistors will reveal which one if any is defective.

Mechanical Tuner

Since the tuning buttons are so frequently used they tend to break up around the star shape which pushes over the tuner bar, making it impossible to tune or, in extreme cases, making it impossible to push the bar in to select any channel. The compression springs stretch or get caught under the push-button bar, with the result that it's impossible to change channels.

The main cause of failure is the moulded nylon nuts or slugs which can be responsible for no colour, intermittent colour, a snowy picture, lines on the picture, picture jumping or rolling, poor sound, buzz on sound – even a poorly focused picture. The nylon nuts can get slack and slide on the bar, or crack and break up altogether.

A word of warning. After removing the metal can that covers the tuning slugs, make sure that it's replaced correctly. If you obtain a replacement, check whether it's received a knock in the post. The problem is that a misfitting cover can cause component short-circuits at the back of the tuning assembly. This may result in a blank raster with no sound or picture, which can be misleading – especially if you are out in the field.

If when changing channels you get flicks and flashes and have to retune there's excess grease around the bar on which the tuning vanes are mounted. Remove and clean, also oil the ball bearing at the end of the tuner assembly. Check that there are no particles of solder floating around as these can cause a temporary short-circuit on the vanes. Check that the vanes themselves aren't touching – when held up to the light it should be possible to see a small gap all round the traverse of the vanes.

When the tuner cover has to be removed make sure that you replace the rubber packing and copper screen when the job has been completed. Failure to do this can lead to mistuning and affect the performance on the higher channels.

A blank raster (no sound or picture) may be due to oscillator failure. Check the BF181 mixer/oscillator transistor 1VT2. It's possible to change this transistor, but make sure that you cut the leads to the same length and insulate them where necessary to avoid short-circuits. The lead length and positioning are important.

If the picture is grainy or snowy, check the BF180 r.f. amplifier transistor 1VT1 which sometimes goes open-circuit. Check that the 12V supply is reaching the tuner unit at 3Z5 pin 3, and that the bias resistor 1R3 (1·2kΩ, mounted on top) is not open-circuit.

One point I feel it's important to emphasize is that the aerial isolator is a safety component which should be replaced only with the correct type from the manufacturer.

Varicap Tuner

The usual faults caused by the varicap tuner are a snowy picture, a blank raster (no signals) or intermittent thin black pencil lines. The tuner is difficult to service and it's much simpler and more economic to unsolder it from the subpanel and fit a replacement. If the picture is slightly grainy after doing this, adjust the r.f. bias control 1R102 for a clean picture – do this with a signal you know and is clean to start with.

One of the most common faults is tuning drift. In this event check the TAA550 tuning voltage stabiliser i.c. You may find that applying freezer and warm air results in a variation on the 33V line. Take care not to apply excessive heat or you may get extra trouble. I've noticed on several occasions that a voltage reading of 28V is obtained with a defective TAA550, so this is one clue. Other causes of drift are the tuner unit itself and the tuning potentiometers – check the carbon tracks.

Miscellaneous Points

Random channel changing can occur with touch-tuned sets. Check whether the sensors are clean, also for spray polish. If still in trouble replace the ETT6016 touch-tune control i.c. Remember to handle it with care as it's a MOS device. On later models a 100kΩ resistor was added between the base and emitter of the BC157 shunt stabiliser transistor 9VT1, mounted on the print side, to prevent damage to 9VT1 and/or the ETT6016 i.c.

If the remote control unit won't change channels or mute the sound, check the PP3 9V battery and the switch (11SW1) which cracks the metal strip, resulting in failure to turn on. Also check the switch contacts which can bend and fail to operate. A high-*Q* coil is used to give maximum battery life – battery failure should lead to a check on the switch contacts in case they are making all the time.

The following circuit changes apply to 20/22/26in. models and should have been noted in the captions to Figs. 3 and 4. An 0·1μF decoupling capacitor is added between pins 3 and 2 of the line output transformer. A 2·2μF decoupler is added between the h.t. end of the line driver transformer's primary winding and chassis. One side of the line windings on the NS transductor is earthed (instead of being taken to pin 5 of the line output transformer). The capacitor in 5VT6's base circuit is 0·33μF.

Finally note that "standard" and quick-heat c.r.t.s have been fitted. If you change from one to the other, it's important to adjust the c.r.t. heater voltage coil 5L14 – otherwise the tube will be damaged.

Letters

THORN 9000 CHASSIS

I've also had the fault of tripping on channel change with the Thorn 9000 chassis (Service Bureau, September). After a period of time the set would trip intermittently. The problem was cured by replacing the 87.9V line reservoir capacitor C715 (22μF) – on removal it had white deposits around the base. Mick Dutton referred to this trouble in the March 1982 issue (page 247).

R.J. Musson,
Solihull.

CAPACITOR TESTER

With reference to my letter on Victor Rizzo's simple capacitor tester in the January 1982 issue and your editorial note, I tried the modified circuit arrangement suggested but found that the voltage across the test probes was only about 26V. This was increased to 100V by changing the value of the 47kΩ resistor to about 140kΩ. I've since developed the device to make it more flexible, the resultant circuit being shown in Fig. 1. The initial capacitor test remains as before. To recap, no suggestion of a flicker when a capacitor is tested indicates that it's open-circuit, a continuing glow that it's short-circuit, and continuing flickers that it's leaky: a good capacitor will light the neon (N1) momentarily as it charges, the glow depending on the capacitor's value.

A second capacitor test has been added as follows. If the first test indicates that the capacitor is good, discharge the capacitor through the neon (the power supply can be left on or switched off). A good capacitor will flash the neon as before, but there are advantages in making this second test. First the discharge flash obtained is brighter than the charging flash. If the flash is missed when making the initial test, especially with low capacitor values which produce a weak flash, this second test will prove the point one way or the other. It also proves that the capacitor can hold a charge: I've found that a new 0·1μF 600V capacitor will flash the neon 24 hours after charging.

In use, check first with probes A and B to each side of the capacitor. If the capacitor is good, remove probe A and after a few seconds apply probe C or D depending on the capacitor's value. Below 0·2μF, use probe C; for 0·2μF or above use probe D which adds the current limiting resistor R5 (10kΩ).

Note that the tester is not meant for testing electrolytics. Low-value electrolytics of up to 25μF can be connected across the probes however provided the capacitor is rated at over 100V – observe polarity! The neon should glow and extinguish in less than thirty seconds. After the electrolytic has charged, leave it for a while before discharging it via the 10kΩ resistor. If the neon glows you will know that the electrolytic has held its charge.

Probes A and B can be used to make continuity tests on neons, fuses, lamps, etc. Rectifier diodes can also be checked. With the anode to A the neon will glow – if it glows with the cathode to A the diode is short-circuit. For most other types of diode the tester is unsuitable.

A mains polarity test is also included. Plug the tester into the mains socket, make sure that all probes are clear, then switch the power on. Press push-button switch PB. If both neons are off, link probes A and B. Two electrodes should glow (one in each neon), indicating that the polarity and earth connections are o.k. If all four neon electrodes glow when switch PB is operated the input is a.c. – don't use the probes, switch the power off as the polarity is reversed.

Leave switch PB open for all other tests so that the circuit is disconnected from earth. Capacitors being tested must not be connected to earth.

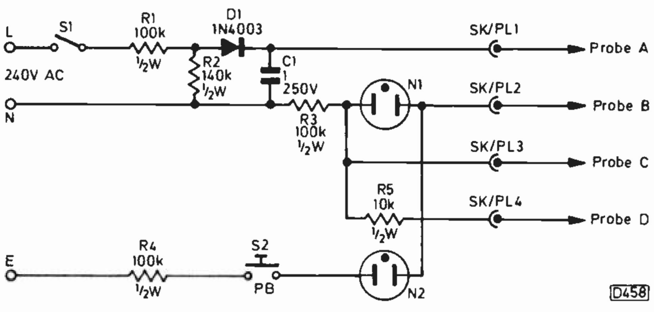

Fig. 1: Modified capacitor tester circuit.

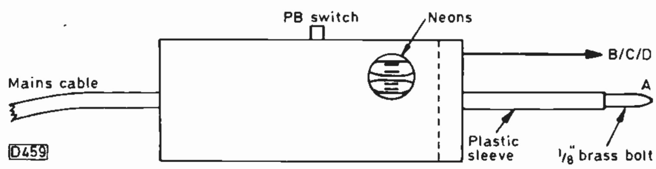

Fig. 2: Method of housing the capacitor tester.

Fig. 3 (right): Method of securing the neons.